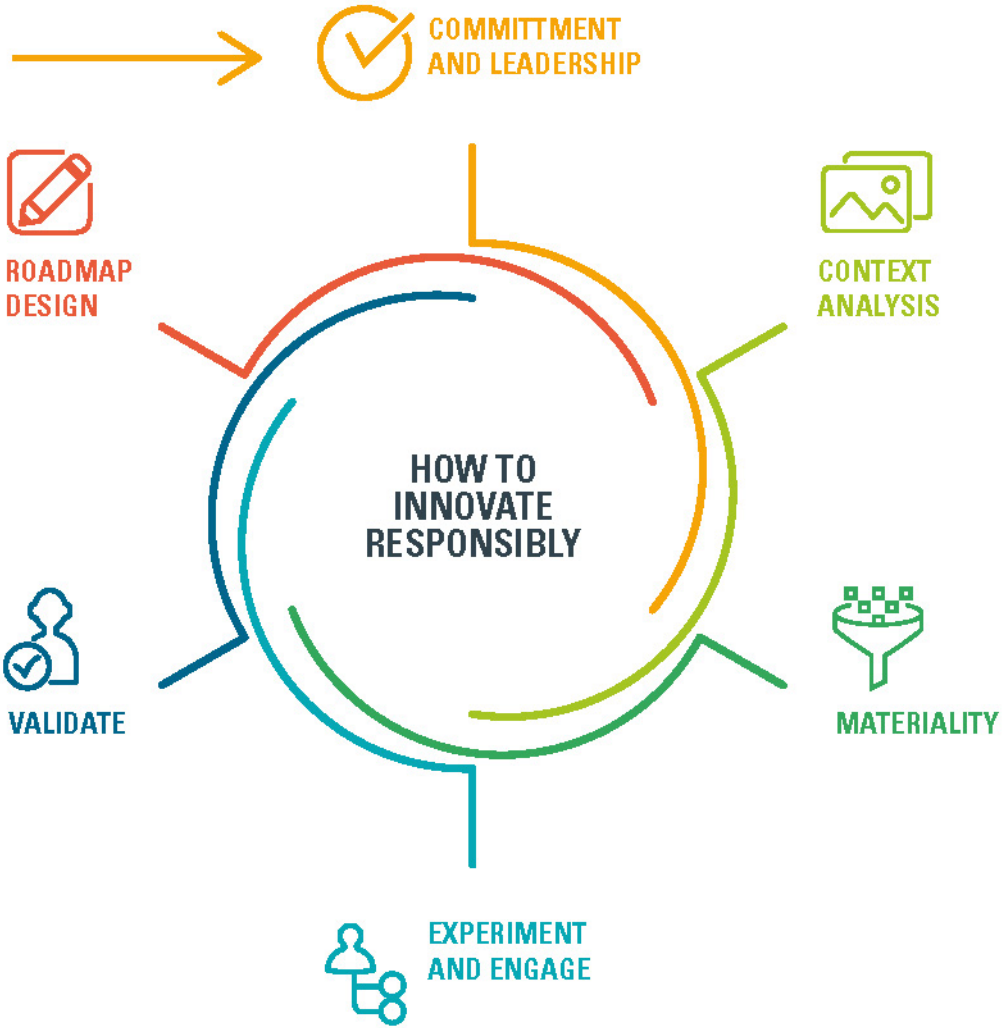

COMMITTMENT
AND LEADERSHIP
ROADMAP
DESIGN
CONTEXT
ANALYSIS
HOW TO
INNOVATE
RESPONSIBLY
VALIDATE
MATERIALITY
EXPERIMENT
AND ENGAGE

CEN

WORKSHOP

AGREEMENT

CWA 17796

September 2021

ICS 03.100.02; 03.100.40

English version

Responsibility-by-design - Guidelines to develop long-term strategies (roadmaps) to innovate responsibly

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which is indicated in the foreword of this Workshop Agreement.

The formal process followed by the Workshop in the development of this Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN-CENELEC Management Centre can be held accountable for the technical content of this CEN Workshop Agreement or possible conflicts with standards or legislation.

This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its Members.

This CEN Workshop Agreement is publicly available as a reference document from the CEN Members National Standard Bodies.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

CEN/WS 105 FOR INTERNAL USE ONLY



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2021 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Contents

Foreword **3**
Introduction **5**
1 Scope **7**
2 Normative references **7**
3 Terms and definitions **8**
4 Principles for implementing RRI **15**
5 Methodological approach **19**
6 Framework for developing an RRI roadmap **20**
6.1 General 20
6.2 Top management commitment and leadership 21
6.3 Context analysis 21
6.4 Materiality analysis 23
6.5 Experiment and engage 27
6.6 Validation 28
6.7 Roadmap design 29
Annex A (Informative) Examples of RRI actions 33
Annex B (Informative) Examples of tools 39
Annex C (Informative) Examples of applying the guidelines 41
Annex D (Informative) SWOT analysis for RRI implementation in industry 42
Annex E (Informative) Tools for materiality and stakeholder analysis 43
Annex F (Informative) Methods for stakeholder engagement 46
Annex G (Informative) Criteria for impact analysis of RRI actions 48
Annex H (Informative) Examples of RRI key performance indicators 50
Annex I (Informative) Informative resources from other initiatives 53
Bibliography **55**

CEN/WS 105 FOR INTERNAL USE ONLY

Foreword

This CEN Workshop Agreement (CWA 17796:2021) has been developed in accordance with the CEN-CENELEC Guide 29 “CEN/CENELEC Workshop Agreements – A rapid prototyping to standardization” and with the relevant provisions of CEN/CENELEC Internal Regulations - Part 2. It was approved by a Workshop of representatives of interested parties on 2021-04-21, the constitution of which was supported by CEN following the public call for participation made on 2019-06-27. However, this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

The final text of this CEN Workshop Agreement was provided to CEN for publication on 2021-08-02.

Results incorporated in this CWA received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 710059.

The following organizations and individuals developed and approved this CEN Workshop Agreement:

- Andrea Porcari, Airi - Associazione Italiana per la Ricerca Industriale – Chairman
- Ibo van de Poel, Vice chair
- Giovanni Baldi, Colorobbia Consulting
- Francesca Braca, Laboratori ARCHA Srl
- Giulia Bubbolini, CISE – Centro per l’innovazione e lo sviluppo economico
- Mario M. D’Elios, University of Florence
- Donato Di Donato, Agrate & Castelletto Site Labs & Sustainability Quality Manager
- Marc Dreyer, Futopedia Consulting
- Linden Farrer
- Luisa Fracassini Agrate & Castelletto Site Labs & Sustainability Manager
- Jonathan Hankins, Foreign Scientific Correspondent – Fondazione Giannino Bassetti
- Kostas Iatridis, School of Management University of Bath
- Pim Klaassen, Assistant professor
- Zenlin Kwee, Delft University of Technology
- Joost Groot Kormelink, Delft University of Technology
- Agata Gurzawska, TRILATERAL RESEARCH
- Panagiotis Isigonis, Ca Foscari University of Venice
- Maria Maia, Karlsruhe Institute of Technology (KIT) - Institute for Technology Assessment and Systems Analysis (ITAS)

CEN/WS 105 FOR INTERNAL USE ONLY

- Ineke Malsch, Malsch TechnoValuation
- Elvio Mantovani
- Christopher Nathan, University of Warwick
- Francesco Niglia, CEO - KOYS srls
- Daniela Pimponi, Airi - Associazione Italiana per la Ricerca Industriale
- Tom Sorell, Professor of Politics and Philosophy, University of Warwick
- Rene Von Schomberg
- Bernd Carsten Stahl, De Montfort University, Centre for Computing and Social Responsibility
- Emad Yaghmaei, Delft University of Technology
- Thamar Zijlstra, Consultant Standards Development – NEN, SHERPA project

Attention is drawn to the possibility that some elements of this document may be subject to patent rights. CEN-CENELEC policy on patent rights is described in CEN-CENELEC Guide 8 “Guidelines for Implementation of the Common IPR Policy on Patent”. CEN shall not be held responsible for identifying any or all such patent rights.

Although the Workshop parties have made every effort to ensure the reliability and accuracy of technical and non-technical descriptions, the Workshop is not able to guarantee, explicitly or implicitly, the correctness of this document. Anyone who applies this CEN Workshop Agreement shall be aware that neither the Workshop, nor CEN, can be held liable for damages or losses of any kind whatsoever. The use of this CEN Workshop Agreement does not relieve users of their responsibility for their own actions, and they apply this document at their own risk. The CEN Workshop Agreement should not be construed as legal advice authoritatively endorsed by CEN/CENELEC.

CEN/WS 105 FOR INTERNAL USE ONLY

Introduction

Responsible research and innovation (RRI) addresses the development of products and processes that are safe, ethically acceptable, and responsive to the needs and expectations of people and society.

The essential difference between RRI and existing practices regarding corporate social responsibility (CSR), responsible business conduct, risk, and quality management is RRI's focus on the research and innovation (R&I) process, from the early stages to prototyping to going to market, and the high degree of societal involvement RRI requires to assess potential (future) ethical and social impacts of innovation. The goal of RRI is to design and develop innovations that have socially desirable outcomes, thus addressing specific ethics and social concerns and providing solutions for acknowledged societal challenges (e.g., sustainable development goals). Some examples are provided in the Annex III.

The ability to translate technological developments into innovations that generate benefits and value for the organization and its shareholders and stakeholders and for society is a core aspect of RRI.

Initiatives to put RRI into practice in industry, for instance in the form of action plans, are still limited, with most being related to cooperative projects within EU framework programmes or national equivalents. Examples include Horizon 2020's SwafS (Science with and for Society) projects such as Responsible Industry, Compass, SMART-map, Liv-In, Orbit, Satori, Sherpa, Sienna, and TechEthos.

However, it's worth noting that principles and approaches related to RRI have elements in common with acknowledged business and innovation management methods and practices, such as theory of change, business model generation, stakeholder management, design thinking, and agile management.[1]

The guidelines offered here were developed by the PRISMA project,[2] which worked with eight industrial pilot projects dealing with the application of transformative technologies in different sectors. The pilots were used to integrate RRI principles in the participating companies' strategies and actions in order to improve the societal value and overall performances of their R&D (research and development) outcomes and to develop specific "pilot RRI roadmaps".

For an effective RRI uptake, it is essential for companies to identify strategies and practices that fit within the realities and constraints in which they operate. The roadmap described in these guidelines aims to help them do just that. The overall goal is to help strengthen aspects of responsibility all along the research, development, and design process for innovations and thus to support a "responsibility-by-design" approach.

Besides helping to identify a vision, a set of actions, and a timeline (roadmap) for implementing RRI approaches, this guideline also analyses the potential barriers, opportunities, and benefits in pursuing RRI.

Within this guidance, we understand research and innovation as intertwined: research (besides its role of creating knowledge) has an applied character and is oriented towards innovation, with the final goal of generating both economic and societal value.

At the industry level, technology roadmapping is already a quite widely utilized method in strategy planning. A technology roadmap visualizes an organization's strategic aims (vision/development plans) and can be utilized to structure its research, development, and business activities. In recent years, the concept of IPRM (innovation policy roadmapping methodology) has been developed to connect the development of technologies and innovations to a wider societal sphere.[3] A main aspect of IPRM is identifying those societal needs that create a potential demand for new solutions and possibly favour the emergence of new products and markets.

CEN/WS 105 FOR INTERNAL USE ONLY

[1] A description of the relevance of these methods for RRI is provided in Dreyer et al., 2017.
[2] The PRISMA project received funding from the EU's Horizon 2020 research and innovation programme (grant agreement No. 710059). More information is available on the PRISMA website: www.rri-prisma.eu/
[3] Ahlqvist, T., Valovirta, V., & Loikkanen, T. (2012). Innovation policy roadmapping as a systemic instrument for forward-looking policy design. *Science and Public Policy*, *39*(2), 178–190

IPRM integrates a foresight exercise into enabling technologies, applications, products, and markets with analysis of socio-economical and sectorial drivers and policy and regulatory tools and strategies.

The RRI roadmap proposed in this guideline adapts a generic IPRM architecture to the definition of long-term visions and action plans for RRI uptake within the innovation strategies of organizations and others agents (e.g., cooperative projects) active in research and innovation. It provides the methodological and technical conditions to address RRI principles in the context of rapid (and possibly disruptive) scientific and technological developments to ensure such developments are relevant to society.

CEN/WS 105 FOR INTERNAL USE ONLY

1 Scope

This document provides guidelines to develop long-term strategies (roadmaps) for innovating responsibly, thereby helping organizations to achieve socially desirable outcomes from their innovation processes.

These roadmaps encourage a “responsibility-by-design” approach that integrates considerations of technical, ethical, social, environmental, and economic aspects all along the research, development, and design process leading to an innovation.

The document aims at all organizations and agents involved in planning and performing research and innovation and technological development.

The focus is on innovation enabled by transformative technologies.

This document has been designed to be consistent with, and to support, as much as possible, existing management system standards and management/governance standards (e.g. EN ISO 9001). Particular attention has been given to social responsibility (i.e. EN ISO 26000).

2 Normative references[4]

The existing management standards and normative references used in this document are listed below. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 26000, Guidance on social responsibility

ISO 31000, Risk management – Guidelines

ISO 45001, Occupational health and safety management systems – Requirements with guidance for use

EN ISO 14001, Environmental management

EN ISO 9001, Quality management systems – Requirements

Series CEN/TS 16555, Innovation management

Series CWA 17145, Ethics assessment for research and innovation

IWA 26 Using ISO 26000:2010, in management systems

UNI/PdR 27, Guidelines for management and processes development for responsible innovation

UNI/PdR 18, Social responsibility in organizations – Guidance to the application of UNI ISO 26000

CEN/WS 105 FOR INTERNAL USE ONLY

[4] These standards and guidelines (in their scope and contents) refer to and can be used to contribute to the UN’s Sustainable Development Goals. This document also takes into account the Rome Declaration on Responsible Research and Innovation in Europe (European Union, 2014). In addition, it recognizes the need to consider efforts towards responsibility in research and innovation within the broader framework of corporate sustainability, responsible business, and sustainable finance practices (UN Global Compact: unglobalcompact.org), though these aspects are not explicitly addressed within the scope of this guidance.

EN ISO 56000, Innovation management – Fundamentals and vocabulary

EN ISO 56002, Innovation management – Innovation management system – Guidance

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at https://www.electropedia.org/

3.1
context of the organization
combination of internal and external issues that can have an effect on an organization's approach to developing and achieving its objectives.

Note 1 to entry: The organization's objectives can be related to its *products* and *services*, investments and behaviour towards its *interested parties*.

Note 2 to entry: The concept of context of the organization is equally applicable to not-for-profit or public service organizations as it is to those seeking profits.

Note 3 to entry: In English, this concept is often referred to by other terms such as "business environment", "organizational environment", or "ecosystem of an organization".

Note 4 to entry: Understanding the *infrastructure* can help to define the context of the organization.

[SOURCE: ISO 9000:2015 Quality management systems -- Fundamentals and vocabulary]

3.2
corporate social responsibility (CSR)
a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis", as well as "the responsibility of enterprises for their impacts on society.

[SOURCE: European Commission, 2011].

3.3
documented information
information required to be controlled and maintained by an organization and the medium on which it is contained.

Note 1 to entry: Documented information can be in any format and media, and from any source.

Note 2 to entry: Documented information can refer to:

- the management system, including related processes;
- information created in order for the organization to operate (documentation);
- evidence of results achieved (records).

CEN/WS 105 FOR INTERNAL USE ONLY

3.4
engagement
involvement in, and contribution to, activities to achieve shared objectives.

[SOURCE: ISO 9000:2015 Quality management systems -- Fundamentals and vocabulary]

3.5
ethics
systematic reflection on right and wrong conduct according to norms and values that we believe should be followed. Ethics refers to duties, responsibilities, rights, welfare, justice and the avoidance of harms. Typical moral values include autonomy, freedom, dignity, privacy, justice, well-being and responsibility.

[SOURCE: Series CWA 17145]

3.6
framework
an outline, or skeleton, of interlinked items and actions that supports a particular approach to a specific objective and serves as a guide that can be modified as required by adding or deleting items.

3.7
human-centred design (HCD)
characterized by:

- The design is based upon an explicit understanding of users, tasks and environment;
- Users are involved throughout design and development;
- The design is driven and refined by user-centred evaluation;
- The process is iterative;
- The design addresses the whole user experience;
- The design team includes multidisciplinary skills and perspectives.

[SOURCE: ISO 9241-210:2010]

3.8
impact assessment
assessment of research and innovation for its projected or actual societal impacts.

[SOURCE: Series CWA 17145]

3.9
involvement
taking part in an activity, event or situation.

[SOURCE: ISO 9000:2015 Quality management systems -- Fundamentals and vocabulary]

3.10
innovation
new or changed *entity*, realizing or redistributing *value.*

Note 1 to entry: Novelty and value are relative to, and determined by the perception of, the *organization* and *interested parties*.

Note 2 to entry: An innovation can be a *product*, *service, process*, model, method etc.

CEN/WS 105 FOR INTERNAL USE ONLY

Note 3 to entry: Innovation is an outcome. The word “innovation” sometimes refers to activities or processes resulting in, or aiming for, innovation. When “innovation” is used in this sense, it should always be used with some form of qualifier, e.g., “innovation activities”.

Note 4 to entry: For the purpose of statistical measurement, refer to the Oslo Manual (OECD/Eurostat, 2018): New or changed entity’ corresponds to ‘a new or improved product or process, or combination thereof, that differs significantly from the unit’s previous products or processes’. Realising or redistributing value’ corresponds to ‘and that has been made available to potential users or brought into use by the unit’.

[SOURCE: EN ISO 56000]

3.11
innovation ecosystem
system of organizations, people and resources, complementing each other and contributing to a common objective with regards to innovation.

Note 1 to entry: An innovation ecosystem can include private companies, public authorities, universities, institutes, individual entrepreneurs, investors, researchers as well as funding and infrastructures.

Note 2 to entry: An innovation ecosystem generally includes intangible and qualitative interactions and relationships necessary for its effectiveness.

[SOURCE: EN ISO 56000]

3.12
management system
set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives.

Note 1 to entry: A management system can address a single discipline or several disciplines.

Note 2 to entry: The system elements include the organization’s structure, roles and responsibilities, planning, and operation.

Note 3 to entry: The scope of a management system may include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations.

[SOURCE: ISO/TMB/JTCG Joint technical Coordination Group]

CEN/WS 105 FOR INTERNAL USE ONLY

3.13
management standard
management standard designed to be widely applicable across economic sectors, various types and sizes of organizations and diverse geographical, cultural and social conditions.

[SOURCE: ISO/IEC Directives, Part 1, Consolidated ISO Supplement, 2018]

3.14
management system standard (MSS)
MSS designed to be widely applicable across economic sectors, various types and sizes of organizations and diverse geographical, cultural and social conditions.

[SOURCE: ISO/IEC Directives, Part 1, Consolidated ISO Supplement, 2018]

3.15
materiality
identification and understanding of priorities within the context of social responsibility in which an organization operates. These priorities reflect the economic, social, and environmental factors that need to be considered.

[SOURCE: UNI/PdR 18 Social responsibility in organizations – Guidance to the application of UNI EN ISO 26000]

3.16
monitoring
determining the status of a system, a process or an activity.

Note 1 to entry: To determine the status, there may be a need to check, supervise or critically observe.

[SOURCE: ISO/TMB/JTCG Joint technical Coordination Group]

3.17
organization
person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives.

Note 1 to entry: The concept of organization includes, but is not limited to sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private.

[SOURCE: ISO/TMB/JTCG Joint technical Coordination Group]

3.18
participatory design
a “practice of collective creativity” that emphasizes active involvement by the users and all the stakeholders in design and development of new systems.

[SOURCE: Niemelä et al., 2014].

3.19
process
set of interrelated or interacting activities which transforms inputs into outputs.

[SOURCE: ISO/TMB/JTCG Joint technical Coordination Group]

3.20
performance
measurable result.

Note 1 to entry: Performance can relate either to quantitative or qualitative findings.

Note 2 to entry: Performance can relate to the management of activities, processes, products (including services), systems or organizations.

[SOURCE: ISO/TMB/JTCG Joint technical Coordination Group]

CEN/WS 105 FOR INTERNAL USE ONLY

3.21
quadruple helix stakeholder
key local actors from public institutions, private organizations, academia and the public.

[SOURCE: Carayannis et al., 2009]

3.22
quality management
management with regard to quality.

Note 1 to entry: Quality management can include establishing quality policies and quality objectives, and processes to achieve these quality objectives through quality planning, quality assurance, quality control, and quality improvement.

[SOURCE: ISO 9000:2015 Quality management systems — Fundamentals and vocabulary]

3.23
responsible research and innovation (RRI)
transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).

[SOURCE: Von Schomberg, 2012]

3.24
responsible research and innovation (RRI) maturity level
how RRI is perceived and valued within an organization. Empirical research has identified five different stages: unaware (the organization is not aware of RRI or its components); exploratory/reactive (the organization reacts to external pressures concerning aspects of RRI); defined (the organization has definitions for RRI components and has integrated these components into its practices); proactive (the organization realizes the benefits of RRI and increasingly integrates RRI into its business); strategic (the organization has adopted RRI as a component of its strategic framework and aims to ensure that all R&D activities consider most of the RRI components).

[SOURCE: Stahl et al., 2017]

3.25
roadmap
strategic plan that defines a goal or desired outcomes and includes the major steps or milestones needed to reach them.

3.26
roadmapping exercise
collaborative learning process and a tool for drawing up strategies, reaching consensus on requirements and needs, and driving proactive planning and future studies.

CEN/WS 105 FOR INTERNAL USE ONLY

3.27
risk
effect of uncertainty on objectives.

Note 1 to entry: An effect is a deviation from the expected. It can be positive, negative or both, and can address, create or result in opportunities and threats.

Note 2 to entry: Objectives can have different aspects and categories, and can be applied at different levels.

Note 3 to entry: Risk is usually expressed in terms of risk sources, potential events, their consequences and their likelihood.

[SOURCE: ISO 31000:2018 Risk management — Guidelines]

3.28
risk assessment
overall process of risk identification, risk analysis and risk evaluation.

3.29
risk identification
process of finding, recognizing and describing risks.

3.30
risk analysis
process to comprehend the nature of risk and to determine the level of risk.

3.31
risk evaluation
process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable.

[SOURCE: ISO Guide 73:2009 Risk management – Vocabulary]

3.32
RRI product
research and innovation output (e.g., product, service, process, model, method) selected by the organization as the focus of the RRI roadmap design.

3.33
social responsibility
responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical behaviour that:

- contributes to sustainable development, including health and the welfare of society;
- takes into account the expectations of stakeholders;
- is in compliance with applicable law and consistent with international norms of behaviour; and
- is integrated throughout the organization and practiced in its relationships.

Note 1 to entry: Activities include products, services and processes.

Note 2 to entry: Relationships refer to an organization's activities within its sphere of influence.

[SOURCE: EN ISO 26000:2020]

CEN/WS 105 FOR INTERNAL USE ONLY

3.34
stakeholder
individual or group that has an interest in any decision or activity of an organization.

[SOURCE: EN ISO 26000:2020 Guidance on social responsibility].

3.35
strategy
plan to achieve a long-term or overall objective.

[SOURCE: EN ISO 9000:2015 Quality management systems – Fundamentals and vocabulary]

3.36
sustained success
organization success over a period of time.

Note 1 to entry: Sustained success emphasizes the need for a balance between economic-financial interests of an organization and those of the social and ecological environment.

Note 2 to entry: Sustained success relates to the interested parties of an organization, such as customers, owners, people in an organization, providers, bankers, unions, partners, or society.

[SOURCE: EN ISO 9000:2015 Quality management systems – Fundamentals and vocabulary]

3.37
technology assessment (TA)
scientific, interactive and communicative process which aims to contribute to the formation of public and political opinion on societal aspects of science and technology.

[SOURCE: Decker/Ladikas, 2014, 14]

3.38
Technology Readiness Level
Technology Readiness Levels (TRLs) are indicators of the maturity level of particular technologies. This measurement system provides a common understanding of technology status and addresses the entire innovation chain. There are nine technology readiness levels; TRL 1 being the lowest and TRL 9 the highest.

[SOURCE: European Commission, Horizon 2020 Framework Programme]

3.39
transformative/enabling technologies
knowledge-intensive technologies associated with high R&D intensity, rapid innovation cycles, high capital expenditure, and high-skilled employment. They enable innovation in processes, goods, and services throughout the economy. They are systemically relevant and multidisciplinary, cutting across many technology areas, with a trend towards convergence and integration. These technologies have the capacity to improve people's health, safety, and security and they support sustainable development and secure connectivity and communication among systems and individuals.

[SOURCE: European Commission, High-Level Strategy Group on Industrial Technologies, 2009 and 2018]

CEN/WS 105 FOR INTERNAL USE ONLY

3.40
top management
person or group of people who directs and controls an organization at the highest level.

Note 1 to entry: top management has the power to delegate authority and provide resources within the organization.

Note 2 to entry: If the scope of the management system covers only part of an organization then top management refers to those who direct and control that part of the organization.

[SOURCE: ISO 9000:2015]

3.41
usability
extent to which specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [ISO/IEC 1998] can use a product.

3.42
user-centred design (UCD)
approach to interactive system development that focuses specifically on making systems or applications easy to use.

[SOURCE: ISO/IEC 13407:1999].

3.43
user committees
method that involves users and other stakeholders in the formal monitoring and steering of the research and innovation process. Typically, there is a kick-off, a mid-term, and a final workshop.

[SOURCE: Engage2020 Project, 2014].

CEN/WS 105 FOR INTERNAL USE ONLY

4 Principles for implementing RRI

Definitions and principles for RRI vary throughout the literature. The definition selected for this guideline – a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability, and societal desirability of the innovation process and its marketable products[5] – focuses on the social value in product development. This definition was developed considering the EU normative framework, with explicit reference to the Charter of Fundamental Rights of the European Union.[6]

From this definition, a set of principles has been developed in the literature[7] to support the implementation of RRI in different kinds of decisional and operative structures and practices. In this guideline, these "management" principles are connected to specific action lines for RRI implementation along the R&I value chain (Table 1).

[5] Von Schomberg, R. (2012). Prospects for technology assessment in a framework of responsible research and innovation. In D. Marc. & B. Richard (Eds.), *Technikfolgen abschätzen lehren* (pp. 1–19). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-531-93468-6_2.
[6] See https://www.europarl.europa.eu/charter/pdf/text_en.pdf
[7] 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. https://doi.org/10.3390/su9050721.

Table 1 — Set of principles and actions for RRI implementation

Principles for RRI implementation	Action lines
Reflection & Anticipation	Integrate analysis of ethical, legal, and social impacts (ELSI) from the earliest stages of product conception and product development
Inclusion	Promote stakeholder engagement and involve stakeholders from the quadruple helix to inform all phases of product development and ensure that research and innovation activities are societally relevant and desirable
Responsiveness	Integrate monitoring, learning, and adaptive mechanisms to address public and social values and normative principles in product development

CEN/WS 105 FOR INTERNAL USE ONLY

These principles are further described in the following[8]:

- **Reflection:** scrutinize each activity, commitment, and assumption to connect them with a moral value system and the good practices of science, taking into account the limits of knowledge and that a particular framing of an issue may not be universally held. Reflexivity in the RRI context does not refer to the moral responsibility of the single researcher or developer, nor is it a self-critique of the single professional. Instead, it is intended as an institutional practice. It should therefore be intended as a public matter, and all parts of the quadruple helix should play a role in the reflexivity actions. Reflexivity is also important in other phases of the product value chain or other functions (besides R&D) inside the organization that could be affected by an R&I action or result.

- **Anticipation:** systematically extrapolate all plausible scenarios for the application of R&I results with quadruple helix stakeholders; identify in these scenarios the possible risks, opportunities, uncertainties, and critical issues and consider possible ways to prevent, manage, or exploit them. Anticipation is intended to not only prevent undesirable events but also shape desirable futures and organize activities and resources towards those futures. When describing desirable futures, anticipation should be realistic and avoid overestimating the benefits of the innovation.

- **Inclusion:** introduce participatory approaches in R&I processes from the very earliest stages in order to engage people interested in the innovation process or its results. Inclusion refers to the engagement of both internal and external stakeholders. It considers all potentially impacted groups or users, taking into account gender and other social attributes and making particular efforts to involve marginalized or hard-to-reach groups that may be most impacted or excluded by innovations. Inclusion is connected to the other RRI principles because reflexivity, anticipation, and responsiveness will likely be improved by a broad participation of different stakeholders.

- **Responsiveness:** change the direction of the innovation process in response to stakeholder and public indications, needs, and values or in reaction to changing circumstances. Innovation actions may also need to be adjusted due to insufficient knowledge and control or in response to new knowledge,

[8] Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, *42*(9), 1568–1580. https://doi.org/10.1016/j.respol.2013.05.008.

perspectives, or regulatory requirements.[9] The entire R&I process should be shaped to be as responsive as possible.

The goal of RRI is to support mutual responsiveness among the different actors in the research and innovation process in order to jointly shape and direct the innovation towards the generation of value and impact. Mutual responsiveness is expected to contribute to learning and to the building of relationships, trust, and trustworthiness.[10] However, given this guideline's focus on the management practices of an individual organization, practical implementation of this approach should be done only to the extent possible within the actions and responsibilities of the organization.

Other important aspects to consider include research integrity[11] and transparency (especially in connection to the open access of research results). The precautionary principle, the "do no significant harm" principle,[12] and general corporate social responsibility principles, such as business and human rights[13] should also be considered.

It is important to note that from an institutional and policy perspective, the principles of RRI can be referred to as a series of dimensions, including those of multi-actor and public engagement, gender equality, science education, ethics, open science, and governance.[14]

Box 1 includes a collection of the scopes, principles, and values of some ISO management systems, providing a useful reference for the implementation of the RRI approach described above.

CEN/WS 105 FOR INTERNAL USE ONLY

[9] Note that inclusion and responsiveness have similarities with business concepts such as design-thinking and agile management.
[10] An analysis of sources of trust and distrust in relation to technology governance is provided by the project TigTech (www.tigtech.org). The trust drivers identified are intent, public interest, competence, respect, integrity, inclusion, openness, and fairness.
[11] See the European Code of Conduct for Research Integrity, ALLEA, 2017
[12] R&I activities should not include supporting or carrying out activities that significantly harm any of the six environmental objectives set in the EU Taxonomy Regulation. See Regulation (EU) 2020/852 (Taxonomy) on the establishment of a framework to facilitate sustainable investment.
[13] See the UN Guiding Principles on Business and Human Rights.
[14] Responsible research and innovation: Europe's ability to respond to societal challenges, EC DG Research, 2014.

Box 1: Scopes, principles, and values of ISO standards on social responsibility, risk management, quality, and innovation management

EN ISO 26000 (Social Responsibility)	ISO 31000 (Risk Management)	ISO 9001 (Quality Management)	ISO 56000 (Innovation Management)
Guidance to integrate, implement, and promote socially responsible behaviour throughout the organization and, through its policies and practices, within its sphere of influence	Guidance on a common approach to managing any type of risk throughout the life of the organization	Requirements to demonstrate organization's ability to consistently provide products and services that meet customer needs (conformity) and applicable statutory and regulatory requirements	Describes the fundamental concepts, principles, and vocabulary of innovation management
➢ Accountability ➢ Transparency ➢ Ethical behaviour ➢ Respect for stakeholder interests ➢ Respect of the rule of law ➢ Respect for international norms of behaviour ➢ Respect for human rights	A risk management framework: ➢ Integrated in all organizational activities ➢ Structured and comprehensive ➢ Customized to the organization's external and internal context ➢ Inclusive, considering knowledge, views, and perceptions of stakeholders ➢ Dynamic and adaptable ➢ Based on best available information ➢ Considering human and cultural factors ➢ Based on continual improvement through learning and experience	➢ Customer focus ➢ Ensure leadership in the management system ➢ Engagement of people ➢ Process approach, to operate as an integrated and complete system ➢ Continuous improvement to meet customer requirements and enhance customer satisfaction ➢ Evidence-based decision-making ➢ Relationship management	➢ Realization of value as the ultimate objective for organizations engaging in innovation activities ➢ Future-focused leader, driven by curiosity and courage, challenges the status quo ➢ Strategic direction for innovation ➢ Culture of creativity, quality, and innovation ➢ Exploiting insights: using a diverse range of internal and external sources ➢ Managing uncertainty ➢ Adaptability ➢ System approach

CEN/WS 105 FOR INTERNAL USE ONLY

5 Methodological approach

The methodological approach to the process leading to RRI implementation in industrial practices is schematically represented in Figure 1 and explained in detail in Clause 6. The final goal is the defining of an RRI roadmap that sets a strategy and indicates a vision and specific actions for RRI implementation in product development. The structure and visualization of the roadmap is provided in Figure 2 (Clause 6.7). The roadmap design includes definitions of the following elements:

- The R&I product(s) the RRI roadmap should focus on
- The vision for RRI implementation in the product's development
- The timescale for implementing the RRI roadmap
- The drivers and challenges, risks and barriers to achieving the vision, according to an assessment of the present status
- The RRI actions to pursue as possible path(s) between present and future to reach the vision
- The human and financial resources needed, their feasibility and consistency with the overall organizational strategy and the innovation ecosystem

The list of the methodological steps for roadmap design is reported in Table 2, including the different phases of the roadmap structure development leading to the roadmap design.

The process proposed in this guideline is circular: top management's commitment prompts and facilitates the roadmap design process and is also informed by it.

This approach was tested in practice through eight industrial research pilot projects related to transformative technologies (see the Annex III), specifically, nanotechnologies, biotechnologies, the Internet of Things, and autonomous vehicles. This exercise helped to refine and deepen the different issues, steps, and actions. The outcomes have been translated into the framework described below.

CEN/WS 105 FOR INTERNAL USE ONLY



Figure 1 — Overall approach and steps leading to the defining of an RRI roadmap

Table 2 — List of methodological steps for RRI roadmap design

	Step (Clause)	Goal
	**6.2: Top management commitment and leadership**	Ensure endorsement of the organization moving towards RRI values and approach
	**6.3: Context analysis**	Analyse the organization and the R&I product(s) and technologies to focus on; Identify ethical, social, and legal impacts of the product and stakeholders of the product innovation ecosystem
	**6.4: Materiality**	Identify and prioritize drivers and challenges for RRI, risks and barriers to overcome, stakeholders to work with, significant RRI actions to pursue
	**6.5: Experiment and engage**	Perform exploratory/pilot RRI actions, engaging with stakeholders to inform the RRI roadmap
	**6.6: Validate**	Evaluate roadmap's impact on both the product development and the organization (key performance indicators)
	**6.7: Roadmap design**	Consolidate and visualize the long-term RRI strategy, covering the entire R&I value chain (time to market) and product life cycle

CEN/WS 105 FOR INTERNAL USE ONLY

6 Framework for developing an RRI roadmap

6.1 General

In developing the framework described in Clauses 6.2 to 6.7, the high-level structure (HLS) – that is, the identical core text, common terms, and core definitions for all ISO management system standards, as well as other relevant management standards – has been considered.

NOTE — For items concerning ISO management system standards, ISO 9001 series and ISO/FDIS 56000 series were used. For items concerning management standards, EN ISO 26000 and ISO 31000 were used.

It is envisaged that the implementing organization would engage a third-party organization to advise and oversee the implementation of these guidelines. The third-party organization should have specific expertise in RRI-related issues (e.g., ethical, social, legal impacts analysis).

The final RRI roadmap can either be distinct or integrated into the organization's existing quality, responsibility, sustainability, and innovation strategies.

6.2 Top management commitment and leadership

A prerequisite for RRI implementation is top-level management commitment. This commitment is necessary but not sufficient to achieve RRI's intended outcomes, as the top-down approach should be integrated with a bottom-up approach, involving other roles providing leadership.

Top management shall demonstrate leadership and commitment on RRI by:

- Ensuring that an RRI roadmap, related actions, objectives, and vision are established and are compatible with the organization's values, identity, and stakeholders
- Identifying and sustaining motivation for engaging with RRI
- Integrating RRI principles into the organization's management and governance systems to ensure the RRI achieves its intended outcome(s); signalling internally and externally the organization's willingness to consider societal inputs in the development of products/outcomes
- Ensuring that the resources needed for both the roadmap design and its future implementation are available (including in the long term)
- Communicating the importance of effective RRI; supporting the application of the guidance provided in this document
- Supporting other relevant roles for RRI implementation (e.g., supporting RRI promoters)
- Considering implementation of the RRI roadmap either on an operational/project basis (for a specific RRI product) or on a strategic/institutional basis; the latter approach might include integration into the organization's existing quality, responsibility, sustainability, and innovation strategies

This process will lead to the initial vision for the RRI roadmap and to a selection of possible R&I projects or products to focus on in the design of the RRI roadmap (i.e. the "RRI products").

6.3 Context analysis

RRI is connected to a broad spectrum of factors related to the type of company and its management policies, the technology and products it works on, the sectors and markets it operates in, and the pertinent regulatory frameworks and stakeholders involved. For an effective and efficient RRI uptake, an organization must identify strategies and practices that fit within the realities and constraints in which it operates.

The following elements should be identified, at least in draft form:

- **The ethical, legal, and societal impacts and the technical, strategic, organizational, and economic impacts of the RRI product**. This analysis will influence the selection of all roadmap elements and the setting of the vision. It will also feed into Clause 6.4 (materiality)
- **The specific technologies and products**, and related R&I projects, the RRI roadmap design will be focused on (RRI product)
- **The development stages of the RRI product** (e.g., technology readiness level), from the start of analysis to the expected time to market
- **The stakeholders interested/involved in the development of the RRI product** throughout the innovation ecosystem, including an initial understanding of their needs and perspectives (based on a desk analysis)

NOTE — If the RRI roadmap is meant to cover the entire life cycle of the product, the roadmap's time frame should include the product end of life.

Internal and external issues regarding the organization and the specific RRI product help shape the analysis. For **internal issues**, it is essential to consider the organization's identity as well as the following items:

- **Mission:** the organization's purpose for existing

CEN/WS 105 FOR INTERNAL USE ONLY

- **Vision:** aspiration of what the organization would like to become
- **Values:** principles and thinking patterns that support the mission and vision by helping to shape the culture of the organization and to determine what is important to it
- **Culture:** beliefs, history, ethics, and observed behaviour and attitudes that are interrelated with the identity of the organization
- M**anagement models** used in research and innovation
- Formal and informal **policies and procedures** implemented by the organization for social responsibility and for quality and risk management
- Impact of R&I on the organization's **core business**
- Level of awareness about RRI (**RRI maturity level**)
- **Characteristics of the RRI product**: type of technology and innovation, expected applications, technology readiness level (TRL), societal readiness level (SRL), time to market, expected R&I steps to develop the final RRI product

NOTE — Some of these items were derived from EN ISO 9004:2018 [p. 6].

The specific type of technology can be classified as: front runner, directly product oriented, incremental innovation, or radical innovation.

For a proper understanding of the **external issues**, at least the following aspects should be considered:

- **Market segments and structure** in terms of opportunities and barriers to exploitation and deployment of the RRI product within the innovation ecosystem and in the market
- **Normative and regulatory regimes** affecting the RRI product
- **Public and stakeholder awareness and views** about the developed technology and product
- What information can or cannot be disclosed to stakeholders (**intellectual property rights and trade secrets**)
- Which **stakeholders** (and procedures) are usually considered within the innovation ecosystem

Once the internal and external issues have been identified, they can be analysed using tools such as SWOT (analysis of strengths, weaknesses, opportunities, and threats) and PESTLE (analysis of political, economic, socio-cultural, technological, legal, and environmental factors).

The organization should then use the identification and analysis of internal and external issues to map the relevant stakeholders and understand their needs and expectations, considering those parties that are relevant for RRI implementation, particularly those linked to the organization's innovation ecosystem. Particular attention should be given to potential sources of opposition to – or wariness about – any products or outcomes. Considering the needs and expectations of interested parties can help the organization:

- To achieve objectives effectively and efficiently
- To eliminate conflicting responsibilities and relationships
- To harmonize and optimize practices
- To create consistency
- To improve communication
- To facilitate training, learning, and personal development
- To manage risks and opportunities for its brand or reputation
- To acquire and share knowledge

Box 2 presents an example of relevant aspects to consider when performing the context analysis.

CEN/WS 105 FOR INTERNAL USE ONLY

Box 2: Model of a questionnaire to compile information for the context analysis

Facts and figures:
- Field of activity
- Company ownership
- Organization size
- Date established
- Trade organization membership

Type of organization:
- Organizational structure
- Business model
- Organizational culture
- Gender balance and gender/diversity policy (focus on R&I)

R&D and innovation function:
- Size
- Relevance for the organization
- Type of research activity
- Diversity of personnel (e.g., age, education, gender, home country)
- R&I role compared to the organization's CSR strategy
- Innovation management model

Experience with CSR and RRI:
- CSR, sustainability, risk, and quality strategies
- Responsibilities within the organization
- Experience with stakeholder engagement

Case description:
- Project description
- Technologies
- Regulatory regimes
- Type of R&I activities
- Type of business
- Time to market

CEN/WS 105 FOR INTERNAL USE ONLY

6.4 Materiality analysis

A key aspect of RRI is anticipation. Identifying material aspects of the RRI product and organization early in the R&I value chain is essential for anticipating impacts and thus having the time to change and adapt the process. This is where RRI creates value. The materiality analysis aims to[15]:

- Understand what content is **relevant** for RRI considering the context the organization operates in
- Assess how significant the relevant content is (up to what point and for whom)

[15] The materiality concept is applied in diverse contexts, including accounting, financial, legal, and risks, as well as environmental, social, and governance (ESG) and sustainability domains. For example, materiality and materiality assessment are now considered in the "Communication from the Commission: Guidelines on non-financial reporting (2017/C 215/01)", in relation to the Directive 2014/95/EU. Here we refer to the definition provided in UNI/PdR 18 Social responsibility in organizations - Guidance to the application of UNI ISO 26000.

The goals of this phase are the following:

- Identifying **relevant ethical, social, and legal impacts** of the RRI product and describing them in terms of **drivers** (creation of value, positive impacts) and **challenges** (in achieving the impacts)
- **Identifying the risks and barriers** (uncertainties) that must be addressed. Scientific, technical, strategic, organizational, economic, ethical, and social aspects should be considered
- **Selecting stakeholders** from across the quadruple helix to engage with **within the innovation ecosystem** of the RRI product
- **Selecting significant RRI actions** that can contribute to achieving impacts and addressing risks and barriers

In this phase, the roadmap vision set in Clause 6.1 is refined to address the identified drivers and challenges. A first draft of the roadmap is prepared on the basis of these elements. Examples of specific RRI actions are reported in the Annex I.

NOTE — In elaborating the roadmap, the materiality analysis should be linked to the technology readiness level of the product and to the time to market (first line of the roadmap). When specific issues will arise along the product development phase must be defined, including what actions will be taken and when.

The ultimate goal of this phase is to identify what impacts and what RRI actions are relevant to the organization's decisions and activities and to develop a set of criteria for deciding which of them are most significant. This means determining how issues should be prioritized: for example, by the impact on stakeholders, society, biodiversity, the climate, or sustainable development; by the consequences arising from non-management of an issue and stakeholders' perceptions and expectations of it; or by the overall impact on the product development and the organization.

Particular attention should be given to the "agents" of the innovation ecosystem, those whose actions and decisions can affect the organization and on whom the organization's activities may have an impact (positive or negative).

Additionally, the determination of materiality should be based on:

- A strong link to organizational governance and to the determinants of the value chain and of the creation of economic value (value drivers)
- A set of clear and transparent criteria that support the organization in deciding what is "material"
- An integration with the governance itself

Understanding an organization's context and sphere of influence is critical in this exercise, as it implies the ability to reflect broadly on the impact the organization's actions and decisions will have, or might have, within the organization itself and on the stakeholders and RRI (and vice versa).

Identifying the material issues to address is not a simple exercise (see EN ISO 26000 for examples from the social responsibility field). While the methods for analysing economic and financial materiality capture impacts on performance or risks in the short term, analysis of RRI materiality must consider not only short-term impacts but also medium-term and long-term ones, including both tangible and intangible aspects. Analysis of R&I processes may also require specific ethics considerations compared to analyses of sustainability and responsibility in industrial and business processes. A list of general and field-specific ethical principles for different research fields can be found in CWA 17145 – Ethics Assessment for Research and Innovation - Part 1. In addition, an example of ethics principles for a specific technology (artificial intelligence) is provided in the Annex.

CEN/WS 105 FOR INTERNAL USE ONLY

It is important to always consider and appropriately integrate stakeholders' views into the organization's internal reflections. A stakeholder analysis involves identifying the appropriate groups, organizations, and people, their perspectives, and their relevance and influence with respect to the organization and the specific issue. Stakeholders can then be mapped using one of the many tools available for this purpose, such as the materiality matrix and the interest/influence grid (see the Annex V). An example of a stakeholder analysis is presented in Box 3.

The materiality analysis developed in this phase is complemented by other phases. The experiment and engage phase (Clause 6.5), for example, requires the organization to perform inclusion actions (e.g., stakeholder engagement), a fundamental element in determining the significance of issues and impacts. Inclusion actions help to broaden perspectives on issues and impacts and to capture inputs on prospects and emerging needs that may not seem particularly critical at the moment but could become so in the future. The validation phase (Clause 6.6) helps the organization identify a set of criteria to evaluate the impact of RRI actions on both the product development and the organization, the final step in the materiality analysis. An example of questions to consider in a materiality analysis are those regarding safety and privacy issues related to the operation of autonomous vehicle devices. What are the safety concerns (both actual and perceived by stakeholders) related to how the device works in different conditions? How should any data collected by the device be handled? Is the collection of particular data critical from social, ethical, and legal points of view? What are the possible ethical issues regarding autonomous decisions the device might have to take during its operation? All these aspects are relevant, but depending on the specific device (e.g., autonomous cars or drones), the technology (e.g., the type of data collected, the way these are managed by the device, etc.), the use scenarios (e.g., use of the device in buildings, cities, farms, etc.) and the stakeholders concerned, the definition of significant issues for the specific products (materiality) could completely change.

CEN/WS 105 FOR INTERNAL USE ONLY

Box 3: Example of an exercise for stakeholder analysis in the innovation ecosystem

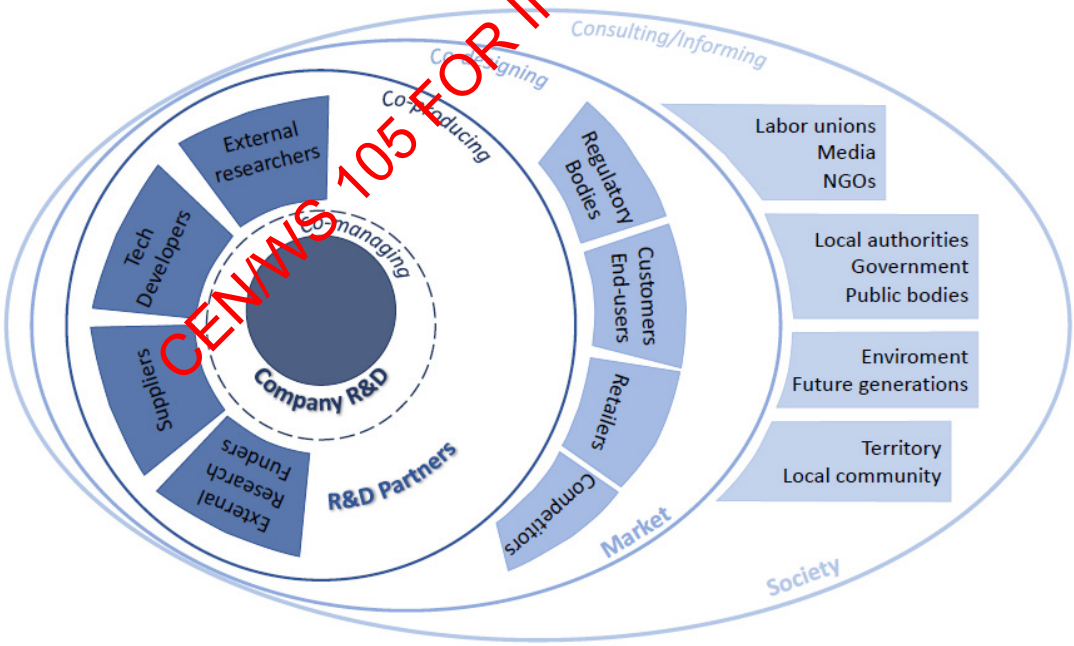
Stakeholder analysis consists of identifying all the relevant stakeholders and their interests connected to a specific topic. This can be done by following four main steps:

- Identify: determine relevant groups, organizations, and people
- Analyse: consider each stakeholder's possible contribution, their legitimacy or willingness to be engaged, how much influence they have (and who/what they are able to influence), and how they could delegitimize the process if not involved
- Map: organize stakeholder information in a graphical way to visualize which stakeholders would be most useful to engage with, according to selected criteria (see the Annex for practical examples)
- Prioritize: rank stakeholder relevance to determine who should be engaged from the beginning or more intensively, clearly explaining why each stakeholder has been selected (this is important to save time and to interact with stakeholders at the right time and with the proper motivation)

It is important to implement RRI with an innovation ecosystem approach. The ecosystem has to be identified and built (or strengthened, if already in place). Some useful actions could be:

- Identify the roles of all the stakeholders sharing the benefits and risks of innovation
- Select instruments enabling interaction with these actors at all levels
- Establish common (RRI compliant) standards/processes/procedures/certifications within the innovation ecosystem

The following figure is an example of a stakeholder mapping in the innovation ecosystem, including their potential roles in product development.



CEN/WS 105 FOR INTERNAL USE ONLY

6.5 Experiment and engage

Stakeholder engagement is one of the pillars of RRI. It is essential for helping organizations achieve socially desirable outcomes from their innovation processes. It is also used to validate the materiality analysis and the roadmap design. Thus, in this phase, the organization identifies one or more RRI pilot actions to perform to ascertain the appropriateness and feasibility of the RRI roadmap. The following aspects are addressed:

1. **At least one inclusion action is performed** involving stakeholders within the innovation ecosystem in discussing and analysing key ethical and social impacts of the project and in reviewing the draft roadmap
2. **Additional RRI actions are performed** as a way to practice and pilot activities planned in the roadmap

In selecting which actions to perform, the organization should go a step beyond its usual organization practices (i.e., out of its “comfort zone” regarding issues discussed, information provided, stakeholders engaged, methods used, etc.). There are plenty of methods available for engaging stakeholders and for determining the different goals that could be pursued (e.g., inform, consult, involve, share, collaborate).

The main objective in this phase is to create a dialogue with stakeholders in the innovation ecosystem (as selected in the materiality analysis) to discuss their views and perspectives on the RRI product; its ethical, legal, and social impacts; and the specific elements included in the roadmap.

Examples of suitable methods include focus groups, plenary sessions, multi-stakeholder workshops, and world café and fishbowl exercises. A more detailed list of the methods is provided in the Annex VI. Recommendations for stakeholder engagement are provided in Box 4.

Initiatives aimed only at informing on product development, observing and studying people’s behaviour, or testing a product should be avoided.

The outcomes of this phase should be used to refine the materiality analysis in terms of the significant ethical, social, and legal impacts to address and the stakeholders in the innovation ecosystem. They should also be used to prepare a consolidated version of the roadmap.

CEN/WS 105 FOR INTERNAL USE ONLY

Box 4: Practical recommendations for stakeholder engagement

- Learn from past and ongoing engagements. Reflect on the positive aspects and possibilities for improvement
- Identify and communicate the goals and expected outcomes to all stakeholders in advance
- Ensure that most stakeholders along the quadruple helix and the value and supply chains are engaged. If appropriate, consider different types of engagement activities for different stakeholders (e.g., a focus group with research and business partners, a workshop with authorities, a multi-stakeholder initiative to bring users together with research and business partners)
- Be social. Social media provide a perfect opportunity to identify and reach lesser-known stakeholder groups
- Select the engagement method, considering the number of stakeholders to be involved, their level of interest and knowledge, their willingness to participate, and the kind of contribution they could provide (as identified in the materiality analysis)
- Look for a diversity of participants in terms of experience, skills, geography, gender, and age
- Set clear rules for engaging stakeholders (e.g., confidentiality, decision-making process)
- Identify motivation for stakeholders to contribute, consider a reward mechanism for them
- Carefully design/select the information to provide before and during the event, the event structure, the moderators/facilitators, the outcome reporting methods, the feedback mechanism and evaluation methodology, and the communication and dissemination tools
- Look for interactive ways to engage stakeholders, consider assigning active roles to the participants
- Consider stakeholder expectations, ensure equal opportunities for all, avoid polarization and mitigate possible tensions, keep the discussion focused on the agenda and the objectives, avoid off-topics
- Ensure that no stakeholder or stakeholder group dominates the discussion, ensure an open and safe space to state views and debate ideas
- Provide documented information on the engagement activities. Include at least a summary of stakeholder concerns, expectations, and perceptions; a summary of key discussions and interventions; and a summary of outputs (e.g., queries, proposals, recommendations, agreed decisions and actions)
- Ensure follow-up of the event (e.g., share presentations, distribute a report of the event, give all participants the opportunity to comment, communicate decisions taken on the basis of the event's results, organize follow-up initiatives, etc.)
- Keep in mind that stakeholder engagement is a process, not an event or a one-off exercise

CEN/WS 105 FOR INTERNAL USE ONLY

6.6 Validation

The success of RRI uptake is strongly context dependent and is affected by several factors (e.g., company size, organization complexity, technology's features, innovation level and associated risks), as specified in Clause 6.3, the context analysis clause. RRI actions could have both tangible and intangible impacts, ranging from long-term strategic factors at the company level (e.g., company reputation) to short-term factors in product development (e.g., alignment with user needs and stakeholder values). In this phase, the organization evaluates and validates the roadmap's impact on the product development and the company, according to selected criteria. This process is used to evaluate the roadmap's feasibility for the organization and, if necessary, to refine it.

The defining of criteria is also helpful in providing documented information on the roadmap that the organization can then control and maintain while implementing the roadmap's actions. Thus, in this phase the following aspects are addressed:

- **Identify what needs to be measured and monitored and how to do it**, selecting criteria and methods to evaluate the roadmap's impact on the RRI product and the organization
- **Measure (at least qualitatively) the impacts of the RRI actions** defined in the roadmap, focusing on both tangible and intangible added values, according to selected criteria
- **Explore whether and to what extent the roadmap could be embedded in the usual practices of the organization** (innovation, risk, quality, social responsibility practices)

Relevant examples are provided in the Annex VII with respect to the criteria and qualitative methodology for evaluating the RRI roadmap's impact on product development, and in the Annex VIII with respect to the quantitative key performance indicators for evaluating RRI's impact on the organization.

The organization should also determine the resources and processes needed to operationalize the actions indicated in the roadmap, namely:

- People
- Time
- Knowledge
- Finance
- Infrastructures (i.e., tangible and intangible assets and technological infrastructures)

The role and contribution of relevant agents (i.e., relevant interested parties within the innovation ecosystem) in implementing the roadmap should also be considered.

As mentioned, the validation step proposes ways to evaluate the RRI roadmap's impacts on the organization, but together with the materiality step, it also helps to reflect on the potential impacts of RRI on the stakeholders (a list of indicators is proposed in the Annex VIII).

The organization should retain appropriate documented information as evidence of the results.

The assessment should be integrated within a broader non-financial impact assessment of company operations. This would help to better assess how technological innovations generate benefits and value for the organization and its shareholders as well as for the stakeholders and society.

Defining appropriate and reliable indicators for these aspects is a complex task. On-going sustainability work and non-financial reporting could provide relevant references.[16]

The validation step might result in changes to the planned RRI actions to ensure they are aligned with the organization's overall strategy and the available resources. It then leads to the final version of the RRI roadmap.

CEN/WS 105 FOR INTERNAL USE ONLY

6.7 Roadmap design

An RRI roadmap, based on the steps in Clauses 6.1–6.6, is designed to guide an organization as it puts into practice the key RRI implementation principles indicated in Clause 4:

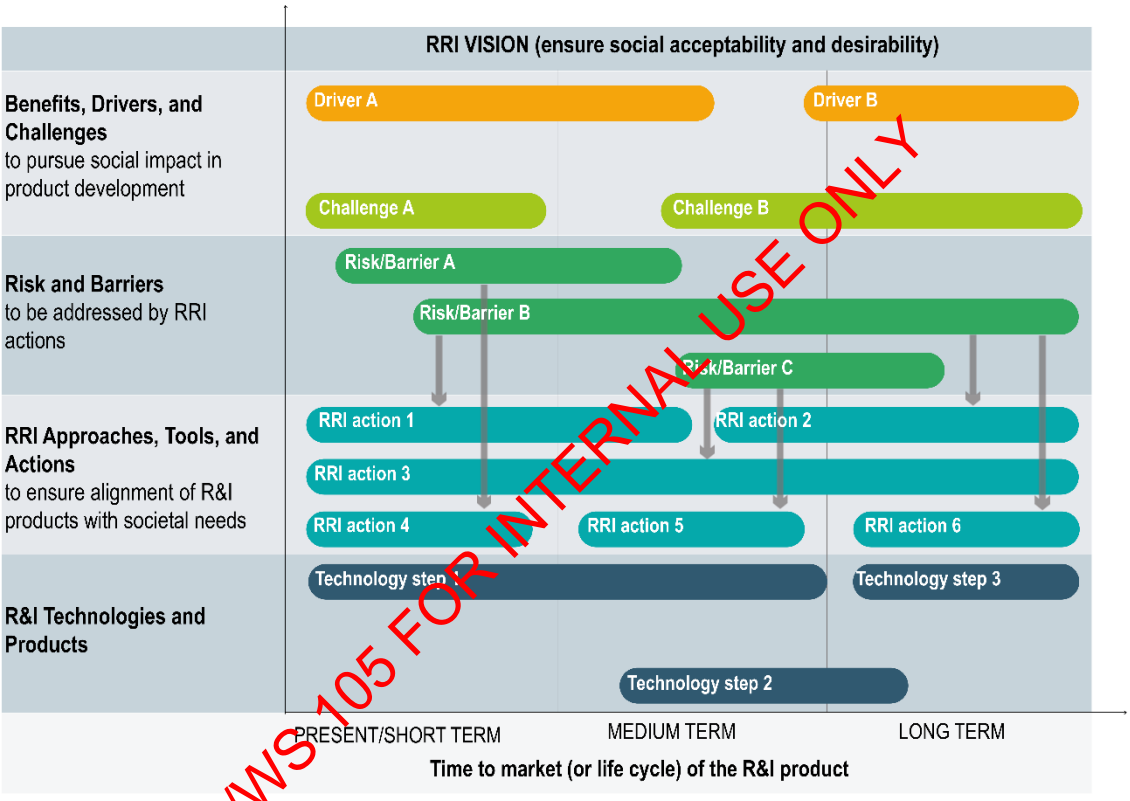
- Anticipation & Reflection: integrate analysis of ethical, legal, and social impacts from the early stages of product development
- Inclusion: engage and involve stakeholders to inform all phases of product development

[16] See the Commission's proposal for a corporate sustainability reporting directive (CSRD): https://ec.europa.eu/info/publications/210421-sustainable-finance-communication_en

- Responsiveness: integrate monitoring, learning, and adaptive mechanisms to address public and social values and normative principles in product development

The organization's RRI roadmap should include at least one specific action for each of these three key principles. Examples of specific actions are provided in the Annex I.

The RRI roadmap template (Figure 2) adapts the architecture of the generic IPRM to decision-making on RRI strategies. It was developed on the basis of eight industrial pilots' experiences (see Annex III and Bibliography), in the context of rapid (and possibly disruptive) developments associated with transformative technologies.



CEN/WS 105 FOR INTERNAL USE ONLY

Figure 2 — Template of the RRI roadmap

As shown in the template, the RRI roadmap has four areas of action, and its design starts with the definition of the desired outcome of RRI implementation (the vision) (Clause 6.2). That means:

- Defining the drivers and the challenges on the basis of the significant ethical, social, and legal impacts and the strategic, organizational, and economic issues at stake for both the organization and the specific RRI product
- Identifying the risks and barriers addressed by the RRI actions
- Identifying an action plan to implement RRI all along the steps for product development; this is the core part of the roadmap
- Identifying the innovative technologies for addressing the R&I objectives (the RRI product)

The x-axis of the RRI roadmap template shows the expected duration of the research and product development, lasting until entry into the market (time to market). It might also include the product use and end

of life if a life-cycle perspective is considered in the definition of the roadmap (in this case, time to market is replaced by life cycle). Risks and barriers are linked (arrows) to the RRI actions that address them.

Market demand plays an important role in the technology-based solutions under investigation, and societal implications may affect the technological developments.

Stakeholder involvement plays an important role at all levels.

The design of the proposed roadmap is a flexible and adaptable process that uses a “toolbox” with different modules and consisting of several levels. The starting point is the long-term RRI vision. All the intermediate targets should be designed in relation to the long-term RRI targets and should include the RRI anticipatory, reflective, deliberative, and responsive principles (Clause 4).

Other important elements for the roadmap’s design and implementation are the RRI pilot actions that the organization should perform to ascertain the roadmap’s feasibility (Clause 6.5) and the evaluation and validation of the roadmap’s added value for the product development and regarding the resources necessary to put actions into practice (Clause 6.6).

In addition to the graphical representation in Figure 2, documented information should be provided to describe the RRI roadmap in more detail. See Box 5 for an example.

CEN/WS 105 FOR INTERNAL USE ONLY

Box 5: Template of documented information to be provided on the RRI roadmap

Case description

- The company
- RRI commitment
  - Functions of the organization endorsing the roadmap
  - Motivation to implement the roadmap
- Context
  - Size and ownership of the organization
  - Date of establishment, country
  - RRI product selected
  - Technologies
  - Regulatory regimes relevant for the RRI product (both current and emerging/future)
  - Type of R&I activities
  - Type of business
  - Time to market
  - CSR policies
  - Gender and diversity (of societal and behavioural roles) in R&D/R&I
  - RRI maturity level
- Materiality & experimentation
  - Significant stakeholders
  - Significant ethical, social, and legal impacts
- Validation aspects
  - Criteria to evaluate impact of RRI actions on the RRI product
  - Key performance indicators to monitor RRI aspects within the organization

RRI roadmap

- RRI vision
- R&I technologies and products
- Benefits, drivers, and challenges for RRI
- Risks and barriers to be addressed by RRI actions
- RRI actions
- Roadmap design

CEN/WS 105 FOR INTERNAL USE ONLY

Annex A
(Informative)

Examples of RRI actions

Tables A.1–A.3 provide examples of the main actions necessary for implementing RRI in product development at the company level, including the expected benefits, the R&I value chain, the corporate functions, the stakeholders, and the investment term. These actions were derived from PRISMA's experience and a literature review.

Table A.1 — REFLECTION & ANTICIPATION actions for integrating analysis of ethical, legal, and social impacts (ELSI) throughout all stages of product development

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
Include RRI principles in company's mission and vision, include reflection on creating shared value	- Improve product quality, desirability, and acceptability - Improve product sustainability, safety, and reliability - Address uncertainties, prevent and mitigate risks - Motivate workers	All	Management	R&I partners	Short
Set specific targets in R&I strategies in order to provide solutions for sustainable development goals		All	Management, R&D	R&I partners	Short, Medium
Conduct ethical analysis and ethics impact assessment through foresight, scenario analysis, social phenomena, trends evaluation, etc.		Basic and applied research, Engineering and testing	Management, R&D	R&I partners, End-users, Policy makers	Short, Medium
Design for values; stakeholder and value inventories/scenarios (values hierarchy, conflicting values, etc.)			R&D	R&I partners, Suppliers, End-users	Short, Medium
Hold internal meetings with R&D personnel to reflect on ethical issues and promote internal knowledge transfer			R&D	Internal to the company	Short
RRI training and internal knowledge exchange mechanisms for R&D personnel					
Solicit ELSI advice from (independent and external) experts as needed			R&D, CSR, Legal	Internal to the company	Short
Develop and introduce ethical frameworks, codes of conduct		All	Management, Legal, R&D, CSR, Quality	Internal to the company	Medium

CEN/WS 105 FOR INTERNAL USE ONLY

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
Implement life cycle assessment (LCA) and social LCA		Applied research, Engineering and testing	Management, R&D, Quality, CSR	Suppliers	Long
Re-evaluate expected impacts prior to market launch		Go to market	R&D, Quality, CSR	R&I partners, End-users	Short
Achieve a common internal understanding of stakeholder engagement and define a strategy to its approach		All	All	Internal to the company	Long

NOTE — For investment terms, Short = 1–3 years; Medium = 3–5 years; Long = more than 5 years.

Table A.2 — INCLUSION actions for stakeholder engagement that inform all phases of product development

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
Set and implement a communication and dialogue strategy on ELSI	- Strengthen relations and trust with all stakeholders, network building - Reconcile opposing views and bridge opposing values - New values creation - Motivate employees	Engineering and testing, Go to market	R&D, CSR, Marketing	All	Long
Set and implement an internal platform that promotes a culture of internal knowledge exchange (including reflection on company values)		All	All	Internal to the company	Short
Work with business and social actors (e.g., civil society organizations, NGOs, and citizens) sharing values and creating positive ethical networks		All	CSR	All (including societal actors and citizens)	Medium
Co-design product through dialogue with policy actors, authorities, and normative bodies (EU, regional, and local)		Applied research, Engineering and testing	R&D, Quality, Legal	Policy makers, Regulators	Short
Organize public dialogues, build/use public platforms for			R&D, CSR		Medium

CEN/WS 105 FOR INTERNAL USE ONLY

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
expressing needs and concerns	- Anticipate potential regulatory change - Product quality, desirability, and acceptability				
Connect to or organize living labs and social experimentation using participatory methods			CSR, R&D	End-users and consumers	Short, Medium
Build user-based communities of practice			R&D, CSR		Medium
Promote initiatives for social inclusion, provide consumers an official role in the innovation process		All	CSR	End-users, Policy makers	Medium
Promote capacity building with vulnerable actors in the value chain		Engineering and testing, Go to market	CSR	End-users	Medium

NOTE — "End-users and consumers" includes civil society organizations, NGOs, and citizens. For investment terms, Short = 1–3 years; Medium = 3–5 years; Long = more than 5 years.

Table A.3 — RESPONSIVENESS actions to integrate monitoring, learning, and adaptive mechanisms that address public and social values and normative principles in product development

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
Integrate user-centred design, user innovation, flexible and adaptive design, co-creation approaches	- Create value, increase the social value/impact of R&D - Build corporate image and reputation	Applied research, Engineering and testing	R&D, Management, Legal, Marketing	R&I partners, Supply chain suppliers, End-users and consumers	Long
Screen suppliers for positive practices			CSR, Management	Supply chain suppliers	Medium
Set up procedures for investigating reports of concerns or misconduct (e.g., whistleblowing)			All	Internal R&D, R&I partners, Supply chain suppliers, End-users	Medium

CEN/WS 105 FOR INTERNAL USE ONLY

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
	- Compliance with qualified norms and standards - Facilitate access to financial support			and consumers	
Ensure non-discriminatory recruitment processes in all company activities (e.g., hiring committees, engagement activities), support a culture of knowledge exchange			HR, CSR	Internal to the company	Short
Employ adaptive risk management			Management, R&D, Quality	Internal to the company	Medium
Embed ethicists in the R&I process		All	CSR, R&D	Internal to the company	Medium
Establish an ethical, social, and legal monitoring board		All	R&D, Management	R&I partners, Suppliers, Policy makers, End-users	Long
Include ELSI criteria in internal procedures for R&D project quality monitoring		Applied research, Engineering and testing	R&D, Management	Internal to the company	Short
Ensure ethical management of research data and FAIR data management**		R&I, CSR	R&I, CSR	R&I partners, Internal to the company	Medium
Ensure transparency in the handling (collection, analysis, interpretation) of research data		R&I	R&I	R&I partners	Medium
Promote a culture of transparency by making research open access whenever possible		R&I	R&I	R&I partners	Medium
Perform regular ethical reviews and get ethical certification (by independent bodies)		Engineering and testing, Go to market	CSR, Quality	Certification bodies, Regulators and authorities	Medium

CEN/WS 105 FOR INTERNAL USE ONLY

Actions	Benefits	R&I value chain phase	Corporate functions involved	Stakeholders involved	Investment term
Obtain social accountability and quality certification at company and supply chain levels			CSR, Quality	Certification bodies, Regulators and authorities, Investors	Medium
Monitor post-marketing ELSI impacts		Go to market	R&D, Quality	Regulators and authorities	Long
Include ELSI for R&D and Innovation products in the CSR/sustainability reporting			CSR, Marketing	All	Long
Support and invest in sustainable supply chains		Go to market	Management	Suppliers	Long
Select funding mechanisms based on ethics/responsibility requirements		All	R&D, management	Funding bodies, Investors	Short

NOTE — FAIR data principles: Findable, accessible, interoperable, re-usable (https://www.go-fair.org/fair-principles/). "End-users and consumers" include civil society organizations, NGOs, and citizens. For investment terms, Short = 1–3 years; Medium = 3–5 years; Long = more than 5 years.

Table A.4 discusses having embedded ethicists in the R&I process as a key action for responsiveness.

Table A.4 — Focus on the embedded ethicist approach

Description	Opportunities and barriers
Embedded ethicists aim at what has been described as "cooperative co-shaping" of technology, which involves iterations of the following steps by Van Gorp and Van der Molen (2011): • Gathering data about the project to help identify ethical issues • Reflecting on these issues and searching for relevant ideas in the literature	This approach has the potential of facilitating more dynamic and deeper reflection on the issues that are raised, though it may also be yet more demanding of technologists' time. On the positive side, interacting with technologists on particular problems is a very effective way of accelerating understanding of the issues within a company, and a company's willingness to engage frequently with ethics is a good measure of its seriousness regarding ethics. The fact that this is time-consuming for ethicists is outweighed by the accelerated understanding they get of the technology issues.

CEN/WS 105 FOR INTERNAL USE ONLY

Description	Opportunities and barriers
• Preparing discussions on the ethical issues and decisions that will have to be made • Discussing ethical issues with the team or some of the researchers and taking a decision • Reporting about the ethical issues and decisions taken	

CEN/WS 105 FOR INTERNAL USE ONLY

Annex B
(Informative)

Examples of tools

A variety of tools are available to help companies implement RRI actions such as those in Tables A.1–A.3. Table B.1 presents a selection of tools drawn from the PRISMA RRI toolkit (www.rri-prisma.eu/rri-toolkit). A broader inventory of tools can be found at https://rri-tools.eu/.

Table B.1 — Selection of tools to support implementation of the RRI actions included in Tables 3–5

Name	AR	IN	RE	Organization
Matter Principles for Responsible Innovation	☐			MATTER (UK)
Responsible Innovation Quick-Scan assessment matrix	☐	☐		Karim project (EU)
B-Impact: Social and environmental impact benchmarking	☐	☐	☐	bcorporation.net
Ethics Impact Assessment	☐	☐	☐	CWA 17145, part 1, 2
Gendered innovations in research and innovation		☐		European Commission
Orbit Self-Assessment Tool	☐	☐	☐	orbit-rri.org
Stakeholder maps		☐		Transnational Network for Social Innovation Incubation (EU)
Stakeholder engagement: Rethinking your strategy for stakeholder engagement	☐	☐	☐	BSR.org
Synthetic Biology deliberation aid	☐			Forum for the Future
Designing for values: A reflection tool to embed values in your product				TUDELFT (NL)

CEN/WS 105 FOR INTERNAL USE ONLY

Name	AR	IN	RE	Organization
Techno-moral vignettes/scenarios: Exploring moral aspects of future technologies	☐			Rathenau Instituut (NL)
Gender equality, toolkit to improve gender equality in the organization strategy			☐	Australian government
Stage-Gate model	☐		☐	Stage-Gate International
Sustainability method selection tool	☐			RIVM (NL)
Safe Innovation Approach: Balancing risks, benefits, and costs of nanomaterials	☐		☐	NanoReg 2 Project
Licara NanoScan: Integrating risk assessment and life-cycle analysis for nanomaterials	☐			LICARA project (EU)
Trusted environment: Creating a safe (technical) environment for sharing information and data	☐			Public Impact company

NOTE — AR= Anticipation & Reflection; IN = Inclusion; RE= Responsiveness.

CEN/WS 105 FOR INTERNAL USE ONLY

Annex C
(Informative)

Examples of applying the guidelines

Table C.1 summarizes the pilot cases on which the guidelines were originally applied, indicating the technologies and sectors of the companies engaged in the pilot; the key ethical, legal, and social impacts addressed; and the RRI visions designed through the RRI roadmap process. Further details on the PRISMA pilot cases are available in PRISMA project, RRI-CSR Roadmap - case studies, D5.2.

Table C.1 — Summary of the pilot cases used to develop and test these RRI guidelines

Technology and sector	RRI vision	Significant ethical, legal, and social impacts addressed
Nanotechnologies for healthcare	Realize a personalized and point-of-care therapy for highly effective, accessible, and affordable treatment of severe diseases	Product efficacy and safety, risk perception and user acceptability, patient's rights (precaution, safety, beneficence, dignity, informed consent, data ownership, transparency)
Nanotechnologies for cosmetics and medical devices	Create nano-based dermocosmetic products, based on ethically acceptable and sustainable production methods and safe and more effective use of natural and organic ingredients	Product efficacy, safety, and safe production, risk perception and user acceptability, improved quality, affordability, compliance with sustainability norms, information to consumers
Synthetic biology for healthcare and nutrition	Create a mutual understanding of a desirable innovation pathway that can benefit the synthetic biotechnology value chain and other stakeholders	Safety of genetically modified organisms, value chain/benefit sharing, environmental sustainability, information to consumers
Internet of Things for public health and hygiene applications	Develop new cleaning technologies that contribute to public health and hygiene (and respect other relevant values) and offer the possibility to increase market share	Public/patient health and hygiene, sustainability, privacy, security, transparency, autonomy, reliability, trust
Internet of Things for unmanned aerial vehicles (UAVs)	Developing drones, combining data collection and AI, ensuring safety, and safeguarding users' rights, including privacy and fair use of data	Safety, security, and users' rights, including privacy, data protection, data ownership
Internet of Things for online applications for data sharing	Develop distributed data platform as a mechanism for increased personal control of data	Information privacy, data ownership, commercial use of private data, respect of users' rights, transparency, security
Autonomous vehicles for smart cities	Developing automated and personalized public transport to reduce traffic, pollution, and parking land use in urban areas	Information privacy, commercial use of private data, urban planning, safety
Synthetic biotec for algae feedstocks production for consumer and industrial sectors	Developing bio-based (algae) feedstock to replace petrochemicals, based on RRI-aware life-cycle assessment	Environmental, social, and economic impact, open innovation, transparency

CEN/WS 103 FOR INTERNAL USE ONLY

Annex D
(Informative)

SWOT analysis for RRI implementation in industry

Based on PRISMA's experiences and reflections provided so far, a summary of the strengths, weaknesses, opportunities, and threats (SWOT) of RRI implementation in industry is provided in Table D.1. Further details are provided in PRISMA deliverable 5.1.

Table D.1 — SWOT analysis for RRI implementation

	Helpful to achieve the objective	Harmful to achieve the objective
Internal origin	**STRENGTHS** • Create value • Motivate workers • Offer competitive advantage • Strengthen relations with all stakeholders • Increase trust among stakeholders • Increase the social value/impact of R&D • Strengthen quality of innovation at industrial level • Ensure compliance with qualified norms and standards • Identify new market needs • Potential to communicate benefits and risks of products • Increase transparency in product development	**WEAKNESSES** • Limited awareness of and skills in the RRI concept • Additional bureaucratic burden, lack of resources (particularly for SMEs) • Low perception of tangible impact on product development • Lack of integration of RRI across company functions • Internal boycott from some company functions • Difficulties in measuring associated costs • Extra costs for product development • Intellectual property rights
External origin	**OPPORTUNITIES** • Improve product quality, desirability, and acceptability • Improve product sustainability, safety, and reliability • Increase customer satisfaction • Improve effect on quality of life and health of customers by addressing existing social needs • Improve efficiency (e.g., use of resources, decision-making process) and cost reduction in the medium/long term • Build corporate image and reputation • Improve market penetration, profit • Facilitate access to financial support	**THREATS** • Difficulties in engaging with stakeholders • Possible slowdown or even premature stop of innovation • Misuse of the concept (checkbox exercise) • Few practical examples available from industry (case studies, applications) • Lack of engagement along the value and supply chain • Lack of endorsement by partners and suppliers • Seen by stakeholders as a "window dressing" exercise • Lack of incentives (at policy and regulatory levels)

CEN/WS 103 FOR INTERNAL USE ONLY

Annex E
(Informative)

Tools for materiality and stakeholder analysis

Different studies and projects have developed tools supporting materiality and stakeholder analysis.

Some are useful for identifying the most relevant issues or the business areas that could benefit the most from the application of RRI practices. Or they may be helpful in determining the extent to which a company's practices are aligned with RRI principles and how to move the innovation process towards being more responsible.

For example, the RRI self-check tool developed by the Compass project allows a company to analyse its innovation process from different perspectives (management, idea generation and research, development and testing, and market and impact) and to find the most relevant issues from an RRI point of view.[17]

Other tools can be useful for visualizing and analysing the different issues. This is the case with the materiality matrix (Figure E.1), in which each issue's relevance to both the stakeholders and the company is estimated based on the impact it could have.[18]

CEN/WS 105 FOR INTERNAL USE ONLY

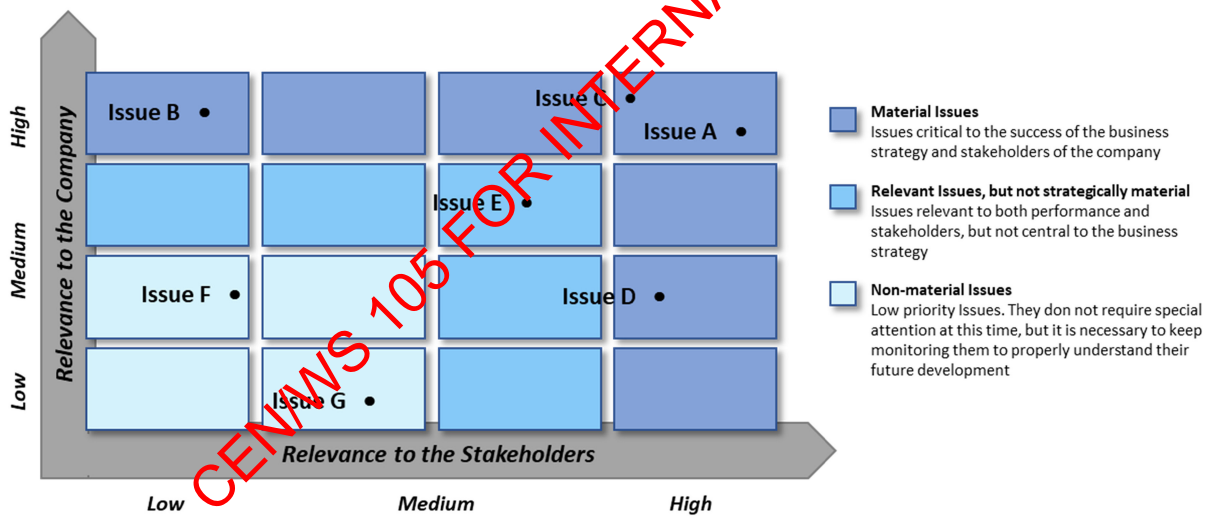


Figure E.1 — Example of a materiality matrix

When it comes to stakeholder analysis, several steps can be taken. One of these steps is stakeholder mapping, which is a visual exercise and analysis tool that can be used to further determine which stakeholders are most useful to engage with. Stakeholder maps can be visualized based on several criteria: for instance, level of influence against willingness to engage, type of stakeholder against level of influence, and capacity to engage

[17] Compass project: https://innovation-compass.eu/self-check/
[18] UNI/PdR 18 Social responsibility in organizations - Guidance to the application of UNI ISO 26000

and knowledge of issues against expectations of stakeholder supporting or criticizing your initiative. It is important to clearly set the criteria for mapping stakeholders in accordance with the goals of the engagement. Other criteria can be represented through dimensions or colours.

An Interest/Influence grid is one type of stakeholder mapping. In this exercise, the categorization of the stakeholders should be conducted according to their potential interest in and influence on the goal. Stakeholders should be placed on the grid according to a realistic assessment and not based on a personal assessment of where they should be located. A practical example is presented in Figure E.2.

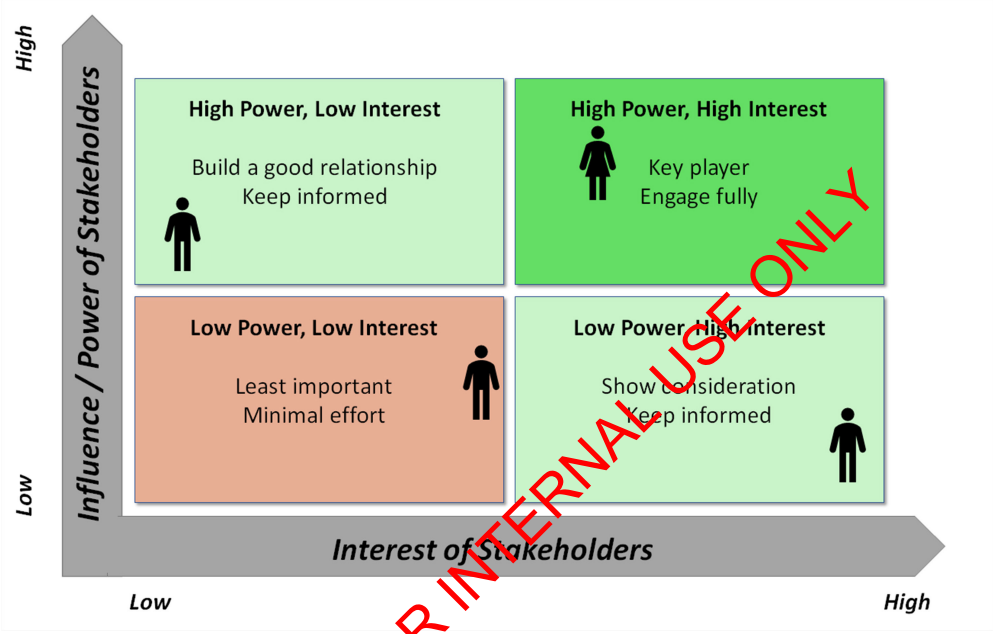


Figure E.2 — Example of the Interest/Influence grid

The Interest/Influence grid is particularly helpful in determining what type of engagement process is required. This exercise can also be done using "Interest" and "Power" on the x- and y-axis, respectively.

Another type of tool is the ring stakeholder map (Figure E.3). This diagram generally starts on the micro-level, for instance with the identification of the primary stakeholders (e.g., investors, shareholders, customers, directors, employees, suppliers), and scales up to the meso- and macro-levels, where secondary (e.g., government, media, local communities, activists) and contextual (e.g., natural resources, past/future generations) stakeholders, respectively, are identified. Other tools and recommendations can be found in the PRISMA project RRI tool-kit[19] and in PRISMA deliverables D4.1 and D4.2.

CEN/WS 105 FOR INTERNAL USE ONLY

[19] http://www.rri-prisma.eu/toolkit/stakeholder-maps/

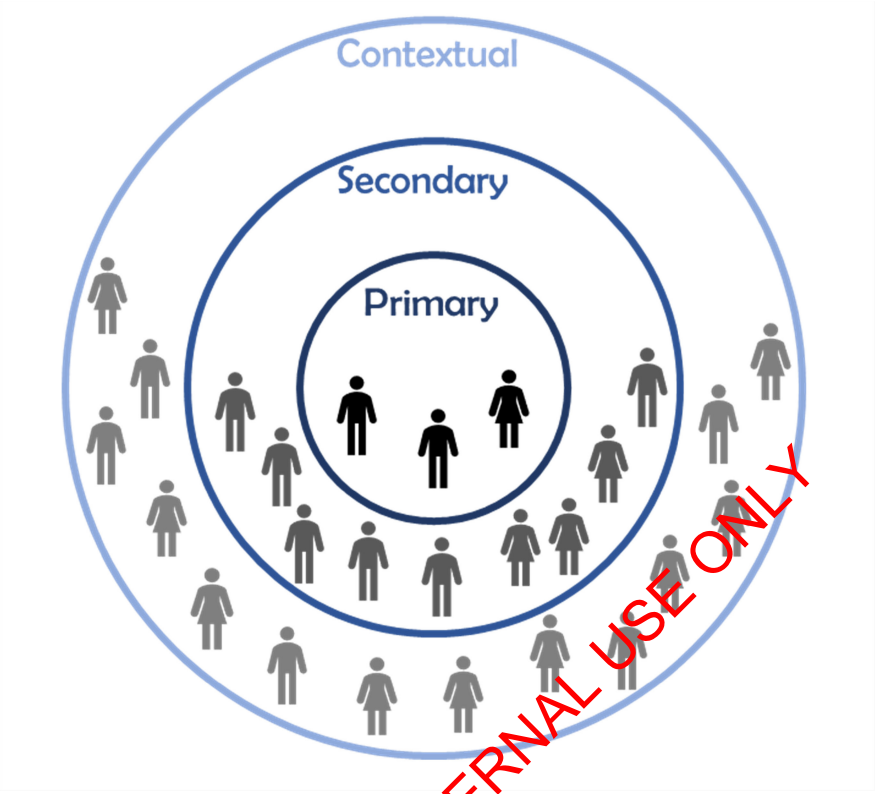


Figure E.3 — The ring stakeholder map

CEN/WS 105 FOR INTERNAL USE ONLY

Annex F
(Informative)

Methods for stakeholder engagement

There are different methods for stakeholder engagement depending on the issue to discuss, the group or stakeholder to engage, the level of engagement (inform, consult, involve, share, collaborate), the desired outcomes, and in some cases, the topic itself.

Table F.1 provides some examples of stakeholder engagement methods, including a brief description of the level of engagement, the methodology, and the expected outcomes, based on PRISMA's experience (Deliverables 4.1 and 4.2) and analysis.

Table F.1 — Methods for stakeholder engagement

Methods	Level of engagement	Description	Expected outcomes
Conferences and presentations with selected stakeholders	- Inform - Involve	- A formal meeting of people with a shared interest in which experts provide information to a specific target (even large) audience	- Stimulate dialogue
Focus groups	- Consult - Involve	- Discussion in a small (4–12 members) group of stakeholders facilitated by a skilled moderator	- Obtain a range of insights (people's attitudes, beliefs, desires, reactions) in a relaxed, non-threatening environment
Workshops	- Consult - Involve - Collaborate	- Single, short event designed to introduce or teach participants practical skills, techniques, or ideas that they can then use in their work or their daily lives. Generally small groups, allowing everyone some personal attention and the chance to be heard	- Obtain feedback from participants - Collect opinions, values, needs, concerns about the topic and related issues - Generate new ideas and ways to improve the material introduced
World café	- Consult - Involve - Collaborate	- Discussion in few small groups and multiple rounds. Host introduces the process and the "Café etiquette" - After the first round, people are free to change tables for the next round - Each round starts with a question designed for the specific context and purpose - At the end, individual group results are shared in a plenary discussion	- Generate new ideas, joint decision-making, key strategic issues, new ways for collaboration, etc. - Reflect on implications of a complex issue - Identify specific steps for further exploration and implementation - Create a graphic recording of people's ideas and expressions in words, images, and colours to be shared as a framework or guide

CEN/WS 105 FOR INTERNAL USE ONLY

Methods	Level of engagement	Description	Expected outcomes
Fishbowl exercise	- Involve - Collaborate	- Form of dialog to discuss specific topics in large groups. A few chairs are arranged in an inner circle (the fishbowl), and a few participants are selected to start the conversation, sitting in the fishbowl, while the others are sitting outside (all around) - The moderator introduces the topic, and those in the fishbowl discuss it, while those outside listen - Anyone is allowed to join the conversation by occupying an empty chair in the fishbowl or tapping the shoulder of the person (not talking) they want to replace - At the end, the moderator closes the fishbowl and summarizes the discussion	- Collect opinions, values, needs, concerns about the topic and related issues - Reflect on implications about a complex issue - Generate new ideas, joint decision-making, key strategic issues, new ways for collaboration, etc.
Co-creation/co-design	- Involve - Collaborate - Consult - Share	- Joint creation and evolution of value with stakeholders that is intensified and enacted through platforms of engagement or crowdsourcing - To be successful, the process needs to be transparent and stakeholders need to have access to the company data on the co-creation topic	- Share specific and detailed information to allow a proactive creation - Identify values, needs, concerns, etc. - Generate new concepts and ideas - Joint value creation based on stakeholders' experiences - Collect, share, and spread ideas (e.g., design, functionality) - Unexplored ideas emerge because of open conversations - Improves costs and increases diversity
One-to-one interview	- Involve - Consult	- The list of issues to be addressed or questions to be asked can be presented in a structured or semi-structured way	- Collection of detailed information on a specific matter or sets of issues
Surveys	- Consult	- Data collection on a specific topic(s). Predominantly, data is collected by self-completion questionnaires or by (semi-) structured interviews	- Collection of a data set that allows the identification of patterns of relationships between the topics

CEN/WS 105 FOR INTERNAL USE ONLY

Annex G
(Informative)

Criteria for impact analysis of RRI actions

A model questionnaire for a company's self-assessment of the impact of RRI actions is proposed in Table G.1.

The questionnaire is structured as a set of five questions (Q1–5) regarding lines of evidence (LoE), plus a sixth question (Q6) related to the direct costs of RRI actions. Each of the first five questions includes a set of sub-questions (criteria) derived by criteria for RRI implementation. Though both Q5 and Q6 involve financial aspects, Q5 refers to economic criteria related to product development (e.g., time to market), while Q6 refers to the costs of performing the RRI action (e.g., doing stakeholder engagement activities, establishing an ethical and social advisory board, etc.).

To use the questionnaire, product/programme managers should evaluate the impact each RRI action would have on each criterion, using a three-score scale (positive, neutral/irrelevant, or negative for Q1–5; low, medium, or high for Q6). An example outcome is provided in the self-assessment matrix in Table G.2 (based on a generic set of three possible RRI actions: A1, A2, and A3).

Note that, instead of using scores, the evaluation could be visualized by using emoticons (a "sentiment analysis" technique[20]), to facilitate qualitative comparisons of results. The methodology is further described in Porcari et al. (2020).

CEN/TS 16555 FOR INTERNAL USE ONLY

Table G.1 — Questions and sub-questions (criteria) proposed for a company's self-assessment of the impacts (benefits, barriers, costs) of RRI actions

Main questions	Criteria	Impact of RRI action(s)
Q1: Scientific & Technological line of evidence	- Q1.1: Inspire technological innovation - Q1.2: Feasibility of the technology solution - Q1.3: Product quality (performance/efficiency) - Q1.4: Product reliability - Q1.5: Extend the product life cycle - Q1.6: Trust with/avoid conflicts with business partners, suppliers, and end-users	- Positive - Irrelevant - Negative
Q2: Ethical & Societal LoE	- Q2.1: Product acceptability - Q2.2: Product safety - Q2.3: Product environmental sustainability - Q2.4: Effect on quality of life and health of customers - Q2.5: Product related services and guidance (e.g., ethical protocols) - Q2.6: Address users' needs and rights (e.g., privacy, data ownership, etc.)	- Positive - Irrelevant - Negative
Q3: Strategic LoE	- Q3.1: Competitive advantage - Q3.2: Corporate image - Q3.3: Transparency on product qualities	- Positive - Irrelevant - Negative

[20] The "sentiment analysis" aims to determine one's attitude regarding a specific topic or one's emotional reaction to a document or an event. The attitude could be an emotional state but also a judgment or evaluation.

	- Q3.4: Customer satisfaction, meeting new consumers' needs or requests - Q3.5: Build legitimacy and gain consumer loyalty on the product - Q3.6: Improve relationships with partners, suppliers, and sub-suppliers - Q3.7: Fulfil ethical and social requirements (e.g., for access to funding)	
Q4: Organizational LoE	- Q4.1: Allocation and deployment of resources (e.g., human resources) - Q4.2: Team cooperation and motivation for product development - Q4.3: Address regulatory barriers - Q4.4: Risk management, safety in the workplace - Q4.5: Gender and diversity contribution to product development - Q4.6: Avoid irresponsible behaviour	- Positive - Irrelevant - Negative
Q5: Economic LoE	- Q5.1: Product cost - Q5.2: Time to market - Q5.3: Profit, market penetration - Q5.4: Market size - Q5.5: (Favoured) access to financial support - Q5.6: Use of human Resources	- Positive - Irrelevant - Negative
Q6: RRI action costs	- Q6.1: Direct costs to perform the RRI action (compared to product development costs)	- Low - Medium - High

CEN/WS 105 FOR INTERNAL USE ONLY

Table G.2 — Example of a self-assessment matrix for the overall impact of possible RRI actions, based on specific criteria for product development. Assessment is done using emoticons, as in a sentiment analysis

Impact of RRI actions on criteria	Impact of RRI A1	Impact of RRI A2	Impact of RRI A3
Q1: Scientific & Technological line of evidence	🙂	🙂	😐
Q2: Ethical & Societal LoE	🙂	🙂	🙂
Q3: Strategic LoE	😐	😐	🙂
Q4: Organizational LoE	😐	😐	🙂
Q5: Economic LoE	☹	😐	🙂
Q6: Direct costs of the RRI action	🙂	🙂	☹

Annex H
(Informative)

Examples of RRI key performance indicators

The identification and measurement of indicators to monitor the implementation of RRI principles and actions at the company level could facilitate long-term adoption of RRI. In particular, it could help to align RRI activities with key business drivers and processes, stimulate continuous improvement of RRI "performances", and allow consideration of RRI aspects in a company's usual sustainability reporting.

RRI key performance indicators (KPIs) can be monitored separately or they can be integrated into/aligned with wider existing company KPI sets or dashboards by connecting responsible business cases to those sets or dashboards.

The PRISMA project developed, selected, and tested a set of 10 RRI KPIs together with the eight pilot companies. The KPIs are based on literature reviews, interactive sessions with the individual pilot companies, in-field observation and auditing, monitoring of RRI-KPI within the pilot companies, meta-analysis of data, and self-reflection and auditing by internal and external reviewers before a pilot started and after it ended.

An additional KPI (outcome-focused measures) was added to these guidelines to introduce more business-oriented elements (costs, risks, and benefits of RRI for company financial operations). This KPI should be seen as an initial proposal that would need to be tested in real cases. In addition, the complexity of RRI and the long-term, mediated nature of most of the associated outcomes might challenge the measuring of this KPI.

These indicators should be considered as indicative and as a starting point for developing more specific KPIs tailored to a company's specific needs. Table G.3 provides an overview of PRISMA's RRI KPIs. Further details are provided in PRISMA deliverables D3.1, D3.2, and D3.3.

CEN/WS 105 FOR INTERNAL USE ONLY

Table G.3 — Examples of quantitative indicators to monitor implementation of RRI principles at the company level

	Item	RRI KPIs	Examples of quantitative parameters to measure KPIs
Anticipation & Reflection	1	Awareness of public and social values	- Number of training sessions/meetings per year aiming to address public and social values within the company's strategic innovation plans
	2	Awareness of ethical issues of innovations	- Number of training sessions/meetings per year aiming to integrate social and ethical values into specific R&I/R&D projects
	3	Integration of public and social values into company innovations	- RRI principles formally integrated into the company's mission and vision (e.g., ethical code of conduct)
			- Number of R&I/R&D projects per year in which public and social values are actively included in innovation strategies and technological design
	4	Anticipation of social effects in the company innovations	- Number of R&I/R&D projects per year in which internal/external stakeholders were involved from the early stages of product development
			- Number of consultancy initiatives with other innovators and external advisors to discuss and identify social impacts of R&I/R&D projects

	Item	RRI KPIs	Examples of quantitative parameters to measure KPIs
Inclusion	5	Stakeholder engagement	- Number of stakeholder engagement and user experience initiatives organized per year by the company
			- Number of R&I/R&D projects per year in which active external stakeholder engagement is integrated into in R&I/R&D plans
			- Number of R&I/R&D projects per year in which engagement with end-users was performed
			- Number of employee engagement initiatives (e.g., training sessions) organized per year by the company
	6	Diversity and gender equality	- Percentage of men and women involved in R&I/R&D functions/teams in the company
			- Percentage of individuals from minority and vulnerable groups within the company
Responsiveness	7	Transparency and accountability about RRI-relevant choices	- Formal communication strategy established at company level to ensure most relevant RRI choices are explained in key company documents or on the website
			- Number of patents per year aiming to integrate non-financial values
			- Number of open access publications
			- Number of events, webpages, social media channels, etc. disseminating project results to the general public
	8	Learning mechanisms to address public and social values in product development	- Number of user-centred approaches per year formally integrated into the company innovation model (e.g., user-centred design, co-creation)
			- Number of user experience tools carried out per year to respond to (new) societal demands and developments
	9	Capacity to align to societal goals	- Number of socially/ethically oriented products/services in the market per year
	10	Active monitoring of RRI impacts	- Percentage of R&I/R&D projects per year that apply impact analysis strategies for their product/services (e.g., risk management, ethical/social impact analysis, etc.)
			- Number of formal external auditing procedures (at least yearly basis) in place to monitor non-financial values of the company
Purposes of Innovation	11	Outcome-focused measures (backward- and forward-looking)	- Number of new product/service innovations per year arising from stakeholder engagement and user experience initiatives
			- Percentage of sales of products/services developed with formal RRI processes per year
			- Yearly customer satisfaction index (CSI)
			- Improvement in net promoter score (NPS) per year
			- Improvement in employee engagement index per year

CEN/WS 105 FOR INTERNAL USE ONLY

	Item	RRI KPIs	Examples of quantitative parameters to measure KPIs
			- Direct/indirect costs of RRI engagement initiatives per year
			- Adoption of brand value strategies aimed at socially responsible products/services
			- Number of employees recruited per year for developing socially responsible products/services

CEN/WS 105 FOR INTERNAL USE ONLY

Annex I
(Informative)

Informative resources from other initiatives

Example of definition and use of societal readiness levels

The concept of societal readiness level (SRL) was inspired by the notion of technology readiness level (TRL), which was widely adopted in science and technology innovation strategies (e.g., Horizon 2020 framework programme). Currently, no unique definition of SRL exists, though it is broadly interpreted as a way to determine an R&I project's maturity regarding societal needs and expectations.

Table I.1 provides an example of SRL definitions from the Innovation Fund Denmark[21] and further revised by Bruno et al. (2020), who defined SRL as "*a way of assessing the level of societal adaptation of, for instance, a particular social project, a technology, a product, a process, an intervention, or an innovation (whether social or technical) to be integrated into society*". Other examples are provided by the EU project NewHorizzon 2020 (newhorrizon.eu/thinking-tool) and the SRL thinking tool (thinkingtool.eu).

The table is an initial attempt to design a practical definition of SRLs that could help in defining the RRI maturity level of an innovation product or an organization, as recommended in the RRI roadmap proposed in these guidelines.

Table I.1 — Example definitions of societal readiness levels

Societal readiness level	Description
SRL1	Identification of the generic societal need and associated readiness aspects
SRL2	Formulation of proposed solution concept and potential impacts; appraisal of societal readiness issues; identification of relevant stakeholders for the development of the solution
SRL3	Initial sharing of the proposed solution with relevant stakeholders (e.g., through visual mock-ups); a limited group of society knows the solution or similar initiatives
SRL4	Solution validated through pilot testing in controlled environments to substantiate proposed impacts and societal readiness; a limited group of society tests the solution or similar initiatives
SRL5	Solution validated through pilot testing in real or realistic environments and by relevant stakeholders; society knows the solution or similar initiatives but is not aware of their benefits
SRL6	Solution demonstrated in real world environments and in cooperation with relevant stakeholders to gain feedback on potential impacts; society knows the solution or similar initiatives and awareness of their benefits increases
SRL7	Refinement of the solution and, if needed, retesting in real world environments with relevant stakeholders; society is completely aware of the solution's benefits, a part of society starts to adopt similar solutions
SRL8	Targeted solution, as well as a plan for societal adaptation, is complete and qualified; society is ready to adopt the solution and has used similar solutions on the market
SRL9	Actual solution proven in relevant societal environments after market launch; society is using the solution available on the market

CEN/WS 105 FOR INTERNAL USE ONLY

[21] https://innovationsfonden.dk/sites/default/files/2018-08/societal_readiness_levels_-_srl.pdf

Example of ethical principles for a specific R&I field

Table I.2 provides an example of ethical principles and values for the materiality analysis in a specific R&I field, using the case of artificial intelligence and big data.

These principles were taken from the EU-funded SHERPA project and aligned with the ethical principles of the European Commission High Level Expert Group on Artificial Intelligence. Further information on the practical implementation of these principles is provided in Ryan (2019a,b).

Table I.2 — Example of ethical principles in the field of artificial intelligence

High-level requirements and sub-requirements
1 Human agency, liberty, and dignity: Positive liberty, negative liberty, and human dignity
2 Technical robustness and safety: Including resilience to attack and security, fallback plan and general safety, accuracy, reliability, and reproducibility
3 Privacy and data governance: Including respect for privacy, quality and integrity of data, access to data, and data rights and ownership
4 Transparency: Including traceability, explainability, and communication
5 Diversity, non-discrimination, and fairness: Avoidance and reduction of bias, ensuring fairness and avoidance of discrimination, and inclusive stakeholder engagement
6 Individual, societal, and environmental well-being: Sustainable and environmentally friendly systems, individual well-being, social relationships and social cohesion, and democracy and strong institutions
7 Accountability: Auditability, minimization and reporting of negative impact, internal and external governance frameworks, redress, and human oversight

CEN/WS 105 FOR INTERNAL USE ONLY

Bibliography

Terms and definitions, principles for RRI implementation

EN ISO 26000, Guidance on social responsibility.

ISO 31000, Risk management – Guidelines.

ISO 45001, Occupational health and safety management systems – Requirements with guidance for use.

EN ISO 9001, Quality management systems – Requirements.

ISO/DIS 56000, Innovation management – Fundamentals and vocabulary.

ISO/FDIS 56002, Innovation management – Innovation management system – Guidance.

Series CEN/TS 16555, Innovation management.

Series CWA 17145, Ethics assessment for research and innovation.

IWA 26 Using ISO 26000:2010, in management systems.

UNI/PdR 27, Guidelines for management and processes development for responsible innovation.

UNI/PdR 18, Social responsibility in organizations - Guidance to the application of UNI ISO 26000.

PAS 440:2020, Responsible innovation guide, BSI standards limited 2020, ISBN 978 0 539 04613 7

Carayannis, E. G., & Campbell, D. F. (2009). 'Mode 3'and'Quadruple Helix': Toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management, 46*(3–4), 201–234. https://doi.org/10.1504/IJTM.2009.023374

Collingridge, D. (1980). *The social control of technology*. London: Francis Printer.

Decker, M., & Ladikas, M. (Eds.). (2004). *Bridges between science, society and policy: Technology assessment, methods and impacts*. Berlin: Springer-Verlag. https://doi.org/10.1007/978-3-662-06171-8

Engage2020 Consortium. (2015). *Engage2020 project, science, society and engagement: An e-anthology* http://engage2020.eu/media/Engage2020_withVideo.pdf

European Commission. (2011). *A renewed EU strategy 2011-14 for corporate social responsibility* [Communication: COM(2011) 681 final].

European Union. (2014). *Rome declaration on responsible research and innovation in Europe*.

Nathan, C. (2016). *Report on ethicists' views* [PRISMA project, Deliverable 2.3].

Sonck, M., Asveld, L., Landeweerd, L., & Osseweijer, P. (2017). Creative tensions: Mutual responsiveness adapted to private sector research and development. *Life Sciences, Society and Policy*, *13*(1), 14. https://doi.org/10.1186/s40504-017-0058-6

Stahl, B., 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. http://dx.doi.org/10.3390/su9061036

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy, 42*(9), 1568–1580. https://doi.org/10.1016/j.respol.2013.05.008

TIGTech. (2020). *Trust & tech governance: Toward a more engaged, collaborative, communicative approach*. SocietyInside and Fraunhofer Institute for Systems and Innovation Research. www.tigtech.org

Van de Hoven, J. (Ed.). (2013). *Options for strengthening responsible research and innovation*. Brussels: European Commission. https://doi.org/10.2777/46253

CEN/WS 105 FOR INTERNAL USE ONLY

Von Schomberg, R. (2012). Prospects for technology assessment in a framework of responsible research and innovation. In M. Dusseldorp & R. Beecroft (Eds.), *Technikfolgen abschätzen lehren* (pp. 1–19). VS Verlag für Sozialwissenschaften. https://doi.org/https://doi.org/10.1007/978-3-531-93468-6_2

Top management commitment, motivations for RRI

British Standards Institution. (2020). *PAS440:2020: Responsible Innovation* [Guide]. BSI. ISBN 978 0 539 04613 7

Chatfield, K., Borsella, E., Mantovani, E., Porcari, A., & Stahl, B. (2017). An investigation into risk perception in the ICT industry as a core component of responsible research and innovation. *Sustainability*, *9*(8), 1424. http://dx.doi.org/10.3390/su9081424

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. http://dx.doi.org/10.3390/su9101719

Garst, J., Blok, V., Jansen, L., & Omta, O. (2017). Responsibility versus profit: The motives of food firms for healthy product innovation. *Sustainability*, *9*(12), 2286. http://dx.doi.org/10.3390/su9122286

Gurzawska, A., Mäkinen, M., & Brey, P. (2017). Implementation of responsible research and innovation (RRI) practices in industry: Providing the right incentives. *Sustainability*, *9*(10), 1759. http://dx.doi.org/10.3390/su9101759

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. http://dx.doi.org/10.3390/su9050721

Martinuzzi, A., Blok, V., Brem, A., Stahl, B., & Schönherr, N. (2018). Responsible research and innovation in industry – Challenges, insights and perspectives. *Sustainability, 10*(3), 702. https://doi.org/10.3390/su10030702

Porcari, A., Borsella, E., & Mantovani, E. (2016). *A framework for implementing responsible research and innovation in ICT for an ageing society* [Report]. Responsible Industry Project. ISBN 978-88-98935-11-6

Porcari, A., Pimponi, D., Borsella, E., & Mantovani, E. (2016). *Report on conditions for success of RRI uptake by industry* [PRISMA project, Deliverable 5.1].

Van de Poel, I., Asveld, L., Flipse, S., Klaassen, P., Scholten, V., & Yaghmaei, E. (2017). Company strategies for responsible research and innovation (RRI): A conceptual model. *Sustainability*, *9*(11), 2045. http://dx.doi.org/10.3390/su9112045

CEN/WS 105 FOR INTERNAL USE ONLY

Context and materiality analysis

Klaassen, P., Smit, K., Ng-A-Tham, J., Groenewold, M., Westra, J., Nathan, C., Asveld, L., Van de Poel, I., Flipse, S., Maia, M., Mantovani, E., & Porcari, A. (2017) *Workplans of PRISMA pilots* [PRISMA project, Deliverable 1.2].

Transnational Network for Social Innovation Incubation FP7 Project. (2013). *Transition SIJ toolbox*.

Van de Poel, I., Asveld, L., Flipse, S., Klaassen, P., Scholten, V., & Yaghmaei, E. (2017). Company strategies for responsible research and innovation (RRI): A conceptual model. *Sustainability*, *9*(11), 2045. http://dx.doi.org/10.3390/su9112045

Experiment and engage

AccountAbility. (2015). *AA1000 stakeholder engagement standard 2015*.

Brown, J., & Isaacs, D. (2005). *World café – Shaping our futures through conversations that matter*. San Fransisco: Berrett-Koehler Publishers, Inc.

Bryman, A. (2012). *Social research methods* (4th ed.). New York: Oxford University Press, Inc. ISBN: 978-0-19-958805-3

BSR. (2019). *Five-step approach to stakeholder engagement*. https://www.bsr.org/en/our-insights/report-view/stakeholder-engagement-five-step-approach-toolkit

Compass Project. *Responsible innovation good practice cases*. https://innovation-compass.eu/training/cases/

Engage2020. (2014). *Engage2020: D3.2 Public engagement methods and tools*. http://engage2020.eu/media/D3-2-Public-Engagement-Methods-and-Tools-3.pdf

“Engage2020 (2015). *World café*. Action catalogue. http://actioncatalogue.eu/method/7402”

Guelke, J. (2018) *Final Report on Pilots* [PRISMA project, Deliverable 2.4].

Kuenkel, P., Gerlach, S., & Frieg, V. (2011). *Working with stakeholder dialogues – Key concepts and competnecies for achieving common goals: A practical guide for change agents from public sector, private sector and civil society*. Collective Leardership Institute. ISBN: 978-3-8391-8302-1

Maia, M., & Coenen, C. (2017). *A practical guide for change agents from public sector, private sector and covil society* [PRISMA project, Deliverable 4.1].

Maia, M., & Coenen, C. (2018). *Final report on the stakeholder dialogues* [PRISMA project, Deliverable 4.2].

Morgan, D. (Ed.). (1993). *Successful focus groups – Advancing the state of the art*. Newbury Park: Sage. ISBN: 9780803948747

Morris, J., & Baddache, F. (2012). *Back to basics: How to make stakeholder engagement meaningful for your company*. BSR.

Porcari, A., Pimponi, D., Borsella, E., & Mantovani, E. (2018). *PRISMA RRI-CSR roadmap – Part A – Exemplar Roadmap* [PRISMA project, Deliverable 5.2].

Porcari, A., Pimponi, D., Borsella, E., & Mantovani, E. (2018). *PRISMA RRI-CSR roadmap – Part B – Pilots roadmaps* [PRISMA project, Deliverable 5.2].

Ramaswamy, V., & Ozcan, K. (2014). *The co-creation paradigm*. Stanford, Calif.: Stanford Univ. Press. ISBN: 978-0-8047-8915-8

Ravn, T., & Mejlgaard, N. (2014). *Inventory of PE mechanisms and initiatives D.1.1*. https://tuhat.helsinki.fi/ws/portalfiles/portal/156529701/FINAL_D.1.1_report_PE2020_1.pdf

The World Café. (2021). *Services*. http://www.theworldcafe.com/services-programs/

Van de Poel, I., Asveld, L., Flipse, S., Klaassen, P., Kwee, Z., Maia, M., Mantovani, E., Nathan, C., Porcari, A., & Yaghmaei, E. (2020). Learning to do responsible innovation in industry: Six lessons. *Journal of Responsible Innovation*, *7*(3), 697–707. https://doi.org/10.1080/23299460.2020.1791506

CEN/WS 105 FOR INTERNAL USE ONLY

Validation

Flipse, S. M., Van Dam, K. H., Stragier, J., Oude Vrielink, T. J. C., & Van der Sanden, M. C. A. (2015). Operationalizing responsible research & innovation in industry through decision support in innovation practice. *Journal on Chain and Network Science*, *15*(2), 135–146. https://doi.org/10.3920/JCNS2015.x004

Flipse, S. M., Van der Sanden, M. C. A., & Osseweijer, P. (2014). Improving industrial R&D practices with social and ethical aspects: Aligning key performance indicators with social and ethical aspects in food technology R&D. *Technological Forecasting and Social Change*, *85*, 185–197. https://doi.org/10.1016/j.techfore.2013.08.009

Flipse, S. M., Van der Sanden, M. C. A., Van der Velden, T., Fortuin, F. T. J. M., Omta, S. W. F. (Onno), & Osseweijer, P. (2013). Identifying key performance indicators in food technology contract R&D. *Journal of Engineering and Technology Management*, *30*(1), 72–94. https://doi.org/10.1016/j.jengtecman.2012.11.003

Linkov, I., Satterstrom, F. K., Kiker, G., Batchelor, C., Bridges, T., & Ferguson, E. (2006). From comparative risk assessment to multi-criteria decision analysis and adaptive management: Recent developments and applications. *Environment International*, *32*(8), 1072–1093. https://doi.org/10.1016/j.envint.2006.06.013

Porcari, A., Borsella, E., & Mantovani, E. (2015). *A framework for implementing responsible research and innovation in ICT for an ageing society*. Agra Editrice srl. ISBN 978-88-98935-11

Porcari, A., Pimponi, D., Borsella, E., Klaassen, P., Maia, M. J., & Mantovani, E. (2020). 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*. Routledge. https://doi.org/https://doi.org/10.4324/9780429298998

Stahl, B., 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. http://dx.doi.org/10.3390/su9061036

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, *42*(9), 1568–1580. https://doi.org/10.1016/j.respol.2013.05.008

Strand, R., Spaapen, J., Bauer, M. W., Hogan, E., Revuelta, G., Stagl, S., Lino, P., & Pereira, Â. G. (2015). *Indicators for promoting and monitoring responsible research and innovation: Report from the Expert Group on Policy Indicators* (Directorate-General for Research and Innovation, Ed.). Luxembourg: European Union. https://doi 10.2777/9742

Yaghmaei, E. (2015). Addressing responsible research and innovation to industry – Introduction of a conceptual framework. *SIGCAS Computers & Society*, *45*(3), 294–300. https://doi.org/https://doi.org/10.1145/2874239.2874282

Yaghmaei, E. (2018). Responsible research and innovation key performance indicators in industry: A case study in the ICT domain. *Journal of Information, Communication and Ethics in Society*, *16*(2), 214–234. https://doi.org/10.1108/JICES-11-2017-0066

Yaghmaei, E., & Flipse, S. (2016). *Assessment of added value of RRI in industry based on pilots and additional projects and KPIs* [PRISMA project, Deliverable 3.1].

Yaghmaei, E., Mantovani, E., Porcari, A., & Flipse, S. (2019). Monitoring the value of RRI in industrial nanotechnology innovation projects. In I. Eisenberger, A. Kallhoff, & C. Schwarz-Plaschg (Eds.), *Nanotechnology: Regulation and public discourse* (pp. 147–175). Rowman & Littlefield. ISBN: 978-1786608932

CEN/WS 105 FOR INTERNAL USE ONLY

Roadmap design

Ahlqvist, T., Valovirta, V., & Loikkanen, T. (2012). Innovation policy roadmapping as a systemic instrument for forward-looking policy design. *Science and Public Policy*, *39*(2), 178–190. https://doi.org/https://doi.org/10.1093/scipol/scs016

Compass Project. (2019). Comparative assessment of sector roadmaps: Indicative findings [Deliverable D2.6]. https://innovation-compass.eu/wp-content/uploads/2019/04/D2.6-Compartive-assessment-report_FINAL.pdf

Cosner, R., Hynds, E., Fusfeld, A., Loweth, C., Scouten, C., & Albright, R. (2007). Integrating roadmapping into technical planning. *Research Technology Management*, *50*(6), 31–48. http://www.jstor.org/stable/24135252

Deloitte. (2010). *UN Global Compact Management Model*. https://www.unglobalcompact.org/library/231

Phaal, R., Farrukh, C. J. P., & Probert, D. R. (2004). Technology roadmapping — A planning framework for evolution and revolution. *Technological Forecasting and Social Change*, *71*(1–2), 5–26. https://doi.org/10.1016/S0040-1625(03)00072-6

SMART-map Project. (2018). *Short public report about project outcomes* [Deliverable 1.3]. http://projectsmartmap.eu/wp-content/uploads/2018/10/D1.3_ShortPublicReport.pdf

Technology Roadmapping: http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/roadmap/

Annex - RRI actions: Focus on the embedded ethicist

Bruce, C. R., Peña, A., Kusin, B. B., Allen, N. G., Smith, M. L., & Majumder, M. A. (2014). An embedded model for ethics consultation: Characteristics, outcomes, and challenges. *AJOB Empirical Bioethics, 5*(3), 8–18. https://doi.org/10.1080/23294515.2014.889775

Bruno, I., Schiavone Panni, A., Marchetti, V., Molinari, F., and Valente Covino, B. (2020). *A multi-dimensional framework to evaluate the innovation potential of digital public services* (G. Misuraca & G. Lobo, Eds.). *Publications Office of the European Union*. Luxembourg. ISBN 978-92-76-21455-7. https://doi.org/10.2760/09628

Clegg, S., Kornberger, M., & Rhodes, C. (2007). Business ethics as practice. *British Journal of Management, 18*(2), 107–122. https://doi.org/10.1111/j.1467-8551.2006.00493.x

Progressive Project. *Guidelines for user co-production in standardization* [Deliverable D9.1].

Ryan, M. (2019a). Ethics of public use of AI and Big Data. *ORBIT Journal*, *2*(2). https://doi.org/10.29297/orbit.v2i1.101

Ryan, M. (2019b). Ethics of using AI and Big Data in agriculture: The case of a large agriculture multinational. *ORBIT Journal*, *2*(2). https://doi.org/10.29297/orbit.v2i2.109

Van Gorp, A., & Van der Molen, S. (2011). Parallel, embedded or just part of the team: Ethicists cooperating within a European security research project. *Sci Eng Ethics*, *17*(1), 31–43. https://doi.org/doi: 10.1007/s11948-009-9187-5

CEN/WS 105 FOR INTERNAL USE ONLY