



# Article The Drivers of Technological Eco-Innovation—Dynamic Capabilities and Leadership

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**Abstract:** In the paper, a theoretical framework that combines the multidimensional conceptualization of dynamic capabilities (sensing, seizing, and reconfiguring) with two leadership styles (transactional and transformational) and two types of eco-innovation (incremental and radical) was developed and empirically tested. The purpose of this study is to answer the key question: how different leadership styles influence the potential of dynamic capabilities to generate ecological changes. The research examining the theoretical framework was quantitative and was based on a deliberately selection of the sample, which included 54 of the most evo-innovative Polish companies. The results indicate that transformational leadership moderates the positive relationship between seizing capability and both incremental and radical technological eco-innovation, whereas transactional leadership moderates the positive relationship between seizing the theoretical concepts, showing the importance of a given leadership style as a factor enhancing the potential of dynamic capabilities for the development of technological eco-innovation. Moreover, the study may be a contribution to a broader discussion on the specifics of eco-innovative activity and its behavioral conditions.

Keywords: dynamic capabilities; eco-innovation; leadership

## 1. Introduction

Modern companies have to deal with increasingly frequent changes taking place in their environment. These changes result from globalization [1], liberalization of trade, the growing intensity of competition in international markets [2], the accelerating pace of technological progress, and the associated shortened life cycle of many technologies [3]. These changes are accompanied by environmental problems related to the increase in population and industrial production and the depletion of nonrenewable resources [4]. The growing range of environmental restrictions, including high and unstable energy prices [5], restrictive environmental regulations [6,7], the limited possibility of using natural resources [8], as well as increasing environmental awareness of consumers [9,10] imply the necessity to include ecological issues in the activities undertaken by companies. After years of ignoring the ecological consequences of their activities, most entrepreneurs are aware of the need to create innovative technological solutions leading to balancing economic and environmental benefits. This is happening in many economies and is testified by the Polish Ministry of Climate's program entitled 'GreenEvo—Green Technology Accelerator' that is prepared for Polish entrepreneurs. The aim of the GreenEvo Program, financed by the Polish National Fund for Environmental Protection and Water Management, is to support the best innovative environmental technologies developed by Polish companies and assist in the promotion and international transfer of these solutions.

Considering eco-innovation in the development strategies implemented by companies requires undertaking academic research leading to the search for an answer to the question: how to conduct eco-innovation activities effectively? The paper refers to previous studies

suggesting that efficient management of eco-innovation—embedded in the organizational culture [11], organizational structure [12], strategic vision [13], and strategy development processes [14]—requires developing, integrating, and modifying the resources and competences held by companies. It, therefore, requires building dynamic capabilities. The logic of the dynamic capability concept [2,15] may explain why many companies that succeeded in the past (by generating environmentally friendly innovations) have faced deepening problems resulting from their inability to adapt to changes in their environment flexibly. Moreover, since the concept of dynamic capabilities is embedded in the processes of organizational learning and knowledge management (i.e., critical mechanisms of organizational change) [16,17], an attempt was made to extend it to the role and significance of leadership strategies implemented in companies.

The paper integrates various theoretical concepts, including the innovation theory, dynamic capabilities concept, and the transactional and transformational leadership theory. Then, the impact of different leadership styles on the potential of dynamic capabilities to generate technological eco-innovations in Polish companies was described and empirically tested. The research was carried out among 54 of the most innovative Polish companies that were winners of the GreenEvo Program (1st round of research) and companies selected by the Specialist Observatory in Technologies for Environmental Protection (2nd round of research).

Despite the growing number of scientific papers dealing with the importance of dynamic capabilities, many researchers [17–20] emphasize that this concept still requires empirical confirmation. Moreover, the current scientific achievements in this area are relatively limited. They consist of primarily theoretical research and, if supported by empirical research, mostly case studies (except for [3,11,12,21]). Third, conceptual and empirical works [22,23] explore the role of dynamic capabilities mainly for generating conventional innovations. What is more, the reference of the concept of dynamic capabilities to ecoinnovative activities is a topic explored to a relatively limited extent. Some of the few examples are qualitative studies by Mousavi et al. [24] and studies described by Chen and Chang [25] and Huang and Li [26] who, however, capture dynamic capabilities as a unidimensional construct. Fourth, the literature review indicates a shortage of research that would include the issue of dynamic capabilities in the context of managing technological eco-innovation. Therefore, the results presented in the paper extend the knowledge on the mechanisms of developing such innovation among eco-leaders. Moreover, the scope of the research responds to the need, emphasized by researchers [27,28], to identify organization capabilities that are antecedents of generating and implementing eco-innovations. Finally, the inclusion of leadership styles in a multidimensional conceptualization of dynamic capabilities has—so far—not been included in any model, despite its importance emphasized by researchers [25,29] for eco-innovation.

This paper aims to fill described gap, both in terms of the theoretical and empirical layers. In summary, although categories such as 'dynamic capabilities', 'eco-innovation', 'transactional leadership' and 'transformational leadership' have been theoretically analyzed in various approaches and contexts, the study is the first to examine—to the author's best knowledge—the moderating effect of leadership styles on the relationship between multidimensional view of dynamic capabilities and incremental and radical technological eco-innovations.

## 2. Literature Review and Hypothesis Development

The changes that shape the business are critical determinants of the development of sustainable innovations (eco-innovations, green innovations). Eco-innovation is defined in this paper as a new solution that leads to the avoidance or reduction of adverse environmental impacts [13,29–38]. Eco-innovation can be developed by companies or non-profit organizations [39], it can occur in different sectors [37], it can be marketed or not, and it can be technological or non-technological nature [30]. Eco-innovation may concern the development of new products—including eco-design and recycling of products as a partic-

ular form of their recovery [40], new technological processes—end-of-pipe technologies or cleaner technologies [36], new organizational methods—environmental management systems [41] and new marketing solutions—i.e., eco-labels [4].

The paper analyses technological environmental innovations (TEIs) developed by Polish companies. Due to the specificity of the GreenEvo Program, which is part of the implementation of the National Strategy of Energy Security and Environment, the simple division of technologies into integrated and end-of-pipe technologies was abandoned. However, because interviewed companies were sometimes multiple winners of the GreenEvo Program, the TEIs were divided into incremental and radical (for a given company). Incremental (evolutionary) TEIs concern progressive modifications of technological solutions known to the company [42]. Radical (revolutionary) TEIs are rarer than incremental ones, more original and complex, more challenging, and more resistant to change [43,44]. Referring to the definition of Chen et al. [13] (p. 7789), incremental TEIs concern 'environmental technology that reinforces, modifies, or extends current environmental knowledge'. As both incremental and radical TEIs require the development of resources (especially knowledge resources) and competences, they were included in the research model.

## 2.1. Determinants of Technological Eco-Innovation

The results of numerous studies indicate that generating and implementing ecoinnovation brings significant financial benefits. It also contributes to the increase in nonfinancial efficiency, strengthening the company's reputation, and building a green image. Research confirming this conclusion was carried out on various research samples, in different national contexts, and among companies of contrasting sizes, including Polish and Hungarian publicly traded companies [45], Slovenian companies [46], Italian manufacturing firms [40], green-oriented SMEs in New Zealand [47], and Taiwanese manufacturing companies [48] as well as ICT firms [26] and Chinese companies [38]. For the eco-innovative activity conducted by companies to have an efficiency dimension, it is necessary to have a specific resource and competence base. According to innovation theory, the resources required for conducting such activities include financial, human (knowledge, skills, and experience of organizational members), and physical resources (machines and equipment for laboratories and other research and development units) [49,50]. According to the resource-based view of the firm (RBV), resources should be valuable, rare, imperfectly imitable, and non-substitutable (Barney's VRIN framework), as well as durable and not easily traded [51,52].

The importance of resources for TEIs has well-established theoretical and empirical foundations. Concerning financial resources, Segarra-Oña et al. [53] state that total expenditure on the acquisition of new technologies determines the eco-innovative orientation of firms. According to human resources, Horbach [33] argues that the improvement of knowledge capital (measured by the number of highly qualified employees) stimulates TEIs. Similarly, Triguero et al. [36] indicate that qualified managers and available technical knowledge obtained from external sources increase the implementation of these changes. Moreover, research conducted among Italian [54] and German [10] entrepreneurs indicates the critical importance of conducting R&D activity for generating TEIs.

The competence-based theory is an extension of RBV, according to which gaining a competitive advantage (thanks to eco-innovation) not only depends on the resources held by firms, but also on the developed competences [55]. Some researchers use the terms 'competences' and 'capabilities' interchangeably, defining them as bundles of skills necessary to organize resources [7], the ability to achieve something by using and coordinating a set of tangible and intangible resources [40], capabilities that result from multiple repeated actions [56] or the ability to arrange resources thanks to the use of organizational processes [5]. These processes are specific to a given company and can be developed due to complex interactions between resources [52].

Both resource-based view of the firm and competence-based theory have been criticized due to their relatively static nature. Even though the resources and competences may be a source of a firm's competitive advantage, Collis [57] states that, although they are valuable, they are not always the source of a permanent advantage and are certainly not its ultimate source. Moreover, other researchers [20,58] argue that such a perspective is inadequate to explain companies' competitive advantage in a dynamically changing environment. Following this argument, it can be assumed that resources and competences alone will not be enough to develop TEIs; it will not be sufficient to maintain a relatively permanent competitive advantage. One also (or primarily) needs other capabilities (higher-order

## 2.2. Dynamic Capabilities and Technological Eco-Innovation

base. In other words, dynamic capabilities are needed.

In a landmark paper, Teece et al. [15] (p. 516) defined dynamic capabilities as 'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments'. Following this logic, some researchers consider them as organizational skills or capabilities [59,60]. Such an approach emphasizes that dynamic capabilities not only change the resource base but must also be embedded in it and in nature-repeatable. In contrast, Eisenhardt and Martin [61] define dynamic capabilities in terms of processes (as concrete and identifiable strategic and organizational processes), while Zollo and Winter [62] consider them in the context of organizational routines, directly referring to the evolutionary perspective of change described by Nelson and Winter [63]. Finally, new definitions of dynamic capabilities characterize them much more broadly, as the orientation [64] or potential [20] of an organization, i.e., an aggregated multidimensional construct consisting of interrelated components.

capabilities) to dynamically develop, integrate, and modify the resource and competence

According to Teece et al. [15] and Teece [2], dynamic capabilities can be disaggregated into the firm's capacity: to sense and shape opportunities and threats (sensing capability); to seize opportunities (seizing capability), and to enhance, combine, protect, and reconfigure its resource base (reconfiguring capability).

Sensing capability requires constant searching and exploration—Teece [2] analyses it in terms of creative activity—technological, market, and regulatory changes. Such a strategy not only results in undertaking R&D activities and, consequently, in developing technological competences, but also in understanding hidden demand, structural evolution of markets, and future (foreseen) environmental regulations. The more information and knowledge firms accumulate, the greater their chances of being involved in creating and developing economically viable TEIs and the lower the risk of carrying out such activities (both in terms of incremental and radical changes).

Seizing capability involves maintaining and strengthening technological competences and complementary resources and investing in selected TEIs when the opportunity arises. The most important in this context is the time (overtaking competitors), place (specific consumer groups or market segments), and the level of risk (a derivative of the amount of necessary financial outlays) of strategic activities [2].

Finally, reconfiguring capability is crucial for a flexible and anticipatory response to changes occurring both in the companies and their environment [2]. One of the traps limiting TEIs is the excessive attachment to the resource base, which is manifested by the limited scope of actions related to searching and exploration of changes. Another trap is the targeted development of technological competences conditioned by the held resources and problem-solving strategies. Such a strategy may result in companies not making the most potential opportunities, even if they recognize them early. Therefore, according to Teece's [2] logic, managers must overcome at least two limitations, i.e., cognitive limitations and limitations resulting from the excessive concentration on resources and competences, which—using the Leonard-Barton [65] terminology—may paradoxically lead to core rigidities inhibiting TEIs. The described conceptualization of dynamic capabilities (sensing, seizing, and reconfiguring) has well-established analytical foundations because researchers used it both in theoretical analyses [2,17] and in empirical research [11,12,58]. Therefore, it can be a foundation for understanding the mechanisms that determine incremental and radical TEIs. What is more, such an approach to dynamic capabilities is characterized by internal consistency and solves the ambiguity of this construct emphasized by some researchers [58,66] and facilitates its operationalization.

## 2.3. Leadership Style As a Driver of Technological Eco-Innovation

The critical importance of the leadership style for eco-innovation is emphasized in the literature [13,25,67,68]. Moreover, concerning the development of TEIs, researchers indicate that the success of such activities—especially given their high level of complexity—requires the support (commitment, motivation, and inspiration) of the CEO and, therefore, requires strong leadership [29,56]. Vaccaro et al. [69] argue that new solutions do not necessarily have to be developed by the CEO. Still, their role is crucial to creating an intra-organizational context conducive to experimenting and introducing new processes, innovative practices, or flexible organizational structures. In the most synthetic approach, leaders can stimulate TEIs by formulating a shared and ecological vision [29], implementing an effective incentive system [25], and building an innovative organizational culture [13].

However, considering the level of novelty and the specificity of TEIs, it may turn out that incremental change requires a different leadership style than radical innovation. Building on the work of Burns [70] and Bass [71], the study examines two leadership styles (transactional and transformational leadership) to consider how specific leadership behaviors enhance the potential of dynamic capabilities to generate TEIs. Moreover, because—concerning innovative activity—the transactional and transformational leadership theory has been empirically confirmed, it was included in the research model and associated with TEIs (Figure 1).



Figure 1. A Theoretical framework.

According to Bass's [71] model, the critical difference between transactional and transformational leader is the degree of commitment to conducting eco-innovation activities and the nature of their relationship with subordinates. Transactional leadership is based on building contractual relationships and creates a bond between the leader and subordinates based on the mutual benefits of such a relationship [69–72]. A transactional leader strengthens subordinates' involvement in the development of TEIs by awarding conditional rewards for the effective and timely implementation of tasks [69]. Besides, due to the complexity of TEIs, subordinates may be more likely to become involved in eco-innovation processes if it is associated with the possibility of obtaining tangible benefits (e.g., bonuses) offered by a transactional leader [72]. Moreover, the generation of TEIs often requires maintaining effective relationships with customers, suppliers, research and scientific institutions, participation in professional associations, and adherence to best practices [21,68].

In this context, transactional leadership can effectively establish transparent and straightforward goals and policies and the expected outcomes of collaboration [69,72]. Moreover, in changing environments, companies need stability to identify opportunities or eliminate threats [16]. Due to the technological uncertainty accompanying the processes of generating TEIs, transactional leaders (who analyze the internal and external risks associated with undertaking such activities and identify discrepancies regarding agreed contracts) may favor its maximal reduction. Finally, transactional CEOs (rewarding proactive attitudes of subordinates and punishing them for reactive actions) can support the processes of strengthening the competences necessary to generate TEIs and reduce organizational inertia [73]. It can be assumed that task- and outcome-oriented transactional leaders will strengthen the potential of dynamic capabilities for the generation of TEIs. Based on this assumption, the following research hypotheses were developed:

**Hypothesis 1 (H1).** *Transactional leadership amplifies the positive relationship of sensing capability with (a) incremental TEIs and (b) radical TEIs.* 

**Hypothesis 2 (H2).** *Transactional leadership amplifies the positive relationship of seizing capability with (a) incremental TEIs and (b) radical TEIs.* 

**Hypothesis 3 (H3).** *Transactional leadership amplifies the positive relationship of reconfiguring capability with (a) incremental TEIs and (b) radical TEIs.* 

Transformational leadership is not so much based on external motivation (exchange relationships) but internal one [69–71,74–76]. It is based on the assumption that the CEO considers the interests and the psychological needs of subordinates [76]. Thus, the emphasis is not on the consent or submission of employees but on their commitment, which strengthens their feeling that they go beyond self-interest to achieve the team's goals and/or the company [74]. The impact of transformational leadership on TEIs is manifested in four dimensions: inspirational motivation, individualized consideration, idealized influence, and intellectual stimulation. Thanks to their inspirational motivation, CEOs are a catalyst for TEIs, because they inspire and motivate subordinates expressing high expectations and giving meaning to their work [75]. Through individualized consideration, leaders treat each subordinate exceptionally, considering their individual needs and development paths [76]. Thanks to idealized influence, respected and trusted leaders are an authority for subordinates, making employees want to emulate them [64]. Finally, intellectual stimulation means that leaders encourage their subordinates to think creatively and innovatively [25,74] and mobilize them to seek environmentally safe—and not just economically effective—technological solutions. The climate of trust built by transformational CEOs [11] makes it possible to notice and understand the changing market, technical conditions, as well as potential threats essential to eco-innovative activity [26]. Likewise, supportive leaders facilitate the intensification of learning processes and the sharing of knowledge and experience [69]. Concerning the generation of TEIs, it is-therefore-necessary to adopt a broader perspective, taking into account not only the resources and competences, but also the learning processes, as well as the processes of coordination, integration, and reconfiguration of internal and external knowledge [15]. As argued by Wolter and Veloso [77], in this perspective, knowledge plays an equally important role as technology. In other words, transformational leaders-by supporting the orchestration processes of resources and competences [2], as well as (or primarily) strengthening the incentives for creative, productive, and innovative thinking [25,74] and mobilizing subordinates to question the status quo [76]—will enhance the potential of dynamic capabilities to generate TEIs. Based on this assumption, the following research hypotheses were developed:

**Hypothesis 4 (H4).** *Transformational leadership amplifies the positive relationship of sensing capability with (a) incremental TEIs and (b) radical TEIs.* 

**Hypothesis 5 (H5).** *Transformational leadership amplifies the positive relationship of seizing capability with (a) incremental TEIs and (b) radical TEIs.* 

**Hypothesis 6 (H6).** *Transformational leadership amplifies the positive relationship of reconfiguring capability with (a) incremental TEIs and (b) radical TEIs.* 

## 3. Method—Sample, Data Collection, and Measures

To test the research hypotheses, a survey was conducted among the most innovative Polish companies generating TEIs. Non-random sample selection was used due to the requirement to meet restrictive conditions (companies participating in the study should be eco-leaders on the Polish market). The consequence of the adopted research methodology (and, at the same time, a significant limitation of the research) is the limited representativeness of the sample resulting from its arbitrary selection and its relatively small size. Both limitations significantly hinder statistical inference.

The survey was carried out from January to February 2019 and covered all GreenEvo winners (n = 66). As a result, the research sample includes companies involved in the TEIs development, which is confirmed by winning the competition and not only declarative assurances of the respondents. The survey was carried out using a Computer Assisted Telephone Interview. Since only 38 completed questionnaires were obtained (the response rate was 57.6%), it was decided to conduct the second round of survey among the most eco-innovative Silesian companies generating TEIs (n = 32). The companies were selected by the Specialist Observatory in Technologies for Environmental Protection (it was established in 2013 and was part of the 'Network of Regional Specialist Observatories in the Entrepreneurial Discovery Process' Project, implemented in 2017–2019 and co-financed by the European Regional Development Fund). The result of both rounds of surveys was obtaining 54 completely filled-in questionnaires. The descriptive characteristics of the research sample are presented in Table 1. The average organization size is 54 employees, and the average existence of an organization in the market is 19 years.

Green Technologies	% of Sample <sup>1</sup>
Air protection	5.5
Renewable energy sources	37
Solutions supporting energy saving	28
Waste management	9
Water and sewage management	20
Biodiversity protection	9

**Table 1.** Descriptive characteristics of the sample (n = 54)

<sup>1</sup> Percentages do not add up because respondents could select more than one answer.

The first stage of the research methodology was the development of a structured questionnaire using a 7-point Likert scale (from 1—'I strongly disagree' to 7—'I strongly agree' with a given statement). The original questionnaire was prepared in English and then translated into Polish. For this reason, the adequacy of the questions was assessed by analyzing them with five experts dealing with innovation and environmental changes. The received expert opinions helped improve several statements to ensure their clear and unambiguous understanding.

Several standard procedures were used in the study to increase response quality and to avoid the problem of common method bias. As Zhou et al. [3] (p. 738) notice 'using a single survey respondent as the source for both the independent and dependent data may cause the possibility of common method bias'. Therefore, two independent respondents from each surveyed company were examined. Members of the management team answered questions concerning dynamic capabilities and the TEIs, while lower-level managers' answers were the basis for measuring moderating variables. Both groups of respondents were guaranteed full confidentiality and anonymity of their answers. Finally, confirmatory factor analysis was performed, the internal consistency of the research tool was assessed, and the reliability and credibility of the measurement scales were checked. As shown by Kiefer et al. [78] such a procedure is associated with certain limitations, resulting from different respondents' perceptions, which is not unusual in the research on eco-innovation.

The survey questionnaire was divided into four modules. The first module included the measurement of multi-dimensional dynamic capabilities and referred to: (1) sensing capability, (2) seizing capability, and (3) reconfiguring capability. For the first two dimensions, the scales of Wilden et al. [12] were used. An essential premise for this choice was that the developed measuring scales were re-tested by Fainshmidt and Frazier [11]. The original scale developed by Wilden and Gudergan [21] was adapted for the measurement of reconfiguring capability. This scale is more detailed than the 2013 scale and allows capturing a broader spectrum of issues. The second module concerned the measure of technological eco-innovations developed by Polish companies. For both incremental and radical TEIs, the modification of Subramaniam and Youndt's [43] measurement scales was used [13]. The questionnaire included six statements (three for each dimension) regarding the development of TEIs, with varying degrees of novelty. In module three, respondents were asked to characterize their company's leadership style. Due to the necessity to limit the number of questions, the measurement of leadership with the original research tool (Multifactor Leadership Questionnaire) was abandoned. Instead, the questionnaire included six transformational leadership statements developed by Chen and Chang [25] and five transactional leadership statements, a modification of the measurement scale developed by Podsakoff et al. [79]. An essential premise of this choice was that Bass [71] originally distinguished only two aspects of transformational leadership, i.e., intellectual and emotional aspects, considering the dimension of charisma and inspirational motivation. Moreover, in subsequent studies, Bass showed the empirical lack of independence of both dimensions, emphasized by Waldman et al. [74]. Moreover, the meta-analysis by Lowe et al. [80] showed a lack of independence between individualized consideration and other transformational behaviors.

Finally, the statistical part of the questionnaire covered control variables, particularly the age and size of the company (measured by the number of employees) and the technological domain of their activity.

## 4. Analyses and Results

The Confirmatory Factor Analysis (CFA) was performed to assess the validity and reliability of measures. The obtained results showed that (concerning all variables) the degree of matching of the model to empirical data is satisfactory, which is confirmed by the theoretically proposed conceptual dimensions. Then, to assess convergent validity, the following parameters were calculated: Cronbach's Alpha (CA), composite reliability (CR), average variance extracted (AVE), and maximum shared variance (MSV). For all constructs, reliability parameters (CA and CR) reached values above the required thresholds of 0.7 [21]. The AVE surpassed the threshold of 0.5 for all scales [12]. Moreover, the condition relating to discriminant validity was met, stating that AVE should be higher than MSV. Taken together, these results show that the developed theoretical model largely overlaps with the empirical model (Table 2).

To test the research hypotheses, an analysis was performed based on hierarchical regression models, for which incremental and radical TEIs were considered as dependent variables. Following Aiken and West [81], the variables were centered to reduce the potential problem of multi-collinearity. Table 3 shows the results of hierarchical multiple regressions.

Construct	Source	Mean	SD	CA	CR	AVE	MSV
Sensing capability	[12]	4.42	1.17	0.725	0.815	0.527	0.069
Seizing capability	[12]	5.69	0.48	0.825	0.854	0.595	0.069
Reconfiguring capability	[21]	3.45	0.97	0.863	0.878	0.510	0.048
Incremental TEIs	[13]	4.17	1.54	0.701	0.835	0.628	0.002
Radical TEIs	[13]	4.91	1.76	0.871	0.917	0.786	0.002
Transactional leadership <sup>1</sup>	[74]	4.81	1.18	0.853	0.843	0.520	0.028
Transformational leadership	[22]	4.96	0.76	0.961	0.950	0.760	0.028

Table 2. Measurement scales and reliability.

<sup>1</sup> Regarding transactional leadership, it turned out that Cronbach's alpha calculated after removing the last item from the scale increased from 0.853 to 0.888. Such results indicate that this item negatively affects the consistency of the entire scale and constitute a premise for its removal from further statistical analyses.

Table 3. The results of the Hierarchical Regression Analysis.

Construct		Incremental TEIs			Radical TEIs		
		Model 1A	Model 1B	Model 1C	Model 2A	Model 2B	Model 2C
	Organizational Age ^	-0.001	-0.061	0.020	-0.034	-0.029	-0.003
Control Variables	Organizational Size ^	0.184	0.251	0.172	0.017	0.029	-0.015
	Technological domain 1	-0.090	-0.076	-0.084	-0.037	-0.079	-0.011
	Technological domain 2	-0.021	0.025	0.023	-0.139	-0.116	-0.115
Sensing Capab	oility (SNC)	-0.010	1.426	0.379	0.323 **	-1.016	0.136 *
Transactional Leadership (TRC)			1.023 *			-0.338	
Transformation	nal Leadership (TRF)			0.506			0.087
Interaction	SNC*TRC		-1.807			1.588	
Effects	SNC*TRF			-0.638			0.408 *
R <sup>2</sup>		0.050	0.120	0.075	0.136	0.338	0.331
$\Delta R^2$		-0.049	-0.014	-0.066	0.046	0.238	0.229
F		0.501	0.898	0.533	1.509	3.360	3.251
	Organizational Age ^	-0.020	-0.008	-0.016	-0.133	-0.139	-0.127
Control	Organizational Size ^	0.149	0.150	0.150	-0.028	0.019	0.005
Variables	Technological domain 1	-0.078	-0.072	-0.074	-0.017	-0.033	0.032
	Technological domain 2	0.009	0.010	0.014	-0.115	-0.083	-0.065
Seizing Capability (SZC)		0.299 **	1.549 **	1.321 **	0.426 **	1.174	0.834 **
Transactional Leadership (TRC)			2.238 *			1.773	
Transformational Leadership (TRF)				1.119 **			1.608
Interaction	SZC*TRC		-2.691*			-1.748	
Effects	SZC*TRF			-1.103 **			-1.584 **
$\mathbb{R}^2$		0.135	0.218	0.273	0.209	0.295	0.365
$\Delta R^2$		0.045	0.099	0.162	0.127	0.187	0.269
F		1.501	1.832	2.468	2.543	2.745	3.785
	Organizational Age ^	-0.110	-0.232	-0.214	-0.283	-0.218	-0.224
Control	Organizational Size ^	0.260	0.362 **	0.338 **	0.145	0.125	0.108
Variables	Technological domain 1	-0.068	-0.021	0.012	0.001	-0.046	0.017
	Technological domain 2	-0.016	-0.029	0.011	-0.151	-0.102	-0.119
Reconfiguring	Capability (RCC)	0.304 **	2.326 **	2.140 **	0.493 ***	0.591 **	-0.378
Transactional Leadership (TRC)			1.139**			0.370	
Transformational Leadership (TRF)				1.488 **			-0.048
Interaction	RCC*TRC		-2.537 **			-0.294 **	
Effects	RCC*TRF			-2.765 *			0.954
$\mathbb{R}^2$		0.133	0.290	0.258	0.254	0.374	0.290
$\Delta R^2$		0.042	0.182	0.145	0.177	0.278	0.182
F		1.467	2.679	2.288	3.274	3.919	2.682

^ Natural logarithm. Technological domain: 1-Water and sewage management. Technological domain 2-Biodiversity conservation. The estimation of the parameters for adjusting moderation models to empirical data is based on the use of the least squares' method. \* p < 0.1 \*\* p < 0.05 \*\*\* p < 0.001. An essential part of the analysis was the identification of direct relationships between dynamic capabilities and the generation of both incremental and radical TEIs. Model 2A indicates that sensing capability directly and significantly (p < 0.05) affects radical TEIs ( $\beta = 0.323$ ). In regards to incremental TEIs, no significant relationship was identified (p = 0.946). Seizing capability directly and significantly affects the generation of both incremental and radical TEIs ( $\beta = 0.299$ ; 0.426). Reconfiguring capability directly and significantly affects are: 0.304 and 0.493, respectively).

To test the research hypotheses, the remaining hierarchical regression models were assessed. An analysis of them shows that, for incremental TEIs, the coefficients of interaction between sensing capability and transactional and transformational leadership are statistically insignificant (p > 0.1). Similarly, concerning radical TEIs, the interaction factor between sensing capability and transactional leadership is insignificant (model 2B). In turn, the estimation of model 2C only allows for the assumption that there is a tendency for the moderating influence of transformational leadership on the analyzed dependence ( $\beta = 0.408$ , p = 0.084). Therefore, the obtained results do not justify the confirmation of H1 and H4, assuming that (transactional and transformational) leadership style amplifies the positive relationship of sensing capability with (a) incremental TEIs and (b) radical TEIs.

In contrast, the results presented in Table 3 show that the interaction coefficients between seizing capability and transformational leadership are significant in both model 1C and 2C (p = 0.011 and 0.016, respectively). Such results confirm H5, which states that transformational leadership amplifies the positive relationship of seizing capability with (a) incremental TEIs and (b) radical TEIs. In turn, by narrowing the analysis to transactional leadership, the estimation of model 1B only allows assuming the tendency for the existence of a moderating influence of this leadership style on the relation between seizing capability and incremental TEIs ( $\beta = -2.691$ , p = 0.080), which—as in the case of sensing capability—does not constitute a basis for concluding the nature of this relationship. Finally, the data included in Table 3 (model 2B) shows that the interaction coefficient between seizing capability and transactional leadership is statistically insignificant. Therefore, the obtained results do not justify the confirmation of H2, which states that transactional leadership amplifies the positive relationship of seizing capability with (a) incremental TEIs and (b) radical TEIs.

Regarding reconfiguring capability, the coefficients of interaction between this dimension and transactional leadership are statistically significant, both in model 1B and 2B (p = 0.049 and 0.027, respectively). In other words, the obtained results confirm H3, assuming that transactional leadership amplifies the positive relationship of reconfiguring capability with (a) incremental TEIs and (b) radical TEIs. The analogous analysis carried out for transformational leadership (model 1C) only indicates the tendency to have a moderating influence of this leadership style on the relationship between reconfiguring capability and incremental TEIs ( $\beta = -2.765$ , p = 0.057). In turn, as shown by the estimation of model 2C, the interaction coefficient between reconfiguring capability and transformational leadership is statistically insignificant. Therefore, the obtained results do not justify the confirmation of H6, assuming that transformational leadership amplifies the positive relationship of reconfiguring capability with (a) incremental TEIs and (b) radical TEIs.

### 5. Discussion

The objective of the paper was to investigate how different leadership styles affect the potential of dynamic capabilities to generate technological environmental innovations in Polish companies. The results confirm (overwhelmingly) the importance of dynamic capabilities for both incremental and radical TEIs. Only concerning sensing capability and incremental TEIs, no statistically significant relationship was noted. Such results mean that companies with a strong ability to monitor the environment will better understand what the stakeholders expect and meet these needs by generating (according to the research radical rather than incremental) TEIs. This conclusion can also be linked with the concept of organizational learning [82] and with the research stream relating it to innovation [17]. Although both exploration and exploitation play an essential role in undertaking innovative activities, the main effect of exploitation is incremental innovation. The result of exploration is the development of radical solutions [83,84]. It can be assumed that radical TEIs require organizational procedures that support the search and detection of new external knowledge while using internal knowledge [85]. In turn—according to the obtained results—relying on internal knowledge may be enough to develop less original and less complex TEIs successfully. Moreover, the highest statistical significance was noted for the relationship between seizing and reconfiguring capability and radical TEIs. Therefore, the results show that investing in green research and development and increasing interdisciplinary cooperation in developing new environmental technologies are the critical conditions for creating original and complex TEIs.

#### 5.1. Implications for Theory

A significant theoretical contribution of this paper is the confirmation—in the conditions of the Polish economy—of the usefulness of operationalization of individual variables. The reliability of the applied measurement scales indicates that the developed research model can be used in subsequent studies confirming the strength and direction of the analyzed relationships. Moreover, the results of the conducted research indicate the existence of several interesting theoretical implications relating to individual dimensions of dynamic capabilities.

## 5.1.1. Sensing Capability

The identified lack of statistically significant interactions between sensing capability and the leadership styles suggests that identifying new opportunities and eliminating threats (in conducting effective eco-innovation activities) may require changing the concept of leadership adopted in this paper. In other words, the described dimensions of leadership may not be theoretically appropriate for the context of dynamic search for opportunities to create TEIs. Secondly, even with the failure to build contractual or emotional relations between leaders and subordinates, they may undertake cooperation (in eco-innovation) with customers, suppliers, and R&D partners. It would not necessarily result from the proactive attitudes of employees (being a consequence, rather than a condition for undertaking cooperation), but from the desire to maintain a positive image of the company [41] or meet the expectations of key stakeholders [74]. Thirdly, the dimensions of transactional and transformational leadership can complement each other. This joint style of leadership is known as situational leadership [86] and has much in common with the recently studied enabling leadership [87]. What is more, leadership may be direct (close leadership) or indirect (distant leadership), in which the influence of leaders on subordinates occurs in a cascade through the decisions of middle and lower-level management [75]. In this approach, the transactional (or transformational) leadership style does not necessarily condition the same behavior at lower levels in the management hierarchy. Finally, it may turn out that other leadership characteristics affect the relationship between sensing capability and generating TEIs. Such a conclusion refers to Teece [2] and Fainshmidt and Frazier [11], who argue that the effectiveness of dynamic capabilities is an effect of the skills, knowledge, and experience of senior managers. Therefore, when interpreting the results, it is worth referring to the analysis of the impact of the management team's characteristics on undertaking innovative activities. Numerous studies (e.g., [88]) explain why the same environment is perceived by some managers as a source of opportunities, while for others, it is synonymous with danger. Such divergent managerial attitudes lead to the general conclusion that environment is usually interpreted by the CEO through mental 'filters', resulting from their age and level of education [89], managerial tenure [90], and professional experience [91].

### 5.1.2. Seizing Capability

The critical difference between a transactional and transformational leader is the nature of their relationship with subordinates. A transformational leader promotes employees' creativity, inspires them to think creatively, and mobilizes them to undertake research and experimental work [25,72]. Such activities (focused on the effective use of opportunities) result—as the research shows—in incremental and radical TEIs. These results partially support the arguments of Ambrosini et al. [18], according to which managerial perceptions of the need to change are crucial for developing dynamic capabilities. Moreover, the results obtained are consistent with the findings of Lopez-Cabrales et al. [92], who empirically proved that transformational CEOs' leadership style is positively related to seizing capabilities.

Thanks to inspirational motivation and individualized consideration, a transformational leader strengthens the personal involvement of subordinates in conducting environmental R&D activity and increases its effectiveness (by stimulating subordinates' sensitivity to specific ecological problems). Moreover, since generating TEIs is risky, a charismatic leader may facilitate the implementation of selected technological projects by formulating a clear vision integrated with the green strategy (common ecological goals, collective values, and desired organizational behavior [75]). Finally, through intellectual stimulation, a transformational leader strengthens the subordinates' sense of the economic importance of the opportunities and the environmental and social outcomes of the projects. This is especially important when undertaking experimental activities with results that are difficult to predict. Thus, the results complement the research conducted by Akkaya [93], indicating the critical role of transformational leadership in building dynamic capabilities by creating an organizational environment in which employees are encouraged, motivated, and inspired, as they are open to change and innovation.

Interpretation of the results is related to the specificity of activities leading to the use of opportunities and their time horizon. The logic of transactional and transformational leadership indicates that the former is based on the pursuit of personal (and assumed short-term) benefits by both the leader and their subordinates. In contrast, transformational leadership enables the organization's long-term goals to be achieved as a whole [74]. Since conducting environmental R&D is assumed to be long-term in nature, it can be expected that transformational (not transactional) leadership will strengthen the effectiveness of developing both incremental and radical TEIs.

#### 5.1.3. Reconfiguring Capability

Despite the suggestion that transactional leadership may be less effective (in the context of enhancing the effectiveness of innovative activities) [72], the results indicate that it is transactional behavior that strengthens TEIs due to reconfiguring resources and competences. Such results do not support the findings of Lopez-Cabrales et al. [92], according to which not transactional but transformational leadership style is positively related to reconfiguration capability.

However, even a small change of processes, procedures and organizational structures is often costly and challenging (as it involves questioning conventional ways of thinking), deviating from proven (and routine) problem-solving methods [2]. Consequently, it can lead to increased anxiety within the organization. Therefore, the critical factor in this context is the scope and manner of influence of the CEO, who, thanks to a precise formulation of goals, directions, pace, and anticipated effects of such changes, can mitigate the negative attitudes of subordinates. The results obtained are consistent with discussion by Schoemaker et al. [94] on how dynamic capabilities, individual leadership skills, and strategic innovation are connected in a volatile, uncertain, complex, and ambiguous environment. Researchers indicate that crucial leader's characteristics that support reconfiguration are alignment and learning. Both refer to rather transactional actions such as ensuring challenging issues are surfaced to pinpoint misalignment, provide a compelling strategic vision, encourage and exemplify transparent and rigorous debriefs, and stay agile course-correct quickly if off track.

Since strong resistance to change also results from psychological barriers, the most effective way to overcome it may be an equivalent exchange of benefits (which is the basis of transactional leadership). As emphasized by Kang et al. [72], in conditions of considerable uncertainty (referring to employees' concerns regarding their further employment), employees of new and innovative firms may be more interested in obtaining tangible benefits offered for the effective and timely implementation of their tasks.

Effective management of uncertainty (as well as overcoming the psychological barriers of subordinates) is much easier in innovative culture, i.e., an organizational culture, in which innovation is recognized as both a desired and a regular pattern of organizational changes. In such a way, the results obtained are consistent with the arguments of Vera and Crossan [95], who indicate that transactional leaders seek to strengthen not only strategy and structure but also the organization's culture.

Creating an innovative culture (including values, beliefs, and organizational symbols) is complex and requires the CEO to stimulate innovative attitudes of subordinates. Such motivating does not necessarily result from building emotional ties between the leader and subordinates but can (just as effectively) be based on the immediate satisfaction of their needs. Moreover, transactional leadership is not limited to rewarding (and punishing) the fulfillment of agreed contracts. It also considers the exchange of values (responsibility, honesty) between the leader and employees. Therefore, both transformational and transactional leadership may imply creating an organizational context supporting the involvement of subordinates in the implementation of a long-term green vision of organizational development.

## 5.2. Managerial Implications

The research results provide valuable insights to managers who wish to invest in both incremental and radical technological environmental innovations. While there is no universal recipe for success, this paper shows that building dynamic capabilities is positively related to TEIs. Thus, from a practical point of view, the sometimes elusive and abstract concept of dynamic capabilities may strengthen the effectiveness of companies' eco-innovative activities.

Moreover, research results suggest that the CEO's leadership style significantly determines the potential of dynamic capabilities to generate TEIs. In other words, not only the support and empathy of leaders but also establishing formal control and incentive mechanisms can help build an organizational climate that supports the use of dynamic capabilities in the TEIs development process. Building emotional relations between the leader and subordinates may increase eco-innovation activities by motivating and inspiring project members, investing in environmental R&D activities, and implementing individual development paths of employees involved in designing TEIs. On the other hand, building contractual relations between the leader and subordinates will be more critical in a periodic reconfiguration of the organizational structure. It can be done by creating new departments dealing with ecological solutions or appointing interdisciplinary teams dealing with the development of technologies and including specialists in environmental protection. These activities can help managers effectively use emerging opportunities and eliminate threats and configure (and reconfigure) their assets to flexibly respond to technological and competitive challenges of the future.

#### 5.3. Limitations and Future Research

The limitations of the conducted research can be related to two categories concerning the model and research methodology. One of the most critical substantive limitations is popular in the literature view on dynamic capabilities by Teece [2]. In this way, the testing of hypotheses relating to other dimensions of dynamic capabilities was purposely abandoned. Moreover, while the direct and positive influence of these capabilities on TEIs has been identified, developing them also carries costs that should be considered in future research. It would also be interesting to present dynamic capabilities not only through the prism of their multidimensionality but also the importance of each dimension perceived by the respondents. In such an approach, the conceptualization of dynamic capabilities should constitute a non-linear function of individual components. Moreover, their operationalization may require estimating different weights for each dimension [20]. Secondly, the paper is only limited to technological environmental innovations and does not consider other types of changes (e.g., organizational innovations). Thirdly, it views transactional and transformational leadership as two different leadership strategies. The suggested situational character of leadership indicates the limited effectiveness of a single leadership style for sensing capability. Finally, future research may consider other variables moderating the assumed relationships.

Concerning the research methodology, the most important objection is the limited representativeness of the sample and its relatively small size. Hence, the likely extension of the conducted research will be their replication in other contexts and on other (larger) populations. Secondly, because the research used subjective methods of measuring variables, it should complement them with objective indicators that could be verified a priori. Thirdly, the acquired data is cross-sectional. As Dangelico et al. [85] (p. 503) state: 'although this approach is quite common among academic studies, scholars have raised some concerns about its validity that relate to causal inference'. Therefore, longitudinal studies should be a necessary extension of the performed analyses. An interesting direction for future research may also be to conduct qualitative research-based, for example, on in-depth interviews or case studies.

## 6. Conclusions

The research results indicate the necessity to consider different leadership styles in the analysis of the potential of dynamic capabilities for the generation of technological eco-innovations. The effectiveness of dynamic capabilities depends on specific social interactions, which is one of the most critical challenges for the CEO. On the other hand, the relationships between leaders and subordinates are the basis for implementing long-term development strategies, including the generation of TEIs. An important implication resulting from research is the confirmation of a given leadership style's ambiguous influence on the relationship between dynamic capabilities and TEIs. In other words, the analysis results may contribute to a broader discussion on the specifics of an effective eco-innovative activity in which a given leadership style is characterized by the greatest organizational effectiveness.

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## References

- Sáez-Martínez, F.J.; Mondéjar-Jiménez, J.; Ferrari, G. Eco-innovation: Trends and approaches for a field of study. *Innov. Manag. Policy Pract.* 2015, 17, 1–5. [CrossRef]
- Teece, D.J. Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strateg. Manag. J.* 2007, 28, 1319–1350. [CrossRef]
- 3. Zhou, S.S.; Zhou, A.J.; Feng, J.; Jiang, S. Dynamic capabilities and organizational performance: The mediating role of innovation. *J. Manag. Organ.* **2019**, *25*, 731–747. [CrossRef]
- 4. Albino, V.; Balice, A.; Dangelico, R.M. Environmental Strategies and Green Product Development: An Overview on Sustainability-Driven Companies. *Bus. Strategy Environ.* 2009, *18*, 83–96. [CrossRef]
- Albino, V.; Dangelico, R.M.; Pontrandolfo, P. Do Inter-Organizational Collaborations Enhance a Firm's Environmental Performance? A Study of the Largest U.S. Companies. J. Clean. Prod. 2012, 37, 304–315. [CrossRef]

- 6. Kesidou, E.; Demirel, P. On the drivers of eco-innovations: Empirical evidence from the UK. *Res. Policy* **2012**, *41*, 862–870. [CrossRef]
- Doran, J.; Ryan, G. The Importance of the Diverse Drivers and Types of Environmental Innovation for Firm Performance. Bus. Strategy Environ. 2016, 25, 102–119. [CrossRef]
- 8. Hart, S.L.; Dowell, G. A Natural-Resource-Based View of the Firm: Fifteen Years After. J. Manag. 2010, 37, 1464–1479.
- 9. Bossle, M.B.; de Barcellos, M.D.; Vieira, L.M.; Sauvée, L. The drivers for adoption of eco-innovation. *J. Clean. Prod.* 2016, 113, 861–872. [CrossRef]
- 10. Horbach, J.; Rammer, C.; Rennings, K. Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull. *Ecol. Econ.* **2012**, *78*, 112–122. [CrossRef]
- 11. Fainshmidt, S.; Frazier, M.L. What Facilitates Dynamic Capabilities? The Role of Organizational Climate for Trust. *Long Range Plan.* **2017**, *50*, 550–566. [CrossRef]
- 12. Wilden, R.; Gudergan, S.P.; Nielsen, B.B.; Lings, I. Dynamic Capabilities and Performance: Strategy, Structure and Environment. *Long Range Plan.* **2013**, *46*, 72–96. [CrossRef]
- 13. Chen, Y.S.; Chang, C.H.; Lin, Y.H. The Determinants of Green Radical and Incremental Innovation Performance: Green Shared Vision, Green Absorptive Capacity, and Green Organizational Ambidexterity. *Sustainability* **2014**, *6*, 7787–7806. [CrossRef]
- 14. Wang, C.L.; Senaratne, C.; Rafiq, M. Success Traps, Dynamic Capabilities and Firm Performance. *Br. J. Manag.* **2016**, *26*, 26–44. [CrossRef]
- 15. Teece, D.J.; Pisano, G.; Shuen, A. Dynamic capabilities and strategic management. Strateg. Manag. J. 1997, 18, 509–533. [CrossRef]
- 16. Danneels, E. The dynamics of product innovation and firm competences. *Strateg. Manag. J.* **2002**, 23, 1095–1121. [CrossRef]
- Fallon-Byrne, L.; Harney, B. Microfoundations of dynamic capabilities for innovation: A review and research agenda. *Ir. J. Manag.* 2017, 36, 21–31. [CrossRef]
- 18. Ambrosini, V.; Bowman, C.; Collier, N. Dynamic Capabilities: An Exploration of How Firms Renew their Resource Base. *Br. J. Manag.* 2009, *20*, 9–24. [CrossRef]
- 19. Easterby-Smith, M.; Lyles, M.A.; Peteraf, M.A. Dynamic Capabilities: Current Debates and Future Directions. *Br. J. Manag.* 2009, 20, S1–S8. [CrossRef]
- 20. Barreto, I. Dynamic Capabilities: A Review of Past Research and an Agenda for the Future. J. Manag. 2010, 36, 256–280. [CrossRef]
- 21. Wilden, R.; Gudergan, S.P. The impact of dynamic capabilities on operational marketing and technological capabilities: Investigating the role of environmental turbulence. *J. Acad. Mark. Sci.* **2015**, *43*, 181–199. [CrossRef]
- 22. Teece, D.; Leih, S. Uncertainty, Innovation, and Dynamic Capabilities. Calif. Manag. Rev. 2016, 58, 5–12. [CrossRef]
- Farhana, M.; Swietlicki, D. Dynamic Capabilities Impact on Innovation: Niche Market and Startups. J. Technol. Manag. Innov. 2020, 15, 83–96. [CrossRef]
- 24. Mousavi, S.; Bossink, B.; van Vliet, M. Microfoundations of companies' dynamic capabilities for environmentally sustainable innovation: Case study insights from high-tech innovation in science-based companies. *Bus. Strategy Environ.* **2019**, *28*, 366–387. [CrossRef]
- 25. Chen, Y.S.; Chang, C.H. The Determinants of Green Product Development Performance: Green Dynamic Capabilities, Green Transformational Leadership, and Green Creativity. J. Bus. Ethics **2013**, 116, 107–119. [CrossRef]
- Huang, J.W.; Li, Y.H. Green Innovation and Performance: The View of Organizational Capability and Social Reciprocity. J. Bus. Ethics 2017, 145, 309–324. [CrossRef]
- 27. Demirel, P.; Kesidou, E. Sustainability-oriented capabilities for eco-innovation: Meeting the regulatory, technology, and market demands. *Bus. Strategy Environ.* 2019, *28*, 847–857. [CrossRef]
- 28. Arranz, N.; Arroyabe, M.; Li, J.; Fernandez de Arroyabe, J.C. Innovation as a driver of eco-innovation in the firm: An approach from the dynamic capabilities theory. *Bus. Strategy Environ.* **2020**, *29*, 1494–1503. [CrossRef]
- 29. Chen, Y.S.; Chang, C.H.; Wu, F.S. Origins of green innovations: The differences between proactive and reactive green innovations. *Manag. Decis.* **2012**, *50*, 368–398. [CrossRef]
- 30. Hemmelskamp, J. Environmental policy instruments and their effects on innovation. Eur. Plan. Stud. 1991, 5, 177–194. [CrossRef]
- 31. Rennings, K. Redefining innovation—Eco-innovation research and the contribution from ecological economics. *Ecol. Econ.* **2000**, 32, 319–332. [CrossRef]
- 32. Chen, Y.S.; Lai, S.B.; Wen, C.T. The Influence of Green Innovation Performance on Corporate Advantage in Taiwan. *J. Bus. Ethics* **2006**, *67*, 331–339. [CrossRef]
- 33. Horbach, J. Determinants of environmental innovation—New evidence from German panel data sources. *Res. Policy* **2008**, 37, 163–173. [CrossRef]
- 34. Oltra, V.; Saint Jean, M. Sectoral systems of environmental innovation: An application to the French automotive industry. *Technol. Forecast. Soc. Chang.* **2009**, *76*, 567–583. [CrossRef]
- 35. Carrillo-Hermosilla, J.; del Río, P.; Könnölä, T. Diversity of eco-innovations: Reflections from selected case studies. *J. Clean. Prod.* **2010**, *18*, 1073–1083. [CrossRef]
- 36. Triguero, A.; Moreno-Mondéjar, L.; Davia, M.A. Drivers of different types of eco-innovation in European SMEs. *Ecol. Econ.* **2013**, 92, 25–33. [CrossRef]
- 37. Melece, L. Eco-innovation and its development in Baltic states. *Manag. Theory Stud. Rural Bus. Infrastruct. Dev.* **2015**, *37*, 415–424. [CrossRef]

- Chan, H.K.; Yee, R.W.Y.; Dai, J.; Lim, M.K. The moderating effect of environmental dynamism on green product innovation and performance. *Int. J. Prod. Econ.* 2016, 181, 384–391. [CrossRef]
- Pacheco, D.A.J.; Caten, C.S.; Jung, C.F.; Ribeiro, J.L.D.; Navas, H.V.G.; Cruz-Machado, V.A. Eco-Innovation determinants in manufacturing SMSs: Systematic review and research directions. J. Clean. Prod. 2017, 142, 2277–2287. [CrossRef]
- 40. Dangelico, R.M.; Pontrandolfo, P.; Pujari, D. Developing Sustainable New Products in the Textile and Upholstered Furniture Industries: Role of External Integrative Capabilities. *J. Prod. Innov. Manag.* **2013**, *30*, 642–658. [CrossRef]
- 41. Frondel, M.; Horbach, J.; Rennings, K. What triggers environmental management and innovation? Empirical evidence for Germany. *Ecol. Econ.* 2008, *66*, 153–160. [CrossRef]
- 42. Calza, F.; Parmentola, A.; Tutore, I. Types of Green Innovations: Ways of Implementation in a Non-Green Industry. *Sustainability* 2017, *9*, 1301. [CrossRef]
- Subramaniam, M.; Youndt, M.A. The Influence of Intellectual Capital on the Types of Innovative Capabilities. *Acad. Manag. J.* 2005, 48, 450–463. [CrossRef]
- 44. Klewitz, J.; Hansen, E.G. Sustainability-oriented innovation of SMSs: A systematic review. J. Clean. Prod. 2014, 65, 57–75. [CrossRef]
- 45. Przychodzen, J.; Przychodzen, W. Relationships between eco-innovation and financial performance—Evidence from publicly traded companies in Poland and Hungary. J. Clean. Prod. 2015, 90, 253–263. [CrossRef]
- 46. Hojnik, J.; Ruzzier, M. The driving forces of process eco-innovation and its impact on performance: Insights from Slovenia. *J. Clean. Prod.* **2016**, 133, 812–825. [CrossRef]
- 47. Zhang, J.A.; Walton, S. Eco-innovation and business performance: The moderating effects of environmental orientation and resource commitment in green-oriented SMEs. *R D Manag.* **2017**, *47*, E26–E39. [CrossRef]
- Chen, Y.S.; Chang, T.W.; Lin, C.Y.; Lai, P.Y.; Wang, K.H. The Influence of Proactive Green Innovation and Reactive Green Innovation on Green Product Development Performance: The Mediation Role of Green Creativity. *Sustainability* 2016, *8*, 966. [CrossRef]
- 49. Adams, R.; Bessant, J.; Phelps, R. Innovation Management Measurement: A Review. Int. J. Manag. Rev. 2006, 8, 21–47. [CrossRef]
- 50. Pichlak, M. The innovation adoption process: A multidimensional approach. J. Manag. Organ. 2016, 22, 476–494. [CrossRef]
- 51. Barney, J. Firm Resources and Sustained Competitive Advantage. J. Manag. 1991, 17, 99–120. [CrossRef]
- 52. Amit, R.; Schoemaker, P.J.H. Strategic Assets and Organizational Rent. Strateg. Manag. J. 1993, 14, 33–46. [CrossRef]
- 53. Segarra-Oña, M.V.; Peiró-Signes, A.; Albors-Garrigós, J.; Miret-Pastor, M. Impact of Innovative Practices in Environmentally Focused Firms: Moderating Factors. *Int. J. Environ. Res.* **2011**, *5*, 425–434.
- 54. Mazzanti, M.; Zoboli, R. Examining the Factors Influencing Environmental Innovations. The Fondazione Eni Enrico Mattei2006. Available online: http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm (accessed on 17 April 2021).
- 55. Hazen, B.T.; Bradley, R.V.; Bell, J.E.; In, J.; Byrd, T.A. Enterprise architecture: A competence-based approach to achieving agility and firm performance. *Int. J. Prod. Econ.* 2017, 193, 566–577. [CrossRef]
- 56. Del Río, P.; Peñasco, C.; Romero-Jordán, D. What drives eco-innovators? A critical review of the empirical literature based on econometric methods. *Int. J. Prod.* 2016, *112*, 2158–2170. [CrossRef]
- 57. Collis, D.J. Research Note: How Valuable are Organisational Capabilities? Strateg. Manag. J. 1994, 15, 143–152.
- 58. Gajendran, T.; Brewer, G.; Gudergan, S.; Sankaran, S. Deconstructing dynamic capabilities: The role of cognitive and organizational routines in the innovation process. *Constr. Manag. Econ.* **2014**, *32*, 246–261. [CrossRef]
- 59. Zahra, S.A.; Sapienza, H.J.; Davidsson, P. Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda. *J. Manag. Stud.* **2006**, *43*, 917–955. [CrossRef]
- 60. Helfat, C.E.; Finkelstein, S.; Mitchell, W.; Peteraf, M.A.; Singh, H.; Teece, D.J.; Winter, S.G. *Dynamic Capabilities: Understanding Strategic Change in Organizations*; Blackwell: London, UK, 2007.
- 61. Eisenhardt, K.M.; Martin, J.A. Dynamic capabilities: What are they? Strateg. Manag. J. 2000, 21, 1105–1121.
- 62. Zollo, M.; Winter, S.G. Deliberate Learning and the Evolution of Dynamic Capabilities. Organ. Sci. 2002, 13, 339–351.
- 63. Nelson, R.R.; Winter, S.G. An Evolutionary Theory of Economic Change; Belknap Press: Cambridge, MA, USA, 1982.
- 64. Wang, C.L.; Ahmed, P.K. Dynamic capabilities: A review and research agenda. Int. J. Manag. Rev. 2007, 9, 31–51. [CrossRef]
- 65. Leonard-Barton, D. Core capabilities and core rigidities: A paradox in managing new product development. *Strateg. Manag. J.* **1992**, *13*, 111–125. [CrossRef]
- 66. Strønen, F.; Hoholm, T.; Kværner, K.; Støme, L.N. Dynamic capabilities and innovation capabilities: The case of the 'Innovation Clinic'. *J. Entrep. Manag. Innov.* **2017**, *13*, 89–116. [CrossRef]
- 67. Del Brío, J.Á.; Junquera, B. A Review of the literature on environmental innovation management in SMEs: Implications for public policies. *Technovation* **2003**, *23*, 939–948. [CrossRef]
- 68. Dangelico, R.M. Green Product Innovation: Where we are and Where we are Going. *Bus. Strategy Environ.* **2016**, *25*, 560–576. [CrossRef]
- 69. Vaccaro, I.G.; Jansen, J.J.P.; Van Den Bosch, F.A.J.; Volberda, H.V. Management Innovation and Leadership: The Moderating Role of Organizational Size. *J. Manag. Stud.* 2012, 49, 28–51. [CrossRef]
- 70. Burns, J.M.G. Leadership; Harper & Row: New York, USA, 1978.
- 71. Bass, B.M. Leadership and Performance Beyond Expectations; The Free Press: New York, NY, USA, 1985.

- 72. Kang, J.H.; Solomon, G.T.; Choi, D.Y. CEOs' Leadership Styles and Managers' Innovative Behaviour: Investigation of Intervening Effects in an Entrepreneurial Context. *J. Manag. Stud.* **2015**, *52*, 531–554. [CrossRef]
- 73. Levinthal, D.A. Organizational Adaptation and Environmental Selection-Interrelated Processes of Change. *Organ. Sci.* **1991**, *2*, 140–145. [CrossRef]
- 74. Waldman, D.A.; Siegel, D.S.; Javidan, M. Components of CEO Transformational Leadership and Corporate Social Responsibility. *J. Manag. Stud.* **2006**, *43*, 1703–1725.
- 75. Jansen, J.J.P.; George, G.; Van den Bosch, F.A.J.; Volberda, H.V. Senior Team Attributes and Organizational Ambidexterity: The Moderating Role of Transformational Leadership. *J. Manag. Stud.* **2008**, *45*, 982–1007. [CrossRef]
- 76. Deconinck, J.; Beth, M. The relationship among transformational leadership, supervisory trust, performance and turnover intentions. *J. Bus. Rev.* **2013**, *2*, 205–211.
- 77. Wolter, C.; Veloso, F.M. The Effects of Innovation on Vertical Structure: Perspectives on Transaction Costs and Competences. *Acad. Manag. Rev.* 2008, 33, 586–605.
- Kiefer, C.P.; Carrillo-Hermosilla, J.; del Río, P.; Barroso, F.J.C. Diversity of eco-innovations: A quantitative approach. J. Clean. Prod. 2017, 166, 1494–1506. [CrossRef]
- 79. Podsakoff, P.M.; MacKenzie, S.B.; Moorman, R.H.; Fetter, R. Transformational leader behaviors and their effects on followers' trust in leader, satisfaction, and organizational citizenship behaviors. *Leadersh. Q.* **1990**, *1*, 107–142.
- 80. Lowe, K.B.; Kroeck, K.G.; Sivasubramaniam, N. Effectiveness correlates of transformational and transactional leadership: A meta-analytic review of the MLQ literature. *Leadersh. Q.* **1996**, *7*, 385–425.
- 81. Aiken, L.S.; West, S.G. Multiple Regression: Testing and Interpreting Interactions; Sage Publications: Newbury Park, CA, USA, 1991.
- 82. March, J.G. Exploration and Exploitation in Organizational Learning. *Organ. Sci.* **1991**, *2*, 71–87. [CrossRef]
- 83. Atuahene-Gima, K. Resolving the Capability-Rigidity Paradox in New Product Innovation. J. Mark. 2005, 69, 61–83.
- 84. Lennerts, S.; Schulze, A.; Tomczak, T. The asymmetric effects of exploitation and exploration on radical and incremental innovation performance: An uneven affair. *Eur. Manag. J.* **2020**, *38*, 121–134. [CrossRef]
- 85. Dangelico, R.M.; Pujari, D.; Pontrandolfo, P. Green Product Innovation in Manufacturing Firms: A Sustainability-Oriented Dynamic Capability Perspective. *Bus. Strategy Environ.* **2017**, *26*, 490–506.
- 86. Thompson, G.; Vecchio, R.P. Situational leadership theory: A test of three versions. Leadersh. Q. 2009, 20, 837–848. [CrossRef]
- Schulze, J.H.; Pinkow, F. Leadership for Organisational Adaptability: How Enabling Leaders Create Adaptive Space. *Adm. Sci.* 2020, 10, 37. [CrossRef]
- Kiss, A.N.; Libaers, D.; Barr, P.S.; Wang, T.; Zachary, M.A. CEO cognitive flexibility, information search, and organizational ambidexterity. *Strateg. Manag. J.* 2020, 41, 2200–2233. [CrossRef]
- Bantel, K.A.; Jackson, S.E. Top management and innovations in banking: Does the composition of the top team make a difference? Strateg. Manag. J. 1989, 10, 107–124. [CrossRef]
- 90. Damanpour, F. Organizational Innovation: A Meta-Analysis of Effects Of Determinants and Moderators. *Acad. Manag. J.* **1991**, *34*, 555–590.
- 91. Kimberly, J.R.; Evanisko, M.J. Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations. *Acad. Manag. J.* **1981**, *24*, 689–713.
- 92. Lopez-Cabrales, A.; Bornay-Barrachina, M.; Diaz-Fernandez, M. Leadership and dynamic capabilities: The role of HR systems. *Pers. Rev.* 2017, 46, 255–276. [CrossRef]
- 93. Akkaya, B. Review of Leadership Styles in Perspective of Dynamic Capabilities: An Empirical Research on Managers in Manufacturing Firms. J. Adm. Sci. 2020, 18, 389–407.
- 94. Schoemaker, P.J.H.; Heaton, S.; Teece, D. Innovation, Dynamic Capabilities, and Leadership. *Calif. Manag. Rev.* 2018, *61*, 15–42. [CrossRef]
- 95. Vera, D.; Crossan, M. Strategic leadership and organizational learning. Acad. Manag. Rev. 2004, 29, 222–240. [CrossRef]