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Naser Shekarian

*University of Colorado Denver*, [naser.shekarian@ucdenver.edu](mailto:naser.shekarian@ucdenver.edu)

Ronald Ramirez

*University of Colorado Denver*, [ronald.ramirez@ucdenver.edu](mailto:ronald.ramirez@ucdenver.edu)

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# The Impact of Corporate Sustainability and Technology Investment on Firm Innovation

*Emergent Research Forum (ERF)*

**Naser Shekarian**

University of Colorado Denver  
naser.shekarian@ucdenver.edu

**Ronald Ramirez**

University of Colorado Denver  
ronald.ramirez@ucdenver.edu

## Abstract

Corporate sustainability is becoming an important component of corporate strategy, resulting in new areas of goal setting, planning, and process-level change. Despite the growing importance of corporate sustainability in organizations, there is a lack of research examining how the coexistence of corporate sustainability practices and a firm's technology investment impacts critical processes such as innovation. In this study, we use resource orchestration theory and the information disclosure perspective to examine how the combination of a firm's corporate sustainability efforts and technology investment can influence and impact a firm's innovation process. Using a longitudinal data of S&P firms, from 2017 to 2020, we show that corporate sustainability performance, as reflected through ESG (environmental, social, and governance) measures, and technology investment positively impact a firm's innovation process outcomes. Surprisingly however, the combination of these two individually contributing factors leads to a lower innovation performance. Implications for practitioners and academics are discussed.

## Keywords

Corporate sustainability, ESG, innovation, information disclosure, resource orchestration, technology

## Introduction

Firms must look beyond financial and competitive factors such as profitability and market share when conducting business. In an interdependent social and ecological network, firms must also embrace sustainable business practices to operate in a socially responsible manner (Guo et al. 2020). In 2021 alone, US firms have invested over 120 billion dollars in sustainability assets<sup>1</sup>, aligning firm behavior with the demand of stakeholders. Firms are willing to disclose such activities, allowing stakeholders to evaluate a firm's operations, value creation processes, and sustainable activities to determine if the organization is consistent with their own sustainability goals (Baumgartner 2014; Lee et al. 2016). For instance, stakeholders may be concerned with how a firm's products and services impact the environment or how a firm contributes to more diversity, equity, and inclusion (D&I). As such, firms are motivated to incorporate sustainability into strategic decision making as doing so will differentiate their business to attract more employees, customers, and investors (Baumgartner and Ebner 2010). Especially investors, as primary stakeholders, believe firms with higher levels of corporate sustainability performance are associated with a greater return on investment (Amel-Zadeh and Serafeim 2018). A key factor growing in importance, that measures a firm's corporate sustainability performance, is ESG (environmental, social, and governance). ESG is a composite measure that calculates a firm's exposure to environmental, social, and governance risks (Minutolo et al. 2019). ESG has been extensively used in organizational research around corporate sustainability areas (Broadstock et al. 2020; Lee et al. 2016).

As firms consider adopting and innovating new sustainable practices, acquiring external sources of knowledge and information becomes essential. Firms adjust organizational and operational level strategies through a more comprehensive view of industry best practices, customer demands, and new technology advancements (Kleis et al. 2012; Wu et al. 2020). Firms find, absorb, and incorporate such

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<sup>1</sup> <https://www.bloomberg.com/news/newsletters/2021-12-01/the-esg-market-is-controlled-by-a-few-big-investors>

information and knowledge to develop new organizational capabilities to achieve targeted sustainability goals through innovation in products, services, and processes (Guo et al. 2020). A firm's sustainable practices can lead to new constraints that impact how key resources such as energy, carbon, water, and materials are used in the development and design of products or services. However, such constraints can push a firm to pursue innovative ways to produce and develop products or services with a same level of performance and at a lower level of resource usage (Gallego-Álvarez et al. 2011). For instance, Kraft Heinz is investing in plant-based products as part of its long-run sustainability efforts.<sup>2</sup> Fairphone has changed its smartphone production processes by using recycled and responsibly mined materials and providing its workers with fair wages and good labor conditions<sup>3</sup>.

Research has demonstrated that technology-enabled capabilities can help a firm become more innovative. The adoption of technologies such as ERP systems (Joshi et al. 2010) and data analytics (Wu et al. 2020) has enabled data driven insight for both business process improvement and new product development that leads to innovation. Technologies allow a firm to integrate, disseminate, and utilize external knowledge within critical processes (Joshi et al. 2010) as in the case of technology and improvements in the efficiency and speed of a firm's innovation process (Kleis et al. 2012). Beyond new product and service impacts, research is needed to understand how the requirements and demands of sustainability enhance or throttle critical IT-enabled processes like innovation. Incorporating sustainable considerations in business operations can impact existing organizational policies and standards and add new constraints to business processes like those involved with the development of products or services (Baumgartner and Ebner 2010). As a result, it is essential that firms understand how to pursue processes like innovation in the new sustainable environment while also pursuing operational efficiency under new constraints. Therefore, in this study, we examine the following: How do corporate sustainability requirements affect the relationship between technology-enabled capabilities and a firm's innovation performance? We turn to the theory of resource orchestration (Liu et al. 2016; Sirmon et al. 2011) and information disclosure perspective (Minutolo et al. 2019) to develop our theoretical model on the synergistic benefits of technology-enabled capabilities and corporate sustainability practices. We test our theoretical model through a longitudinal data spanning from 2017 to 2020 for 469 S&P firms. The results of an econometric analysis supports our first two hypotheses; showing a positive impact of technology investment and corporate sustainability on a firm's innovation performance. However, the combination of these two factors leads to a reduction in innovation performance. We discuss the implications and contributions of our study.

## **Theoretical Background**

Resource orchestration theory informs how a firm can effectively organize its resources, turn them into capabilities, and utilize those capabilities to become innovative and achieve superior business performance (Sirmon et al. 2011). Resource orchestration has a long history of application in IT and organization research (Liu et al. 2016; Sirmon et al. 2011) and has been applied to research in firm innovation (Li and Jia 2018). Resources should be bundled effectively and managed to create innovations. IT competency enables a firm to integrate the resources effectively and this can lead to innovations. IT competency can improve alignment in business processes and generate transactional efficiency in supply chain (Liu et al. 2016). Innovation can be an outcome through an impact on business process redesign, coordination in supply chain, and operational efficiency and agility (Liu et al. 2016; Li and Jia 2018).

Literature also highlights the role of corporate sustainability on innovation performance through the lens of information disclosure (Broadstock et al. 2020; Gallego-Álvarez et al. 2011). Corporate sustainability is an important factor in organizational performance in which ignoring sustainability practices can impact a firm performance negatively (Eccles and Serafeim 2013). As firms implement sustainability practices in their product design and development cycle, and business processes, changes in the technology used becomes required. As a result, such sustainability practices and considerations can create opportunities for innovation through the use of social, environmental, and governance drivers to create new products or services, redesign business processes, and identify new market opportunities (Gallego-Álvarez et al. 2011).

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<sup>2</sup> [ir.kraftheinzcompany.com/news-releases/news-release-details/kraft-heinz-outlines-benefits-scale-agility-2021-barclays-global](https://ir.kraftheinzcompany.com/news-releases/news-release-details/kraft-heinz-outlines-benefits-scale-agility-2021-barclays-global)

<sup>3</sup> <https://www.fairphone.com/en/>

## Hypotheses

Technology-enabled capabilities can help a firm to acquire new external sources of knowledge, combine internal and external resources to build organizational capabilities, and assimilate those capabilities into business processes. This can lead to higher innovation performance in a firm (Joshi et al. 2010). For instance, technology-enabled capabilities can contribute to process-level innovations through the mechanisms of management of knowledge assets, production support, and interorganizational coordination (Kleis et al. 2012). Additionally, innovation in a firm demands new ideas or significant changes in current business processes. By being more transparent and providing a higher information disclosure on business operations, a firm may be pushed to consider more external information into its operational processes to satisfy stakeholders (Amel-Zadeh and Serafeim 2018). This may lead to higher innovation performance as a firm plans to retain its process-level efficiency with the newly added constraints and compliances:

**H1:** Technology-enabled capabilities can enable a firm to become more innovative.

**H2:** Higher corporate sustainability performance is associated with an increase in firm innovation.

As a firm becomes more transparent on business operations and invests more in sustainable practices, adjustment of business processes becomes a requirement to reflect new standards and policies (Baumgartner 2014; Broadstock et al. 2020). As a result, a firm may also acquire more external knowledge to create a comprehensive view of industry best practices, customers' expectations, and competitors (Kleis et al. 2012). However, the new standards and sources of information may lead to complexity and inefficiency in current business processes. Technology-enabled capabilities can help a firm to reduce such complexity and inefficiency through effectively integrating new external resources with current organizational resources, managing knowledge assets, and assimilating such capabilities into business operations. As a result, process-level innovation can be an outcome (Joshi et al. 2010; Kleis et al. 2012). Therefore, we argue a firm needs to rely on technology-enabled capabilities to effectively integrate and assimilate sustainability resources and existing organizational resources into business processes to impact innovation performance (Liu et al. 2016; Li and Jia 2018):

**H3:** Technology-enabled capabilities can combine with corporate sustainability practices for a higher innovation performance.

## Methodology and Results

Research primary data sources are Compustat, USPTO (United States Patent and Trademark Office), and CI technology database (CITDB). We also collected ESG data from public sources. Table 1 shows the study variables. Our data consists of 469 S&P firms across the years 2017 to 2020 and eleven major sectors such as technology, financial, healthcare, and utilities. Table 1 provides a description of research variables. Also, Table 2 provides summary statistics of research variables.

Variable	Description
Patents	Number of patents.
ESG	Measures a firm's exposure to environmental, social, and governance risks.
IT Intensity (ITIntst)	Annual firm's IT expense in million dollars divided by sites.
Firm Size (FirmSize)	Number of firm's employees in thousand.
Firm Age (FirmAge)	Firm's years of operation from the opening year.
MultiNational Firm (MultiNat1)	If the firm's type is multinational: 1=Yes; 0=No.
Advertising Intensity (AdvIntst)	Annual firm's research/development expense in million dollars divided by sites.
R&D Intensity (R&DIntst)	Annual firm's advertising expense in million dollars divided by sites.
Total Revenue(TotRev)	Annual firm's revenue in million dollars divided by sites.
Product Diversification(ProdDivers)	Number of four-digit SIC codes that a firm is operating.

**Table 1. Description of Variables**

*Estimation Equation:* Since our study uses a panel dataset with 469 S&P companies from 2017 to 2020, we utilize the following equation: 
$$Y_{i,t} = \beta X_{i,t} + u_i + \varepsilon_{i,t} \quad (1)$$

where Y shows an outcome variable; X is a vector of firm-related information,  $\beta$  are the coefficients; i represents a firm and t indicates time; u demonstrates unobserved time-invariant fixed factors, and  $\varepsilon$  is

the error term. Generalized Estimation Equation (GEE) estimates the marginal effect of covariates averaged across units (Ballinger 2004). We use GEE to examine the variation in number of patents per firm-year across a 4-year unbalanced panel data. We use GEE for the correction of autocorrelation (Ballinger 2004). Also, GEE allows for the specification of an outcome variable distribution. In last, we are able to use robust standard errors in an unbalanced panel data. We specify the covariance structure of our model as exchangeable. We used White's test for homoscedasticity checking, leading to the rejection of the null hypothesis. Therefore, we use the robust standard (Wooldridge 2016). The check of multicollinearity by calculating the variance inflation factor (VIF) shows a value of less than 2.0; therefore, our models should not have a multicollinearity issue. To calculate the interaction term, variables were mean-centered. Due to space limitations, we are not presenting the correlation table.

	Mean	SD	Min	Max
Patents	51.9	171.3	0.0	5781.0
ESG	35.7	20.6	5.0	91.0
ITIntst	8.6	20.8	0.0	325.1
FirmSize	53.3	121.2	0.0	2300.0
FirmAge	80.0	46.6	3.0	236.0
MultiNatl	0.8	0.4	0.0	1.0
AdvIntst	3.8	19.8	0.0	448.0
R&DIntst	14.5	63.6	0.0	1256.0
TotRev	195.8	661.0	0.0	14812.5
ProdDivers	22.2	25.5	1.0	374.0

**Table 2. Summary Statistics**

	(1)	(2)
Dependent Variable: Number of Patents		
Variables	Direct Effect	Interaction Effect
ITIntst	<b>0.070*** (0.002)</b>	0.070*** (0.002)
ESG	<b>0.031*** (0.002)</b>	0.031*** (0.002)
ESG×ITIntst		<b>-0.002*** (0.000)</b>
FirmSize	0.003*** (0.000)	0.003*** (0.000)
FirmAge	-0.009*** (0.001)	-0.009*** (0.001)
Multinational	0.824*** (0.084)	0.825*** (0.084)
AdvIntst	0.001* (0.003)	0.002* (0.003)
R&DIntst	0.011*** (0.001)	0.009*** (0.001)
TotRev	0.002*** (0.000)	0.002*** (0.000)
ProdDivers	0.027*** (0.001)	0.026*** (0.001)
Constant	0.72*** (0.101)	1.689*** (0.096)
Observations	1,790	1,790
Number of Firms	469	469
Wald Chi <sup>2</sup>	3260.36***	3281.29***

**Table 3. GEE Estimation Results**

Table 3 shows the GEE estimation results (Robust standards errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ ). As hypothesized in H1, there is a significant and positive relationship between *ITIntst* and *Patents* (Table 3, column 1,  $\beta = 0.070$ ,  $p < 0.01$ ). Therefore a higher intensity of technology is associated with an increase in firm innovation performance, and **H1 is supported**. Also, as hypothesized in H2, there is a significant and positive relationship between *ESG* and *Patents* (Table 3, column 1,  $\beta = 0.031$ ,  $p < 0.01$ ). Therefore a higher performance of firm corporate sustainability is associated with a higher innovation performance, and **H2 is supported**. In last, while there is a significant relationship between *ESG×ITIntst* and *Patents* (Table 3, column 2,  $\beta = -0.002$ ,  $p < 0.01$ ), the sign is negative. Therefore, **the result is not consistent with H3** and indicates the combination of a firm's sustainability efforts and technology-enabled capabilities impacts innovation performance negatively. The negative combination may speak to the importance of strategic fit between a firm's corporate sustainability efforts and existing business processes. Sustainable efforts may cause higher standards or add new constraints to business processes. Therefore, the efficiency of process-level capabilities may decrease. Perhaps the alignment between corporate sustainability efforts and technological resources takes time to be materialized and can result in a negative combination in the short run.

## Discussion and Conclusion

In this study, we use resource orchestration theory and the information disclosure perspective to build our theoretical model and examine the effect of corporate sustainability on the technology-innovation performance relationship. Using a 4-year panel data of S&P firms, the results of our study show that corporate sustainability and information technology individually contribute to firm innovation. Technology continues to have a positive impact on a firm's innovation production performance. Surprisingly, however, the combination of these two elements leads to a reduction in innovation performance. This suggests that firms that wish to operate with sustainable principles may face the challenge of operational process constraints and limitations (Baumgartner and Ebner 2010), the result of

which may be negative consequences for process-level outcomes. For example, sustainability standards such as those identified in ESG, may align a firm's activities with socially conscious stakeholders. On the other hand, from a productivity perspective, such sustainability goals may impose constraints that negatively impact a firm's process efficiency. We see these as short-term impacts that should resolve as firms move to new sustainable designs. The change may also bring deeper investments in technology as firms look to efficiency improvements through automation and analytics-based applications focused on the optimization of resource usage (Wu et al. 2020). In future research, we will examine how a firm's specific IT technologies and characteristics, including its board and organizational structures, can combine with corporate sustainability factors to impact a firm's innovation productivity.

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