Radical product sustainability oriented innovation (soi) and triple-bottom-line (3bl) performance: findings from Malaysian and Singaporean B2B firms

Abstract

Despite the ongoing debate, there is an absence of research in finding the relationship between radical product sustainability-oriented innovation (SOI) and firm's triple-bottom-line (3BL) performance. While radical product SOIs may lead to 3BL performance, they may also be fraught with commercialization risks and uncertainty. This study aims to examine the relationship between radical product SOI and firm's 3BL performance in a business-to-business (B2B) context with a mediating variable – radical innovation uncertainty. Using a multi-informant approach, survey data were collected from 187 Malaysian and Singaporean privately-owned B2B firms involved in R&D and NPD activities, provided by 326 R&D and marketing managers. The radical product SOI was found to have a significant positive effect on radical innovation uncertainty, which is negatively related to 3BL performance dimensions i.e., environmental, social, and financial. Moreover, this study examines the moderated-mediation effect by industry type, service vs. manufacturing: it moderates the negative mediation effect of radical innovation uncertainty, and this effect is weaker for service firms compared to manufacturing firms. The findings offer clear guidelines to B2B managers for the marketing and development of radical product SOI and facilitate firms' 3BL performance. The study also acknowledges its limitations and suggests potential avenues for future research.

Keywords: Radical innovations; sustainability-oriented-innovation, firm performance; triple-bottom-line; innovation uncertainty

1. Introduction

Radical product sustainability-oriented innovations (SOI) encompass innovative concepts that significantly enhance the environmental and social performance of a system, all the while prioritizing financial sustainability. This holistic approach is commonly referred to as the triple-bottom-line (3BL) performance of a firm (Arnold & Hockerts, 2011). In response to a shift in customer preferences, there is a growing interest in purchasing products based not only on their features, but also on their social and environmental and social benefits (Balderjahn et al., 2018). Consequently, firms are actively developing and offering sustainable innovative products to align with these changes in customer buying behavior (Varadarajan, 2015). Radical product SOIs can provide firms with valuable and difficult-to-imitate resources, improve performance (Hall & Wagner, 2012), and can thus be a source of competitive advantage (Vasileiou et al., 2022). But, they also face uncertainty stemming from customer resistance to breakthrough technology, and the increased costs associated with commercialization (O'Connor & Ayers, 2005). Firms are more likely to be discontinued due to the extended development timelines and the pressure for a high return on investment within short time frames (Carmona-Lavado et al., 2020; Sandberg & Aarikka-Stenroos, 2014). This pressure is compounded by the challenges posed by the novelty and complexity of radical innovations, particularly when introduced as new products, leading to increased uncertainty in innovation. Hence, we argue that radical product SOIs necessitate significant investments in customer education and communication. Consequently, this study investigates how the radical product SOIs are less likely to create firm 3BL performance in the presence of an inhibiting factor (i.e., radical innovation uncertainty). Moreover, it is noteworthy to examine whether these relationships differ based on the type of firm or industry characteristics (Weidner, Nakata, & Zhu, 2021). Therefore, we build a conceptual framework where radical innovation uncertainty negatively mediates between radical product SOI and 3BL performance (i.e., environmental, social, and financial) and take one step further by examining the context of industry type. The industry type was used as a moderating variable to explore whether service firms versus manufacturing firms exert a moderating effect in the mediation relationship.

Furthermore, within B2B marketing, there is an emphasis on cultivating long-term profitable customer relationships. However, the introduction of radical innovations may encounter strong customer resistance due to their unfamiliarity, potentially resulting in damage to customer relationships and a negative impact on overall firm performance. Hence, it is

crucial to investigate the links between radical product SOI and 3BL performance of firms in a business-to-business context.

Adopting a multi-informant approach, data were collected from 187 privately-owned B2B firms in Malaysia and Singapore engaged in Research and Development (R&D) and New Product Development (NPD) activities, with insights from 326 participants. In our findings, we observed that radical product SOI is positively associated with radical innovation uncertainty, which in turn negatively affects the 3BL factors. Furthermore, our findings revealed that radical innovation uncertainty negatively mediates the relationship between radical product SOI and 3BL. Notably, this negative mediation effect was weaker (vs. stronger) for service firms (vs. manufacturing firms). This study adds value to academic literature in three significant ways: (a) by investigating the relationship between radical product SOI and a firm's 3BL performance within a business-to-business context; (b) by analyzing disparities in B2B innovations between the services and manufacturing sectors; and (c) by determining the relationships between radical product SOI and 3BL factors across multiple product categories. Practically, the findings of this study recommend developing relevant marketing and communication strategies that should communicate products' benefits to customers. Marketing efforts should include new product improvement plans such as focusing on product's relative advantage. Moreover, customer education and learning strategies will work to reduce the negative effect of innovation uncertainty.

The paper follows this structure: the next section outlines the Theoretical Background, followed by presenting the Hypotheses. The Methodology elaborates on data collection procedures and construct measures. Findings are then presented in the Results section, followed by discussions on theoretical and practical implications, concluding with study limitations.

2. Theoretical background

2.1. Stakeholder theory

The stakeholder theory serves as the theoretical lens in this study (Freeman, 1984). This theory posits that a firm can only achieve success when it delivers value to a majority of its stakeholders. It closely aligns with Corporate Social Responsibility (CSR) and, consequently, sustainability as well. This implies that business success should not be solely measured by profit alone; instead, the firm aims to fulfill all 3BL goals. The firms do not exist in isolation and must consider the preferences of all these groups. The firms' operations have varied

ramifications for all stakeholders and groups, and excellent functioning is achieved when firms meet interests of all stakeholders rather than adopting priorities of the shareholders. According to stakeholder theory, businesses thrive by consciously considering and managing broader interests beyond their boundaries (Freeman, 1984).

Our hypotheses state that radical SOIs lead to 3BL performance of firms. These innovations are designed and launched to not only achieve firms' financial objectives but also attaining environmental and social goals. But due to higher uncertainty linked to radical SOIs, firms might face challenges in achieving these objectives. Moreover, the success of radical SOIs depends on the sector, where radical innovations have more uncertainty in the manufacturing sector rather than the service sector. The firms' 3BL goals are well entrenched under the stakeholder theory. Therefore, this theory provides a sound theoretical foundation for the present study.

2.2. Radical product SOI and firm's 3BL performance

Research on innovation indicates that implementing radical product innovation is notably challenging, given its demand for fundamental changes to current practices (Sandberg & Aarikka-Stenroos, 2014). This includes a departure from the present knowledge base and/or market relations (Story, Daniels, Zolkiewski, & Dainty, 2014). Kennedy, Whiteman, and Van den Ende (2013) define radical sustainability-oriented innovations (SOI) as novel ideas that create a significant improvement in the environmental and/or social performance of a system while simultaneously considering its economic sustainability – *the triple-bottom-line*. Radical product SOI offers substantial benefits. First, innovating for sustainable development can provide firms with valuable and difficult-to-imitate resources (Hall & Wagner, 2012; Vasileiou et al., 2022). Second, SOIs for new products/services seek to achieve market differentiation, simultaneously improving environmental and/or social performance, and offering a source of competitive advantage (Kennedy, Whiteman, & van den Ende, 2017). Third, radical innovations in new markets can lead to monopoly profits due to the limited presence of direct competition (Sood & Tellis, 2005).

Despite the evident benefits, radical product SOI in the B2B context faces several costs and challenges. Firstly, purchase decision making is very complex in B2B settings (Aarikka-Stenroos & Lehtimäki, 2014; Lilien, 2016). This complexity contributes to increased risk in purchases, as customers invest a significantly longer time in adopting new products, requiring a thorough training and education. Hence, B2B firms may encounter significant challenges in

the commercialization of radical innovations to generate firm value. Second, firms may lack the complementary resources and competencies that radical product SOI may require for success (Kyriakopoulos et al., 2016). Third, innovation teams frequently grapple with the added intricacy of integrating likely conflicting sustainability dimensions and facing heightened scrutiny from stakeholders (Dangelico, Pontrandolfo, & Pujari, 2013). Similarly, radical product SOI entails several costs in the form of uncertainties and risks that a firm assumes (Geels, Hekkert, & Jacobsson, 2008; Hall & Wagner, 2012). Thus, implementing radical SOI can be a costly innovation process fraught with high uncertainty and risk.

Earlier studies explored how radical product SOI relates to a firm's 3BL performance, but those investigations remained in the realm of concepts and theories (Kennedy et al., 2013; Kennedy et al., 2017). One stream of research focused on examining the relationship between environmental innovation and financial performance, neglecting two other 3BL factors, namely environmental and social performance (Vasileiou, Georgantzis, Attanasi, & Llerena, 2022). A recent research attempt was made by Weidner et al. (2021) where they found an association between sustainable innovation and 3BL, although the study did not specify the type of sustainable innovation considered, whether in products, services, or processes. Some scholars have reached a consensus on the positive effect of product radicalness on firm performance (e.g., Carmona-Lavado et al., 2020; Ordanini & Parasuraman, 2011), while other studies did not find this relationship (Stock & Reiferscheid, 2014). Surprisingly, the current literature has not addressed the link between radical product SOI and the 3BL performance of firms. Surprisingly, the current literature has not addressed the link between radical product SOI and the 3BL performance of firms. Some studies have found a positive association between product radicalness and firm performance (Carmona-Lavado, Gopalakrishnan, & Zhang, 2020), while others did not find a relationship between them. Another realm of research finds that the association between SOI and firm performance is dependent on factors like the competitiveness of the firm (Le & Ikram, 2022), technology (Kyriakopoulos, Hughes, & Hughes, 2016), and product related factors **(**Sheng, Zhou, & Lessassy, 2013). The mixed results lead us to suspect that there are two possible reasons behind them. First, we suggest that higher uncertainty and risks associated with radical innovations could be the factors behind such inconsistent findings, and we therefore examine the mediating effect of radical innovation uncertainty between radical product SOI and a firm's 3BL performance. Second, high diversity can generate disparities in the effect of radical product SOI on firm performance. Hence, we introduce industry type as a moderator (service vs. manufacturing).

Our extended literature review indicates that the outcomes of sustainable innovations have received comparatively less attention than their antecedents. A few studies have explored broad impacts, such as organizational performance (Maletic, Maletic, Dahlgaard, Dahlgaard-Park, & Gomiscek, 2014), firm performance (Carmona-Lavado et al., 2020), or more specific impacts like consumer resistance to natural gas vehicles, etc. (Wiedmann, Hennigs, Pankalla, Kassubek, & Seegebarth, 2011). Interestingly, the 3BL as an outcome of radical product SOI has not been examined. Furthermore, recent work on radical product SOI is conceptual in nature (Kennedy et al., 2017) leaving the outcomes of SOI for radical products as a 'black box'. Summing up, radical product SOI remains an understudied phenomenon. Thus, in line with this, this study aims to examine the missing link by empirically testing the relationship between radical product SOI and firm 3BL performance.

2.3. Radical innovation uncertainty

Uncertainty is commonly understood as a multidimensional concept. In the innovation process, there are different types, factors, or classifications of uncertainty (Ramirez Hernandez & Kreye, 2021). Generally, in innovations development, a categorization of types of uncertainty is difficult because they are interdependent. However, particularly in product/service innovations, the conceptual framework of five uncertainty types is considered as a basis for informed decision making (Poeppelbuss, Ebel, & Anke, 2022). It includes environmental, technical, organizational, resource, and relational uncertainty. The speed of technological developments, greater competition, and rapid changes in customer requirements increasingly make innovations more complex, thus escalating their exposure to uncertainty (Williams, Rodriguez Sanchez, & Škokić, 2021). The present study uses Poeppelbuss et al., (2022) conceptual framework to define innovation uncertainty.

Radical innovations are highly complex and idiosyncratic, and the primary challenge for firms is to reduce uncertainty (Hall & Wagner, 2012). B2B firms are grappling with formidable obstacles in the process of commercializing radical innovations, aiming to foster the creation of value for the firm (Aarikka-Stenroos & Lehtimäki, 2014). Since radical innovations are high in novelty, ambiguity, and uncertainty, therefore customers are likely to show reluctant behaviors to buy new products because they have less know-how and incomplete information about the innovation (Wu & Pagell, 2011). Radical innovation uncertainty has been deemed as a barrier to the success of new products, thereby negatively impacting the firm performance. Whereas, seminal works view uncertainty as a driver of

innovation development/diffusion because it creates the opportunity for profit which would only be temporary if change was predictable (Knight, 1921). These contradictory views and decisive nature of uncertainty factors warrant examination of their role in the successful commercialization of radical product innovations. Hence, in this study we examine how radical innovation uncertainty mediates the relationship between radical product SOI and 3BL performance. Fig. 1 displays the conceptual framework.

3. Hypotheses and framework

3.1. Radical product SOI and radical innovation uncertainty

Innovation is a nuanced and intricate process, with radical innovations proving especially challenging due to their necessity for fundamental changes to established practices (Sandberg & Aarikka-Stenroos, 2014). By nature, radical innovations involve higher uncertainty compared to their incremental counterparts, making them more prone to discontinuation. This is often attributed to the extended development period and the need for substantial returns on investment within relatively short time frames (Carmona-Lavado et al., 2020). Existing literature has exhibited radical product SOI to be a challenging process with higher levels of risk and uncertainty (Hall & Wagner, 2012). Consequently, B2B firms face crucial issues in commercializing radical innovations to a value for firms (Carmona-Lavado et al., 2020). Moreover, the commercialization of sustainable innovative products is fraught with difficulties as companies grapple with issues such as ensuring commercial viability (Dangelico et al., 2013), facing higher scrutiny from stakeholders (Hall, 2002) and contending with lock-in mechanisms (Carrillo-Hermosilla, Del Río, & Könnölä, 2010). Therefore, the commercialization of radical product SOI is an expansive innovation process fraught with a higher degree of uncertainty. Indeed, when uncertainty is on the rise, a firm adopting a technology-oriented strategy might opt to halt the use of radical innovations, even with their innovative solutions and proactive approach, due to the heightened risks involved (Sainio, Ritala, & Hurmelinna-Laukkanen, 2012). Hence, it is logical to assume that radical product sustainability-oriented innovations have a higher degree of uncertainty. Thus, we hypothesize the following:

H1. Radical product SOI is positively related to radical innovation uncertainty.

3.2. Radical innovation uncertainty and 3BL

Indeed, while radical innovations provide clear advantages to incumbents, there is a notable cost associated with them. The adoption of a new product tends to be a lengthier process for customers, requiring essential steps of education and training (Sorescu, Chandy, & Prabhu, 2003); additionally, the success and widespread acceptance of a radically new product may encounter challenges if the firm lacks access to critical complementary assets and relational resources (Kyriakopoulos et al., 2016). These costs result from the risks and uncertainties assumed by a launching firm. It is well-established that uncertainty can impede innovation development, and conversely, innovations inherently carry greater uncertainty and risks. This uncertainty is often driven by the market competition and unpredictable technological changes. Moreover, a higher market uncertainty in the business environments typically leads to difficulty in innovation commercialization in those market (López-Gamero, Molina-Azorin, & Claver-Cortés, 2011).

When the uncertainty associated with radical innovations is high, the innovations fail to generate required outcomes and performance (Eng & Quaia, 2009). Han and Kang (2021) further demonstrate that the uncertainty has a direct negative effect on firm performance. Recent studies also found that uncertainty reduces the environmental, social, and governance (ESG) performance of firms (Wang, Sun, Wang, Hua, Wu, 2023). The stakeholders including investors and customers, as well as firms themselves are doubtful about resource cycling and pollutant discharge of radical innovations that hamper all three 3BL performance measures of firms (Liu, Zhu, Yang, & Chu, 2022). The innovation uncertainties generate negative effects on CSR, which further reduces the social reputation of firms (El Khoury, Nasrallah, Harb, & Hussainey, 2022). Moreover, the technology uncertainty decreases the share of sales generated by innovative products (Bolli, Seliger, & Woerter, 2020), which negatively impacts the financial performance of firms. The firms' profitability increases with higher level of product innovations while this positive relationship is likely to be weaker in the presence of uncertain situations (Holzner & Wagner, 2022). In summary, the radical innovation uncertainties directly lead to low firm performance on all three dimensions i.e., environmental, social, and financial. Therefore, we hypothesize the following:

H2a. Radical innovation uncertainty is negatively related to environmental performance.

H2b. Radical innovation uncertainty is negatively related to social performance.

H2c. Radical innovation uncertainty is negatively related to financial performance.

3.3. Mediation

Radical product SOIs are novel ideas that not only bring about substantial improvement in system performance concerning environmental and social performance but also enhance financial sustainability (Vasileiou et al., 2022). Studies have shown that product SOIs do not only aim for attaining market differentiation but also to achieve a reciprocal growth in both social and environmental performance dimension, in comparison to the existing state of affairs (Kennedy et al., 2017). It is well established that radical product SOIs help firms achieve all 3BL goals (Weidner et al., 2021). However, radical SOIs are characterized as more complex due to a broader array of stakeholders involved and more ambiguous, as many stakeholders often have contradictory demands and expectations (Hall & Vredenburg, 2003). This complexity hinders firms from achieving the 3BL goals. The broader array of stakeholder demands amplifies complexity, making it challenging to navigate interactions with these parties. Addressing their concerns is not always straightforward, especially since their considerations often revolve around the perception of a technology's impact on society. Consequently, radical innovations work in a highly ambiguous and uncertain environment (Wu & Pagell, 2011), often considered too risky. When managers experience high uncertainty in markets, it is always challenging to align innovation activities into the business objectives and decision making (López-Gamero et al., 2011). Empirical evidence also suggests that the additional interacting pressures from social and environmental concerns add complexity to the success of a radical innovation compared to conventional market-driven innovations (Dangelico et al., 2013). If uncertainty is low, firms can easily determine their innovation strategies (Aragón-Correa & Sharma, 2003). In an uncertain environment, the cycles of product innovation are often short that obstructs firm's performance in the long-term (Ramirez Hernandez & Kreye, 2021). The uncertain environmental factors such as lack of prior knowledge contributes to the failure of innovations in markets (Oke, Walumbwa, & Myers, 2012). To sum up, it is logical to propose that the uncertainty associated with commercialization or launch of radical product SOI negatively mediates the already established link of radical product SOI and triple-bottom-line (3BL) performance. Hence, we propose the following:

H3a. Radical innovation uncertainty negatively mediates the relationship between radical product SOI and environmental performance.

H3b. Radical innovation uncertainty negatively mediates the relationship between radical product SOI and social performance.

H3c. Radical innovation uncertainty negatively mediates the relationship between radical product SOI and financial performance.

3.4. Moderated-Mediation

There are numerous important distinctions between the service and industrial sectors. The innovation process for services differs from that for manufacturing because services have a variety of unique characteristics, such as heterogeneity, intangibility, perishability, and inseparability (Wilson, Zeithaml, Bitner, & Gremler, 2012). The specialty where more customization is required and technology aspects of B2B services should also be considered because they might complicate the innovation commercialization (Carmona-Lavado et al., 2020).

In the service industry, there is less perceived risk of competitors' imitation than in the manufacturing sector (Drejer, 2004), which lowers the uncertainty associated with innovation commercialization and implementation. Typically, radical inventions in manufacturing organizations are costly and require significant R&D expenditures, thus businesses must employ patents to safeguard their profits (Green, Gavin, & Aiman- Smith, 1995). Since innovations are typically not patentable in the service industry as services typically focus on continuous innovation, service firms generally allocate fewer resources to formal R&D. As a result, being quickly imitated is something that is expected in service industries (Prajogo, 2006). In other words, due to the frequent occurrence of imitation, businesses promptly respond to new service improvements through incremental innovations to maintain competitiveness. According to Djellal and Gallouj (2001), service innovations are simpler to develop and implement than product innovations and have a shorter time-to-market. Additionally, according to Biemans and Griffin (2018) service-dominant businesses exhibit shorter B2B development cycle times than product-dominant industries, especially for initiatives that are more groundbreaking and inventive. Due to the increased frequency of user interactions resulting from ongoing advancements, service firms are likely to carry out a superior and agile product/market fit. Additionally, spiral developments and agile methodologies are anticipated to be more swiftly applied to innovations in services than in manufacturing (Cooper, 2019). This increases the likelihood of translating the new offering into firm success. As Ettlie and Rosenthal (2011, p. 295) conclude: "services are more likely to convert novelty into success."

Consequently, the impact of radical product SOI on radical innovation uncertainty appears to be stronger for services firms than for manufacturing firms.

Generally speaking, services sectors are characterized to introduce and implement incremental rather than radical innovations (Hipp & Grupp, 2005). In the B2B context, service-dominant firms are observed to allocate a significantly higher percentage of their R&D budget to incremental innovations, placing a lesser emphasis on radical innovations compared to product-dominant firms (Biemans & Griffin, 2018). Therefore, there is an expectation that customers perceive new services as variations of existing ones, aiding in mitigating the negative impact of uncertainty associated with radical innovation in the service sector. Even when both product and service innovations exhibit an equivalent level of radicalness, the concept of inseparability—defined as the simultaneous production and consumption of services—assumes crucial significance. Particularly in a B2B context marked by heightened collaboration (Jackson, Neidell, & Lunsford, 1995), inseparability contributes significantly across various stages of the innovation process. These contributions work to mitigate the impact of radical product SOI on innovation uncertainty within the service industries. Accordingly, we state:

> **H4.** The industry type moderates the mediated effect of radical innovation uncertainty on the relationship between radical product SOI and (a) environmental performance, (b) social performance, and (c) financial performance – wherein, the negative effect between radical product SOI and innovation uncertainty is weaker for service firms than manufacturing firms.

Industry: Manufacturing vs. Service

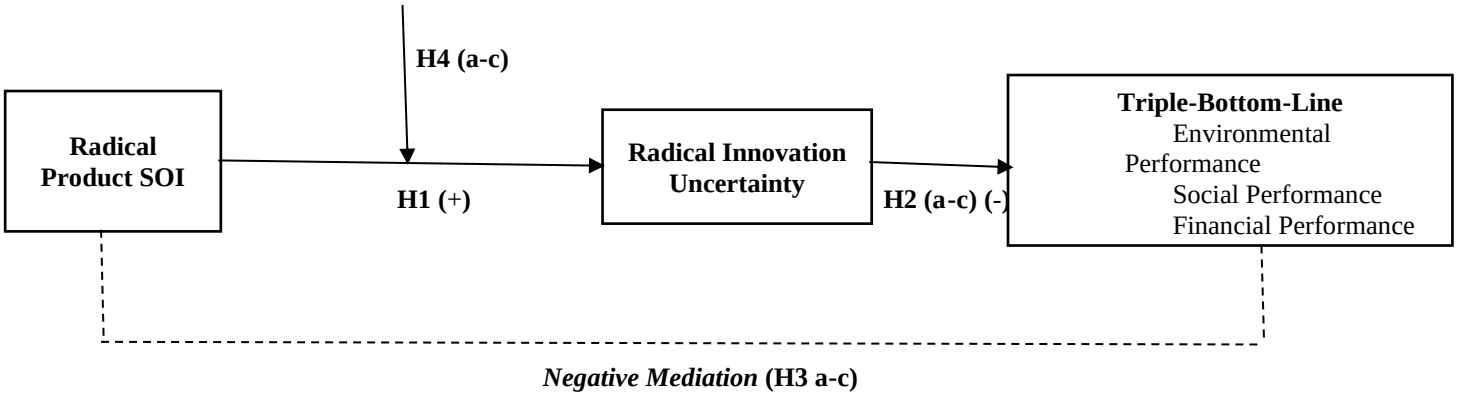

Fig.1. Conceptual framework

4. Method

4.1. Sample and data collection

A survey involving multiple informants was conducted to examine privately-owned B2B firms in Malaysia and Singapore. These firms were categorized as either manufacturing firms (such as chemicals and equipment) or service firms (such as software and programming) and had a minimum of 50 employees. According to Global Innovation Index (2022), Singapore is the most innovative country in Asia and ranked 9th worldwide, while Malaysia is also shining with 36th position worldwide, according to GII 2022. Moreover, the identified industries were found to have a high percentage of innovative companies (Forbes, 2018), hence fit well with present study's objectives. We used criteria to select firms: (1) firms should be located and operational in Malaysia and Singapore, (2) firms should be privately-owned, and (3) firms should be engaged in innovation and R&D activities. For this, we apply search filters in Orbis while extracting firms' data. Firms were used as the unit of analysis. Each firm represents multiple respondents. A total of 617 firms from the Orbis Bureau Van Djick database were identified. These firms were actively involved in NPD and/or R&D activities. The general and financial information of the firms were also collected. The email contact information of R&D managers and marketing managers were obtained from Orbis. They were contacted through the official email address of one of the authors along with the cover letter and purpose of research. To enhance the response rate, we assured the confidentiality of the provided information. Consequently, 469 firms agreed to participate out of the 617 identified firms. Responses were collected using a structured questionnaire. The participants were approached via email invitations. A total of 326 responses were received from 187 firms, indicating a satisfactory response rate of 30.30% (187/617). No responses were discarded, as all firms met the criteria

of minimum 50 employees, and there were not any missing cases. The participants held positions of NPD managers, R&D managers and marketing managers which indicates that they had key roles in firms' innovation activities. Given the research aims, they served as the best informants (Table 1).

Table 1. Companies profile

	No. of companies	Percentage
Company size (no. of employees)		
50–99	30	16.04
100 – 249	69	36.89
249 – 499	58	31.01
500 and above	30	16.04
Age (years)		
0 – 10	51	27.27
11 – 20	59	31.55
21 – 30	45	24.06
More than 30	32	17.11
Industry		
Manufacturing firms	96	51.33
Service firms	91	48.66
Total	187	100

4.2. Measurements

Radical product SOI. Respondents were queried about the new products or services introduced by their firms in the last two years. The items from Gatignon, Tushman, Smith and Anderson (2002) and Hermundsdottir and Aspelund (2021) were used to measure radical product SOI. From Gatignon et al. (2002), five items on product radicalness were adopted. From Hermundsdottir and Aspelund (2021), only items of sustainable product innovation were used, and the items of sustainable process innovation were ignored. It was measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Radical innovation uncertainty. Respondents were asked about the uncertainty of the radical product innovations. Four item scale of O'Connor and Rice (2013) was used to measure it. A five-point Likert scale was used (1 = strongly disagree, 5 = strongly agree).

Triple bottom line. Respondents were inquired about the environmental, social, and financial performance of firms. Scales by Bansal (2005) were adapted to capture the social and environmental dimensions of the 3BL. Since the original scales denote the presence or absence of environmental integrity and social equity, each question of the scale was converted to a Likert scale. The questions were then rephrased to reflect the social and environmental performance of the firm over the past two years. To gauge the financial performance of the

firm, a subjective measure was adapted from Zhou, Yim, and Tse (2005). This measure assessed the firm's profitability, return on investment (ROI), market share, and sales revenues over the previous two years. To measure triple bottom line variables, a five-point Likert scale was used (1= strongly disagree, 5 = strongly agree).

Industry type. The industry type was used as a moderating variable. A dummy coding ("0 = manufacturing, 1 = service") was used to measure it. This is an objective data that was directly obtained from Orbis (Bureau Van Dijk).

Control variables. The size of the firm was controlled by using the sales figures of the firms. Firm size is typically public information and was obtained from the Orbis database. Firm age was also controlled, and this information was similarly obtained from the Orbis database. Additionally, the R&D intensity of the firms was controlled, as it might influence radical product innovation (Godoe, 2000). R&D intensity was measured as the percentage share of R&D investments of total sales, and this information was directly obtained from the Orbis database.

4.3. Common method bias and inter-rater agreement

We used both *ex ante* and *post hoc* measures to address potential common method variance (CMV). In the case of *ex ante* remedies, we shuffled the order of the questions, explicitly informing participants during the data collection stage that there were no right or wrong answers (Chang, Witteloostuijn, & Eden, 2020). Participants were also encouraged to complete the survey honestly, with the assurance that their responses would be kept confidential. As part of *post hoc* measures, we conducted two statistical analyses. First, Harman's one-factor test shows that the single factor accounted for 19.793 percent of the total variance, falling below the threshold of 50.0 percent. (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Secondly, we verified this using the common latent factor method in SPSS AMOS Graphics. Standard estimates were obtained both with and without the common latent factor, and the values without the common latent factor were subtracted from those with it. The differences for all standard estimates were not greater than 0.20, indicating the absence of common method bias. Thus, common method bias was unlikely to be an issue in this research.

Since a multi-informant survey approach was adopted in this research, an inter-rater reliability test was employed to assess a within-firm agreement among. An intra-class correlation coefficient (ICC) test was performed in SPSS. The obtained value of ICC

coefficient for average measures was 0.72 (lower bound = 0.54; upper bound = 0.85), exceeding the threshold of 0.70 (Cicchetti, 1994). Hence, the ICC value suggested an acceptable degree of consistency or agreement among the participants.

4.4. Measurement model

The confirmatory factor analysis produced model fit scores that demonstrated a good fit (χ^2 (195) = 576.727, χ^2/df = 2.958, SRMR = .051, RMSEA = .067, GFI = .892, AGFI = .859, CFI = .936; TLI = .925, RFI = .890, NFI = .907). Then, the tests for convergent and discriminant validity were performed. We gauged convergent validity using three indicators: factor loadings, composite reliability (CR), and average variance extracted (AVE). All factor loading values exceeded the 0.70 threshold, except one item of radical product SOI (0.21) which was deleted. The CR scores were also above 0.70, and AVE values were over 50%. Cronbach's alpha values also surpassed 0.70. Hence, the convergent validity was achieved (Table 2).

Table 2. Convergent validity

Construct	Scale items	λ	CR	AVE	α
Radical product SOI (1= strongly disagree, 5 = strongly agree)			0.91	0.59	0.87
	The new products launched by the firm in previous two years were based on a groundbreaking change in technology.	0.83			
	The new products launched by the firm in previous two years represented a major technological advance in the subsystems.	0.80			
	The new products launched by the firm in previous two years were a breakthrough innovation with a reduced consumption of energy, water, other natural resources.	0.71			
	The new products launched by the firm in the previous two years led to products that cannot be replaced with alternatives.	0.74			
	The new products launched by the firm in the previous two years led to products that can be easily recycled and reused.	0.84			
	The new products launched by the firm in the previous two years led to innovative products that are manufactured with environment friendly materials.	0.76			
	The new products launched by the firm in previous two years led to innovative products that reduce waste.	0.70			
Radical innovation uncertainty (1= strongly disagree, 5 = strongly agree)	*The radical innovation has the following:*		0.90	0.70	0.90
	Technical uncertainty	0.86			
	Market uncertainty	0.83			
	Organizational uncertainty	0.81			

	Resources uncertainty	0.85			
Environmental performance (1= strongly disagree, 5 = strongly agree)	*Our company's past two year environmental performance relative to closest competitors, in….*		0.85	0.66	0.83
	Providing products or services that have a less environmentally harmful impact than in previous years.	0.82			
	Providing products or services with less environmentally damaging inputs than in previous years.	0.85			
	Reducing or eliminating environmentally harmful processes.	0.77			
Social performance (1= strongly disagree, 5 = strongly agree)	*Our company's past two year social performance relative to closest competitors, in….*		0.84	0.65	0.85
	Employee health, well-being, and safety.	0.81			
	The well-being of marginalized members of society.	0.78			
	Access to opportunities and resources for all members of the society.	0.83			
Financial performance (1= strongly disagree, 5 = strongly agree)	*Our company's past two year financial performance relative to your closest competitors, in….*		0.88	0.65	0.86
	Profitability	0.80			
	Return on investment	0.75			
	Market share	0.90			
	Sales	0.79			

λ = Factor loading, CR = Composite reliability, AVE = Average variance extracted, α = Cronbach's alpha

For discriminant validity, we followed two approaches: (1) Fornell-Larcker (1981) and (2) Henseler et al. (2015). The square roots of AVE were greater than construct correlation with other constructs (Table 3). We also assessed discriminant validity with $HTMT_{0.85}$ and the Heterotrait–Monotrait Ratio Inference ($HTMT_{inference}$) (Henseler *et al.*, 2015). The maximum value of HTMT is 0.74, which is below the threshold value of 0.85 ($HTMT_{0.85}$). As for the Heterotrait–Monotrait Ratio Inference, all 90% confidence intervals ($CI_{0.90}$) are significantly different from 1.0, so discriminant validity is achieved (Table 4).

Table 3. Correlations and discriminant validity

	Radical product SOI	Radical innovation uncertainty	Environmental performance	Social performance	Financial performance
Radical product SOI	**0.76**				
Radical innovation uncertainty	0.47	**0.83**			
Environmental performance	0.50	0.51	**0.81**		
Social performance	0.11	0.09	0.05	**0.80**	
Financial performance	0.60	0.56	0.62	0.06	**0.80**
Mean	3.78	3.58	3.75	3.57	3.82
Standard deviation	0.84	1.22	1.02	1.16	1.06
VIF	1.47	1.46	1.52	1.01	2.17

Table 4. Heterotrait–Monotrait ratio (HTMT) at 90% confidence interval ($CI_{0.90}$)

	Radical product SOI	Radical innovation uncertainty	Environmental performance	Social performance	Financial performance

Radical product SOI				
Radical innovation uncertainty	0.63[.56; .74]			
Environmental performance	0.59 [.55; .69]	0.15 [.08; .21]		
Social performance	0.14 [.06; .14]	0.11 [.05; .15]	0.54 [.46; .62]	
Financial performance	0.42 [.36; .47]	0.39 [.33; .47]	0.34 [.27; .38]	0.21 [.16; .23]

5. Results

Since our hypotheses include both mediation and moderation, therefore PROCESS analysis was adopted for hypotheses testing (Hayes & Scharkow, 2013). The results reveal a positive relationship between radical product SOI and radical innovation uncertainty ($\beta = 0.69$, $t = 11.22$, $p < 0.001$), which was negatively related to environmental performance ($\beta = -0.28$, $t = 7.75$, $p < 0.001$), social performance ($\beta = -0.08$, $t = -1.98$, $p < 0.05$), and financial performance ($\beta = -0.48$, $t = 14.14$, $p < 0.001$). H1 and H2 were supported. We subsequently examined negative mediations, positing that radical innovation uncertainty negatively mediates the relationship between radical product SOI and 3BL factors. The indirect effect from radical product SOI to environmental performance through radical innovation uncertainty was -0.19, with significance at a 95% confidence interval (CI: LL = 0.13, UL = 0.26). Hence, H3a was supported. Furthermore, a noteworthy indirect effect of radical product SOI on social performance through radical innovation uncertainty emerged ($\beta = -0.36$, 95% CI: LL = -0.10, UL = -0.36). therefore, H3b was also supported. H3c states that radical innovation uncertainty negatively mediates the relationship between radical product SOI and financial performance. The mediation test generated an effect size of -0.21 for the indirect relationship; its 95% confidence interval (CI) did not include 0 [0.15; 0.27], in support of the presence of mediation. Hence, H3c was also supported (Table 5).

Next, to test the moderated-mediation effects, we used PROCESS in SPSS. Because of interaction terms, we used a mean-centred function in PROCESS. H4 states that the industry type moderates the indirect effects of radical product SOI on 3BL factors via radical innovation uncertainty. The interaction term of radical product SOI × industry type on environmental performance through radical innovation uncertainty was significant ($\beta = -0.21$, $p < 0.05$). The indirect effect of radical product SOI on environmental performance was significant for manufacturing ($\beta = 0.22$, 95% CI: 0.16, 0.29) and service firms ($\beta = 0.16$, 95% CI: 0.09, 0.24). The value of index moderated-mediation further confirmed that the indirect effect of radical

product SOI on environmental performance through radical innovation uncertainty was moderated by industry type (difference between conditional indirect effects = 0.06, CI: 0.07, 0.12). Hence, H4a was supported. Likewise, the interaction effect of radical product SOI × industry type on social performance through radical innovation uncertainty was significant (β = -0.13, p < 0.05). The indirect effect of radical product SOI on social performance was significant both types of firms: manufacturing (β = 0.36, 95% CI: 0.04, 0.11) and services (β = 0.26, 95% CI: 0.08, 0.30). The difference between these two effects was 0.10 and significant (95% CI: 0.11, 0.44), thus showing presence of moderated-mediation (H4b). Finally, we tested whether the indirect relationship between radical product SOI and financial performance is moderated by type of industry. We found a significant interaction effect of radical product SOI × industry type on financial performance through radical innovation uncertainty (β = -0.31, p < 0.05). The conditional indirect effect of radical product SOI on financial performance through radical innovation uncertainty was significant for both manufacturing (β = 0.24, 95% CI: 0.16, 0.31) and service firms (β = 0.17, 95% CI: 0.10, 0.24). The difference between two indirect effects was 0.07 and significant (95% CI: 0.06, 0.14), thus in support of H4c.

Table 5. Direct effects and mediation

Relationship	Radical innovation uncertainty	Environmental performance	Social performance	Financial performance	Result
Predictors					
Radical product SOI (**H1**)	0.69***	0.41***	0.13*	0.55***	Supported
Radical innovation uncertainty (**H2**)	-	-0.28***	-0.08**	-0.48***	Supported
R^2	0.22	0.34	0.12	0.46	
Mediation effects					
Radical product SOI → Radical innovation uncertainty (**H3**)	-	-0.19 (95% CI, 0.13, 0.26)	-0.36 (95% CI, 0.10, 0.36)	-0.21 (95% CI, 0.15, 0.27)	Supported
Moderated-Mediation (H4)	**Interaction term**	**Manufacturing**	**Services**	**Index of Moderation**	**Result**
Radical product SOI × Industry type → Radical innovation uncertainty → Environmental performance ***(H4a)***	-0.21*	0.22 (95% CI, 0.16, 0.29)	0.16 (95% CI, 0.09, 0.24)	0.06 (95% CI, 0.07, 0.12)	Supported
Radical product SOI × Industry type → Radical innovation uncertainty → Social performance ***(H4b)***	-0.13*	0.36 (95% CI, 0.04, 0.11)	0.26 (95% CI, 0.08, 0.30)	0.10 (95% CI, 0.11, 0.44)	Supported
Radical product SOI × Industry type → Radical innovation uncertainty → Financial performance ***(H4c)***	-0.31*	0.24 (95% CI, 0.16, 0.31)	0.17 (95% CI, 0.10, 0.24)	0.07 (95% CI, 0.06, 0.14)	Supported

Notes: n = 326; CI = confidence interval
∗p < 0.05.
∗∗p < 0.01.
∗∗∗p < 0.001.

5. Discussion

The radical innovation adoption and success has become an important area of research. The findings of this study support the revisionist perspective that radical product SOI can create win-win situations for the firms (Hermundsdottir & Aspelund, 2021). The findings further confirmed that the products/services must go beyond continuous and incremental improvements, which corroborates with the prior research findings (Hall & Wagner, 2012). Rather than competency enhancing incremental innovations, the competency-destroying radical innovations are needed, that validates the debate on this topic (Kennedy et al., 2017). There should be the integration between radical product SOIs and business strategies (Dangelico et al., 2013). Previous studies propose that firms aspire for radical product innovations to fulfill all 3BL goals, yet the 3BL components seem to be in tension with one another (Ozanne et al., 2016). This situation presents the dilemma of opting between safeguarding business interests and promoting societal welfare. The current study provides valuable insights by addressing the question: "would firms' radical product SOI lead to all three 3BL goals; in other words, can all three types of goals be achieved at the same time with radical product SOI? The findings affirm that radical product SOI has been successful in meeting all three 3BL goals.

5.1. Theoretical implications

The current investigation results provide valuable insights. First, we found a positive association between radical product SOI and radical innovation uncertainty. This answers the research calls by the innovation research scholars (Hall & Wagner, 2012) where they argued that radical innovations might have higher degree of risk and uncertainty. This study is a valuable contribution to the scarce literature on the outcomes of radical product SOI. The uncertainty is a restraining factor that is directly associated with radical innovations.

Second, the results in this study also contribute to the marketing literature (Carmona-Lavado et al., 2020). We demonstrate that the favorable impact of radical product SOI on 3BL performance through radical innovation uncertainty, as noted in previous studies, can be extended to the relationship between radical product SOI and overall organizational performance. The direct effects of radical product SOI on environmental ($\beta = 0.41$), social ($\beta = 0.13$) and financial performance ($\beta = 0.55$) were greater than indirect effects ($\beta = 0.19$; $\beta = 0.36$; $\beta = 0.21$). This further confirms the view that a firm must consider the interests of all the

stakeholders. It further advises that customer benefits derived by radical products/services possibly cancel out their perceived risks of these products.

Third, this study took place in a B2B marketing context and utilized samples from both the services and manufacturing sectors. To the authors' best knowledge, the relationships in the conceptual framework have not undergone testing in previous studies. One stream of research in the extant literature did not differentiate between products, services, and processes innovation, and largely focused on one type of innovation (e.g., products, Vasileiou et al., 2022; Kennedy et al., 2013; Kennedy et al., 2017; Weidner et al., 2021). The other stream of studies reveals inconsistent and contradictory findings for the radicalness-performance link (Ettlie and Rosenthal, 2011). The moderated-mediation effects in this study further add some novel insights into the current body of knowledge by demonstrating distinctive differences between goods and services in B2B marketing. This analogy between the service and manufacturing sectors in the business-to-business context enables effective control for potential contradictory effects arising from industry characteristics.

Fourth, the business model concepts were narrowly defined within a single rather than 3BL perspective in previous literature, with the recognition of a narrow range of stakeholders (Hall & Wagner, 2012). Other studies only considered the relationship between environmental innovation and financial performance, ignores other performance types (i.e., social, and environmental) (Vasileiou et al., 2022). Whereas, current research has taken all 3BL dimensions to measure firms' performance at a wider level. This attempt provides a complete picture on the effects of radical product SOI on firm's overall performance.

5.2. Practical implications

From the managerial perspective, managers should strategically cultivate radical product innovations, taking into account their positive influence on the firm's 3BL performance. In manufacturing firms, managers need to consider that as the product uncertainty is greater, the likelihood of purchase or usage will decrease. Managers need to ensure that customers are likely to be more hesitant to adopt radical innovations because of the associated risks. Customers require higher learning effort to adopt these products. So, relevant marketing and communication strategies that contemplate on customers' risk behavior will work to reduce these adverse effects. In both manufacturing and service firms, the promotional strategies should further communicate products' benefits to customers. While launching radical

innovations, marketing efforts in the manufacturing sector should include the product's relative advantage component so that customers' perceived risk and uncertainties are reduced. The product advertisements should have functional components, rather than emotional, that demonstrate clear advantages and benefits of the products (Talke & Heidenreich, 2014). Since customers have been found to show resistance towards radical products because of the required learning effort and perceived complexity, a preannouncement strategy containing customer education components and strategies of offering radical product SOI with existing product would seem to work. This will weaken the negative effect of innovation uncertainty in manufacturing firms' context. Moreover, product demonstrations provide customers with the opportunity to acquaint themselves with radical product innovations (Heidenreich & Kraemer, 2016).

The findings of this study additionally revealed that the negative impact of radical innovation uncertainty on 3BL performance was more pronounced in the manufacturing sector compared to the service sector. Consequently, manufacturing firms should invest additional efforts in adoption strategies to entice customers to embrace their innovations. Since the manufacturing sector is characterized with less firm-customer interaction, more firm-customer meetings are encouraged. It will help firms to develop new product ideas in the product development stage and will also provide solutions to customer problems. Since manufacturing firms allocate higher R&D investments, require more time to launch products into market, therefore innovation uncertainty seems to have more negative impact. Thus, in the business-to-business context, manufacturing firms, in contrast to service firms, should prioritize the establishment of long-term relationships with customers.

6. Limitations and future research

The present study has some limitations that provide a foundation for future research. First, this study used 3BL as an outcome variable of radical product SOI. While this study, along with previous research capturing crucial business aspects (Weidner et al., 2021), delves into the effects of radical product SOI, there remains a need for further analysis of other dimensions of firm performance. Particularly, exploring customer-focused performance, such as customer satisfaction, could contribute to a more comprehensive understanding. Second, this study did not consider the type of innovation and focused only on the product aspect of innovation. Future studies could investigate other innovations – such as service and process and examine their impact on firms' 3BL performance. Future research could also draw comparisons and check which innovation (product, service, process) has a big role in creating

a firm's 3BL performance. Scholars should also attempt to differentiate between radical and incremental forms of innovation (Dangelico, 2015). Third, the investigation of other mediators and moderators: innovation risk (Wiedmann et al., 2011), innovation type (radical vs. incremental innovation) (Kennedy et al., 2017), and contextual factors such as culture (individualist versus collectivist societies) (Carmona-Lavado et al., 2020) in explaining the commercialization and 3BL performance of innovations could provide valuable insights, which will subsequently assist NPD managers in devising appropriate innovation strategies. Finally, participants for this study were recruited from firms in Malaysia and Singapore, suggesting caution in generalizing findings to other country contexts. Therefore, we propose that scholars explore the same theoretical framework in a more diverse geographic setting. Furthermore, given the use of cross-sectional survey data in this study, future research should contemplate collecting longitudinal data. This approach would enable researchers to test and compare results across two distinct time periods, providing valuable insights for managers regarding the optimal timing for introducing new products into markets.

7. Conclusion

We developed a conceptual framework and tested it in the Malaysian and Singaporean B2B context. The findings of our study have led us to conclude that the radical product SOI can be developed and launched to enhance the firm performance. Whereas the radical innovation uncertainty negatively mediates between radical product SOI and 3BL performance. This study also examines the role of industry type as a moderator where the mediating effect of radical innovation uncertainty in the framework was weaker for service firms than for manufacturing firms. This study offers deep and useful insights on how radical innovation undermines the environmental, social, and financial performance of B2B firms. The NPD and R&D managers have clear suggestions on how to develop and market radical sustainability-oriented innovations in the emerging markets like Malaysia and Singapore.

REFERENCES

Aarikka-Stenroos, L., Sandberg, B., & Lehtimäki, T. (2014). Networks for the commercialization of innovations: A review of how divergent network actors contribute. *Industrial Marketing Management, 43*(3), 365-381.

Aragón-Correa, J. A., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review, 28*(1), 71-88.

Arnold, M., & Hockerts, K. (2011). The Greening Dutchman: Philips' Process of Green Flagging to Drive Sustainable Innovations. *Business Strategy and the Environment, 20*, 394–407.

Balderjahn, I., Peyer, M., Seegebarth, B., Wiedmann, K., & Weber, A. (2018). The many faces of sustainability-conscious consumers: A category-independent typology. *Journal of Business Research, 91*(October), 83–93. https://doi.org/10. 1016/j.jbusres.2018.05.022.

Bansal, P. (2005). Evolving sustainably: A longitudinal study of corporate sustainable development. *Strategic Management Journal, 26*(3), 197–218. https://doi.org/10.1002/smj.441
Biemans, W., & Griffin, A. (2018). Innovation practices of B2B manufacturers and service providers: Are they really different? *Industrial Marketing Management, 75*, 112–124.

Bolli, T., Seliger, F., & Woerter, M. (2020). Technological diversity, uncertainty and innovation performance. *Applied Economics, 52*(17), 1831-1844.

Boons, F., Montalvo, C., Quist, J., & Wagner, M. (2013). Sustainable innovation, business models and economic performance: an overview. *Journal of Cleaner Production, 45*, 1-8.

Carmona-Lavado, A., Gopalakrishnan, S., & Zhang, H. (2020). Product radicalness and firm performance in B2B marketing: A moderated mediation model. *Industrial Marketing Management, 85*, 58-68.\

Carrillo-Hermosilla, J., Del Río, P., & Könnölä, T. (2010). Diversity of eco-innovations: Reflections from selected case studies. *Journal of Cleaner Production, 18*(10-11), 1073-1083.

Chang, S. J., Witteloostuijn, A. V., & Eden, L. (2020). Common method variance in international business research. In *Research methods in international business* (pp. 385-398). Palgrave Macmillan, Cham.

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment, 6*(4), 284.

Cooper, R. G. (2019). The drivers of success in new-product development. *Industrial Marketing Management, 76*, 36–47.

Dangelico, R. M., Pontrandolfo, P., & Pujari, D. (2013). Developing sustainable new products in the textile and upholstered furniture industries: Role of external integrative capabilities. *Journal of Product Innovation Management, 30*(4), 642–658. https://doi.org/10.1111/jpim.12013.

Djellal, F., Gallouj, F., 2001. Patterns of innovation organisation in service firms: Postal survey results and theoretical models. *Science and Public Policy*, Oxford University Press, 28 (1), 57–67.

Drejer, I. (2004). Identifying innovation surveys of services: A Schumpeterian perspective. *Research Policy*, *33*(3), 551–562.
El Khoury, R., Nasrallah, N., Harb, E., & Hussainey, K. (2022). Exploring the performance of responsible companies in G20 during the COVID-19 outbreak. *Journal of Cleaner Production*, *354*, 131693.
Eng, T.-Y., & Quaia, G. (2009). Strategies for improving new product adoption in uncertain environments: a selective review of the literature. *Industrial Marketing Management, 38*(3), 275-282.
Ettlie, J. E., & Rosenthal, S. R. (2011). Service versus manufacturing innovation. *Journal of Product Innovation Management, 28*(2), 285–299.
Forbes (2018). The World's Most Innovative Companies. https://www.forbes.com/innovative-companies/list/#tab:rank_industry:Health%20Care%20Equipment%20%26%20Services
Freeman, R. E. (1984). *Strategic management: A stakeholder approach*. Pitman Publishing.
Gatignon, H., Tushman, M., Smith, W., & Anderson, P. (2002). A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics. *Management Science, 48*(9), 1103–1122.
Geels, F.W., Hekkert, M.P., & Jacobsson, S. (2008). The dynamics of sustainable innovation journeys. *Technology Analysis & Strategic Management, 20*(5), 521-536.
Godoe, H. (2000). Innovation regimes, R&D and radical innovations in telecommunications. *Research Policy*, *29*(9), 1033–1046.
Green, S., Gavin, M., & Aiman-Smith, L. (1995). Assessing a multidimensional measure of radical technological innovation. *IEEE Transactions on Engineering Management, 42*(3), 203–214.
Hall, J. (2002). Sustainable development innovation; a research agenda for the next 10 years. Editorial for the 10th anniversary of the Journal of Cleaner Production. *Journal of Cleaner Production*, *10*(3), 195-196.
Hall, J., & Vredenburg, H. (2003). The challenges of innovating for sustainable development. *MIT Sloan Management Review*, *45*(1), 61-68.
Hall, J., & Wagner, M. (2012). Integrating sustainability into firms' processes: Performance effects and the moderating role of business models and innovation. *Business Strategy and the Environment*, *21*(3), 183-196.

Han, J., & Kang, R. (2021). Market uncertainty, innovation of firms in alliance and alliance partner characteristics. *European Journal of Innovation Management*, *24*(5), 1883-1905. https://doi.org/10.1108/EJIM-05-2020-0195.

Hayes, A. F., & Scharkow, M. (2013). The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis: does method really matter?. *Psychological Science*, *24*(10), 1918-1927.
Heidenreich, S., Kraemer, T., & Handrich, M. (2016). Satisfied and unwilling: Exploring cognitive and situational resistance to innovations. *Journal of Business Research, 69*(7), 2440–2447.
Henseler, J., Ringle, C.M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modelling. *Journal of the Academy of Marketing Science*, 43(1), 115–135.

Hermundsdottir, F., & Aspelund, A. (2021). Sustainability innovations and firm competitiveness: A review. *Journal of Cleaner Production, 280*, 124715.
Hipp, C., & Grupp, H. (2005). Innovation in the service sector: The demand for service-specific innovation measurement concepts and typologies. *Research Policy, 34*(4), 517–535.
Holzner, B., & Wagner, M. (2022). Linking levels of green innovation with profitability under environmental uncertainty: An empirical study. *Journal of Cleaner Production, 378*, 134438.
Jackson, R. W., Neidell, L. A., & Lunsford, D. A. (1995). An empirical investigation of the differences in goods and services as perceived by organizational buyers. *Industrial Marketing Management, 24*, 99–108.
Kennedy, S., Whiteman, G., & Van den Ende, J. (2013). Enhancing radical innovation using sustainability as a strategy choice. *Sustainability and the Corporation: Big Ideas*, 1-24.

Kennedy, S., Whiteman, G., & van den Ende, J. (2017). Radical innovation for sustainability: The power of strategy and open innovation. *Long Range Planning, 50*(6), 712-725.

Knight F. H. 1921. *Risk, Uncertainty and Profit*. New York: Hart, Schaffner and Marx.

Kyriakopoulos, K., Hughes, M., & Hughes, P. (2016). The role of marketing resources in radical innovation activity: antecedents and payoffs. *Journal of Product Innovation Management, 33*(4), 398-417.

Le, T. T., & Ikram, M. (2022). Do sustainability innovation and firm competitiveness help improve firm performance? Evidence from the SME sector in Vietnam. *Sustainable Production and Consumption, 29*, 588-599.
Lilien, G. L. (2016). The B2B knowledge gap. *International Journal of Research in Marketing, 33*(3), 543–556.
Liu, P., Zhu, B., Yang, M., & Chu, X. (2022). ESG and financial performance: A qualitative comparative analysis in China's new energy companies. *Journal of Cleaner Production, 379*, 134721.

López-Gamero, M. D., Molina-Azorin, J. F., & Claver-Cortés, E. (2011). Environmental uncertainty and environmental management perception: A multiple case study. *Journal of Business Research, 64*(4), 427-435.

Maletic, M., Maletic, D., Dahlgaard, J. J., Dahlgaard-Park, S. M., & Gomiscek, B. (2014). The relationship between sustainability-oriented innovation practices and organizational practices and organizational performance: Empirical evidence from Slovenian organizations. *Organizacija*, *47*(1), 3–13. https://doi.org/10.2478/orga-2014-0001.

O'Connor, G. C., & Ayers, A. D. (2005). Building a radical innovation competency. *Research-Technology Management, 48*(1), 23-31.

O'Connor, G. C., & Rice, M. P. (2013). A comprehensive model of uncertainty associated with radical innovation. *Journal of Product Innovation Management, 30*, 2-18.

Oke, A., Walumbwa, F. O., & Myers, A. (2012). Innovation strategy, human resource policy, and firms' revenue growth: The roles of environmental uncertainty and innovation performance. *Decision Sciences, 43*(2), 273-302.

Ozanne, L. K., Phipps, M., Weaver, T., Carrington, M., Luchs, M., Catlin, J., Gupta, S., Santos, N., Scott, K., & Williams, J. (2016). Managing the tensions at the intersection of the triple bottom line: A paradox theory approach to sustainability management. *Journal of Public Policy & Marketing*, *35*(2), 249–261. https://doi.org/10. 1509/jppm.15.143.
Prajogo, D. I. (2006). The relationship between innovation and business performance—A comparative study between manufacturing and service firms. *Knowledge and Process Management, 13*(3), 218–225.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879.

Poeppelbuss, J., Ebel, M., & Anke, J. (2022). Iterative uncertainty reduction in multi-actor smart service innovation. *Electronic Markets*, *32*(2), 599-627.

Ramirez Hernandez, T., & Kreye, M. E. (2021). Uncertainty profiles in engineering-service development: exploring supplier co-creation. *Journal of Service Management*, *32*(3), 407-437.

Sainio, L. M., Ritala, P., & Hurmelinna-Laukkanen, P. (2012). Constituents of radical innovation—exploring the role of strategic orientations and market uncertainty. *Technovation*, *32*(11), 591-599.

Sandberg, B., Aarikka-Stenroos, L. (2014). What makes it so difficult? A systematic review on barriers to radical innovation. *Industrial Marketing Management*, *43*(8), 1293-1305.

Sheng, S., Zhou, K. Z., & Lessassy, L. (2013). NPD speed vs. innovativeness: The contingent impact of institutional and market environments. *Journal of Business Research*, *66*(11), 2355-2362.

Sood, A., & Tellis, G. J. (2005). Technological evolution and radical innovation. *Journal of Marketing*, *69*(3), 152-168.

Sorescu, A. B., Chandy, R. K., & Prabhu, J. C. (2003). Sources and financial consequences of radical innovation: Insights from pharmaceuticals. *Journal of Marketing*, *67*(4), 82-102.

Story, V. M., Daniels, K., Zolkiewski, J., & Dainty, A. R. (2014). The barriers and consequences of radical innovations: Introduction to the issue. *Industrial Marketing Management*, *43*(8), 1271-1277.

Talke, K., & Heidenreich, S. (2014). How to overcome pro-change bias: Incorporating passive and active innovation resistance in innovation decision models. *Journal of Product Innovation Management, 31*(5), *8*94–907.

Varadarajan, P. R. (2015). Innovating for sustainability: A framework for sustainable innovations and a model of sustainable innovation orientation. *Journal of the Academy of Marketing Science*, *45*(1), 14–36. https://doi.org/10.1007/ s11747-015-0461-6

Vasileiou, E., Georgantzis, N., Attanasi, G., & Llerena, P. (2022). Green innovation and financial performance: A study on Italian firms. *Research Policy, 51*(6), 104530.

Wang, W., Sun, Z., Wang, W., Hua, Q., & Wu, F. (2023). The impact of environmental uncertainty on ESG performance: Emotional vs. rational. *Journal of Cleaner Production*, *397*, 136528.

Weidner, K., Nakata, C., & Zhu, Z. (2021). Sustainable innovation and the triple bottom-line: a market-based capabilities and stakeholder perspective. *Journal of Marketing Theory and Practice, 29*(2), 141-161.

Wiedmann, K.-P., Hennigs, N., Pankalla, L., Kassubek, M., & Seegebarth, B. (2011). Adoption barriers and resistance to sustainable solutions in the automotive sector. *Journal of Business Research*, *64*(November), 1201–1206. https://doi. org/10.1016/j.jbusres.2011.06.023

Williams, A. M., Rodriguez Sanchez, I., & Škokić, V. (2021). Innovation, risk, and uncertainty: A study of tourism entrepreneurs. *Journal of Travel Research, 60*(2), 293-311.
Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). Services marketing: Integrating customer focus across the firm (Second European ed.). New York: McGraw- Hill.
Wu, Z., & Pagell, M. (2011). Balancing priorities: decision-making in sustainable supply chain management. *Journal of Operations Management*, *29*(6), 577-590.

Zhou, K. Z., Yim, C. K., & Tse, D. K. (2005). The effects of strategic orientations on technology- and market-based breakthrough innovations. *Journal of Marketing*, *69*(April), 42–60. https:// doi.org/10.1509/jmkg.69.2.42.60756.