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ORIGINAL PAPER

Rainbow Wash or Rainbow Revolution? Dynamic Stakeholder Engagement for SDG-Driven Responsible Innovation

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Abstract

The United Nations' increasing involvement in global sustainability culminated in 2015 with the release of the 2030 Agenda. This agenda puts businesses in the spotlight, and their innovation and stakeholder partnering activities are portrayed as essential strategies for achieving an ambitious set of 17 Sustainable Development Goals (SDGs). In this study, we identify six distinct dynamic stakeholder engagement strategies—resilient specialists, opportunity explorers, uncommitted diversifiers, rainbow warriors, rainbow washers, and progressive learners—and distinguish two approaches to innovate, depending on the range of SDG targets aimed to achieve simultaneously. On the one hand, for firms that take a narrow approach intended to achieve a reduced set of SDG targets, we predict that successful dynamic stakeholder engagement strategies are those that end up with an intensive collaboration with a reduced number of stakeholder groups. On the other hand, for firms adopting a broad innovation approach to satisfy a wide set of SDG targets, we predict that successful dynamic stakeholder engagement strategies are those that end up interacting with a wide number of stakeholder groups. Longitudinal analysis of more than 3900 Spanish firms supports our predictions and suggests clear implications for responsible innovation research and the advancement of sustainable development through collaboration.

Keywords Responsible innovation · Stakeholder engagement · Sustainable Development Goals · Sustainability · Grand challenges · Innovation

Introduction

The trajectory that began with the 2012 Rio+20 United Nations Conference on Sustainable Development and culminated with the publication in 2015 of an agenda for achieving 17 ambitious Sustainable Development Goals (SDGs) by 2030 represented a notable disruption in global and regional efforts to promote sustainable development worldwide (Mio et al., 2020). By specifying its list of 17 SDGs, 169 targets, and 232 indicators, the 2030 Agenda provides key actors in sustainability with a shared and tangible understanding of what sustainable development means and seeks to accomplish. This understanding is essential to steer these key actors' actions towards sustainable development (Bowen et al., 2017; Pattberg & Widerberg, 2016; UN, 2015). Unlike its predecessor, the 2000 UN Millennium Declaration, the 2030 Agenda confers a critical role onto businesses and their partnering and innovating strategies for the accomplishment of the 17 SDGs (MacDonald et al., 2019a; Montiel et al., 2021; Pogge & Sengupta, 2015; Scheyvens et al., 2016; UN, 2015). Thus, once considered one of the main sources of

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sustainable development problems, firms are now seen as part of the solution (UN, 2015).

To contribute effectively to the 2030 Agenda, firms must do more than just repackaging their current activities and "cherry-picking" a few SDGs that fall within their comfort zone: Firms are required to undergo a substantial transformation in their core business activities (PwC, 2015). Firms enable this transformation by leveraging and redeploying their innovation capabilities to develop new products, services, processes, and business models that address sustainability issues (Halme & Korpela, 2014; Sachs et al., 2019b; Scherer & Voegtlin, 2020; Scheyvens et al., 2016). Firm innovation is, thus, more than one of the 17 SDGs: It is a means for undertaking the disruptive transformations required to achieve the 2030 Agenda (Schot & Steinmueller, 2018). And a considerable amount of empirical evidence has consistently documented the positive impact of firms' sustainably oriented innovation, or responsible innovation (RI) (von Schomberg, 2012), on progress towards the SDGs (Cordova & Celone, 2019; Mio et al., 2020; Rosca et al., 2018).

Conducting SDG-Driven RI can be a complex endeavor, as sustainability problems are ill-defined, multi-dimensional, span across boundaries, lack clear-cut solutions, and cannot be solved by one actor alone (Barnett et al., 2018; Doh et al., 2019). A successful generation and implementation of this form of innovation require firms to integrate and recombine specialized knowledge from multiple domains, which usually differs from the knowledge relevant to these innovators' core business activities (Choi & Majumdar, 2015; Ghisetti et al., 2015; Horbach et al., 2013). Therefore, firms that engage in RI need to expand their knowledge base through collaboration with stakeholders (Cainelli et al., 2015; Ghisetti et al., 2015; Horbach et al., 2013). In fact, the 2030 Agenda emphasizes the importance of collaborative approaches via SDG 17 on Partnerships for the Goals (Caiado et al., 2018). However, firm collaboration with partners often comes with challenges (MacDonald et al., 2019a; Pattberg & Widerberg, 2016; van Tulder & Keen, 2018). Coordination problems and conflicting interests among partners (Bode et al., 2019); sub-optimal partner mixes (Inkpen & Pien, 2006); weak governance (Scherer & Voegtlin, 2020); lack of leadership (Muff et al., 2020); and inadequate fit between the partnership and the sustainability problem to be addressed (Vazquez-Brust et al., 2020) represent some of the most commonly studied challenges.

A challenge that has received much less scholarly attention is the temporal dynamics of business partnerships, despite the extensive evidence highlighting the time-consuming, evolutionary, adaptive, and interactive process of building effective collaborations aimed at generating innovative solutions to sustainability issues (Horan, 2019; MacDonald et al., 2019a, 2019b; Pattberg & Widerberg, 2016). Based on these considerations, the current study is designed to identify dynamic stakeholder engagement strategies or collaboration pathways between the firm and different stakeholder groups and examine the degree to which each pathway delivers innovation outcomes linked to the accomplishment of different sets of SDG targets. Adopting such a perspective extends research on SDG-Driven RI by examining two critical dimensions of the relationship between collaboration with stakeholders and SDGs: First, firms may pursue different sets of SDGs and targets, and second, in moving towards them, firms may interact with stakeholder groups in dynamic ways.

On the first element, progress towards the SDGs can be measured by the capacity of firms to generate innovations that do good and avoid harm. These RIs can be more narrowly or broadly oriented. For instance, firms may decide to focus only on environmental or social aspects of innovation—narrow RI—while others may choose to undertake both social and eco-innovation efforts—broad RI (Hoek, 2018; Markman et al., 2016; Scherer & Voegtlin, 2020; van Zanten & van Tulder, 2018). This variety in sustainability objectives is important because responsible innovators' collaboration strategies will likely depend on which problems the partnership seeks to address (Pattberg & Widerberg, 2016).

The second element, achieving their sustainability objectives, requires firms to proactively establish partnerships with various stakeholder groups. Through partnerships, firms seek to broaden their knowledge base and range of perspectives, better balance multiple stakeholder interests and consider a larger set of socio-cultural and environmental conditions (Voegtlin & Scherer, 2017). Drawing upon existing research on collaboration for external knowledge access (Chapman et al., 2018; Laursen & Salter, 2006; Love et al., 2014), we characterize firms' strategies of engaging with stakeholder groups by the *diversity* of partner types and the *intensity* of the interactions with these partners. Since engagement strategies are a dynamic phenomenon that may lead to different configurations over time (van Zanten & van Tulder, 2018; Waddock et al., 2015), we study the engagement dynamics and propose a typology of six different stakeholder engagement strategies. These strategies range from developing repeated intensive interactions with a reduced number of stakeholder groups to adopting a long-term strategy of trust-based interactions with a wide set of stakeholder groups. Also, we characterize middle-range strategies that combine intensity and diversity of stakeholder engagement over time. Finally, we connect the different stakeholder engagement strategies to the generation of certain types of RI, whether more or less broad, which, in the end, allow firms to address SDG targets.

Based on this plurality of SDGs and stakeholder engagement strategies, we suggest that achieving complex

objectives like the SDGs depends on the collaborative pathways that firms develop with stakeholder groups to have access to these stakeholders' knowledge, resources, and skills. Specifically, for firms that concentrate their efforts on a narrow form of RI—either social or eco-innovation—successful collaborative strategies are those that, over time, end up focusing on a reduced number of stakeholder groups that provide a valuable contribution to the innovation process. In contrast, firms with a more broad-focused approach to RI—those pursuing both social and eco-innovation efforts simultaneously—should develop a strategy that ultimately cultivates close relationships with a larger number of stakeholder groups. We found empirical support for these predictions using the Spanish Technological Innovation Panel (PITEC) database. This survey adopts the structure of the CIS European survey and includes more than 12,000 firms.

Our study offers several contributions to the literature. First, our study contributes to innovation studies by (i) identifying different types of responsible innovators based on their approach to addressing social or environmental issues—narrow responsible innovators or broad responsible innovators—and (ii) analyzing the effectiveness of dynamic stakeholder engagement strategies on RI. Second, our research adds to the relatively young yet fast-growing body of research that looks at the connection between partnering and SDGs. Our study reinforces recent findings that have shown the importance of external knowledge acquisition for the advancement of the 2030 Agenda and move a step further to illustrate that the externally acquired knowledge's value depends on the collaboration pathway that firms follow and the specific SDG targets they aim to achieve. Also, we believe our findings have important managerial implications as firms continue revamping their innovation efforts to contribute effectively to the 2030 Agenda.

The Road to the Sustainable Development Goals

The UN has played a major role in promoting sustainable development worldwide during the last two decades. The culmination of these efforts was the release in 2015 of the 2030 Agenda and its SDGs, after an unprecedented global consultation that lasted three years and involved a wide set of actors (e.g., governments, firms, civil society entities, universities) from all parts of the globe (UN, 2015). The 17 SDGs, with its 169 targets and 232 indicators, are considered the most comprehensive framework ever formulated to address global grand challenges (Sachs et al., 2019a; Salvia et al., 2019; van Zanten & van Tulder, 2018; Wettstein et al., 2019).

Beyond serving as a template for concrete action, the SDGs intend to promote societal change and channel business investments towards these pressing challenges (van Tulder, 2018). The private sector is seen as a key actor in driving the societal transformation necessary to meet the SDGs (Rasche, 2020; Scheyvens et al., 2016). For this reason, several tools and guidelines have been developed to assist firms in engaging with the SDGs, such as the SDG Compass, which helps firms in aligning their strategies with the SDGs and in measuring and managing their contribution to the SDGs (Rasche, 2020); the SDG Action Manager, a tool introduced by the UN Global Compact that provides businesses an opportunity "to learn, manage, and directly improve their sustainability performance (UN Global Compact, 2020); and the Global Reporting Initiative, which has redirected their sustainability reporting guidelines towards helping firms to report on their SDG achievements (Global Reporting Initiative, 2015). In this sense, the available empirical research has shown an increase in the number of firms that started to use these initiatives for responsible management, which has had positive consequences for the advancement of sustainability (Blasco et al., 2018; Hummel, 2019; Rashed & Shah, 2020; Schönherr et al., 2017)—although the pace of this advancement seems below expectations (UN, 2018).

The release of the 2030 Agenda must be conceived as the last stage of a process that started in 2000 with the launch of the Millennium Development Goals (MDGs) and found an interim stage in 2012 with the UN Rio+20 Conference on Sustainable Development (UN, 2012a). During the conference, the UN member states agreed on the document "The Future We Want," which included a new set of sustainability objectives applicable to both developing and developed countries, which built on the MDGs and represented a more comprehensive framework for achieving global sustainability by 2030. Without this document, the current SDGs could not be adequately understood, as it called for different actions in preparation for the 2030 Agenda, including the inclusion of the green economy narrative in the discussion about sustainability development, the adoption of a framework for tackling sustainable consumption and production, improving gender balance, and promoting corporate sustainability reporting measures, among others (Pattberg & Mert, 2013; Saner et al., 2019; UN, 2012a). As a means to implement these actions, Rio+20 emphasized the importance of promoting innovation—with the collaboration among different actors as its driving force—and the key role of the private sector in the progression towards sustainability (UN, 2012a). Moreover, "The Future We Want" declaration conveyed a strong signal to business leaders, politicians, and other stakeholders about the issues that would merit their highest attention for the coming years (Dodds et al., 2014; UN, 2012b). In response to these signals, 200 leading companies announced sustainable innovation commitments at Rio+20, with examples such as Microsoft and its

carbon neutrality commitment, Unilever's greenhouse gases ambitious reduction programs, Nike's supply chain hazardous chemical reduction program, P&G's sales of "sustainable innovation products," and H&M's upgrading to 100% sustainable cotton in all its cotton garments (UN, 2012c). Similar initiatives were developed in Spain, with companies such as BBVA, Telefonica, and Acciona, just to name a few, presenting innovative plans to promote renewable energy and sustainable communities (Ecodes, 2013).

The evolution from the MDGs to SDGs through Rio+20 allows us to draw four important conclusions: (i) SDGs have provided clarity and guidance to firms in their endeavor to foster sustainability; (ii) the 2030 Agenda is built upon the Rio+20 agreements so that these agreements signaled the direction firms' sustainability actions should take; (iii) the clarity of the signal increased from Rio+20 to the 2030 Agenda; and more importantly, (iv) SDGs, though launched in 2015, were not developed in a vacuum, but represented the latest stage of a process in which business leaders have been influenced by a relatively consistent set of sustainability objectives.

Theory and Hypotheses

Responsible Innovation in the Narrow and Broad Sense

In their pursuit of sustainability, firms have a broad array of tools, spanning from philanthropic activities to implementing eco-efficiency and management systems, product differentiation through eco-friendly and ethical products, and innovation (Martinuzzi & Schönherr, 2019). However, none but innovation has the potential to solve pressing sustainability challenges while helping firms to create and sustain a competitive advantage (Adams et al., 2016). Essentially, non-innovative approaches may miss opportunities to understand better the sustainability challenges that could shape and steer their activities to capture future market opportunities (Scheyvens et al., 2016; van Tulder & Lucht, 2019).

Firm innovation is, thus, seen as one of the most effective tools to improve the welfare of society and the well-being of the planet (Scherer & Voegtlin, 2020). Though firms may embark on innovation on their own, it is common for them to share their innovative efforts with external stakeholders, especially when the pursued inventions seek to add both commercial and sustainable (social and environmental) value (Adams et al., 2016). This shared effort is what has been termed responsible innovation (RI). Though characterized differently, all RI definitions agree that it is a participative and transparent form of co-creation oriented to generate significant social and environmental value (von Schomberg, 2012). Its most visible outcomes are new or significantly improved products, services, processes, or business models whose implementation in the market seeks to avoid harm, do good, and partner with others for the sake of protecting the people and the planet (Halme & Korpela, 2014; Scherer & Voegtlin, 2020).

There is less agreement among scholars on firms' approaches to innovate responsibly. In some cases, firms focus all of their RI efforts on a particular area, such as addressing a single SDG, while other firms take a more ambitious innovation approach and attempt to address simultaneously multiple sustainability objectives by, for example, tackling multiple SDGs at once (Bowen et al., 2017; Ike et al., 2019; PwC, 2015; Rawhouser et al., 2019; van Zanten & van Tulder, 2018). In their study, van Zanten and van Tulder (2018) showed, for instance, the substantial differences in the sustainability orientation of multinational apparel companies such as GAP and Nike, with GAP prioritizing a much narrower set of SDGs (SDG 1 and 5) than Nike (SDG 6, 7, 8, 12, and 13).

In this study, we rely on this idea of SDG prioritization to differentiate between narrow and broad-focused responsible innovators. We identify as "narrow responsible innovators" as firms whose innovative efforts are oriented to either social or environmental RI outcomes and as "broad responsible innovators," firms that simultaneously pursue multiple social *and* environmental RI outcomes. By social innovators, we consider firms engaged in "the process of collective idea generation, selection, and implementation by people who participate collaboratively to meet social challenges" (Dawson & Daniel, 2010). Social innovators focus on addressing targets within a particular social domain, such as the SDG 8 on "Decent Work and Economic Growth." Conversely, we identify eco-innovators as firms developing new ideas, behaviors, products, and processes that reduce environmental burdens or ecologically specified sustainability targets (Rennings, 2000). Eco-innovators devote their efforts to targets within a particular environmental domain, primarily on SDG 12 on "Responsible Production and Consumption."

Stakeholder Engagement Strategies

Substantial research emphasizes the importance of knowledge search for firms to identify innovative solutions that help them cope with changes in the business environment (e.g., Katila & Ahuja, 2002), including the increasing pressures to move towards sustainability (Berchicci et al., 2019). Firms, however, often lack this knowledge, and the costs of developing it internally may be so high that collaborating with external partners emerges as the most effective innovation strategy (Chapman et al., 2018; Laursen & Salter, 2006; Love et al., 2014). Through collaboration, firms can extract ideas from external partners to deepen their internal set of technological capabilities and, hence, improve their

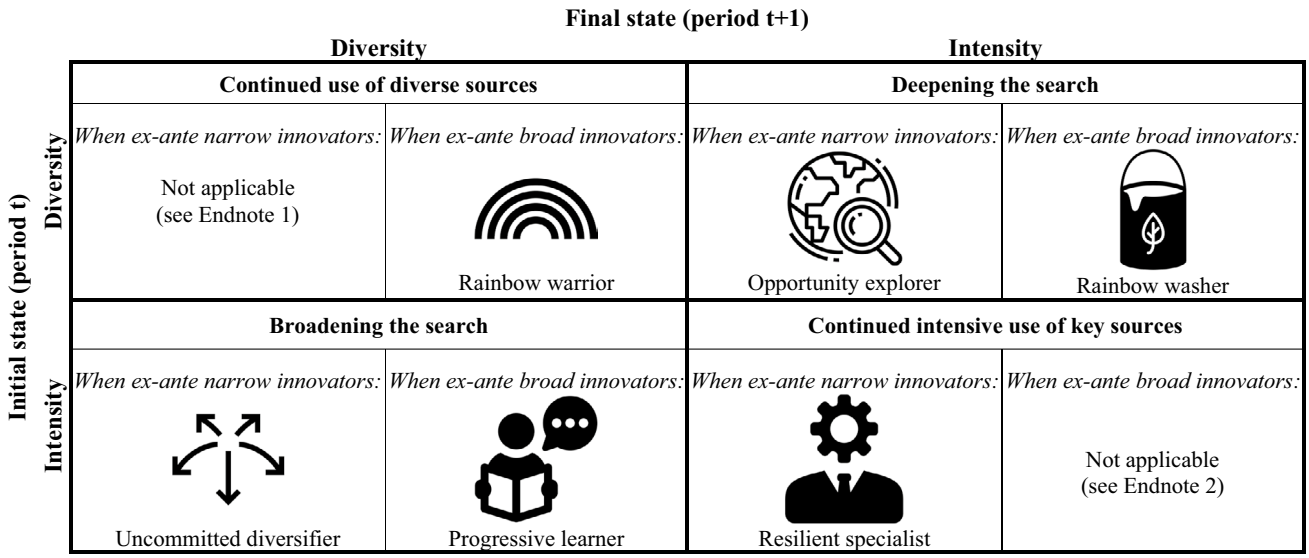

Fig. 1 Typology of dynamic stakeholder engagement strategies. The use of the six icons representing stakeholder engagement strategies is permitted by The Noun Project under a Creative Commons License

innovation outcomes (Garriga et al., 2013). Yet, a well-formulated strategy is needed for effective collaboration in generating new innovative opportunities. Drawing on Katila and Ahuja's (2002) work on the influence of search strategies on external knowledge acquisition, Laursen and Salter (2006) developed the concepts of search breadth and depth as the two basic components of the openness of firms' innovative search strategies to different knowledge domains. External search depth is defined as "the extent to which firms draw deeply from the different external sources or search channels" and can be characterized by the *intensity* of the interactions between the firm and its partners; while external search breadth is defined as the "number of external sources or search channels that firms rely upon in their innovative activities" and it is characterized by the *diversity* of partner types (Laursen & Salter, 2006).

Despite the widespread use of Laursen and Salter's (2006) typology of external search strategies (see, for a review, Laursen, 2012), some scholars, including the authors themselves, acknowledged that the cross-sectional focus of most studies on external search strategies is an important limitation to understanding the ongoing nature of innovation. Hence, scholars called for a more dynamic perspective that examines whether firms' search behavior varies over time (Chesbrough et al., 2006; De Massis et al., 2016; Drechsler & Natter, 2012). In response to this call, a growing body of research studied the impact on innovation outcomes of a continued use of external knowledge sources over time (Berchicci et al., 2019; Bernal et al., 2019; Cricelli et al., 2016; Poot et al., 2009). To our knowledge, however, there is limited research that measured Laursen and Salter's (2006) breadth and depth strategies at different points in time, which prevents accounting for changes in external knowledge search strategies over time. The few studies that examined trends in breadth and depth depicted variations across firms and years in the use of diversity and intensity (Bernal et al., 2019; Cricelli et al., 2016). However, no attempt has been made to identify collaboration partners or examine their effect on RI.

Along these lines, we extend Laursen and Salter's (2006) static, two-dimensional approach by considering time as the third dimension that characterizes stakeholders' interaction within an innovation process. With the addition of time, we define four generic dynamic strategies, or trajectories, of external knowledge search. Each strategy is defined as a combination of knowledge search decisions implemented by the firm at two different points in time (see Fig. 1). *Continued use of diverse sources* describes the strategy of firms that seek to learn over time and accumulate experience from as many sources as possible to identify better solutions to their innovation challenges. Moreover, given their long-term orientation, these firms may spread the substantial costs of screening and implementation over multiple periods (Berchicci et al., 2019). At the other extreme, *continued intensive use of key sources* reflects a strategy in which firms draw intensively and continuously on few external sources to build and sustain virtuous exchanges and collaborations. Firms will become more familiar with the knowledge they exchange through these repeated interactions and, hence, identify valuable ideas and resources easily integrated into their innovation processes (Katila & Ahuja, 2002; Laursen & Salter, 2006). There are two mixed dynamic strategies between these two extreme solutions: broadening the search and deepening the search. *Broadening the search* defines the

strategy of a firm that starts using external sources that it knows well, given their closeness to its existing knowledge base; this allows the firm to discover viable solutions to its innovation challenges. However, over time the firm becomes aware of the significant overlaps and rigidity problems of repeatedly using the same knowledge sources. Hence, it tries to search more broadly and attempts to add new collaborators to identify innovative solutions (Piezunka & Dahlander, 2015; Rosenkopf & Nerkar, 2001). Finally, the strategy of *deepening the search* describes firms that search for new ideas initially by scanning a wide number of sources. However, the difficulty of choosing among the many ideas, the attention required for their implementation, and the cost of integrating diverse knowledge lead these firms to end up concentrating their attention, efforts, and resources on a limited number of sources to devise innovative solutions (Katila & Ahuja, 2002; Koput, 1997).

Moreover, it is important to account for the number of innovation objectives initially pursued by the firm to properly understand the effectiveness of knowledge search strategies (Leiponen & Helfat, 2010). In the previous section, responsible innovators have been categorized into two groups, depending on their innovation priorities: narrow innovators that either prioritize environmental or social SDG targets and broad innovators that adopt a more balanced approach that addresses both social and environmental issues (Markman et al., 2016; Scherer & Voegtlin, 2020). Thus, based on the combination of generic dynamic stakeholder engagement strategies and the two types of responsible innovators, we define a typology of six dynamic stakeholder engagement strategies, which are portrayed graphically in Fig. 1. It is important to highlight that the identification of the six dynamic stakeholder strategies is based on the combination of two elements: (1) the firm's ex-ante approach to RI, which may be narrow or broad, and (2) the firm's generic dynamic stakeholder engagement strategy. The combination of both elements is, thus, the basis of a successful innovation outcome.

In the next two sections we develop arguments about the effectiveness of each strategy in generating responsible innovation outcomes that will advance the 2030 Agenda. Narrow responsible innovators will opt for determined search strategies that address targets within single SDG domain, whereas broad responsible innovators will choose search strategies to fulfill multiple targets within social and environmental SDG domains.

Stakeholder Engagement Strategies for Narrow Responsible Innovators

Narrow responsible innovators are defined by their narrow ex-ante expectations of RI outcomes. In their search for external knowledge, narrow innovators tend to rely on a reduced set of sources of innovation and incorporate a limited variety of information into the creative process (González-Moreno et al., 2019). Different reasons explain this narrow orientation, including the lack of resources, capabilities, or knowledge to address more ambitious objectives; the difficulty of finding suitable partners; or a lack of matching with their core business when adopting a broader sustainability approach (De Marchi, 2012; van der Waal & Thijssens, 2020; van Geenhuizen & Ye, 2014).

Within the category of narrow responsible innovators, social innovators concentrate their narrow RI efforts in solving social issues (Edwards-Schachter & Wallace, 2017; van der Have & Rubalcaba, 2016), while eco-innovators focus on protecting the natural environment (Rennings, 2000). In our study, social innovators prioritize targets connected to social SDGs, such as SDG 8 on Decent Work and Economic Growth, and eco-innovators prioritize targets connected to environmental SDGs, such as SDG 12 on Responsible Production and Consumption (Hoek, 2018; Rawhouser et al., 2019; van Zanten & van Tulder, 2018). Based on the generic framework of dynamic stakeholder engagement strategies previously described and these innovators' narrow RI interests, we identify three types of narrow strategists: (i) resilient specialists, (ii) opportunity explorers, and (iii) uncommitted diversifiers (see Fig. 1).[1]

Resilient Specialists

Resilient specialists' innovation strategy centers on developing continued intensive interactions with a reduced number of stakeholder groups—or a single group—to pursue a reduced set of SDG targets. In their search for social innovation that contributes to specific social SDG targets, such as those included in SDG 8 (Decent Work and Economic Growth), or eco-innovation contributing to environmental SDG targets related to SDG 12 (Responsible Production and Consumption), firms need to deal with different technical and economic problems that require an integration and recombination of specialized knowledge (Choi & Majumdar, 2015; Horbach et al., 2013). Eco-innovators working towards SDG 12 targets, for example, need knowledge about the materials to be used, information about environmental standards and regulations, and access to sustainable inputs

[1] We excluded the strategy of continued use of diverse sources because research has unequivocally shown that a continued broad search strategy for narrow innovators is not sustainable (De Marchi 2012; Ghisetti et al., 2015). Though narrow innovators may need some knowledge variety to attain their environmental objectives, broadening the external search excessively may expose innovators to inapplicable and/or inconsistent information, which may generate substantial costs that prevent their incorporation into the innovation processes (Ghisetti et al., 2015).

(Ghisetti et al., 2015). This knowledge typically differs from that relevant to these innovators' core business activities, which requires them to expand their knowledge base by searching external sources of information (Cainelli et al., 2015; Ghisetti et al., 2015; Horbach et al., 2013). However, this search strategy poses two risks that can only be addressed with intense and long-lasting relationships with a reduced number of stakeholder groups. First, narrow innovators may need to distance their knowledge base from that of their partners to succeed in their innovation efforts, which may result in mismatches difficult to grasp and correct (De Marchi, 2012). Second, narrow innovators may find it difficult to find suitable partners to innovate responsibly (Rennings, 2000). This reduced availability of partners makes both their selection and subsequent maintenance crucial aspects of the interactive process of learning for achieving environmental or social inventions (Ghisetti et al., 2015). Based on these risks, resilient specialists recognize the need to develop intensive and long-lasting relationships with a reduced number of knowledge sources to innovate successfully (De Marchi, 2012; Ghisetti et al., 2015). Developing such strong stakeholder relationships requires persistent efforts, which can only be built over an extended period (Fombrun, 1996; Hillman & Keim, 2001).

Summarizing, resilient specialists' stakeholder engagement strategy is based on (i) the identification of a small and focused set of stakeholder groups with the knowledge and resources needed to push forward these innovators' narrow objectives, and (ii) the continuous engagement with the same set of stakeholder groups heading forward (Ghisetti et al., 2015). As shown in the literature (Lee et al., 2004; Schaltegger & Wagner, 2011; Tang et al., 2012; Wang & Choi, 2013), two important benefits accrue from this intertemporal consistency in stakeholder engagement. First, there is a development of complementary resources that are necessary to absorb and accumulate partners' knowledge progressively, which is necessary to innovate. And second, the repeated interactions help develop relationships based on trust among stakeholder groups, which make them more willing to contribute with their knowledge and resources to the firm's innovation process. Based on the narrower innovation focus of the resilient specialists, we, thus, predict:

Hypothesis 1 A narrow responsible innovator's continuous and intensive engagement with a reduced set of stakeholder groups is positively related to a narrow responsible innovation outcome.

Opportunity Explorers

An important number of social and eco-innovators falls within the category of opportunity explorers. They still maintain a narrow and focused ex-ante orientation to RI, but they tackle the uncertainty of addressing specific SDG targets differently than resilient specialists. Opportunity explorers are likely to be newer to the sustainability space and, thus, lack crucial information on sustainability (Cainelli et al., 2015; Horbach et al., 2013). Focusing exclusively on internal knowledge and resources could hinder these firms from identifying potential new ideas to embrace sustainability (Wiener et al., 2020). The complexity of developing eco- or social innovations (Ferraro et al., 2015; Montiel et al., 2020) requires knowledge and competences that exceed opportunity explorers' current knowledge base, thereby leading these firms to engage in a broad external knowledge and information search (Horbach et al., 2013). From this initial exploratory stage of ideas with a wide set of stakeholder groups, opportunity explorers tend to narrow down their external search over time in order to focus on intense interactions with a few of them (van Zanten & van Tulder, 2018). At a certain point, firms realize that a wide set of relationships with different stakeholder groups increases the complexity of the external knowledge and the distance between the knowledge bases of the firm and its sources. This fact, on the one hand, limits the capacity of the firm to successfully incorporate this broad knowledge into its innovation process and, on the other hand, subtracts organizational resources and managerial cognitive attention away from the firm's ultimate innovation objectives (Ghisetti et al., 2015).

A more reduced and intensive set of partners, therefore, offers opportunity explorers long-run advantages to their innovation processes. In particular, (i) the integration of knowledge bases becomes easier; (ii) external partners can be controlled and coordinated more effectively; (iii) organizational costs and managerial overburden decrease; and (iv) more novel inventions to address social or environmental challenges can be discovered (Wiener et al., 2020). Based on this explorative approach, firms manage to select the best partners to innovate towards addressing a narrow set of SDG targets and, thus, we expect:

Hypothesis 2 A narrow responsible innovator's initial engagement with a wide set of stakeholder groups and a subsequent intensive engagement with a reduced number of these groups is positively related to a narrow responsible innovation outcome.

Uncommitted Diversifiers

In their efforts to innovate responsibly and address the different targets associated with several SDGs, such as SDG 8 or SDG 12, uncommitted diversifiers take an opposite approach to the one adopted by opportunity explorers. Their strategy begins with engaging with a very reduced set of stakeholder groups and, in a later stage, widening the stakeholder base to

interact with. Katila and Ahuja (2002) provided a rationale for this dynamic strategy: A deep interaction with external sources increases the understanding of the exchanged knowledge and helps the firm to adapt and develop its innovation competences. However, it also imposes substantial costs over time. As the intensity of these interactions increases, "further developments based on the same knowledge elements become increasingly expensive and the solutions excessively complicated, leading to the costs of depth eventually exceeding its benefits" (Katila & Ahuja, 2002). The result is a firm becoming more rigid, which hinders finding effective innovative solutions. To sort out these limitations, uncommitted diversifiers expand their knowledge search to other sources (Katila & Ahuja, 2002).

Such external search strategy can be counterproductive and risky when the RI objectives are narrow. Research on collaboration for sustainability advancement has warned that a diversification of knowledge sources may be a suboptimal collaboration strategy when multi-stakeholder partnerships become increasingly widespread, and the objectives expected from that collaboration remain narrow (Pattberg & Widerberg, 2016; Pfisterer & van Tulder, 2014). Under these conditions, some partners' resources will be underused, which may hurt the internal cohesion and trust of the partnership (Pattberg & Widerberg, 2016). For example, the key stakeholder groups, connected to a particular SDG that a firm has initially interacted with, may feel they are diminished once this firm starts collaborating with a broader and more diverse set of stakeholder groups. The consequence is that original stakeholder(s) will disengage from the partnership and generate conflicts with other partners (Arenas et al., 2020), which in the end is likely to result in collaborations that are difficult to sustain over time (Arenas et al., 2020; Bryson et al., 2006), hindering the generation of narrow RI. Thus, we propose:

Hypothesis 3 A narrow responsible innovator's initial intensive engagement with a reduced number of its stakeholder groups and a subsequent engagement with a wide set of groups is negatively related to a narrow responsible innovation outcome.

Stakeholder Engagement Strategies for Broad Responsible Innovation

A second category of innovators identified in existing literature adopts a more balanced ex-ante approach to RI (Markman et al., 2016; Scherer & Voegtlin, 2020). In contrast to the previous three narrow responsible innovators, broad responsible innovators orient their RI efforts towards meeting multiple SDGs and their associated targets simultaneously. As they pursue both social and environmental SDG targets, the complexity of the innovation process increases and makes firm's internal resources insufficient, requiring innovators to search for knowledge externally in order to succeed in their innovation endeavors (Goodman et al., 2017; Holmes & Smart, 2009). In this knowledge search, broad innovators tend to rely on an ample set of stakeholder groups (Holmes & Smart, 2009; Inigo et al., 2020; Wiener et al., 2020). Such reliance on broader knowledge sources becomes even more pronounced in comparison to the narrow responsible innovators (van Tulder & Keen, 2018). Stakeholders are explicitly encouraged to bring in their diverse perspectives, resources, and expertise throughout the innovation development process (Buhl et al., 2019). Based on the previously defined generic dynamic stakeholder engagement strategies and these firms' wide innovation orientation, we define three broad responsible innovators: (i) rainbow warriors, (ii) rainbow washers, and (iii) progressive learners.[2]

Rainbow Warriors

Realizing the ambitious aspirations of the SDGs represents a major challenge for innovating firms. The multiplicity of SDG targets, the trade-offs between them, the transformative nature of the SDGs, the necessary engagement of multiple actors, and the disruption from the current innovation regimes, make firms' stand-alone efforts insufficient to foster innovations that comply with the extensive list of SDG targets (Bowen et al., 2017; Caiado et al., 2018; Voegtlin & Scherer, 2017). Focusing exclusively on internal knowledge and resources may hinder firms from detecting significant new ideas for addressing these complex challenges. Joint collaborative efforts between firms and a diverse range of stakeholder groups are proved to be conducive to such broad innovations. Stakeholders encourage creativity and "out-of-the-box" thinking by bringing in new ideas and knowledge that can then be used to develop innovations that tackle both environmental and social challenges (Caiado et al., 2018; MacDonald et al., 2019a; Wiener et al., 2020). Moreover, these positive effects of external resources on innovation increase as knowledge sources become broader and more diverse (Goodman et al., 2017; Inigo et al., 2020).

However, for a successful stakeholder engagement, it is crucial to achieve a high level of integration and coordination between the firm and its constellation of stakeholders

[2] Sustainability-oriented innovation research suggests that tackling multiple objectives simultaneously can only be achieved by engaging a wide number of diverse stakeholders who collaborate towards sustainable development (Adams et al., 2016). Such a statement holds even when there is wide variability among firms about when these multiple stakeholders engage in the innovation process (Buhl et al., 2019). Relying on these considerations, it seems unlikely that in equilibrium, broad innovators will follow a strategy based on continued intensive use of a narrow set of key sources. Hence, we do not consider such an out-of-equilibrium strategy in our analysis.

(Scherer & Voegtlin, 2020). Trust becomes an important, if not the most important, mechanism to foster the collaboration for RI co-creation (van Tulder & Keen, 2018). Yet, building trust is a long-term endeavor because it requires continued interactions, commitment, reciprocity, mitigation of power asymmetries, open communication, and mutual understanding between the firm and its stakeholders (Goodman et al., 2017; Inigo et al., 2020; Pattberg & Widerberg, 2016).

Given these requirements, we argue that rainbow warriors are in a good position to address the challenge implied by embracing multiple SDGs and their targets simultaneously. We define them as innovators that: (i) aspire to meet a broad range of social and environmental SDG targets and (ii) adopt a long-term strategy of developing wide interactions with a diverse set of stakeholder groups to build a dense network of close stakeholder relationships sustained on trust. Their approach is based on managing their partnership portfolio in a consistent manner by starting and then continuing engaged with the same broad portfolio of stakeholder groups (Inigo et al., 2020; Pfisterer & van Tulder, 2014); working together on a common vision, mission, and objectives (Clarke & Fuller, 2010); and ensuring that they are all well aligned (van Tulder & Keen, 2018). Rainbow warriors conceive a long-term strategy as the best strategy to embrace most of the 17 different colors of the "rainbow" SDG framework. Such sustained interaction with multiple stakeholder groups, including employees, customers, communities, and the natural environment, leads to the development of broad RI, which integrates both social and eco-innovation (MacDonald et al., 2019a). Thus, we propose:

Hypothesis 4 A broad responsible innovator's continuous engagement with a wide set of stakeholder groups is positively related to a broad responsible innovation outcome.

Rainbow Washers

With the consolidation of the SDG framework as a template to assess firms' contribution to sustainability, some critical voices have started to express concerns about what has been termed "SDG washing": firms' attempt to use partial achievements in their promotion of SDGs to conceal their modest or null efforts towards sustainability (Nieuwenkamp, 2017). A manifestation of these greenwashing attempts involves firms' stakeholder engagement strategies. Some firms, for example, engage in ambitious partnerships, in some cases with publicly notorious organizations, which seem distantly related to firm's core goals and competences—risking, therefore, the viability of the collaboration (van Zanten & van Tulder, 2018). Relying on this idea, we borrow Visser's (2019) term *rainbow washer* to describe a dynamic stakeholder engagement strategy in which innovators initially engage with a wide base of stakeholder groups but end up establishing intensive interactions with only one or few of them. The reason is the existence of a misalignment between the different stakeholders in terms of intention and resource allocation, which leads partnerships to become deficient and ineffective and are, thus, discontinued as times goes by.[3]

The collaboration pathway of rainbow washers finds support in the literature on the failure of firms' partnerships (e.g., Kolk, 2014; Pattberg & Widerberg, 2016; Pfisterer & van Tulder, 2014). The collapse of such ambitious attempts to engage multiple stakeholder groups is explained by several factors. Among them, Scherer and Voegtlin (2020) mentioned the inability to create appropriate incentives and governance tools to keep all stakeholders engaged in the long run. Similarly, the lack of a long-term plan or capabilities to manage the wide stakeholder constellation effectively, the absence of resource compatibility between partners, the inappropriate balance of power, and the distrust explain such generalized disengagement (Goodman et al., 2017; Inigo et al., 2020).

Moreover, the collaborative strategy of rainbow washers can be interpreted as an inauthentic attempt to achieve SDG targets. Rainbow washers might have never intended to keep their interactions with multiple stakeholder groups over time, as they are possibly aware that implementing such a broad RI strategy of meeting various SDG targets simultaneously is unrealistic. Embracing but ultimately not executing ambitious collaborative plans with stakeholders in the pursuit of SDG targets may reflect that the 17 SDGs are not authentically embedded thorough the organization. For these firms, a wide and diverse partnership portfolio turns out to be a symbolic tactic of signaling stakeholder engagement to reap reputational or legitimacy gains (Delmas & Montes-Sancho, 2010; Marano & Tashman, 2012), rather than a substantive plan for acquiring knowledge for progressing towards their multiple and diverse SDG targets (van Tulder, 2018; van Zanten & van Tulder, 2018). Their final engagement with a narrow set of stakeholder groups after the ambitious initial constellation of collaborators is a signal of their inauthenticity in their interaction with an initial wide sample of different stakeholders. As research on authenticity has pointed out (Lehman et al., 2019), feelings of inauthenticity can produce negative outcomes within organizations, such as decreased stakeholder satisfaction and engagement, which ultimately can preclude the realization of firms' objectives such as the SDGs. Also, these partnerships

[3] The term rainbow wash has also been used to describe organizations that make symbolic claims towards LGBTQIA equality without substantive implementation (in reference to the use of the rainbow-colored flag, especially during the pride month of June).

illustrate a disconnection between a firm's actions and objectives—a behavior known as means/end decoupling (Bromley & Powell, 2012; Lyon & Montgomery, 2015). In essence, rainbow washers commit to pursue an ample 2030 Agenda by having a broad portfolio of partnerships. However, since this wide-ranging engagement does not conform with the firms' core business strategy, these firms are unable to leverage all these efforts to fulfill their ambitious plans of tackling multiple and diverse SDG targets simultaneously (Ghisetti et al., 2015; Pfisterer & van Tulder, 2014). Based on these arguments, we predict:

Hypothesis 5 A broad responsible innovator's initial engagement with a wide set of stakeholder groups and a subsequent intensive engagement with only a reduced number of them is negatively related to a broad responsible innovation outcome.

Progressive Learners

Broad RI requires active participation of a wide array of stakeholder groups who can complement firm internal resources by providing non-redundant knowledge and expertise required to address multiple and diverse SDG targets (Adams et al., 2016; Goodman et al., 2017). However, the integration of the diverse, and sometimes conflicting, knowledge coming from many stakeholder groups poses a significant challenge to firms, preventing an effective stakeholder engagement to innovate sustainably (Inigo et al., 2020). In response to this knowledge integration problem, some firms adopt a progressive approach to stakeholder engagement that (i) identifies relevant stakeholder knowledge and (ii) integrates it afterwards (Buhl et al., 2019; Goodman et al., 2017). Engagement must progressively shift from narrow, intense, and efficiency-focused connections to broader, more knowledge diverse, and systemic efforts (Adams et al., 2016). This progressive approach will facilitate firms' learning (Seebode et al., 2012), improve internal knowledge management processes (Ayuso et al., 2011), and develop capabilities in managing larger stakeholder portfolios (Inigo et al., 2020).

Progressive learners' strategy exemplifies a gradual approach to RI. They pursue RI that addresses multiple and diverse SDG targets incrementally. Initially, progressive learners' focus on a core set of stakeholder groups that are the subject of intensive interactions to learn and develop organizational processes and routines on how to innovate responsibly while collaborating (Inigo et al., 2020; MacDonald et al., 2019a). This unique set of processes and routines has sometimes been called alliance capability (Inigo et al., 2020). Subsequently, progressive learners invite additional stakeholder groups to join the partnership to deepen the analyses of the solutions that came out in the first-stage interactions and that can effectively address a broad SDG agenda (Adams et al., 2016; Inigo & Albareda, 2019). Unlike uncommitted diversifiers, the incremental approach in the collaborative network will not damage the interests of progressive learners' initial stakeholders, who remain engaged in the partnership. The addition of more partners can have positive spillover effects for the initial stakeholder groups, since RI implies information flows in three directions: from stakeholders to the firm, from the firm to stakeholders, and among stakeholder groups (Inigo et al., 2020; MacDonald et al., 2019a). Such wide partnership offers learning opportunities from other partners' success and requires a dialog among all parties involved through which the firm becomes aware of the aims and needs of its stakeholders in order to generate a broad RI that satisfy various SDG targets (Bryson et al., 2006; MacDonald et al., 2019a). We, therefore, predict:

Hypothesis 6 A broad responsible innovator's initial intensive engagement with one or a reduced number of its stakeholder groups and subsequent engagement with a wide set of them is positively related to a broad responsible innovation outcome.

Our theoretical contentions are summarized in Fig. 2.

Methods

Data and Sample

We draw our data from the Spanish Technological Innovation Panel (PITEC). PITEC is "a panel database that allows the monitoring of technological innovation activities of Spanish firms, result of the joint effort of the Spanish National Statistics Institute (INE) and the Spanish Science and Technology Foundation (FECYT) together with the advice of a group of academic experts" (PITEC, 2020). PITEC is based on the Community Innovation Survey (CIS), a valid and reliable tool to study organizational innovative dynamics that has become one of the most used datasets in innovation studies, allowing comparisons with previous studies (e.g., Hagedoorn et al., 2018). Importantly, the PITEC database has already been validated in innovation research (e.g., Barge-Gil & López, 2014; Fernández-Olmos & Ramírez-Alesón, 2017).

PITEC is the most comprehensive dataset to study business innovation in Spain as it compiles more than 460 variables from approximately 12,000 firms that provided information in at least one period. The year when the largest number of firms reported to PITEC was 2012, with 9,709 firms. A strength of PITEC is its time-series nature, which allows analyzing organizational innovation strategies over time

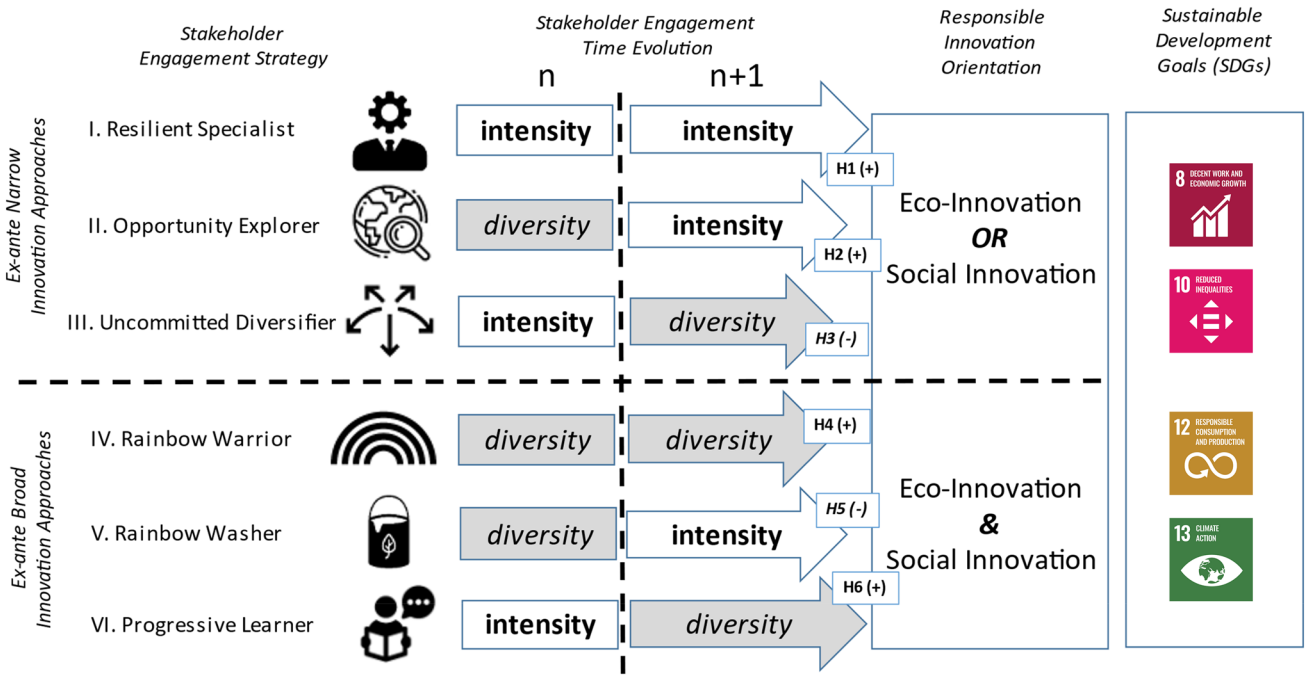

Fig. 2 Dynamic stakeholder engagement strategies for SDG-driven responsible innovation. The use of the SDG icons is permitted under the United Nations Department of Global Communications (UN, 2019)

and introducing lags for explanatory variables (Barge-Gil & López, 2014). Additionally, although PITEC anonymizes some data for confidentiality purposes, it does not affect the reliability of the results (Fernández-Olmos & Ramírez-Alesón, 2017).

To test our hypotheses, we used a time horizon of five years, from 2012 to 2016. We removed those firms with no information on key model variables (see specification (1) below). We also eliminated firms with an abnormal patent innovation activity (upper 1% tail of the distribution), because such outliers created distortions in the estimations and are highly likely to be connected to errors in data gathering. After applying these filters, our sample consisted of 3916 firms and 9691 observations.

Dependent Variable

Some studies have used PITEC (e.g., Sáez-Martínez et al., 2016) or CIS (e.g., Ghisetti et al., 2015) to measure sustainability-oriented innovation, especially eco-innovation. In our case, we use PITEC to build measures of social and eco-innovation—each aligned with specific SDG targets. We include items connected to SDG 8 targets (Decent Work & Economic Growth) in our proxy of social innovation and items connected to SDG 12 targets (Sustainable Production and Consumption) in our variable of eco-innovation.[4] "Appendix" shows the connection between SDGs, SDG targets and SDG indicators, and our RI measures.

To measure social innovation in line with targets under SDG 8, such as achieving full employment or promoting safe and secure working environments, we use five items: (i) improving employee health and safety; (ii) increasing total employment; (iii) increasing qualified employment; (iv) maintaining existing employment; and (v) compliance with health and safety regulations as well as environmental ones (Cronbach's $\alpha = 0.881$). To measure eco-innovation, we used items that proxy SDG 12 targets related to the efficient use of natural resources or the adoption of sustainable production practices. These items are: (i) reducing environmental impact; (ii) lower energy consumed per unit; (iii) lower materials employed per unit; (iv) higher production or service provision flexibility; and (v) higher production or service provision capacity (Cronbach's $\alpha = 0.871$). All the items use a four-point Likert scale (1 = highly important; 4 = no important) to account for the importance of each objective to innovate from period $t-2$ to period t. Once these scores

[4] Some of these items can also be connected to targets included in other SDGs such as SDG 9 (Infrastructure, Industrialization), SDG 10 (Reduced Inequality), and SDG 13 (Climate Action). However, these possible multiple adscriptions of our items do not affect the validity of our measures, as the convergent and discriminant tests show (see Footnote #4).

are computed, we also define the corresponding dummies of *Eco-innovation* and *Social innovation*, which are equal to 1 (0) if the previous scores have a non-null (null) value. Based on both dummies, we create the final dependent variables: narrow and broad RI. *Narrow RI* takes the value 1 if the firm performs eco-innovation *or* social innovation, but not both simultaneously. *Broad RI* takes the value 1 if the firm does eco-innovation *and* social innovation simultaneously. Finally, we tested the validity of the two variables using two methods: convergent validity and discriminant validity. From the results of both methods, it can be concluded that *Eco-innovation* and *Social innovation* are valid measures.[5]

Independent Variables

To analyze stakeholder engagement for RI, we employ two variables: *Intensity* and *Diversity* in stakeholder engagement. To create both stakeholder engagement variables, we adapted Laursen and Salter's (2006) measures to our data. These measures have been widely used in the literature (e.g., Chapman et al., 2018; Hagedoorn et al., 2018; Laursen & Salter, 2006). *Intensity* is connected to the importance of the information obtained from each stakeholder group (Hagedoorn et al., 2018; Laursen & Salter, 2006). PITEC includes one question to evaluate the importance of the information received from each stakeholder group for the interval of t to $t-2$. To operationalize *Intensity*, we create two dummy variables, *Stakeholder information* and *Relevant stakeholder information*, for each stakeholder group tracked in PITEC (i.e., customers, suppliers, competitors, consultants, research institutes, public organizations, and universities). *Stakeholder information* takes the value 1 when the firm received information to innovate from the corresponding stakeholder group in the last 2 years, and 0 otherwise. We lag this variable one year to capture the fact that a temporal lag is needed to process this information and transform it in productive knowledge to generate RI. *Relevant stakeholder information* takes the value 1 if the information received for the stakeholder was "relevant" (above the median) to innovate, and 0 otherwise. Since firms could engage with seven potential stakeholder groups, we create an overall score of *Intensity* by computing the following ratio: the sum of *Stakeholder information* for each of the seven stakeholder groups in the numerator and the sum of *Relevant stakeholder information* in the denominator. This ratio increases as firms use a wider set of sources of information, but the most relevant ones are concentrated in a few stakeholder groups. Such variable accounts for the idea that to be intense, stakeholder engagement needs to be focused on a narrow set of stakeholder groups.

Diversity is measured through a variable that collects the total number of different stakeholder groups with which a firm collaborates. Thus, each firm has a *Diversity* value that ranges from the minimum = 0 (no cooperation with any stakeholder group) to the maximum = 7 (cooperation with seven different stakeholder groups). This cooperation must have run from $t-2$ to t years, t being the year in which the survey is completed.

We have characterized the six types of firms in terms of their ex-ante innovation approach (i.e., narrow or broad RI) and their dynamic stakeholder engagement strategies (i.e., *Intensity* and *Diversity* along time). In order to identify ex-ante narrow innovators from the ex-ante broad innovators, we compute the 3-year rolling window average of the sum of the variance of the different information sources and the variance of the different types of cooperation. We, thus, define the variable *Ex-ante broad innovation view* = 1 (*Ex-ante narrow innovation view* = 1) if this average is larger (lower) than the median sample value for that year; in this case, we consider that a firm has an ex-ante broad (narrow) innovation orientation given that it is sensitive to a wide (narrow) set of different knowledge and collaborative sources.

Departing from this variable, we define six different types of responsible innovators. *Resilient specialists*, *Opportunity explorers* and *Uncommitted diversifiers* belong to the category of firms with an ex-ante narrow RI orientation. At the other extreme, *Rainbow warriors*, *Rainbow washers* and *Progressive learners* belong to the group of firms with an ex-ante broad innovation view. (i) *Resilient specialists* are characterized by an ex-ante narrow innovation approach and the maintenance over time of intensive stakeholder engagement. We approach this type through the interaction $Intensity_t \times \text{Intensity}_{t+1}$ in the sample of firms with an *Ex-ante narrow innovation view* = 1. (ii) *Opportunity explorers* have an ex-ante narrow innovation orientation and are characterized by evolving from a diverse stakeholder engagement to developing an intensive engagement. We model this type by the interaction $\text{Diversity}_t \times \text{Intensity}_{t+1}$ in the sample of firms with an *Ex-ante narrow innovation view* = 1. (iii) *Uncommitted diversifiers*, also belonging to the group of ex-ante narrow innovators, evolve from an intensive to a diverse stakeholder engagement. This type is defined by the interaction

[5] To test the validity of the variables of *eco-innovation* and *social innovation*, we conducted convergent validity and discriminant validity analyses. The convergent validity test gives information on the internal consistency of the constructs defined. The tests reveal that all five loadings for each variable have a lambda larger than 0.7. Also, the Average Variance Extracted (AVE) is larger than .5 in both cases—AVE (eco-innovation) = 0.621 and AVE (social innovation) = 0.676. Concerning discriminant validity, the HTMT test, which is more efficient than the Forner Larcker test (Henseler et al., 2015), shows a HTMT = 0.80, lower than the 0.85 threshold indicating that both constructs are not measuring the same issue. Besides, the square correlation of these two variables is lower than the AVE of each variable. Both tests indicate that social and eco-innovation variables are not collinear and, thus, measure different dimensions of firms' innovation outcomes.

Intensity$_t$ × Diversity$_{t+1}$ in the sample of firms characterized by *Ex-ante narrow innovation view* = 1. (iv) *Rainbow warriors* are characterized by an ex-ante broad innovation approach and the maintenance over time of diverse stakeholder engagement. We approach this type through the interaction of Diversity$_t$ × Diversity$_{t+1}$ in the sample of firms that have an *Ex-ante broad innovation view* = 1. (v) *Rainbow washers* have an ex-ante broad innovation view and their engagement with multiple stakeholder groups evolves from diverse to intensive. We characterize this type by the interaction Diversity$_t$ × Intensity$_{t+1}$ in the sample of firms with an *Ex-ante broad innovation view* = 1. (vi) *Progressive learners*, the final type of broad innovators, evolve from an intensive to a diverse stakeholder engagement. This type is characterized in our models by the interaction *Intensity*$_t$ × Diversity$_{t+1}$ in the sample of firms characterized by an *Ex-ante broad innovation view* = 1.

Control Variables

A list of control variables was included in our analyses. *Firm age* accounts for the potential effect of experience on innovation performance (de Leeuw et al., 2014). *Firm size* has been shown to affect innovation levels, as larger firms possess more resources to invest in innovation. This variable is measured using the logarithm of the number of employees (Laursen & Salter, 2006). We also incorporate three dummy variables to measure whether the organization (1) *Exports* part of its products and/or services, (2) has headquarters abroad (*Foreign headquarters*), and (3) belongs to a *Business group*. These relationships capture situations that facilitate the acquisition of external knowledge that may be useful for innovation development (Hagedoorn et al., 2018). We included the *Number of patent* applications, as a proxy of the innovation capacity (van Beers & Zand, 2014), together with firms' *Absorptive capacity*, defined as the "ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990). We operationalize absorptive capacity as the ratio of the number of specialized R&D employees to the total number of employees. Specialized R&D employees are better prepared to absorb and assimilate the external knowledge necessary to innovate (García-Romero et al., 2017). We have also included a dummy variable *Cooperation*, which is equal to 1 if a firm is involved in any type of cooperation and 0 otherwise. Such variable allows us to tackle externalities not captured by the variables of *Intensity* and *Diversity*. Additionally, in order to avoid spurious correlations between the key independent variables of *Intensity* and *Diversity* and the dependent variable of RI, we include three variables capturing difficulties that can rise during the innovation process (de Leeuw et al., 2014): *Financial constraints*, measured through the lack of external sources of funding; *Technological constraints*, measured through the lack of qualified staff within the firm; and *Industry uncertainty*, observed through the difficulty to access the market information necessary to develop innovations. All these items are captured through the corresponding dummies that take the value of 1 (0) if the corresponding factor hinders in some way the innovation process during the interval t to $t-2$. Finally, we incorporate year dummies for the years from 2013 to 2016 (year 2012 serves as the reference year), and in the random-effect models (see below), we include sectorial dummy variables.

Empirical Methodology

We rely on panel data firm-level analyses with firm's fixed effects when the Hausman test reveals the existence of problems of consistency in the estimations. When this test does not provide evidence of such a problem, we rely on the most efficient *random-effect* approach (Wooldridge, 2010). The empirical model to examine the effects of stakeholder engagement strategies on narrow and broad RI is a lineal probability model of the following specification:

$$\begin{aligned} Narrow/Broad\ RI_{it+1} = {} & \beta_0 + \beta_1 Intensity_{it} \times Intensity_{it+1} \\ & + \beta_2 Diversity_{it} \times Diversity_{it+1} \\ & + \beta_3 Diversity_{it} \times Intensity_{it+1} \\ & + \beta_4 Intensity_{it} \times Diversity_{it+1} \\ & + Control\ variables_{it} + \eta_i + \psi_t + \epsilon_{it} \end{aligned} \quad (1)$$

Subscripts i and t index firm and period, respectively. A firm-specific component of the error term (η_i) is included, when the Hausman test shows problems of consistency in the estimations because of the correlation between explanatory variables and the unobservable firm heterogeneity (e.g., managers' cognitions). However, for the main specifications, the Hausman test has shown that there are no problems of consistency and a random-effect approach is used. In this case, apart from year dummies (ψ_t), sectorial dummies are also included in the specifications. Hypotheses 1, 2, and 3 are supported when $\beta_1 > 0$, $\beta_3 > 0$, and $\beta_4 < 0$ for the sample of firms with an *Ex-ante narrow innovation view* = 1. Hypotheses 4, 5, and 6 are supported when $\beta_2 > 0$, $\beta_3 < 0$, and $\beta_4 > 0$ for the sample of firms with an *Ex-ante broad innovation view* = *1*.

Results

Table 1 includes the descriptive statistics. The correlations show that *Intensity* is positively correlated with *Narrow RI* and negatively with *Broad* RI ($r = 0.02$ and $r = -0.04$ respectively). On the contrary, *Diversity* is negatively

Table 1 Descriptive statistics and correlations

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Eco-innovation	0.588	0.350	0	1																
2. Social innovation	0.519	0.375	0	1	0.60															
3. Narrow RI	0.190	0.392	0	1	− 0.36	− 0.53														
4. Broad RI	0.735	0.441	0	1	0.60	0.70	− 0.80													
5. Intensity	1.704	1.273	0	7	− 0.06	− 0.07	0.02	− 0.04												
6. Diversity	1.276	1.805	0	7	0.12	0.19	− 0.12	0.16	− 0.09											
7. Cooperation	0.514	0.499	0	1	0.09	0.12	− 0.07	0.12	− 0.04	0.68										
8. Number of employees	32.406	20.676	1	313	0.05	− 0.00	− 0.01	0.01	0.00	0.01	0.00									
9. Firm age	4.423	1.583	0	10.60	0.13	0.01	0.01	0.03	− 0.01	0.15	0.15	0.32								
10. Exports	0.797	0.401	0	1	0.08	0.11	− 0.09	0.08	0.00	0.05	0.03	0.05	0.00							
11.Int. headquarters	0.164	0.370	0	1	0.06	0.01	0.00	0.00	0.00	− 0.00	0.06	0.07	0.25	0.11						
12. Business group	0.518	0.499	0	1	0.08	− 0.00	0.03	− 0.00	0.01	0.09	0.17	0.10	0.46	0.07	0.34					
13. Number of patents	0.180	0.559	0	3	0.05	0.07	− 0.06	0.06	− 0.00	0.17	0.11	0.00	0.04	0.07	− 0.01	0.00				
14. Absorptive capacity	0.183	0.333	0	11.07	− 0.05	0.04	− 0.03	0.00	− 0.02	0.15	0.11	− 0.17	− 0.35	− 0.01	− 0.10	− 0.15	0.07			
15. Financial constraints	0.751	0.432	0	1	0.05	0.09	− 0.08	0.08	0.01	0.09	0.05	− 0.08	− 0.13	0.00	− 0.10	− 0.09	0.02	0.08		
16. Tech constraints	0.331	0.470	0	1	0.11	0.13	− 0.08	0.09	− 0.03	− 0.02	− 0.00	0.00	− 0.07	0.03	− 0.06	− 0.07	− 0.01	− 0.00	0.14	
17. Market uncertainty	0.354	0.478	0	1	0.10	0.15	− 0.09	0.10	− 0.03	0.03	0.03	− 0.03	− 0.10	0.05	− 0.06	− 0.09	0.00	0.05	0.15	0.58

Table 2 Determinants of broad and narrow responsible innovation

	Model 1 Narrow RI ($t+1$)	Model 2 Eco I ($t+1$)	Model 3 Social I ($t+1$)	Model 4 Broad RI ($t+1$)	Model 5 Narrow RI ($t+1$) Ex-ante narrow	Model 6 Broad RI ($t+1$) Ex-ante broad
Intensity (t) × Intensity ($t+1$)	0.002**	0.003**	− 0.000	− 0.004***	0.002*	− 0.002*
	(1.964)	(2.561)	(− 0.528)	(− 3.619)	(1.747)	(− 1.615)
Diversity (t) × Diversity ($t+1$)	− 0.002**	− 0.001	− 0.001**	0.003***	− 0.003***	0.006***
	(− 2.153)	(− 1.191)	(− 2.004)	(2.747)	(− 2.597)	(6.032)
Diversity (t) × Intensity ($t+1$)	0.003**	0.001	0.002**	− 0.005***	0.005**	− 0.005***
	(2.267)	(1.094)	(2.364)	(− 3.340)	(1.975)	(− 3.015)
Intensity (t) × Diversity ($t+1$)	− 0.002	− 0.002	− 0.000	0.005***	− 0.007**	0.006***
	(− 1.381)	(− 1.446)	(− 0.195)	(2.778)	(− 2.335)	(3.616)
Firm age	− 0.006	0.004	− 0.010**	− 0.004	0.000	− 0.000
	(− 0.848)	(0.634)	(− 2.552)	(− 0.527)	(0.727)	(− 0.300)
Firm size	− 0.012	− 0.007	− 0.006	0.046*	− 0.003	0.014**
	(− 0.506)	(− 0.311)	(− 0.422)	(1.840)	(− 0.428)	(2.415)
Exports	− 0.010	− 0.011	0.001	0.017	− 0.022	0.032**
	(− 0.474)	(− 0.619)	(0.128)	(0.784)	(− 1.071)	(1.969)
International headquarters	− 0.021	− 0.016	− 0.004	− 0.004	− 0.040*	− 0.006
	(− 0.876)	(− 0.784)	(− 0.337)	(− 0.164)	(− 1.649)	(− 0.361)
Business group	− 0.016	− 0.014	− 0.002	0.027	0.029	− 0.025
	(− 0.602)	(− 0.604)	(− 0.128)	(1.032)	(1.486)	(− 1.602)
Number of patents	− 0.003	− 0.007	0.004	0.002	− 0.006	0.019**
	(− 0.290)	(− 0.727)	(0.635)	(0.222)	(− 0.427)	(1.976)
Absorptive capacity	0.000	− 0.001	0.001	− 0.007	− 0.050	0.010
	(0.015)	(− 0.046)	(0.101)	(− 0.294)	(− 1.583)	(0.561)
Cooperation	− 0.014	0.005	− 0.019***	0.021	− 0.039**	0.053***
	(− 1.088)	(0.418)	(− 2.640)	(1.556)	(− 2.261)	(4.026)
Financial constraints	− 0.007	− 0.006	− 0.001	0.012	− 0.024	0.031**
	(− 0.501)	(− 0.501)	(− 0.109)	(0.825)	(− 1.359)	(2.404)
Technological constraints	0.007	0.005	0.002	− 0.003	− 0.011	0.018
	(0.529)	(0.448)	(0.246)	(− 0.240)	(− 0.592)	(1.354)
Market uncertainty	0.006	− 0.001	0.007	0.014	− 0.015	0.035***
	(0.466)	(− 0.122)	(1.039)	(1.072)	(− 0.792)	(2.695)
Constant	0.471*	0.060	0.410***	0.598**	0.341***	0.498***
	(1.886)	(0.275)	(2.982)	(2.321)	(5.645)	(10.016)
Type of estimation	FE	FE	FE	FE	RE	RE
Observations	9,691	9,691	9,691	9,691	2,956	6,735
R^2	0.004	0.003	0.004	0.012	0.059	0.081

t-statistics in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

correlated with *Narrow RI*, and positively with *Broad RI* ($r = -0.12$ and $r = 0.16$ respectively). These results conform to the general statement connecting *Intensity* to *Narrow RI*, and *Diversity* to *Broad RI.*

Table 2 presents the results for our empirical specification (1). Models 5 and 6 test our six hypotheses, while Models 1–4 show the results for the whole sample without distinguishing if firms focus ex-ante in narrow or broad SDG targets. For ex-ante narrow RI sample (Model 5), we test Hypotheses 1, 2, and 3 for *Resilient specialists*, *Opportunity explorers*, and *Uncommitted diversifiers*, respectively. Results show that the coefficient of $Intensity_{it} \times Intensity_{it+1}$ (*Resilient specialists*) is positive ($\beta_1 = 0.002$, $p < 0.1$), supporting Hypothesis 1. Also, the coefficient of $Diversity_{it} \times Intensity_{it+1}$ (*Opportunity explorers*) is positive ($\beta_3 = 0.005$, $p < 0.05$), supporting Hypothesis 2; while that of $Intensity_{it} \times Diversity_{it+1}$ (*Uncommitted diversifiers*) is negative ($\beta_4 = -0.007$, $p < 0.0.05$), supporting Hypothesis 3.

Once we focus on Model 6 on the sample of ex-ante broad RI firms, we find that the coefficient of $Diversity_{it} \times Diversity_{it+1}$ (*Rainbow warriors*) is positive ($\beta_2 = 0.006$, $p < 0.01$), supporting Hypothesis 4; the coefficient of $Diversity_{it} \times Intensity_{it+1}$ (*Rainbow washer*) is negative ($\beta_3 = -0.005$, $p < 0.01$), supporting Hypothesis 5; and the coefficient of $Intensity_{it} \times Diversity_{it+1}$ (*Progressive learner*) is positive ($\beta_4 = 0.006$, $p < 0.01$), supporting Hypothesis 6.

Robustness Checks

Our results withstand a battery of robustness tests. The first two analyses examine alternative measures for the main model variables and the effects of the release of the SDGs in 2015. As additional tests, we use alternative empirical methods and samples and account for potential endogeneity problems. All the robustness tests are available from the authors upon request and are consistent with the results reported in Table 2.

Alternative Measures

In a first set of robustness checks, we employ alternative proxies for the dependent and main independent variables. Regarding the measurement of social and eco-innovation, following De Marchi (2012) we have moved the item of "*Improving employee health and safety*," initially used to build the social innovation proxy, to the measurement of eco-innovation. The results found using this alternative characterization are consistent to those of Table 2. Also, following Sáez-Martínez et al. (2016), we have moved not only the item of "Improving employee health and safety" but also the item "Compliance with environmental, health or safety regulations" from being a component of the social innovation proxy to a component of the eco-innovation proxy. Again, results are consistent to those shown in Table 2.

We also re-did our analysis with an alternative measurement of *Diversity* that, in addition to measuring intergroup heterogeneity (i.e., diversity across stakeholder groups), also captures intragroup heterogeneity (i.e., diversity within each stakeholder group). To account for the effect of intragroup heterogeneity, we consider the differences in terms of location within each of the different stakeholder groups. In the PITEC database, each stakeholder is categorized depending on its location in 5 regions: (i) Spain; (ii) other European countries; (iii) United States; (iv) China and India; and (v) other countries. Based on this information, we have defined a measure of diversity that combines intergroup heterogeneity (cooperation with different stakeholders as a group) with an intragroup one (sum of different locations). The results using that measure indicate that there is no improvement in terms of significance of key coefficients and overall fit of the models with respect to our former measure based on intergroup heterogeneity. Hence, we can infer that the relevant source of heterogeneity is the intergroup one rather than the intragroup one.[6]

In addition, we considered an alternative proxy for absorptive capacity, which is measured by the expenses in internal R&D as a percentage of total R&D expenses divided by the number of employees (García-Romero et al., 2017). The results do not change.

Pre- and post-SDG Publication Analysis

In an additional test, we have replicated the estimations of Table 2 once we separate the effects in the period before the release of the SDGs in 2015 and the period afterwards (analyses available upon request).[7] With this separation, we aim to assess the consistency of the results between the period in which the SDGs were signaled (Rio + 20 Conference) but not yet launched and the period in which the SDGs were officially in place. The results of this analysis suggest that, for firms with an ex-ante broad RI view, there are no significant differences in the results once we compare the pre-SDG period with the post-SDG period. This finding suggests that concrete knowledge about the final list of SDGs, which were under discussion since Rio+20 in 2012, did not change these firms' RI activities, as they were already pursuing a broad sustainability agenda. More interestingly, our analysis suggests a different pattern for responsible innovative firms with an ex-ante narrow RI view. As with their ex-ante broad RI counterparts, we have tested the effect of the SDG publication on the generation of narrow RI for ex-ante narrow RI firms by comparing pre- and post-SDG periods. The results of this comparison show significant differences for *Resilient specialists* and *Opportunity explorers* (both at $p < 0.05$). So, while Rio +20 signaled the sustainability goals to be prioritized, it was not until the concrete 2030 Agenda was released that firms, particularly *Resilient specialists* and *Opportunity explorers,* could channel their innovation efforts towards the achievement of focused SDG-based innovations through their intensive collaboration activity with a few stakeholder groups.

[6] It may still be possible that some degree of heterogeneity persists within each stakeholder-location group. Such within-group heterogeneity, not captured with the proxies we use, may be reducing the current significance of our proxies of stakeholder engagement strategies, which capture between-groups heterogeneity, in explaining innovation performance. In this sense, we believe the findings reported in this study can be considered a lower-bound estimate of the true effect of stakeholder strategies on responsible innovation.

[7] Given the temporal structure of our empirical models, for this test we need to consider at least three periods in each subsample to run our estimations. So, for the pre-SDG subsample we considered the period 2012–2014 and, for the post-SDG subsample, the period 2014–2016.

Additional Robustness Checks

Our results also withstand tests examining alternative empirical methods, alternative samples, and the potential endogeneity between the explanatory variables and RI variables.

First, we run a series of logit models, instead of lineal regression estimations, to test our hypotheses, given that the dependent variables are dichotomous. Conclusions after this test remain unaltered. Second, we re-run our estimations focusing on a sample of firms with complete information in at least four periods of analysis (2012–2016). Also, we winsorized at 1% all model variables. The results in both cases are consistent with the ones reported in Table 2.

A potential problem in our analyses is that the key explanatory variables—*Intensity* and *Diversity*—may have an endogenous connection with the RI variables. In particular, a reverse causality relationship connecting RI to the interaction of firms with different stakeholder groups through the variables of *Intensity* and *Diversity* may seem plausible. A potential second problem concerns the correlation between unobserved firm's fixed effects (e.g., managers' cognition) and key explanatory variables. We address these problems in two ways. First, to minimize reverse causality problems, we used the variables of *Intensity* and *Diversity* with a temporal lag. Further, we conducted the Granger causality test, which showed that there are no reverse causality issues, and the direction of causality moves from *Intensity* and *Diversity* variables to the variables of *Eco-innovation* and *Social innovation*. Second, the problem of spurious correlation with the unobservable firm's characteristic is addressed by the firm's fixed effect approach adopted in Models 1 to 4 in Table 2.[8] Such approach allows extracting firms' fixed effect component $-\eta_i$, from the error term in specification (1), potentially correlated with different explanatory variables. Moreover, the use of a parsimonious specification with a wide set of control variables reduces concerns of spurious correlations connected to omitted variables.

Discussion

In this study, we sought to extend previous research about the impact of stakeholder engagement strategies on the responsible innovation (RI) contribution to the advancement of SDGs. The focus of this study is the dynamics of the firm-stakeholder collaboration employed to generate SDG-Driven RI. In assessing SDG-Driven RI, we identify two types of responsible innovators. First, narrow responsible innovators, who opt to pursue social innovation (i.e., to contribute to specific targets associated with SDG 8 on Decent Work and Economic Growth) *or* eco-innovation (i.e., to contribute to specific targets associated with SDG 12 on Responsible Production and Consumption). Second, broad responsible innovators, who decide to embark in both social and eco-innovation to contribute to a wider set of social and environmental targets from both SDG 8 and SDG 12. Based on these two RI orientations of firms, we propose a typology of six distinct dynamic stakeholder engagement strategies: three strategies are focused on a narrow RI orientation—*Resilient specialists*, *Opportunity explorers*, and *Uncommitted diversifiers*—and three focused on a broad RI orientation—*Rainbow warriors*, *Rainbow washers*, and *Progressive leaners*. We argue that such distinctions are important to understand how different stakeholder engagement pathways deliver different RI outcomes.

To characterize these six strategies of engagement with stakeholder groups, we build on existing research on collaboration for external knowledge access (Chapman et al., 2018; Laursen & Salter, 2006; Love et al., 2014), which uses the notions of diversity of partner types and intensity of the interactions with these partners, and extend it to a dynamic framework by applying the diversity/intensity dimensions over time. Using this framework, we find that narrow responsible innovators may follow two dynamic strategies or pathways for contributing to a particular SDG and its associated targets. In the first pathway, *Resilient specialists* develop intensive interactions from the beginning and along time with a reduced number of stakeholder groups. In the second pathway, *Opportunity explorers* develop a progressive strategy of stakeholder engagement, beginning with a wide set of stakeholder groups before focusing on intense interactions with a selection of them. Overall, these findings suggest that to be an effective narrow responsible innovator that addresses a particular SDG, a firm needs to end up developing intense relationships with a reduced number of stakeholder groups.

For broad responsible innovators, findings suggest that there are two pathways to contribute to a broad S DG agenda effectively: these are the strategies of *Rainbow warriors*, who develop long-lasting interactions with a sizable set of stakeholder groups along time, and *Progressive learners*, who begin with a narrow set of intensive stakeholder interactions and then broaden their base to incorporate other stakeholder groups. The key to addressing multiple and diverse SDG targets simultaneously is, thus, to learn how to keep a wide spectrum of stakeholder groups engaged in the long run.

[8] In Models 5 and 6, we adopt a random-effect approach given that the Hausman test reveals that there is no such a potential problem of correlation with the firm's fixed effect component of the error term.

Contribution to the Innovation Literature

Our study contributes to the rapidly growing literature on RI. Since RI is a participative and transparent form of co-creation that generates social and environmental value (von Schomberg, 2012), firms are likely to require the development of new capabilities. These capabilities can be acquired by partnering with external stakeholders (Lashitew et al., 2020), which will in turn create an "enabling environment" to succeed in the innovation process (van Tulder & Lucht, 2019). Nonetheless, the ways in which firms establish such enabling environments by partnering for RI not only varies in terms of the *diversity* of partner types and *intensity* of interactions with these partner types (Laursen & Salter, 2006), but also on how diversity and intensity are deployed over *time*.

On the one hand, we propose that some firms adopt a narrowly focused approach to RI: a social *or* eco-innovation focus, which in the long run prioritizes *intensity* in the relationships with partners to contribute to a limited number of SDG targets. On the other hand, broad responsible innovators—a social *and* eco-innovation focus—will benefit from partner *diversity*, in the long run, to fulfill more ambitious, innovative approaches that seek to address multiple SDGs and targets simultaneously. Once we incorporate temporal considerations into our analysis, we can propose a more complete stakeholder engagement typology that includes six dynamic strategies that vary in their prioritization of partner diversity and intensity strategies over time. These different approaches diverge in terms of type and effectiveness, but all can contribute to the 2030 Agenda.

Contribution to SDG Research and this Special Issue

Our study contributes to calls for a better understanding of the role of businesses and their partnering and innovating strategies as contributors to the 2030 SDG Agenda (Beyne, 2020; Mio et al., 2020; Rashed & Shah, 2020). By taking a dynamic approach that accounts for stakeholder engagement evolution over time, we characterized six distinct stakeholder engagement strategies that firms put into practice when innovating responsibly. Of particular interest for SDG advocates are two stakeholder engagement strategies implemented by responsible innovators with an ex-ante broad orientation towards different SDGs simultaneously: *Rainbow warriors* (i.e., innovators engaging over time with a wide base of stakeholder groups) vs. *Rainbow washers* (i.e., innovators engaging, initially, with a wide base of stakeholder groups but ending up establishing intensive interactions with only one or few of these groups). Even though both types of firms expect a priori to embrace an ample range of SDGs and their associated targets, the so-called "rainbow" approach, *Rainbow washers* seem to adopt a more symbolic strategy of engagement with their stakeholders, which ends up hurting their RI. On the opposite side, by means of their long-term engagement strategy, *Rainbow warriors* are better able to use SDGs as a business opportunity to innovate responsibly and meet SDG targets along the entire rainbow spectrum, from social to environmental targets.

Moreover, undertaking a dynamic study of stakeholder engagement strategies over time allows us to offer a more complete picture of the role of business in achieving the 2030 Agenda on time. Indeed, our findings might help managers adjust their stakeholder engagement strategies to innovate responsibly based on how their firms currently place with respect to our set of six dynamic strategies characterizations.

It is also worth exploring the extent to which managers incorporate the SDGs into the design of their firms' RI strategy instead of simply generating RI without a specific connection to SDGs. Our empirical analysis provides some insights on this issue. In the case of narrow innovators, we find two relevant results. First, it is only after 2015, once the SDGs were launched that the two effective narrow responsible innovators—*Resilient specialists* and *Opportunity explorers*—started to generate RI. Second, these innovators end up relying on an intense relationship with a single stakeholder group and *quickly* (in one period) generate RIs once the SDGs were released. This fact indicates that managers of narrow responsible innovators were likely to be implementing processes already, anticipating the upcoming SDGs. Once the specific SDGs were known, the managers of narrow responsible innovators firms adapted quickly and developed deep relationships with the relevant stakeholders to contribute to specific SDG targets.

In the case of broad responsible innovators, we do not find significant differences in the positive generation of RI between the pre-SDG and post-SDG publication periods for the most effective strategies to generate broad RI (i.e., *Rainbow warriors* and *Progressive learners*). These results may indicate that, for broad innovators addressing multiple sustainability objectives, the specifics of the SDGs have had a limited impact on the implementation of their stakeholder engagement strategies as they were already committed to pursuing a universally accepted sustainability agenda.

Managerial Implications

Based on whether firms decide to undertake narrow or broad SDG-Driven RI approaches, we draw two managerial implications. First, when firms focus on a reduced set of SDG targets, they must end up interacting in an intensive way with a limited set of stakeholder groups to be effective at their innovation efforts. However, initially firms may decide to interact with a wide set of stakeholder groups or focus on intensive interactions with a smaller set of stakeholder

groups before their long-term interaction with a reduced set of stakeholder groups is solidified. Second, those firms that seek to innovate responsibly to contribute to a broader set of SDG targets will need to end up engaging with a diverse set of stakeholder groups. Nevertheless, these firms have also two different paths before their broad long-term stakeholder interaction strategy is set in stone. They can engage with a wide set of stakeholder groups from the beginning or concentrate on intensive interactions with a small set of stakeholder groups before they go wider.

The 2030 Agenda is complex, and firms need to engage with different stakeholder groups to ensure that SDG-Driven RI efforts are effective. Some firms benefit from a narrow approach and end up with a reduced set of stakeholder interactions to innovate, while others take a broader approach that requires of a more diverse set of interactions with different stakeholder groups. Two approaches with the same ultimate objective: meet the SDGs by 2030.

Limitations and Future Research

Our study has several shortcomings that suggest future research opportunities. First, we recognize that our measures of narrow and broad RI are far from perfect and there is room for improvement. Even though we are constrained by the items compiled by the PITEC survey, our multiple-item measures are still able to capture a variety of RI efforts in the social vs. environmental realm. Second, we study the Spanish context, and it would be ideal to expand our study to an international context to explore whether differences across institutional environments may have an impact on our predictions, and whether multinational companies' behavior differs depending on their multiple national locations. Third, although we study stakeholder engagement strategies over time, our data does not allow us to analyze whether such strategies hold down the road. It would be interesting to follow up with these firms to see how their strategies evolve over time, especially until 2030—when the SDGs are supposed to be met.

There are many calls for collaborative action to tackle all the 17 SDGs and 169 targets specified in the 2030 Agenda. No sustainability actor seems prepared to address such complex issues in insolation and, thus, more research on understanding how firms can more effectively engage different stakeholder groups, from governments to civil society groups, is needed. Ours is another attempt to understand such complex dynamics—but more research on this issue should be quickly developed if these goals are to be met by 2030. Another future avenue that emerges from our study relates to the 2020 global COVID-19 pandemic and how firms are recalibrating their efforts for innovating responsibly and addressing the different SDGs. For instance, SDG 3, on "Good Wealth and Wellbeing," is likely to have more relevance in the near future. Under these conditions, understanding the most effective dynamic stakeholder engagement strategies to tackle targets on this SDG will be crucial.

In Conclusion…and Moving Forward

Sustainability advocates call for a more systemic approach to study how firms can advance the ambitious 2030 Agenda. We respond to this call by (i) identifying a typology of dynamic stakeholder engagement strategies for firms to innovate responsibly towards contributing to specific SDG targets, whether in isolation or simultaneously, and (ii) testing empirically whether such strategies are effective at addressing a set of SDG targets based on firms' innovation efforts.

Even though the SDGs were officialized in 2015, our study also recognizes that businesses had been working to generate innovations for sustainable development even before these SDGs were released. The 2000 MDGs already called for collaborative action. The Rio+20 UN Summit activated the path for a more ambitious and detailed global sustainability agenda, substantiated three years later with 17 SDGs, 169 targets, and 232 indicators to be met by 2030. One clear conclusion emerges from our study: Firms will not be able to contribute to the 2030 Agenda without focusing their RI efforts towards establishing substantive and long-term partnerships with relevant stakeholder groups.

Appendix: The Evolution Towards SDG-Driven Responsible Innovation

MDG targets 2000→2015	MDG indicators 2000→2015	Rio+20 future we want 2012→2030	SDG targets 2015→2030	SDG indicators 2015→2030	SDG-Driven Responsible innovation
 **Target 7A**: Integrate the principles of sustainable development into country policies and programs' reverse loss of environmental resources	**27.** Energy use per $1.00 Gross Domestic Product **28.** Carbon dioxide per capita and consumption of ozone-depleting chlorofluorocarbons **30.** Proportion of population with sustainable access to improved urban and rural water source	**61.** We recognize that urgent action on unsustainable patterns of production and consumption where they occur remains fundamental in addressing environmental sustainability and promoting conservation and sustainable use of biodiversity and ecosystems, regeneration of natural resources and the promotion of sustained, inclusive and equitable global growth **128.** We recognize that improving energy efficiency, increasing the share of renewable energy and cleaner and energy-efficient technologies are important for sustainable development, including in addressing climate	 **Target 12. 1.** Implement the 10-Year Framework of Programs on Sustainable Consumption and Production Patterns, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries **Target 12.2** By 2030, achieve the sustainable management and efficient use of natural resources	**12.1.1.** Number of countries with sustainable consumption and production (SCP) national action plans or SCP mainstreamed as a priority or a target into national policies **12.2.1.** Material footprint, material footprint per capital, and material footprint per GDP **12.2.2.** Domestic material consumption, domestic material consumption per capita, and domestic consumption per GDP	*Eco-innovation* 1. Reducing environmental impact 2. Lower energy consumed per unit 3. Lower materials employed per unit 4. Higher production or service provision flexibility 5. Higher production or service provision capacity
 **Target 1B**: Achieve decent employment for women, men, and young people	**CCA 30.** Employment to population of working age ratio **CCA 31.** Unemployment rate **CCA 32** Informal sector employment as a percentage of employment **45**. Unemployment rate for young people	**30.** We recognize that many people, especially the poor, depend directly on ecosystems for their livelihoods, their economic, social, and physical well-being, and their cultural heritage. For this reason, it is essential to generate decent jobs and incomes that decrease disparities in standards of living (…) **152.** We recognize that workers should have access to education, skills, health care, social security, fundamental rights at work, social and legal protections, including occupational safety and health, and decent work opportunities (…)	 **Target 8.3.** Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity, and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services **Target 8.5.** By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value **Target 8.8**. Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	**8.3.1.** Proportion of informal employment in non-agriculture employment, by sex **8.5.1.** Average hourly earnings of female and male employees, by occupation, age and persons with disabilities **8.5.2.** Unemployment rate, by sex, age and persons with disabilities **8.8.1.** Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status	*Social innovation* 1. Improving employee health and safety 2. Increasing total employment 3. Increasing qualified employment 4. Maintaining existing employment 5. Compliance with health and safety regulations

Declarations

Conflict of interest All authors declare they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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