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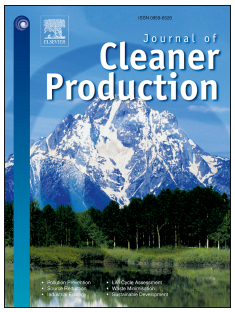

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Innovation ecosystems for meeting sustainable development goals: The evolving roles of multinational enterprises

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Abstract

Meeting the United Nations sustainable development goals (SDGs) will require breakthrough innovations in a number of areas. Multinational enterprises (MNEs) can contribute to these goals by fomenting innovation considering the coevolution of responsible research and innovation (RRI) with the maturity of innovation ecosystems. Therefore, a conceptual model of the roles of multinational enterprises contingent on the evolutionary phases of a firm and the ecosystem in which it is embedded is derived. These MNE roles and RRI activities in SDG-oriented innovation ecosystems are explored through case examples of specific multinationals. Based on different archetypes of innovation ecosystems and RRI maturity levels, the identified roles include secretive innovators, builders, theater directors, platform leaders, dominators, and amplifiers. More responsible enterprises are found to support the SDGs through platform leadership and by amplifying the sustainable innovations of other ecosystem participants, whereas less responsible firms innovate internally and achieve less sustainable results.

Keywords: Sustainable Development Goals; Responsible Research and Innovation; Multinational Enterprise; Innovation Ecosystems; Sustainability Management

1. Introduction and Motivation

The breakthrough innovations required to meet the great challenges of our century are rarely developed by multinational enterprises (MNEs), but entrepreneurial ventures, which tend to create innovations, fundamentally impact populations, the planet, the economy, and peace, as detailed in the United Nations Sustainable Development Goals (SDGs) (2020). The impact of MNEs on markets and policy making does, however, grant them an important role in SDG-oriented innovation ecosystems through partnerships that only large firms can forge (Kolk et al., 2017). The power of MNEs increases their responsibility within the global economic order (Petricevic and Teece, 2019). MNEs thus increasingly recognize the importance of acting within a wider innovation ecosystem expanding well beyond contractual relationships such as subsidiaries for their product development (McDermott et al., 2013).

To develop new products and services in a sustainable way, the concept of responsible research and innovation (RRI) has been introduced (Von Schomberg, 2013) and applied to industry contexts (Van de Poel et al., 2017). RRI involves considering ethical issues and the inclusion of external stakeholders beyond customers throughout the innovation process (Stahl et al., 2019). Inclusion, in terms of engagement with external stakeholders, is a critical building block for RRI. Innovation ecosystems provide a common platform for organizations to interact with other stakeholders and to create and capture value from innovation (Adner and Kapoor, 2010; Autio and Thomas, 2014). Firms engage in different RRI activities (Van de Poel et al., 2017) and assume different roles based on, e.g., the complexity of ecosystem relationships and levels of turbulence and innovation (Iansiti and Levien, 2004). As the ecosystem matures, the roles of firms may evolve. Our understanding of the dynamics of innovation ecosystems is still at an

early stage (Autio and Thomas, 2019; Dattée et al., 2018; Howard et al., 2019), and so far, corresponding relationships to RRI activities have not been explored.

In this article, we thus explore how the role of MNEs in the implementation of SDGs evolves as the innovation ecosystem and firm RRI mature. We therefore conduct a theoretical synthesis aiming at the conceptual integration of different theoretical fields (Jaakkola, 2020). This method has previously been fruitfully applied to the field of sustainability by Hörisch et al. (2020). The approach does not synthesize similar studies as a systematic review would do but instead links different strands of literature into one framework (Sandelowski et al., 2012). We hence focus on how different theories inform each other by aggregating them, rendering theoretical synthesis conceptual in terms of both processes and outputs (Dixon-Woods et al., 2005).

In our synthesis, we employ innovation ecosystem theory as a methodological theory to inform RRI as a domain theory. We also study the evolution of sustainability within MNEs before defining the different roles that MNEs assume in SDG innovation based on phases of ecosystem maturity and MNE sustainability maturity.

2. Theoretical Background

2.1 Responsible research and innovation (RRI)

The concept of RRI has evolved since 2010 (Stahl et al., 2017). Multiple definitions and interdisciplinary linkages have been proposed and discussed since. The most accepted definition is given by Owen et al. (2014), who state that RRI occurs when research and innovation activities are aligned with social desirability, sustainability and ethical aspects. RRI involves an

ongoing process of relating innovation and research activities to ethical and social needs (Van de Poel et al., 2017). Offering a more processual perspective, Owen et al. (2014) proposed four dimensions of the RRI process – anticipation, reflexivity, inclusiveness, and responsiveness. Anticipation refers to the identification of potential risks/implications of the proposed innovation, and reflexivity involves auditing activities with respect to quality, compliance, safety and the environment. Inclusiveness concerns the interdisciplinary collaboration of stakeholders across processes and innovation outcomes (Stahl et al., 2019), and responsiveness is considered necessary to be able to react quickly to changes (Dreyer et al., 2017). Van de Poel et al. (2017) offer an overview of RRI activities that firms engage in to contribute to these RRI dimensions, e.g., scenario building and workshops used for anticipation, user-center design, stakeholder engagement strategies, public dialogues for inclusiveness, codes of conduct, living labs, and social experiments for reflexivity and responsiveness (Van de Poel et al., 2017)

To operationalize the concept of RRI further, Stahl et al. (2017) offer a maturity-model tool to identify the current status of firms in the RRI process. The model proposes that firms are either unaware of RRI or exploratory/reactive, defined, proactive or strategic in RRI work. The last two levels refer to firms that assume an active role in taking responsibility for their innovation, and proactive firms are considered to understand the benefits of RRI and to proactively and increasingly integrate RRI into their firm processes, whereas strategic firms aim for all R&D activities to be carried out in a responsible manner and include RRI in their strategic frameworks.

The trade-off between economic returns and societal impact is an ongoing challenge to a large number of MNEs and is discussed in academia across multiple research streams. Corporate

social responsibility, corporate sustainability, corporate shared value, business ethics, and sustainable business model innovations (Boons and Lüdeke-Freund, 2013) are a few of these streams; however, the emerging concept of RRI is an attempt to condense these different streams and embed responsible behavior at very early stages of the research and innovation process. RRI focuses on the strong integration of social values and business ethics with economic returns (Martinuzzi et al., 2018) and aims to bring these aspects to the core of businesses.

Most of the RRI focuses have emerged from academia or government without garnering much attention from industry. A lack of operationalization of the concept hinders broader acceptance of the term, especially in the industrial sector. Challenges in terms of understanding what to focus on through RRI and how to implement RRI have been identified as major hinderances. The emergence and acceptance of the United Nations' 17 sustainable development goals (SDGs) offered a consensus in defining what is 'responsible' for RRI (Stahl et al., 2019). With the adoption of the SDGs, MNEs are being pressurized to indulge in responsible research and innovation and show their impacts on society and the environment (Martinuzzi et al., 2018). To tackle these grand challenges and engage in RRI, MNEs tend to start from their internal operations and gradually extend these to the whole value chain, including upstream and downstream suppliers or distributors (Topple et al., 2017). Scholars discuss various forms of activities that MNEs engage in, such as revising their ecostrategies, engaging in responsible and ethical R&D activities, and implementing corporate social responsibility activities, among others.

Responsibility is not a singular phenomenon, but rather responsibilities are multiple and networked (Timmermans et al., 2017). We must therefore consider the networked nature of responsible innovation (Martinuzzi et al., 2018) by viewing responsibilities as embedded within ecosystems (Chatfield et al. 2017). A firm attends to different types of responsibilities, and these responsibilities are often shared by different entities (Iatridis and Schroeder, 2016). MNEs hence engage in various collaborations and innovation ecosystems to achieve sustainability goals (Durugbo and Amankwah-Amoah, 2019). However, this linkage between RRI activities and ecosystems has been relatively underresearched (Neumeyer and Santos, 2018).

To develop sustainable innovations, companies form interorganizational networks with other stakeholders and wider social systems (Boons and Lüdeke-Freund, 2013). MNEs may start with incremental steps and later accelerate to radical steps (Schaltegger, Lüdeke-Freund, and Hansen, 2016), such as leading innovation ecosystems. MNEs often start with internalizing the RRI concept (Shah and Arjoon, 2015). One of these radical steps involves leading innovation ecosystems focused on sustainability, which is the focus of this study. These innovation ecosystems involve participation at multiple levels and complex relationships between stakeholders. The range of partners involved varies from nongovernmental organizations such as grassroots organizations and trade unions to the media, small and medium-sized local firms, and sustainable entrepreneurs (Kolk et al., 2017). These entrepreneurs are also important target groups since their interactions with external stakeholders can be framed in a different way: newly formed companies have found it easier to frame the integration of external stakeholders such as established companies. Thus, the ecosystem of different actors, activities and normative foundations can be configured in a more sustainable way (Stahl and Brem, 2013). Such

partnerships could take various forms, such as government-community-business, business-business and basic learning partnerships (Durugbo and Amankwah-Amoah, 2019). Here, policy makers emerge as important contributors by developing evolutionary approaches that help stimulate radical technologies and systemic change from a long-term perspective (Nill and Kemp, 2009).

The roles of ecosystem participants depend on the focus area and evolve over time. For example, for research and innovation on technology-oriented topics such as clean technologies (solar and wind energy, etc.), MNEs assume a leading role, whereas for more reactive topics, e.g., environmental research, government- and publicly-funded organizations drive ecosystems (Kolk et al., 2017). While there is a significant amount of literature exploring the role of government or publicly funded organizations in RRI, insights into the role of MNEs and their RRI activities in innovation ecosystems directed towards SDGs are scarce (Kolk et al., 2017).

2.2 Innovation Ecosystems and Sustainability

The RRI maturity of MNEs coevolves with the innovation ecosystems in which they are embedded, since such innovation ecosystems are composed of loose networks of organizations and individuals that interact and coevolve to create and capture value from innovation (Iansiti and Levien, 2004, Adner and Kapoor, 2010). Such interaction is based on a platform or focal firm (Autio and Thomas, 2014). The platform is a crucial resource that enables and focuses on the innovation of different firms (Gawer and Cusumano, 2002; 2014). There is a wide array of platform types, e.g., technologies such as the Android operating system, which enables the development of mobile applications, or dominant designs, e.g., lithium-ion batteries, that reduce

competing innovation in energy storage and permit focused efforts in complementary innovations (Sivaram et al., 2018). MNEs participate in these innovation ecosystems together with a multitude of other organizations, including small and medium-sized enterprises, universities, financial institutions, and governmental and nongovernmental organizations. (Ferras-Hernandez and Nylund, 2019). Whereas the innovation of MNEs suffers from the inherent organizational inertia of established firms (Hannan and Freeman, 1984), innovation ecosystems are characterized by biological processes such as the birth and selection of new ventures (Nelson and Winter, 1982).

The evolution of an innovation ecosystem is S-curved with slow initial growth followed by a phase of rapid expansion and then slowed progression to a more stable state (Katz, 1961; Utterback, 1994). In this stable state, the ecosystem still evolves but at a slower pace (Wareham et al., 2014). Standards and dominant designs then focus on innovation within the ecosystem (Brem et al., 2016). Stable ecosystems can evolve further by entering new domains in which mature technology may trigger disruption (Levinthal, 1998). Research has described the phases of ecosystem evolution in different ways depending on the perspective of the authors (Table 1).

Table 1: Phases of ecosystem evolution

Article	Phases		
Abernathy and Utterback, 1978	Flexibility,	intermediate,	mature.
Nelson and Winter, 1982	Variation,	selection,	retention.
Abernathy and Clark, 1985	Regular, revolutionary,	niche creation,	architectural.
Anderson and Tushman, 1991	Ferment,	incremental change.	
Moore, 1993	Expansion,	leadership,	self-renewal.
Ritala, et al., 2013	Building,	managing.	
Cusumano et al., 2015	Ferment,	transition,	mature.

Dedehayir et al., 2018	Preparation,	formation,	operation.
Ma et al., 2018	Mixed impact,	light-green,	deep-green.
Nylund et al., 2019	Nascent,	emergent,	mature.

The early work of Abernathy and Utterback (1978) viewed innovation as the internal R&D of a firm and defined a fluid, flexible phase followed by a transitional intermediate phase and a specific mature phase. Later research added the perspective of industry evolution as cyclic with radical innovations capable of sparking new cycles (Abernathy and Clark, 1985). The period after a breakthrough innovation is characterized by convergence towards one dominant design, which is followed by a period of incrementally increasing innovation, e.g., production efficiency (Anderson and Tushman, 1991). Recent research also indicates that events such as the 2008 financial crisis may have an impact on the emergence of dominant designs, e.g., through an even greater role of globalization (Brem et al., 2020).

Nelson and Winter (1982) focus on entire economies and suggest that evolution happens through ecological processes e.g. variation, selection, and retention. When business ecosystems are seen only as loose networks of customers and suppliers, they mature through the phases of expansion and leadership to eventually face self-renewal through innovation (Moore, 1993). Then, the focus of MNEs becomes to create and capture value by building and managing the ecosystem (Ritala, et al. 2013). In a similar vein, Dedehayir et al. (2018) define the phases of an ecosystem according to the activities of the ecosystem leader, namely, preparation, formation and operation. The complexity of innovation ecosystems is, however, much greater, and we must consider the coevolution of the ecosystem as such and of individual organizations conforming to the system.

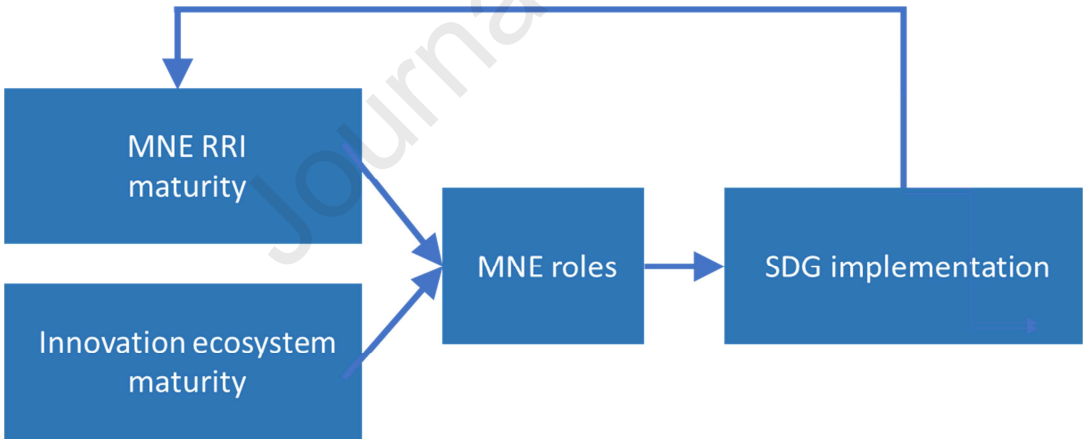
Cusumano et al. (2015) define the phases of evolution in line with the early thoughts of industry convergence as follows: ferment, transition and mature. Nylund et al. (2019) also consider the birth of ecosystems, e.g., the phase prior to ferment in their classification of ecosystems as nascent, emergent or mature. We thus follow this classification for our conceptual model and analyze how the roles of MNEs evolve as the ecosystem passes through the nascent, emergent and mature phases of development.

To comprehend the specific roles of MNEs in SDG achievement, however, we add the sustainability perspective. Ma et al. (2018) study a sharing-mobility ecosystem and define the first phase as a mixed impact on socioeconomic relations, the second phase as a light-green change where sharing-mobility innovations begin to be implemented, and the third phase as a deep-green change where sharing-mobility forms a platform for other sustainable innovations due to an alignment of society with sustainable values. This indicates that an ecosystem can become more sustainable as the values of its participants coevolve. We therefore delve deeper into how sustainability develops within MNEs in innovation ecosystems before considering how this development affects the roles of MNEs in supporting the SDGs.

To understand SDG-oriented innovation ecosystems, maturity in terms of RRI is particularly important. However, the RRI activities of firms coevolve with those of the innovation ecosystem, with individual firms adapting to the level of responsibility of the ecosystem as a whole (Arnaldi et al., 2015; Ladikas et al., 2019). In this study, we explore the SDG-oriented innovation ecosystem and explore how the roles of firms and RRI activities change over time. We specifically focus on firms with a high level of RRI maturity (strategic and proactive), as

engagement in SDG-oriented innovation ecosystems occurs when firms are aware of the benefits of RRI and seek to proactively integrate it into business processes across all levels (Stahl et al., 2019). Furthermore, firms can assume many different roles in ecosystems, e.g., supplier, assembler, complementor, expert, champion, entrepreneur, sponsor, and regulator (Dedehayir et al., 2018), but we focus on the different roles of an MNE as an ecosystem leader or ecosystem orchestrator (Leten et al., 2013). Figure 1 shows the overarching conceptual framework applied in this study, where we consider how both the RRI maturity of MNEs and the maturity of the SDG-oriented innovation ecosystem influence the roles of MNEs and thus how they lead the ecosystem towards SDG implementation. In addition, SDGs promote clear objectives that help increase the RRI maturity of MNEs. This framework is further developed in the next section.

Figure 1: Overarching conceptual framework



3. MNEs orchestrating SDG-oriented innovation ecosystems

Understanding the linkage between the innovation ecosystem and RRI is necessary, as innovation is required to achieve most, if not all, of the SDG goals. MNEs no longer rely on their closed strategies and superior assets manifest in large R&D labs for innovations but are finding

more open and inclusive ways to innovate (Chesbrough, 2003) in a responsible and ethical manner. Whereas innovation is explicitly mentioned under SDG 9 Industry, Innovation and Infrastructure, eliminating poverty (SDG 1) requires new structures for microentrepreneurship and other wealth distribution measures (SDGs 8 & 10) (Prahalad, 2004) as with social innovation approaches (Fahrudi, 2020). These structures often aim to lift families from poverty by empowering women (SDG 5) as highlighted by Rosca et al. (2020). Eradicating hunger (SDG 2) requires more efficient agricultural methods and frugal innovation driven by resource scarcity, e.g., lacking infrastructure (SDGs 3 & 6) (Zeschky et al., 2011; Agarwal et al. 2017). New technologies are also needed to reduce our environmental impact (SDGs 11-15). Finally, forming partnerships to achieve the goals is directly reflected in SDG 17, involving powerful MNEs and the ecosystems through which they act.

When companies were less connected, much innovation was generated in internal R&D labs without reliance on an ecosystem. As firms increasingly mature in terms of sustainability and in taking into account the stakeholders around them, they aim to build and lead ecosystems. For this purpose, different roles and RRI activities are observed in innovation ecosystems at nascent, emergent and mature levels, as discussed below (see Table 2).

Table 2: MNE roles and RRI activities of SDG-oriented innovation ecosystems

Innovation Ecosystem/ RRI Maturity	**Nascent**	**Emergent**	**Mature**
Strategic	***Builder*** Gathers partners around an ecosystem platform. *High inclusiveness and responsiveness*	***Platform leader*** Influences the ecosystem through platform management. *High inclusiveness and responsiveness*	***Amplifier*** Amplifies the sustainability endeavors of others *High inclusiveness and responsiveness*
Proactive	***Secretive innovator*** Innovates internally based on own discoveries. *Low inclusiveness*	***Theater director*** Considers innovation activities as results in themselves. *Low reflexivity and high inclusiveness*	***Dominator*** Uses its bottleneck positioning to capture more value than it creates. *High inclusiveness and low responsiveness*

3.1. Secretive-innovator role

Traditionally, innovation has been carried out internally in the R&D labs of large firms, primarily building on previous firm innovations and on knowledge accumulated within organizations over the years. With fewer means for interfirm interaction, the efficiency and size of MNEs give them competitive advantages in R&D processes (Chesbrough, 2003). This type of innovation process is, however, prone to organizational inertia and produces incremental innovations that improve on existing solutions rather than the disruptive, game-changing innovations required to meet the SDGs (Christensen, 1997). In fast-moving markets with competitors imitating every move, the protection of intellectual property is often complex, and firms may choose not to develop an innovation ecosystem but to opt for internal innovation (Leiponen and Byma, 2009). In such firms, RRI activities are also internalized, and firms anticipate and are highly responsive to new developments but limit their inclusiveness.

3.1.1 Apple's secretive-innovator role

To this day, many MNEs favor internal R&D. Strategies of secretive internal development are particularly common among innovators that push the design frontier (Almirall and Casadesus-Masanell, 2010). Whereas Apple provides a platform for open innovation, allowing applications to be developed on its iOS operating systems and distributed through its AppStore, the development of iOS is a secretive affair (Vanhaverbeke and Chesbrough, 2014). Apple's closed-innovation approach contrasts with the open approach of competing Android OS, which is open for development by users. Over the years, Apple has used a conscious strategy of very secretive development when it suits the firm while switching to involving ecosystem actors when it benefits from such input (Lakhani et al., 2013). The key behind this successful secretive-innovator role lies in the underlying strategy for intellectual property protection with a strong emphasis on the adequate use of measures such as trade secrets, patents, copyrights, and trademarks (Chesbrough, 2006). Since patents require a disclosure of innovation, they are inconsistent with maintaining secrecy, and Apple therefore often depends on other measures. When Apple has relied on patents, this has sometimes required protecting them throughout lengthy patent wars (Trappey et al. 2016). The advantages of secretive innovation lie not only in first-mover advantages but also in avoiding sharing the value of innovation with ecosystem participants. Additional income streams can be obtained from the cross-device integration of apps and functionality and from releasing innovations incrementally in subsequent versions of the same device (Yun et al., 2018). Both practices encourage additional consumption and indicate a lack of RRI maturity. The lack of transparency of this role may serve as a barrier to RRI maturity since the MNE is not held accountable throughout the opaque innovation process.

3.2. Builder role

The MNE's secretive-innovator role is becoming less viable in times of increasingly vast amounts of digital information. In addition, transaction costs for open, collaborative innovation processes can be reduced in times of digital innovation (Helfat and Raubitschek, 2018). Furthermore, firms find it difficult to meet societal and scientific challenges without involving affected stakeholders in the innovation process (Reypens et al., 2016). Key firms in nascent ecosystems therefore tend to build ecosystems partner by partner, subsequently engaging in an increasing number of organizations within a platform (Nylund et al. 2019). The builder role hence involves attracting and gathering relevant stakeholders (Ritala et al., 2013).

3.2.1 The builder role of Safaricom and Fairphone

The M-Pesa mobile payment platform was launched by Safaricom in Kenya in 2007 (Mas and Morawczynski, 2009). The platform has been unusually successful as a driver of growth in the country and reached 15 million users soon after inception (Heinrich, 2014). The platform has contributed to a number of SDGs, e.g., those related to poverty (SDG 1), hunger (SDG 2), equality (SDGs 5 and 10), water (SDGs 6 and 14), growth (SDG 8), innovation (SDG 9), and the environment (SDGs 7 and 11-15). At its inception, the service filled an important gap regarding secure money transfer (Sadoulet and Furdelle, 2014). Many rural-born Kenyans had gone to work in faraway cities and would send money home through friends or by inefficient postal services (Mas and Morawczynski, 2009). Conventional banking not accessible to most people, and existing technologies for money transfer were out of the question. Safaricom therefore had to develop a completely new technological platform that did not require an infrastructure that

potential users had no access to and drew on Safaricom's distribution network instead (Hughes and Lonie, 2007).

To introduce M-Pesa, Safaricom had to build an ecosystem, partnership by partnership, drawing on the legitimacy and trustworthiness of the Safaricom brand (Sadoulet and Furdelle, 2014). MNE Vodafone owned part of Safaricom and supplied technical and project management expertise. The Commercial Bank of Africa contributed the necessary mechanisms pertinent to conventional banking. Microfinance institution Faulu Kenya was approached to gain lead users for the project. Regulatory issues were solved in collaboration with the Central Bank of Kenya (Mas and Morawczynski, 2009).

Another example of such a technological platform is illustrated by the company Fairphone. The firm's goal is to reinvent the smartphone supply chain such that all suppliers are treated fairly and all sources of materials are sustainably and fairly sourced.[1] The objective is a systemic change for all smartphones, which is apparently difficult to achieve (Wernick and Strahl, 2015). Since its launch, several smartphones have been launched on the market, indicating the existence of a market niche for such products. The idea of exchanging key parts of a phone, such as batteries, cameras, and cases, serves as a good example of addressing environmental concerns in saving resources. A sustainable lifestyle could hence be achieved through sustainable consumption with such a technical artifact (Haucke, 2018).

[1] See www.fairphone.com

The builder role demonstrates the relevance of the RRI inclusiveness and responsiveness dimensions. M-Pesa with Safaricom developed a new platform to overcome infrastructure and accessibility challenges. Different stakeholders were employed and mapped to specific requirements of innovation. The same happened for Fairphone. A new platform had to be set up to organize sustainable sourcing and to make spare parts available for all key phone elements over a longer period of time. The company thus applies RRI principles without explicitly referring to them.

3.3. Theater-director role

As the ecosystem grows, the role of leading firms becomes more focused on strengthening the platform. Less sustainably aware firms may replace this role with activities that aim to support the innovation of others but with few results. MNEs may engage in an innovation ecosystem by organizing incubators and innovation hubs and through activities such as hackathons, design thinking classes, and innovation workshops. When these initiatives do not build on underlying shared beliefs and validated principles, the role of the MNE is rather that of a director of an innovation theater, where the activities in themselves are seen as a result rather than as generating sustainable innovation (Blank, 2019). This is usually a consequence of MNE corporate culture. Although few firms admit to engaging in innovation theater, considering the ratio of investments into innovation activities and later numbers of concrete innovations offers certain insights.

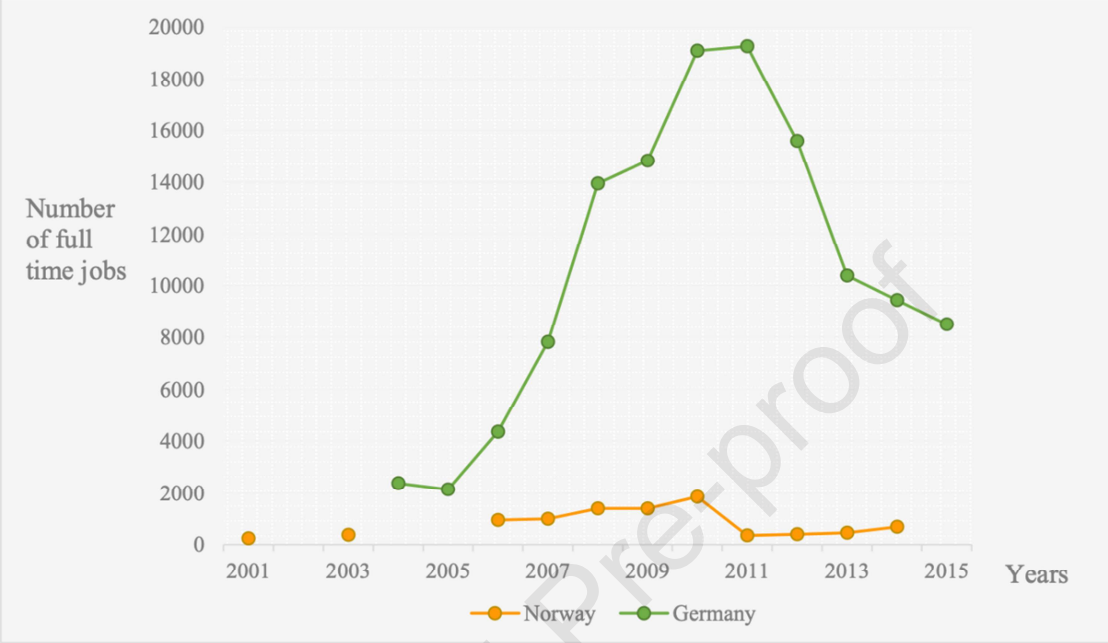
3.3.1 The theater-director role of the German solar energy ecosystem

MNE innovation is less sustainable when actions are not accompanied by values, and the firm as a result engages in innovation theater and similar practices. The German solar energy ecosystem

serves as a prime example of innovation theater conducted on a grand scale, since it collapsed as soon as government funding was removed, and we therefore introduce it below.

The first initiative to promote solar energy emerged in the early 1990s with the introduction of the first feed-in tariffs. The feed-in tariffs were increased in 2000 in parallel with a similar movement in Spain. With these incentives, solar business models could be directed towards businesses as well as towards the installation of solar panels by private households. Even though the prices for equipment were high and the resulting performance was low, solar grew at a high rate. In 2008, Germany and Spain together accounted for two-thirds of globally installed capacities. From this year on, Spain started cutting its tariffs, with a full end to support occurring in 2012, mainly due to a missing limitation for feed-in tariffs and rising costs. In Germany, the downturn occurred later since the business became even more profitable with the rising efficiency of the technology. However, from 2012 onwards, the whole sector became much less attractive as the German feed-in tariffs were dramatically cut (Kriechbaum et al., 2018). In parallel, Chinese low-price module producers started to flood European markets. The Chinese companies were supported by their government, which led to a call for collecting import duties from these areas. Such import barriers were not sufficient to save the German solar industry in the long term, as Figure 2 shows.

Figure 2. Total number of jobs in the photovoltaic manufacturing industry in Norway and Germany 2001-2015



Source: Hansen (2016), p. 42.

This price war led to a downturn in European production and to a particular rise in Chinese production capacities (Hansen, 2016). Similar developments are currently observable in the Spanish wind industry (Rosales-Asensio et al., 2019).

Hence, it can be concluded that innovation ecosystems can be strongly driven by external factors, e.g., regulatory incentives. This leads to considerable policy and revenue risks (Blondiau, 2018, with innovation theater possible on the firm level and innovation bubbles emerging within the innovation ecosystem. As we have seen, regulatory changes can burst these bubbles and lead to the demise of entire ecosystems. This has also been the case for embargos of products, e.g., glyphosate or CFC chlorofluorocarbon (Männer et al., 2012). Therefore, with such a role,

reflexivity in terms of gauging risks, learning orientation and the integration of values becomes critical. Solely focusing on inclusiveness is not sufficient.

3.4. Platform-leader role

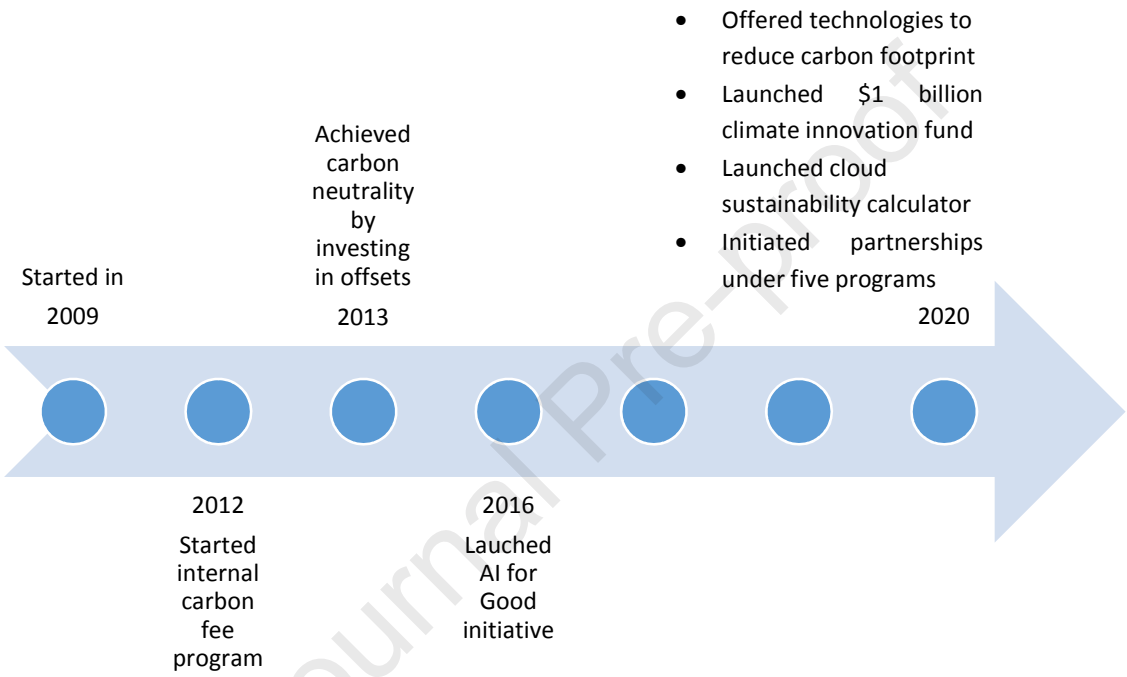
Platform leaders are, according to Gawer and Cusumano (2014), "organizations that manage to successfully establish their product, service, or technology, as an industry platform and rise to a position where they can influence the trajectory of the overall technological and business system of which the platform is a core element". Iansiti and Levien (2004) defined the keystone role of an innovation ecosystem as ensuring the robustness, variety, and productivity of the system as a whole.

3.4.1 Microsoft's platform-leader role

Microsoft software has assumed a platform-leader role in the reduction of carbon emissions. The technology giant has been committed to combating climate change since 2009. From 2009 to 2020, Microsoft's journey towards sustainability was intriguing (Figure 3). Microsoft goes beyond working with formal partners to extended stakeholders and proactively engages with them. Apart from leading policy-level talks with governments, businesses, and civil societies, Microsoft is investing in cloud technologies to make the company more responsible and inclusive. In collaboration with key organizations, Microsoft awards grants to change makers and innovators, which grant access to its cloud computing services, AI tools, technical support, and cash awards. The initiative is called 'AI for Good' and is divided into five different programs, namely, AI for Earth, AI for Accessibility, AI for Health, AI for Humanitarian Action and AI for Heritage.

Under the AI for Earth program, Microsoft supports projects that address biodiversity and environmental challenges. The AI for Health program supports and empowers nonprofits, researchers and organizations working to improve health outcomes globally, e.g., developing an AI-enabled digital health tool for the early detection of leprosy.

Figure 3: Timeline of Microsoft's sustainability initiatives



AI for Accessibility is targeted at making the world more inclusive for people with disabilities, e.g., by creating a pictogram app for children who are nonverbal. The Rochester Institute of Technology, supported by Microsoft, is working on improving the accuracy of real-time captions for students with hearing problems. AI for Humanitarian Action targets disaster recovery, the needs of children and the promotion of human rights (e.g., SDGs 1, 2, 3, and 16). Microsoft has collaborated with the Clooney Foundation for Justice to leverage AI technology to empower human rights trials. Microsoft is also partnering with the World Bank and UN to help forecast areas that are at risk of famine. AI for Heritage focuses on investing in AI technologies to

preserve cultural heritage around the world. For example, Microsoft is collaborating with indigenous communities in New Zealand to preserve their native languages, which are quickly disappearing.

Each of these programs within 'AI for Good' is developing an innovation ecosystem from which Microsoft is offering its online cloud platform to make the world more sustainable. Thus, Microsoft acts as a platform leader to establish partnerships fomenting the SDG goals (SDG 17). The MNE has used its cloud platform to launch the Climate Neutral Now initiative of the UN Framework Convention on Climate Change, enabling people to measure, reduce and offset their carbon emissions in meeting SDG 12 Responsible Consumption and Production and SDG 13 Climate Action. RRI activities on all important scales from anticipation to responsiveness are thus prioritized for this role.

3.5. Dominator role

As the innovation ecosystem matures, MNEs dedicate less effort to upholding a platform and can either focus on value capture or on amplifying the sustainable initiatives of others. MNEs have been used to apply strategies aimed towards a market-dominating role, excluding competitors from access to customers. When this strategy is applied in innovation ecosystems, MNEs create a bottleneck between suppliers and customers and therefore capture more value than they create (Iansiti and Levien, 2004). This type of value domination squeezes profits from the system and is profitable for the MNE in the short run, but since it depletes the business models of other firms in the ecosystem, the resulting lack of robustness is likely to lead to the demise or reconfiguration of the ecosystem. The sustainable image of the acquired firm then reflects well

on the MNE. However, rather than the whole MNE becoming more sustainable, the RRI of the purchased firm tends to dwindle over time, as assumed by the culture and management practices of the MNE.

Value dominators often end up depleting ecosystem partners of all profits and then acquire these profitless partners so that they can keep sustaining their role in the ecosystem, as in the case of Unilever's purchase of Ben & Jerry's. The famous ice-cream brand was founded in 1978 as a small startup with very high ambitions, placing social responsibility at the core of its activities. The company grew from a store managed by two staff members in Vermont to a wholly owned subsidiary of the MNE Unilever in 2000. To date, the company is the only subsidiary of Unilever with an independent board of directors (Ben & Jerry's, 2020).

MNEs such as Unilever want to profit from the image of social enterprises to give themselves a sustainable image. Since the acquisition, Unilever has received benefits from this investment in terms of turnover and profits. The goodwill, however, appears to be have been short lived. A study by Mei (2018) on the acquisition of Ben & Jerry's by Unilever indicates the negative effect of an acquisition of a social enterprise by an MNE from a consumer perspective. Consumers expect less social commitment and localness when a company is incorporated as one of an MNE's many brands and attribute this negative perception to their earlier experiences of MNEs buying smaller companies and their negative perceptions of multinationals in general. This is critical since social enterprises face specific dilemmas that must be addressed (Agarwal et al., 2020), which might not be the focus of companies such as Unilever.

Studies of the acquisition of sustainability-oriented organization The Body Shop return similar findings. The Body Shop was also founded in the late 1970s and was created based on founders' values regarding corporate social responsibility and ethical decision making (Lassk, 2019). In 2006, the company was acquired by French MNE Loreal and finally sold to Brazilian MNE Natura in 2017. For instance, Chun (2016) found that highly empathic customers respond with lower consumer loyalty when a sustainability-oriented brand lacks empathy. These acquisitions show how MNEs can use their powerful positions to appear sustainable, but they also show that customers are increasingly aware of such strategies.

The responsiveness of RRI activities and adaptive change slowly starts to be depleted as MNEs start dominating RRI activities and pursuing economic objectives.

3.6. Amplifier role

MNEs that are RRI mature and active in mature innovation ecosystems are more likely to shoulder what we call an amplifier role. MNEs then amplify the sustainable initiatives of other, more responsible entities. Even in MNEs with mature RRIs, the focus on efficiency and performance that has enabled the firm to grow and expand tends to reduce RRI in practice. Therefore, the best laid plans lose force when they meet contradictory needs in their implementation. Partnerships with independent organizations that have a sustainability focus then have the advantage of sustainable values never being directly confronted with the efficiencies of day-to-day business.

Multinational supermarket chain Lidl collaborates with Fairtrade and has helped increase the portion of products sold with the Fairtrade label, selling 162 million Fairtrade products in the

2006-2016 period (Fairtrade, 2016). NGO Fairtrade International allows its brand to be shown on products that meet their social, environmental, and economic standards. Fairtrade works towards eight of the SDGs in particular, namely, ending poverty among smallholder farmers and workers (SDG 1), helping such individuals build resilient businesses that help end hunger (SDG 2), supporting women in agriculture (SDG 5), promoting better working conditions (SDG 8), campaigning for sustainable production (SDG 12), building farmers' resilience to climate shocks (SDG 13), promoting the democratic rights of producers (SDG 16), and working with partners to strengthen means of implementation (SDG 17) (Fairtrade, 2020). Collaboration with Lidl thus constitutes a conscious strategy to increase the reach of Fairtrade products.

Lidl launched its own Fairglobe brand of Fairtrade products in 2006 (Langen, 2013), allowing the firm to reduce the impact of intermediaries while better visualizing the chain's commitment to sustainability. This initiative has been criticized since it conveys Lidl as a fair enterprise while the working conditions of Lidl's own employees are substandard (Langen, 2013). Another example of this struggle between sustainable values and MNE profit pressures is illustrated by the fact that Lidl announced that it would only sell Fairtrade bananas from September 2018 but then reintroduced cheaper non-Fairtrade bananas in 2019 due to customer demand (Ried, 2019). These clashes highlight the need for MNEs to collaborate with NGOs and other external ecosystem participants in their support of the SDGs, since sustainable practices do collide with the established business practices of MNEs. MNEs that participate in the ecosystems of producers, NGOs, governments, etc. thus have additional tools for supporting the SDGs.

Rather than internalizing RRI, firms start promoting other ecosystem participants who are high in RRI dimensions and show responsiveness and inclusiveness through them.

4. Discussion and conclusions

4.1. Implications for theory and practice

We have developed a conceptual framework of the evolving roles of MNEs and their RRI activities in the SDG-oriented innovation ecosystem considering the coevolution of these roles with the RRI maturity of the MNE and the maturity of the ecosystem. More RRI maturity allows MNEs to adopt roles that better support the implementation of SDGs. In nascent ecosystems, the inclusiveness of an MNE can create the difference between building the ecosystem and not engaging in ecosystem innovation at all. In emergent ecosystems with high levels of inclusiveness, firms become platform leaders that drive the growth of entire SDG-oriented innovation ecosystems, whereas with low levels of reflexivity, multinationals tend to engage in activities that masquerade as sustainable innovation but bear little fruit. The advantages of MNEs with a mature understanding of RRI remain within mature ecosystems, where firms act as amplifiers of the sustainable innovation of ecosystem partners by endorsing other firms that are high in RRI dimensions, whereas less mature firms impose MNE cultures dominating RRI activities and thus deplete sustainable initiatives in the long run.

For MNEs that assume a value dominator role, Wickert et al. (2017) state that an acquisition of a socially responsible company might serve as an efficient and cost effective option from which multinationals can obtain access to such related knowledge and best practices for their own organizations. The authors, however, highlight the need to consider related cultural processes. Within this context, Mirvis et al. (2016) note that companies seeking knowledge on corporate social responsibility must consider the tacit nature of such information and the considerable

difficulties with transferring it. This might be a reason why many MNEs struggle with these processes. The sustainable image of the acquired firm initially reflects well on the MNE. However, rather than the whole MNE becoming more sustainable, the RRI of the purchased firm tends to dwindle over time as it assumes the culture and management practices of the MNE.

For MNEs to maximize their impact on the SDGs, an integration of sustainable values throughout firms is required. However, this integration is impaired when there is a contradiction between profitability and sustainability. Situations that benefit businesses and society equally are of course ideal (Porter and Kramer, 2006). MNEs are used to put the bottom line first throughout their business processes, and an external conscience in the form of a collaboration partner will therefore be useful. MNEs can then use their economic power and influence to amplify the SDG impacts of the conscientious organization. Thus, by realizing their limits and taking advantage of their strengths, MNEs can optimize their role in SDG innovation and avoid fruitless activities that are based on ideal value alignment rather than the realities of large firms.

We contribute to the theory of innovation ecosystems by developing a framework of ecosystem dynamics that occur over time. In addition, we consider the impact MNEs, which are some of the most powerful ecosystem participants. The different roles that MNEs assume and the circumstances under which MNEs tend to lean towards one role or another have hitherto not been considered in ecosystem research. We contribue to MNE theory by identifying the specific roles that these firms can assume in SDG-oriented innovation ecosystems and the factors upon which such role selection is contingent.

We contribute to the literature on RRI by identifying the activities of MNEs high in RRI maturity and thus of the innovation ecosystem as a whole. As discussed, the current literature on RRI is primarily focused on government initiatives and publicly funded organizations (Stahl et al., 2019). A lack of operationalization of the RRI concept has often caused industry to refrain from engagement. In further developing the RRI maturity model (Stahl et al., 2019) within the context of sustainability, our study offers a road map for MNEs seeking to progress in RRI. The proposed framework illustrates different roles that MNEs can assume over time to run responsible businesses. In reiterating the importance of collaboration to RRI, our study emphasizes innovation ecosystems and partnerships with various stakeholders as attractive pathways through which MNEs can move towards SDGs. The combination of innovation-ecosystems theory and our understanding of RRI leads to the conclusion that MNEs that are more mature in terms of RRI take more sustainable roles and are more likely to make significant contributions to SDG innovation.

Our framework can be readily used by MNE managers to assess the roles of their firms in SDG-oriented innovation ecosystems. The roles that RRI-mature MNEs assume can be considered best practices, including the builder, platform leader, and amplifier roles. When a firm takes an R&D lab, theater-director, or dominator role, this may indicate a need to further consolidate responsible values within the organization. It is not necessary that firms adopt a linear approach and assume these roles gradually. Firms can assume multiple roles in parallel based on the linkages between SDGs and core business strategies. This is an easier endeavor for startups since they can then establish routines and practices from the beginning in an RRI-compliant way. For larger firms, especially MNEs, this is a much longer and sometimes painful process. Routines do

not change from one day to the next, and in an international context, local cultural issues must be considered as well.

Table 3 reflects the framework introduced in Table 2 before the background of specific management behaviors and stakeholder views. The table might help practitioners evaluate which roles their firms currently assume and which roles they aim to assume. These indications can serve as a basis for later strategic decisions to change company positions in the long term.

Table 3: Linkage between MNE roles and management and stakeholder behavior

Innovation Ecosystem/RRI Maturity	**Nascent**	**Emergent**	**Mature**
Strategic	***Builder*** • Corporate management is proactive and rather new • Active gathering of new partners among stakeholders	***Platform leader*** • Management has to be experienced in ethical issues to show leadership capabilities • Stakeholders are present in the ecosystem	***Amplifier*** • RRI activities are well established in corporate routines • Stakeholders are attracted by the benefits of the ecosystem
Proactive	***Secretive innovator*** • Technology-oriented management • Only considers stakeholders such as customers and suppliers	***Theater director*** • Ecosystem-oriented management • Stakeholders are key elements of the MNE strategy	***Dominator*** • Strong market position exposes management to critique • Only considers stakeholders as potential customers

4.2 Limitations and future research

The conceptual model proposed is based on theory and would benefit from empirical verification. For this purpose, qualitative studies on individual company cases are advised. In addition, larger quantitative studies could foster our understanding on a broader scale, e.g., on the industry level. The quantitative valuation of ecosystem goods and services requires going beyond traditional value measures, and scholars are developing creative ways to measure value. The value contributed by different partners has been measured in terms of the impacts of patents (Holgersson et al., 2018), and the value created by digital innovation ecosystems as a whole has been proxied by the interactions of participants (Suseno, et al., 2018; Chae, 2019). Improved measures of value in ecosystems are clearly needed to determine the economic value created in ecosystems. In addition, social and environmental value must be accounted for. The stakeholder literature may inform such improved measures. For example, Wang and Sengupta (2016) relate the quality of stakeholder relations to brand equity, which is a broader measure than pure economic performance. The study of sustainability in innovation ecosystems is still in its infancy, and much more work is expected in this field.

Furthermore, our research is limited to a focus on the roles of MNEs, and extending the proposed model to other ecosystem participants could lead to further insights for theory and practice. For instance, it would be interesting to analyze how small and medium-sized companies organize their innovation ecosystems and find sustainable roles there. Longitudinal studies would be useful in terms of understanding the impacts of these RRI initiatives of firms in the long term and with respect to competition. An international view offers especially interesting insights here. Innovation ecosystems appear to be quite different depending on the cultural contexts in which

they are embedded. Hence, a study of MNEs and SMEs from such contexts could extend our understanding by linking such ecosystems to international trade. Finally, future research should consider different levels of sustainability in addition to the corporate level, e.g., individual accountability (Brem and Puente, 2020).

To conclude, the SDGs help MNEs operationalize RRI and thus accelerate the process towards RRI maturity. In turn, MNEs that are more mature in terms of RRI play more sustainable roles in innovation ecosystems and are more likely to make significant contributions to SDG innovation.

References

Abernathy, W.J., Utterback, J.M., 1978. Patterns of industrial innovation. Technology Review 80(7), 40-47.

Adner, R., Kapoor, R., 2010. Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. Strategic Management Journal 31 (3), 306-333.

Agarwal, N., Grottke, M., Mishra, S., Brem, A., 2017. A Systematic Literature Review of Constraint-Based Innovations: State of the Art and Future Perspectives. IEEE Transactions on Engineering Management 64 (1), 1–13.

Agarwal, N., Chakrabarti, R., Prabhu, J. C., Brem, A., 2020. Managing dilemmas of resource mobilization through jugaad: A multi□method study of social enterprises in Indian healthcare. Strategic Entrepreneurship Journal.

Almirall, E., Casadesus-Masanell, R., 2010. Open versus closed innovation: A model of discovery and divergence. Academy of Management Review 35(1), 27-47.

Anderson, P., Tushman, M.L., 1991. Managing through cycles of technological change. Research-Technology Management 34(3), 26-31.

Arnaldi, S., Quaglio, G., Ladikas, M., O'Kane, H., Karapiperis, T., Srinivas, K. R., Zhao, Y, 2015. Responsible governance in science and technology policy: Reflections from Europe, China and India. Technology in Society 42, 81-92.

Autio, E., Thomas, L. D. W., 2014. Innovation Ecosystems: Implications for Innovation Management. In M. Dodgson, D.M. Gann, and N. Phillips (eds), The Oxford Handbook of Innovation Management. Oxford: Oxford University Press

Autio, E., Thomas, L. D. W., 2019. Value co-creation in ecosystems: insights and research promise from three disciplinary perspectives. In S. Nambisan, K. Lyytinen and Y. Yoo (eds), Handbook of Digital Innovation. Cheltenham, UK: Edwar Elgard

Ben & Jerry's, 2020. Corporate website, company information, available at https://www.benjerry.com/about-us

Blank, S., 2019. Why Companies Do "Innovation Theater" Instead of Actual Innovation. Harvard Business Review.

Boons, F., Lüdeke-Freund, F., 2013. Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. Journal of Cleaner production 45, 9-19.

Brem, A., Puente-Díaz, R., 2020. Are you acting sustainably in your daily practice? Introduction of the Four-S model of sustainability. Journal of Cleaner Production, 122074.

Brem, A., Nylund, P., Viardot, E., 2020. The impact of the 2008 financial crisis on innovation: A dominant design perspective. Journal of Business Research 110, 360-369.

Blondiau, Y., 2018. Investments in Renewable Energy under Uncertainty: The Role of Energy Policy, Project Economics and Investor Cognition (Doctoral dissertation, Universität St. Gallen).

Chae, B.K., 2019. A General framework for studying the evolution of the digital innovation ecosystem: The case of big data. International Journal of Information Management 45, 83-94.

Chatfield, K., Borsella, E., Mantovani, E., Porcari, A., Stahl, B., 2017. An Investigation into Risk Perception in the ICT Industry as a Core Component of Responsible Research and Innovation. Sustainability 9, 1424.

Chesbrough, H. W., 2003. Open innovation: the new imperative for creating and profiting from technology. Boston, MA: Harvard Business Press.

Chesbrough, H. W., 2006. Open Business Models: How to Thrive in The New Innovation Landscape. Boston, MA: Harvard Business Press.

Chun, R., 2016. What holds ethical consumers to a cosmetics brand: The Body Shop case. Business & Society 55 (4), 528-549.

Christensen, C. M., 1997. The innovator's dilemma: when new technologies cause great firms to fail. Boston, MA: Harvard Business Press.

Cusumano, M. A., Kahl, S. J., Suarez, F. F., 2015. Services, industry evolution, and the competitive strategies of product firms. Strategic Management Journal 36 (4), 559-575.

Dattée, B., Alexy, O., Autio, E., 2018. Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. Academy of Management Journal 61 (2), 466-498.

Dedehayir, O., Mäkinen, S. J., Ortt, J. R., 2018. Roles during innovation ecosystem genesis: A literature review. Technological Forecasting and Social Change 136, 18-29.

Dixon-Woods, M., Agarwal, S., Jones, D., Young, B. and Sutton, A., 2005. Synthesising qualitative and quantitative evidence: a review of possible methods. Journal of Health Services Research & Policy 10(1), 45-53.

Dreyer, M., Chefneux, L., Goldberg, A., von Heimburg, J., Patrignani, N., Schofield, M., Shilling, C., 2017. Responsible innovation: A complementary view from industry with proposals for bridging different perspectives. Sustainability 9(10), 1–25.

Durugbo, C., Amankwah-Amoah, J., 2019. Global sustainability under uncertainty: How do multinationals craft regulatory policies? Corporate Social Responsibility and Environmental Management 26 (6), 1500–1516.

Fahrudi, A. N. 2020. Alleviating poverty through social innovation. Australasian Accounting, Business and Finance Journal 14(1), 71-78.

Fairtrade, 2016. Fairtrade award 2016, Available at https://www.fairtrade-deutschland.de/fileadmin/DE/newsimport/Presse2016/2016_fairtrade_award_pressekontakte_und_beschreibung_preistraeger.pdf. Accessed 20 February 2020.

Fairtrade, 2020. Sustainable Development Goals (SDGs). https://www.fairtrade.net/issue/sdgs. Accessed 20 February 2020.

Ferras□Hernandez, X., Nylund, P. A., 2019. Clusters as innovation engines: The accelerating strengths of proximity. European Management Review 16 (1), 37-53.

Gawer, A., Cusumano, M. A., 2002. Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation. Harvard Business School Press: Boston, MA.

Gawer, A., Cusumano, M. A., 2014. Industry platforms and ecosystem innovation. Journal of Product Innovation Management 31 (3), 417–433.

Hannan, M. T., Freeman, J., 1984. Structural inertia and organizational change. American Sociological Review 49 (2), 149-164.

Hansen, H. S., 2016. Solar Energy: Jobs and Technology–Learning from Developments in Norway and Germany 2001-2015. Available at: http://urn.nb.no/URN:NBN:no-55106

Haucke, F. V., 2018. Smartphone-enabled social change: Evidence from the Fairphone case? Journal of Cleaner Production 197, 1719-1730.

Heinrich, E., 2014. The Apparent M-Pesa Monopoly may be Set to Crumble. Fortune.

Helfat, C. E., Raubitschek, R. S., 2018. Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems. Research Policy 47 (8), 1391-1399.

Holgersson, M., Granstrand, O., Bogers, M., 2018. The evolution of intellectual property strategy in innovation ecosystems: Uncovering complementary and substitute appropriability regimes. Long Range Planning 51 (2), 303-319

Howard, M. D., Boeker, W., Andrus, J. L., 2019. The Spawning of Ecosystems: How Cohort Effects Benefit New Ventures. Academy of Management Journal 62 (4), 1163-1193.

Hughes N., Lonie S., 2007. M-PESA: Mobile Money for the 'Unbanked': Turning Cellphones into 24-Hour Tellers in Kenya. Innovations, winter and spring, 64-81.

Hörisch, J., Schaltegger, S., Freeman, E., 2020. Integrating stakeholder theory and sustainability accounting: A conceptual synthesis. Journal of Cleaner Production 275, 124097.

Iansiti, M., Levien, R., 2004. Strategy as ecology. Harvard Business Review 82 (3), 68-78.

Iatridis, K., Schroeder, D., 2016. Responsible research and innovation in industry. The Case for Corporate Responsibility Tools. Springer: Cham.

Jaakkola, E., 2020. Designing conceptual articles: four approaches. AMS Review 10, 18-26.

Katz, E., 1961. The social itinerary of technical change: two studies on the diffusion of innovation. Human Organization 20 (2), 70-82.

Kolk, A., Kourula, A., Pisani, N., 2017. Multinational enterprises and the sustainable development goals: What do we know and how to proceed? Transnational Corporations 24 (3), 9-32.

Kriechbaum, M., Prol, J. L., Posch, A., 2018. Looking back at the future: Dynamics of collective expectations about photovoltaic technology in Germany & Spain. Technological Forecasting and Social Change 129, 76-87.

Ladikas, M., Hahn, J., Hennen, L., Kulakov, P., Scherz, C., 2019. Responsible research and innovation in Germany–between sustainability and autonomy. Journal of Responsible Innovation 6(3), 346-352.

Lakhani, K.R., Lifshitz-Assaf, H., Tushman, M.L., 2013. Open innovation and organizational boundaries: task decomposition, knowledge distribution and the locus of innovation. In Handbook of economic organization. Cheltenham, U.K.: Edward Elgar Publishing.

Langen, N., 2013. Ethics and Consumers' Choice. Springer Gabler, Wiesbaden.

Lassk, F. G., 2019. Dame Anita Roddick: Transforming Personal Values and Strengths to Build an Empire. In Crittenden, V. L. Go-to-Market Strategies for Women Entrepreneurs, pp. 25-33. Bingley, U.K.: Emerald Publishing Limited.

Leiponen, A., Byma, J., 2009. If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies. Research Policy 38 (9), 1478-1488.

Leten, B., Vanhaverbeke, W., Roijakkers, N., Clerix, A., Van Helleputte, J., 2013. IP models to orchestrate innovation ecosystems: IMEC, a public research institute in nano-electronics. California Management Review 55 (4), 51-64.

Ma, Y., Rong, K., Mangalagiu, D., Thornton, T. F., Zhu, D., 2018. Co-evolution between urban sustainability and business ecosystem innovation: Evidence from the sharing mobility sector in Shanghai. Journal of Cleaner Production 188, 942-953.

Martinuzzi, A., Blok, V., Brem, A., Stahl, B., Schönherr, N., 2018. Responsible research and innovation in industry—Challenges, insights and perspectives. Sustainability 10 (3), 702-711.

Mas, I. Morawczynski, O., 2009. Designing Mobile Money Services: Lessons from M-Pesa. Innovations, 77-91.

McDermott, G., Mudambi, R., Parente, R., 2013. Strategic modularity and the architecture of multinational firm. Global Strategy Journal 3 (1), pp.1-7.

Mei, S., 2018. The impact of acquisitions of small social enterprises by giant multinational corporations on the consumers' brand perception of the acquired firm: the case of Ben & Jerry's (Doctoral dissertation). https://repositorio.ucp.pt/bitstream/10400.14/25398/1/Silas%20Mei%20MA%20280320188%20whole%20dissertation%20PDFA%21.pdf.

Mirvis, P., Herrera, M. E. B., Googins, B., Albareda, L., 2016. Corporate social innovation: How firms learn to innovate for the greater good. Journal of Business Research 69 (11), 5014-5021.

Moore, J., 1993. Predators and prey: a new ecology of competition, Harvard Business Review 71 (3), 75-86.

Männer, A. L., Bilgram, V., Brem, A., 2012. Regulatory Push/Pull: Neue Impulse für das Innovationsmanagement. Ideenmanagement 38 (2), 64-67.

Nelson, R. R., Winter, S. G., 1982. The Schumpeterian tradeoff revisited. The American Economic Review 72 (1), 114-132.

Neumeyer, X., Santos, S.C., 2018. Sustainable business models, venture typologies, and entrepreneurial ecosystems: A social network perspective. Journal of Cleaner Production 172, 4565-4579.

Nill J., Kemp, R., 2009. Evolutionary approaches for sustainable innovation policies: From niche to paradigm? Research Policy 38 (4), 668-680.

Nylund, P. A., Ferras-Hernandez, X., Brem, A., 2019. Strategies for Activating Innovation Ecosystems: Introduction of a Taxonomy. IEEE Engineering Management Review 47 (4), 60-66.

Owen, R., 2014. The UK Engineering and physical sciences research council's commitment to a framework for responsible innovation. Journal of Responsible Innovation 1, 113-117.

Petricevic, O., Teece, D.J., 2019. The structural reshaping of globalization: Implications for strategic sectors, profiting from innovation, and the multinational enterprise. Journal of International Business Studies 50 (9), 1487-1512.

Porter, M. E., Kramer, M. R., 2006. The link between competitive advantage and corporate social responsibility. Harvard Business Review 84 (12), 78-92.

Prahalad, C.K., 2004. The Fortune at the Bottom of the Pyramid. Philadelphia. Wharton School Publishing.

Reypens, C., Lievens, A., Blazevic, V., 2016. Leveraging value in multi-stakeholder innovation networks: A process framework for value co-creation and capture. Industrial Marketing Management 56, 40-50.

Rosales-Asensio, E., Borge-Diez, D., Blanes-Peiró, J. J., Pérez-Hoyos, A., Comenar-Santos, A., 2019. Review of wind energy technology and associated market and economic conditions in Spain. Renewable and Sustainable Energy Reviews 101, 415-427.

Rosca, E., Agarwal, N., Brem, A., 2020. Women entrepreneurs as agents of change: A comparative analysis of social entrepreneurship processes in emerging markets. Technological Forecasting and Social Change 157, 120067.

Ried, K., 2019. Lidl: "Customers want cheap bananas", W&W.

Ritala, P., Agouridas, V., Assimakopoulos, D., Gies, O., 2013. Value creation and capture mechanisms in innovation ecosystems: a comparative case study. International Journal of Technology Management 63 (3/4), 244-267.

Sadoulet, L., Furdelle, O., 2014. Vodafone M-Pesa: 'Unusual Innovation' – From a Corporate Social Responsibility Project to Business Model Innovation, INSEAD Case Studies.

Sandelowski, M., Voils, C.I., Leeman, J., Crandell, J.L., 2012. Mapping the mixed methods–mixed research synthesis terrain. Journal of Mixed Methods Research 6 (4), 317-331.

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.

Shah, K. U., Arjoon, S., 2015. Through Thick and Thin? How Self-determination Drives the Corporate Sustainability Initiatives of Multinational Subsidiaries. Business Strategy and the Environment 24 (6), 565–582. https://doi.org/10.1002/bse.1838

Sivaram, V., Dabiri, J. O., Hart, D. M., 2018. The need for continued innovation in solar, wind, and energy storage. Joule 2 (9), 1639-1642.

Stahl, B. C., Chatfield, K., Ten Holter, C., Brem, A., 2019. Ethics in corporate research and development: can responsible research and innovation approaches aid sustainability? Journal of Cleaner Production 239.

Stahl, B. C., Obach, M., Yaghmaei, E., Ikonen, V., Chatfield, K., Brem, A., 2017. The Responsible Research and Innovation (RRI) maturity model: Linking theory and practice. Sustainability 9 (6), 1036-1055.

Stahl, B. C., Brem, A., 2013. Spaces for responsible innovation in entrepreneurship—A conceptual analysis. In: 2013 International Conference on Engineering, Technology and Innovation (ICE) & IEEE International Technology Management Conference pp. 1-16.

Suseno, Y., Laurell, C., Sick, N., 2018. Assessing value creation in digital innovation ecosystems: A Social Media Analytics approach. The Journal of Strategic Information Systems 27(4), 335-349.

Timmermans, J., Yaghmaei, E., Stahl, B. C., Brem, A., 2017. Research and innovation processes revisited–networked responsibility in industry. Sustainability Accounting, Management and Policy Journal 8 (3), 307-334

Topple, C., Donovan, J. D., Masli, E. K., Borgert, T., 2017. Corporate sustainability assessments: MNE engagement with sustainable development and the SDGs. Transnational Corporations.

Trappey, C. V., Trappey, A. J., Wang, Y. H., 2016. Are patent trade wars impeding innovation and development? World Patent Information 46, 64-72.

United Nations, 2020. The sustainable development goals report 2020. United Nations.

Utterback, J. M., 1994. Mastering the dynamics of innovation: how companies can seize opportunities in the face of technological change. Boston, MA, Harvard Business School Press.

Van de Poel, I., Asveld, L., Flipse, S., Klaassen, P., Scholten, V., Yaghmaei, E., 2017. Company strategies for responsible research and innovation (RRI): A conceptual model. Sustainability (Switzerland) 9 (11), 1–18. https://doi.org/10.3390/su9112045

Vanhaverbeke, W., Chesbrough, H., 2014. A classification of open innovation and open business models. New frontiers in open innovation 6, 50-68.

Von Schomberg, R., 2013. A vision of responsible research and innovation. Responsible innovation: Managing the responsible emergence of science and innovation in society, 51-74.

Wang, H.M.D., Sengupta, S., 2016. Stakeholder relationships, brand equity, firm performance: A resource-based perspective. Journal of Business Research 69 (12), 5561-5568.

Wareham, J., Fox, P.B., Cano Giner, J.L., 2014. Technology ecosystem governance. Organization Science 25(4), 1195-1215.

Wernink, T., Strahl, C., 2015. Fairphone: Sustainability from the inside-out and outside-in. In Sustainable value chain management (pp. 123-139). Springer, Cham.

Wickert, C., Vaccaro, A., Cornelissen, J., 2017. "Buying" corporate social responsibility: organisational identity orientation as a determinant of practice adoption. Journal of Business Ethics 142 (3), 497-514.

Yun, J.J., Jeon, J., Park, K., Zhao, X., 2018. Benefits and costs of closed innovation strategy: Analysis of Samsung's Galaxy Note 7 Explosion and withdrawal scandal. Journal of Open Innovation: Technology, Market, and Complexity 4 (3), 1-20.

Zeschky, M., Widenmayer, B., Gassmann, O., 2011. Frugal Innovation in Emerging Markets. Research-Technology Management 54 (4), 38-45.

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: