

# Deliverable

## 2.6

Comparative Assessment of Sector Roadmaps:  
Indicative Findings





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## Table of Contents

<b>1. Executive Summary .....</b>	<b>3</b>
<b>2. The COMPASS Project and Responsible Innovation .....</b>	<b>5</b>
<b>3. Comparative Assessment: Themes and Issues .....</b>	<b>10</b>
<b>4. Conclusions .....</b>	<b>19</b>

## Preliminary Note

This report focuses on what are described as commercial enterprises. That is SMEs (Small and Medium Size Enterprises) involved in ‘innovation’ – with innovation defined by Wilford et al (2016) as ‘novelty in processes or outcomes that results (in economic or social contexts) from thought, activity and/or the manner of use (or provision) of products and/or services’.<sup>1</sup>

For two of the sectors, viz. Cybersecurity and Nanotechnology, the products and services that result from the innovation are marketed almost exclusively to (private, public or third sector) corporate customers that include other SMEs and larger enterprises. For the Biomedicine and ICT (Information and Communication Technology) for an Ageing Society sectors the position is more nuanced with the latter, in particular, markets that include growing numbers of individuals. These individuals are in many cases ‘patients’ (and are occasionally noted as such) and are referred to in the text as ‘consumers or users’.

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<sup>1</sup> Wilford S, Fisk M and Stahl B (2016) ‘Guidelines for Responsible Research and innovation’, GREAT Project, De Montfort University, Leicester.

# 1. Executive Summary

The objectives of the COMPASS project were concerned to provide evidence of and promote ‘better uptake’ of Responsible Research and Innovation (RRI) in three key sectors - each of which was seen as linking to particular societal challenges. These sectors are Cybersecurity, Nanotechnology and Biomedicine. ‘Roadmaps’ were developed for each of these.<sup>2</sup> The focus was on SMEs within those sectors.

This report identifies common themes and issues (and some divergences) that help our understandings regarding their views and practices on ‘responsible innovation’. In addition the report draws on outcomes of the predecessor ‘Responsible Industry’ project that developed a framework for RRI in ‘ICT for an Ageing Society’.<sup>3</sup> Hence the text that follows, depending on the specific context, refers to *four* sectors and *three* roadmaps. Some key challenges relating to these are noted in Table 1. The term ‘responsible innovation’ is used throughout but with specific reference to RRI as necessary.

**Table 1:** Sectors in Focus and some Associated Challenges

Sector	Challenges
Cybersecurity	Protecting individuals, businesses and services against cyber-threats and their consequences in terms of service breakdowns, disruption to manufacturing and distribution systems, financial and reputational loss, identity theft, fake news, etc.
Nanotechnology	Avoiding damage to the environment; promoting better air and water quality; ensuring safety when seeking to realise the potential of new products (e.g. for coatings and precision medicine); avoiding the danger to people of ingesting nano-particles.
Biomedicine	Maintaining health and wellbeing in clinic and community contexts through ICT and innovations around precision medicine (e.g. for particular diseases) with view to empowering clinicians, health practitioners and patients / service users.
ICT and an Ageing Society	Developing products and services that help support or promote the health and well-being of an ageing society. <sup>4</sup>

<sup>2</sup> The roadmaps are available on the COMPASS website at [www.innovation-compass.eu](http://www.innovation-compass.eu)

<sup>3</sup> See [www.responsible-industry.eu](http://www.responsible-industry.eu)

<sup>4</sup> It must be noted that the Responsible Industry project, whilst concerned to develop a framework to guide ‘ICT for an Ageing Society’ focused on technologies and devices concerned with health monitoring rather than a wider range of technologies relating to e.g. dwelling design or older people in the workplace. See Stahl et al (2017) ‘Responsible Industry: Benefits of Responsible Research and Innovation in ICT for an Ageing Society’ De Montfort University, Leicester. ‘ .

The report offers an initial discussion around ‘Governance and Ethics’ – seen as foundational (or ‘fundamental’) elements of RRI. These are addressed in the broader context of CSR and of standards.

An overlap or congruency between RRI and CSR is noted. This provides an important backdrop to the ensuing comparative assessment. Specific comment, for each of the sectors, is then made in relation to three themes viz. ‘Openness and Commercial Confidentiality’, ‘Risk and Reflexivity’ and ‘Gender and Ethnic Diversity’.

Four key affirmations are then put forward as a result of this comparative assessment – seen as potentially providing a basis for further research, discussion and debate. These are

**CA1** The comparative assessment indicates an ethical consciousness among all of the commercial enterprises engaged in the project.

**CA2** The ethical consciousness that was evident reflects understandings of ‘responsibility’ that in many cases will have been influenced by notions around CSR.

**CA3** A key focus of attention relates to ‘risk’ and, therefore, to anticipation and ‘reflexivity’ (key elements of both RRI and CSR).

**CA4** In the context of commercial confidentiality, the RRI call to greater openness is in part inappropriate.

Finally a note is added that points to the findings being potentially generalisable to other commercial sectors (at least for SMEs) in respect of the nature of the ‘ethical consciousness’ that was present in the four sectors studied. To help foster this ethical consciousness it may be appropriate for endeavours around RRI to be subsumed within broader understandings that relate to CSR.

## 2. The COMPASS Project and Responsible Innovation

The COMPASS project commenced in mid 2016. It is funded by the European Commission under the GARRI programme on Responsible Research and Innovation (RRI). The European Commission definition of RRI is as ‘an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation’.<sup>5</sup>

### ***Thematic Elements and the Link with Corporate Social Responsibility (CSR)***

The thematic elements of RRI, as defined by the European Commission in 2012, are listed in Table 1.<sup>6</sup> Subsequent work around those elements has pointed to their relevance in the context of ‘responsible innovation’ but also have pointed to the omission of what Wilford et al (2016) labelled ‘environmental stewardship’ and, more broadly, to RRI’s uncertain position in relation to Corporate Social Responsibility (CSR).<sup>7,8</sup>

**Table 1:** RRI Elements (per the European Commission)

European Commission Thematic Elements of RRI	
<b>Public Engagement</b>	Choose Together
<b>Gender Equality</b>	Unlock the Full Potential
<b>Science Education</b>	Creative Learning, Fresh Ideas
<b>Open Access</b>	Share Results to Advance
<b>Ethics</b>	Doing the Right Thing
<b>Governance</b>	Design Science with and For Society

It can be argued that CSR is a broader concept than RRI, with the European Commission defining CSR, albeit somewhat vaguely, as referring to ‘companies taking responsibility for their impact on society’ – though adding that it (CSR) is ‘important for the sustainability, competitiveness and innovation of EU enterprises’.<sup>9</sup> One of the guidelines that the

<sup>5</sup> <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

<sup>6</sup> European Commission (2012) ‘Responsible Research and Development: Europe’s Ability to Respond to Societal Challenges’, Publications Office, Luxembourg.

<sup>7</sup> Wilford et al (2016) op cit.

<sup>8</sup> Van de Poel I, Asveld L, Flipse S, Klaasen P, Scholten V and Yaghmael EI (2017) ‘Company Strategies for Responsible Research and Innovation (RRI): A Conceptual Model’, Sustainability 9 doi:10.3390/su9112045.

<sup>9</sup> See [http://ec.europa.eu/growth/industry/corporate-social-responsibility\\_en](http://ec.europa.eu/growth/industry/corporate-social-responsibility_en)

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Commission's CSR strategy is built on can be noted as that of the ISO regarding Social Responsibility (ISO 26000 highlighted later in this Comparative Analysis).<sup>10</sup>

The EU Multi Stakeholder Forum on CSR has observed that CSR is 'a topic which extends across several policy areas [and] has a fundamental role in ensuring economic growth while concurrently mitigating (the) social and environmental impacts of business'.<sup>11</sup> And, crucially, European Directive 2014/95/EU (on 'the disclosure of non-financial and diversity information by certain large undertakings and groups') points to CSR's multidimensional nature, in relation to which there are requirements for companies to be transparent regarding e.g. respect for human rights, actions taken to ensure gender equality, dialogues with local communities, and instruments to fight corruption and bribery.

The argument that CSR is wider than RRI is supported by Schroeder and Iatridis (2016). They referred to the former as the 'biggest and possibly most powerful concept' by virtue of seeking to address the whole 'cycle of business life'.<sup>12</sup> Pellé and Reber (2015) asserted that the 'CSR framework *already* [our emphasis] provides a basis to develop the conception of responsibility in innovation'. And van de Poel et al (2017) pointed to CSR being a 'more established concept in business and industry' than RRI – with the latter potentially 'superimposed' on the former and matching in many of its elements.

Seemingly going the other way (i.e. positing RRI as wider than CSR) Martinuzzi et al (2018) saw RRI 'building on and going *beyond* [our emphasis] CSR' - expanding 'on concepts and theoretical approaches previously used'. RRI, they suggested (unlike CSR), seeks to embed 'responsibility' at 'very early stages of research and innovation' with 'the potential to bring CSR from the margins into core strategic decision processes'. Such breadth might, however, not be to RRI's advantage if, per D'Andrea et al (2018), it is not seen as a strength. They suggested that RRI is 'too broad in scope and vague in its contents', adding that 'the models developed to make RRI implementable are either too ambitious and unrealistic or are over-simplistic [tending] to overlook the complex barriers ... which may make RRI culturally extraneous, irrelevant, ineffective or unsustainable in the long run'.<sup>13</sup>

In the context of this comparative assessment, any battle for the positioning of a newer RRI approach into the more established world of CSR must remain a secondary matter. But it is a key part of the backdrop to responsible innovation in view of 'responsibility' being a key feature in both. Such responsibility carries, of course, a strong ethical component. For RRI, therefore, we clearly note the elements pertaining to 'Governance' and 'Ethics'.

Governance and ethics have been posited, in the work of COMPASS, as foundational (or 'fundamental'). In other words they were seen as necessarily underpinning the work of commercial enterprises where good governance would include attention to ethical issues

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<sup>10</sup> International Organization for Standardization (2014) 'ISO 26000: Guidance on Social Responsibility', Geneva.

<sup>11</sup> See <http://ec.europa.eu/DocsRoom/documents/8774/attachments/1/translations>

<sup>12</sup> Schroeder D and Iatridis K. (2016) The Basics of Responsible Research and Innovation. In: Responsible Research and Innovation in Industry. Springer Briefs in Research and Innovation Governance. Springer, Cham

<sup>13</sup> D'Andrea L, Marta FL, Khama N and Vase S (2018) 'Report on the Literature Review' Fit4RRI Project Deliverable D1.1.

within which public engagement, gender equality, science education and open access would play a part.

Within RRI there is also an emphasis on ‘anticipation’ and ‘reflexivity’. These ‘dimensions’ are two of four pointed to by Stilgoe et al (2013), the others being ‘inclusion’ and ‘responsiveness’.<sup>14</sup> Both ‘anticipation’ and ‘reflexivity’ are, of course, relevant to reducing and managing risk, and to remedying unanticipated outcomes of processes or actions. Risk is a key issue (with ‘reflexivity’) that is discussed below. Reflexivity has been defined as ‘the process by which experience and knowledge continually influences attitudes, behaviours and actions and *vice versa*. It may be ‘first order’ relating to particular knowledge for a time or event; or ‘second order’ relating to new knowledge and understanding’.<sup>15</sup> It is illustrated in Fig 1.<sup>16</sup>

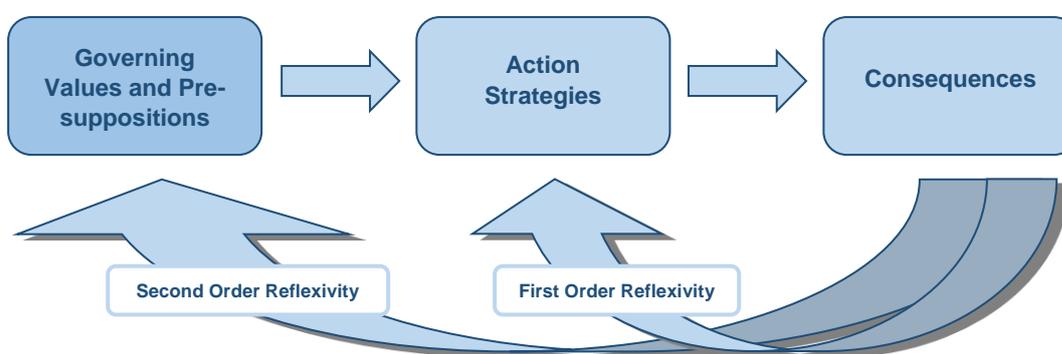


Figure 1: Reflexivity (per Gianni and Goujon)<sup>13</sup>

### The Roadmaps

Roadmaps were produced for three sectors of innovation. Each was seen as linking to particular societal challenges. These sectors are Cybersecurity, Nanotechnology and Biomedicine. To these is added ICT for an Ageing Society which was addressed separately in the Responsible Industry project.<sup>17</sup>

The COMPASS work that led to the setting out of the roadmaps was informed by primary and secondary research and drew on multiple sources. The primary research included workshops and personal interviews with senior staff in commercial enterprises in the three sectors. These are reported on in individual roadmaps and other COMPASS Deliverables.<sup>18</sup>

<sup>14</sup> Stilgoe J, Owen R and Macnaghten P (2013) ‘Developing a Framework for Responsible Innovation’ Research Policy 42 pp1568-1580.

<sup>15</sup> Wilford et al (2016) op cit.

<sup>16</sup> Gianni R and Goujon P (2013) ‘Analytical Grid: Current Theory and Practice (in RRI)’ GREAT Project.

<sup>17</sup> Porcari et al (2015) op cit.

<sup>18</sup> Fisk M, Flick C, Bonneau M, Jegou F, Gouache C and Ogoh G (2018) ‘Responsible Innovation Lab Report and Roadmap: Report 1 – Nanotechnology’; Fisk M, Flick C, and Ogoh G (2018) ‘Responsible Innovation Lab Report and Roadmap: Report 2 – Cybersecurity’; Fisk M, Flick C, Esteban Franco A and Ogoh G (2018) ‘Responsible Innovation Lab Report and Roadmap: Report 3 –Biomedicine’ (all)

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This comparative assessment identifies common issues and some divergences between the four sectors as noted in the roadmaps and in published work from the Responsible Industry project. It helps our understandings regarding the breadth of views and practices around 'responsible innovation' and offers a forward view as to the extent to which these may have relevance to or resonate with other sectors.

The COMPASS project is completing its work through testing and revising the roadmaps for the three sectors and producing educational and training materials (regarding responsible innovation) and a self-test tool. These materials will help corporate enterprises in the four sectors (whether in public ownership, for profit or not for profit), to further consider some specific ethical and governance issues that impact (or will impact) on them as they pursue sustainable commercial goals.

### ***Exploring 'Responsible Innovation'***

The idea of responsible innovation is not new. von Schomberg offered a three hundred year old reference point as that of Bartolomeu Lourenço de Gusmão who, in his efforts to develop a flying machine in the 1700s, reported its potential benefits in terms of transport and also its use in war.<sup>19</sup>

The term CSR is generally attributed to Howard Bowen.<sup>20</sup> CSR's emergence as a specific concept is documented in the roadmaps. The overlaps with RRI were noted above. For CSR, the more recent reference points offered in those roadmaps relate to Robert K. Merton, a sociologist, and Karl Popper, a philosopher (see Fig 2).

In 1942 Merton affirmed that 'scientists have been jarred into a state of acute self-consciousness: consciousness of self as an integral element of society with corresponding obligations and interests'.<sup>21</sup> He railed against 'sanguine isolationism' whereby 'he' [sic, the scientist] might 'regard himself as independent of society'. Merton offered five canons which have and retain relevance to 'responsible innovation'. These included an 'ethos of science' demanding improved knowledge linked with a moral compass; 'disinterestedness' in order to remove judgements that may be biased; and 'organised skepticism' so that questions of fact may be asked about the 'potentialities concerning every aspect of nature and society'.

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COMPASS Project, Vienna University of Economics and Business, 2018. Accessible at [www.innovation-compass.eu](http://www.innovation-compass.eu)

<sup>19</sup> von Schomberg R (2013) 'A Vision of Responsible Innovation' in: Owen R, Heintz M and Bessant J (Eds.) 'Responsible Innovation' London: John Wiley pp51-74.

<sup>20</sup> Pellé S and Reber B (2015) 'Responsible Innovation in the Light of Moral Responsibility', Journal on Chain and Network Science 15,2 pp107-117.

<sup>21</sup> Merton RK (1942) 'Science and Technology in a Democratic Order', Journal of Legal and Political Sociology 1 pp115-126.

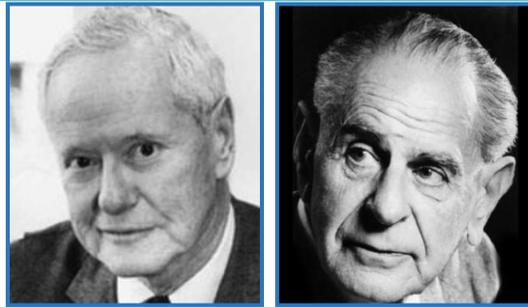


Figure 1: Robert K Merton (1910-2003) and Karl Popper (1902-1994)

Karl Popper's work can be seen as complementing that of Robert K Merton. Popper held that 'scientific practice is characterized by its continual effort to test theories against experience and make revisions based on the outcomes of these tests'.<sup>22</sup> Within that practice he recognised scientific 'boldness' – relating to scientists making testable claims with a 'willingness to take a risk of being wrong'; with a 'readiness to look for tests and refutations'.

The asking of questions (Popper) and the testing of theories (Merton) resonate with the notions of 'anticipation' and 'reflexivity' – dimensions of RRI. Reflexivity, it can be noted, has been defined as 'the process by which experience and knowledge continually influences attitudes, behaviours and actions and *vice versa*. The notion of reflexivity was illustrated in Fig 1.<sup>23</sup>

<sup>22</sup> Shea B (2016) 'Karl Popper, Philosophy of Science' in Fieser J and Dowden B (Eds) Internet Encyclopedia of Philosophy. <http://www.iep.utm.edu/pop-sci/>

<sup>23</sup> Gianni R and Goujon P (2013) 'Analytical Grid: Current Theory and Practice (in RRI)' GREAT Project.

### 3. Comparative Assessment: Themes and Issues

The sections above point to the emergence of some key aspects of responsible innovation that would be expected to emerge from the exploration of the four sectors (and reflected in the three roadmaps). Importantly the report has noted the foundation (or fundamental) elements of RRI concerned with governance and ethics. ‘Governance and Ethics’, and the notion of responsibility, provide our starting point for this comparative assessment. These are followed by ‘Openness and Commercial Confidentiality’, ‘Risk and Reflexivity’ and ‘Gender and Ethnic Diversity’. With regard to the last of these, there is insufficient evidence from the work undertaken to develop the roadmaps, to facilitate an appraisal of further aspects of diversity (such as religion, sexual orientation, age and disability).

#### ***Governance and Ethics***

The first key point in respect of governance is that *all* commercial enterprises have concerns around it - at least in the most basic of ways relating to tasks undertaken, products developed and/or services marketed. For most such enterprises the concerns around governance will be accompanied by a consciousness of ethics – this helping to determine, at least in part, the enterprise’s conduct and that of its staff. It follows, therefore (and whether or not the enterprise is conscious of notions of ‘responsible innovation’ or CSR) that some kind of ethical ‘compass’ will normally be in place.

The absence of or, more to the point, a deviation from such a moral compass may be construed as ‘irresponsible’ and, if exposed through the actions of ‘whistle-blowers’ or is the subject of criminal investigation, can be hugely damaging (e.g. for reputation, loss of custom and investment). Questions may arise as to ‘Who knew?’ How much of and in what way was any irresponsibility hidden? What is the position of (or risks for) whistle-blowers within enterprises? To what extent are the enterprises reflexive? Are related regulatory systems adequate? What moral compass did the enterprises have and how far were these known and endorsed by staff? What ‘freedom’ do commercial enterprises have to act irresponsibly (if they aren’t found out)? The mention of regulatory systems is significant here and this, with a clear pointer to international and European standards, is taken as one reference point for this comparative assessment.

CEN defines a standard as ‘a technical document designed to be used as a rule, guideline or definition. It is a consensus-built, repeatable way of doing something’.<sup>24</sup> The European Commission defines standards as ‘technical specifications defining requirements for products, production processes, services or test-methods’ adding that these specifications are voluntary (and) developed by industry and market actors following some basic principles such as consensus, openness, transparency and non-discrimination. Standards ensure interoperability and safety, reduce costs and facilitate ‘integration in the value chain and

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<sup>24</sup> See <https://www.cen.eu/work/ENdev/whatisEN/Pages/default.aspx>

trade'.<sup>25</sup> Service standards are noted elsewhere by the Commission as 'requirements to be fulfilled by a service to establish its fitness for purpose'.<sup>26</sup>

Standards can be written, therefore, to guide the development, design or configuration of products or services. The ethical element is not, however, explicit. The International Organization for Standardization in their ISO26000 guideline does, however, point to an ethical dimension in relation to social responsibility.<sup>27</sup> This guidance was used as a key reference point for CSR by Pellé and Reber (2015).<sup>28</sup> It argues that 'an organization's commitment to the welfare of society and the environment has become a central criterion in measuring its overall performance and its ability to continue operating effectively' adding that 'this, in part, is a reflection of the growing recognition that we need to ensure healthy ecosystems, social equity and good organizational governance'.

Elsewhere Graz and Hauert (forthcoming) have criticised the general absence of civil society organisations (CSOs) in the standardisation process – noting that, as greater prominence is given to standards, the existing power disparities between commercial enterprises and the 'markets' they serve are exacerbated or re-affirmed. They call for lay voices to be heard.<sup>29</sup> This links with the promotion of the concept of co-production in the world of standards.<sup>30</sup>

Having said this, it is useful to point to the seven 'core subjects' defined within the ISO guidelines (ISO26000). Each contributes to what is considered good governance. All carry an ethical dimension (see Fig 3).<sup>31</sup> Clause 4 of the guidelines, it can be noted, sets out principles of social responsibility (see Table 2). Ethical behaviour can be noted as one of these.

**Table 2: Principles of Social Responsibility**

Principles of Social Responsibility
<b>Accountability</b>
<b>Transparency</b>
<b>Ethical Behaviour</b>
<b>Respect for Stakeholder Interests</b>
<b>Respect for International Norms of Behaviour</b>
<b>Respect for Human Rights</b>

<sup>25</sup> See [https://ec.europa.eu/growth/single-market/european-standards\\_en](https://ec.europa.eu/growth/single-market/european-standards_en)

<sup>26</sup> European Commission (2016) 'Tapping the Potential of European Service Standards to Help Europe's Consumers and Businesses', Staff Working Document COM(2016) 358 Final.

<sup>27</sup> International Organization for Standardization (2014) op cit..

<sup>28</sup> Pellé and Reber (2015) op cit.

<sup>29</sup> Graz JC and Hauert C (forthcoming 2019) 'Translating Technical Diplomacy: The Participation of Civil Society Organisations in International Standardisation', Global Society.

<sup>30</sup> Co-production has been one of the foci of the PROGRESSIVE project (see [www.progressivestandards.org](http://www.progressivestandards.org)) and has put forward 'Guidelines' for potential adoption by CEN.

<sup>31</sup> See <https://www.iso.org/publication/PUB100259.html>



Figure 3: Social Responsibility: Seven Core Subjects (ISO)

Sitnikof and Bocean (2012), however, in an analysis that links the standard with CSR, suggest that as ISO26000 is a tool shaped with corporate interests in mind. They suggest that ‘corporations can choose any of the provisions [of the guidelines] that they consider convenient and can ignore what they think does not apply to them’.<sup>32</sup> They see it as poor in comparison with ISO14001 with the latter (addressing environmental management systems) being enforceable and giving ‘impetus’ to the sustainability agenda.<sup>33</sup>

In general terms, therefore, some consideration of ethics is signaled within the broader frame of governance and offers part of the background to this comparative assessment. And we can note that standards (or linked guidelines) can be considered as at least potentially contributing to this.

Looking at the three sectors (Cybersecurity, Nanotechnology and Biomedicine), there is some reassurance that arises through what appear to be high apparent levels of ‘ethical consciousness’ evident in the interviews and workshops that were undertaken. It must be recognised, however, that this consciousness will have impacted on the predisposition of the commercial enterprises to engage with the project and will have influenced the range, the level of seniority and the nature of the contributions by participants in workshops.

The main foci for ethical consciousness for the three sectors, and also for ICT for an Ageing Society, are noted in Table 3. The foci for Biomedicine and ICT for an Ageing Society can be

<sup>32</sup> Sitnikof CS and Bocean CG (2012) ‘Corporate Social Responsibility through the Lens of ISO Standards’, Business Excellence and Management 2,4 pp56-6.

<sup>33</sup> For information on ISO14001 see <https://www.iso.org/iso-14001-environmental-management.html>

seen to be closely aligned though the former carries a stronger clinical orientation and relates to a wider ‘target’ group.

The ethical consciousness demonstrated by the commercial enterprises in the three sectors also influenced the configuration of the roadmaps - in terms of the balance of emphasis that was given to key processes or stages in product or service development and marketing; and on the extent to which pointers were made to the necessity or importance of feedback both within the enterprises concerned and with consumers or users.

**Table 3:** Ethical Consciousness – Main Focus by Sector

Ethical Consciousness - Main Focus by Sector	
<b>Cybersecurity</b>	Obligations around client, consumer and public protection in context of cyber threats
<b>Nanotechnology</b>	Obligations around client, consumer and public protection in context of risk to environment and health
<b>Biomedicine</b>	Obligations around the promotion of health and well-being and ‘doing no harm’.
<b>ICT for an Ageing Society</b>	Obligations around the promotion of health and well-being for older people.

Our ensuing considerations for which more specific comments are possible (for the four sectors) are dealt with under the headings of ‘Openness and Commercial Confidentiality’ ‘Risk and Reflexivity’ and ‘Gender and Ethnic Diversity’. These in part link to and/or overlap with the RRI thematic elements and to the ISO principles of social responsibility. Openness and Commercial Confidentiality (below) can be seen as linking with Open Access (RRI) and Transparency (ISO); and Gender and Ethnic Diversity can be seen as linking with Gender Equality (RRI) and Respect for Human Rights (ISO). Risk and Reflexivity can be seen as linking within the broader elements of Governance and Ethics (RRI) and both Accountability and Ethical Behaviour (ISO).

***Openness and Commercial Confidentiality***

Maintaining commercial confidentiality is seen as a normal (and ethically defensible) aspect of commercial practice. Indeed, an individual’s employment by a company demands the performance of activities that contribute to commercial goals that will help business sustainability. Those activities include demonstrations of loyalty - part of which demands that confidentiality is maintained regarding many or all aspects of the work undertaken. There may be good reason for the extent of that loyalty to be ‘absolute’ in the sense that innovation may involve new designs or processes that are being considered for patents and for which any sharing of information that is not already in the public arena (e.g. through publicity material produced by the company itself) could both invalidate a patent application (and the associated Intellectual Property, IP) and jeopardise the enterprise’s commercial position. That loyalty also reflects a sense of ‘responsibility’ towards investors who will have expectations of financial returns.

The position for other kinds of organisation (including academic bodies) is more nuanced, but similar requirements are in place relating to loyalty, IP and the safeguarding any position of special knowledge that contributes to its reputation or kudos. The question arises as to how this, sometimes ‘absolute’, commitment to commercial confidentiality can square with the key element of RRI that is concerned with open access (or ‘sharing results’)?

The European Commission (2012) pointed to open access to research knowledge, etc. as a ‘key tool to bring people together and ideas in a way that catalyses science and innovation’.<sup>34</sup> This links to an ‘open data policy covering the full range of information that *public* [our emphasis] bodies across the European Union produce, collect or pay for’ – possibly an implicit acknowledgement that to seek such openness among private sector enterprises could be at best inappropriate and at worst misguided. There is the desire, however, that ‘innovative industries’ (amongst others) and ‘society at large need to work together’ – a call that signals a wish to at least push the boundary and to at least do some justice to the Commission’s dual vision to ‘ensure economic growth and to address the societal challenges of the 21<sup>st</sup> century’.<sup>35</sup> That vision (including openness), the Commission adds, ‘in no way implies that researchers would be prevented from patenting their inventions or that protection of intellectual property rights in the EU would suffer’ – a statement that cries out for further exploration or a clear explanation of how it fits with commercial objectives that, in large part, drive the innovations that are craved for. Small wonder, therefore, that Engeland et al (2018) from the ‘Responsible Research and Innovation in Practice’ project signalled, for RRI, that ‘open science’ is an ‘*emerging*’ [our emphasis] concept that is ‘not articulated in the policy documents’.<sup>36</sup>

Looking at the three sectors (Cybersecurity, Nanotechnology and Biomedicine), it can be noted that the interviews and workshops undertaken revealed that companies, quite naturally, acknowledged the open access that applied to information that was already in the public arena. But they all sought to maintain firm control over all information that they regarded as commercially confidential. Having said this there was a willingness to share some information (e.g. in marketing literature, on the website and in presentations) that would *inform* potential consumers about the matters that their products or services (innovative or not) addressed. This would, of course, potentially increase the market for those products or services but this could also facilitate the gathering of feedback by which the companies are able to reconfigure products or services as necessary. This links with those facets of RRI and CSR that have been noted above as concerned with ‘reflexivity’. There was, in addition, a clear willingness to engage with consumers in order to understand their markets and to involve them, where appropriate, in aspects of co-design. Such practice (e.g. through focus groups or design ‘workshops’) would, needless to say, have been accompanied by requirements for participants around confidentiality.

For the Cybersecurity sector the informing of potential customers (and, indeed, existing customers) of their products and services was particularly apparent. This linked to the very rapid speed of development of ICT and the accompanying cyber-threats (noted below in the section on Risk and Reflexivity) for which a good degree of customer understanding was

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<sup>34</sup> European Commission (2012) ‘Towards Better Access to Scientific Information: Boosting Benefits of Public Investments in Research’ COM(2012) 401.

<sup>35</sup> op cit.

<sup>36</sup> Engeland C, Maximova-Mentzoni T, Hanssen AB and Forsberg E-M (2018) ‘Report from National Case Study: Norway’ Responsible Innovation in Practice Deliverable 3.1.

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necessary. Indeed, because the commercial enterprises were, in essence, offering services (albeit that there are accompanying hardware and software needs that also require to be satisfied), the informing of customers was recognised as a prelude to an ongoing relationship - with the prospect of later service renewal or the purchase of related service offerings.

For the Nanotechnology sector there was a similar predisposition to ensure that customers were informed. This was, however, somewhat less concerned with marketing – rather it related very strongly to the risks that were recognised as ‘part and parcel’ of working with nanoparticles for which there could be dangers for people and the environment. The importance of precautionary approaches and the gathering (and acting on) feedback from customers was, therefore, seen as paramount. But the nature of the information that commercial enterprises were willing to place in the public arena was not about (in any detail) the science that related to the innovations concerned, it was to influence customer behaviours and guide safe product usage. The rapidity of technological developments was also significant for this sector and, as indicated in the applicable roadmap, is associated with a ‘hype’ (with dramatic forecasts of the size of markets for such products) that contributed to an ‘extra-tight’ approach to confidentiality around which any openness in any wider sense than indicated above is simply not a consideration.<sup>37</sup>

For Biomedicine, as with Cybersecurity and Nanotechnologies, the same commercial realities precluded any predisposition to significant openness. Indeed, as noted in the roadmap ‘a high level of openness was seen as a luxury that could not be afforded given its potential consequences in terms of loss of innovative ideas to competitors and of competitive advantage’. Having said this (and with boundaries in place as for other sectors) there was involvement with customers – in this case many of which, as well as health service providers (often the main consumers), included patients (as consumers or users).

With regard to ICT for an Ageing Society, the Responsible Industry project, whilst pointing to the value of participatory design and the importance of fostering an ethical culture among those who would become researchers and innovators, found no desire for openness in relation to what was proprietary research and for which IP applied. The project affirmed that ‘sharing the know-how of a company would mean lowering its competitive advantage’ with ‘the principle of open access (being) seen as mostly *inapplicable* [our emphasis] to industry’ ... the exception allowed for being in some cases where research is publicly funded.<sup>38</sup>

The foregoing signals openness, excepting for the public sector, as in part unachievable and inappropriate in the context of RRI. The commercial enterprises encountered (in all four sectors), however, demonstrated a willingness to be open in measured ways where this helped to inform customers and/or consumers and/or gather feedback that would enable them to progress their innovation in a ‘responsible’ manner.

### ***Risk and Reflexivity***

Some matters pertaining to risks and reflexivity have been noted in the discussion (above) on ‘Openness and Commercial Confidentiality’. They deserve, however, to be highlighted in view of the crucial tension that exists within many commercial enterprises regarding (for most) their

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<sup>37</sup> An Internet search finds many forecasts for ‘overall’ market size projections and for particular sub-sectors of nanotechnology.

<sup>38</sup> Gauttier S, Søraker JH, Arora C, Brey PAE and Mäkinen M (2015) ‘Models of RRI in Industry’ Responsible Industry project Deliverable D3.3.

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pursuit of, often short term, profits and market share and (for some) their quest for a positive relationship with customers and consumers who, if their custom is retained, will help provide longer term sustainability.

The roadmaps point to different kinds of risk. In the roadmap for the Cybersecurity sector the nature of the risk was explained in graphic terms. It pointed to 'normal commercial battles for customers' but also to the simultaneous 'war against cyber-threats' - with the latter 'constantly morphing; with different points of attack and increasing possibilities for penetration through defences that are erected to protect (the) data'.

For the Nanotechnology sector the roadmap pointed to a '*preoccupation* [our emphasis] with risk' where that risk was recognised as starting 'with the employees or contractors' and 'ends with any potential damage to people, animals and the environment'. The central risk problem for Nanotechnologies was noted as arising from the miniscule size of nanoparticles 'that can be readily inhaled or absorbed into the body and its organs' and where the consequence of such absorption 'can be seriously detrimental to health in view of the nanostructures or products being able to carry toxins'.

It follows that in the Cybersecurity and Nanotechnology sectors there were recognised imperatives around risk that demanded, first (albeit in different ways) the identification and guarding against (with great precision) identified risks; and second that mechanisms should be in place to respond – with any failure to ensure an effective response having potentially substantial adverse consequences. Those consequences could be measured (for the commercial enterprises in question) not just in the extent of harm caused but in terms of financial loss and reputational damage; and (for customers) in terms of *their* financial losses and potential other losses due to e.g. private data being compromised. The guarding against risk and, more particularly, responding to the same links to the reflexivity element of RRI.

With regard to the Biomedicine and ICT for an Ageing Society issues of risk were clearly recognised but were not emphasised in the same way as was apparent for other sectors. This (lack of emphasis) is considered a direct consequence of both sectors being situated in markets that are concerned, in large part, with people's health and well-being – but for which there established (and often very rigorous) regulatory frameworks. This is not to say that the regulatory frameworks (in the form of legislation and standards) are necessarily up to date. Indeed the Biomedicine and ICT for an Ageing Society sectors are (as with Cybersecurity and Nanotechnology) challenged by rapid technological developments where it is often difficult for regulatory frameworks to keep pace. The advent and use of apps in healthcare is an example. But for Biomedicine and ICT for an Ageing Society there *are* established frameworks that carry substantial credibility and which underpin the design and usage of a wide variety of products and services in healthcare. These frameworks (including standards and other regulations) demand that strict precautionary approaches are followed. They follow and re-enforce ethical frameworks that, at their core, are concerned (as explicit in the Hippocratic Oath) to 'do no harm'.

Following from the above, the Biomedicine sector roadmap sets out the context as one where there is a *very* strong ethical imperative. The roadmap noted that the priorities of 'bioethics' include working on a basis of 'robust evidence' and 'reflexive evaluation' - each of which were recognised as contributing to risk control or minimisation and to the commercial enterprises concerned being alert (and ready to effect remedies) whenever problems arise. As with the

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Cybersecurity and Nanotechnology sectors, therefore, the ‘reflexivity’ element of RRI is in place.

Finally for Biomedicine and the ICT for an Ageing Society sectors, risks are identified because of some of the changes that are taking place in service frameworks. These, it is considered represent an area for further research and evaluation on account of the consequences in terms of ‘risk-sharing’ between clinicians, service providers and patients, consumers or users – the latter two of which link with an imperative that relates to people becoming more fulsome ‘partners in their own care’.<sup>39</sup>

The foregoing signals that risk and reflexivity are fixed within the mindsets of the commercial enterprises encountered during the COMPASS project. The exceptional (often health related) risks have been noted, as has been the importance of reflexivity (noted as an RRI dimension) in order to manage or avoid risks. There is some reassurance, therefore, that crucial ethical element is in place as related ‘responsible innovation’ takes place. A ‘dual danger’ has, however, been noted that relates to the ‘hype’ around some innovation (attached in the main to the Nanotechnology sector) and to the push by some commercial enterprises for quick profits – either or both of which might undermine to extent to which ‘responsibility’ is exercised.

### ***Gender and Ethnic Diversity***

The issue of gender and equal opportunity was, for the main part, a focus for discussion with commercial enterprises in the context of current staff ‘balances’ and those which were evident in the recruitment process. The latter was particularly pertinent in the Cybersecurity and Nanotechnology sectors on account of the acute shortage of people with the necessary skills that were available on the job market.

But current staff mixes appeared to demonstrate ‘blindness’ regarding ethnicity or gender on the part of the commercial enterprises encountered. In other words, whether or not special initiatives might have been appropriate to redress any ‘imbalance’, what were probably fairly standard procedures around job descriptions and recruitment processes were pursued in a way that would not have intentionally discriminated against any potential applicant. A question arises, in fact, as to the extent to which there are ‘imbalances’? Many of the commercial enterprises engaged with in the COMPASS project operated in or near major urban centres. And though statistical information was not sought, the enterprises appeared in most cases to have workforces that were ethnically diverse and may have demonstrated a ‘mix’ broadly in line with that of the area or region in question. The notion of ‘imbalance’ has, however, extra traction with the commercial enterprises when considered in relation to gender - in view of the established fact that, at least for generally younger job applicants, there are fewer women who study STEM subjects (science, technology, engineering and mathematics) and can offer employers a technology-oriented qualifications that may lend themselves to employment within each of the four sectors.

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<sup>39</sup> See Doughty K (2018) ‘From Red Buttons to Smart Technology Support: Part 1’, T-Cubed, Caernarfon; and Fisk M (2019) ‘Supporting Older People: ICT and the New Thinking for Social Work and Social Care’ Proceedings of XV Hradec Days of Social Work, University of Hradec Kralové, Czech Republic.

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Very pertinent is the study by Barbieri et al (2018) that focused on the ICT sector. They pointed to the fact that of 8 million ICT specialists in the European Union just 17% are women. This low proportion they attributed, in large part, to the perception of ‘ICT jobs as a playground for men’ even though the sector tended to be able to offer flexible working conditions. For women in ICT, however, the pay gap is reported as less than for other sectors.<sup>40</sup> The broader context, they noted, is one where gender segregation in the labour market is a ‘trend’ - where only 25% of the 20 main sectors of the labour market are ‘gender balanced’. It is not evident from the COMPASS work whether the gender gap in the four sectors is narrowing.

Given the gender imbalance (particularly evident in at least the Cybersecurity and Nanotechnology sectors) it is unremarkable that the issue was a matter of interest and concern to the commercial enterprises engaged. And with regard to recruiting staff, in a context where there was a shortage of people with the right skills, they were at pains to emphasise that absolutely no discrimination took place on their part – either by gender or ethnicity. It is not known where the commercial enterprises may have made special endeavours (information on initiatives regarding the location of advertising or special support being given to women were not sought) to improve the gender balance to one that would be more equal. Intentions to give greater attention in this direction were, however, expressed.

For the Biomedicine and ICT for an Ageing Society sectors, the association with health and care means that, overall, there is a link to services within which (generally speaking) there is substantial ethnic diversity that has arisen from the widespread necessity to employ migrant labour at all levels. There is also a relatively high proportion (often a majority in some specialist areas) of women – perhaps pointing to a ‘reverse’ imbalance. Within the commercial enterprises associated with research, innovation and product development in the four sectors, however, the gender bias towards men may still apply.

The foregoing signals that gender and ethnic diversity are concerns of the commercial enterprises encountered during the COMPASS project – and that substantial ethnic diversity appears, for the most part, to be evident. And although there are challenges (notably for the Cybersecurity and Nanotechnology sectors) with regard to the proportion of women employed, this was seen as an (ethical) issue that the commercial enterprises sought to address – albeit in a context where there were shortages of people with the required skills.

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<sup>40</sup> Barbieri D, Lelleri R, Maxwell K, Mollard B, Karu M, Salanauskaite L and Reingard J (2018) ‘Women and Men in ICT: A Chance for Better Work-Life Balance: Research Note’, European Institute for Gender Equality, Luxembourg.

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## 4. Conclusions

The four sectors for which this comparative assessment has been undertaken are substantially different from each other (though some overlap is apparent for Biomedicine and ICT for an Ageing Society). But despite this difference some key themes have been identified that, in part, are likely to be relevant in other commercial sectors.

Much of the discussion (above) set out the broader context around governance and ethics. These two RRI elements were posited as foundational (or ‘fundamental’) - necessarily underpinning the work of commercial enterprises. In understanding these and the broader context of responsible innovation it was important at this point to indicate how RRI ‘fitted’ with CSR. A signal was also given to the linked role of standards, most notably the ISO26000 guidelines regarding social responsibility. This discussion pointed to at least an overlap or even a congruency between RRI and the more well established (at least in the minds of commercial enterprises) CSR. Specific comment, with comparisons made, were then offered on the three themes of ‘Openness and Commercial Confidentiality’, ‘Risk and Reflexivity’ and ‘Gender and Ethnic Diversity’.

What has been established through the discussion is a clear commonality of perspectives between the four sectors that reflect a shared ‘ethical consciousness’ – with that consciousness being frequently reflected in mission statements and strategies of the commercial enterprises concerned.

An important point was made, however, regarding the fact that commercial enterprises that engaged with the COMPASS project may have been disproportionately willing to do so *because* their ethical consciences were better attuned (than others in their sectors) to the kinds of elements (of RRI) or principles of social responsibility (ISO26000) that are ‘in focus’ for the project. This means that it is necessary to be cautious about any suggestion of a wider predisposition to ‘responsible innovation’ for commercial enterprises within those four sectors or, indeed, in other commercial sectors. Having said this, there are four key affirmations that can be put forward as a result of this work. These may provide a basis for further research, discussion and debate.

**CA1** The comparative assessment indicates an ethical consciousness among all of the commercial enterprises engaged in the project.

**CA2** The ethical consciousness that was evident reflects understandings of ‘responsibility’ that in many cases will have been influenced by notions around CSR.

**CA3** A key focus of attention relates to ‘risk’ and, therefore, to anticipation and ‘reflexivity’ (key elements of both RRI and CSR).

**CA4** In the context of commercial confidentiality, the RRI call to greater openness is in part inappropriate.

There are, perhaps, other affirmations that could be added to the list (e.g. relating to commitments around gender equality and ethnic diversity) – but these would make little difference to what is a comparative assessment that is, on the whole, positive for the sectors concerned and relating to which there can be some confidence about the credentials (in terms of ‘responsible innovation’) of at least some commercial enterprises within those sectors.



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The findings in this comparative assessment might, therefore, be generalisable to other commercial sectors (for SMEs) in respect of the nature of that 'ethical consciousness' – especially where this may link with understandings about risk.

In conclusion, in order to help further foster this ethical consciousness, it might be appropriate for endeavours around RRI to be subsumed within broader understandings that relate to CSR (and from which key elements have, in any case, been drawn).