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SUPER MoRRI – Scientific understanding and provision of an enhanced and robust monitoring system for RRI

Understanding impact, impact pathways and benefits of RRI within SuperMoRRI WP5 and beyond

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Table of Contents

1 OBJECTIVE OF THIS DOCUMENT

This document contributes to a shared understanding in SUPER MoRRI about the impacts and benefits of RRI as well as their pathways. It addresses how these can be understood and described within the context of the SUPER MoRRI project. It prepares and is part of Tasks 5.3 and 5.4, the latter being the synthesis of the six SuperMoRRI case study projects[1] of impacts, benefits, and pathways. These case study projects have been developed by proposition by the Consortium partners in an iterative process and are (see Table):

Table 1: WP 5 Case Study Projects

Civil Society Organizations at the Science -Society interface
Coding of ethics and values into autonomous systems
Public value research careers (PVRC)
Creating knowledge for societal transformation: Transdisciplinary research (funding) in JPI climate
Gendered eco-innovations
Alignment of preferences, practices and repertoires in public engagement with science

(Source: Deliverable 5.1, Super MORRI project)

2 SUPER MORRI WP5 APPROACH

2.1 Focussing on impacts and benefits of RRI

According to the Grant Agreement (p. 24) SUPER MoRRI performs research on impact pathways and RRI benefits:

Task 5.3: Qualitative case studies on RRI impact pathways. (M13-M52; Lead IHS, supported by Fraunhofer, UiB, TU Delft). Task 5.3 is devoted to clarifying pathways from responsible practices to different kinds of impacts/benefits. The qualitative case studies will also be designed and carried out in a way that allows for studying the interconnections of RRI benefits. SUPER_MORRI's project duration of five years allows long-term monitoring of RRI activities over a continued period, starting from the planning of RRI activities to their implementation and the emergence of short term and medium-term benefits. It will also allow the detection of factors that support or impede RRI activities and realization of benefits. The six qualitative case studies will apply qualitative methods such as document analysis, interviews, focus groups and participant observation.

Task 5.4: Analytical synthesis of cases (M49-M59; Lead IHS, supported by CSCIC and all partners). All cases are tailored to identify potential new indicators for RRI benefits. The case studies will be interesting as standalone outputs, and they are likely to be published through academic outlets. In the last Task of WP 5, we will set out to organise synthesis across all cases, taking on board results from WP 2 as well. The aim is to validate data sources for replicable data points and to analyse all emerging cross cutting themes from pathways and patterns studies. The synthesis will be mainly based on a narrative approach and will inform a policy brief about the benefits of RRI.

Therefore, the question is how to employ, understand, and define RRI benefits.

2.2 Identifying benefits

Only in a few cases, will we be able to identify impacts and to some extent, impact indicators (for explanation see Sectio 3.1). In consequence, it is the task of SUPER MoRRI to increase the

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[1] The case studies are detailed in Deliverable D5.1

understanding of impact pathways in ways that also allow for the measurement of factors that influence the process of impact creation. To do this we aim to showcase and build *impact narratives* to identify and understand pathways by which impacts come about, and the aspects and their various shapes (e.g., contextual) that influence impact. This also leads to a closer idea of modes of monitoring.

WP 5 of Super MORRI is dedicated to describing, analysing, and understanding pathways for impacts in different case study projects (see Table). **For each case study, the WP5 leader, IHS, together with case study authors, will create specific narratives to show pathways, impacts, and benefits**. In this way, the SUPER MoRRI Consortium will establish shared points of reference to analyse and compare pathways, impacts, and benefits. **To create these narratives, we want the partners to reflect on how researchers, and the actors in their case study (or who might use their case study), define impact, pathways, and benefits.**

We want to create a holistic interpretative framework around the conceptions and expertise on impacts and benefits, and on what the different partners mean by benefits in their cases. **In summary, we want to get a closer idea about what counts as an impact in relation to each case**.

This will eventually enable us, as SuperMoRRI advances, to suggest a holistic WP5 framework further downstream in our collective research process about the conceptual interpretations of impacts and benefits. We understand the development of a sound definition of impacts, benefits, and pathways with SUPER MoRRI as a joint process of knowledge creation and learning, that is based on a shared analytical framework of all WP 5 case study projects and is aligned with WP1 (theory), WP2 (data collection).

3   LESSONS FROM LITERATURE

The following section provides our understanding of the general framing of the topic of **impacts**, **pathways,** and **benefits,** as well as **methodological problems** of evaluation.

3.1   Methodological problems of linear Research Impact Assessment (RIA)

Review of relevant literature shows that Research Impact Assessment (RIA) offers a wide and puzzling variety of approaches and is a challenging task in every field. For different reasons, the issue becomes even more complex with inter-and transdisciplinary research (Belcher & Hughes, 2020; Reale et al., 2018). Key methodological problems challenge RIA and measuring output, outcomes, and impact. Amongst them are **data availability** and **understanding of contextual dynamics of research** (European Court of Auditors 2008). Others are **causality claims** (attribution and contribution), **impact trajectories,** and the **time lag between research intervention and impact**. In addition, there are **marginal differences**, **transaction costs** and the **units of assessment** (Adam et al., 2018).

Although it is possible to a certain extent to assess outputs and end-of-project outcomes, it is often hard - or even impossible - to perform robust measurements of higher-level outcomes and impacts because they are "typically well outside the sphere of control and sphere of influence of a research project or programme". In other words, "in complex systems, with multiple actors, processes, and time-lags, it is theoretically impossible to make definitive attribution claims" (Belcher & Hughes, 2020, p. 12). **RRI interventions are often seen as interventions in such complex systems and thus face these very challenges**.

This leads to the assumption that **the measurement of RRI** – in whatever terms – **needs to be seen in its context**. The different RRI narratives described in the SUPER MoRRI concept note[2] implicate that, independent of which narrative for RRI we choose, indicators are influenced by their use and the purpose for which they are developed. SUPER MoRRI wants to **gain a better understanding of how possible impact pathways and benefits of RRI and RRI-like activities**

could be described in the presence of such complexity. This is also considered by the *credible contextualisation* SUPER MoRRI integrates into its framework in WP1 and WP2.

Furthermore, **SUPER MoRRI** shares with key RIA literature the fundamental assumption that it specifically **tries to** produce **an understanding that can serve to improve governance of research and innovation**, both as self-governance (to be performed within institutions and networks that perform research and innovation) and external governance (performed by research funding organisations, regulatory authorities, and ultimately civil society). Of course, in the context of RRI, the distinction between self-governance and external/imposed governance neither is nor should be absolute since the very idea of RRI is to develop cultures and practices of inclusive governance and co-production. However, as we shall develop in further detail below, the issue of governance frames and constrains our methodological approach in various ways.

3.2   Simplistic intervention logic

Indeed, arguably the largest constraint to identifying RRI benefits is built into the very design of the SUPER MoRRI project, namely, the choice to study RRI processes in terms of outcomes, impacts, and benefits. Together with the concepts of *inputs* and *outputs,* the notion of *outcomes* and *impacts* belong to a conceptual universe resonant to **conventional "command-and-control logic" intervention logic**, while perhaps above all, the concept of *benefits* belongs to a **policy discourse of justification and legitimization**. Figure 1 depicts a conventional intervention logic.

Figure 1. Conventional intervention logic

Inputs	Outputs	Outcomes	Impacts

The above-mentioned conventional intervention logic in Figure 1 was also used in the predecessor project MoRRI (Peter et al. 2018: 30), which assumes that a process has *input(s)* and *output(s)*. As Owen et al. (2021) recently remarked, this decision expresses the gradually increasing influence of so-called "SMART" criteria as a form of New Public Management, also with respect to the development of RRI within Horizon 2020. The frame produced by these choices is one of *RRI as intervention* and a type of input into a research and innovation process, practice, or institution, and that this input intends to and does linearly lead to an *output* that subsequently leads to *outcome* and *impact*. This framing has several epistemological implications.

First, the phenomenon is conceptualised in terms of a system that is linear and simple enough to be controlled and commanded by carefully choosing the inputs.

Second, it is implicitly assumed that command and control are *desirable,* for instance by adhering to a policy narrative that posits a particular function to RRI (such as that of "regaining control of the runaway train of innovation", or "improving public acceptance")[3]. None of this is trivial and all of it would be challenged by network models of RRI governance.

Third, residual complexity mainly appears on the right side of the diagram, that is, the phenomenon is framed as being relatively low in uncertainty on the left side and then with propagating uncertainty towards the outcome and impact side. This means there is more clarity and shared understanding about what inputs and outputs are or might be and less consensus on definitions (or even assessment) on outcomes and impacts. As such, assessing the downstream trajectory from inputs to impacts is an increasingly complex process of multiple possible pathways towards impacts and consequences (of change) as one continues downstream. This feature is implied by the framing of conventional intervention logic. A reverse framing, for instance, an investigation of an accident or "good/best practices" defined by their result, would see the ultimate event as certain and determinate, and then uncertainty and indeterminacy would propagate as one moves towards the left and struggles with the problem of attributing causality to a network of antecedents.

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[3] https://super-morri.eu/3-policy-narratives-for-rri/

Another observation to be made about Figure 1 and the mental model it proposes, is that there is no emphasis on the system that is the target of the input. "Input" and "output" can be thought of both in literal and metaphorical ways. In the literal sense, these concepts belong to the model of signal transduction (see Figure 2)

Figure 2. Introducing the « transducer » between input and output.

By bringing emphasis on the "black box" in the middle (Figure 2), we may also see more clearly the difference between the framing provided by conventional intervention logic and alternatives.[4] The evident narrative is one of "doing RRI" in terms of acting *onto* the R&I process/system such that it gives a certain *output.* It is about the activities that happen and the steps necessary to reach change. An alternative narrative is that "doing RRI" is about endogenous processes of change within the black box itself. In the various case studies, we might wish to keep some attention to and sensitivity to such framing choices.

In summary, our review of RIA literature shows that[5]

- Theories and models for impact assessment are many and diverse.
- Not every model of RIA provides a clear definition of inputs, outputs, outcomes, and impacts.
- Not all RIA models provide clear methodological guidelines on how to proceed in the assessment of inputs, outputs, outcomes, and impact (pathways).
- Thus, there is a diverse, but no agreed-upon and shared understanding of these issues.
- Different understandings of input, output, outcomes, and impact are highly intertwined with the specific (research) contexts,
- Major theories and methods for assessment are connected to Theory of Change (ToC) approaches.

4 THE SUPERMORRI WP5 MODEL

To align the assessment of impact, impact pathways, and benefits over WP5 case research projects, we propose a model which includes the combined logic of different theories and frameworks based on a Theory of Change (ToC).

ToC is a general framework for the desired change and the identification of influencing factors related to this change. In the case research projects, for example, the ToC model is an open frame to describe the casual assumptions about the links in the impact pathway (Mayne, 2017). ToC is a useful model for the inclusion of diverse case research projects[6] as it is sufficiently open but theoretically elaborate enough to eventually synthesize them. The ToC approach is not meant to be strictly linear, as it should provide a means to capture all RRI-type outcomes, results, and

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[4] See also Astbury and Leeuw (2010) on unpacking black boxes in evaluation

[5] This included a look into impact assessment in the social sciences and humanities (SSH) and a description about input, output, outcome and impacts within Theory of Change (ToC), Realist impact evaluation, Qualitative comparative analysis (QCA), Payback framework, ASIRPA approach (Socio-Economic Analysis of the Impacts of Public Agricultural Research) and SIAMPI model (Social Impact Assessment Methods) for research and funding instruments through the study of Productive Interactions and the refined method for theory-based evaluation of societal impacts of research by Belcher et al.

[6] While all the cases may not explicitly refer to their interventions RRI, they are closely connected to RRI practices in which case our model takes RRI practices as a proxy for an intervention into the R&I system.

benefits that may not be obvious at first glance. In summary, the ToC model should guide the case research projects in the following ways:

- It should provide flexibility in the concept so that multiple narratives about impact and benefits can be included through the different cases. We are looking at various potential processes triggered by RRI.
- The impact process and mechanisms that play a role during implementation and/or assessment are depicted as the intermediaries of turning and critical points. Intermediaries are intermediate steps from outputs to outcomes and outcomes to impacts which can be defined as proxies for benefits (see also Section 5).
- Within the model, the role of impact pathways is described, and vehicles of transformation / change are made visible.
- There are medium-term temporal effects that are – in the long run – topped by long-term effects of RRI interventions and change, which – most likely – are out of our scope because of time constraints and problems of attribution. Further, any emerging impacts are vague and while assessing benefits is not possible, we can develop a deeper understanding of possible effects, both positive and negative.

Figure 3. Model of impact pathways and assessment within SUPER MoRRI WP5
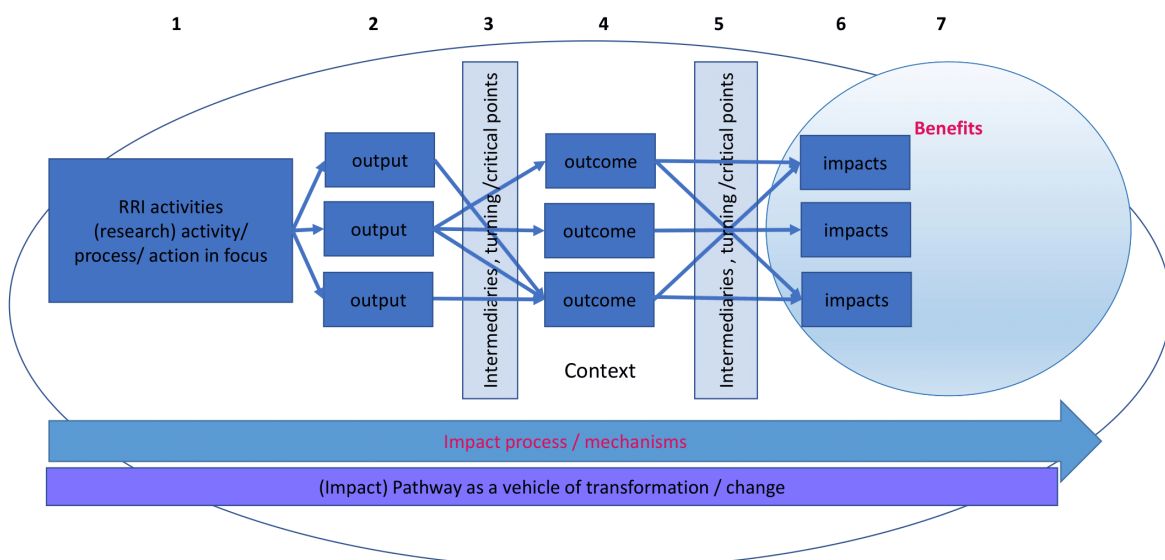
(Source: SUPER MoRRI project WP5)

Figure 3 sketches the way from RRI activities and processes the case projects focus on, their outputs, outcomes, and proposed impact pathways and the elements connected to them. (1) RRI activities produce (2) outputs. These outputs transit (3) several turning/critical points and generate (4) outcomes. They transit (5) again turning/critical points and generate (6) impacts. Some of these impacts might be defined as (7) benefits.

Intermediaries are relevant in the impact pathway(s) as proxies for benefits and impacts in the making. Like the "final" outcome or impact, they are connected and dependent on the context in which they emerge. In contrast to the simplified schema of Figure 3, there is no linearity in impact pathways. Rather, the process can change and turn in unexpected ways, such as looping back and starting again. As such, intermediaries can be a step in themselves in describing and in understanding the pathways toward RRI/RRI-like outcomes and impacts.

Connected to the pathways towards impacts, various factors might influence the process(es). These are:

- interactions of people (and, as Actor-Network-Theory suggests, non-human (Latour, 1996)) that involve networks, communities, and people involved in the process, stakeholders, etc.;

- the role of learning and knowledge creation: (co-)creation and diffusion of knowledge and
- norms, values, rules and beliefs in the system (scientific, policy, social, etc.).

In Figure 3, context refers to anything in the environment of the activity and/or process that might affect these. Contextualities such as those listed above need to be adapted according to the frame of research for each case and can change over time. As can be concluded from most of the mentioned theories and approaches, context is extremely important, may it be political, social, organisational or even individual. "(C)ontext (is) seen as important in terms of replicating the intervention in any future setting or in learning about possible generalizable causal pathways" (Blamey & Mackenzie, 2007, p. 441). This is in line with the credible contexualisation approach SuperMoRRI is taking (see the strategic plan, D1.2[7]). Therefore, major considerations must be taken when describing and assessing these context(s).

5   WP5 DEFINITIONS

Based on our literature analysis, we suggest the following definitions to be used and, if seem fit, slightly adapted in each of the SuperMoRRI WP 5 case research projects.

5.1 Input

We define input as RRI signal into the (R&I) system. This could be a decision, an intervention, and the different kinds of resources employed in this intervention. Examples for inputs are:

- money/capital
- human resources
- ideas
- decisions
- statements
- physical resources
- physical equipment
- information
- skills
- utilities, and
- services

5.2 Output

We define output as an immediate translation of an input signal by the system. These can be material or immaterial products or other results emerging from the system. Examples for outputs are:

- products
- services
- technologies
- artefacts
- tools
- goods
- output can also be linked to knowledge and processes inspired by the measures/activities and
- changes in organizational and/or epistemic culture

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[7]

https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5d4fc130b&appId=PPGMS

5.3 Intermediaries and Turning/Critical Points

We define intermediaries and turning/critical points as the processes and mechanisms that play a role during implementation and/or assessment. Intermediaries are intermediate steps from outputs to outcomes and outcomes to impacts which can be defined as proxies for benefits because of their supportive role in the process of establishing impact.

5.4 Outcome

We define outcomes as outputs of a secondary system for which the output of the primary system is an input. Primary and secondary systems can overlap. Outcomes include changes in knowledge, practices, attitudes, skills, relationships, constellations of networks/actors, and behaviour. Outcomes can be excepted or unexpected; they can be on different levels (process and product) and timescales (short/medium/long-term); they can be products or processes. Examples for outcomes are:

- Products
  - service improvement
  - cost-savings
  - project adjustments
  - growth (in sales, participation, etc.)
- Process
  - on behavioural, cognitive, or individual level;
  - culture, norms and values, changes in attitudes; etc.

5.5 Impact

Impacts are how wider society is affected by or takes up outputs and outcomes. These outputs and outcomes are the results of an intervention or action with an objective in a specific context. Impacts can be artifacts, qualities, or processes.

In the case of SUPER MoRRI, impacts are outputs or outcomes connected to an intervention or RRI practice that interact with and influence the dynamics of R&I on the system level. The intervention may, but not necessarily needs to be, linked to so-called RRI activities.

In the context of R&I a variety of definitions for impact exist (Belcher & Palenberg, 2018; Belcher & Hughes, 2020). To distinguish between them works on (research) impact and impact assessment describe different kinds of impacts such as, e.g.,

- economic impact
- social/societal impact
- political or policy impact
- scientific impact
- environmental impact
- organisational and institutional impact

So far, most attention has been given to scientific and economic impacts, followed since the 2000ies by social/societal impacts. The notion of political or policy impact often understood as part of societal impacts, is rather recent. Further, at least at the European level, environmental impacts play a crucial role. Organizational and institutional impacts and organisational change play a relevant role in organisational processes. In addition, there is work on the impacts of specific key aspects of RRI-like public engagement activities, like Gender and Diversity (Otera-Hermida & Garcia-Melon, 2018), economic and societal dimensions of Open Access (Fell, 2019) or benefits of Open Science practices (Arza et al., 2018) – just to mention a few.

Throughout WP5, we endevaour to keep processes and effects connected through the narratives developed.

5.6 Impact pathway

Following Muhonen et al. (2019), impact pathway(s) are conditions that lead to and enable impact processes. In connection to our ToC model, impact pathways are based on certain assumptions about how activities link to impacts and the directionality they will take towards a specified objective (Mayne, 2017).

Within the MoRRI project, an impact pathway was understood as "(t)he process of moving from the delivery of planned outputs to the eventual accrual of broad aggregate impacts, some of which may be unforeseen" (Peter et al.: 22). They describe a chain of inputs / activities or multiple causal pathways, processes, and outcomes that lead to impact (Douthwaite & Hoffecker, 2017) and how and why activities work. There may be several pathways to impact (Mayne, 2015), they can be linear, non-linear, or iterative (I Vogel, 2012). Impact pathways aim to describe and capture system dynamics, interdependencies, and emerging interconnections to produce context-specific understandings that inform ongoing innovation, actions, and activities.

In other words, impact describes the ways that wider society is affected by outputs and outcomes and the impact pathway is the way towards this effect.

Pathways can be manifold, e.g.,

- collaboration
- public engagement
- expertise
- points of contact (productive interactions) between scientific and societal partners mediating wider changes
- reaction to societal change: anticipation, reacting to windows of opportunity, social innovation, and commercialisation pathways

Drivers for societal change:

- research engagement as key to impact pathway
- knowledge transfer into society
- building new epistemic communities (Muhonen et al. 2019)

5.7 Benefits

The notion of benefit adds normativity to impacts[8]. The basic rationale for defining and measuring the benefits and impacts of science is that, in our contemporary Western understanding, research should improve society and the environment. In its final report, MoRRI described scientific, economic, societal, and democratic benefits[9]. SUPER MoRRI is not obliged to start with the given framings, and it is for us to determine how we identify "the good" and connect our assessments to narratives about (pathways to) outcomes and impacts that should indicate beneficial changes in the R&I system.

We think that three groups of arguments must be considered in this respect (some of which apply to RIA in general).

- All effects of interventions are hard or (partly) impossible to measure, and, because of time lags and problems of causality, difficult to attribute[10].

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[8] A thorough definition of society is beyond the scope of the paper. We want to stress that "society" includes all spheres, levels and systems, micro/meso/macro levels and all types of stakeholders, from science, policy, economy, culture, etc.

[9] In 2013, the European Commission issued a call for tender for the MoRRI project beginning with a triad of "economic, social and democratic" benefits. The MoRRI project identified a fourth category of benefits, i.e., "scientific" benefits for research and the research system itself (Peter et al., 2018).

10 RRI and any connected intervention or activity, technology, and innovation development can only be seen as "one of many factors responsible for any realised benefits" (see also Belcher & Hughes 2020: 8).

- Benefits are (a) normative and (b) depend on interests and values. We need to question who is served when defining and assessing the impacts and benefits of R&I and or RRI.
- Evaluation and measurement impact the R&I system. We need a responsible way of assessing and monitoring impacts and therefore must consider what RIA means for scientists when applying our framework.

Looking into how the definition of "benefits" was previously used in MoRRI, we could assume that:

"the concept of RRI benefits cannot be simply read off this intervention logic as an inevitable extension of the impacts of RRI. Although RRI benefits may indeed be partly or, in some contexts, largely based on an accumulation of positive impacts of RRI, this conceptualisation is not sufficient to capture what is meant by RRI benefits" and that "RRI benefits cannot be sensibly interpreted, or systematically monitored, in the absence of a framework that guides expectations about the (expected) qualities and (desirable) directions of change", (MoRRI final report, Peter et al. 2018: 30).

We want to start from this position again. Which qualities and desirable directions of change do we expect? How do we define this desirable state in RRI? Different expectations and notions of "responsibility" might emerge, depending on the person, the organisation –possibly the broader context and system (Ashworth et al. 2019).

With respect to benefits, even more than with outcomes and impacts, "Beauty is in the eye of the beholder". Benefits are qualified by a normative frame, as such the beholder inspects outcomes and impacts to qualify them as beneficial. Benefits can only be described as emergent possible outcomes and impacts of RRI, but not as a factum per se produced by RRI, thus discussion of benefits cannot happen in isolation from the assessment of outcomes and impact. The assessment and the increased understanding of impact pathways should be able to inform choosing relevant benefits or better, discarding unrealistic ones (that either do not exist, or that can not be traced or attributed to RRI practices) and focusing on benefits that can be observed and robustly ascribed to RRI.

5.8 Context

Context includes all aspects that are connected to the "environment" of the impact pathway(s) and could influence the emergence of impacts and benefits. Contexts can but do not have to be differentiated by level, e.g., micro (individual, team), meso (organizational) or macro (country, national).[11]

Examples of context factors include:

- Organisational complexities
- Public discourse: community attributes and norms, societal norms, attributes
- Policy discourse: policies and changes therein, rules and legislations in governments, funding, organisations, etc.
- Definition of "missions", SDGs, etc.
- Infrastructure / material context(s)

6 APPLYING THE MODEL TO THE CASE PROJECTS

You might conclude that the overall model is overly ambitious and pretends to include everything connected to the narrative(s) of the single WP5 case projects. Somehow, you are right, it is very broad and complex – and, to some extent, it also includes a certain degree of openness.

The ToC model and narratives of impact pathways should provide qualitative information on the background and development of the single case study projects in order to assess the pathways towards impacts and benefits. The narratives should be points of departure for discussion which

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[11] SUPER MoRRI concept of credible contextualization recognizes that indicators cannot be developed for universal and context-free use; they should be developed in a way that is meaningful to specific use and contexts.

help prompt thinking about what we try to measure, in which context – and for whom. For that, we propose the following points for dealing with the complexity of the topic:

1. All case projects:
   - Stick to the research proposal presented in D5.1
   - Define the research question(s);
   - Describe the research design in substantial detail;
   - Follow a research process using appropriate quantitative and/or qualitative methods to collect data and identify patterns and/or pathways of RRI / RRI-like activities;
   - Aim for research outputs in the form of publishable scientific results, wherever possible, and
   - Either
     - Identify data elements that can contribute to the monitoring framework,
     - identify potential monitoring element(s) that could be populated by future data collection, describing these in detail, or
     - identify principles or concepts for innovative monitoring elements that could be experimented with in the future.

2. The cases do not necessarily have to connect to single RRI keys but should keep these in mind and document potential monitoring opportunities related to keys that emerge.

3. To describe impact pathways on different levels, each case research project will outline a simplified theory of change (ToC), following a template provided by the WP5 lead (IHS). Each case study project should identify its key outcomes and describe how these outcomes can be expected to lead toward impacts/benefits etc.

7 ANNEX

a. Glossary

- Benefits - Benefits refer to any kind of change connected to transformations (defined as outcomes and impacts of any kind of RRI/RRI-like related measures/ changes/ research/research related processes /policy /practice / implementation activities…) that have a normative connotation towards adding "something good" to society12. Described as an emergence of possible outcomes and impacts of RRI, but not as a factum per se produced by RRI measures or practices.
- Context - Context includes all aspects that are connected to the "environment" of the impact pathway(s) and could have an effect on the emergence of impacts and benefits. Contexts can, but do not have to be differentiated on different levels: micro (individual, team), meso (organizational) or macro (country, national).
- Input - Input is an RRI signal into the (R&I) system. This could be a decision, an intervention, and the different kinds of resources employed in this intervention
- Impact - Imapct refer to the result of the intervention as a product of its context in broader society in terms of specific issues/areas/questions. Impacts can be processes. It is change that initiates outcomes on another/any other level than the original status.
- Impact Pathway(s) - Impact pathway(s) are conditions supporting impact processes (Muhonen et al., 2019), linking activities and impacts (ToC, (Mayne, 2017) and based on certain assumption how these pathways might look like (directionality). They describe a chain of inputs / activities or multiple causal pathways, processes and outcomes that lead to impact (Douthwaite & Hoffecker, 2017) and how and why activities work. There may be several pathways to impact (Mayne, 2015), they can be linear, non-linear or iterative (I Vogel, 2012).
- Outcome - Outcomes are outputs from secondary systems for which the first output is an input. The secondary system may overlap with the primary. Outcomes include changes in knowledge, practices, attitudes, skills, relationships, constellations of networks/actors and behaviour. They can be excepted and unexpected, on different level (process and product) and timescales (short/medium/long-term).
- Output - Output is the immediate translation of an input signal by the system, in terms of a material or immaterial product or other result emerging from the system

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[12] A thorough definition of society is beyond the scope of the paper. We want to stress that "society" includes all spheres, levels and systems, micro/meso/macro levels and all types of stakeholders, from science, policy, economy, culture, etc.

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8.1 List of Tables

Table 1. WP 5 Case Study Projects

8.2 List of Figures