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Article

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Foundations of Management

Provided in Cooperation with:
Faculty of Management, Warsaw University of Technology

Suggested Citation: Jassem, Suaad; Zarina Zakaria; Azmi, Anna Che (2020) : Sustainability balanced scorecard architecture and environmental investment decision-making, Foundations of Management, ISSN 2300-5661, De Gruyter, Warsaw, Vol. 12, Iss. 1, pp. 193-210, https://doi.org/10.2478/fman-2020-0015

This Version is available at:
https://hdl.handle.net/10419/237015

SUSTAINABILITY BALANCED SCORECARD ARCHITECTURE AND ENVIRONMENTAL INVESTMENT DECISION-MAKING

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Abstract: This study is centered around a set of research questions that aim to explain how sustainability balanced scorecard architectures with sustainability parameters either embedded or treated as a separate perspective relate to environmental investment decision-making. The research also examines the mediating role of sustainability balanced scorecard knowledge and moderating role of strategic risk information. This article presents the results and answers to the research questions via conducting an experimental study approach using a two-factor factorial design. This is possibly the first study that determines, through an experimental procedure conducted with managers working in large manufacturing companies, whether any significant difference exists in environmental investment decision outcomes when decision-makers are presented with either an architecture where sustainability is embedded with the traditional four perspectives of balanced scorecards versus when it is presented as a separate fifth perspective. Furthermore, the development of an integrated model is possibly a significant contribution to the extant literature.

Keywords: sustainability balanced scorecard, SBSC architecture, environmental investment decision, SBSC knowledge, strategic risk information.

JEL Classification: M41, D81.

1 Introduction

Nowadays, stakeholders are demanding that business organizations attach equal weight to their environmental and social impacts as they do to their businesses (Myung, et al., 2019; Nazari-Shirkouhi, et al., 2020). Such shifts in stakeholder priorities have alerted managers on the importance of tools such as, the sustainability balanced scorecards (SBSC) (Hristov, et al., 2019). SBSC is an evolved version of the traditional balanced scorecard (BSC) developed by Kaplan and Norton (2001). However, despite the changing stakeholder expectations, industry surveys indicate that a small percentage of sustainability initiatives, such as environmental stewardship goals, are being implemented successfully (Davis-Peccoud, et al., 2016).

Even though, several hybrids of SBSC architecture (Hansen and Schaltegger, 2016) are presented in the extant literature, most published articles have focused on two types of SBSC architectures. The first being with sustainability parameters embedded into the four traditional perspectives of BSC (hereinafter referred to as SBSC-4); the second deals with the treatment of sustainability parameters as a stand-alone fifth perspective (hereinafter referred to as SBSC-5) (Alewine and Miller, 2016; Alewine and Stone, 2013; Kalender and Vayvay, 2016; Jiangtao and Pin, 2010).

There is a need for more nuanced understanding on whether significant differences exist between the use of SBSC-4 and SBSC-5 in environmental investment decision-making. Jassem, et al. (2018) alluded to the possibility that the link between SBSC architecture and environmental decision-making may not be straightforward, and stated that in fact the constructs may be linked through other variables that represent organizational knowledge about SBSC and its applications (i.e., SBSC knowledge).

This study will focus on examining SBSC-4 and SBSC-5, and their impact on environmental investment decision-making through the role of strategic risk information (SRI) and SBSC Knowledge.

The study also leverages the theoretical lens provided by the Adaptive Decision Maker Framework (ADMF) (Payne, et al., 1993) and the "loss-aversion" component of Prospect Theory (Kahneman and Tversky, 1979).

2 Literature review

2.1 Application of theories

The ADMF developed by Payne, et al. (1993) has been used in managerial decision psychology, especially in cases where decision-makers are presented with more than one alternative and are required to select the most preferred outcome. The theory stipulates that preferential decision problems are framed using the following essential components:

1) The alternatives available to the decision-maker in terms of the number of attributes and possible outcomes;
2) Experiences of the decision-maker based on events that relate actions to probable outcomes;
3) The perceived value of those outcomes to the decision-maker.

Beresford and Sloper (2008) suggests that decision-makers would select alternatives that are less complex with less cognitive effort. Therefore, if certain decision-making tools are perceived to be more complex, there would be lesser interests in choosing them. Thus, when selecting between SBSC architecture to evaluate environmental investment decisions, simpler configurations will likely be the default option with effects of such complexity may be mitigated by the knowledge and experience of the decision-maker.

Prospect Theory explains how individuals prioritize loss-avoidance over potential gains (Kahneman and Tversky, 1979). Therefore, when the potential risks associated with an investment decision are added to the decision scenario, the decision-makers are likely to assign greater weight to outcomes that pose minimum risk to the organization.

For instance, if the decision involves investments that are likely to enhance financial gains but, at the same time, expose the firm to significant regulatory scrutiny or negative media coverage due to environmental hazards, the decision-maker will focus on avoiding potential risk instead of concentrating on the potential gains.

2.2 Environmental investment decision-making

Environmental investment decision-making entails selecting between alternatives that require the allocation of resources (Bostian, et al., 2016). Mostly, such decision options are in the form of project investments to be taken up by organizations to meet their environmental stewardship objectives (Rikhardsson and Holm, 2008).

Literature has established that business organizations usually pursue environmental projects either to comply with regulations (e.g., effluent treatment plants) or because they offer tangible benefits for the organization (e.g., combined cycle power plants that reduce energy consumption) (Pekovic, et al., 2018).

Managers apply various types of decision-making tools and frameworks to allocate resources to investment options (Hourneaux Jr., et al., 2018; Rikhardsson and Holm, 2008). There is also a growing consensus that good environmental performance creates value for organizations (Berrone, et al., 2010). Empirical evidence suggests that a positive correlation exists between environmental and financial performance in business organizations (Fayers, 1999).

2.3 Sustainability balanced scorecard (SBSC)

The SBSC has been widely recognized as a valuable tool in managing sustainability (Schaltegger and Wagner, 2011). SBSCs evolved from the traditional BSC that aims at integrating social and environmental considerations within it and enable management to address goals in all three dimensions of sustainability by integrating economic, environmental, and social aspects and keeping abreast of the triple bottom line concept (Jano-Ito and Crawford-Brown, 2017; Schaltegger and Wagner, 2017). The evolution from BSC to SBSC took place through multiple phases summarized below in Table 1.

Table 1. Evolution of BSC to SBSC-4 and SBSC-5
(*Source*: Authors` own research)

Phase	Summary of Phase	Source
1	BSC: Was introduced as a performance measurement system through a longitudinal research on 12 companies, at the leading edge of performance measurement. The study designed a dashboard (i.e., the BSC) that gives top management a fast and comprehensive view of their business. The BSC includes financial measures that tell the results of actions already taken by complementing financial measures with operational measures on customer satisfaction, internal processes and people within the organization.	Kaplan and Norton (2001)
2	SBSC-4: Four components (i.e., environment, safety and health performance, employment practices, and community investment) were embedded into the four BSC perspectives. This scorecard was designed for companies to comply with national and local regulations on the environment, employee health and safety, hiring and employment practices to avoid shutdowns or litigations, and so on.	Kaplan and Norton (2001)
3	SBSC-5: Stephan Schaltegger along with two of his Ph. D students published a seminal paper that introduces the SBSC framework where the sustainability parameters are proposed as a separate 5th perspective. Their initial intent was to introduce non-market perspectives such as “child labor.” In several follow-up papers, Schaltegger and his team introduced other components of sustainability related to the physical environment from environmental management accounting. The introduction of the 5th perspective, thus gave birth to two separate schools of thought on SBSC; one where sustainability parameters are embedded into BSC perspectives (SBSC-4) and the 5th perspective type configuration with sustainability as a separate perspective (SBSC-5), see Fig. 1.	Figge, et al. (2002)

SBSC-4: where Sustainability Perspective is embedded into each of the 4 BSC perspectives.	SBSC-5: where sustainability is shown as a separate 5th perspective.

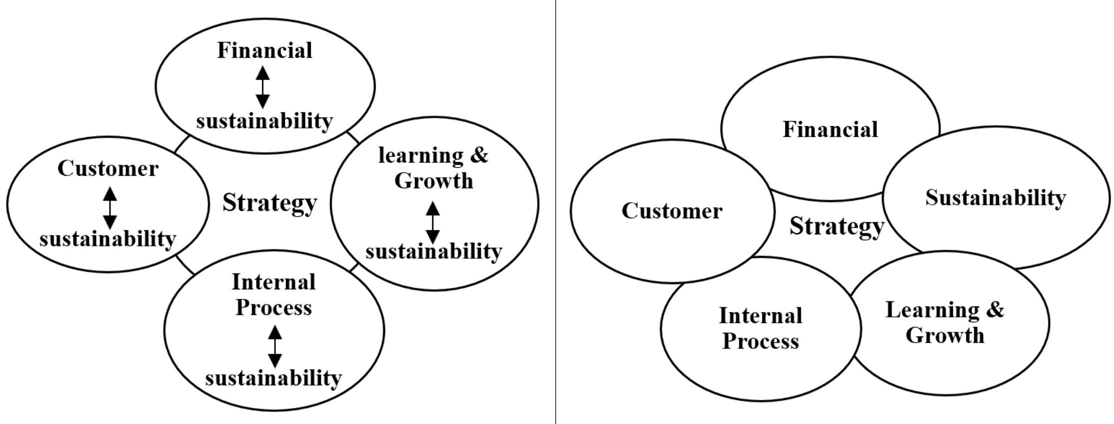

Figure 1. Architecture of SBSC-4 and SBSC-5 (*Source*: Authors’ own research)

2.4 SBSC knowledge

Effective decision-making requires the translation of SBSC to enable managers to utilize them for their intended outcomes (Gandhi, et al., 2018). Furthermore, the link between information received by managers and decisions taken by them is influenced by their knowledge (Cagno, et al., 2012; Ferreira, et al., 2013), as having information without adequate knowledge to synthesize them into actionable plans is unlikely to translate into effective decision-making (Kettinger and Li, 2010). SBSC, therefore, need to be well understood by managers to achieve their intended goals (Jassem, et al., 2018) as lack of adequate knowledge in implementing sustainability strategies can affect the outcomes of investments (Kaplan, et al., 2012). Therefore, this study assumes that, the SBSC can be used as an effective analysis tool to make effective environmental investment decisions.

2.5 Strategic risk information and SBSC architecture

Strategic risks are events or conditions that may be created due to external or internal changes such as decisions of policymakers, changes in market dynamics and consumer behavior, failures in internal processes, environmental impacts, and so on (Simons, 2000). Cheng, et al. (2018) investigated the influence of SRI with BSC used as a performance evaluation tool and established that organizations choose to combine their reporting of strategic risks and performance information in making strategic decisions. Hence, incorporating SRI into investment decision making tools, such as the SBSC, is crucial. (Olson and Wu, 2017; Wisutteewong and Rompho, 2015).

Several other studies (e.g., Kotze, et al., 2015; Wu and Olson, 2009) have examined the benefits of having a separate scorecard that manages strategic risks by balancing short- and long-term goals through risk consideration. Integrating strategic risk with BSC gives an overview of what might go wrong and potential opportunities to formulate reaction plans to satisfy a variety of stakeholders (Wu and Olson, 2009).

3 Theoretical framework and hypotheses development

The ADMF (Payne, et al., 1993), suggests that, in complex settings, a trade-off between the desire to maximize decision quality and the limited processing capacity of human decision-makers will lead to decisions that seek to minimize the cognitive effort required for decision-making (Beresford and Sloper, 2008). Hence, the way the sustainability information is presented to decision-makers through SBSC-4 and SBSC-5 is likely to influence their evaluation of environmental investment alternatives. This relationship will possibly be further impacted by, integrating SRI along with the SBSC architecture.

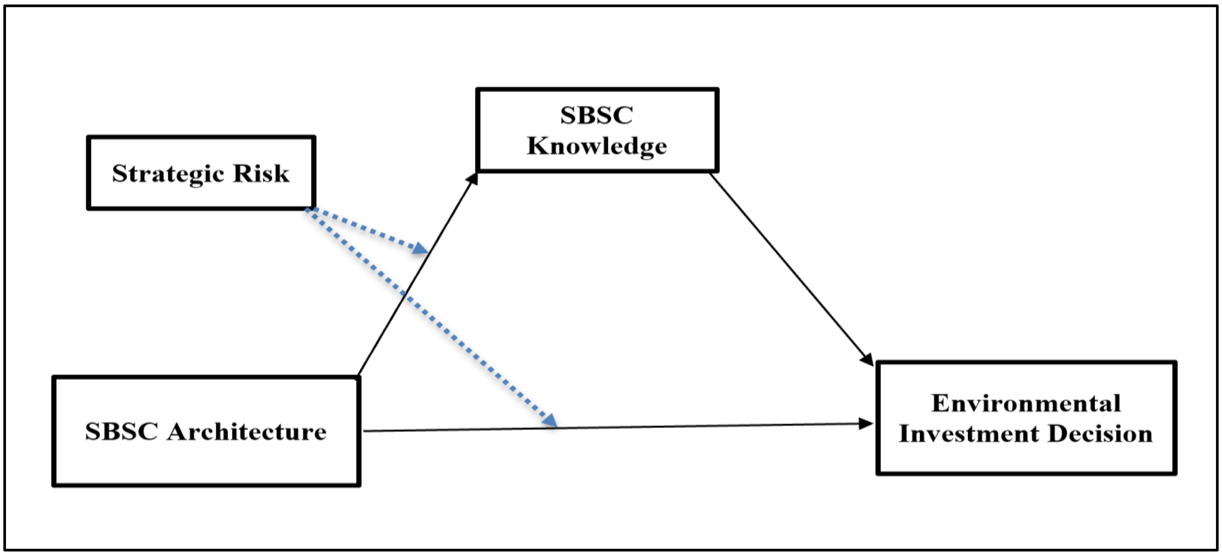

Figure 2. Research Model (*Source*: Authors` own research)

Furthermore, the loss-aversion component of Prospect theory leads to the possibility that decision-makers will prioritize decisions that minimize potential risk exposure to the organization. Hence, SRI is likely to moderate the relationship between SBSC-4 and SBSC-5 (i.e., SBSC architecture) and environmental investment decision-making. Therefore, the confluence of the two theories provides a suitable platform to predict the association between the constructs in the research model (Fig. 2).

3.1 Hypothesizing the difference between effects of SBSC-4 and SBSC-5 on environmental investment decision-making

Jiangtao and Pin (2010) found no significant difference between SBSC4 and SBSC-5 when decision-makers utilize them to select environmental investment alternatives, but they discovered that participants in their experiment took more time to utilize SBSC-5 compared to SBSC-4. In contrast, Kaplan and Wisner (2009) conducted an experimental study and discovered that environmental parameters data were discounted in judgments (i.e., less emphasized) by decision-makers. This was more prominent in the case of SBSC-5 as compared to SBSC-4, when management communication of environmental goals of the organization was low. However, when management communication was enhanced, environmental measures received more emphasis in SBSC-5 compared to SBSC-4. Furthermore, the study found no difference in judgement weightage for SBSC-4, both in cases of low and high levels of management communication about environmental goals. Alewine and Miller (2016) investigated the saliency of decision-makers on environmental features of dual-natured measures of SBSC and examined how past environmental reputation of organizations interact with SBSC architectures to impact saliency of environmental features in dual-natured measures. To summarize, the difference between SBSC-4 and SBSC-5 emanates from two sources: (1) ‘cognitive efforts’ are required by decision-makers to understand the SBSC architecture and (2) the ‘decision weights’ assigned by decision-makers to different features of the SBSC measures. Therefore, it is hypothesized that:

H-1a: *There is a significant difference between SBSC-4 and SBSC-5 when decision-makers utilize the architectures for environmental investment decision-making.*

Another pertinent aspect of managerial decision-making is the consideration of SRI in the process of evaluating environmental investment alternatives. When SRI is presented along with the SBSC architecture to decision-makers, the complexity of the framework is likely to be greater, thus demanding more cognitive effort. Therefore, it is expected that the difference between SBSC-4 and SBSC-5 will remain significant when SRI is presented to decision-makers. Hence, it is posited that:

H-1b: *When managers utilize SBSC architecture for environmental investment decision-making, the difference between the SBSC-4 and SBSC-5 will be significant when SRI is presented to them along with the two SBSC architectures.*

3.2 Mediation effect of SBSC knowledge

SBSC knowledge is defined as the knowledge about SBSC measures (i.e., common and unique measures) and how to apply them to make effective investment decisions (Kang and Fredin, 2012). Managers with limited experience in using scorecards tend to base their performance evaluations on common measures across units while ignoring the unique strategy measures of each unit (Banker, et al., 2011). A lack of sufficient knowledge on the efficient use of SBSC architecture can lead to undesirable outcomes in terms of environmental investment decisions (Jassem, et al., 2018). Case studies carried out on transnational companies by Epstein (2018) showed the difference that a thorough comprehension of sustainability measures among managers makes on the decision quality, when translating measures into sustainability management actions. The findings suggest that knowledge accounts for the link between measures and outcomes.

Based on the above arguments, it may be inferred that a thorough understanding of the concepts and application of SBSC architecture is essential for decision-makers to optimize environmental investment decisions. The level of knowledge and understanding of the SBSC metrics are likely to mediate the relationship between SBSC architecture (both SBSC-4 and SBSC-5) and environmental investment decision-making. Therefore, the following hypothesis is posited:

H-2a: *SBSC knowledge mediates the relationship between SBSC architecture (both SBSC-4 and SBSC-5) and environmental investment decision-making*

In the event of SRI being added to the SBSC architecture, the complexity of the parameters is likely to be compounded, thereby putting greater importance on SBSC knowledge. Therefore, it is expected that when SRI is added to the already complex SBSC configuration, the mediation effect of SBSC knowledge will be significant. This is formally stated by the following hypothesis:

H-2b: *When SRI is presented to decision-makers, SBSC knowledge mediates the relationship between SBSC architecture (both SBSC-4 and SBSC-5) and environmental investment decision-making.*

3.3 The moderating role of strategic risk information

It has been suggested that strategic decisions need to be made in the context of SRI assessments (Ignatius, 2018). Hence, organizations need to have a comprehensive risk management strategy in place. As prescribed by prospect theory, individuals react disproportionately to issues framed as losses than as gains (Kahneman and Tversky, 1979).

Accordingly, SRI in the SBSC architecture could allow managers to evaluate the performance of the existing strategy in light of its effect on the organization's overall risk exposure as well as to appraise investments that achieve environmental targets (Kaplan, 2009).

Therefore, this study predicts that integrating SRI as a moderator between SBSC architecture and environmental investment decision-making could influence managerial decisions when choosing between alternatives. Considering the above arguments, the following hypothesis is stated:

H-3: *SRI will moderate the relationship between SBSC architecture (both SBSC-4 and SBSC-5) and environmental investment decision-making.*

3.4 Integrated moderated-mediation model

The extant literature is appearing to be undecided on which SBSC format (i.e., SBSC-4 or SBSC-5) is preferable when including environmental performance measures (Jassem, et al., 2018). Hence, a finer-grained understanding of this issue is likely to benefit managers by providing a better understanding of how SRI interact with the SBSC architecture to influence environmental investment decision-making. Although previous studies have investigated this concept (e.g., Alewine and Stone, 2013; Alewine and Miller, 2016; Kaplan and Wisner, 2009) as well as the relationships between SBSC knowledge and SBSC architecture (Jassem, et al., 2018), and SRI and traditional BSC (Cheng, et. al., 2018), it appears that, so far, there has been no integration of all four variables into a single model. In such a model, the SRI would act as moderators on both the direct and indirect paths, and SBSC knowledge would act as a mediator while considering the impact of SBSC architecture on environmental investment decision-making. Therefore, this study proposed an integrated moderated-mediation hypothesis, as follows:

H-4: *SRI will moderate the indirect effect of SBSC architecture on environmental investment decision-making through SBSC knowledge. Specifically, SBSC knowledge will mediate the indirect effect of SBSC architecture on environmental investment decision-making when SRI is present.*

4 Research method

This section presents the research design employed for testing the hypotheses drawn from the research framework.

4.1 Participants

The participants selected for this study were senior executives in strategic and operational roles in multinational companies involved in the manufacturing of earthmoving equipment under the brand of Caterpillar, Volvo, Mitsubishi, and so on.

The participants were selected after reviewing their corporate profiles, which indicated that these organizations utilize BSC tools within their strategic and operational decision-making with fully functional Enterprise Risk Management programs in place. 43 and 65 individuals in Arabian Gulf country and Southeast Asia respectively, resulting in the participants with mixed levels of experience and geographical and cultural backgrounds. The use of industry practitioners, instead of using surrogates of real-world managers, is expected to produce more robust findings (Sarker and Burrit, 2008).

4.2 Experimental instrument design

The instrument used for this study was adapted from Alewine and Stone (2013) and further customized by borrowing the procedure suggested by Kaplan (2009) to suit the context of this experimental research. The current research divided the participants into four separate groups, and each was provided with a different SBSC architecture: SBSC-4 (with and without SRI) and SBSC-5 (with and without SRI), as presented in Table 2.

Table 2. Four groups and manipulated conditions (*Source*: Authors` own research)

Conditions	Configuration	Including risk	Number of SBSC perspectives	Experimental group No.
1	SBSC-4 without risk	No	4	Group 1
2	SBSC-4 with risk	Yes	4	Group 2
3	SBSC-5 without risk	No	5	Group 3
4	SBSC-5 with risk	Yes	5	Group 4
Note: Appendix A presents the details of the research instrument with four conditions.				

4.3 Case scenario and alternatives presented

The participants were asked to allocate funds between two investment options (A and B). The dependent variable was the investment outcome, measured based on the amount of money allocated (out of USD $20 million), to be invested and to align with the company's two primary strategic objectives: financial success and environmental stewardship. Participants were also given benchmarks for each measurement metric and projected performance measures for the investment options with only one alternative was projected to achieve each performance measure's targeted value (Appendix A).

In terms of the three SBSC perspectives (i.e., customer, internal business processes, and learning and growth), investment A would meet the target in two out of four metrics, while investment B would achieve the target in the other two metrics. The SRI was measured on a rating of 1 to 25 for each SBSC perspective. Thus, the SBSC architecture and SRI were projected to perform equally for both investments. However, from the financial perspective of the SBSC, investment B would achieve three out of the four metrics, while A would achieve the single remaining metric, signifying less financial risk in B compared to A. Investment B is an investment with higher financial return with a higher environmental risk. From the environmental perspective, investment A achieved the target in three out of four metrics, while investment B only achieved the other single environmental metric, reflecting a trade-off between higher financial risk and/or higher environmental risk.

4.4 Manipulated variables

Two sets of manipulated variables were considered in this study:

1) To manipulate the SBSC architecture, participants were presented with one of the two types of SBSC architecture (either SBSC-4 or SBSC-5); and
2) In order to manipulate the SRI, this study utilized the model suggested by Kaplan (2009) where the author proposed a 3 x 3 matrix (known as a Heat Map) where one axis presents scores for likelihood of occurrence of a certain type of risk, and on the other axis there are scores for magnitude of impact if such risk does occur. The product (i.e., multiplication) of the score for likelihood of occurrence

and magnitude of impact, gives a value that ranges from 1 to 25. Kaplan (2009) suggests that any score > 15 is considered a risk that has higher probability of occurrence with severe consequences if it does occur, hence it is a high priority risk, whereas any score < 15 would be the opposite (i.e., a low priority risk).

4.5 Measuring the mediator: SBSC knowledge

To measure the SBSC knowledge, a set of true or false questions, were adapted from Alewine and Stone (2013).

5 Results of the analysis

5.1 Background and homogeneity of participants

The participants' demographic features were generated by computing the descriptive statistics separately for each of the four groups in this experimental study. The four groups were determined to be demographically homogeneous by using the Chi-Square test (Rana and Singhal, 2015). The homogeneity of the participants between the two sets of participants (i.e., from Seminar 1 and Seminar 2) was tested using a sample t-test to determine whether the mean-scores of the groups were significantly different, and no statistically significant differences were found.

5.2 Descriptive statistics for allocation of funds (Investments A and B)

Table 3 shows the central tendency (mean) and dispersion from the mean (standard deviation) of the data on environmental investment decision-making. Based on this table, the mean scores of Investment B appear to be higher than those of Investment A (for both with and without risk included in the architecture), in the case of SBSC-4.

On the other hand, the results indicate that for SBSC-5, the mean scores of A were higher than those of B (without risk), but the mean score of B was higher than A (when risk was included).

Table 3. Descriptive statistics of environmental investment decision-making
(*Source*: Authors` own research)

SBSC Architecture	Risk	Investment A		Investment B	
		Mean	SD	Mean	SD
SBSC-4	Without risk	8.409 (42%)	2.922	11.591 (58%)	2.922
	With risk	5.521 (27.6%)	1.647	14.478 (72.4%)	1.647
SBSC-5	Without risk	12.833 (64.2%)	1.786	7.167 (35.8%)	1.786
	With risk	7.56 (37.8%)	2.123	12.44 (62.2%)	2.123
Mean-scores and SD are in millions of dollars allocated by the participants					

5.3 Results of manipulations

Both normality and homogeneity test performed indicated a normally distributed data and the assumption of the homogeneity of variances was met (Jayalath, et al., 2017).

5.3.1 Testing for hypotheses H-1a and H-1b

The two-way ANOVA compared the mean difference (MD) between groups that were split on two independent variables (SBSC-4 and SBSC-5) and the SBSC architecture (i.e., both SBSC-4 and SBSC-5) had a significant main effect on environmental investment decision-making ($F (1, 90) = 52.39$, $p < 0.001$, $\eta2 = 0.368$). Additionally, there was a significant main effect of SRI (with risk and without risk) on environmental investment decision-making ($F (1, 90) = 83.541$, $p < 0.001$, $\eta2 = 0.481$). The effect of the interaction between SBSC architecture (SBSC-4 and SBSC5) and SRI (with risk and without risk) on environmental investment decision-making was also statistically significant ($F (1, 90) = 7.141$, $p = 0.009$, $\eta2 = 0.074$).

Therefore, the results (Table 4) suggest that SBSC-4 and SBSC-5 have significantly different patterns of impact on environmental investment decision-making, thus supporting the hypothesis H-1a.

Table 4. Results of ANOVA for environmental investment decision-making (between subject effect)
(*Source*: Authors` own research)

Source	df	MS	F-Value	p-Value	η2
SBSC architecture	1	244.807	52.39	<0.001	0.368
Risk	1	390.369	83.541	<0.001	0.481
SBSC architecture risk	1	33.37	7.141	0.009	0.074
Dependent variable: environmental investment decision making, significant at p < 0.05					

In regards the Bonferroni post hoc test (Lee and Lee, 2018) for hypothesis H-1b to compare the impacts of the SBSC architectures with two levels of strategic risk (i.e., with and without SRI) on environmental investment decision-making, the difference was shown to be statistically significant ($p < 0.05$) with mean difference ($MD = 4.424$, $\eta2 = 0.384$). Therefore, the presence of SRI resulted in a significant difference between the two architectures in the pattern of impact on environmental investment decision-making. Therefore, hypothesis H-1b is supported.

Table 5. Pairwise Comparison between SBSC-4 and SBSC-5 (with risk and without risk)
(*Source*: Authors` own research)

Risk level	SBSC architecture		Mean difference (MD)	SE	p-value	95% CI for difference		η2
						LB	UB	
Without risk	SBSC-4	SBSC-5	4.424*	0.638	<0.001	3.157	5.692	0.384
With risk	SBSC-4	SBSC-5	2.038*	0.625	0.002	0.797	3.279	0.106
* The mean difference (MD) is significant at p < 0.05								

5.3.2 Test for the mediation effect of SBSC knowledge (H-2a and H-2b)

To test Hypotheses H-2a and H-2b, Table 6 revealed significant effects of the SBSC architecture on SBSC knowledge (IV to Mediator) where ($B = -0.697$, $p < 0.05$). Furthermore, SBSC knowledge was also shown to significantly affect environmental investment decision-making (Mediator to DV) ($B = 1.606$, $p < 0.001$). In addition, the direct effect of SBSC architecture on environmental investment decision-making (IV to DV) is negative and statistically significant ($B = -3.305$, $p < 0.001$). Finally, the indirect effect of SBSC architecture on environmental investment decision-making through SBSC knowledge as the mediator (IV-Mediator-DV) is negative and significant ($B = -1.119$, $p < 0.05$), indicating that SBSC knowledge mediates the relationship between SBSC architecture and environmental investment decision-making, thus supporting Hypothesis H-2a.

Table 6. Path coefficient for the mediation effect of SBSC knowledge between SBSC architecture and environmental investment decision-making (*Source*: Authors` own research)

Path	B	SE	T/Z	p-value	LLCI	ULCI
IV to Mediators (path a) SBSC architecture–SBSC knowledge	−0.697	0.334	−2.085	<0.05	1.371	−0.023
Mediator to DV (path b) SBSC knowledge–env. investment decision-making	1.606	0.210	7.641	<0.001	1.182	2.030
Direct effect (path c) SBSC architecture–env. investment decision-making	−3.305	0.488	−6.766	<0.001	−4.290	−2.320
Indirect effect (path ab) SBSC architecture–env. investment decision-making	−1.119	0.561	−1.996	<0.05	−2.046	−0.165
Significant at p-value < 0.05. The negative signs of the values of B are a result of the manner in which the dichotomous variables are coded. If the coding were reversed, then the values would appear positive. Hence the negative values do not warrant any remarks						

Table 7 revealed that in the presence of SRI, there is a significant effect of SBSC architecture on SBSC knowledge (IV to Mediator) ($B = -1.557$, $p < 0.001$). In addition, SBSC knowledge was shown to significantly affect environmental investment decision-making (Mediator to DV) ($B = 1.633$, $p < 0.001$).

Furthermore, the indirect effect of SBSC architecture on environmental investment decision-making through SBSC knowledge as mediator (IV-Mediator-DV) is negative and significant ($B = -2.542$, $p < 0.001$).

However, the results indicated that in the presence of SRI, the direct effect of SBSC architecture on environmental investment decision-making (IV to DV) is not statistically significant ($B = -0.503$, $p = 0.323$). It is worth mentioning that Hayes (2017) has argued that significant direct relationships between the IV and DV are not necessary to infer the presence of mediation.

Therefore, based on the above results, in the presence of risk, SBSC knowledge mediates the relationship between SBSC architecture and environmental investment decision-making, indicating that Hypothesis H-2b is supported.

Table 7. Results of the mediation test of SBSC Knowledge between SBSC Architecture and Environmental Investment Decision-Making (with risk) (*Source*: Authors` own research)

Path	B	SE	T/Z	p-value	LLCI	ULCI
IV to Mediators (path a) SBSC architecture–SBSC knowledge	−1.557	0.252	−6.180	<0.001	−2.064	−1.049
Mediator to DV (path b) SBSC knowledge–env. investment decision-making	1.633	0.218	7.493	<0.001	1.194	2.071
Direct effect (path c) SBSC architecture–env. investment decision-making	−0.503	0.504	−0.999	0.323	−0.511	1.518
Indirect effect (path ab) SBSC architecture–env. investment decision-making	−2.542	0.536	−4.743	<0.001	−3.640	−1.695
Significant at p-value < 0.05. The negative signs of the values of B are a result of the manner in which the dichotomous variables are coded. If the coding were reversed, then the values would appear positive. Hence the negative values do not warrant any remarks.						

5.3.3 Test for the moderating effect of strategic risk (H-3)

Hypothesis H-3 predicts that SRI moderates the relationship between SBSC architecture and environmental investment decision-making. To test the hypothesis, the Bonferroni Post Hoc test was applied. Results (Table 8) indicate that for both SBSC architectures (SBSC-4 and SBSC-5), the difference in the impact on environmental investment decision-making was significant for both risk scenarios (i.e., with and without risk).

The mean difference was greater for SBSC-5 (MD = −5.273, η2 = 0.238) compared to SBSC-4 (MD = −2.887, η2 = 0.182).

Table 8. Pairwise comparison between both risk levels (with risk and without risk) (*Source*: Authors` own research)

SBSC architecture	Risk		Mean Difference (MD)	SE	p-value	95% CI for difference		η2
						LB	UB	
SBSC-4	Without risk	With risk	−2.887*	0.645	<0.001	−4.168	−1.607	0.182
SBSC-5	Without risk	With risk	−5.273*	0.618	<0.001	−6.501	−4.046	0.447
* The mean difference is significant at p-value < 0.05. The negative signs of the values of MD are a result of the manner in which the dichotomous variables are coded. If the coding were reversed, then the values would appear positive. Hence the negative values do not warrant any remarks.								

5.3.4 Test of hypothesis H-4: Moderated-mediation effect

Hypothesis H-4 is an integrated moderated-mediation model, which predicts that the type of SBSC architecture affects environmental investment decision-making directly as well as indirectly through SBSC knowledge acting as a mediator, and that such effects are contingent upon the presence of risk parameters as a moderator on both direct and indirect paths.

Table 9 shows that the direct effect of SBSC architecture with risk was not significant (B = 0.477) while the direct effect without risk was significant (B = −3.298). The indirect effect of SBSC architecture with risk with a value of B = −2.516 was significant, and the indirect effect of SBSC architecture without risk with a value of B = −1.126 was significant.

This means that when the regression models are combined, all effects are significant except for the direct effect between the SBSC architecture and environmental investment decision with risk as the moderator. Based on guidelines provided by Hayes (2017), the significance of the conditional direct effect is not required to conclude presence of a moderated-mediation effect.

Table 9. Conditional direct and indirect effects of SBSC architecture on environmental investment decision-making (with and without risk) (*Source*: Authors` own research)

Effect	Risk	Effect	SE	LLCI	ULCI
Direct	Without risk	−3.298	0.511	−4.313	−2.282
	With risk*	0.477	0.490	−0.497	1.452
Indirect	Without risk	−1.126	0.503	−2.276	−0.215
	With risk	−2.516	0.490	−3.570	−1.671

* Effects are all non-standardized values. The negative signs of the values of B are a result of the manner in which the dichotomous variables are coded. If the coding were reversed, then the values would appear positive. Hence the negative values do not warrant any remarks.

For dichotomous moderators, Hayes (2015) suggested checking the index of moderated mediation (IMM). The IMM produced by SPSS PROCESS Macro assesses the equality of the conditional indirect effects in the groups being compared. When the index is not significant, these effects are equivalent (Hayes, 2015).

Based on the bootstrapping results, Table 10 shows that the confidence intervals did not straddle a zero-value, meaning that the IMM index was statistically significant, which further proves that the indirect effect of different risk levels (with and without risk) were significantly different. Therefore, hypothesis (H-4) is supported.

Table 10. Index of moderated mediation (*Source*: Authors` own research)

Mediator	Index	SE (Boot)	Boot LLCI	Boot ULCI
SBSC knowledge	−1.389	0.717	−2.992	−0.216

6 Discussions

This study has several findings. Firstly, it found that a significant difference exists between the two SBSC architectures (i.e., SBSC-4 and SBSC-5). The above finding is aligned with the theoretical premise of the ADMF model, which argues that "general measures of cognitive ability have been found to be associated with decision-making performance, with performance being adversely affected with increasing decision task complexity" (Beresford and Sloper, 2008, p. 35).

The result is also in agreement with the recent discourse in the extant literature, where Hansen and Schaltegger (2016) argued that sustainability parameters are often quite challenging to embed them into the traditional four scorecard perspectives (i.e., SBSC-4), which may make the architecture more complex compared to clustering the sustainability information into a separate perspective (i.e., SBSC-5).

Secondly, the difference between SBSC-4 and SBSC-5 is significant when SRI is presented to decision-makers compared to when it is left out. This result is expected because when SRI are presented to managerial decision-makers, they are more likely to emphasize the risk components over the sustainability components.

Third, SBSC knowledge mediates the relationship between SBSC architecture and environmental decision-making, in the presence or absence of SRI. This is consistent with prior discourse in the literature that suggests that SBSC architectures are complex in terms of their configuration (Kalender and Vayvay, 2016). Therefore, decision-makers would be required to have a firm grasp of the parameters of the SBSC (whether SBSC-4 or SBSC-5), as well as substantial experience to effectively utilize them to make decisions related to an organization's environmental stewardship objectives.

Fourth, the impacts of SBSC-4 and SBSC-5 are amplified when SRI is integrated with the architecture. In this regard, Kaplan and Mikes (2012) suggested that risk parameters are now an integral part of the organizational decision-making framework and that decision-makers generally aim to prevent negative outcomes. As a result, organizational decision-makers are more cautious when making investment decisions when potential strategic risks are not forecasted and laid out during the decision-making process. These findings are in alignment with one of the key premises of Prospect theory, which argues that individuals react more disproportionately to issues framed as losses than those framed as gains (Kahneman and Tversky, 1979). In the organizational setting, integrating SRI into the SBSC architecture allows managers to evaluate the performance of the existing strategy in light of its effect on the organization's overall risk exposure as well as to appraise investments that achieve environmental targets (Kaplan, 2009).

Fifth, the impact of SBSC architecture on environmental investment decision-making could be formulated as an integrated moderated-mediation model, where the above relationship is mediated by SBSC knowledge when both the direct and indirect paths are moderated by SRI. The findings from the integrated model align with the previous hypotheses that looked at relationships in isolation.

The fact that the indirect effect with SBSC knowledge as the mediator was significant (with and without SRI) conforms with the general logic that when decision-makers have substantial understanding and experience with using SBSC to make investment decisions, they are able to effectively and efficiently deploy such analysis tools to make decisions, regardless of whether or not SRI is presented. This is largely because of the fact that they can strike a balance between their organization's financial goals and environmental stewardship goals.

On the practical implications, the concomitant roles of SRI and SBSC knowledge in the relationship between SBSC architecture and environmental investment decision-making may provide important clues to senior managers on ensuring effective utilization of SBSC as investment evaluation tools to achieve environmental stewardship goals of their respective organizations. For instance, training modules for managers can be updated to include sufficient case studies and scenario analysis where SBSC architecture are utilized to build capacity of decision-makers to take effective decisions when trade-off situations between environmental targets and financial targets are apparent.

7 Limitations of the study and future research directions

This study has several limitations.

First, it is possible that many pertinent variables that were not considered in this study affect the judgments of decision-makers. For instance, Kaplan and Wisner (2009) suggested that management communication levels in organizations regarding environmental stewardship objectives impact on the judgment of decision-makers.

Second, environmental investment decision options in this study were limited to two hypothetical investments (A and B). If more than two investment options were presented, judgments by the participants may have been different. In the future, researchers should consider multiple outcomes in their experimental study.

Another opportunity for future researchers is to examine the difference in behavior of decision-makers based on different visual presentations of SBSC architecture. This may be done by exposing the same group of participants to different SBSC architecture, and thereafter, comparing their decision outcomes with each visual presentation.

8 Conclusions

The objective of this experimental study was to determine whether the type of SBSC architecture used influences the resulting environmental investment decisions.

The results demonstrate that SBSC architecture with sustainability parameters such as environmental metrics integrated into each of the four traditional perspectives of the scorecard was significantly different from a configuration where sustainability parameters were clustered into a separate fifth perspective. The fact that SBSC knowledge mediates the relationship between SBSC architecture and environmental investment decision-making suggests that the complexity of SBSC architecture and the amount of cognitive effort required by decision-makers can be minimized.

Additionally, the role of SRI as a moderating variable in the relationship between SBSC architecture and environmental investment decisions reveals an important difference between SBSC-4 and SBSC-5. Finally, an integrated moderated-mediation model was proposed and tested. The analysis of this model revealed that the conditional indirect effects of SBSC architectures and environmental investment decision-making using SBSC knowledge as a mediator (both with and without risk indicators) are significant, as is the direct conditional effect without risk.

9 Appendix A: Experimental instrument

Panel G1. An example of the information that the participants could see at one time (SBSC-4)

Financial perspective	Goals	Investment A	Investment B
Return on investment	17%	12–14%	16–22%
Annual cash flow increase	$325,000	$100,000–$300,000	$300,000–$400,000
Sales growth	24%	22–27%	18–23%
Payback period	3 years	5 years	3 years
Energy cost savings	**325,000**	**300,000–400,000**	**100,000–300,000**

Panel G2. An example of the information that the participants could see at one time (SBSC-4 with risk)

<table>
<tr><th>Financial perspective</th><th>Goals</th><th>Investment A</th><th>Risk</th><th>Investment B</th><th>Risk</th></tr>
<tr><td>Return on investment</td><td>17%</td><td>12–14%</td><td rowspan="5">>15</td><td>16–22%</td><td rowspan="5"><15</td></tr>
<tr><td>Annual cash flow increase</td><td>$325,000</td><td>$100,000–
$300,000</td><td>$300,000–$400,000</td></tr>
<tr><td>Sales growth</td><td>24%</td><td>22–27%</td><td>18–23%</td></tr>
<tr><td>Payback period</td><td>3 years</td><td>5 years</td><td>3 years</td></tr>
<tr><td>Energy cost savings</td><td>325,000</td><td>300,000–400,000</td><td>100,000–300,000</td></tr>
</table>

Panel G3. An example of the information that the participants could see at one time (SBSC-5)

Environmental perspective	Goals	Investment A	Investment B
Energy cost savings	**325,000**	**300,000–400,000**	**100,000–300,000**
Number of community complaints about company pollutant emissions	3	1–3	7–9
Annual tons of nitrogen dioxide emissions	30	20–30	40–55
Number of hours of training per factory employee for environmental emergency responses	275	180–250	240–300

Panel G4. An example of the information that the participants could see at one time (SBSC-5 with risk)

<table>
<tr><th>Environmental perspective</th><th>Goals</th><th>Investment A</th><th>Risk</th><th>Investment B</th><th>Risk</th></tr>
<tr><td>Energy cost savings</td><td>325,000</td><td>300,000–400,000</td><td rowspan="4"><15</td><td>100,000–300,000</td><td rowspan="4">>15</td></tr>
<tr><td>Number of community complaints about company pollutant emissions</td><td>3</td><td>1–3</td><td>7–9</td></tr>
<tr><td>Annual tons of nitrogen dioxide emissions</td><td>30</td><td>20–30</td><td>40–55</td></tr>
<tr><td>Number of hours of training per factory employee for environmental emergency responses</td><td>275</td><td>180–250</td><td>240–300</td></tr>
</table>

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