



Deliverable 1.1

**Initial report on RRI
in start-ups and impact
investment**

Due by: 31.03.2022 (postponement)

Deliverable Responsible: Wageningen University and Research

Status: Draft

Function	Staff	Delivery date
Prepared by	Mark Ryan, Eugen Popa, and Vincent Blok (WUR)	04-02-2022
Reviewed by	Andrea Declich, Maresa Berliri, and Alfonso Alfonsi (K&I); Natalia Costanza and Eleni Stefanatou (EBAN); and Simeon Veloudis (SEERC)	21-02-2022
Submitted to EU by	Andrea Riccio (UNIROMA)	31-03-2022



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101005937



Initial report on RRI in start-ups and impact investment

Executive Summary:

RRIstart is an Horizon2020 Project that responds to the EU efforts to foster impact investment (an investment that delivers social, environmental and economic benefits) by developing an innovative responsible research and innovation (RRI)-based model for start-ups, complemented by an RRI-based impact investment indicator list in a multi-stakeholder (quadruple helix) context. Through RRIstart, the consortium aims to demonstrate the value of RRI for the Science, technology, engineering, and mathematics (STEM) entrepreneurship ecosystem. At the moment, start-ups and investors do not adopt existing RRI principles and indicators due to the limited compatibility of existing RRI models (tailored mostly public R&I) with responsible investment. Nevertheless, by adopting a lean/agile approach to RRI embedment, RRIstart proposes a novel RRI model for start-ups blended with novel RRI-based impact investment indicators. RRIstart tests the developed innovation through a translational piloting approach (from lab to market). Three pilots will be organized (on environmentally sustainable start-ups from Northern Europe, 3D printing & advanced materials in Italy and bioeconomy (agrifood) in Greece). In each pilot, extended quadruple helix actors will be involved to assess the feasibility of embedding RRI in start-ups and to facilitate (public and private) impact investment through the RRI-based indicator set.

In this Deliverable, RRIstart responds to the EU efforts to foster impact investment (an investment that delivers social, environmental and economic benefits) by developing an innovative RRI-based model for start-ups, complemented by an RRI-based impact investment indicator list in a multi-stakeholder (quadruple helix) context. This report is the first Deliverable of the RRIstart project and provides the theoretical grounding for the entire project. Tasks 1.1., 1.2., and 1.3. that were outlined in our Description of Actions (see project proposal) are comprised within this report.

This Deliverable (D1.1) will take stock and seek the common ground between the theoretical literature of RRI, past RRI reports within the Horizon 2020 framework (e.g., New Horizon, MORRI, RRI Tools, RIConfigure, RRIng) and literature on ethics and responsibility of finance. This review will be the first of its kind given its focus and will generate insights for our key indicators and it will provide us with a theoretical and methodological starting point for the specific context of start-ups. An original aspect of the literature review in comparison to past reviews is that it will extract insights on both the why question (i.e., arguments and counter-arguments for applying RRI in the context of start-ups) and the how question (i.e., challenges and opportunities for applying RRI in the context of start-ups).

This report aims to provide a systematic review (**Task 1.1 from DoA**) on socially responsible investment (SRI) by studying the extent to which current tools for achieving socially responsible investments are attuned to the specificities of social tech start-ups. To do this, we employ as a case in point the industry-standard screening method developed by GIIN known as *Impact Reporting and Investment Standards* or 'IRIS'. We draw upon literature on start-ups and specific entrepreneurial and financial features, and the field of *responsible research and innovation* or 'RRI' and the IRIS+ model (IRIS+ is simply the updated version of the IRIS model developed by GIIN). In sum, we

undertake a critical investigation of the IRIS+ method through the lenses of start-ups that wish to engage in responsible research and innovation.

The research seeks to be a cross-fertilization between the more financially-oriented world of socially responsible investment (SRI) and the more ethically oriented world of *responsible research and innovation* (RRI). This will be particularly instructive for those in the field of socially responsible investment who want to extend their scope towards small-scale research and development (R&D) in start-ups and their investors through a better understanding of this specific investment context, but also for researchers in RRI who wish to integrate the investment process in the consideration of how responsible the innovation is within an R&D or science, technology, engineering and mathematics firm (STEM). Currently, there is little communication between the scholars involved in SRI and RRI. We believe the time is ripe for such a communication and we consider this report to be a first step in the right direction. We also draw upon literature on lean start-ups (LSA) and the field of RRI. In sum, we undertake a critical investigation of the IRIS+ method through the lenses of lean start-up theory and RRI for start-ups aiming to implement responsible practices.

While lean start-up theory focuses more on the impacts and requirements for successful start-up businesses, RRI often focuses on the research and societal impacts of businesses. This is why we apply the quadruple helix framework (QH) to better account for the multitude of stakeholders involved in the process of responsible start-up practices. The reason for choosing the QH approach is because it extends the scope of financially focussed investment tools on economic value creation, and allows for the integration of RRI aspects of value creation. It provides a better balance than either RRI or LSA approaches alone, or together. The QH approach states that four helixes should be important for responsible enterprises: societal, research, business, and policy.

We use the QH approach to frame the extensive reviews of indicators found within the IRIS+ model (**Task 1.2 from DoA**), the multitude of RRI projects and approaches, and the general suggestions found within LSA literature. Our conceptual model combines the challenges, impacts, and requirements, for responsible behaviour found in LSA and RRI theory, and the IRIS+ model, and frames those within the four helixes of the QH approach. Overall, we integrate the IRIS+ model, the LSA approach, the RRI framework, framed within the QH approach, to provide a model for responsible investment. Altogether, our Responsible Impact Assessment Model should be used by start-ups aiming to behave responsibly and as a way for responsible investors to identify which companies they will invest in.

This Responsible Impact Assessment Model culminates with 24 indicators enabling us to ‘measure’ best practices for responsible start-ups or investors in start-ups (**Task 1.3 from DoA**). By measuring, we can identify strategies and drivers and barriers that these actors experience in their effort to engage in responsible investment in start-ups. Based on these insights, we can provide advice to start-ups on how to become more responsible organisations.

The QH-RRI-LSA indicators themselves are meant to provide insights about how start-ups can act responsibly but are not clear-cut or restrictive because they need to take into account the context and challenges faced by start-ups. The indicators provide areas and topics to indicate good practices for a responsible start-up, but should also be examined in context: the particular industry-ecosystem that the start-up is in, the nature of the start-up, comparisons with similar industry start-ups, and the reasons for their success or failure to meet up to the indicator.

The indicators are also an initial draft, which will be revised during the project, based on the feedback, experiences, and implementation throughout the pilots. In particular, the pilots will provide examples of how certain start-ups achieved the indicators (providing advice for how the

indicators can be realised) or reasons why they were unable to meet the indicators (providing insights about the implementation and universalizability of some indicators). These insights will help us re-formulate and refine the indicators throughout the project's lifespan.

The indicators are written more qualitatively because of the innovativeness of this task, and the validity of such indicators is so far unmeasured and unprecedented in start-ups. It will be shown in the report that start-ups are highly dynamic, adaptable, and do not typically follow many of the structures in more mature businesses, which can perhaps have more static indicators. Because of this, there has to be some relative flexibility and contextual evaluation of responsible investment metrics, rather than more quantitative measurements or check-box evaluations, that are typically used in business performance analysis.

Table of Contents

1. Introduction	6
2. RRI as a Basis for Responsible Behaviour	10
3. The IRIS+ method as an industry standard	12
3.1. Applicability of IRIS+ in a start-up context	14
3.2. IRIS+ as a model of responsibility	17
4. Responsible Research and Innovation Indicators	22
4.1 The Ideal of RRI Applied: Highlights from Past Approaches.....	23
4.1.1. Challenges for Implementing RRI.....	23
4.1.2. Development of RRI Indicators	31
5. Supporting RRI and SRI with the Lean Start-up Approach	33
6. Responsible Impact Assessment Model	37
6.1. Societal Indicators	42
6.2. Research Indicators.....	42
6.3. Political Indicators.....	43
6.4. Business Indicators	43
6.5. Indicator Correlation	45
7. Conclusion	45
8. References	47
9. Appendices.....	50
9.1. Appendix 1: IRIS+ Indicators Suitable for Responsible Start-ups	50

1. Introduction

RRIstart is an Horizon2020 Project that responds to the EU efforts to foster impact investment (an investment that delivers social, environmental and economic benefits) by developing an innovative RRI-based model for start-ups, complemented by an RRI-based impact investment indicator list in a multi-stakeholder (beyond quadruple helix) context. Through RRIstart, the consortium aims to demonstrate the value of Responsible Research and Innovation (RRI) for the Science, technology, engineering, and mathematics (STEM) entrepreneurship ecosystem. At the moment, start-ups and investors do not adopt existing RRI principles and indicators due to the limited compatibility of existing RRI models (tailored mostly for large organizations). Nevertheless, by adopting a lean/agile approach to RRI embedment, RRIstart proposes a novel RRI model for start-ups blended with novel RRI-based impact investment indicators. RRIstart tests the developed innovation through a translational piloting approach (from lab to market). Three pilots will be organized (on environmentally sustainable start-ups from Northern Europe, 3D printing & advanced materials in Italy and bioeconomy (agrifood) in Greece). In each pilot, extended quadruple helix actors will be involved to assess the feasibility of embedding RRI in start-ups and to facilitate (public and private) impact investment through the RRI-based indicator set.

RRIstart responds to the EU efforts to foster impact investment (an investment that delivers social, environmental and economic benefits) by developing an innovative RRI-based model for start-ups, complemented by an RRI-based impact investment indicator list in a multi-stakeholder (beyond quadruple helix) context. Before this can be done, however, it is important to clarify how the application of RRI principles in the context of start-ups will provide a richer understanding of the societal context in which start-ups are normally active and will provide investors with evidence for the advantages of impact investment. This report will provide a systematic literature review of research and practice regarding the integration of RRI in business contexts, with a focus on start-ups.

To benefit from existing research and practice, WP1 will take stock and seek the common ground between the theoretical literature of RRI, past RRI reports within the Horizon 2020 framework and literature on ethics and responsibility of finance. This literature review will be the first of its kind given its focus and will generate insights for our key indicators and it will provide us with a theoretical and methodological starting point for the specific context of start-ups.

An original aspect of the literature review in comparison to past reviews is that it will extract insights on both the why question (i.e., arguments and counter-arguments for applying RRI in the context of start-ups and the how question (i.e., challenges and opportunities for applying RRI in the context of start-ups). The answers to these two questions will constitute the point of departure for T1.2 and, in a more general sense, the point of departure for the entire project. It is crucial therefore that they are presented in D1.1 in an easy-to-understand language with concrete and illustrative examples.

In the context of a broader global movement towards sustainability and moral accountability of institutions, the field of investment has shown increasing interest in turning away from investees that are exclusively profit-oriented. In the process, many new terms (OECD 2022) have been coined to designate the resulting novel approach to investment and business more generally: “socially responsible investment”, “social investing/finance”, “ethical investing”, “impact investment”, “value-based investment” and many more (Losse & Geissdoerfer, 2021; Widyawati, 2020). For ease of reference, we will employ the term “socially responsible investment” (SRI) in what follows to stand for this cluster of related methods.

Regardless of the label employed to designate it, this relatively novel approach is characterized by the use of additional criteria in the selection and management of investment, meaning that financial considerations regarding performance are now combined with non-financial considerations regarding the ethical value, social justice, political accountability and the like. The earliest example of such practices is already an indication of the intentions behind such a combination: screening out 'sin stocks' (tobacco, arms, alcohol etc.), a practice already common two decades ago, is a form of integrating societal values into investment under the assumption that the 'sins' in question need to be curbed or discouraged. Later, this rather basic screening has been complemented with a more complex and proactive one where societal gains are actively sought through shareholder activism and community investment as opposed to just hazards or societal risks being eliminated (Chatzitheodorou, Skouloudis, Evangelinos, & Nikolaou, 2019; Widyawati, 2020, p. 623). This later approach "goes beyond minimizing harmful outcomes to actively creating good ones by creating a positive impact" (Cohen, 2020, p. 17). Complex screening before and during the investment based on pre-established criteria – sometimes referred to as ESG factors, with "ESG" standing for "environmental, social and governance [ESG]" – remains one of the main tools for this novel form of investment (Gangi & Varrone, 2018).

This transition integrates stakeholder value with shareholder value – where 'stakeholders' are those individuals and institutions affected or potentially affected by a firm, or people and organisations that have interests and stakes on ESG issues, such as citizens, societal organizations, political organizations, environmental organizations, research institutes, media, the arts etc. – giving rise to numerous subsequent questions. Yet by far, the most urgent of these subsequent questions have been and still is, the question of profitability *now reposed as profitability in the context of sustainability*. Thus, scholars and practitioners ask: "Does it pay to be good?" (Barnett & Salomon, 2012), or "What is the price of being good?" (Renneboog, Ter Horst, & Zhang, 2008) or "Are they profitable?" (Syed, 2017). The major concern seems to be that the "investable universe" decreases due to the implementation of non-financial criteria (i.e., screens typically reduce potential investees) and the use of the same criteria in a firm's activity can decrease returns (i.e., being socially responsible can be expensive). The question is thus whether gains can be achieved in some other way – perhaps by strategically exploiting an early entry on a growing market of investment - and, if not, whether investors, beneficiaries and perhaps other stakeholders are willing to pay the price for doing good (Borgers & Pownall, 2014, p. 29). There is quite a controversy on whether socially responsible investments indeed perform worse than conventional ones (Erragragui & Lagoarde-Segot, 2016) but the heat of this controversy reinforces the point made here namely that the main concern remains that of profitability in the context of sustainability.

A parallel strand of research is directed, not at resolving cost-benefit calculation of this transition, but at the ideas (and ideals) of responsibility employed in defining and operationalizing socially responsible investment. Here the main problem seems to be that

[...] the quest for firm foundations in measurement is hampered by significant differences of interpretation among practitioners. These disagreements relate to such basic issues as what forms of 'impact' should be measured; who should decide on key outcomes to assess; and whether rigour in attribution is practicable or indeed feasible (Reeder, Colantonio, Loder, & Rocyn Jones, 2015)

Being still in its early stages, even though forms of socially responsible investment have been practised in the United States before the 1990s, the field is bound to deliver "mechanisms of SRI are

very heterogeneous” such that “what is considered to be SRI by one market participant might not be fully recognized by another” (Widyawati, 2020, p. 623). Such differences prevent any serious attempt towards a systematic comparison between different (ESG) metrics systems (*idem*, p. 633). Yet this diversity might also be a symptom of a more fundamental disagreement between stakeholders and scholars involved in practising or studying the phenomenon of socially responsible investment. Either the ones involved are not working with the same ideal of ‘socially responsible investment’ or they are not working with the same operationalization of the ideal. It is plausible indeed that both these conditions apply.

Faced with this diversity, attempts have been undertaken to increase knowledge exchanges between all stakeholders interested or active in socially responsible investment. To this end, the past decade has seen notable research, policy, and infrastructure endeavours that are directed *inter alia* at improving the exchange of insights on both the ideal of socially responsible investment and its application in a variety of fields (Ormiston, Charlton, Donald, & Seymour, 2015, p. 3). Global networks such as the Global Impact Investment Network (GIIN), Impact Investment Policy Collaborative (IIPC) and the Social Value International Network seek to further this exchange of insights from various areas where the ideal of socially responsible investment is applied. Several journals such as *Journal of Business Ethics*, *Journal of Sustainable Finance and Investment* and *Corporate Governance* have become platforms where the dialogue on socially responsible investment is being carried out.

Such encouraging developments notwithstanding, the studies and practices mentioned above typically focus on companies whose products are already sufficiently developed to ensure a relatively low risk of investment (a by-product of this choice being that the high-net-worth investor is the prototypical investor taken as a case in point). We notice relative neglect of what happens ‘upstream’ in the product- or technology-building process. The present paper aims to fill this gap by taking as a starting point the situation of socially responsible investment in (high-)tech start-ups with an ambition for social responsibility, sometimes known as *social tech start-ups* (Alvord, Brown, & Letts, 2004; Arena, Bengo, Calderini, & Chiodo, 2018; Tracey & Stott, 2017). The applicability of current literature on SRI to social tech start-ups hinges on whether current screening methods take into consideration some or all of the following aspects typical of social tech start-ups:

- (i) *The size of the enterprise.* Start-ups are significantly smaller than regular companies and this might affect the degree to which SRI can be undertaken, predicted and evaluated.
- (ii) *The fluidity of the organizational structure.* Start-ups are generally fluid when it comes to titles, roles, status and function within the organization. Incomplete or underdefined business models and processes add to this fluidity
- (iii) *The high reliance on the network.* Start-ups are heavily reliant on networks of stakeholders (suppliers, advisers, service providers) to ensure the commercialization of their product
- (iv) *Product uncertainty.* Start-ups are not fully in control of the many technical, social, economic and political values that might end up shaping the product design. Flexibility regarding product design is highest in the early stages but can sometimes last even past the commercialization phase.

- (v) *Creativity and high skill.* Start-ups are brooding places for innovation. They survive if and only if they initiate creativity and adaptability, along with the hiring of high-skilled employees.

We aim to contribute to the literature on SRI by studying the extent to which current tools for achieving socially responsible investments are attuned to the specificities of social tech start-ups, i.e., the extent to which points (i)-(v) above are taken into consideration. One of the aims of our research is to build a model in which we merge existing investment tools with RRI, LSA and QH (see chapter 4). We employ as a case in point the industry-standard screening method developed by GIIN known as *Impact Reporting and Investment Standards* or 'IRIS'.¹ For (i) and (ii) we draw upon literature on start-ups and specific entrepreneurial and financial features (Alvord et al., 2004; Arena et al., 2018; Tracey & Stott, 2017). For (iii), we draw upon the field of *responsible research and innovation* or 'RRI' (Asveld, 2017; Koops, Oosterlaken, Romijn, Swierstra, & van den Hoven, 2015). For (iv) and (v) we incorporate the lean start-up approach to innovative and dynamic companies, which will also complement the RRI approach.

The research in this Deliverable seeks to be a cross-fertilization between the more financially-oriented world of SRI and the more ethically oriented world of RRI. This will be particularly instructive for those in start-ups or the field of socially responsible investment who would wish to extend their scope towards small-scale R&D and their investors through a better understanding of this specific investment context, but also for researchers in RRI who wish to integrate the investment process in the consideration of how responsible the innovation process is within an R&D or STEM firm.

Although the fields of SRI and RRI seem to share both aims and terminology, there is currently little or no communication between the scholars involved in these two fields. We believe the time is ripe for such a communication and we consider this deliverable to be a first step in the right direction. While RRI can inform responsible investment, and much of the IRIS+ implies responsibility, both approaches can benefit from each other's strengths. For example, the IRIS+ model focuses on more concrete solutions, provide more practicality, hence operationalisation, to RRI; while RRI is a more reflexive approach, allowing for contextuality to the more rigid IRIS+ model (which will be shown is very important for dynamic, changing, and adaptive start-ups). In this framework, we found it useful to consider also aspects of LSA since, being specific to start-up, could help in operationalizing the results of the cross-fertilization between SRI and RRI fields, and the indicators found in the IRIS+ model and the 12 RRI projects that we analysed.

In sum, we will begin by providing an overview of what we mean by responsibility, taking the examples found in RRI literature (Section 2). Following this, we will undertake a critical investigation of the IRIS+ method through the lens of start-ups that wish to engage in responsible research and innovation (Section 3). To ensure we properly account for available indicators to help start-ups act responsibly, we complemented our evaluation of the indicators that we found in the IRIS+ model, which were found in 12 large RRI projects with available indicator outputs (Section 4). Section 5 will outline the LSA and will demonstrate how it can support RRI and SRI approaches. However, it will be shown that all three have their strengths and weaknesses in different areas to guide start-ups. Section 6 will show the benefit of framing the approaches within the context of the quadruple helix approach, which gives equal importance to business, societal, social, and political factors. Section 6

¹ <https://iris.thegiin.org/metrics/>

will culminate in our Responsible Impact Assessment Model and 24 indicators to guide start-ups for best practices.

By measuring, we can identify strategies and drivers and barriers that these actors experience in their effort to engage in responsible investment in start-ups. Based on these insights, we can provide advice to new entrants and low performers about how to become higher performers. The indicators are written qualitatively because of the innovativeness of this task, and the validity of such indicators is so far unmeasured and unprecedented in start-ups. Because start-ups are highly dynamic, adaptable, they do not typically follow many of the structures in more mature businesses, which can perhaps have more static indicators.

2. RRI as a Basis for Responsible Behaviour

RRI may be viewed as a precautionary endeavour that seeks to avoid social and environmental hazards and injustice. But this view only provides a passive interpretation of RRI that fails to address the positive contributions that research and innovation may (or must) actively bring about to society. In the simplest terms, to innovate responsibly means to innovate without creating societal problems: environmental issues, public health issues, discrimination and the like. This is then responsible for innovation in a 'negative' sense as an innovation that does not damage our society and our environment. Classic examples of this kind are asbestos and leaded gasoline - two discoveries that were heralded as miracles of science at the moment of their introduction in the early twentieth century but had disastrous environmental and public-health effects that last until the present day (Gee, 2001). Responsible innovation is thus at first instance a precautionary endeavour that seeks to avoid social and environmental hazards. Although this is a good starting point, the negative conception of responsible innovation does not pay due attention to the positive contributions that innovation can (and generally speaking should) produce in society. In a similar way that SRI started as an approach to avoid 'sin stocks' and later evolved into a more complex approach actively seeking societal gains, RRI started as a passive approach to avoid negative societal impact and evolved into an approach actively seeking positive societal impact.

After all, innovation is not just an intellectual endeavour of finding new solutions to problems, rather, it is a social endeavour in which society and science change together and influences each other. New technologies are not just answers to technical questions – they change the world we live in. RRI is thus a way of “taking care of the future through collective stewardship of science and innovation in the present.” (Owen et al., 2013). Innovation is, as the phrase goes, “society in the making” (Callon, 1987). The need for this alignment between scientific activity and societal needs has many origins. The moral obligation of scientists to innovate responsibly has been linked with, e.g., the democratic control over public funds, the prospect of ‘technology traps’ (see overview in Popa, Blok, & Wesselink, 2020a).

With this backdrop, various models of RRI have been developed in the past decades to help bring this idea of science closer to reality (Asveld, 2017; Koops et al., 2015; van den Hoven, Swierstra, Koops, & Romijn, 2014). A model that has been particularly successful in capturing the essence of RRI

is the one proposed in (Owen et al., 2013; Stilgoe et al., 2013). This model revolves around four principles or ‘process requirements’.²

Process Requirement	Description
Anticipation	Asking questions about the future, taking into consideration not just what is known and fairly certain but also what is not known, what is likely, what is plausible and what is possible. This forward-looking thinking is not only aimed at preventing negative consequences but also improving the embedding of the technology in society and discovering opportunities for innovation.
Reflexivity	Thinking and being critical about the innovation process and being aware that perspectives, cultures, paradigms, frames of reference and other parameters might play a role in framing that issue such that no universal viewpoint is valid at all times.
Inclusion	Engaging various stakeholders to participate from the start in science and innovation such that societal values are absorbed in the process of bringing new technologies to the market. This aspect involves setting up deliberative structures that empower stakeholders to defend their values in a dialogue with the experts involved in innovation.
Responsiveness	Responsiveness refers to the practice of responding and modifying ways of thinking and behaviours. It asks scientists, companies, and industries to change their research and innovation practices if their stakeholders or the public deems their practices ethically unacceptable or contrary to the needs of society. It is responding to changing perspectives, knowledge, and values within society.

Table 1: RRI's Four Process Requirements

These process requirements are the cornerstone of the RRI literature, but have not been incorporated into literature on socially responsible investment. In addition, there is also a tension between how RRI is implemented in academia and how it is used by companies in practice. While existing RRI research and practice mainly focuses on public Research & Innovation (R&I) at universities, privately funded industrial R&I provides a completely different context with its own challenges (Blok & Lemmens, 2015). The self-evidence of public engagement in public RRI (Stilgoe, Owen, MacNaghten, 2013) turned out to provide particular challenges in the industrial context (Blok et al. 2015) because of fundamental tensions between the social logic and the economic logic employed by companies (Brand & Blok, 2019). This particular context of industrial RRI received increasing attention in the literature, resulting in dedicated special issues in recent years (Scholten & Blok, 2015; Blok, Scholten, Long, 2018; Martinuzzi et al. 2018). While research highlighted how RRI can provide a competitive advantage of firms (Blok et al. 2020), can be aligned with the Corporate Social Responsibility (Blok, 2019) and open innovation strategy (Long et al. 2018) of companies, and how RRI can be implemented in R&D decision making processes (Blok et al. 2017) and company strategy (van de Poel et al. 2017) to mature over the years (Stahl et al. 2017), the particular context of finance and private investment in RRI didn't receive attention in the literature so far.

² These differ from the six keys of the EU's RRI model (Ethics, Science Education, Gender Equality, Open Access, Governance and Public Engagement) because they respond to ‘how’ to do RRI, whereas the six keys focus on the ‘what’, i.e. the RRI content’ (ORBIT RRI 2022).

3. The IRIS+ method as an industry standard

The origins of the Impact Reporting and Investment Standards (or ‘IRIS’, also known as ‘IRIS+’ since 2019) are to be traced back to the idea that mission-driven enterprises need an effective and consistent way to articulate their social and environmental performance to establish credibility, enable peer comparisons, and effectively raise funds among the growing set of investors seeking social and environmental returns alongside financial profits (Bouri, 2011, p. 116). The organization that develop the IRIS+ methodology is the Global Impact Investing Network (GIIN) which was founded in 2009 by the Rockefeller Foundation, Acumen Fund and B Lab. Crucial factors that lead to the success of IRIS+ and it is becoming the industry standard today are: (i) its reliance on usage data across different sectors, (ii) its usability by a great variety of stakeholders from fund managers to investors and firms (USAID 2019), (iii) the possibility to tailor its metrics according to one’s needs, (iv) its alignment with already-existing third-party standards (e.g., Greenhouse Gas Protocol and LeadData), (v) its development as a free public good, thus avoiding financial barriers and institutional gatekeepers.

A major function of IRIS+ is the provision of unified semantics applicable across institutions and fields of application. In this sense, IRIS+ functions “like a dictionary” meaning that it provides “clear and consistent definitions for terms commonly used to describe social, environmental, and financial performance” (Bouri, 2011, p. 121). But IRIS+ is more than just a very advanced glossary. Through the selection of constructs, definitions and operationalization, IRIS+ embodies a certain theory about what responsibility in finance and investing must look like. At the core of IRIS+, there is a vision on what it means to incorporate social impact into (or alongside) financial return on investment. At first, this vision was constructed through the aggregation of already-existing methodologies and standards, but later, the 2019 version known as IRIS+ resulted from a broad stakeholder consultation process. In this way, IRIS+ is aligned both with fundamental principles governing socially responsible investment (such as the Sustainable Development Goals (SDGs) and other internationally recognized standards) and with the needs of actual practitioners in the field.

For the present purposes, the most important element of IRIS+ is the *Catalogue of Metrics*, a comprehensive repository of metrics that are then compiled and categorized in a variety of ways for individual use. The Catalogue of Metrics is the ‘database’ from which more specific tools can be carved out simply by excluding metrics that are irrelevant for a certain enterprise. The Catalogue of Metric consists of a total of 685 indicators. The catalogue of metrics is organized along the following lines.

Organizing categories in the catalogue	Explanation
<i>Metric Identification</i>	These include a code for each metric (e.g., ‘O19891’) and a name for each metric (e.g., ‘Pesticide use’)
<i>Definition, Footnote, Calculation, Usage Guidance</i>	Together, these categories explain the content of the metric and how it must be used (e.g., ‘Pesticide use refers to insecticides, fungicides, herbicides, disinfectants, and any substance intended for preventing, destroying, attracting, repelling, or controlling any pest...’ etc.)
<i>Categories</i>	This category divides the metrics into themes (e.g., ‘Agriculture’, ‘Bio-diversity’, ‘Climate’, ‘Infrastructure’). Some metrics fall under a category called ‘cross-category’, meaning that they are not specific to any one category but more than one. Also, each category has a highlighted sub-category (e.g., ‘Employment’ has ‘Quality jobs’). Finally, two ‘higher-order’ categories specify whether the metric is focused on positive social impact or positive environmental impact (or both).

<i>Metrics characteristics</i>	These categories specify various features of the metric (e.g., whether the metric pertains to the company or the product, whether the metric relates to other metrics).
<i>SDGs</i>	The Sustainable Development Goals to which the metric pertains
<i>Dimension of impact</i>	<p>WHAT: Understanding the outcomes the enterprise is contributing to and how important the outcomes are to stakeholders.</p> <p>WHO: Understanding which stakeholders are experiencing the effect and how underserved they were before the enterprise's effect.</p> <p>HOW MUCH: Understanding how many stakeholders experienced the outcome, what degree of change they experienced, and how long they experienced the outcome.</p> <p>CONTRIBUTION: Assessing whether an enterprise's and/or investor's efforts resulted in outcomes that were likely better than what would have occurred otherwise.</p> <p>RISK: Assessing the likelihood that impact will be different than expected.</p>

Table 2 The IRIS+ Catalogue of Metrics and its organization

It should be clear from Table 2 that IRIS+ needs to be customized along various cross-cutting lines making it interoperable between institutions and industry sectors and thus facilitating data comparison. It should be noted that IRIS+ was not specifically designed with the tech start-up context in mind. However, the methodology is presented as being generally applicable for impact investors and no restrictions on inapplicability are made explicit. Thus, the method is presented as “the generally accepted system for impact investors to measure, manage, and optimize their impact”³. Furthermore, there are no restrictions mentioned in any of the ‘Core Characteristics’ that function as the methodological basis for the IRIS+ method.⁴

The GIIN method contains an important distinction between indicators⁵ that pertain to a specific industry (or sector) and indicators that apply to all sectors, the so-called cross-category. The distribution of the indicators per category is given below:

Category of indicators	Number of indicators
Agriculture	32
Biodiversity	5
Biodiversity & Ecosystems	3
Climate	12
Diversity and Inclusion	5
Education	46
Employment	14
Energy	16
Financial services	63
Health	13
Infrastructure	21
Land	19

³ See <https://iris.thegiin.org/about/>

⁴ See https://thegiin.org/assets/Core%20Characteristics_webfile.pdf

⁵ The terms “metric” and “indicator” will henceforth be used interchangeably.

Pollution	2
Real estate	19
Waste	19
Water	45
SUBTOTAL (specific categories)	318
Cross-category indicators	368
TOTAL	686

Table 3 Distribution of indicators per category in the GIIN framework

We notice from the beginning that cross-categorical indicators constitute the bulk of the IRIS+ method. A combination of cross-category and one or two specific sectors will always yield, as can be seen in Table 3 above, an evaluation instrument that is primarily shaped by these cross-category indicators. Although the category-specific indicators and the cross-category indicators are typically used in combination, it is important to note that the cross-category indicators are meant to be generally applicable, while category-specific ones are to be taken into consideration only when a firm is active in the relevant sectors. For example, the indicator PD6363 *Species extension threat* which “describes applicable threats to species during the reporting period” is a specific indicator about the category of Biodiversity. It is only applicable if the firm is active in that sector. By contrast, a cross-category indicator such as FP3774 *Charitable donations* which captures the “Value of all financial contributions and in-kind donations of goods and services made by the organization to charities, private foundations, non-profit organizations, or non-governmental organizations during the reporting period” is applicable regardless of whether the firm is active in the biodiversity sector.

Given the weight of the cross-category indicators in the IRIS+ method, it is expedient to examine the extent to which these indicators apply to start-ups. The question is then to what extent the cross-category indicators are applicable and what can be done to increase this applicability. Unless mentioned otherwise, we will refer in what follows to cross-category indicators exclusively.

3.1. Applicability of IRIS+ in a start-up context

Numerous indicators from the IRIS+ method pertain to companies or organisations that have some business relationship with the organization (suppliers, distributors, advisors etc.). These indicators measure the degree to which the organization is sensitive to issues regarding minorities, gender disparity, disadvantaged groups but also the degree to which the well-being or satisfaction of individuals is taken into consideration. For example, the indicators in Table 4 illustrate the measurement of company responsibility by investigating the wages of minorities and/or previously excluded groups:

CODE	Name Indicator	Description indicator
OI1084	Permanent Employee Wages: Minorities/Previously Excluded	Value of wages (including bonuses, excluding benefits) paid to all full-time and part-time employees of the organization who belong to minority or previously excluded groups during the reporting period.

OI1508	Full-time Wages: Minorities/Previously Excluded	Value of wages (including bonuses, excluding benefits) paid to all full-time employees of the organization who belong to minority or previously excluded groups during the reporting period.
OI2362	Minority/Previously Excluded Wage Equity	The ratio of the average wage paid to minority/previously excluded employees of the organization for a specified position, compared to the average wage paid to dominant culture employees of the organization for the same position during the reporting period.
OI3862	Full-time Wages: Minorities/Previously Excluded Management	Value of wages (including bonuses, excluding benefits) paid to all full-time management employees (managers) of the organization who belong to minority or previously excluded groups during the reporting period.

Table 4 Example of internally sourced indicators

When applying such indicators to a start-up – technology-oriented or otherwise – the typically small size of the organization makes it difficult to devise any sensible statistics based on which to evaluate how responsibly the company is acting. Relative to industry standards, a small start-up might score unusually high or unusually low, simply because of the small sample that the evaluator will be working with. Quantitative measurement of responsibility is of course necessary, but statistical frequency and percentages are not the right instruments to determine whether a small-size firm such as a start-up is responsible. More generally, operationalizing responsibility as action or policy relative to *employees* is a difficult concept to apply to small-size companies such as tech start-ups.

Yet it is not just the size of the firm that affects the application of these indicators. In the fluid working environment of a start-up, employees do not typically fall within standard organizational categories that commonly apply to regular-sized organizations. The standard difference between manager and subordinate, between organizational departments and between types of employment are less clear-cut. As a result, the number of, say, women in managerial positions or the number of disabled individuals with full-time contracts might be not only exceedingly low relative to industry standards but it might also be difficult to assess. The same individual might navigate various positions within the start-up and the job might also evolve in ways that are not easily captured by standard organizational categories.

The third and fifth characteristic of tech start-up poses problems for the application of quantitative methods: a tech start-up will typically require a network and highly-skilled employees. This means that selection of employees takes place from a much smaller pool of individuals as compared to a larger organization. If the field from which the start-up needs to select their highly-skilled employees is biased or does not adequately include marginalised groups, it will be correspondingly difficult (and perhaps practically impossible) to ensure equality in the workplace.

To illustrate these problems, consider the indicator OI2362 given above which pertains to the normative concept of ‘wage equity’ (OI2362): “Ratio of the average wage paid to minority/previously excluded employees of the organization for a specified position, compared to the average wage paid to dominant culture employees of the organization for the same position during the reporting period.” It is, of course, responsible for a tech start-up to consider minorities and previously excluded groups, but the indicator revolves around the idea of equal pay relative to a “specified position”. Here, all three elements mentioned above will make the application of this indicator very difficult. For example, it may very well be the case that minorities are under-represented in the pool of individuals from which a start-up may hire its (very highly-skilled) employees (e.g. because people from minorities are less likely to be given the same opportunities as people from the dominant culture to obtain the (very high) qualifications required to hire). Simply put, there might not be two

individuals in two identical (or even similar) positions in a start-up and the positions themselves might change rapidly in a short period depending on the start-up's development.

Not all indicators from the IRIS+ method are 'internally sourced' in the way described above. The IRIS+ pool of indicators also contains numerous indicators that pertain not to the organization as such but rather to the network in which the organization operate. For example, indicators PI1728, PI2302, PI2551, PI6659, and PI8330 all pertain to gender issues but applied to business partners as opposed to the members of the organization; PI1160 and PI6189 measure percentages of business partners (suppliers/distributors) with disabilities; PI4341 and PI6858 measure, respectively, earnings of distributors with disabilities and payments to suppliers with disabilities. PI7814, PI8470, PI9261, PI9654 concern percentages of business partners (suppliers/distributors) from minorities. These 'externally sourced' indicators measure the sensitivity of a company to socio-ethical themes such as the inclusion of minorities and gender disparities (see Table 5).

CODE	Name Indicator	Description indicator
PI1728	Supplier Individuals: Female	Number of female individuals who sold goods or services to the organization during the reporting period.
PI2302	Payments to Supplier Individuals: Female	Value of payments made by the organization to female individuals who sold goods or services to the organization during the reporting period.
PI2551	Earnings of Distributor Individuals: Female	Earnings generated by female individual distributors from selling the organization's products/services during the reporting period.
PI6659	Distributor Individuals: Female	Number of female individuals who served as distributors of the organization's products/services during the reporting period.
PI8330	Client Individuals: Female	Number of unique women who were clients of the organization during the reporting period.
PI1160	Distributor Individuals: Disabilities	Number of individuals with disabilities who served as distributors of the organization's products/services during the reporting period.
PI6189	Supplier Individuals: Disabilities	Number of individuals with disabilities who sold goods or services to the organization during the reporting period.
PI4341	Earnings of Distributor Individuals: Disabilities	Earnings generated by individual distributors with disabilities from selling the organization's products/services during the reporting period.
PI6858	Payments to Supplier Individuals: Disabilities	Value of payments made by the organization to individuals with disabilities who sold goods or services to the organization during the reporting period.
PI7814	Payments to Supplier Individuals: Minorities/Previously Excluded	Value of payments made by the organization to individuals belonging to a minority or previously excluded groups who sold goods or services to the organization during the reporting period.
PI8470	Distributor Individuals: Minorities/Previously Excluded	Number of individuals who belong to minority or previously excluded groups and served as distributors of the organization's products/services during the reporting period.
PI9261	Supplier Individuals: Minorities/Previously Excluded	Number of individuals who belong to minority or previously excluded groups and who sold goods or services to the organization during the reporting period.

PI9654	Earnings of Distributor Individuals: Minorities/Previously Excluded	Earnings generated by individuals who belong to minority or previously excluded groups from selling the organization's products/services during the reporting period.
--------	---	---

Table 5 Equality-related Indicators

Another category that is more directly applicable to the context of a start-up are indicators that pertain to the products or services developed by the organization. These are for example indicators such as OI1479, OI4112, OI5732, PD9604, PI2764, PI9878 and PD9427 which are concerned with the amount of greenhouse gas emitted through the operations of the organization and its products. Similarly, OI1495 and OI1496 measure, respectively, the amount of energy generated/consumed or purchased from non-renewable resources. Of course, in a sense, the object produced by an organization is not external to the organization itself, yet we place it here under 'externally sourced indicators' since it does not have to do with the employees of the organization. Surely, the application of these indicators will have to take into consideration the small size of the start-up, but the numbers will not be skewed as in the case of externally sourced indicators: a small organization can still have a high carbon footprint through its operation, its product and its services. Even in the case that these metrics are not directly applicable to a start-up itself, e.g. due to its typically small size or because the kind of services that it offers are not amenable to such measurements (e.g. software services), the indicators may be externalized by measuring the ethical inclination of the organizations and individuals with which the start-up partners to provide its services. In such a situation, the outsourced service or product counts for evaluation in the same way a larger organization would be screened for an in-house service or product. The same, of course, equally applies to the internally sourced indicators outlined at the beginning of this section (e.g., OI2362 could focus on the wage equity of partners, rather than the start-up itself).

3.2. IRIS+ as a model of responsibility

The IRIS+ methodology captures some of the great themes around responsibility: inclusion, gender disparity, environmental protection, waste, education etc. Additionally, how the indicators within IRIS+ were compiled exhibits a high degree of awareness of the many stakeholders involved in impact investment. The IRIS+ method was constructed and refined through numerous stakeholder consultation sessions. Of course, it will be inevitable that opinions, both within and outside academia, will differ as to the best operationalization of abstract ideals such as, say, gender disparity (Beede et al., 2011; Nissan, Carrasco, & Castaño, 2012).

While the IRIS+ model provides indicators for investors, it is still vague about the normative underpinnings of each indicator and the indicators as a whole. This is something valuable that RRI can bring to the evaluation and implementation of the indicators. RRI can formulate *why* we should care about these indicators, not simply how we can follow them. In the following section (3. "Evaluation in Responsible Innovation literature"), we will outline how examining the IRIS+ model through the lens of RRI can demonstrate the normative underpinnings of its indicators. Thus, we propose the integration of the RRI normative ideal into the IRIS+ model to ensure responsible investment.

The normative idea behind the indicators

An instrument for evaluating responsibility must ideally help the evaluator cut the empirical reality into two mutually exclusive categories: the responsible and the irresponsible. Of course, empirical reality, consisting in this case of organizational activities and products, will be too complex to conform to such simple separations. But the image of a clear-cut separation reminds us that, at the very least, the two (ideal) categories should not be ‘uncontaminated’ by other moral precepts, important as these other precepts might be. We can see the ‘responsibility’ sphere that partially shares its semantic content with other concepts such as ‘freedom’, ‘happiness’, ‘justice’, ‘tradition’, ‘creativity’, ‘humanity’ and certainly others. However, for our analysis, and eventual model, it is important to distinguish between responsibility and other moral precepts.

Responsibility is typically understood as having a duty to do something or being accountable/blameworthy for something. It often has both proactive and reactive meanings. One should be proactive to carry out a particular activity, but may also have to respond or react when a particular action is not carried out. Responsibility implies a sense of duty or obligation to someone or something, to perform a particular activity, respond in a certain way, or be the person of blame. However, determining responsibility, and differentiating it from other moral precepts, can often be a quite difficult task, as responsibility often gets blurred between other normative concepts and principles.

First of all, it is important to distinguish whether or not one is causally responsible for a particular outcome or event. One must have the capacity to understand their responsibility in a given situation (e.g., children are often relinquished from responsibility for some of their actions because they have not yet developed a cognitive awareness) and it is important to distinguish the intent behind the outcome or event. There are also varying degrees of responsibility and irresponsibility, and the types of obligations on one to initiate action or be a source of blame for the lack thereof. There is also a distinction between legal and moral responsibility, whereby the former is a requirement by law, the latter may or may not be represented in law. While both are extremely important for the evaluation of responsible organisations, we start with the presumption that the start-ups for which we are proposing our model will be following the legal restrictions and fulfilling their legal responsibilities as a prerequisite.

These considerations create the need for additional reflection when scanning through the IRIS+ catalogue for responsibility indicators. For instance, consider the example of indicator PI0617 ‘Availability of Basic Services/Facilities’ which ‘indicates whether there are basic services present onsite and a system in place to maintain them as of the end of the reporting period’. The question one must reflect upon is: does this construct fall within (or somehow stands for) the larger construct of responsibility? It is undoubtedly necessary to have basic facilities, and it certainly contributes to good health and well-being (i.e., it aligns with SDG 3 Good Health and Well-Being and SDG 6 Clean Water); moreover, having a toilet on site and access to clean water is in many countries legal responsibility towards one’s employees, which as mentioned earlier, is a prerequisite for adopting our model.

In some cases, what adds to the problem is that it is difficult to say what the ideal behind a certain metric is. This is typically the case with metrics that seem to be measuring a company’s efficiency such as the metrics relating to Units/Volume (see Table 6).

Indicator	Indicator Description	Metric	Status
-----------	-----------------------	--------	--------

OI4564	Number of status-quo products that were replaced by products sold during the reporting period.	Units/Volume Replaced	
PI7289	Amount of the product/service sold by the organization as certified during the reporting period.	Units/Volume Sold	Certified
PI9029	Amount of the product/service exported by the organization during the reporting period.	Units/Volume Sold	Exported
PI8329	Amount of the product/service provided by the organization for free during the reporting period.	Units/Volume Sold	Free
PI1509	Amount of the product/service provided by the organization for free as a result of loss or leakage during the reporting period.	Units/Volume Sold	Lost/Leaked
PI8454	Amount of the product/service sold during the reporting period where no direct payment was provided to the organization at the time of service but for which the organization expects to be reimbursed.	Units/Volume Sold	No Direct Payment

Table 6 Indicator Metrics of the Company's Efficiency

These cross-categories indicators state that they “are relevant to any IRIS+ Impact Category or Impact Theme (i.e., these metrics are not specific to any particular industry/category or theme)” (see also our explanation in Section 2.1). Nevertheless, they seem to capture a construct of efficiency or productivity, something that has little to do with responsibility. All those indicators are of course important for a company’s wellbeing, efficiency, and market value but it is difficult to see how the evaluation is a matter of responsibility in the same way it is when we evaluate, e.g., toxic waste.

Users can always exclude such indicators from a list of criteria that focuses on responsibility indicators, but we should not assume that users will be able to do this. These related indicators can distort the process of identifying responsibility indicators and might do so in a way that affects what is known as the ‘content validity of the screening process (Sireci, 1998). This means that, in practice, scoring well on a large set of ‘muddled’ concepts can result in a very positive image of a firm’s activity – however, that result is achieved quantitatively or qualitatively – but this image would be nothing more than the alignment of the firm’s activity and related indicators.

The outline of responsibility provided in the preceding paragraph will be further developed when we return to this topic during our discussions of start-ups later in this report. It will become clearer later how we use the terminology of responsibility during the assessment of start-ups.

Restricted evaluation

Working exclusively with ready-made indicators restricts the ideal of responsibility to a set of fixed data points. The immediate issue is that these data points might not always cover the many complex ways in which firms can be responsible and, conversely, the many ways in which they can be irresponsible (Grunwald, 2011; Stilgoe, Owen, & Macnaghten, 2013). In Table 5 we list for illustration purposes the metrics that pertain to permanent employees.

The four distinguished categories (‘females’, ‘low-income areas’, ‘disabilities’ and ‘minorities’) are of course well-known areas where organisations must tackle disparities and ensure equality at the workplace. Under the assumption that the offering of permanent employment is a solution for improving the condition of disfavoured groups, the four areas of interest are of course

more than welcome. At the same time, the application of this concept of ‘responsibility-as-fair-access-to-permanent-employment’ is restricted to those four areas. Individuals that fall outside those four categories – and thus forms of responsibility that are not covered by the four categories – will be excluded. Some examples: (i) reverse discrimination can lead to the exclusion of precisely the individuals that have not been excluded in the past; (ii) xenophobic sentiments can lead to the exclusion of minorities; (iii) strong political sentiments can lead to the exclusion of people with a certain political background or that are openly in favour of a certain political doctrine. These extraneous categories can be multiplied indefinitely, depending on the specific context in which the organization operates.

Code	Name indicator	Description indicator
OI2444	Permanent Employees: Female	The number of females employed by the organization as of the end of the reporting period. This is the sum of all paid full-time and part-time female employees.
OI3236	Permanent Employees: Minorities/Previously Excluded	The number of people employed by the organization who belong to minority or previously excluded groups as of the end of the reporting period. This is the sum of all paid full-time and part-time minority or previously excluded employees.
OI4038	Permanent Employees: Disabilities	The number of people with disabilities employed by the organization as of the end of the reporting period. This is the sum of all paid full-time and part-time employees with disabilities.
OI8266	Permanent Employees: Low-Income Areas	The number of people employed by the organization who reside in low-income areas as of the end of the reporting period. This is the sum of all paid full-time and part-time employees residing in low-income areas.

Table 7 Metrics of permanent employees

Evaluation of responsibility is thus much more complex than a fixed set of indicators can cover. In the case at hand, responsibility around permanent employment cannot be reduced to the number of individuals in pre-defined categories such as ‘minority’ and ‘female’. If employment is seen as a good, then responsibility around it comprises the entire social process of access to that good: fairness of access, employer performance, negotiation, fair dialogue, transparency, inclusivity, etc.

The evaluating investor must labour between two undesirable extremes: excessive flexibility of the evaluation instrument (which might do justice to context but requires additional ‘calibration’ with every organization) and excessive rigidity of the evaluation instrument (which works better with multiple organizations but will lead to superficial or even distorted evaluations). We will argue later that the burden of navigating this dilemma can be shared by giving responsibility to the firm itself: the start-up (in this case) should devise their categories by reflecting on the notions that are important for, and applicable to, their activity and their mission.

The Standards Employed

The IRIS+ method is intended, generally speaking, to evaluate impact. For such a task, the evaluator employs a norm (or ideal) to decide whether to invest in a certain organization or whether to impose measures for the next investment cycle. More often than not, however, there are many norms applicable to the situation at hand. Traditionally, there are many authoritative sources of ‘responsibility’ within a society (Cane, 2002). To give an example: if we want to decide whether a

teenager has behaved recklessly in buying an automatic machine-gun we can appeal to the ideal of responsibility as developed within the Christian doctrine, within legal prescriptions, within familial institutions, within a certain culture and historical context, within the ethical theory and many more. Conceptually, there is also some variation: being normative relative to the same situation one could employ a 'backwards-looking' notion of responsibility and check whether the machine-gun owner is at fault in some way or a 'forward-looking' notion to check whether the owner has fulfilled her duty of capturing future scenarios and counter-arguments within her decision-making process (van de Poel, 2011; van de Poel & Sand, 2018). In sum, words such as 'moral', 'responsible', 'virtuous', 'decent' etc. are not the sole territory of one institution nor are they subjectable to only one theoretical and conceptual development.

With this in mind, let us turn to some of the indicators in the IRIS+ method for which the plurality of norms of responsibility is relevant. To illustrate specifically this problem, we will take as an example a set of indicators for which problems (a) and (b) are not particularly relevant, i.e., where the definition of the principle behind the indicator is relatively clear and where scoring negatively on that account is a matter of irresponsibility. Consider the following set of indicators concerning waste:

CODE	NAME INDICATOR	Description Indicator
O12535	Waste Disposed: Recycled/Reused	Amount of waste disposed of by the organization through reuse and recycling during the reporting period.
O14483	Waste Disposed of: Landfill	Amount of waste disposed of by the organization through landfills during the reporting period.
O16192	Waste Disposed of: Total	Amount of waste disposed of by the organization during the reporting period.
O18357	Waste Disposed of: Incinerated	Amount of waste disposed of by the organization through incineration during the reporting period.
O18843	Waste Disposed of: Other	Amount of waste disposed of by the organization through other means during the reporting period.
O19847	Waste Disposed of: Composted	Amount of waste disposed of by the organization through composting during the reporting period.

Table 8 Metrics on waste disposed

In the case of these indicators, the backstory is clear: firms should strive to produce as little waste as possible or to reduce/reuse their waste. Yet while the backstory is clear, it is unclear where the normative line must be drawn. What is responsible in terms of disposed waste through landfills? What is responsible in terms of disposed waste through composting? One possible answer is that an investor is presumed/expected to research different organisations before deciding upon an investment: i.e., to apply the same data points across several organisations that are as representative as possible of the sector/industry/product/region (or a combination thereof) of interest; this may enable the investor to formulate a 'benchmark of responsibility that will enable the drawing of these "normative lines"'.

In addition, there are differences between sectors, industries, products, and regions (or countries), and these need to be taken into consideration and incorporated in the employed normative idea. Time is also a significant factor here, because the responsibility decision 'thresholds' - i.e. the "normative lines" that distinguish between responsible and irresponsible, may dynamically

evolve with time. This time dependence may partially stem from the normative lines which are drawn based on comparative analyses across organisations relevant to a sector/industry/product/region.

The problems don't stop here. After all, the norms employed need not coincide with the norms that are already in place in a particular context. The already existing norms might themselves lead to organizational activity that is, from the evaluator's perspective, irresponsible. Going outside and beyond these 'natural' ideals, as the evaluator should, means borrowing normativity from other sources, e.g., scholarly literature on sustainability or ethics, Christian moral and ethical views, Aristotelian virtues, communitarian groups etc. And there is no guarantee that these multiple sources of normativity will not conflict. In any case, the norms behind a set of indicators need to be explicated or else be dealt with through reflective discussions either in the organization or between the organization and the evaluator.

In total, we narrowed the list of 685 indicators in the IRIS+ model down to only 45 indicators that were relevant for start-ups, which focus on issues of responsibility, and that were clear and usable. The exclusion process has been discussed and detailed in abundance in this section and the final IRIS+ indicators can be seen in Appendix 1.

4. Responsible Research and Innovation Indicators

In addition to the 45 indicators found in GIIN's IRIS+ model, we needed to supplement these indicators with what has been discussed within RRI on responsible business practices, and which may be relevant to guide start-ups. Before this analysis, it was believed that there would be a lot of crossover and duplication with the recommendations found in the IRIS+ model, but which would be further refined after the collation process. Firstly, we evaluated 78 projects focusing on RRI in business and narrowed this initial selection to 44 of the most relevant projects. After careful selection and further refinement, it became clear that there were only a very few projects that met our exclusion criteria: 1. Relevance for start-ups; 2. A clear and concise reference to measurable/usable indicators; 3. Were focused on companies/businesses (a lot were focused on public research institutions or were for a more general audience). Finally, we were left with 12 of the most relevant projects (see Table 9 later) and these provided us with 411 relevant indicators, to eventually combine and evaluate with the indicators from the IRIS+ model.

The reason that we felt the GIIN approach needs an additional supplementation of indicators is because it lacks any theoretical underpinning of responsibility. Of course, the GIIN method is an instantiation of *some* ideal of responsibility, but this ideal remains implicit and, as mentioned in the previous section, can only be hinted at through this instantiation. One has to 'reverse engineer' the indicators to arrive at the principles/ideals that generated them. While some of the indicators are very useful to guide start-ups towards responsible behaviour, these IRIS+ indicators need additional 'responsible indicators', which we aimed to find within RRI literature and the RRI projects that we focused on. The following section gives a brief overview of the projects that we focused on, some common issues for companies to implement RRI principles, and finally, how we identified the most relevant RRI indicators from these RRI projects.

4.1 The Ideal of RRI Applied: Highlights from Past Approaches

The ideal of responsibility as presented earlier has been operationalized in various research projects at a European level, particularly through coordination and support actions within the Horizon2020 research programme. Some of these projects have sought to derive indicators from known theoretical articulations of responsibility, such as the one put forward in (Stilgoe et al., 2013), and have adapted these theoretical articulations for various purposes and fields of application (Jonas, 1984; Julia Abelsona & Elisabeth Martin, 2003; Koops et al., 2015; van den Hoven et al., 2014).

Applying the theoretical and philosophical work carried out in the field of RRI is an ongoing endeavour that requires a complex balance between theoretical accuracy and practical feasibility (Dreyer et al., 2017; Garst, Blok, Jansen, & Omta, 2017; Gianni, Pearson, & Reber, 2019; Lubberink, Blok, Van Ophem, & Omta, 2017; Martinuzzi, Blok, Brem, Stahl, & Schönherr, 2018; van de Poel et al., 2020). The endeavour of elevating RRI to a business context has been preceded by work in the field of corporate social responsibility or 'CSR' (Iatridis & Schroeder, 2016). In some instances, the empirical work has resulted in a reconsideration of the RRI model and its four dimensions to make this model more directly applicable to the complexity of industry and business (Klaassen et al., 2017; Porcari et al., 2021).

4.1.1. Challenges for Implementing RRI

Often with RRI, there are several theoretical and practical challenges when it comes to its implementation in business. It is important to bear these challenges in mind when developing an approach of RRI to be implemented in real-life practical settings. For our project, it is specifically important for considering how these challenges and impacts are relevant for start-ups. Before assessing what RRI indicators may be beneficial for start-ups, one should examine the typical challenges found when implementing RRI, so that the established list of indicators can respond to, and overcome, these issues.

Therefore, we believe that it is very important to keep these points in mind, especially since tools for operationalising RRI will inevitably be selective regarding the particular points that they address. In this project, we want to draw upon the lessons learned from the past and construct a tool that is optimally designed for the context of tech start-ups with a significant R&D component. To do this, we aimed at checking how the issue of RRI was dealt with concerning the issue of promoting the development of tech start-ups. For this reason, we singled out the European projects that dealt with RRI and enterprise/start-ups. We proceeded in an explorative way, carrying out a scoping review of the documents produced by the relevant EC funded projects. We searched the internet using keywords connected to these issues and, particularly we looked at the various collections reporting the European experience through dedicated projects (e.g., the database of European projects and other repertories).

The keywords that guided our search were of two types and we related both to European projects. The first was related to the issue of the practice of responsible innovation. Among these types, there were, for example: Responsible; Responsibility, Responsible Research and Innovation, RRI, Corporate Social Responsibility, CSR, Sustainability, Impact. The second type of keywords was related to the economic domain and included for example: SMEs; Small and Medium Enterprise; Start-up; Enterprise; Investment; Investor(s); Business Value; Finance.

Based on this search, a set of 78 projects were selected as possibly containing relevant input for our analysis. After the first analysis of this set, a sub-set of 44 projects containing documents that were relevant to us and were singled out.

We focused on the documents, collected during the literature review (Task T.1.1.), related to the sub-set of projects that we considered relevant. We analysed these documents to understand how and why RRI principles have been used and/or are relevant for start-ups, including investors. The analysis was carried out by reading the text and by singling out those quotations connected to the topics of our analysis (we used Atlas.ti 9, a software suitable for this kind of analysis). The results of the reading provided the inputs that made it possible to define the overall approach at RRI for start-ups represented by the model. Within the sub-set of 44 projects whose documents were analyzed, we also sought those that reported indicators that were relevant for start-ups (either directly or indirectly). After several rounds of analysis and refinement, the projects in which we found indicators relevant for our work were 12 which are now listed in table 9.

List of Projects that apply the ideal of Responsible Innovation in a Business Context			
Name of Method or Deliverable	Source Project	Leading Organization	Objective(s)
GREAT – Governance for Responsible Innovation	https://www.great-project.eu/	University of Namur (Belgium)	Develop a model for governance in RRI, especially from a multi-stakeholder & policy perspective. The project proposes the use of a framework and a self-assessment tool, through open questions, that takes into account business related aspects such as product, process, governance.
Responsible Innovation COMPASS	https://innovation-compass.eu/	Wien University (Austria), Institute for Managing Sustainability	Compass Self-check is a specialized RRI assessment tool, tailored to the needs of SMEs. Its main purpose is to lower entry barriers for SMEs wishing to engage with responsible innovation, but unsure of their options and potential benefits.
ProGReSS <ul style="list-style-type: none"> • RRI Funder Requirements Matrix, • Best Practices of RRI in Industry 	https://www.progressproject.eu/	University of Central Lancashire (United Kingdom), Center on Ethics	To compare the strategies of funding research organisations, using RRI criteria for assessing research proposals against the compliance of ethical acceptability, sustainability and social desirability
	https://www.progressproject.eu/	University of Central Lancashire (United Kingdom), Center on Ethics	To analyse the RRI practices of industries (including “de-facto RRI practices) in addressing societal challenges, pursuing sustainability, and social desirability in innovation, with ethical compliance and avoiding significant adverse effects.
Framework for Responsible Research and Innovation in ICT	https://www.orbit-rri.org/	Engineering and Physical Sciences Research Council (EPSRC)	The focus is on the assessment of the embedment of RRI in products and research and innovation process in ICTs; to identify the reflection capacity within organisations, to anticipate possible impacts, to identify alternatives, to engage stakeholders, to make desirable, sustainable and accepted research and innovation processes and products.

Assessing Open access in Industries	https://on-merrit.eu/	Know-Center GmbH (Austria)	The objective is to investigate the orientation and practices towards seeking and using research information and data for innovation and if they are benefiting Open Access opportunities.
Knowledge Acceleration and Responsible Innovation Meta-Network – KARIM	https://www.nweurope.eu/	Centre Francilien de l'Innovation (FR)	It is an RRI guide for enterprises to help them to do a diagnostic of their business model, develop new products and services, new technologies or even improve their production processes based on the innovation project's impacts (social, economic and environmental).
Responsible Open Science in Europe (ROSIE) <ul style="list-style-type: none"> Self-assessment questionnaire UNI/PdR 27-2017 Guidelines for the responsible innovation management and development process 	https://www.interreg-central.eu/	CISE, <i>Centro per l'Innovazione e lo Sviluppo Economico</i> , Special Agency of the Chamber of Commerce of Forli-Cesena	The inclusion of RRI elements within the funding criteria of Regional development organisations. The road mapping includes the assessment of the maturity of the local innovation policy framework and ecosystem and SMEs; the use of a questionnaire investigating how SMEs saw their commitment for the RRI keys; then based on the results starting a stakeholder dialogue on the action planning process to bring RI within SMEs.
	https://www.interreg-central.eu/Content.Node/ROSIE/CE1004ROSIE-OT11-factsheet-UNI-PdR.pdf and http://store.uni.com/catalogo/uni-pdr-27-2017?store=en&josso_bac_k_to=http%3A%2F%2Fstore.uni.com%2Fjosso-security-check.php&josso_cmd=login_optional&josso_partnerapp_host=store.uni.com&from_store=it	CISE, <i>Centro per l'Innovazione e lo Sviluppo Economico</i> , Special Agency of the Chamber of Commerce of Forli-Cesena, together with AIRI and Italian National Standardisation Organisation UNI	These Guidelines include standards to be applied by SMEs in all stages of their life cycle for carrying out innovation processes in a responsible manner, i.e. aimed at the improvement of the quality of life, according to the interested parties' expectations, and at the same time be environmentally, socially and economically sustainable. UNI/PdR starts from the assumption that, to be an integral part of a company's business model, RI needs to move from company-culture level to real practice and be embedded into the actual innovation process. It is a system of certification based on the performance assessment of the applicant organisations.
MULTI-ACT Master Scorecard	https://toolbox.multiact.eu/multi-act-manual#_Toc70265315	Italian Multiple Sclerosis Society Foundation (FISM)	The objective of the Multi-Act Master Scorecard is to provide a new tool to assess the value of research in terms of increasing the positive impact of health research on patients. The tool has been defined with the involvement of patients and patient organizations, academics, private and public stakeholders. It can be used as a strategic management tool to monitor the progress of research and innovation

			initiatives and to demonstrate whether and how the initiative is producing an actual impact.
START HEATMAP EUROPE	https://www.startupheatmap.eu/	Deep Ecosystems (Germany)	The self-check guide is designed to help ecosystem builders in their work by providing validated insights that can be used to check whether an entrepreneurial ecosystem project is on the right track to achieve systemic growth and development.
Newhorizon	NewHoRRizon https://newhorizon.eu/	Institute for Advanced Studies (Austria)	It is a self-assessment tool providing a set of questions to guide research projects and early stage companies to consider all RRI principles in their day to day business and structure internal processes consistently. The framework stimulates the team to reflect upon the intended and unintended consequences of their research and development practices, with a particular focus on data collection and analysis.
PRISMA	PRISMA - https://www.rri-prisma.eu	Delft University of Technology (TUD)	Develop a roadmap that will help companies to integrate RRI into their businesses. The roadmap includes the application of a framework and of self assessment tool set up by PRISMA.
Responsible Industry project	http://www.responsible-industry.eu/	De Montfort University, Leicester (UK)	The Responsible-Industry Project intends to demonstrate how the industry can work together with societal actors to integrate principles and methodologies of Responsible Research and Innovation (RRI) into research and development processes.

Table 1 List of Projects ⁶that apply the ideal of Responsible Innovation in a Business Context

⁶ The projects singled out are 12 but in two cases – PROGRESS and ROSIE – indicators have been developed on the basis of two slightly different approaches. In a first phase of our study, we considered also the differences within these approaches. We decided to report them in the table to give an account of the variety of the ways in which the matter has been dealt with by the various projects.

During our analysis of the sub-set of 44 projects, it became clear that there were several “open issues” connected to the actual practice of RRI and responsible innovation in the framework of enterprise creation. The seven challenges discussed below resulted from brainstorming sessions, and analysis of the RRI project reports to uncover what were the most significant issues and themes for operationalising RRI in business. An issue was defined as “open” depending on if a consensus about its relevance or its very definition was still to be reached; if it was unexpectedly omitted in the discourse on responsible innovation or if it was not clear to whom a certain topic should be addressed.

We used these seven issues, which sometimes prohibit RRI from being effectively adopted, as goals that our indicators should overcome. Our indicators should be able to respond to these challenges to be usable by start-ups that want to behave responsibly.

Notably, the list of challenges below is not meant to be comprehensive, but rather to capture some of the most prevalent and important difficulties in operationalising RRI found in the grey literature. While conducting our identification of RRI indicators within these projects, we also mapped if these indicators responded or were relevant for the seven key issues that we outline below. The purpose of this was to classify and group the indicators, making it easier to identify overlap and duplication, but also to somewhat rank which topics received most attention within these documents (this can be seen in the seven points below with the number of projects that reference them in parentheses).

It must be made clear that the seven issues discussed below are not the only ones available, as others appear in the academic literature on RRI, such as the difficulties to deal with tensions between social and economic logic (see Brand and Blok (2019), the motivation to engage in RRI (see Garst et al. 2017), the difference in decision-making processes (see Blok et al. 2017), and the institutionalisation of RRI in the industry (see Garst et al. 2019). However, our focus was on the content of the sub-set of 44 EU projects on RRI and enterprise and is meant to capture a snapshot of some of the most prevalent and important difficulties with implementing RRI in practice.

The seven points that are highlighted as issues towards RRI uptake in the industry are interrelated (e.g., a lack of clarity of RRI (2) may alienate people and inhibit them from becoming more familiar with RRI (1), which may also restrict their chances to reap the benefits that RRI may provide (3)). These seven criteria were used as a way to identify important RRI indicators. The following sections will highlight these themes and which of the 12 projects discuss them (underlined text) and also where these themes correlate with academic literature (non-underlined references).

1. Familiarity with the notion of RRI

RRI is a relatively new concept that has not been widely disseminated in the industry sector (this conclusion came from COMPASS Project; GREAT Project; ORBIT RRI; Responsible Industry; PRISMA; ProGReSS Project; and ROSIE). Many companies have not heard of it or are not aware of its theoretical and practical development (see also Novitzky et al. 2020). One of the causes of this lack of familiarity seems to be that most of the output stemming from RRI literature and projects is directed towards academic or semi-academic (grey literature) publications that are not more widely disseminated throughout society (see also Novitzky et al. 2020). Additional causes may be because of a lack of clarity about RRI (because of confusing terminology), benefits may be unclear, and it may be difficult to measure and provide certification (these possible causes are also discussed in the sections following as issues). Even when the conclusions of the research are reached through collaborative

interactions with the business environment, the results are not channelled back into this environment but rather remain embedded in academic publications.

2. Clarity of the notion and practice of RRI

Organizations that have been in contact with RRI often perceive the language accompanying it as academic, abstract and full of jargon. The lack of clarity of RRI came up in many of the RRI research projects that we examined (e.g., COMPASS Project; GREAT Project; ORBIT RRI; Responsible Industry; PRISMA; ProGReSS Project; and ROSIE). In some cases, differences and even incompatibilities between extant definitions of responsible innovation are perceived as barriers to disseminating, and ultimately implementing, these ideas. There is of course a core idea common to all or most approaches to RRI: the shift of focus from the internal (the interest of the firm, the respect of regulations or ethical norms) to the external (societal and environmental impacts of the innovation pursued and its outcomes). But beyond this general idea, there is a plurality of definitions and theoretical models, and it is not always clear how companies are to navigate this plurality. Organizations perceive scholars as developing their own ‘local’ models of responsibility instead of attempting to draw general lessons that can provide a degree of unity and measurability. This being the case, companies prefer to invest their time and energy in more established forms of social responsibility (or ethical investment) such as CSR and international framework agreements and ISO standards.

3. Benefits of applying RRI

The implementation of RRI in the business context is associated with upfront costs that cannot often be readily associated with a clear measurable benefit or tangible impact – at least for organizations whose activity does not directly entail health, environmental and social risks. On the other hand, from the projects of Table 9 emerges an ample discussion about the competitive advantage that RRI can provide to start-ups and SMEs, using an abundance of “case statements”. At the same time, a multitude of success stories – backed by testimonials - about how RRI has helped the core business of innovation-oriented firms is reported (see also Blok et al. 2020). Nevertheless, some aspects of RRI are indeed associated with clear benefits (this emerged within the COMPASS Project; GREAT Project; ORBIT RRI; Responsible Industry; PRISMA; MULTI-ACT; and ROSIE). It is clear, for example, that the upstream engagement of stakeholders (cf. the RRI principle of inclusion), i.e. from the early stages of the innovation process, can help *anticipate* risks downstream (cf. the RRI principle of anticipation), hence improving the end product and its acceptability (see also Blok et al. 2020); this may also bring about collateral benefits such as improving a firm’s image and reputation (see also Blok et al. 2020).

4. The status of ‘de facto RRI’

Another emerging theme is what could be designated as “de-facto” RRI (also found in the literature, e.g., Blok, Hoffmans, and Wuben 2015 and Randles et al. 2016). This includes those practices that are already performed by a firm and which are akin to RRI principles but are not indicated as such. As a movement, RRI builds on past approaches and practices, but it does so in a mostly implicit way (see also Blok, Hoffmans, and Wuben 2015). RRI is perceived as being at the same time old and new, creating some confusion as to what exactly counts as RRI and the status of ‘de facto’ RRI (this emerged within the COMPASS Project; ORBIT RRI; ProGReSS Project; ROSIE; and Responsible Industry). There are cases in which the firms “discover” that they were unwittingly performing RRI

practices and get interested in adopting the full package. SMEs could build upon existing practices to further develop ways of being responsible (see also Blok, Hoffmans, and Wuben 2015).

5. Collaboration possibilities and hurdles

There are many advantages and potential for collaboration between RRI and open innovation⁷, which was a common theme throughout the projects and grey literature that we analysed (this emerged within the COMPASS Project; Ecosystem Health Check; GREAT Project; ORBIT RRI; Responsible Industry; NewHorizon Project; PRISMA; ProGReSS Project; MULTI-ACT; and ROSIE). These benefits include improved marketability as being a ‘responsible’ organisation, identifying problems or issues before they occur, avoiding controversy over irresponsible activities, and giving back to one’s community and society. For example, Long and Blok (2018) conducted 11 semi-structured interviews with entrepreneurs developing climate-smart agricultural innovations. They found evidence for the “compatibility between exploratory open innovation activities and dimensions of responsible innovation”. It was shown that many socio-ethical issues can be addressed through open innovation that implements a sensitivity to ethical considerations within innovation (see also Long and Blok 2018).

However, the engagement of external stakeholders is often discussed (e.g., within the COMPASS Project; Ecosystem Health Check; GREAT Project; ORBIT RRI; Responsible Industry; NewHorizon Project; PRISMA; ProGReSS Project; MULTI-ACT; and ROSIE). from the point of view of the firm and its interest or resistance to such engagement; in some cases, the discussion focuses on the stakeholders themselves. From this perspective, the stakeholders’ culture(s) and their interests are considered and what makes them willing to embrace the engagement or sceptical to it. In this regard, some recurring hurdles are reported below.

- The unwillingness of social actors to be fully engaged beyond a certain point.
- A mutual lack of trust.
- A divergence of interests (commercial interest in the firms and values in the stakeholders)
- Uncertainty on the added value and the forms of remuneration for the engagement of the external actors.
- A perceived lack of financial and organisational resources to spend on stakeholder dialogue is often considered time-consuming because it burdens employees who have to deduct time from other duties to perform it.
- Complex professional relations are necessary to facilitate the interaction between the firms as such and the engaged social actors

6. Measurement, certification and compliance

One of the consequences of the plurality of notions of responsibility mentioned under point 2 above is that the measurement and certification of RRI practices remain uncertain. One issue that is felt by the firms is that of the certification of the introduction of RRI. This, in turn, raises the issue of reliable indicators but brings about the risk of falling into a “compliance” frame, turning RRI into a tick box exercise, rather than a dynamic, interactional approach. Certification for the enterprises would increase their visibility and reputation, including for investors (this conclusion came up in COMPASS

⁷ Open innovation refers to a form of innovation that is open to collaboration with people and organisations outside of the company.

Project; GREAT Project; ORBIT RRI; Responsible Industry; Ecosystem Health Check; PRISMA; NewHorizon; ProGRess Project; and ROSIE). In this respect, the IRIS+ methodology could be taken as an example: it is an internationally recognized set of metrics that takes into consideration ISO standards as well as experiences from practice. Certification can also be a way of addressing the issue mentioned under point 1 since it could increase awareness of RRI and its mode of application. But since certification is based on some standardized measurement, issues regarding the accuracy of measurement carry over to the problem of certification. The issue of measurement refers to both the practice of RRI (whether RRI is practised or not) and the impact that RRI has in the context within which it is practised.

An aspect that concerns the mainly qualitative nature of the data resulting from monitoring and complying with RRI standards. With this as an input for evaluation, the process is either slow or becomes relatively subjective (hence increasing the chances of inaccuracy), based on the nature of the data provided and the interpretation by the evaluator.

Finally, there is the question of who is in a better position to carry out the evaluation. On one hand, self-assessment tools may stimulate and help organizations to think about what they want to achieve with RRI and monitor their progress toward objectives. Internal monitoring may be easier to implement and less sensitive for an organization. Moreover, as the organization takes the initiative itself it may be more open to learning from experiences. On the other hand, internal monitoring only may raise doubts on whether RRI activities are merely a form of windows-dressing. A form of external auditing is desirable in the long run: such assessment may resemble an investor process.

7. Policy and funding

The political context of the regulation (policy) and financing (investment) is not geared towards fostering or monitoring RRI (this came up in ProGRess Project and MULTI-ACT project). There is therefore a lack of policy-related incentives for organizations to develop products and technologies by investing in RRI activities. The Collingridge dilemma (early intervention faces lack of knowledge about impacts, late intervention faces lack of power in changing those impacts) is typically tackled by using the second horn: develop technology first, deal with policy and regulation later. Policy and funding are thus organized around a linear model of innovation whereas, in reality, the innovation process is likely to occur in iterations – a process that is difficult to fund and regulate.

4.1.2. Development of RRI Indicators

As mentioned above, within the sub-set of 44 projects whose documents were analysed, we also sought those that reported indicators that were relevant for start-ups (either directly or indirectly) and that could be used without extensive prior knowledge of SRI, RRI, CSR or related approaches. The projects in which we found indicators relevant for our work were 12 and are those listed in Table 9. From this list of projects and deliverables, we selected those that take a responsible innovation approach and formulate indicators at a “micro” level, i.e., that could be used to assess an individual start-up and its practice of Responsible Investment (either from the point of view of “startupper” or of possible investors). We excluded, therefore, indicators referring to the practice of RRI at the level of entire research systems (local/regional/national). An example is represented by the MORRI indicators that focus on the national level (European Commission 2018; the project was anyhow taken into consideration because of its general relevance for dealing with RRI related policies and as an orientation for the continuation of RRIstart, European Commission 2019).

The landscape of projects as presented in Table 9 resulted in a selection of 411 indicators. However, the indicators shortlisted in this way also presented several methodological issues. We want to discuss them here and the solution proposed to clarify the relationship between the indicators harvested from the 12 projects and the list compiled here ('RRI Start' indicators).

First, we encountered significant areas of overlap between the projects analysed. This needed to be resolved because given considerations of consistency, a read-to-use tool cannot involve superfluous data points or repetition of this sort. For example, half of the projects contained some measurement of inclusion, whether defined as "representation" (COMPASS), "participation" (GREAT), or "engagement" (Framework for RRI in ICT) then the main idea captured by these indicators is that innovation, and consequently investment in innovation, should target processes in which stakeholders are part of the decision-making process.

To distil these ideas, we had to look for the greatest common divisor between the two and formulate that in a way that covers as much as possible the intention behind the original indicators. The common idea in all these projects is the notion of openness of the decision-making process: decisions regarding the innovation should be open to the participation of stakeholders with different views than those who are in effect managing the process (see S5 in Section 6.1, later in this report). To this, we added the idea that the participation should be fair and effective, highlighting that the mere consultation of stakeholders (which might technically fall under 'participation' poorly understood, since those consulted participated by giving their opinion).

Second, we discovered areas that were under-represented or even completely lacking in the projects analysed. Most projects were not developing indicators that pertained directly to specific political values but rather served these values implicitly or indirectly. For the most part, the ideas implemented in these projects are assumed to be the liberal, democratic ideals of western society. However, within these ideals, specific values need to be singled out since they are not in all situations compatible with one another: a technology that fosters, e.g., justice, is not necessarily at the same time one that fosters equality, liberty, tradition, family values and other values that are generally subsumed under our liberal, democratic ideals. Working within the QH approach (which will be discussed in Section 6), however, the relationship between innovation and political value needs to be singled out explicitly which resulted in indicators (for example, see P1-P4 in Section 6.3 later in this report).

Third, we sought to create a responsibility that could be employed with ease through different worksheets (this was further developed in Deliverable 1.2 – see this report for further details) by stakeholders that are not familiar with RRI literature or methodologies. To create this reduced version of the 411 indicators selected, some hard choices needed to be made. For example, while NewHorizon contains a large number of (otherwise important) indicators about research ethics covering a wide variety of topics from integrity to open access, the indicators are too detailed for our purposes. The same holds for, e.g., accounting indicators as developed in the MULTI-ACT Scorecard or gender indicators as developed in the ROSIE program. But for our purposes, we need to keep in mind that open access, fair accounting and gender equality are but some of the features that make up the construct of responsible innovation and need to be implemented alongside others. To this end, we sought to create a relatively small, user-ready instrument that can be employed without significant use of financial and other resources. Our methodology and further exclusion criteria for narrowing down this list will be discussed further in Section 6.

5. Supporting RRI and SRI with the Lean Start-up Approach

One issue that is sometimes put against RRI is that it often focuses on the research and societal impacts of businesses, rather than taking into account many of their business and economic components. While RRI provides a normative framework to underpin the IRIS+ indicators for responsible investment, it may focus too stringently on the societal and research aspects of a business, which may be inappropriate for a start-up. It may also put too much pressure on a start-up to allocate an imbalanced amount of resources towards societal concerns, which could lead to them overlooking their business obligations.

To overcome this issue, we claim that the RRI approach to responsible investment and responsible start-ups should be supplemented with the lean start-up approach. The RRI model needs to account for the multitude of stakeholders involved in start-ups in a more balanced way. In particular, the lean start-up approach provides insights to start-ups to increase chances that they will thrive as a company, so can offer valuable insights into RRI for responsible investment. The following section will demonstrate how these two approaches align and subsequently, how the quadruple helix approach can appropriately frame the aligned RRI lean start-up approach for responsible investment.

To begin with, the “lean startup concept”, or Lean Startup Approach (LSA, as it will be called here), has been widely used in the literature on the start-up phenomenon in recent years. The main ideas about LSA have been highlighted not only by the authors who proposed it in 2011 (Ries 2011) and contributed to its diffusion (see Blank 2013) but by a very wide range of scholars. The approach is highly relevant as it is based on the idea of bringing innovations closer to the market in a resource-efficient manner. Such an idea is attuned with the approaches to the institutionalization of RRI that are focused on the promotion of multi-stakeholder engagement stages. In our view, LSA and RRI, in their various meanings, have a common element represented by the idea that the relationship between an organisation (the start-up in the case of LSA) and its context (i.e. the actors that are part of it) is based on openness and exchange. Some interesting consequences may emerge from this commonality, provided that one considers the entirely different origins of the two approaches.

LSA is a technique for the development of start-ups that aims to make the process of their formation and early development more agile through a systematic interaction with possible customers. LSA takes various ideas from other management approaches and theories, starting with the same idea of leanness (Luise 2019), of dialogue with customers, of "Open Innovation" and co-creation (Frederiksen and Brem 2017). In general, the idea is that the development of a start-up is a process of discovery (of customer needs) and construction (of the business model) rather than the execution of prearranged operations (a business plan). This idea implies a strong focus on the context in which the entrepreneurial action takes place, the collection and exchange of information and points of view with a variety of actors inside and, even more, outside the enterprise. As a process, the practice of LSA implies it is iterative change, updating not only action plans but also, and above all, the objectives of the activities that are carried out (pivoting). The operational core of the LSA consists of the exploitation of the hypotheses around which the business model is built and their validation. This validation takes place with various forms of consultation with customers (and the various actors potentially interested/involved in the use of the product/innovation) using the so-called Minimum Viable Product (MVP), i.e. a simplified prototype of the product that is tested with customers. This testing process, which has elements of experimentation, enables the acquisition of

information (e.g. the orientations of consumers and other recipients of an innovative product) that would otherwise be unattainable. One of the central aspects of LSA is the use of appropriate "metrics" and indicators. Hypothesis testing is carried out through the use of indicators that are specifically defined. One speaks in this regard of a "Build-measure-learn loop" (Gbadegeshin and Heinonen 2016).

The literature suggests that the merit of LSA is eminently economic. The idea is that, through the practices that are suggested, the whole process of creating a start-up can become more effective (leading to fewer failures) and therefore more efficient (by saving time, reducing expenses in hypothesis testing and so on; Blank 2013). The LSA is not aimed at anything other than achieving entrepreneurial success or, conversely, minimising the damage of failure. This assumption, which might appear to be somewhat obvious, has some unexpected implications when comparing LSA with RRI.

In addition, the construction of the business model that underpins a start-up is the result, if LSA is practised, of a process of construction through successive approximations. The problem is that a given scientific discovery or innovative technological solution must be transformed into an economic opportunity, but that the latter is not a necessary consequence of the former. The LSA suggests to the entrepreneurial entity a series of procedures of a participatory nature to make this transition.

RRI focuses on an element that is not included in the LSA, namely the issue of responsibility and ethical foundations for implementing innovation. However, from a practical/operational point of view, the LSA indications concerning product validation through articulated and complex forms of confrontation with an important category of stakeholders, the customers, could be seen as in line with the 4 dimensions of an organisation practising responsible innovation: anticipation, inclusiveness, responsiveness and reflexivity. In general, the practice of LSA can be considered as a way to produce anticipatory behaviour (i.e. to anticipate customer behaviour or product problems). By definition, LSA aims at the inclusion of an important type of stakeholder - the customer - and is intended to promote a learning process on the part of the business group (an aspect of responsiveness). Furthermore, from the literature, it emerges that customer involvement implies also a reflexive process (Mansoor 2017) in which various actors, both external and internal to the company, participate. Concerning these same actors, one must be able to show consequentiality (i.e. that the indications that have come from the dialogue carried out have been taken into account).

In essence, it can be argued that the practice of LSA, although different from RRI, could be seen as a specific way of actually pursuing the drive towards responsible innovation. Again: if it is true that there is an overlap, albeit partial, between RRI and LSA, then it can be argued that the practice of RRI, at least in principle, is not in conflict with the pursuit of the goals of cost-effectiveness by companies and start-ups (for the same reason that LSA is not). More specifically, it can be argued that if an organisation seeks to practice reflexivity, inclusiveness, anticipation and responsiveness, this orientation is not necessarily at odds with the pursuit of cost-effectiveness and that, under certain conditions, the cost-effectiveness of a start-up can benefit from RRI-related practices. At first appearance, there is no fundamental reason against the alignment of RRI and LSA.

The potential alignment of LSA and RRI and, in particular, the fact that the latter does not contradict the goal of the economic viability of a company, is not the only reason to consider RRI as

an appropriate approach to promote successful start-ups. The RRI approach could be crucial for start-ups that strive to meet the challenges of innovation based on advanced scientific and technological research (such as STEM). Research is increasingly the result of a complex interaction between different actors, many of them from the private and non-academic sector, others from the public sector and civil society (cf. the Quadruple Helix approach). This is the outcome of a broad transformation process, which affected science since the 1950s, coming to maturity at the end of the century. Such a change has been interpreted in a variety of ways, not just through the above mentioned Quadruple Helix Approach, but also through the Mode 1 - Mode 2 model (Nowotny, Scott, & Gibbons, 2001), the concept of Post-academic Science (Ziman, 2000) and that of Post-Normal Science (Funtowicz and Ravetz, 1993).

Although different from each other, all these formulations describe a paradigm shift from the consolidated social model of science – often associated with the image of the “Ivory Tower” – to a new social model, which can be referred to as an “open social model” of science. Gibbons (1999) highlighted that the new social model is no longer based “on the understanding that universities will provide research and teaching in return for public funding and a relatively high degree of institutional autonomy” and on the recognition of the authority and exclusiveness of science in validating scientific knowledge as well as on a set of internal mechanisms that make this possible (see Merton 1979/1942). Rather, the new social model recognizes the embeddedness of science in society and, therefore, the connection of science with social, political and economic dynamics, as well as the relevance for the scientific endeavour of societal expectations, needs, worries, including the concern for the use of scientific outcomes.

It can thus be assumed that technology start-ups, to adapt to this paradigm shift, need to conduct their research activities in connection with various stakeholders to anticipate and include their general views and orientations and not only market behaviours. In both RRI and LSA, an interpretative activity by the entrepreneurs through a dialogue with their internal group and external stakeholders is placed at the centre. More specifically, this interpretation is the product of a learning process triggered by the interaction with stakeholders (both for an existing company and a start-up). It is in the interest of technology start-ups to be able to operate in a context in which the drive to align the processes and outcomes of scientific research with the values, needs and expectations of society (see EC definition of RRI) is gaining saliency. The practice of RRI, therefore, far from appearing as an additional bureaucratic burden placed on the full deployment of entrepreneurial energy, presents itself to technology start-ups as a way of operating that is appropriate to the current challenges they are facing.

The literature on the LSA and RRI proposes some elements that deserve further specific attention and that focus on the issue of interpretation and the nature of the entrepreneurial actor. In this regard, the following considerations can be made.

The RRI approach implies a step that is not taken for granted, i.e. making explicit the issue of responsibility in the system of choices that underlies the entrepreneurial process in general and, therefore, also the construction of a start-up and its business model. The time factor and uncertainty in the process of business creation is highly important for start-ups. Therefore, there is a need for entrepreneurs to raise shared expectations about the future of the economic activities to which they give birth.

The process of creating a start-up has a pronounced discursive and, therefore, communicative nature, which implies the collection of information on the business model hypothesis as well as the production of a representation of it for the use of investors who are called upon to finance it. In addition, it can be stressed that the evolution of the business model through the pivoting process must find consensus within the entrepreneurial team that develops it (Mansoori 2017 focuses the attention on the possible divergences among the start-up's team members concerning the results of the application of the LSA) so that communication dynamics are very relevant. The importance of storytelling in the start-up industry, connected to the management of expectations and uncertainty (Beckert 2016, Declich 2014), has also been stressed by Wiener (2021) and Luise (2019).

The group dimension of the enterprise, in this framework, becomes a non-secondary issue that must be placed at the centre of the reflection on the process of building start-ups. The suggestions coming from the LSA and RRI literature on this aspect could be interpreted in the light of the recent studies that highlight the centrality of the entrepreneurial group and its dynamics in the life of enterprises and the process of start-up creation (Quaranta and Mastropietro 2003, Stamm et al 2019, Stamm and Gutzeit 2021). The importance of entrepreneurial groups and their dynamics also emerged in the debate regarding the evaluation of start-ups by potential investors (see the so-called "jockey vs horse' framework", Gompers et al 2020, Blair and Shaver 2020). These dynamics are particularly relevant especially in the early stages of start-up experience, especially of those of an academic nature, thus particularly focused on technological development (Visintin and Pittino 2014 and Blair and Shaver 2020).

However, one deficiency still underpinning the marriage of RRI and LSA is that one often pulls more in the direction of research and societal concerns (RRI), while the other pushes a start-up more towards economic and business concerns. This difference in orientation crucially manifests in the ranges of stakeholders with which RRI and LSA seek interactions: RRI typically requires a wide range of interactions with a multitude of stakeholders, as opposed to LSA where stakeholder interactions are mostly confined to prospective customers. RRI thus inherently broadens and proliferates the interactions that LSA traditionally entails. Moreover, the aforementioned difference in orientation also naturally manifests in the discourse used in stakeholder interactions: in LSA these interactions typically revolve around ways of ultimately making (more) profit, whereas in RRI the focus is typically on a broader range of themes oriented towards social responsibility. Hence the need for the adoption of the QH approach to structure, along its helices, stakeholder interactivity and to discern between RRI-oriented interactivity and customer-centred interactivity in the LSA sense.

There will also be this tension when trying to identify responsible investment and responsible start-up practices unless we find a way to pair these approaches more. For this reason, we chose the QH approach because it extends the scope of financially focussed investment tools on economic value creation, and allows for the integration of RRI aspects of value creation. It provides four helices that should be important for responsible start-ups: societal, research, business, and policy.

We use the QH approach to identify the particular helix about each indicator to frame the extensive reviews of indicators found within the IRIS+ model, the multitude of RRI projects and approaches discussed earlier, and the LSA. Our conceptual model combines the challenges, impacts, and requirements, for responsible behaviour found in lean start-up and RRI theory, and frames those within the four helices of the quadruple helix approach. Altogether, we propose the quadruple helix RRI lean start-up model as a way to ensure responsible practices in start-ups (the QH RRI LSA model).

This approach to responsible investment gives a more balanced concentration on the four helixes important for start-ups and overcomes the deficiencies of RRI, LSA, individually and when they are aligned (concerning a certain lack of business orientation). The following section will give a brief overview of the characteristics of the QH approach and how we will use it as a way to frame our overall model for responsible investment.

6. Responsible Impact Assessment Model

As we have argued in the previous section, one of the shortages of current evaluation methods is that they ignore the innovation activities of the organization (or otherwise simply treat them under the umbrella term of ‘product development’). In technology-based start-ups, however, the R&D component can be not only important – it can constitute its central activity and its *raison d’être*. This component thus needs to be duly taken into consideration and the specific form of responsibility it entails needs to be conceptualized. For this purpose, the evaluator must be representing organizational activity through a model that does justice to the importance of the R&D component and thus the centrality of innovation in organizational activity and identity.

To achieve this representation, we take as a conceptual starting point the quadruple helix model of innovation (Carayannis & Campbell, 2009, 2012; Fitzpatrick & Malmborg, 2018; Monteiro & Carayannis, 2017). According to this model, innovation occurs as the result of an interaction between four sectors (or ‘helixes’) defined as types of stakeholders: the *industry helix* contains businesses and for-profit organizations, the *policy helix* contains policymakers as well as regulatory and executive bodies at different policy levels, the *academic helix* contains universities, research organizations and other knowledge institutes, and the (civil-)society helix contains citizens as well as media, non-governmental organizations and various other cause group and arts. But since we are dealing with the (responsibility) evaluation of actual innovation processes and not with the interaction between stakeholder representatives, it will be more expedient to utilize a more recent interpretation of quadruple helix innovation in *processual* terms (Popa, Blok, & Wesselink, 2020b). In a processual interpretation, the focus lies not on stakeholder types, their titles and identities, but on the processes through which stakeholders regardless of their identity – in our case the members of the start-up and their external partners – create different types of values during the innovation process. In this processual interpretation, then, a helix stands for the behaviour that is directed at a certain value and that is rewarded in prototypical ways when that value is achieved. For example, the helix ‘Industry’ will stand for, not a group of stakeholders with certain titles or identities, but the prototypical behaviour directed at the creation of ‘business value’ defined as ‘direct or indirect monetary worth’. Examples of such behaviour are ‘starting a business or ‘managing a business’ and when business value is achieved, the behaviour is rewarded with prototypical outputs such as ‘return on investment’ or ‘market share’. In the processual quadruple helix model, helixes are thus distinguished by these three determinants: the value aimed at by goal-directed behaviour, the prototypical forms of this behaviour and the prototypical outputs (see Table 10).

Helix	Values	Definition	Prototypical Behavior	Prototypical outputs
Industry	Business Value	Direct or indirect monetary worth	Starting a business, investing in a business, mergers and	Return on investment, market share etc.

			acquisitions, managing a business.	
Policy	Political Value	Contributing to a fair and just system.	Campaigning (arguing) for or against a policy, a programme or an individual.	Votes (for a party or policy)
Research	Research and education Value	Producing new knowledge contributing to the development of a disciplinary field or science in general	Researching, publishing and presenting scientific work.	Publications, patents, books, academic and honorary titles, citations
Civil society	Societal Value	The contribution of an act to the protection and implementation of civil, political and social rights.	Protests, petitions, lobbying, starting and managing an NGO.	Rights and artefacts that answer societal needs.

Table 2 Innovation as value-creation along four helixes

Of course, this ideal model should be distinguished from the complexity and ‘messiness’ of a start-up’s activity. In real life, it is not always possible to make this analytical distinction between values created on each helix. Indeed, real-life innovation activity will ideally appear as being simultaneously directed towards all four types of value: if the start-up creates an innovative product, then the act can result in added market value (e.g. if the product is marketable), research value (e.g., if in making the product knowledge was produced that can be used for future progress), societal value (e.g., if the new product solves a social problem) and added political value (e.g., if the product answers a political ideal of free democratic societies). In any given innovation act, the *values are thus entangled*.

Equally important is the fact that the values thus entangled are in a state of competition with one another. Since the decision-making process that constitutes innovation cannot maximally satisfy all four values, balance is needed between the four helixes and this balance will inevitably serve some values at the expense of others. Since every start-up has limited resources, the question of responsibility is in essence a question of optimum value creation. The central question for the organization looking to act responsibly, and consequently the central question for the evaluator looking to assess the responsibility of the organization is: Is the activity/product optimally serving the four helixes such that no value overpowers others and no value is sacrificed for the sake of others? Technological progress might contribute to a gain in value generally speaking, but this gain might not translate into an equal gain for all individual values. In some cases, the disparity between two or more values can be particularly obvious leading to friction or conflict (Garst, Blok, Branzei, Jansen, & Omta, 2019; Ligtoet et al., 2016).

In extreme cases, artefacts excel on some values while the others are not just poorly served, but they are disadvantaged. The case of health risks is a standard example in this case. The start-up might create a product with amazing market value but with a decrease in the quality of life of its end-users (e.g., individual health risks) and other stakeholders (e.g., environmental risks). The gain in business value might be said in this case to overpower the loss in social value, in which case we can speak of irresponsibility. The same idea applies, *mutatis mutandis*, to other cases where the decrease in value on one side is sought to be compensated by the increase in value on the other side.

This kind of exchange is sometimes referred to as ‘domination’ (Miller & Walzer, 1995; Walzer, 1983). In the case of health risks, the market value – or more precisely the anticipated creation of market value – dominates the innovation process in a way that is detrimental to the other three helices. Responsibility thus becomes a form of balance between the four helices. In Figure 1, we represent this process visually. As the start-up innovates, there is a value gain on the Y-axis. The increase in coloured surface designates this gain in value. But the gain needs to be distributed, meaning that each helix will be served more or less depending on the degree the activities/product in question result in value on that helix. An interesting observation is that, as time passes, represented by the X-axis, there is more at stake since there will be more valuable to balance between the four helices.

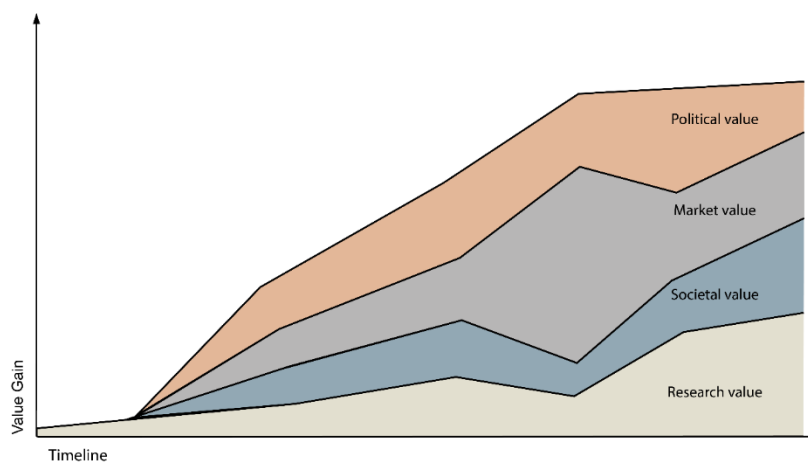


Figure 1 Value gain (Y-axis) distributed unequally in time (X-axis) along four helices (Popa, Blok, and Wesselink 2020).

The Responsible Impact Assessment Model that we propose views innovation as a broad social phenomenon involving a multiplicity of actors and with impacts that go beyond those affecting the parties directly involved in entrepreneurial activity, i.e. firms and customers. In the context of start-ups, they must implement knowledge from the four helices at a very early stage of development to fully and effectively learn from the implementation of the indicators of the four helices. This approach can help steer start-ups towards more responsible practices through the inclusion of a broader range of stakeholders and values (societal, political, business and research). The Responsible Impact Assessment Model can use the research and approaches outlined in RRI and LSA while giving each of the four helices more balanced importance than either approach alone. This model will balance the indicators found during our research of the IRIS+ model, the large RRI projects, and the LSA, into the four helices classified in the QH approach.

Additionally, the Responsible Impact Assessment Model aims to reiterate and demonstrate what a start-up is already doing well. It will function as a tool for both a broad range of evaluative standpoints and is explicitly meant to guide start-ups, and it is designed in this way, which will be demonstrated by our lists of indicators later in this report.

The model aims to provide a framework of how responsible investment can be used by start-ups and implemented within the early life-cycle stage of a company. It is not meant to cover every

single aspect that the start-up should consider, but it specifically focuses on how a company can implement responsible practices at this early stage of development in the context of the four helices. While the model is aimed mostly at high-tech start-ups, it could also be used by most start-up companies that want to implement ethical behaviour in their company, ensure that their employees are ethically trained, and have a positive societal impact through their products.

While the model is designed and meant for the pre-investment phase of a start-up life-cycle the principle of a quadruple helix ‘check’ of practices – the investigation of the Minimum Viable Product (MVP) against the background of the four helices – can be adopted by companies that are further into the business life-cycle, as well. Certainly, not everything would be relevant or applicable to a company post their pre-investment phase, but many of the same recommendations, indicators, and insights would still apply to the Model.

Figure 2 below illustrates the particular pre-investment phase of the start-up life cycle, which we have discussed.

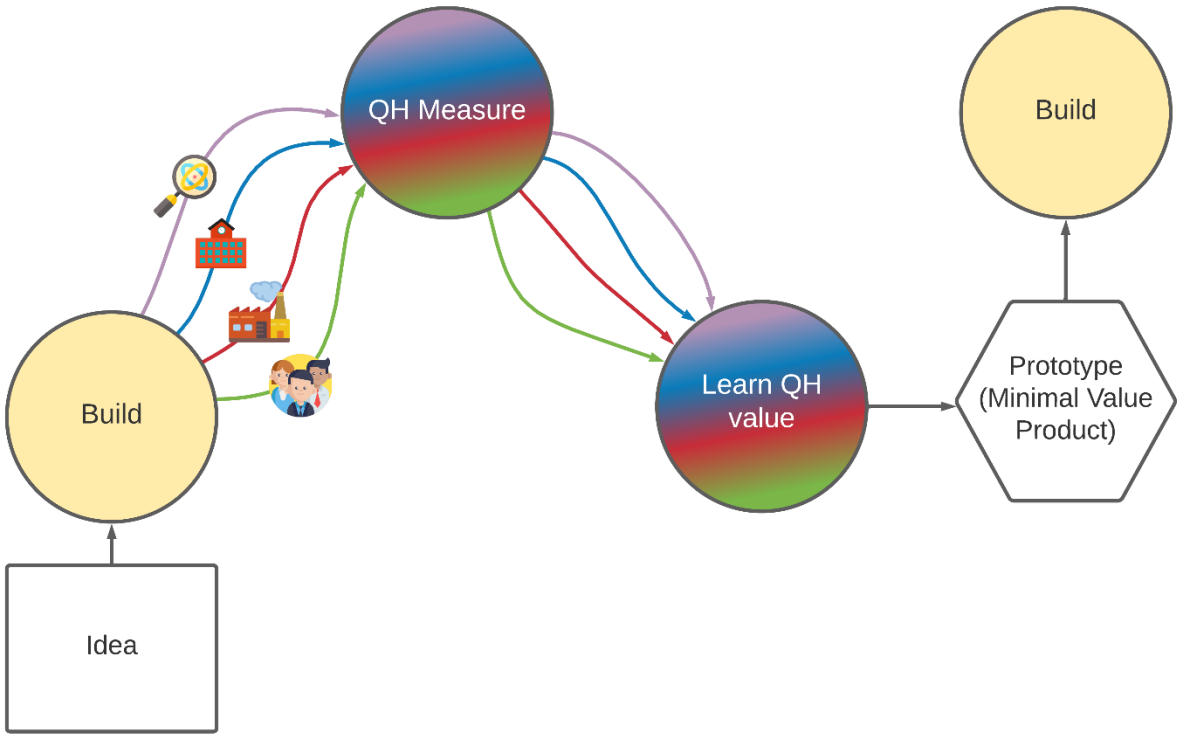


Figure 2 Life-cycle of the Responsible Impact Assessment Model

Figure 2 indicates the life-cycle of the start-up company and where the quadruple helix lean start-up model should be implemented and how it can benefit the company. Once the individual(s), or organisation, come up with an idea and begin to build their MVP, they should then implement the Responsible Impact Assessment Model to identify how they can act responsibly when they begin developing the prototype of their product. The Responsible Impact Assessment Model allows the start-up to evaluate their idea and business model in the context of its impact on society, business, research, and policy. The model could also help to single out the possible stakeholders through which to evaluate the MVP. Of course, the customers will evaluate it from the stance of the particular functionalities they are most interested in. Other stakeholders would assess different aspects of the

same MVP (for example, in terms of the impacts on certain classes of people, such as workers). The most practical way of implementing this model is through the models' set of 24 indicators.

To arrive at this list of 24 indicators, we had to identify which ones were relevant for start-ups, bearing in mind the context and applicability to the Responsible Impact Assessment Model outlined in the previous sections. It was noted, based on our research in this report, that certain indicators were more or less relevant for start-ups. This section aims to demonstrate the most relevant indicators take from the Global Impact Investment Network (GIIN).

In particular, we use the standard screening method developed by GIIN known as *Impact Reporting and Investment Standards* or 'IRIS', COMPASS, PRISMA, and many other EU responsible innovation projects mentioned earlier (see Table 9). We have already provided several criteria on how to evaluate the relevance of indicators within the IRIS+ report for start-ups wishing to engage in responsible research and innovation. Our exclusion criteria were:

- If the indicator was not relevant to a start-up
- If the indicator was not relevant to responsibility
- If the indicator was unclear / did not provide clear guidance
- If the indicator was a repetition of one's we already outlined

In addition to this, we dramatically reduced our list by excluding duplication, as there was a great number of indicators that overlapped. After this stage, the large list was further refined and split into the four parts of the quadruple helix model: societal, research, political, and business.

These lists were still too long, regularly overlapping, and constantly repeating the same message. For example, in the societal indicators list of the model, we had two separate sections: one for what the start-up should do, and another for what they should look for in their partner. These were the same indicators, but with different actors. For efficiency-sake, we comprised both of these lists into a single list with the premise that they are suitable for both start-ups and their partners.

For each of the quadruple helix categories, they were narrowed down to 56 societal indicators, 23 research indicators, 14 political indicators, and 44 business indicators. Many of these indicators, within their respective quadruple helix group, were classified and grouped. For example, the first indicator from the societal indicator list, initially comprised of four separate, but related, indicators ("Organisations should implement a company-wide data management plan that uses optimal technologies for data protection. Data collection selection methods should cover the full gamut of expected beneficiaries and end-users. Data should also be used for positive social impact."). For convenience sake, readability, and practical implementation, these were grouped into one indicator. This method was initiated throughout the four quadruple helix subsections below.

In addition to this, there was still a lot of duplication, overlap, and repetition within and between the four helices, which we tried to reduce. Having an initial list of over 130 indicators is simply not realistic, expedient, or fair to expect a start-up will be able to engage with, and realise, in any meaningful sense. Our lists below are much more manageable, as we aimed to have less than ten indicators in each helix. In total, there are 24 indicators that an organisation should adhere to within the four strands of the Responsible Impact Assessment Model. These indicators are the result of the model that was developed and are also the clearest and most succinct way that a start-up can implement this model in practice. The below indicators have derived from our evaluation of RRI

project reports and the IRIS+ model and were distilled down, refined, and clarified, to these 24 indicators.

The indicators are provided in a prescriptive manner to guide and enable start-ups and responsible investors to understand what should be done in particular instances, rather than simply making vague statements where the intent and responsibility is unclear. This also corresponds to our specifically *responsible* set of indicators, which differ from traditional indicators, because they are more forthright in the ethical obligation of relevant stakeholders. A possible result of the implementation of the Model by a start-up could be the identification of some of the impact indicators through which measuring its specific performances. This process would consist of a form of contextualization of the model.

6.1. Societal Indicators

All of the below indicators are relevant for both start-ups and their partners:

- Start-ups should implement a company-wide data management plan that uses optimal technologies for data and privacy protection. Data collection and selection methods should cover the full gamut of expected beneficiaries and end-users. Data should also be used for positive social impact (S1).
- Start-ups should reduce negative environmental impact and produce positive environmental impact by using sustainable materials, sustainable water management, using green energy sustainably, and reducing their carbon footprint (S2).
- Start-ups should set up an ethical advisory board that can positively impact the behaviour within the organisation. These boards should ensure reflection on responsibility and how management can implement it throughout the organisation (S3).
- Start-ups should monitor how their company and products positively impact society, how to reduce risks, and how to respond to such challenges (e.g., through the use of the precautionary principle). This can be implemented through external auditing, risk assessments, feedback and stakeholder engagement (S4).
- Relevant stakeholders should be involved in an effective, fair, and participatory way. There should be frequent and efficient stakeholder mapping and engagement exercises, and a real possibility that stakeholder input can affect decision-making practices (even if this is critical) (S5).
- There should be an exchange of knowledge between the start-up and stakeholders, through education and training about the company and its products. Stakeholders should be given sufficient knowledge and power to voice their concerns (S6).
- There should be adequate room for debate, deliberation and disagreement within the start-up and there should be a setting where this can be voiced fairly and respectfully without penalisation to the individual or group (S7).
- The start-up should optimally contribute to charitable causes (S8).

6.2. Research Indicators

The research indicators that a start-up should follow are:

- The start-up should ensure a level of openness regarding data generated, ensure that it is not exclusionary of any groups, and one's data gathering is in line with the relevant policy and ethical standards, while always respecting the legislation in the GDPR. One's data

management plan should be in line with these standards and ensure optimal data protection methods (R1).

- The start-up's R&D may provide useful knowledge that can be employed by others in research and innovation, as well as the broader scientific community. In this regard, efforts should be made to ensure one's R&D is open access, as long as it does not harm the start-up's business. The start-up should ensure a strong degree of transparency of research to the public (and language attuned accordingly) (R2).
- A start-up's socio-ethical impact can be facilitated by including both internal and external views in this process. Internal, such as an advisory board that provides input on the socio-ethical impacts of R&D activities. While external can come in the form of validation from experts in normative approaches to science (ethics, technical assessments, etc.) (R3).
- Start-ups should receive input from a wide diversity of people and groups, taking into account a plurality of views, values, and insights on their products and business (R4).
- Participants in the R&D process should be informed about the results of this process. Training/assistance needs to be provided to citizens to participate in the R&D process (R5).
- Before the commencement of an R&D process, the start-up should investigate the socio-ethical impacts, and create effective feedback loops, so they can be responsive to societal values and/or risks. The start-up should establish how they can make a positive socio-ethical impact, while avoiding risks, during each stage of this process (R6).

6.3. Political Indicators

The political indicators that a start-up should follow are:

- Start-ups should ensure decency, integrity, and fairness, in the workplace. Employers should ensure that discrimination based on gender, race, disability etc. does not occur. Diversity is something that should be valued and implemented in the workplace (P1).
- Employees should have the opportunity to grow and develop during their participation in the start-up. They should be allowed to be creative in their roles, and also have a healthy work-life balance (P2).
- Start-ups should implement a set of common core values that are made explicit and agreed upon by employees (e.g., a Charter, code of conduct, workshops, etc.). Employees should be trained to be aware of socio-ethical issues about the organisation and its product(s) (P3).
- The start-up should be respectful of societal traditions and customs, sensitive to unwritten conventions and norms, and respect public participation in democratic processes. They should ensure their actions and products do not harm public safety (P4).

6.4. Business Indicators

The business indicators that a start-up should follow are:

- The start-up should assess and anticipate legal, regulatory and other requirements related to the product/service. They should assess the presence of partnerships/agreements establishing responsibilities about possible risks, obligations, sharing of information/technology and protection measures of the involved organisations (B1).

- The start-up should assess what are the potential/actual impacts (social, economic and environmental), from design to post-launch, of their activities and products. It should consider its positive and negative impacts on innovation, try to prevent harmful impacts of the innovation practices on society and the environment, and re-evaluate these impacts at all life-cycle stages (B2).
 - The business model should integrate profit with environmental and social benefits by identifying the start-up's customer base, the mode of distribution, resources and key activities needed, innovation capacities, value creation for clients, and risks.
 - They should assess the life cycle costs of a product (include short, medium, and long-term impact on externalities) and include their principles in a mission statement or code of conduct.
 - The start-up should analyse and treat their impact comprehensively and not restrict it to one criterion, stage or stakeholder (using impact assessment, paying particular attention to environmental and social pillars).
 - They should adopt sustainable development criteria into product and service specification (choice of material, quality assessment, recycling, energy management, etc.), their choice of suppliers or service providers, and communication activities.
- Start-ups should carry out innovation in a responsible manner, using objectives for assessing performance (B3), such as:
 - When uncertain of adverse outcomes, they should decide to invest a minimum amount of their annual share of revenue (this could be 1% or 5% based on the products/services for which this principle applies) in independent research and development activities to eliminate, wherever possible, any threats and anticipate the adoption of preventive measures against actual risks.
 - Compliance with standards should be following the stakeholders' expectations, external benchmarks and obligations, the social and environmental impacts, the supply chain, and the law in force.
 - They should periodically review the system of indicators by obtaining appropriate feedback from major stakeholders and follow best practices on how to assess performance. Internal and external stakeholders should be involved from the early stages of product development.
- The start-up should ensure adequate training is provided for its staff by identifying the skills, knowledge, and experience of staff, and their equipment/technology requirements to fulfil their work. Time and economic resources should be given towards reflection, sharing experiences, consulting experts (e.g., on ethics, gender equality, and open access), participation in RRI workshops and training initiatives, and appointing RRI staff experts (B4).
- The start-up should ensure that there is a fair distribution of traditionally disadvantaged groups of highly skilled employees. They should examine the percentages of demographics in the company to ensure a fair share of researchers from different backgrounds, genders, and races (B5).
- The start-up should be reflexive, open to change when confronted with challenges and shifting norms and encourage employees to reflect on the start-up's research and innovation. It should reflect on the start-up's economic sustainability, their ability to handle the project/product in terms of finances, manpower and material and knowledge of risks (turnover, investment capacity, induced financial savings, cash-flow) (B6).

6.5. Indicator Correlation

It would be beneficial if light could be shed on potential relationships between the 24 indicators above through a process of deliberation that not only seeks to identify these relationships, but also to understand their *raison d'être*, thus laying the foundations for a more coherent and comprehensive model. A model that capitalises upon this understanding to potentially formulate further aggregations of (the existing) indicators at conceptually higher levels of abstraction that pave the way to more 'optimal' applications of the model, either for the benefit of impact investors, or of start-ups. For instance, it would be interesting to understand the relationships, if any, between indicators S6, R3, R4, R5 (see Sections 6.1 and 6.2), and whether the degree of fulfilment of S6 reflects on the degrees of fulfilment of R3, R4, R5: in case it does, these indicators could form a potential new aggregation – a kind of a new 'meta'-indicator – aimed at assessing a start-up's extroversion; this would of course facilitate an 'optimal' application of the model for investors and start-ups specifically interested in assessing extroversion.

The above process of deliberation will unfold mainly in the frame of WP2. It shall be implemented in two phases. In the first phase the application of Structural Equation Modelling (SEM) techniques shall be investigated during the pilot demonstrators for unveiling potential⁸ correlations between variables across all indicators and across all helices of QH by observing the values that these variables assume 'in space', i.e. across start-ups participating in the demonstrators. In the second phase, any correlations identified in the first phase will be further investigated through appropriate interactions (e.g. focus groups) with stakeholders from all helices of QH during the demonstrators and, perhaps, also at a wider scale (e.g. through surveys with a broader participation).

Finally, an Analytic Hierarchy Processes (AHP) method shall be adopted mainly for aiding investors in the decision-making process. More specifically, during the WP2 demonstrators, a set of weights will be devised and attached to the indicators of the QH-RRI-LSA model; these weights shall be decided based on widespread interactions with stakeholders from all 4 helices of QH. They shall be designed such that they take into account any new aggregations generated by the process of deliberation above.

7. Conclusion

This report systematically analysed the literature on socially responsible investment and how current approaches in theory and practice can help organisations achieve innovation, and responsibly invest in, start-up companies. The industry-standard method for screening for investment criteria, developed by GIIN, was used (as *Impact Reporting and Investment Standards* or 'IRIS+'). IRIS+ allowed us to identify what some of the most important indicators should be for start-up companies aiming to initiate, implement, and report their responsible research and innovation practices. The IRIS+ method was critically evaluated through the lens of a start-up and what is most relevant for these companies, which typically are dynamic, fast-moving, small in size, and that heavily rely on innovative practices to grow and sustain themselves.

It was acknowledged that not all criteria within the very large IRIS+ document are relevant or easy for start-ups to address. Furthermore, many of the points were not relevant for responsible

⁸ It is conceded that the relatively small size of our start-up sample in the demonstrators precludes any certainty in identifying correlations.

innovation and investment practice. At the same time, important insights came from the analysis of the grey literature on RRI for enterprises. As a result, we initiated several rounds of an internal and external examination of these indicators, refining them down to the 24 most important ones for start-ups. These 24 indicators were mapped into the four main strands of the quadruple helix model to give consistent regard and merit for each of the four helixes (political, business, societal, and research).

This report brought together the more ethically-focused world of RRI with the practically-orientated LSA and realised through the Responsible Impact Assessment Model. It formulated this approach in the context of indicators for responsible start-up practices and guidelines for investors who want to invest in responsible organisations.

The report provides a template for further refinement into tangible and usable workbooks for organisations implementing responsible practices in the field. In Deliverable 1.2, we will develop and rework these 24 indicators into several workbooks for organisations to keep track and monitor their responsible practices. These will be used so that organisations can practically examine, track, and monitor their responsible innovation practices. These worksheets can also be used for external examination of the start-up and their efforts towards responsible innovation.

This report has provided the Responsible Impact Assessment Model as a way to responsibly invest. This model culminated in 24 clear indicators for start-ups to implement in practice and follow for responsible business practices, and also, for those who wish to know if a business is acting responsibly. Thus, it can also be used for investors in start-ups to provide information about their company and to examine how it responds to these indicators, how it achieved its successes, and where and how they are deficient. And, most importantly, are they aware of their weaknesses and how will they improve them to ensure that investors are investing in responsible organisations. The indicators are qualitative and should be understood contextually and prescriptively to account for the dynamic, adaptive, and evolving nature of start-ups, rather than a 'checklist' or quantitative list where companies get points for each correct or wrong answer. As demonstrated in this report, this type of approach is not suited to the nature of start-ups, and provide misleading and unfair results. Our qualitative indicators provide a more nuanced, clear, and representative analysis of the start-up.

8. References

- Alvord, S. H., Brown, L. D., & Letts, C. W. (2004). Social Entrepreneurship and Societal Transformation: An Exploratory Study. *The Journal of Applied Behavioral Science*, 40(3), 260-282. doi:10.1177/0021886304266847
- Arena, M., Bengo, I., Calderini, M., & Chiodo, V. (2018). Unlocking finance for social tech start-ups: Is there a new opportunity space? *Technological Forecasting and Social Change*, 127, 154-165. doi:<https://doi.org/10.1016/j.techfore.2017.05.035>
- Asveld, L. (Ed.) (2017). *Responsible innovation 3: A European agenda?* Cham, Switzerland: Springer.
- Barnett, M. L., & Salomon, R. M. (2012). Does it pay to be really good? Addressing the shape of the relationship between social and financial performance. *Strategic Management Journal*, 33(11), 1304-1320.
- Beckert, J. (2016). *Imagined futures: Fictional expectations and capitalist dynamics*. Harvard University Press.
- Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. *Economics and Statistics Administration Issue Brief*(04-11).
- Blair, C. A., & Shaver, K. G. (2020). Of horses and jockeys: Perceptions by academic entrepreneurs. *Entrepreneurship Research Journal*, 10(2).
- Blank, S. (2013). Why the lean start-up changes everything. *Harvard business review*, 91(5), 63-72.
- Blok, V. (2018). Innovation as ethos: Moving beyond csr and practical wisdom in innovation ethics.
- Blok, V., Hoffmans, L., & Wubben, E. F. (2015). Stakeholder engagement for responsible innovation in the private sector: Critical issues and management practices. *Journal on Chain and Network Science*, 15(2), 147-164.
- Blok, V., Inigo, E.A., Novelskaitė A., Pučėtaitė, R., Meiji, A., Wakunuma, K., Jiya, T., Fraun, L.G., Lorenz, L., Sánchez de Madariaga, I., Novella, I. (2020). D5.1. Recommendations for the Development of Competitive Advantage Based on RRI. <https://rriing.eu/wp-content/uploads/2020/08/D-5.1.-RECOMMENDATIONS-FOR-THE-DEVELOPMENT-OF-A-COMPETITIVE-ADVANTAGE-BASED-ON-RRI.pdf>
- Blok, V., & Lemmens, P. (2015). The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. In *Responsible innovation 2* (pp. 19-35). Springer, Cham.
- Blok, V., Scholten, V., & Long, T. B. (2018). Responsible innovation in industry and the importance of customer orientation: introduction to the special issue. *International Food and Agribusiness Management Review*, 21(4), 455-462.
- Blok, V., Tempels, T., Pietersma, E., & Jansen, L. (2017). Exploring ethical decision making in responsible innovation: The case of innovations for healthy food. In *Responsible Innovation 3* (pp. 209-230). Springer, Cham.
- Borgers, A. C., & Pownall, R. A. (2014). Attitudes towards socially and environmentally responsible investment. *Journal of Behavioral and Experimental Finance*, 1, 27-44.
- Bouri, A. (2011). How standards emerge: The role of investor leadership in realizing the potential of IRIS. *Innovations: Technology, Governance, Globalization*, 6(3), 117-131.
- Brand, T., & Blok, V. (2019). Responsible innovation in business: A critical reflection on deliberative engagement as a central governance mechanism. *Journal of responsible innovation*, 6(1), 4-24.
- Callon, M. (1987). Society in the making: The study of technology as a tool for sociological analysis. In W. Bijker, T. Hughes, & T. Pinch (Eds.), *The Social construction of technological systems: New directions in the sociology and history of technology* (pp. 83-103). Cambridge, Mass.: MIT Press.
- Cane, P. (2002). *Responsibility in law and morality*. Oxford, UK; Portland, Or.: Hart Pub.
- Carayannis, E., & Campbell, D. (2009). 'Mode 3' and 'Quadruple Helix': toward a 21st-century fractal innovation ecosystem. *International journal of technology management*, 46(3/4), 201-234.
- Carayannis, E., & Campbell, D. (2012). Mode 3 knowledge production in quadruple helix innovation systems. In *Mode 3 knowledge production in quadruple helix innovation systems* (pp. 1-63): Springer.
- Chatzitheodorou, K., Skouloudis, A., Evangelinos, K., & Nikolaou, I. (2019). Exploring socially responsible investment perspectives: A literature mapping and an investor classification. *Sustainable production and consumption*, 19, 117-129. doi:<https://doi.org/10.1016/j.spc.2019.03.006>
- Cohen, R. (2020). *Impact: reshaping capitalism to drive real change*. London: Ebury Press.
- Declich, A. (2014). Aspettative e narrazioni: spunti per una riflessione interdisciplinare. *Quaderni di Sociologia*, (64), 111-138.
- Dreyer, M., Chefneux, L., Goldberg, A., Von Heimburg, J., Patrignani, N., Schofield, M., & Shilling, C. (2017). Responsible innovation: A complementary view from industry with proposals for bridging different perspectives. *Sustainability*, 9(10), 1719.
- Erragragui, E., & Lagoarde-Segot, T. (2016). Solving the SRI puzzle? A note on the mainstreaming of ethical investment. *Finance Research Letters*, 18, 32-42. doi:<https://doi.org/10.1016/j.frl.2016.03.018>
- Fitzpatrick, G., & Malmberg, L. (2018). *Quadruple helix model organisation and tensions in participatory design teams*. Paper presented at the Proceedings of the 10th Nordic Conference on Human-Computer Interaction.

- Frederiksen, D. L., & Brem, A. (2017). How do entrepreneurs think they create value? A scientific reflection of Eric Ries' Lean Startup approach. *International Entrepreneurship and Management Journal*, 13(1), 169-189.
- Funtowicz, S.O., & Ravetz, R.J. (1993). Science for the post-normal age. *Futures*, September
- Gangi, F., & Varrone, N. (2018). Screening activities by socially responsible funds: A matter of agency? *Journal of Cleaner Production*, 197, 842-855.
- Garst, J., Blok, V., Branzei, O., Jansen, L., & Omta, O. S. (2019). Toward a value-sensitive Absorptive Capacity Framework: Navigating Interval and Intra-Interval Conflicts to Answer the Societal Call for Health. *Business & Society*, 0007650319876108.
- Garst, J., Blok, V., Jansen, L., & Omta, O. S. (2017). Responsibility versus profit: The motives of food firms for healthy product innovation. *Sustainability*, 9(12), 2286.
- Gee, D. (Ed.) (2001). *Late lessons from early warnings: the precautionary principle 1896–2000*. Denmark: EEA.
- Gbadegeshin, S. A., & Heinonen, L. (2016). Application of the Lean Start-up technique in the commercialisation of business ideas and innovations. *International Journal of Business Management and Research*, 43(1), 1270-1285.
- Gianni, R., Pearson, J., & Reber, B. (Eds.). (2019). *Responsible Research and Innovation: From Concepts to Practices*. London/New York: Routledge.
- Gibbons, M. (1999). Science's new social contract with society. *Nature*, 402, C81-C84
- Gompers, P. A., Gornall, W., Kaplan, S. N., & Strebulaev, I. A. (2020). How do venture capitalists make decisions?. *Journal of Financial Economics*, 135(1), 169-190.
- Grunwald, A. (2011). *Responsible Innovation: Bringing together Technology Assessment, Applied Ethics, and STS research*: Karlsruhe Institute of Technology.
- Iatridis, K., & Schroeder, D. (2016). *Responsible research and innovation in industry* (Vol. 10). Cham: Springer International.
- Jonas, H. (1984). *The Imperative of Responsibility: In Search of an Ethics for the Technological Age*. Chicago, London: University of Chicago Press.
- Julia Abelsona, Pierre-Gerlier Forestb, John Eylesa, Patricia Smitha,, & Elisabeth Martinb, F.-P. G. (2003). *Deliberations about deliberative methods: issues in the design and evaluation of public participation processes*. France: Laval University.
- Klaassen, P., Kupper, F., Vermeulen, S., Rijnen, M., Popa, E. O., & Broerse, J. (2017). In T. C. o. R. A. I. Approach (Ed.), *Responsible innovation 3: A European agenda?* (pp. 69-92). Cham, Switzerland: Springer.
- Koops, B., Oosterlaken, I., Romijn, R., Swierstra, T., & van den Hoven, J. (Eds.). (2015). *Responsible Innovation 2: Concepts, Approaches and Applications*. Springer Cham Heidelberg New York Dordrecht London: Springer International Publishing Switzerland.
- Ligtvoet, A., Cuppen, E., Di Ruggero, O., Hemmes, K., Pesch, U., Quist, J., & Mehos, D. (2016). New future perspectives through constructive conflict: Exploring the future of gas in the Netherlands. *Futures*, 78, 19-33.
- Long, T. B., & Blok, V. (2018). Integrating the management of socio-ethical factors into industry innovation: towards a concept of Open Innovation 2.0. *International food and agribusiness management review*, 21(4), 463-486.
- Losse, M., & Geissdoerfer, M. (2021). Mapping socially responsible investing: A bibliometric and citation network analysis. *Journal of Cleaner Production*, 296, 126376.
doi:<https://doi.org/10.1016/j.jclepro.2021.126376>
- Lubberink, R., Blok, V., Van Ophem, J., & Omta, O. (2017). Lessons for responsible innovation in the business context: A systematic literature review of responsible, social and sustainable innovation practices. *Sustainability*, 9(5), 721.
- Luise, V. (2019). Le forme dell'innovazione nell'ideologia californiana: Le retoriche, i modelli e le trasformazioni nell'economia startup. EGEE spa.
- Mansoori, Y. (2017). Enacting the lean startup methodology: The role of vicarious and experiential learning processes. *International Journal of Entrepreneurial Behavior & Research*.
- Martinuzzi, A., Blok, V., Brem, A., Stahl, B., & Schönherr, N. (2018). Responsible research and innovation in industry—Challenges, insights and perspectives. In (Vol. 10, pp. 702): Multidisciplinary Digital Publishing Institute.
- Merton, R. K. (1979). The normative structure of science. In R.K. Merton, *The sociology of science: Theoretical and empirical investigations*, 267-278. (First publication: 1942)
- Miller, D., & Walzer, M. (1995). *Pluralism, justice, and equality*. Oxford England; New York: Oxford University Press.
- Monteiro, S. P. D. O., & Carayannis, E. (2017). *The Quadruple Innovation Helix Nexus: A smart growth model, quantitative empirical validation and operationalization for OECD countries*. New York: Palgrave/Springer.

- Nissan, E., Carrasco, I., & Castaño, M.-S. (2012). Women Entrepreneurship, Innovation, and Internationalization. In M.-A. Galindo & D. Ribeiro (Eds.), *Women's Entrepreneurship and Economics: New Perspectives, Practices, and Policies* (pp. 125-142). New York, NY: Springer New York.
- Novitzky, P., Bernstein, M. J., Blok, V., Braun, R., Chan, T. T., Lamers, W., ... & Griessler, E. (2020). Improve alignment of research policy and societal values. *Science*, 369(6499), 39-41.
- Nowotny, H., Scott, P. and Gibbons, M. (2001), *Re-thinking Science: Knowledge and the Public in the Age of Uncertainty*, Polity Press, Cambridge
- OECD (2022) Social Impact Investment. <https://www.oecd.org/industry/social-impact-investment.htm>
- ORBIT RRI (2022). The Keys of Responsible Research and Innovation. <https://www.orbit-rri.org/resources/keys-of-rri/> [accessed 21-01-2022]
- Ormiston, J., Charlton, K., Donald, M. S., & Seymour, R. G. (2015). Overcoming the challenges of impact investing: Insights from leading investors. *Journal of Social Entrepreneurship*, 6(3), 352-378.
- Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E., & Guston, D. H. (2013). A Framework for Responsible Innovation. In R. Owen, J. Bessant, & M. Heintz (Eds.), *Responsible Innovation* (pp. 27-51). London, UK: John Wiley & Sons, Ltd.
- Popa, E. O., Blok, V., & Wesselink, R. (2020a). Discussion structures as tools for public deliberation. *Public Understanding of Science*, 29(1), 76-93. doi:10.1177/0963662519880675
- Popa, E. O., Blok, V., & Wesselink, R. (2020b). A processual approach to friction in quadruple helix collaborations. *Science and Public Policy*. doi:10.1093/scipol/scaa054
- Porcari, A., Pimponi, D., Borsella, E., Klaassen, P., Maia, M. J., & Mantovani, E. (2021). Supporting RRI uptake in industry: A qualitative and multi-criteria approach to analysing the costs and benefits of implementation. In E. Yaghmaei & I. van de Poel (Eds.), *Assessment of Responsible Innovation: Methods and Practices* (pp. 117-143). London/New York: Routledge.
- Quaranta G., Mastropietro E. (2003), *Le condizioni del successo. Linee guida per la creazione d'impresa destinate alla consulenza e alla formazione*, Roma
- Randles, S., Laredo, P., Loconto, A., Walhout, B., & Lindner, R. (2016). Framings and frameworks: six grand narratives of de facto rri. In R. Lindner, S. Kuhlmann, S. Randles, B. Bedsted, G. Gorgoni, E. Griessler, A. Loconto, & N. Mejgaard (Eds.), *Navigating Towards Shared Responsibility in Research and Innovation: Approach, Process and Results of the Res-AGorA Project* (pp. 31-36). Fraunhofer ISI. http://pure.au.dk/portal/files/98634660/RES_AGorA_ebook.pdf
- Reeder, N., Colantonio, A., Loder, J., & Rocyn Jones, G. (2015). Measuring impact in impact investing: an analysis of the predominant strength that is also its greatest weakness. *Journal of Sustainable Finance & Investment*, 5(3), 136-154.
- Renneboog, L., Ter Horst, J., & Zhang, C. (2008). The price of ethics and stakeholder governance: The performance of socially responsible mutual funds. *Journal of corporate finance*, 14(3), 302-322.
- Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Currency.
- Rip, A. (2014). *The Past and future of RRI*. Netherlands: University of Twente.
- Scholten, V. E., & Blok, V. (2015). Foreword: Responsible innovation in the private sector. *Journal on Chain and Network Science*, 15(2), 101-105.
- Sireci, S. G. (1998). The construct of content validity. *Social indicators research*, 45(1), 83-117.
- Stahl, B. C., Obach, M., Yaghmaei, E., Ikonen, V., Chatfield, K., & Brem, A. (2017) "The Responsible Research and Innovation (RRI) Maturity Model: Linking Theory and Practice" *Sustainability* 9(6): 1036 <https://doi.org/10.3390/su9061036>
- Stamm, I., Cruz, A. D., & Cailluet, L. (2019). Entrepreneurial Groups. *Historical Social Research/Historische Sozialforschung*, 44(4 (170), 7-41.
- Stamm, I., & Gutzeit, M. (2021). Group conditions for entrepreneurial visions: role confidence, hierarchical congruences, and the imagining of future in entrepreneurial groups. *Small Business Economics*, 1-19.
- Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, 42(9), 1568-1580.
- Sutcliffe, H. (2011). *A report on Responsible Research & Innovation*. Europe: matter.
- Syed, A. M. (2017). Socially responsible: Are they profitable? *Research in International Business and Finance*, 42, 1504-1515. doi:<https://doi.org/10.1016/j.ribaf.2017.07.090>
- Tracey, P., & Stott, N. (2017). Social innovation: a window on alternative ways of organizing and innovating. *Innovation*, 19(1), 51-60.
- USAID. (2019). IRIS+ and the Five Dimensions of Impact. https://pdf.usaid.gov/pdf_docs/PA00W77T.pdf
- van de Poel, I. (2011). The Relation Between Forward-Looking and Backward-Looking Responsibility. In N. A. Vincent, I. van de Poel, & J. van den Hoven (Eds.), *Moral Responsibility: Beyond Free Will and Determinism* (pp. 37-52). Dordrecht: Springer Netherlands.
- van de Poel, I., Asveld, L., Flipse, S., Klaassen, P., Kwee, Z., Maia, M., . . . Yaghmaei, E. (2020). Learning to do responsible innovation in industry: six lessons. *Journal of Responsible Innovation*, 7(3), 697-707. doi:10.1080/23299460.2020.1791506

van de Poel, I., & Sand, M. (2018). Varieties of responsibility: two problems of responsible innovation. *Synthese*. doi:10.1007/s11229-018-01951-7

van den Hoven, J., Swierstra, T., Koops, B. J., & Romijn (Eds.). (2014). *Responsible Innovation 1: Innovative Solutions for Global Issues*. New York London: Springer Dordrecht Heidelberg.

Visintin, F., & Pittino, D. (2014). Founding team composition and early performance of university—Based spin-off companies. *Technovation*, 34(1), 31-43.

Walzer, M. (1983). *Spheres of justice: a defence of pluralism and equality*. New York: Basic Books.

Widyawati, L. (2020). A systematic literature review of socially responsible investment and environmental social governance metrics. *Business Strategy and the Environment*, 29(2), 619-637.

Wiener, A. (2021) "does tech need a new narrative? In Silicon Valley, 'disruption' is giving way to 'building'. What will be built?", Letter from Silicon Valley, the New Yorker, June 18, 2021

Ziman, J. (2000): *Real Science. What it is, and what it means*. Cambridge University Press

9. Appendices

9.1. Appendix 1: IRIS+ Indicators Suitable for Responsible Start-ups

Indicator	Description
Anti-Discrimination Policy	<p>Indicates whether the organization has a specific, written anti-discrimination policy in place for its employees and a system to monitor compliance with this policy.</p> <p>"Anti-discrimination policies, oftentimes called non-discrimination or equal employment opportunity policies, create codes to prohibit or penalize discrimination based on age, colour, disability, gender expression, gender identity, HIV status, marital status, national, social & ethnic origin, participation in collective bargaining agreements, political opinion, race, religion, or sexual orientation. These policies prohibit activities such as recruitment, compensation, termination, promotions, and other conditions of employment based on any of the affiliations listed above for any employee or job applicant.</p> <p>Organizations can refer to the following source for additional information on best practices:</p> <p>- Human Rights Campaign (http://www.hrc.org/resources/entry/Workplace-Discrimination-Policies-Laws-and-Legislation) and (http://www.hrc.org/resources/entry/sample-equal-employment-opportunity-policies)."</p>
Availability of Basic Services/Facilities	Indicates whether there are basic services present onsite and a system in place to maintain them as of the end of the reporting period. This metric is intended to be used in combination with WASH Facilities Type (PD3668).
Client Type	
Community Service Hours Contributed	<p>Number of hours volunteered by full-time and part-time employees of the organization during the reporting period. "Organizations should include both paid and unpaid time spent volunteering, either for company-organized events or for employee-initiated activities.</p> <p>Organizations are also encouraged to footnote the hours contributed during</p>

	<p>traditional work hours and the hours contributed outside of traditional working hours. Traditional working hours can be defined by the organization and should be footnoted.</p>
<p>Departed Permanent Employees: Voluntary</p>	<p>Number of full-time and part-time employees that departed the organization voluntarily during the reporting period. "Voluntary departure is defined as those employees not dismissed with cause or involuntarily separated from the organization.</p> <p>Organizations can elect to exclude retiring employees when reporting against this metric and should footnote any relevant adjustments.</p> <p>This metric is multi-dimensional in regards to the five dimensions of impact: it may help describe the WHO dimension when the stakeholder group represented by the metric is the stakeholder group targeted by the investment or organization. It may also help measure the HOW MUCH Scale dimension, which helps estimate the number of the targeted stakeholders experiencing the outcome. For more on the alignment of IRIS+ metrics to the five dimensions of impact, see the specific guidance document. No single metric is sufficient to understand an impact; rather, metrics are selected as a set across all dimensions of impact. When possible, the selection of metrics to measure and describe the five dimensions should be based on best practice and evidence."</p>
<p>Distributor individuals> disabilities</p>	<p>Number of individuals with disabilities who served as distributors of the organization's products/services during the reporting period.</p>
<p>Distributor Organizations: Total</p>	<p>Number of organizations that served as distributors of the organization's products/services during the reporting period.</p>
<p>Diverse Representation Policy</p>	<p>Organizations using this metric should consider women, members of minorities and previously excluded groups including people of color, gender and sexual minorities, and people living with disabilities.</p>
<p>Employees Promoted: Female</p>	<p>Number of employees who are female and who were promoted from within the organization during the reporting period. This metric is intended to capture the number of unique female individuals promoted by the organization in full- or part-time roles at the point in time defined by the reporting end date. This metric excludes Temporary Employees (OI9028). Organizations are encouraged to note what roles and levels employees promoted began and ended the reported period in.</p> <p>Promotion (or career advancement) is the movement of an employee who already works for the organization to a higher grade level either within the same department or to another department due to a change in duties and not due to a market adjustment in salary (SHRM, https://www.shrm.org/resourcesandtools/tools-and-samples/policies/pages/job-posting-policy---staff-promotions.aspx).</p>

Energy Purchased: Total	<p>Amount of purchased energy consumed by the organization during the reporting period.</p> <p>Adding Energy Generated for Use: Total (OI9624) with Energy Purchased: Total (OI8825) should equal the total energy consumed by the organization during the reporting period.</p>
Fair Dismissal Policy	<p>Indicates whether the organization has a written policy and practice of ensuring fair dismissal of employees and a system to monitor compliance with this policy.</p> <p>The ILO defines the boundaries for what is considered fair dismissal. Reasons for dismissal which shall be not be considered valid include those based on union membership or participation in union activities, filing of a complaint against an employer, race, color, sex, marital status, family responsibilities, pregnancy, religion, political opinion, national extraction or social origin, temporary absence due to illness, or absence from work during maternity leave.</p>
Forced Labor Policy	<p>Indicates whether the organization has a written policy against forced labor and a system to monitor compliance of this policy.</p> <p>"Forced labor is any work or service which individuals are forced to do against their will under the threat of punishment. Forced labor takes different forms including debt bondage, trafficking, and other forms of modern slavery.</p> <p>Organizations can refer to the following source for further guidance: International Labor Organization standards (<http://www.ilo.org/global/topics/forced-labour/lang--en/index.htm>)."</p>
Full-time Employees: Managers with Disabilities	Number of paid full-time management employees (managers) with disabilities at the organization as of the end of the reporting period
Full-time Wages: Female	Value of wages (including bonuses, excluding benefits) paid to all female full-time employees of the organization during the reporting period.
Greenhouse Gas Emissions of Product	Amount of greenhouse gases (GHG) emitted by the product over its lifetime. Organizations should use Product Lifetime (PD4587) to capture the lifetime of the product.
Local Compliance	<p>Indicates whether the organization has been found to be out of compliance with any local labor, tax, or environmental regulations during the reporting period.</p> <p>Organizations should consider reporting this in conjunction with Number of Legal and Regulatory Complaints (OI2165) and Value of Fines and Settlements (OI7639).</p>
Packaging Type	<p>Type of packaging used by the organization during the reporting period.</p> <p>Select all that apply:</p> <p>-Recycled materials</p>

	<p>-Non-recycled compostable or renewable materials</p> <p>-Non-recycled, non-compostable, non-renewable materials</p>
Part-time Wages: Female	<p>Value of wages (including bonuses, excluding benefits) paid to all female part-time employees of the organization during the reporting period. This metric is intended to capture pre-tax wages/salaries paid to the organization's part-time female employees and should not include benefits nor include payroll expenses. These wages should exclude Temporary Employee Wages (OI4202).</p>
Part-time Wages: Minorities/Previously Excluded	<p>Value of wages (including bonuses, excluding benefits) paid to all part-time employees of the organization who belong to minority or previously excluded groups during the reporting period.</p> <p>This metric is intended to capture pre-tax wages/salaries paid to the organization's part-time employees who belong to minority or previously excluded groups and should not include benefits nor include payroll expenses. These wages should exclude Temporary Employee Wages (OI4202).</p>
Permanent Employees: Total	<p>Permanent Employees: Total</p> <p>Number of people employed by the organization as of the end of the reporting period. This is the sum of all paid full-time and part-time employees.</p>
Poverty Assessment	<p>Indicates whether the organization assesses the poverty levels of its intended stakeholders.</p>
Product Lifetime	<p>"Lifetime of the product provided by the organization (based on reasonable use).</p> <p>Organizations should report product lifetime in number of years."</p> <p>Product lifetime refers to the length of time for which it is estimated that the product will perform its intended functions, assuming reasonable use.</p> <p>Examples of methods for estimating the lifespan, to footnote, include: research and development, field test, customer surveys, or other.</p>
Product/Service Certifications	<p>Describes third-party certifications for products/services sold by the organization that are valid as of the end of the reporting period.</p>
Product/Service Detailed Type	<p>This metric is intended to capture a detailed description of the product or service provided from the options given in the definition.</p> <p>Organizations can report on this metric at an organization level (selecting all of the product/service details of the organization) or at the specific product/service level (selecting the product/service detail for the product/service reporting against).</p> <p>Organizations working with water, sanitation, and hygiene (WASH) services may use this metric in conjunction with WASH Facilities Type (PD3668) to</p>

	more specifically describe the facilities provided to target stakeholders through their investments.
Product/Service Type	<p>Describes the economic activities categories that define the organization's economic activity/operations. Select from the options in the Reference List tab.</p> <p>e.g.</p> <p>Agriculture, forestry and fishing</p> <p>Energy, mining and quarrying</p> <p>Manufacturing</p> <p>Electricity, gas, steam and air conditioning supply</p> <p>Water supply; sewerage, waste management and remediation activities</p> <p>Construction</p>
Sector to Influence	<p>"Describes the sector(s) in which the organization focuses and seeks to influence. Select all that apply:</p> <p>A. Agriculture, forestry and fishing</p> <p>B. Mining and quarrying</p> <p>C. Manufacturing</p> <p>D. Electricity, gas, steam and air conditioning supply</p> <p>E. Water supply; sewerage, waste management and remediation</p> <p>F. Construction</p> <p>G. Wholesale and retail trade; repair of motor vehicles and motorcycles</p> <p>H. Transportation and storage</p> <p>I. Accommodation and food service activities</p> <p>J. Information and communication</p> <p>K. Financial and insurance activities</p> <p>L. Real estate activities</p> <p>M. Professional, scientific and technical activities</p> <p>N. Administrative and support service activities</p> <p>O. Public administration and defence; compulsory social security</p> <p>P. Education</p> <p>Q. Human health and social work activities</p> <p>R. Arts, entertainment and recreation</p> <p>S. Other service activities</p> <p>T. Activities of households as employers; undifferentiated goods- and services- producing activities of households for own use</p> <p>U. Activities of extraterritorial organizations and bodies"</p>
Service Level Type	<p>"Describes the level of access to services provided to households or individuals as a result of the organization's activities as of the end the reporting period. Choose all that apply within the appropriate sector or service:</p> <p>Drinking Water</p> <ul style="list-style-type: none"> - Safely managed - Basic - Limited

	<ul style="list-style-type: none"> - Unimproved - Surface water <p>Sanitation</p> <ul style="list-style-type: none"> - Safely managed - Basic - Limited - Unimproved - Open defecation <p>Hygiene</p> <ul style="list-style-type: none"> - Basic - Limited - No facility <p>Electricity</p> <ul style="list-style-type: none"> - Tier 5 (advanced access) - Tier 4 - Tier 3 - Tier 2 - Tier 1 - Tier 0 (no access)"
Sexual Harassment Policy	<p>Indicates whether the organization has a written policy to combat and prevent sexual harassment of employees and a system to monitor compliance with this policy.</p> <p>The policy should be in line with internationally-recognized standards.</p>
Social and Environmental Performance Risk Assessment	<p>Indicates whether the organization assessed social and environmental risks during the reporting period.</p> <p>Examples of social risks to footnote, if relevant, include: mission drift, reputational risk, incidents resulting in harm to clients, client exit, employee dissatisfaction, incentives that can lead to negative behaviors among employees, lack of transparency, negative environmental impacts, gender inequalities and/or discrimination, lack of implementation of policies, and others.</p> <p>Examples of environmental risks to footnote, if relevant, include: license to operate, reputational risk, incidents resulting in harm to client or the environment (e.g., hazardous waste spills), negative social risks, sustainable supply chain and supply chain security, regulatory, climate risk, and others.</p> <p>Organizations are also encouraged to footnote the frequency with which social and environmental performance risks are assessed and whether the organization's risk management procedures reflect social and environmental risk criteria.</p>

<p>Strikes and Lockouts</p>	<p>This metric is intended to capture the number of strikes and lockouts occurring among the organization's employees during the reporting period. Strikes and lockouts can be representative of a breakdown in labor/management relations and a suspension of consultative processes. Data on the occurrence of such industrial incidents can convey a useful measure of the state of labor/management relations and the direction of its progression over time. It will need to be set against the context of any limitations set by local legislation and be benchmarked against norms for inter-country, inter-industry, and inter-category comparisons. Organizations may observe strikes and lockouts increasing as employees take greater freedom in questioning their rights and respect in the workplace. When policies begin to work and change is affected, there may then be a decrease.</p> <p>An employee strike is a work stoppage caused by one or several of the following voluntary actions by a number of employees: reducing the normal performance of their employment, breaking their employment agreements, refusing or failing to accept engagement for work in which they are usually employed, reducing their normal output or their normal rate of work, etc. A strike usually takes place in response to employee grievances.</p> <p>A lockout is also a work stoppage or temporary denial of employment initiated by the employer. It can occur as a response by the employer to the employee strike in order to reach certain terms in an agreement. This metric is intended to capture the number of strikes and lockouts occurring among the organization's employees during the reporting period.</p>
<p>Supplier Locations</p>	<p>Organizations can determine the precise threshold for which they report suppliers. Note, in some cases, organizations may only include enterprises which supply goods and services that are fundamental to the operations of the reporting organization.</p>
<p>Target Area Ecoregion</p>	<p>"Describes the ecoregions the organization seeks to benefit as of the end of the reporting period. Choose all that apply:</p> <p>Terrestrial Ecoregions</p> <ul style="list-style-type: none"> - Deserts and xeric shrublands - Tropical and subtropical moist broadleaf forests - Tropical and subtropical dry broadleaf forests - Tropical and subtropical coniferous forests - Temperate broadleaf and mixed forests - Temperate coniferous forest - Boreal forests/Taiga - Tropical and subtropical grasslands, savannas and shrublands - Temperate grasslands, savannas and shrublands - Flooded grasslands and savannas - Montane grasslands and shrublands - Tundra

	<ul style="list-style-type: none"> - Mediterranean forests, woodlands, and scrubs - Mangroves - Other terrestrial ecoregion (describe) <p>Freshwater Ecoregions</p> <ul style="list-style-type: none"> - Large river ecosystems - Large river headwater ecosystems - Large river delta ecosystems - Small river ecosystems - Large lake ecosystems - Small lake ecosystems - Xeric basin ecosystems - Other freshwater ecoregion (describe) <p>Marine Ecoregions</p> <ul style="list-style-type: none"> - Polar ecoregions - Temperate shelf and seas ecoregions - Temperate upwellings - Tropical upwellings - Tropical coral - Other marine ecoregion (describe)"
<p>Target Area Protected Status</p>	<p>Describes the protected status of the land the organization seeks to benefit during the reporting period. Choose all that apply:</p> <ul style="list-style-type: none"> - Strict Nature Reserve (IUCN Category 1a) - Wilderness Area (IUCN Category 1b) - National Park (IUCN Category II) - Natural Monument or Feature (IUCN Category III) - Habitat/Species Management Area (IUCN Category IV) - Protected Landscape/Seascape (IUCN Category V) - Protected Area with Sustainable Use of Natural Resources (Category VI) - No Current Protections - Other (describe)
<p>Target Stakeholder Demographic Target Stakeholder Setting Target Stakeholder Geography</p>	<p>"Describes the demographic groups of stakeholders targeted by the organization. Select all that apply:</p> <p>Age group:</p> <ul style="list-style-type: none"> - Children (younger than 10 years old) - Adolescents (10 years of age or older but younger than 19) - Adults (19+ years old) - Elderly/older adults <p>Gender:</p> <ul style="list-style-type: none"> - Female - Male

	<ul style="list-style-type: none"> - Gender Non-Binary - Undisclosed - Other (describe) <p>Disability Status:</p> <ul style="list-style-type: none"> - Persons with disabilities - Persons without disabilities - Undisclosed <p>Race/Ethnicity/Minority Status:</p> <ul style="list-style-type: none"> - Minority/previously excluded populations - Dominant culture populations - Undisclosed <p>Other target populations</p> <ul style="list-style-type: none"> - Pregnant women - Other (describe)" <p>"Describes the setting of the groups of stakeholders targeted by the organization. Select all that apply:</p> <ul style="list-style-type: none"> - Rural - Urban - Peri-urban" <p>"Indicates the geography of stakeholders targeted by the organization, expressed by country, as of the end of the reporting period. Choose all that apply:</p>
Target Stakeholder Socioeconomics	<p>Describes the socioeconomic groups of stakeholders targeted by the organization as of the end of the reporting period. Choose all that apply:</p> <ul style="list-style-type: none"> - Very poor - Poor - Low-income - Middle-income - Other (describe)
Temporary Employees Hours Worked	<p>Number of paid hours worked by temporary employees of the organization during the reporting period.</p>
Water Conservation Strategy	<p>Indicates whether the organization implements a water conservation strategy to reduce its water usage.</p> <p>This metric is intended to provide detailed information on the water conservation strategy in place but does not provide an evaluation of the success with which the strategy is implemented.</p> <p>Water conservation refers to efforts made to reduce the amount of water</p>

	<p>needed to carry out current processes or tasks. The term does not include overall reduction in water consumption due to reduced organizational activities (e.g., partial outsourcing of production).</p> <p>Water conservation efforts include organizational or technological innovations that allow a defined process or task to consume water more efficiently. This may include improved water management practices, process redesign, the conversion and retrofitting of equipment (e.g., water-efficient equipment), or the elimination of unnecessary water use due to changes in behavior. Water reduction strategies could include seeking alternative water sources such as gray water or rainwater capture systems. Organizations should footnote which efforts are components of their strategy.</p> <p>The mismanagement of water can pose risks to an organization's elements of their operations including their brand, credibility, credit rating, insurance, and operating costs. Organizations should footnote what these risks are and how they are being addressed.</p> <p>Organizations are encouraged to report the amount of water conserved using Water Conserved (OI4015) and Water Used: Total (OI1697) and its 5 submetrics.</p>
Earnings of Distributor Individuals: Peri-urban	Earnings generated by individuals distributors residing in peri-urban areas from selling the organization's products/services, during the reporting period.
Distributor Individuals: Very Poor	Number of very poor individuals who served as distributors to sell the organization's products/services during the reporting period. "This metric is intended to capture self-employed very poor individuals who sell the organization's products or services, either to other distributors (wholesale) or to the ultimate consumer (retail). This metric is intended to be used by organizations who seek to support individuals living in poverty through their distribution chains.
Units/Volume Sold: Exported	Amount of the product/service exported by the organization during the reporting period. Organizations selling different types of products/services should consider reporting against each type of different product/service separately.
OI1084 Permanent Employee Wages: Minorities	This metric is intended to capture pre-tax wages/salaries paid to the organization's employees from minorities and should not include benefits nor include payroll expenses. These wages should exclude Temporary Employee Wages.
OI1619 - Value of Community Development Contributions	Value of payments made by the organization during the reporting period towards activities that benefit local communities.

O11571 - Full-time Employees: Female Managers	Number of paid full-time female management employees (managers) at the organization as of the end of the reporting period.
O14202 - Temporary Employee Wages	Value of wages (including bonuses, excluding benefits) paid to all temporary employees of the organization during the reporting period.
O11682 Permanent Employee Wages: Disabilities	This metric is intended to capture pre-tax wages/salaries paid to the organization's employees with disabilities and should not include benefits nor include payroll expenses. These wages should exclude Temporary Employee Wages.