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Chapter 3

Learning from Sustainability-Oriented Innovation



Katharina Jarmai

Abstract This chapter argues that insights from the realm of sustainability-oriented innovation can provide useful answers to the question of why Small and Medium-Sized Enterprises (SMEs) would (or should) become interested in implementing responsible innovation practices. It is based on the assumption that “responsible innovation” and “sustainability-oriented innovation” are different approaches aimed at orienting innovation towards increased positive impacts on social and natural environments. Motivations and influences for pursuing sustainability-oriented innovation have been studied in the past, and can provide insights into reasons for pursuing the implementation of responsible innovation practices.

Keywords Responsible innovation · Sustainability-oriented innovation · Corporate responsibility · Sustainable development · Corporate impact · Societal challenges

3.1 Introduction

Most research on responsible (research and) innovation has so far been conducted from a policy or socio-ethical perspective. In the early years of the debate, research on industry implementation was limited (Blok and Lemmens 2015; Blok et al. 2015; Lubberink et al. 2017). Recent years have, however, seen an increase in EU funding for analysing and supporting responsible innovation in industry. This has been accompanied by a growing number of peer reviewed papers investigating different aspects of responsible innovation in companies and industry sectors. EU projects have contributed to the implementation of responsible innovation in different types of organizations by means of tool kits, methods, self-assessment/self-check tools,

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training materials, etc. (Nwafor et al. 2017). However, company-specific tools that meet the realities of businesses are still missing. Furthermore, the crucial question of why companies should invest time and money into understanding and implementing tools for responsible innovation in the first place still remains to be resolved.

Innovation with the aim to decrease negative impact on the social and natural environment has been discussed for a couple of decades under the terms “eco-innovation”, “environmental innovation” and “green innovation” (Schiederig et al. 2012; Díaz-García et al. 2015); and has been summed up under the term “sustainability-oriented innovation” (SOI) (Klewitz and Hansen 2014). These discourses have identified and classified a range of drivers and barriers for impact-oriented innovation. Applying the definition of sustainability-oriented innovation as “deliberate management of economic, social and ecological aspects” (Klewitz and Hansen 2014: 57) in innovation, we understand sustainability-oriented innovation and responsible innovation as two approaches aimed at orienting innovation towards increased positive impacts on social and natural environments.

The aim of this chapter is to explore sustainability-oriented innovation to identify similarities and differences between this kind of innovation and responsible innovation; and to learn from what has been found about what drives or impedes innovation that aims to increase positive impact on its social and/or natural environment.

3.2 Sustainability-Oriented Innovation

The concept of sustainability-oriented innovation has its roots in the notion of eco-innovation and the debate that followed publication of the *Brundtland Report* in 1987 (Klewitz and Hansen 2014). The *Brundtland Report* stated that “(...) the orientation of technology development must be changed to pay greater attention to environmental factors.” (WCED 1987: para 65). It further pointed out that “Technologies are needed that produce ‘social goods’, such as improved air quality or increased product life, or that resolve problems normally outside the cost calculus of individual enterprises, such as the external costs of pollution or waste disposal.” (WCED 1987: para 67). Since the 1990s, innovation with the aspiration to create positive environmental impacts has been studied under the terms “eco-innovation”, “environmental innovation” and “green innovation” (Schiederig et al. 2012; Díaz-García et al. 2015). The debate has developed to include social criteria in addition to environmental ones; and has been carried forward under the terms “sustainable innovation”, “sustainability-related innovation” and “sustainability-driven innovation” (Klewitz and Hansen 2014). The notion of sustainability-oriented innovation (SOI) subsumes these concepts to describe the integration of “deliberate management of economic, social and ecological aspects” (Klewitz and Hansen 2014: 57) in innovation.

Sustainability-oriented innovation can be defined as the commercial introduction of a new or improved product, service or system that leads to “environmental and (or) social benefits over the prior version’s physical life-cycle” (Hansen and Grosse-Dunker 2013: 2407). In other words, sustainability-oriented innovations can be understood as innovations that replace less sustainable solutions on the market. Whether a new solution counts as a sustainability-oriented innovation thus depends on alternative options on the market. This relational character of sustainability-oriented innovation (Schaltegger et al. 2012, 2016) is also reflected in the understanding of sustainable entrepreneurship as transformative process (Adams et al. 2016).

Sustainability-oriented innovations can be differentiated into the categories used to describe different types of “regular” innovation with no normative requirements (see Chap. 2); i.e. product innovation (goods and services), process innovation (production or delivery method), marketing innovation (design, packaging, placement, promotion, pricing), and organisational innovation (business practices, workplace organization, external relations). In addition, increasing the service content of products can be considered another type of sustainability-oriented innovation. By increasing the service content of an innovation, its value for the consumer is decoupled from the amount of physical resources needed to produce it. Hansen and Grosse-Dunker (2013) describe three such product-service combinations: Adding a service to an initial product (e.g. a take-back service), product rental or leasing instead of sale (e.g. a car share service), or selling a result instead of a product (e.g. laundered clothes instead of washing machines). In this way, sustainability-oriented innovation can fulfil the same function, or meet the same needs, as an option that is already on the market but with an alternative, more sustainable solution. Companies may also develop sustainability-oriented innovation in an effort to go beyond fulfilling existing consumer needs and come up with entirely different solutions that encourage a more sustainable lifestyle.

Hansen and Grosse-Dunker (2013) identify five phases in the life-cycle of a product (supply chain, production, packaging/distribution, use, and end-of-life phase) in which positive impact can be created through sustainability-oriented innovation, and they provide examples of positive impact on the economy, environment and society; such as e.g. increased customer satisfaction, energy-efficient production, and safe and fair labour conditions. They emphasize the fact that the valuation of impact may change over time, as has been the case, for example, in the assessment of bio-fuels: “Although a short hype around its potential to fuel cars with renewable resources emerged, the enthusiasm for bio fuels was rather short-lived as the necessary cultivation of oil-bearing trees also implicated a displacement of food crops and thus negative side effects to the local population (e.g., advances of food prices).” (Hansen and Grosse-Dunker 2013: 2409).

3.3 Sustainability Versus Innovation?

Before an innovation reaches the market a succession of decisions are taken. This includes decisions about following up on a particular idea, and including or dismissing specific features of the novel product or process as well as design and marketing aspects. All companies are forced to balance their expenses with their revenues and to plan their investments based on expected returns. Small or Medium-sized Enterprises (SMEs) are typically particularly dependent on external (market) developments and thus tend to operate at relatively high levels of uncertainty. They need good reasons to allocate resources (personnel as well as financial) to activities that do not immediately support their core business model. This is particularly true when the expected return on their investment remains elusive.

In the discussion about sustainability-oriented innovation, three broad positions can be distinguished on the relationship between sustainable development and innovation (Fichter et al. 2006):

1. Ecologic and ethical considerations can hinder innovation;
2. Deteriorating environmental quality increases the pressure to innovate;
3. The guiding principles of sustainable development generate ideas and are a source of competitive advantage.

The literature on sustainability-oriented innovation has identified a number of barriers that impede the integration of sustainability criteria in innovation practices and strategies. Madrid-Guijarro et al. (2009), for example, list aspects connected to costs, risks, resistance to change, and difficulties in attracting and retaining qualified personnel (internal barriers), and to lack of information about markets or technologies and the need for additional support from the government or external partners (external barriers). In addition, small companies tend to have specialized portfolios and little access to venture capital. In addition to limited personnel and financial resources, sustainability-oriented innovation is further hindered by limited knowledge of decision-makers about two crucial aspects: First, their options to increase environmental and societal benefits, and second, the medium- to long-term benefits they can expect from doing so (Walker et al. 2008). This problem is sometimes exacerbated by information about companies' options to increase environmental and societal benefits that is inadequate in a business context, uses language which is too technical or academic, or is simply difficult to access (cf. Walker et al. 2008).

In the spectrum between highly formalised structures and decision-making processes and ad hoc decision-making, smaller and younger companies tend to appear at the ad hoc end. A lack of management and organisational structures as well as little planning of innovation processes can hinder innovation in SMEs. In environments that are defined by high speed, creativity and enthusiasm, the requirements posed by responsible innovation might inspire a fear of being slowed down and confined by forms, checklists and other bureaucratic obstacles.

3.4 Drivers for Sustainability-Oriented Innovation Practices

The literature on sustainability-oriented innovations identifies several potential drivers for the integration of sustainability criteria in companies' innovation strategies and practices. These drivers are traditionally based in innovation theory and environmental policy, and can be classified into supply-side factors, demand-side factors and the regulatory framework. Supply-side factors include technological and managerial capabilities and tangible and intangible assets, as well as knowledge and skills that enable companies to develop sustainability-oriented innovations. Collaborations with research institutes, private or public agencies and universities are also acknowledged as important sources of external knowledge. Demand-side factors include market demand and the way the company is perceived by its main target groups of customers. The regulatory framework includes laws, regulations and standards, such as those developed by the Eco-Management and Audit Scheme (EMAS) or the International Organization for Standardization (ISO), and is considered an important driver for the implementation of sustainability-oriented innovation in businesses. In a similar manner, Kesidou and Demirel (2012) differentiate between demand-side factors, organisational capabilities and the regulatory framework.

The multi-impulse model developed by Fichter (2005) is one prominent explanatory approach of a company's internal and external factors pushing or pulling innovation towards sustainability. The model is based on Schumpeter's (1947) model of creative response and understands innovation as a result of the creative performance of actors under specific framework conditions in which a combination of factors exert influence on the innovation process. The multi-impulse model illustrates company-internal (company vision, key individuals) and company-external influences (technological developments, market demand, regulation, civil society) on an innovation process. Fichter (2005) describes a range of company-internal and company-external factors that influence decisions and interaction in a company's innovation process. These factors are not isolated but can reinforce one another to affect the general orientation of an innovation process as well as particular decisions that are taken within it. Company-external factors include impulses through radical technological innovation, market demands, regulation and support mechanisms, public opinion conveyed via the civil society or the media, and national or sectoral overarching goals. How these external impulses are processed within a particular organisation depends on internal structures, actor constellations both within the organisation and with external actors, influential individuals, and internalised strategic orientation as well as basic cultural and value-based settings. Different studies emphasise the relevance of different internal or external factors. While Kopfmüller et al. (2001), for example, emphasize the role of technological developments, market demand and regulation in the context of sustainability innovation, Fichter et al. (2006, 2007) stress the importance of company culture and the intrinsic motivation of key individuals as decisive influences.

A variety of business motivations for conducting sustainability-oriented innovation have been described in the literature. The spectrum ranges from moral and ethical obligations, which evolve around the morality of products and services, their effects on human beings and social issues within global value chains, to economic motivations. Fichter et al. (2006) provide the following possible reasons for including considerations about impact on society and the environment in the innovation process:

1. Sustainable development is perceived as relevant by the company;
2. Sustainability-oriented visions serve as drivers for innovation in the company's relevant environments;
3. Changing legal frameworks require adjustments or adaptation;
4. Public funding is increasingly oriented by criteria of sustainable development;
5. Sustainable development becomes an important criterion for the financial market;
6. Prevention of reputation and acceptance losses.

According to Gil et al. (2001), competitive motivations positively relate to the implementation of environmental practices in a company. Opportunities to improve productivity or to reduce costs are expected from changes of business processes and products. In the absence of strong external push or pull factors, internal factors become more relevant in the decision to orient innovation processes and output to sustainability or responsibility criteria.

Dijkema et al. (2006) describe engagement with sustainability as process in four phases: In the first phase, a company primarily reacts to external pressure, forcing it to decrease negative impacts on its environment. The second phase is characterized by internal engagement with the topic of sustainable development, including discussions and the development of action strategies; this phase includes the adaption of innovation strategies. In phase three, the company commits to a more long-term orientation along the lines of sustainable development and takes appropriate measures such as the institutionalisation of new processes. Companies that have entered the fourth phase have advanced to formulating their own sustainable development strategies through interaction with external actors; they understand sustainable development as a continuous process, where innovation activities are continuously re-defined and re-formulated.

Other authors have differentiated indifferent, defensive, offensive and innovative (Steger 1993), or reactive, anticipatory and innovation-based (Noci and Verganti 1999) company strategies with regard to sustainability. What all of these definitions have in common is the distinction between intrinsic company motivation to assume responsibility for their actions towards their – social and/or environmental – environment, and external push and pull factors that increase pressure on the company to comply with certain laws, regulations, needs or expectations.

In recent years, the debate about sustainability-oriented business strategies has moved towards defining a business case for sustainability (e.g. Schaltegger and

Wagner 2006), which can create added value for the company through a range of aspects such as risk reduction, cost efficiency, reputational effects, market differentiation or market development.

3.5 Similarities and Differences Between Sustainability-Oriented Innovation and Responsible Innovation Practices

By comparing the definition of sustainability-oriented innovation quoted above to the definition of responsible (research and) innovation by von Schomberg (2011) as “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 (...)”, one major similarity and one crucial difference present themselves. First, both concepts concern the potential for delivering societal and ecological benefits through innovation; in the case of sustainability-oriented innovation through replacing a less sustainable solution already on the market, and in the case of responsible innovation through responding to sustainability demands and societal needs through innovation. Second, sustainability-oriented innovation addresses the improved performance of the innovative product, service or process, while responsible innovation focuses primarily on the research and innovation process and only secondly addresses the outcomes of the innovation process. While sustainability-oriented innovation is thus defined by its effect on the environment and/or by the intention of the innovator (Díaz-García et al. 2015), responsible innovation is mostly defined by innovation process qualities and criteria.¹ These matters have been recognized in the current debate on responsible innovation, and some recent definitions such as Sutcliffe (2018: 1), put more weight on the output qualities of innovation: “The concept of Responsible Innovation aims to focus attention on ensuring innovation delivers benefits to society; negative impacts are better anticipated and managed in advance and the involvement of people is important in shaping innovation.”

The implementation of both sustainability-oriented innovation practices and responsible innovation practices require willingness, capacities and the development of capabilities to deal with diverse knowledge about economic, social and

¹The European Commission has been promoting responsible research and innovation by funding projects on the thematic elements of ethics, gender and diversity, public engagement, open access, and science education through the previous and current European Framework Programmes “FP7” and “Horizon 2020”. In the academic debate, a common agreement about key aspects of RRI has developed in the form of four dimensions that would lead towards more responsible innovation processes, entailing a collective and continuous commitment to conduct research and innovation processes in an anticipatory, reflective, inclusive (deliberative), and responsive way (Owen et al. 2013).

ecological contexts and phenomena. In addition, the decision to orient company strategy to sustainability or responsibility criteria may require a fundamental shift in mind set, from simply adhering to laws and regulations to actively creating a positive impact on the society and/or the environment. Engaging with sustainability or responsibility issues makes it necessary to gather and process knowledge from external sources. In the case of responsible innovation these external sources explicitly need to include civil society organisations (CSOs) and groups which are potentially put at a disadvantage.

3.5.1 Company Benefits

Both concepts work at the interface of business and society relationships, and are therefore confronted with the question of whether – and if so, which – benefits can be expected for businesses, or for society. In the context of responsible innovation it is frequently asked why companies would engage with the concept and invest time and resources into implementing corresponding practices. It is also a question for those who see it as their task to promote responsible innovation practices in companies or other research and innovation actors. How to best communicate what responsible innovation is all about? What expectations should be raised about benefits and added value? Is it advisable to try and “sell” responsible innovation as a “door opener” to hitherto unrecognized market segments and business opportunities? Is it naïve to focus on the potential of innovation actors to increase their positive impact on society through implementing responsible innovation practices?

Two of the positions about the relationship between sustainable development and innovation introduced by Fichter et al. (2006); i.e. that ecologic and ethical considerations can hinder innovation or, on the contrary, generate ideas and be a source of competitive advantage; are applicable to the context of responsible innovation. The remaining position, that deteriorating environmental quality increases the pressure to innovate is more difficult to interpret in the context of responsible innovation; and this highlights a critical difference between sustainability-innovation and responsible innovation. Sustainable development is driven by an acute need for change – even though the global dimension of this need might be difficult to grasp, it is still not being felt by large shares of the world’s population and remains disputed by many. On a smaller scale, however, ecological deterioration can be felt in terms of reductions in air quality, extreme droughts or floods, disappearance of essential food components or similar local phenomena that impact particular communities. It seems fairly logical for companies to come up with better technological or other forms of solutions that will, for example, aid improving air quality in their customers’ or employees’ living environments. In comparison to these kinds of impacts, the added value of making sure that your innovation is “responsible” is much less obvious. There are a few reasons for this, which can be usefully discussed by focusing on the different constituting elements of responsible innovation:

- Anticipation – Similar to the more complex issues in sustainable development, the added value of taking responsibility for potential future applications of your product or the reciprocal effects of your process component is difficult to integrate into company strategies;
- Inclusion – While it has been said above that adding an inclusive element into company research and innovation can open the door to new market segments, action and change is necessary to profit from this opportunity. While the example about improving air quality should show that improving living conditions for a company’s target groups is fairly obvious, investing extra effort into figuring out other groups potentially affected by a company’s actions and taking measures to improve their living conditions is not;
- Ethics – Being more sustainable can often be in line with being more cost effective; e.g. by reducing the amount of material included in a product or the amount of energy needed in a production process. In contrast, being more responsible tends to be more cost intensive rather than less; at least on short-term time scale. Agreeing upon standards of ethical and responsible conduct in research and innovation, consulting with external ethics advisors or staying up-to-date on the latest data security regulations requires commitment, skills and time.

3.5.2 Assessment of Added Value

Another distinctive difference between what is defined as sustainability-oriented innovation and what has become known as responsible innovation lies in the possibility to assess the qualities of the final output and compare them to their less sustainable/less responsible alternatives on the market. Hansen and Grosse-Dunker (2013: 2407) define sustainability-oriented innovation as “the commercial introduction of a new (or improved) product (service), product-service system, or pure service which – based on a traceable (qualitative or quantitative) comparative analysis – leads to environmental and (or) social benefits over the prior version’s physical life-cycle (‘from cradle to grave’)”. With this definition, they recognize the possibility of applying methods such as lifecycle analysis or material flow analysis to compare two innovative products on the market that satisfy the same customer need. More than just recognizing this, they make this feature a constituting factor of what defines sustainability-oriented innovation. In the realm of responsible innovation, no comparable methods exist that would allow us to measure and compare the “responsibility” of two solutions on the market. There are at least two reasons for this: First, the level of “responsibility” might only become apparent at an unknown point of time in the future, whereas the amount of material or energy needed to produce both products can be compared even before the product goes on the market. Second, assessment criteria for responsibility – as defined in the responsible innovation concept – are difficult to capture in quantitative measures, whereas it is comparatively easy to calculate the amount of waste, for example, that is generated during the production of a product or by offering a particular service. This differ-

ence might be largely due to the fact that environmental criteria are central to sustainability-oriented innovation but not to responsible innovation. Proactive sustainability behavior can be measured through quantifiable values such as increased waste prevention measures or reduced material use (Klewitz and Hansen 2014).

In a literature review of 84 articles on sustainability-oriented innovation, Klewitz and Hansen (2014) identify innovation practices in SMEs and find that a total of 13 out of 20 identified practices can be allocated to the environmental dimension of sustainable development, while only seven concern non-environmental aspects such as stakeholder management, employee development and training or health and safety.

While sustainability-oriented innovation is defined in relational terms through increasing the sustainability of an innovative solution, responsible innovation has been discussed in terms of having been implemented or not (yet) in a particular organisation or network. Von Schomberg (2013) recounts an early distinction between responsible and irresponsible actors with regards to innovation and discusses examples of irresponsible innovation. Responsible innovation is still often treated dichotomously – it has either already been implemented in a particular organisation or sector, or it has not (yet) been implemented.

3.5.3 Individual Responsibility and Actor Networks

In the way that responsible (research and) innovation has been encouraged by the European Commission in its seventh and eighth Framework Programmes for Research and Innovation, until recently the addressees have been individual organizations. In the seventh Framework Programme (2007–2013), the focus was set on universities and research organizations. In the eighth Framework Programme (2014–2020), small, medium and large companies were included in the group of actors that were supposed to implement and promote responsible innovation practices. Many of these European projects have created tools to support their target groups in the implementation of responsible innovation. Such tools include management tools, a toolkit of activities and guidelines for engaging teenagers in STEM,² web 2.0 tools,³ a toolkit for the design of public engagement activities,⁴ tools for international cooperation, or the Gender-Diversity-Index (GDI).⁵ All of these tools are targeted at individual organizations from academia and industry and provide them with customized, targeted support in the implementation of responsible innovation practices. Sustainability-oriented innovation however, goes beyond

²<http://www.expecteverything.eu/hypatia/toolkit/>

³<http://nanopinion.archiv.zsi.at/en/about-nano/multimedia-repository.html>

⁴<https://toolkit.pe2020.eu/>

⁵https://www.gedii.eu/wp-content/uploads/D3.1GenderDiversityIndex_final.pdf

the individual organisation by creating more sustainable production methods, market structures or consumption patterns (cf. Klewitz and Hansen 2014).

3.6 Complementing Responsible Innovation by Learning from Sustainability-Oriented Innovation

What can we learn from research on sustainability-oriented innovation to better understand company engagement with responsible innovation? The previous sections describe how the two concepts are sufficiently similar to assume similar categories of drivers and barriers in companies; even though characteristics and weightings will vary between industries and regions.

3.6.1 Intrinsic Motivation of Key Actors

Based on the first studies of the implementation of responsible innovation in companies, the intrinsic motivation of key company personnel and the strategic orientation of leading actors in the company's environment can be expected to be of similarly high relevance in the realm of responsible innovation. A recent analysis of expert interviews with Chief Executive Officers (CEOs) of SMEs in the Austrian medical device sector, for example, suggests that the moral standards of high-level decision-makers in companies are relevant when it comes to developing an overall innovation strategy (Auer and Jarmai 2018). In this sector, reasons to engage in innovation activities generally include profit-oriented elements, but also refer to the generation of positive impacts on customers, society, or the environment. Similar reasons have been documented for companies that develop eco-innovations or sustainability innovations and are often referred to as moral or intrinsic motivations (e.g. Clark and Charter 2007, Fichter et al. 2007). This suggests that while an expected increase in profits would likely be a good reason for companies to start looking into ways to implement responsible innovation, it does not have to be the only starting point. Moral motivations could open a second door to the implementation of responsible innovation in companies. Potential drivers and barriers to the implementation of responsible innovation are easily integrated into categories developed in the literature on sustainability-oriented innovation. As in the realm of sustainability-oriented innovation, all factors have the potential to act as either drivers or barriers, depending on other situational and contextual factors. Overall, the implementation of responsible innovation practices is more likely to be considered a benefit for a company if it is aligned with existing company practices and structures. Similar conclusions have been drawn from studies set in other sectors, such as ICT for ageing people, or the food industry (Chatfield et al. 2017; Blok et al. 2015).

3.6.2 *Legal Frameworks and Public Funding*

Adjustments or adaptation to changing legal frameworks and the orientation of public funding to responsibility criteria would fall under what Fichter (2005) describes as regulatory push and pull factors, which are probably the two most straightforward reasons for companies to engage with any kind of practice: Either because it is the law, or because they will only receive (public) funding if they comply with certain requirements. With regard to the different elements that make up responsible innovation, the ethical conduct of research and handling of sensitive information are probably the most highly regulated; at least in areas such as healthcare, through certifications and ethical compliance checks (Chatterji 2009). To the best of the author's knowledge, none of the other EU responsible research and innovation elements (European Commission 2012) or the process criteria described by Stilgoe et al. (2013) are currently required by law in any industry.

The European Commission has been promoting responsible (research and) innovation as a cross-cutting priority in the current Framework Programme for Research and Innovation "Horizon 2020"; this means that responsible innovation is not only the focus of particular research projects in the "Science with and for Society Programme", but that responsible innovation elements are also included as requirements for projects throughout the whole work programme. Within the Science with and for Society Programme, the European Commission has recently granted funding to a project with the objective to further integrate responsible research and innovation into research and innovation practice and funding at European, national and local levels.⁶ The RRI-PRACTICE project⁷ has previously conducted stakeholder workshops in 12 countries worldwide to assess the understanding of responsible innovation in national science, technology and innovation debates. Across these 12 workshops, "Awareness of the term RRI varied considerably across stakeholders, many having no prior knowledge of the term." (Owen et al. 2017: 1). At the same time, "Most institutions could readily identify national debates and ongoing activities related to responsible innovation framed as ethics, gender equality, public engagement and open access." (Owen et al. 2017: 2). At national level, the Netherlands Organisation for Scientific Research has had a Responsible Innovation programme since 2013. The UK Engineering and Physical Sciences Research Council (EPSRC) commits to ensuring that responsible innovation is "prominent in our strategic thinking and funding plans, including proposal assessment". The Research Council of Norway has implemented a 10 year programme dedicated to responsible innovation and CSR, with the primary objective to "address the grand global challenges through responsible technology development and socially responsible business organizations".⁸

⁶<https://newhorizon.eu/>

⁷<https://www.rri-practice.eu/>

⁸<https://www.forskningradet.no/en/Funding/SAMANSVAR/1254004068509>

3.6.3 Investors

Another potential push factor concerns the integration of selection criteria in the risk assessment and decision-making procedures of financial institutions. This also includes seed funding organisations and financial investors. Younger and smaller companies are particularly dependent on external funding sources to start a business in the first place or to cover costs of pursuing the development of a novel product or service. Similarly to sustainability criteria in financial investment, societal impact and responsibility are beginning to find their way into financial institutions. Black Rock, one of the largest global investment management corporations, state a commitment to “being a responsible corporate citizen and taking into account environmental, social and governance (ESG) issues”. According to Black Rock, “... sustainable investing is becoming mainstream. Whether to mitigate risks, comply with regulation or target thematic impact, demand for these investment approaches has grown considerably.”⁹ First empirical findings suggest that financial investors who prioritise clients based on responsible innovation criteria would act as a driver for the integration of responsible innovation practices in SMEs (Auer and Jarmai 2018).

3.6.4 Company Reputation

A final potentially strong pull factor concerns the prevention of reputation and acceptance losses. This issue closely connects to the roots of the responsible research and innovation concept in the issue of public resistance to Genetically Modified Organisms (GMOs) in European society. In any innovation process, resources are invested without immediate return in the phase before the innovation goes to market, thus creating risk for the company. If money is invested in the development of an innovation and society rejects it immediately before or after it has entered the market, then the investment is lost. As Nathan (2015) argues, communication with societal actors before putting a final version of a product or service on the market opens up opportunities for adaption and re-consideration. Even though all of these options bring additional costs with them, any of them will be cheaper for a company than a complete roll-back after market entry. In addition, open communication of the objectives underlying a company’s innovation can help to increase trust among target audiences; and it is considered that trust, often coupled with transparency, privacy or data security issues, will be among the most crucial business assets in the future (Leisinger 2017). SocietyInside has recently published a consultation document, “Principles for Responsible Innovation. For technologies

⁹<https://www.blackrock.com/corporate/responsibility>

society can trust”,¹⁰ which focuses the concept of responsible innovation around issues of trust and the trustworthiness of different research and innovation actors.

3.6.5 Combination of Supportive Policy Instruments

The literature on sustainability-oriented innovation describes different company-internal and company-external factors that influence the innovation decisions taken within an organisation. While some factors may be more inductive than others, decisions will generally be taken under the influence of a combination of company-external, company-internal, profit-oriented, mission-oriented and other factors. This means that no one adaptation in the company or its environment will single-handedly aid the implementation of responsible innovation, but that responsible innovation will likely be supported – like sustainability-oriented innovation – through a political pattern that combines different political instruments, creates economic incentives for the implementation of responsible innovation practices and provides orientation about funding requirements in the medium-term future (cf. Blazejczak et al. 1999).

3.7 Conclusions

This chapter describes the characteristics of sustainability-oriented innovation, relates them to responsible innovation and discusses potential reasons for pursuing the implementation of responsible innovation practices. While the European debate about responsible innovation originates in discourses on emerging technologies and research ethics and has been mainly driven by European research and innovation policy, the concept of sustainability-oriented innovation has its roots in the debate about technological progress for sustainable development and the production of social goods, and has been closely connected to corporate innovation management from the very early days.

Developing useful implementation options for a multifaceted, externally developed concept such as responsible innovation requires willingness, resources and structures to engage with the concept and integrate learning into company structures and practices. The requirements posed by responsible innovation might inspire a fear of being slowed down and confined by bureaucratic obstacles. This is particularly true when responsible innovation is communicated as policy regulation and in language that is too far removed from company realities for companies to easily grasp their substance. Legal frameworks, intrinsic motivation, easier access to financing and company reputation can counteract these challenges and function as drivers to the implementation of responsible innovation practices in companies.

¹⁰<http://societyinside.com/our-principles-responsible-innovation>

Legal requirements and conditions to receive funding are two of the most obvious reasons why companies will gear their innovation decisions towards a goal that does not immediately translate into economic benefit. If companies are forced to follow detailed ethical requirements in order to be able to bring a product to the market, for example the ISO 13485 certification concerning medical devices, they will make sure to complete the necessary procedures as quickly and thoroughly as possible.

Companies that consider the impact of their actions on the social and natural environment are often driven by strong intrinsic motivations. This suggests that while an expected increase in profits would likely be a good reason for companies to start looking into ways to implement responsible innovation, it does not have to be the only starting point. Moral motivations could open a second door to the implementation of responsible innovation in companies.

Overall, research to date on sustainability-oriented innovation suggests that innovation decisions in companies are influenced by a combination of company-external, company-internal, profit-oriented, mission-oriented and other factors. This means that a policy pattern aiming to support responsible innovation will need to combine different political instruments, create economic incentives for the implementation of responsible innovation practices and provide orientation about funding requirements in the medium-term future.

References

- Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented innovation: A systematic review. *International Journal of Management Reviews*, 18(2), 180–205.
- Auer, A., & Jarmai, K. (2018). Implementing responsible research and innovation practices in SMEs: Insights into drivers and barriers from the Austrian medical device sector. *Sustainability*, 10(1), 17.
- Blazejczak, J., Edler, D., Hemmelskamp, J., & Jänicke, M. (1999). Umweltpolitik und Innovation. Politikmuster und Innovationswirkungen im internationalen Vergleich. In P. Klemmer (Ed.), *Innovation und Umwelt* (pp. 9–56). Berlin: Analytica.
- Blok, V., & Lemmens, P. (2015). The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. In B.-J. Koops, I. Oosterlaken, H. Romijn, T. Swierstra, & J. van den Hoven (Eds.), *Responsible innovation 2: Concepts, approaches, and applications* (pp. 19–35). Cham: Springer.
- Blok, V., Hoffmans, L., & Wubben, E. F. M. (2015). Stakeholder engagement for responsible innovation in the private sector: Critical issues and management practices. *Journal on Chain and Network Science*, 15(2), 147–164.
- Chatfield, K., Iatridis, K., Stahl, B. C., & Paspallis, N. (2017). Innovating responsibly in ICT for ageing: Drivers, obstacles and implementation. *Sustainability*, 9(6), 971.
- Chatterji, A. K. (2009). Spawned with a silver spoon? Entrepreneurial performance and innovation in the medical device industry. *Strategic Management Journal*, 30(2), 185–206.
- Clark, T., & Charter, M. (2007). *Sustainable innovation: Key Conclusions from Sustainable Innovation Conferences 2003–2006 organised by The Centre for Sustainable Design*. http://cfsd.org.uk/Sustainable%20Innovation/Sustainable_Innovation_report.pdf. Accessed 9 Oct 2018.

- Díaz-García, C., González-Moreno, Á., & Sáez-Martínez, F. J. (2015). Eco-innovation: Insights from a literature review. *Innovations*, 17(1), 6–23.
- Dijkema, G. P. J., Ferrão, P., Herder, P. M., & Heitor, M. (2006). Trends and opportunities framing innovation for sustainability in the learning society. *Technological Forecasting and Social Change*, 73(3), 215–227.
- European Commission. (2012). *Responsible research and innovation—Europe’s ability to respond to societal challenges*. Brussels, Belgium: European Commission Publications Office. https://ec.europa.eu/research/swafs/pdf/pub_rri/KI0214595ENC.pdf. Accessed 26 Sept 2018.
- Fichter, K. (2005). Interpreneurship, Nachhaltigkeitsinnovationen in interaktiven Perspektiven unternehmerischen Handelns. Marburg, Metropolis.
- Fichter, K., Noack, T., Beucker, S., Bierter, W., & Springer, S. (2006). *Nachhaltigkeitskonzepte für Innovationsprozesse*. Stuttgart: Fraunhofer-IRB-Verlag.
- Fichter, K., Beucker, S., Noack, T., & Springer, S. (2007). *Entstehungspfade von Nachhaltigkeitsinnovationen. Fallstudien und Szenarien zu Einflussfaktoren, Schlüsselakteuren und Internetunterstützung*. Stuttgart: Fraunhofer IAO.
- Gil, M.A., Jiménez, J.B., & Lorente, J.C. (2001). An analysis of environmental management, organizational context and performance of Spanish hotels. *Omega*, 29(6), 457–471.
- Hansen, E. G., & Grosse-Dunker, F. (2013). Sustainability-oriented innovation. In *Encyclopedia of corporate social responsibility (2407–2417)*. Berlin, Heidelberg: Springer.
- Kesidou, E., & Demirel, P. (2012). On the drivers of eco-innovations: Empirical evidence from the UK. *Research Policy*, 41(5), 862–870.
- Klewitz, J., & Hansen, E. G. (2014). Sustainability-oriented innovation of SMEs: A systematic review. *Journal of Cleaner Production*, 65, 57–75.
- Kopfmüller, J., Brandl, V., Jörissen, J., Paetau, M., Banse, G., Coenen, R., & Grunwald, A. (2001). Nachhaltige Entwicklung integrativ betrachtet: *Konstitutive Elemente, Regeln, Indikatoren*. Berlin, edition sigma.
- Leisinger, K. (2017). Responsible Research & Innovation: Science with and for society (with special consideration of the “leaving no one behind” aspect of the agenda 2030). Expert paper prepared for the H2020 project “COMPASS – Evidence and opportunities for responsible innovation in SMEs”. https://innovation-compass.eu/wp-content/uploads/2018/01/Klaus-M.-Leisinger_RRI_Science-with-and-for-Society.pdf. Accessed 10 Aug 2018.
- 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.
- Madrid-Guijarro, A., Garcia, D., & Van Auken, H. (2009). Barriers to innovation among Spanish manufacturing SMEs. *Journal of Small Business Management*, 47(4), 465–488.
- Nathan, G. (2015). Innovation process and ethics in technology: An approach to ethical (responsible) innovation governance. *Journal on Chain and Network Science*, 15(2), 119–134.
- Noci, G., & Verganti, R. (1999). Managing ‘green’ product innovation in small firms. *R&D Management*, 29(1), 3–15.
- Nwafor, C., Jarmai, K., Stacherl, B., & Montevercchi, F. (2017). *Integration of the RRI approach into collaborative R&D&I and SME participation in European funded collaborative research in healthcare, nanotechnology and ICT*. Benchmark Report and Policy Paper. Deliverable 1.4 of the Horizon 2020 project “COMPASS – Evidence and opportunities for responsible innovation in SMEs”. https://innovation-compass.eu/wp-content/uploads/2017/09/D1.4-Benchmark-Report_Integration-of-the-RRI-approach-into-collaborative-Research-Development-Innovation-.pdf. Accessed 28 Oct 2017.
- Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E., & Guston, D. (2013). A framework for responsible innovation. In R. Owen, J. Bessant, & M. Heintz (Eds.), *Responsible innovation, managing the responsible emergence of science and innovation in society* (pp. 27–50). Chichester: Wiley.
- Owen, R., Ladikas, M., & Forsberg, E.M. (2017). Insights and reflections from National Responsible Research and Innovation Stakeholder Workshops. Report of the FP7 project “Responsible Research and Innovation in Practice” <https://www.rri-practice.eu/wp-content/uploads/2017/09/Experiences-from-the-RRI-national-workshops-June-2017-final.pdf>. Accessed 30 July 2018.

- Schaltegger, S., & Wagner, M. (2006). Integrative management of sustainability performance, measurement and reporting. *International Journal of Accounting, Auditing and Performance Evaluation*, 3(1), 1–19.
- Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. G. (2012). Business cases for sustainability: The role of business model innovation for corporate sustainability. *International Journal Innovation and Sustainable Development*, 6(2), 95–119.
- Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. G. (2016). Business models for sustainability: A co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation. *Organization & Environment*, 29(3), 264–289.
- Schiederig, T., Tietze, F., & Herstatt, C. (2012). Green innovation in technology and innovation management—an exploratory literature review. *R&D Management*, 42(2), 180–192.
- Schumpeter, J. A. (1947). The creative response in economic history. *The Journal of Economic History*, 7(2), 149–159.
- Steger, U. (1993). The greening of the board room: How German companies are dealing with environmental issues. In K. Fischer & J. Schot (Eds.), *Environmental strategies for industries* (pp. 147–166). Washington, DC: Island Press.
- Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, 42(9), 1568–1580.
- Sutcliffe, H. (2018). *Principles for Responsible Innovation. For technologies society can trust*. Consultation draft, Society Inside. http://societyinside.com/sites/default/files/Principles%20for%20Responsible%20Innovation%20Short%20February%202018_0.pdf. Accessed 10 Aug 2018.
- von Schomberg, R. (2011). Towards Responsible Research and Innovation in the Information and Communication Technologies and Security Technologies Fields. SSRN Electronic Journal.
- von Schomberg, R. (2013). A Vision of Responsible Research and Innovation. In R. Owen, J. Bessant, & M. Heintz (Eds.), *Responsible innovation, managing the responsible emergence of science and innovation in society* (pp. 51–74). Chichester: Wiley.
- Walker, H., Sisto, L. D., & McBain, D. (2008). Drivers and barriers to environmental supply chain management: Lesson from the public and private sectors. *Journal of purchasing & supply management*, 14(1), 69–85.
- WCED, S. W. S. (1987). World commission on environment and development. *Our common future*.

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