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RISK FRAMING IN PERFORMANCE MEASUREMENT SYSTEMS: THE EFFECT ON RISKY DECISION-MAKING

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Abstract

To address the limitations of the traditional performance measurement systems (PMSs) in visualizing risk and preventing excessive managerial risk-taking, a number of research studies proposed to extend the functionality of PMSs by incorporating risk measures and goals and thereby enabling a better view on organizational risk exposures. While researchers still continue to provide claims regarding the benefits of a balanced approach to combined risk and performance representation in PMSs, the literature still lacks a uniform vision about the design of such risk-aware PMS and about how effective it is in the context of making risky decisions. In this study, a laboratory experiment was conducted to investigate how framing risk through strategic goals and key indicators incorporated in a PMS affects risky decision-making. The findings demonstrated a significant direct effect between PMS problem frame and risky decision-making. Specifically, the choice of a PMS frame with performance-driven strategic goal (emphasizing organizational focus on increasing gain/performance) and no risk measure was proved to result in a higher level of managerial risk taking compared to the choice of a risk-aware PMS frame which adopted a risk-driven strategic goal (emphasizing organizational focus on minimizing potential loss/risk), a risk measure or both. The study demonstrated that the inclusion of risk measure(s) and/or risk-driven strategic goal(s) in PMSs allows for risk information to be incorporated in managerial decision-making and thereby results in lower risk-taking.

Keywords: performance measurement system, risky decision-making, decision support, laboratory experiment

1   INTRODUCTION

The inability of organizations to manage uncertainties that arise from constant change in operational, regulatory and socio-technical environment (Chenhall, 2003) have resulted in a number of enterprise losses worldwide (Breden, 2009; Dikstein & Flast, 2009). According to the research evidence mostly originating in the management accounting literature (Mikes, 2009; Mikes, 2011; Power, 2009; Arena et al., 2011), the separation of risk management from managerial strategic and operational decision-makings is amongst the root causes of such losses. The incorporation of risk information in organizational management control systems, including Performance Measurement Systems (PMSs) (Chenhall, 2005), which aim to assist in implementation of strategic and operational corporate goals, should therefore lead to a better integration of risk in managerial decision-makings (Mikes, 2011; Kaplan, 2009; Bai et al., 2012; Valacich et al., 2009). It was argued by Kaplan (2009) that PMSs cannot generate long term success unless risk is taken into account. Without sufficient risk consideration, managerial attention on strategy implementation and performance generation can lead to unrealistic level of risk-taking. As a result, calls have been made for explicit representation of risk in the existing PMSs (Scholey, 2006; Calendro Jr & Lane, 2006; Kaplan & Mikes, 2011). The resulting risk-aware PMS are claimed to represent an effective decision support embedded in organizational information systems as it allows the trade-offs between opportunities to increase performance and organizational exposures to risk to be managed (Mikes, 2009; Beasley et al., 2006; Kaplan & Mikes, 2011).

Despite the growing calls of practitioners and researchers on combining performance and risk indicators as part of integrated PMS tools for decision-making, there is a significant *research gap* in this area characterized by lack of empirical support, coherent theoretical framework and variations in the suggested PMS designs supporting such integration. More specifically, the existing examples of analytical techniques that rely on risk measurement indicators are still scarce in the research literature (Davies et al., 2006; Scandizzo, 2005). There is very limited evidence of attempts of integrating such indicators into the PMSs (Kaplan & Norton, 2004). Moreover, the psychological aspects of decision-making in the context of using such innovative decision support tools as risk-aware PMSs are still largely unexplored. Given the fact that the epistemological nature of risk is closely associated with the manifestation of intent of individuals or organizations (i.e. risk is defined by the International Risk Management Standard AS/NZS ISO 31000:2009 as an effect of uncertainty upon objectives, whereas Committee of Sponsoring Organizations of the Treadway Commission (2004 p. 37) defines risk as "the possibility that an event will occur and adversely affect the achievement of objectives"), the adoption of psychological theories , such as Goal valence theory (Biner & Hua, 1995), that deal with the effect of framing the decision-making context (problem framing) and/or framing the intent that drives the decision-making process (goal framing), is needed for exploring the effect of framing risk in PMS when facing risky decisions. Finally, the role of such highly debated factors that play a major role when making risky decisions as risk perception and risk propensity (i.e. Sitkin & Weingart, 1995; Wong, 2005) has not been explored yet in the emerging literature on risk-aware PMS.

By addressing these research gaps, the study aims to determine the nature of the relationship between risk-aware PMSs and risky decision-making and the role such factors as risk perception and risk propensity play in establishing this relationship. The significance of this study lies in the empirical testing of the potential ways of combining risk and performance indicators (measurement frame) as well as strategic goals (goal frame) within a financial perspective of PMS. More specifically, it is the first study to explore the effect of risk-aware PMS design under performance-driven and risk-driven measurement and goal frames on risky decision-making while taking into account such cognitive factors affecting managerial risky decision-making as risk perception and risk propensity.

The remainder of the paper is organized as follows. In Section 2 the emergent literature on the integration of risk into PMS is reviewed and a set of hypotheses are formulated. Section 3 provides a summary on the laboratory experiment that is conducted to test hypotheses 1-4. The results from the experiment are summarized in Section 4, followed by a discussion in Section 5. Conclusion, limitations and future research directions are outlined in Section 6.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Risk Measurement in Performance Measurement Systems

Through decades of incremental improvement, Performance Measurement Systems (PMSs) have evolved from their original conceptualization into an integrated, organized and balanced framework of nonfinancial and financial measures (Ittner & Larcker, 1998).The integrated nature of PMS is explained by Chenhall (2005) to contain two components: firstly, an information that provide cause-effect linkages between strategy, operations and various aspects of value chain, including supplier and customers; and secondly, the provision of strategy-related measures across a number of perspectives, including financial and non-financial perspectives. Although provision of measures in key strategic areas of company through four perspectives is considered a "balanced" approach to performance measurement by Kaplan & Norton (1992), such provision does not necessarily reflect a "balanced" approach to value creation. Value creation which only focuses on performance improvement without explicit consideration of organizational exposures to risks may result in adverse events entailing a long chain of consequences such as, for example, witnessed in pre-Sarbanes Oxley era (Dikstein & Flast, 2009) and during the global financial crisis (Kaplan, 2009). One of the most common root causes of such corporate failures is considered to be the creation of short term revenue growth, cost control, and quality without systemically accounting for the risk inherent to the organizational activities and business processes (Kaplan & Mikes, 2011). Further examination of the literature in this field (Huelsbeck & Merchant, 2011; Power, 2009; Guo et al., 2011) also demonstrates that managers' cognitive limitations can result in overconfidence in the business models that drive value creation of their organizations and in unwillingness to challenge existing strategy and acknowledge the potential risk associated with it even upon the adoption of the state of the art PMSs.

Due to the weaknesses in PMSs and risk management systems in preventing excessive risk-taking, several studies have proposed to incorporate risk measure(s), or Key Risk Indicators (KRIs) into PMSs. At the same time, while researchers still continue to provide largely unsubstantiated claims regarding the benefits of introducing risk component into the PMS, the literature in this domain lacks a uniform vision about what constitutes a risk-aware PMS. For example, Beasley et al. (2006) proposed to incorporate risk measure and risk objectives into an existing PMS based on performance related strategic goals and Key Performance Indicators (KPIs). Kaplan (2009) suggests quite a different design solution in which a parallel risk scorecard containing risk measure would be created and implemented separately from a traditional Balanced scorecard. The purpose for a separate performance and risk scorecard is that performance measurement and risk measurement systems require different process of computation and under the responsibility of different people (Calendro & Lane, 2006).

Based on the above suggestions from several risk management and performance measurement studies, it can be concluded that risk-aware PMSs consists of risk-aware strategic goals and risk measures which address and draw manager's attention to adverse events that may occur and prevent the achievement of strategy. The connection between risk measure and performance measure is through strategy as performance measure indicates the strategic progression while risk measure indicates issues in the internal and external environments that may impact the implementation of strategy. At the same

time, there is a significant *research gap* in the emerging domain of risk-aware PMS characterized by lack of empirical support, coherent theoretical framework and variations in designs of the combination of performance and risk measures within an integrated tool for decision support.

2.2   Hypothesis Development

The experimental literature has argued that altering the presentation of the properties of a PMS, such as performance target, can lead to variation in managerial decision-making. For example, Luft (1994) empirically demonstrated that an outcome presented as a penalty ($3 deduction from $11 compensation if performance is below the target) is valued as loss due to the fact that such outcome is below the performance target. On the contrary, the outcome framed as bonus is valued as a gain ($3 addition to 8$ compensation if performance is above the target) as it is evaluated to be above the performance target. Although both decision-making contexts are equivalent to one another, outcome framed as bonus is often selected. Chow et al. (2007) demonstrated that performance target can lead to differences in risky decision-making where high performance target will cause more outcomes to be framed as loss-making than low performance target and ultimately result in riskier decision-making.

Different presentation of the same decision-making context which can lead to different decision-making choices is known as the problem framing effect (Sitkin and Weingart, 1995). The framing effect explored in this study is dictated by the very nature of the performance measurement systems that are based : a) on a set of strategic goal statements covering major perspectives of organizational value creation (in our case, the financial perspective); and b) the corresponding measures/indicators which are associated with the strategic goals (i.e. Kaplan & Norton, 1996). Specifically, in the context of this study, problem framing effect is manipulated through varying the representation of the following aspects of PMSs: a) either performance-driven strategic goal (goal which emphasizes the intent of organization to maximize the potential gains associated with one of the major perspectives on value creation i.e. financial, customer-focused etc.) or risk-driven strategic goal (goal which emphasizes the intent of organization to minimize potential losses associated with one of the major perspectives on value creation); and b) the inclusion or exclusion of a Key Risk indicator (KRI) which reflects the potential losses associated with a risky situation.

Prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981) and Goal valence theory (Levin, Schneider & Gaeth, 1998; Biner & Hua, 1995) have demonstrated that negatively framed information, such as the emphasis on potential losses in the decision support tool used by managers, can have a stronger impact on judgment than equivalent positive information and can create a strong loss aversion tendency. The loss aversion tendency resulting from presentation of potential losses in risk-aware PMS that are based on either risk-driven strategic goal and/or KRI will therefore lead to lower risky decision-making. This is because less risky decision options usually involve lower potential losses than risky decision options In the context of this study, we refer to: a) framing of the Strategy Map part of PMS (e.g. Kaplan & Norton, 1996), which is based on either performance driven or risk driven strategic objective(s)), as *goal frame*; and b) framing of the measurementindicators part of PMS (e.g. Kaplan & Norton, 1996),), which either includes Key Risk indicators (KRI(s)) together with Key Performance indicators (KPI(s)), or is based on KPI(s) only, as *measurement frame*. Both frames are two integral components of the *performance measurement system frame.*

Based on the above literature, it is hypothesized that:

H1: Performance measurement system frame (the interaction between goal frame and measurement frame) will directly affect managerial risky decision-making.

The influence of problem framing on risk perception is strongly supported by several research studies, which adopt different methods of problem framing, mostly grounded in Prospect Theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). Based on an analysis of researches, risk perception can be defined as individual assessment of how risky a situation is which in turn influence the assessment of riskiness of available decision options (Sitkin & Weingart, 1995; Williams et al., 2008; high& Milliman, 1997).

Risk-aware performance measurement system frame creates higher perceived situational risk through risk-driven strategic goal which focuses on loss minimization and KRI(s) which measure such potential losses. These features heighten the perception of potential losses and negative situations as well as the awareness of potential threats (Sitkin & Weingart, 1995; Highhouse & Yuce 1996, Levin et al., 1998). High risk perception will cause individual to select less risky options as it offers lower potential losses. On the contrary, performance measurement system frame which contains performance-driven strategic goal and no KRI(s) will lead to lower perceived situational risk. This is because performance-driven strategic goal focuses on gain maximization and without KRI(s) there is insufficient consideration of risk or potential losses. The resulting lower risk perception will cause individual to select risky options as risky options are perceived to be an opportunity to further maximizes the potential gains.

H2: Performance measurement system frame (the interaction between goal and measurement frame) will affect managerial risk perception.

H3: An increase/decrease in managerial risk perception will lead to a lower/higher level of risk taking in managerial decision-making.

Risk propensity is defined by Sitkin & Weingart (1995, pg. 1575) as "individual tendency to take or avoid risks". Risk propensity is a separate construct from risky decision-making as individual may not consistently act on their propensity (Sitkin & Weingart, 1995). For example, individual that takes higher risk in personal investments may takes lower risk in the choice of recreation activities (Maccrimmon & Wehrung, 1985). Sitkin & Weingart (1995) explained that risk propensity can increase or decrease the salience of potential losses or potential gains in risky options and hence may lead to a biased risk perception. Individuals with low risk propensity (i.e. exhibiting tendency to avoid risks) are likely to overestimate probability of losses and weight potential losses more than potential gains (Sitkin & Pablo, 1992). Individuals with high risk propensity (i.e. exhibiting tendency to take risks) are likely to underestimate probability of losses and weight potential losses less than potential gains (Sitkin & Weingart, 1995). In the context of this study, it is therefore hypothesized that:

H4: There is a negative relationship between risk propensity and risk perception exhibited by managers facing a risky decision and using a performance measurement system as a tool to support decision-making.

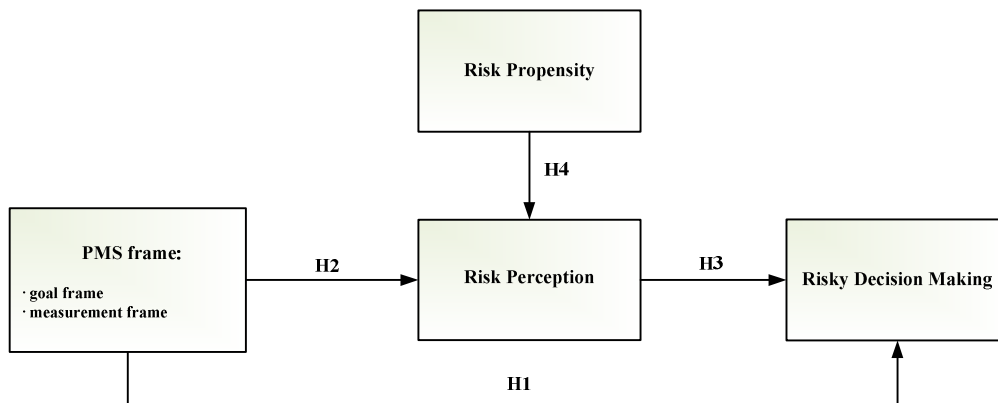Figure 1 below summarizes the hypothesis development.

Figure 1.   Hypothesis development framework

3   RESEARCH METHOD

3.1   Research design

A laboratory experiment was conducted to test Hypotheses 1-4. The experiment followed a 2x2 factorial design in which goal frame and measurement frame are varied across two levels. In this laboratory experiment, the dependent variable was the level of riskiness of decision-making. The independent variables were goal frame and measurement frame, which formed the overall PMS frame as demonstrated in Figure 1. Risk perception and risk propensity were mediating variables in the suggested experimental setting.

3.2 Experimental procedure
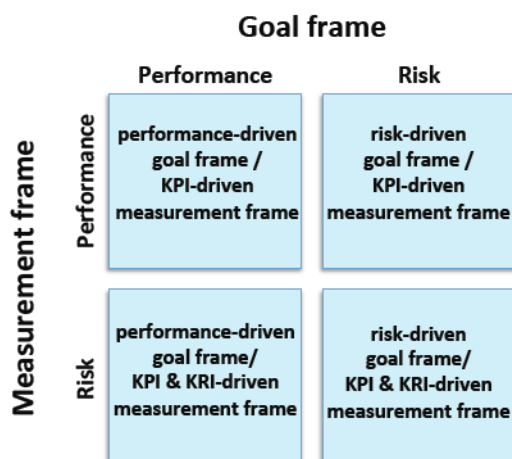
Eighty-five second year undergraduate students with accounting majors were randomly assigned to four experimental groups: i) performance-driven goal frame / KPI-driven measurement frame; ii) risk-driven goal frame / KPI-driven measurement frame; iii) performance-driven goal frame/ KPI & KRI-driven measurement frame; and iv) risk-driven goal frame/ KPI & KRI-driven measurement frame (Figure 2). Due to the relative simplicity of instrument and task, it was found appropriate to use second-year undergraduate students as surrogates of junior managers (Brownell, 1995). Participants required minimal amount of task-specific knowledge to complete the task. A total of 16 experimental sessions were conducted over the period of one week in year 2012.

Figure 2. Outline of the 2x2 between-subjects experimental design implemented in this study

All participants were asked to assume the role of junior product manager at Company XYZ and make an asset allocation decision regarding the investment in new products. At the beginning of each year, at

least two new products were proposed to product manager. The products were characterized by a Return on Investment (ROI) probability distribution associated with each product. Product A's ROI was normally -distributed while Product B's ROI distribution was bi-modal.

The measurement frame was manipulated by the inclusion of the *Expected Risk of Performance Loss (ERPL)* which measured the expected performance loss that will be suffered by the company if product's ROI is below performance target. When a PMS with a risk measurement frame was assigned to a participant, both performance target (15%) and a threshold value for ERPL (11% ROI) were specified to establish a reference point for organizational expectations associated with managerial performance. For individuals who were assigned to measurement frame containing risk measure, ERPL measures of both products were indicated. ERPL for Product A was 4.25% ROI while for Product B was 9.28% ROI. This higher risk however was compensated by higher probability of ROI above the performance target. The goal frame was manipulated by either focusing on risk minimization or performance improvement in the statement of the strategic goal which is the inherent part of the PMS.

Participants indicated their asset allocation decision by stating dollar amounts allocated for Product A and Product B in the designated space. They could either invest the total amount of allocated funds in one product or diversify the investment across two proposed products. Participants' preference towards Product B, expressed as the portion of money allocated for this product, indicated higher risk taking as the choice of Product B reflected a riskier decision than the choice of Product A.

3.3 Assessment tools

3.3.1 Performance measurement system

Although several research studies on PMS (Libby, Salterio & Webb, 2004; Banker, Chang & Pizzini, 2004; Lipe & Salterio, 2000) have manipulated both outcome, such as return on sales, and input/drivers (of the outcome) measures, such as employee job satisfaction, this experiment focuses on the outcome measure only. It is well documented in the literature that there is a tendency for managers to put more weight on outcome measures in the financial and customer perspectives than on input/driver measures in other perspectives of PMS, such as learning and growth and internal business processes (Lipe & Salterio, 2000; Ittner, Larcker & Meyers, 2003). Furthermore, financial perspective is on top of the strategy map hierarchy as it is considered to be the ultimate reference point that reflects suitability of strategic actions and decision-making (Kaplan & Norton, 1996). These considerations determined the focus of this study on the financial perspective of PMSs. The integration of risk into other perspective of PMSs is outside the scope of this study and forms the basis for the future research directions triggered by the findings of this study.

The performance target is chosen to be 15% ROI which is equivalent to the average of both products' ROI probability distribution. This is done to reduce the confound effect (Cook & Campbell, 1979) in which participant's risky decision-making is influenced by the differences in expected value of the product.

3.3.2 Risk measure: Expected risk of performance losses (ERPL)

Expected Risk of Performance Loss (ERPL) risk measure calculates the maximum or expected performance loss[1] that will be suffered by the company if product's ROI is below performance target. Therefore, the inclusion of ERPL risk measure allow for risk of performing below the performance target or performance losses to be accounted for by computing the cumulative probability of specific

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[1] The difference between performance target ROI and specific ROI below the target

ROI occurring below performance target times performance losses at specific product's ROI below performance target.

3.3.3 Risk propensity measurement scales

For the purposes of this experiment, two widely used risk propensity scales were adapted: Sitkin & Weingart's (1995) and Young (1985). Two different types of risk propensity scales were used in this experiment to ensure robustness of the results through measuring different aspects of risk propensity. Sitkin & Weingart's (1995) risk propensity scale consists of five questions which ask participant their tendency to make different risky decisions in different scenarios specifying participants' preferences on a one to seven scale. These questions were modified in order to suit the context of the experiment. The scale proposed by Young's (1985) derives the measure of risk from the preferences that participants make when asked to participate in a virtual lottery with varying probabilistic input and output conditions

3.3. Risk perception measurement scale

Risk perception measurement scale is adapted from Sitkin & Weingart (1995). Participants were asked to characterize the decision-making problem associated with investing in new products according to three dimensions on a one-to-seven scale: opportunity and threats, potential gain and potential loss and positive and negative situations. The scale is highly relevant to this study in comparison to other risk perception measurement scales (Williams et al., 2008; Keh et al., 2002) as it was originally developed to measure the effect of problem framing and risk propensity on risk perception. The importance of asking participants to evaluate the decision-making problem presented to them, rather than the decision they have made, is crucial as it is likely that participant will positively evaluate their own decision. Minor modifications were made to Sitkin & Weingart's (1995) measurement scale so that it matches with the design of the experiment.

4 RESULTS

4.1 Statistical tests and descriptive statistics

Before the hypothesis testing, Partial Least Squares (PLS) measurement model analysis was conducted in order to ensure validity and reliability of the hypothesized model. Then Analysis of Variance (ANOVA) and Partial Least Squares (PLS) structural analysis were conducted to test the hypotheses. Finally, two-way ANOVA and contrast coding were conducted to examine whether there were any significant differences in risky decision-making between different treatment groups. Taking into account the strict page limit of PACIS conference proceedings, only major statistical results are discussed are demonstrated and discussed below. The rest of the statistical analysis output (especially, the results discussed in Section 4.4) will be reported at the conference and is available upon request.

4.2 Descriptive statistics and analysis of the measurement model

Table 1 below presents the descriptive statistics for this study. We also examined convergent and divergent validity of hypothesized constructs with several statistical tests through the use of Partial Least Square (PLS) measurement model analysis. Convergent validity is defined by Brownell (1995) as "an assessment of validity of two quite different measurement methods to produce highly correlated measure of a given trait". Factor loading from confirmatory factor analysis and Average Variance

Extracted (AVE) were used to support the convergent validity of risk perception and risk propensity (Kline, 2005; Fornell & Larcker, 1981). Table 2 reports on the factor loading of individual items. Bootstrapping of 1000 sample was conducted to generate the significance level of each item.

Variable	Minimum	Maximum	Mean	Std. Deviation
Risk propensity (Sitkin & Weingart, 1995)	9.00	31.00	21.46	4.29
Risk propensity (Young, 1985)	10.00, %	100.00,%	62.88,%	17.50,%
Age	17.00	25.00	20.53	1.49
Years of full time work experience	0.00	4.00	0.54	0.95

Table 1.   Descriptive statistics

Although it is recommended by some literatures that loading which is less than 0.70 should be excluded from the model (Kline, 2005; Carmines & Zeller, 1979), several research studies have included variable with lower factor loading (Kober et al., 2007; Shields & Shields, 1998; Chenhall, 2005). Moreover, risk perception and risk propensity scale have been tested in prior studies (Sitkin & Weingart, 1995; Wong, 2005; Young; 1985). Hence, in this study, items with factor loading less than 0.70 were not eliminated. However for risk propensity, Q3[2] (question 3) was eliminated due to the fact that it's part of the risk propensity measurement scale which was not tested in prior studies with problem framing unlike Q2.

Variable and Items	Loading	Standard Error	T-Statistic
Risk perception			
gain/loss	0.76	0.19	4.15
opportunity/threat	0.63	0.26	2.49
positive/negative	0.73	0.19	3.98
Risk propensity			
Q2.1	0.29	0.33	0.86
Q2.2	0.47	0.33	1.43
Q2.3	0.54	0.33	1.64
Q2.4	0.81	0.26	3.09
Q2.5	0.24	0.34	0.72

Table 2.   PLS measurement model

AVE is the amount of variance a latent variable capture from its observed variable relative to the amount due to measurement error (Fornell & Larcker, 1981). The minimum threshold of AVE is 0.50 which suggested that half of the variance in observed variable was explained by latent variable. The results in Table 3 demonstrate that AVE for risk propensity is much below the minimum threshold.

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[2] Q3 factor loading is -0.34, standard error is 0.31 and t-value is 1.08.

Hence, it was concluded that convergent validity for risk perception was reached and the measurement model was usable for testing the hypothesized framework (see Figure 1). However, the lack of convergent validity for risk propensity was considered to be a limitation to the hypothesized framework.

Variable	AVE
Risk perception	0.50
Risk propensity	0.26

Table 3.   Average Variance Extracted (AVE) of Latent Variables

The results in Table 4 report a strong average inter-item correlation for risk perception as its Cronbach Alpha is 50.20% and its composite reliability is 5% greater than the required minimum threshold. On the other hand, risk propensity Cronbach Alpha is 45.86% and its composite reliability is below the threshold. Hence, it can be concluded that risk perception construct is reliable and usable in testing the hypothesized model. However the lack of reliability for risk propensity scale may provide a source of limitation to the hypothesized model.

Variable	Composite reliability	Cronbach alpha
Risk perception	0.75	0.50
Risk propensity	0.60	0.46

Table 4.   Cronbach Alpha and composite reliability

	Goal frame	Goal frame x measurement frame	Measurement frame	Risk perception	Risk propensity	Risky decision-making
Goal frame	1					
Goal frame x Measurement frame	0.74**	1				
Measurement frame	0.09	0.70**	1			
Risk perception	0.33**	0.20	-0.03	0.71		
Risk propensity	-0.21	0.08	0.32**	-0.26**	0.51	
Risky decision making	-0.47**	-0.39**	-0.21	-0.16	0.05	1

** =significant at 0.05 (two-tail)

Table 5.   Correlation of Variables from PLS model and Square Root of AVE (diagonal)[3]

Discriminant validity was assessed based on the correlation of variables and square root of AVE. The results are presented in Table 5. The square root of AVE of each variable was greater than their

correlations with other variables and hence it can be concluded that each variable represents a separate construct.

4.3   Hypothesis testing using PLS structural model

The results reported in Tables 5 and 6 as well as in Figure 3 indicate that there is a significant correlation and association at 5% significance level between 'goal frame x measurement frame' and risky decision-making. Therefore, *Hypothesis 1* was supported. At the same time, the measurement frame direct effect on risky decision-making is not significant. This means that measurement frame, with or without risk indicator, on its own does not affect risky decision-making if the goal framing effect is not considered. On the other hand, according to Table 5 and 6, goal frame on its own significantly affect risky decision making.

Table 6 indicates that 'goal frame x measurement frame' do not significantly affect risky perception. The results in Table 5 show that the association between 'goal frame x measurement frame' is not significant at one-to-one basis as the correlation between the two are beyond 5% significance level. Hence, *Hypothesis 2* was not supported.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="6" align="center">Independent variable</td></tr>
<tr><td>Goal frame</td><td>Goal frame x measurement frame</td><td>Measurement frame</td><td>Risk perception</td><td>Risk propensity</td><td>Risky decision making</td></tr>
<tr><td rowspan="6">Dependent variable</td><td>Goal frame</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Goal frame x Measurement frame</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Measurement frame</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Risk perception</td><td>0.25 (0.090)</td><td>0.01 (0.962)</td><td>0.01 (0.940)</td><td></td><td>-0.37** (0.016)</td><td></td></tr>
<tr><td>Risk propensity</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Risky decision making</td><td>-0.46** (0.000)</td><td>0.27** (0.007)</td><td>-0.16 (0.121)</td><td>0.02 (0.87)</td><td></td><td></td></tr>
</table>

** =significant at 0.05 (two-tail)

Table 6.   Paths coefficients and significance (P-values)

The results in Table 5 demonstrate that on a one-to-one basis, the direction of the relationship between risk perception and risky decision-making corresponded to the initial prediction. However the results of PLS analysis in Table 6 reported on the direction of relationship contrary to the one expected and indicated that there was no significant relationship between risk perception and risky decision-making. Hence, *Hypothesis 3* was not supported.

The results demonstrate a significant negative correlation and relationship between risk propensity and risk perception which is significant at 5% level. The direction of the relationship is according to what is expected as an increase in risk propensity will lead to a decrease in risk perception. Hence, *Hypothesis 4* was supported.

In order to assess the explanatory power of the PLS model or how well the model explains the variance, multiple correlation (R2) analysis was performed. The results of the analysis indicated that the multi R2 measure of the 'Risky decision-making' dependent variable was 0.28, whereas for the 'Risk perception' it was 0.09. These results demonstrated that the explanatory power of the direct effect hypothesis was much higher than the explanatory power of the mediated effect hypothesis.
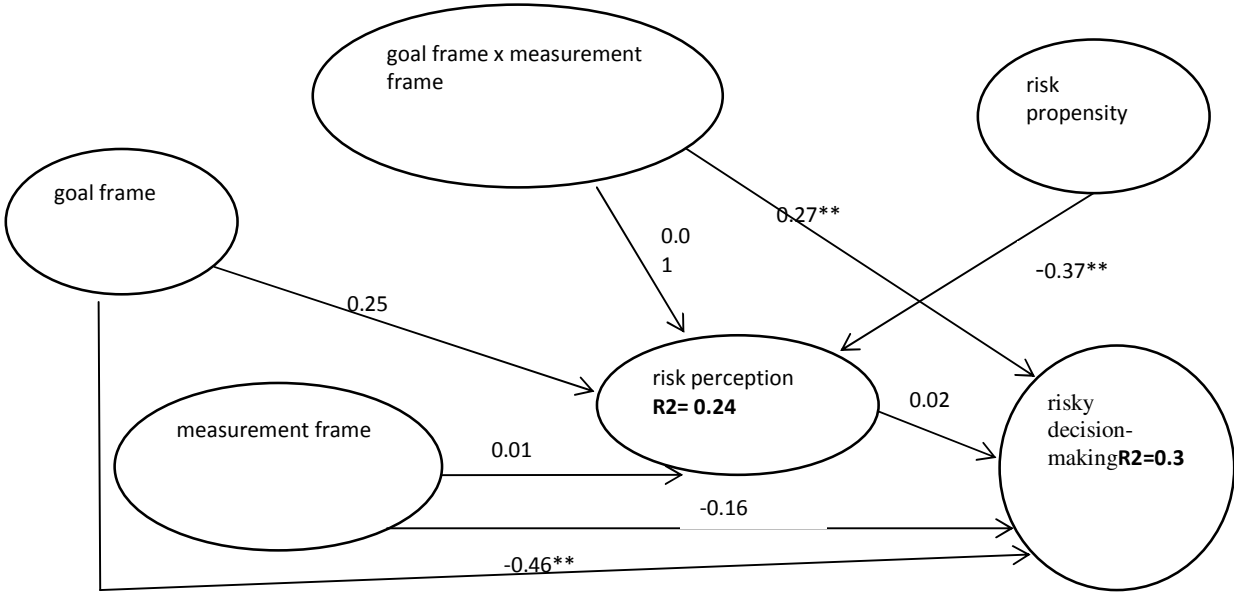
** =significant at 0.05 (two-tail)

Figure 3.　　　PLS structural model

4.4   Two-way ANOVA: the interaction between goal frame and measurement frame
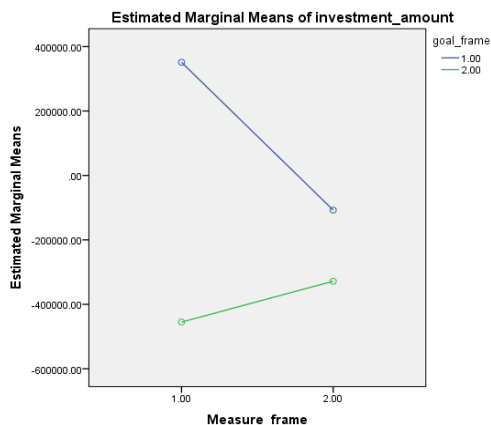

Figure 4.   The ordinal interaction between goal frame and measurement frame (for goal frame: 1 = performance-driven strategic goal and 2 = risk-driven strategic goal; for measurement frame: 1= without risk measure and 2 = with risk measure)

Further analysis was performed in order to confirm and provide additional details on the interaction effect between goal frame and measurement frame. It was found (see Figure 4) that two-way ANOVA results were consistent with those generated by PLS structural model analysis.

The mean difference between participant with performance-driven and risk-driven strategic goal and the interaction of goal frame and measurement frame was found to be significant at 5% level while the mean difference between participant with risk measure and without risk measure was not significant. The results demonstrated that there was an ordinal interaction where the differences between performance-driven goal and risk-driven goal was smaller when risk measure was present than when risk measure was excluded.

5   DISCUSSION

The empirical analysis performed in this study proved that PMS frame (the interaction between goal frame and measurement frame) effect on risky decision-making is not mediated by risk perception. This is consistent with Williams et al. (2008) and March and Shapira (1987) who suggested that managerial risky decision-making is primarily dependent on problem framing and its manipulation of potential losses and gains presentations.

The salience of potential losses in risky options affects managerial risk perception (Sitkin & Weingart, 1995). However, this study has found that managers do not make risky decision-making based on their risk perception as the relationship between risk perception and risky decision-making is found to be insignificant. In addition, the PMS frame (the interaction between goal frame and measurement frame) does not significantly affect risk perception. . Overall, it can be concluded that in the context of PMS framing, risk perception does not play a significant role in determining risky decision-making.

As reported in Section 4, risk-aware PMS leads to less risky decision-making than the traditional PMS (i.e. Kaplan & Norton, 1996) based on the performance goal frame and performance measurement frame. The results demonstrate that there is a significant ordinal interaction between goal frame and measurement frame. PMS frame with performance-driven strategic goal and no risk measure is significantly different from risk-aware PMS frame which consists of either risk-driven strategic goal (strategic risk goal), risk measure or both. The inclusion of strategic risk goal or risk measure in PMS will result in lower risk taking while making strategic decisions.

The practical outputs of these findings are as follows. Firstly, risk measure can be used to decrease managers' excessive risk taking when organizational strategic focus is on maximizing gains. Managers

who are driven by a performance-based strategic goal take significantly lower risk when using a measurement frame that combines KPIs and KRIs compared to the measurement frame driven by KPIs only. Hence, the inclusion of risk measure in PMS allows for risk information to be incorporated in managerial decision-making and decreases excessive risk-taking.

Secondly, the results demonstrated that risk measure and strategic risk goal can both be used to influence risky decision-making. However altering company's strategic goal may have implications on the motivation of managers and hence affect performance (Bonner, 2007; William et al., 2008). Therefore, at the most generic level, the inclusion of risk measure in PMS to influence managerial risky decision-making is considered more beneficial than altering strategic goal of the company to focus on potential losses.

6 CONCLUSION AND FUTURE DIRECTIONS

The study has set out to examine the impact of risk-aware PMS on risky decision-making. Behavioral management accounting literature has suggested two pathways in which PMS frame can impact risky decision-making: directly or mediated through risk perception. Hence, it was predicted that the PMS frame (interaction between goal and measurement frame) will directly impact risky decision-making or the impact on risky decision-making may be mediated through risk perception. Moreover, risk propensity is also suggested to be an important variable as it can influence risky decision-making through its effect on risk perception

The empirical findings of this study only supported the direct relationship between PMS frame and risky decision-making. Moreover, further analysis of the interaction between goal frame and measurement frame demonstrates that there is an ordinal interaction between goal frame and measurement frame. Performance-based strategic goal without risk measure will lead to risky decision-making that is significantly different from risk-aware PMS consisting of risk strategic goal, risk measure or both. In addition, it was found that risk propensity affects risk perception. Accordingly, in line with our findings, a manager with the tendency to take risk (high risk propensity) will perceive the same risk as lower when compared to a manager with the tendency to avoid risk (low risk propensity).

There are several limitations to this study. Firstly, in order to reduce task complexity, the focus of this study was only on the financial perspective of PMS. This excluded other input measures such as those in the process and learning and growth perspectives (see Kaplan & Norton, 1996). Secondly, participants were given the information on probability distribution of the performance indicator (ROI) for each product. However, in practice this information may not be available to support the decision-making process that involves risk. Thirdly, the experiment was conducted over one time period, as opposed to multiple time periods, which did not allow for changes in managerial decision-making that may take place due to the learning effect to be accounted (Hecht et al., 2012).

The results of this study open an avenue for a number of future research directions. Firstly, risk propensity is conceptualized in several studies as a "stable" trait (Sitkin & Weingart, 1995; Fischhoff et al., 1981). However it is demonstrated in this study that two different risk propensity scales of Young (1985) and Sitkin & Weingart (1995) do not converge with each other. Hence, this study highlights the need for development of risk propensity scale which can be used in different business contexts. Secondly, this study has demonstrated that the inclusion of risk measure in PMS will lead to lower risky decision-making. Further studies can investigate the impact of risk measure on risky decision-making when there is a stretch-target (Chen & Jones, 2005) such as extremely high

performance target. Thirdly, because this study has demonstrated that the inclusion of risk measure with outcome performance measure such as ROI has an impact on risky decision-making; future studies may investigate the inclusion of risk measure with input measures such as employee's turnover. This will allow further development of risk-aware PMS across all perspectives of PMS. Finally, because this study only focuses on single period manipulation, future studies can investigate the effect of risk-aware PMS on risky decision-making in a multiple period scenarios.

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