Full Length Research Paper

The impact of myopic loss aversion on continuing a troubled research and development expenditure

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Research and development (R&D) expenditure involve much risk and uncertainty. Failure of a research and development project is a common and dreaded question in innovation processes as a result of causing large losses to businesses. This study explored whether shortening evaluation periods could reduce the willingness of managers of research and development expenditure in continuing a troubled research and development project. The study employed 180 senior managers of high-tech companies as subjects of experimental test. The results indicate that continuing a risky investment decision is less likely in the context of a shorter evaluation period (myopic condition) because decision-makers will experience more frequent losses, leading to the tendency of decision-makers to avoid risk. The theory of 'myopic loss aversion' is useful in explaining this phenomenon.

Key words: Evaluation period; level of project completion; myopic loss aversion, risky decision, research and development expenditure.

INTRODUCTION

Active and incomplete research and development projects usually involve much risk, including the uncertainty of the projects' outcomes, the appearance of competitors and the change of the competitive environment. These factors may cause the project scope to frequently change and may reduce the possibility of the project's success. Research and development expenditure that are subjected to such volatility are more difficult to manage and control. The mismanagement of R&D projects can lead to situations in which R&D projects continue to absorb resources without ever delivering the intended benefits. One of the most challenging decisions confronting managers is whether to continue funding R&D expenditure when its prospects for success are questionable. This is an important topic of decision making under risk, and central in understanding why some troubled R&D projects are often continued for so long before appropriate corrective action is taken to abandon or redirect them. Wallace and Keil (2004) indicate that less than 30% of software development projects are completed on schedule, within budget, and with the

promised functionality, whereas more than 70% of such projects are troubled. This suggests that the failure of R&D projects is a common problem in a business' attempts at achieving innovation.

In light of such facts, the optimal solution would be to abort a troubled project early, but managers of companies are not often able to detect a project's problems in a timely fashion. The losses caused by troubled projects are sometimes increased by the reluctance of organizational members to transmit bad news concerning the true status of a project (Smith and Keil, 2003). Such information sometimes fails to be communicated up the hierarchy, or it is otherwise substantially distorted in the process. There exists, among the managers with the authority to alter the direction of the project and other organizational members, an information asymmetry which is an important factor to continue to invest more resources in a troubled or questionable project.

Prior studies suggest that failing projects are often allowed to continue for too long before appropriate action is taken by management to discontinue or redirect the efforts (Keil et al., 1995; Keil et al., 2000b), resulting in large losses in businesses. The amount of money already spent on a project may bias subsequent decisions toward the continued funding of the project (Keil et al., 1995; Keil et al., 2000a). Garland (1990) suggests that higher

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percentages of invested costs of a project can lead to a greater willingness to continue with a course of action. Garland and Newport (1991) and Conlon and Garland (1993) also argued that the percentage of the total budget of a project already spent affects people's likelihood to commit additional funds to some action. The argument that people's willingness to continue a troubled project is driven by the level of project completion has been suggested by many previous studies (Chow et al., 1997; Keil et al., 2000a; Mann, 1996). The level of project completion has been offered as one explanation for continuing a probably unsuccessful project. Such decision-making behavior behind the continuation of a troubled project has been referred to as irrational risk-seeking behavior in previous studies (Keil et al., 1995; Whyte, 1993; Chow et al., 1997). The determination of how to abort a troubled project early, in order to reduce its negative consequences, is an important and pressing issue in the field of decision making under risk and uncertainty. Recent research in behavioral finance highlighted the impact of the time frame in which investors' decisions are made on their assessment of investment outcomes. The theory of 'myopic loss aversion was advanced by Benartizi and Thaler, which rests on the combination of two behavioral concepts. The first concept is loss aversion (Kahneman and Tversky, 1979, Tversky and Kanhneman, 1992), which refers to the tendency of decision-makers to weigh losses more heavily than gains. The second concept is mental accounting (Kahneman and Tversky, 1984, Thaler, 1985), which refers to the implicit methods people use to code and evaluate financial outcomes: transactions, investments, gambles, etc. The theory of 'myopic loss aversion' argues that decision-makers experience losses more frequently when they evaluate their returns over shorter periods (myopic-condition), and because they are much more sensitive to losses than gains, they become more conservative and more risk-adverse. Shortening evaluation periods to increase the frequencies of information feedback would change decision-makers' aggregation rules to code and evaluate the financial outcomes they follow (Benartizi and Thaler, 1995). Bellemare et al. (2005) also have a similar contention and assert that more frequent evaluations of returns on investments lead to fewer risky decisions being made as a result of more frequently receiving information feedback. They found that decision-makers under myopic condition made fewer risky decisions than their non-myopic counterparts. This raises our research questions:

Do shorter lengths of period evaluations (myopic conditions) providing more frequent information feedback increases the frequency with which decision-makers experience losses? And, do shorter lengths of period evaluations, by providing more frequent information feedback, reduce the information asymmetry existing between managers with decision making power and other organizational members, thereby decreasing their tendency toward risk-seeking behaviors such as pursuing

a troubled research and development expenditure?

Based on the theory of 'myopic loss aversion', when managers take action to shorten lengths of periods evaluated and to increase frequencies of evaluation of research and development expenditure, troubled research and development projects could be duly aborted or turned around and the budgets of research and development expenditure are able to be successfully redirected, thereby decreasing the businesses risk under innovation processes.

As above, there has been some literature exploring the impact of the level of project completion on continuing or abandoning a troubled project (Garland and Newport, 1991; Conlon and Garland, 1993; Keil et al., 1995; Keil et al., 2000a) and the impact of the evaluation period on investment decisions, however, the relationship between myopic decision-behavior and making such decisions of continuing troubled R&D projects has not previously been investigated. The effectiveness of managerial actions taken to turn around or redirect such projects determines if a troubled project ultimately succeeds or fails, and determines whether resources of businesses are wasted or not, thus, the issue of this study is important in current business environments. We integrate literature of risk-decision and of theory of 'myopic loss aversion' to sheds light on and to test the impact of myopic behavior on the continuation of a troubled R&D expenditure. The purposes of this study were to seek a better understanding to the factors that may cause the continuation of such projects and to provide an avenue for decision makers and other responsible actors of how to turn runaway projects around and to reduce such risk-seeking behaviors. Providing a myopic condition by shortening evaluation periods of projects, thereby, improves the productivity of R&D activities, reduces R&D cost, and increases the effectiveness of R&D activities.

METHODOLOGY

Subjects

Consistent with the previous study (Keil et al., 1995) that investigated decision makers' willingness to continue a project, laboratory experiments were used to address the research questions. This approach allowed extraneous variables to be controlled so that causal relationships between constructs in the theoretical model could be tested with minimal interference from extraneous variables. A total of 180 subjects participated in this study. Subjects were senior managers of high-tech companies enrolled in an executive master of business administration (EMBA) programme on high-tech management and investment at a university in Taiwan. The background information of the 180 subjects includes that they had been working for an average of 15.23 years, of which an average of 5.61 years had been spent at their current position.

Experimental scenario

The experimental scenario used in this study was adapted from the 'Mobile Phone Problem' used by Tan and Yates (1995). We made

Table 1. Descriptive statistics.

Total (N=180)	Willingness to continue R&D expenditure (0 to 100%)	
	Mean	Standard deviation
Low degree of project completion (40%) Short evaluation period (3 months)	0.29	0.2311
Low degree of project completion (40%) Long evaluation period (12 months)	0.33	0.2181
High degree of project completion (80%) Short evaluation period (3 months)	0.49	0.2886
High degree of project completion (80%) Long evaluation period (12 months)	0.67	0.2901

minor adjustments to make the problem more appropriate for use with our subjects. In this study, subjects were asked to play the role of president of a small company that had been researching and developing a new product for external sale. After receiving information on the degree of research and development expenditure t completion1 (either 40% or 80%) and on the length of the period evaluated (either short or long), subjects were informed that another company had just started marketing a similar product, reportedly with a better functionality and greater ease of use. Based on this, subjects were asked to indicate their willingness (on a scale of 0% to 100%) to continue investing in the R&D expenditure.

Each subject was randomly assigned one of the four versions of this scenario in a 2×2 factorial design in which the degree of R&D project completion (40 or 80%) and the length of the period evaluated (shorter or longer) served as the independent variables.

Procedure

The subjects who were presented the version with a high degree of R&D expenditure completion were informed that this degree was 80%, whereas those with the lower degree were informed it was 40%. Next, to be consistent with Thaler et al. (1997), we employed the length of the period evaluated (short or long) to distinguish between the myopic condition and the non-myopic condition. Subjects assigned the long evaluation period (non-myopia) were informed that the length of period evaluated was one year, whereas those assigned the short one (myopia) were told three months.

Moreover, all subjects were informed that their projects will be evaluated when each evaluation period ends. The evaluation would fall into one of three grades: Low-grade, Middle-grade or High-grade. If the evaluation was High-grade, thirty points would be added to the performance score of the decision-maker on the R&D project. If the evaluation was Low-grade, thirty points would be deducted to his performance score. And if the evaluation was Middle-grade, no points would be added or deducted. The performance score of each manager will affect his future salary, promotion and annual bonus.

Subjects in the myopic condition were informed that the length of the period evaluated was three months (one quarter), and were shown the four evaluations given to the project in the past year. Subjects in this myopic group will see the following four evaluations, as well as the increase or decrease in their performance scores over the past year, as listed in Appendix 1.

Based on the theory of myopic loss aversion, subjects in the myopic condition more frequently experienced negative outcomes (decreased score) than those in the non-myopic condition because past outcomes are narrowly framed due to the higher frequency of the evaluations.

Next, subjects assigned the long evaluation period (one year) were shown that the single, aggregated evaluation of their project during the past year was Middle-grade (aggregating the grades of four quarters over the past year, including Low-grade, High-grade, High-grade and Low-grade, which are the four grades presented in the above list) as shown in Appendix 2.

In this non-myopic condition, the aggregated outcome averages out the individual differences between each quarter. Based on the myopic loss aversion hypothesis, the trade-off between a negative outcome (score decreased) and a positive outcome (score increased) causes people to experience fewer negative outcomes, while making them more favorable to risky options.

RESULTS

The research model uses ANOVA to look at the relationships among the variables of interest. The degree of R&D project completion and the length of the period evaluated (myopia) are the independent variables, while the willingness to pursue the troubled R&D project is the dependent variable. Furthermore, evaluating the two-way interaction between the degree of R&D project completion and the length of the period evaluated makes it possible to determine the existence of an influence of such an interaction on the willingness to continue the project. A significant and negative two-way interaction indicates that a shorter evaluation period (myopia) reduces the impact of degree of R&D project completion on the willingness to continue a troubled R&D expenditure. Table 1 Gives the descriptive statistics.

Table 2 gives the ANOVA results which indicate that the main effect of the degree of project completion is significant, $F_{(1,176)}=48.91$, $p<0.01$, and that that of the length of the period evaluated is also significant, $F_{(1,176)}=3.53$, $p<0.10$. Moreover, the two-way interaction

Table 2. Summary of the ANOVA for the willingness to continue a troubled project.

Source of variation	df	MS	F	Sig.
Degree of R&D expenditure completion (RD)	1	3.121	48.91	0.00
Length of the period evaluated (EP)	1	0.225	3.53	0.06
RD × EP	1	0.535	8.39	0.00
Residual	176	0.064		

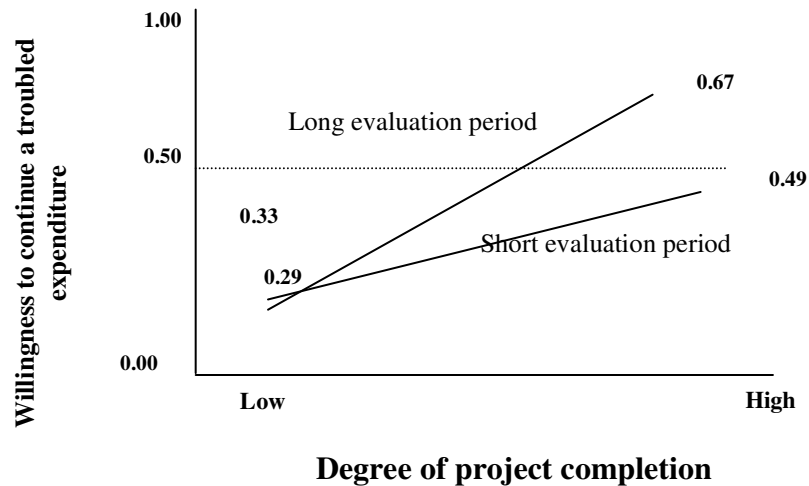Tests of between-subjects effects. Dependent variable: willingness to continue a troubled project.

Figure 1. Willingness to continue a troubled expenditure: degree of project completion and length of the period evaluated predictors.

between project completion and the evaluation period is significant, F (1,176)=8.39, p<0.00. The results support that a shorter evaluation period (myopic condition) reduces the impact of degree of R&D expenditure completion on the willingness to continue a troubled R&D project. The decision-makers in myopic conditions would be more risk-adverse and would exhibit less risk-seeking behavior.

Figure 1 shows the pattern of the willingness to continue a project across various degrees of project completion and evaluation period groups. It is likely to continue a project when the degree of project completion is higher and evaluation period is longer (mean=0.67); whereas when the level of completion is lower and the evaluation period is shorter, the item is unlikely to continue as such a project (mean=0.29). The higher the level of completion is, the more the willingness to continue a troubled R&D expenditure. This result is consentient with the results of Keil et al. (1995) and Keil et al. (2000a). In this scenario, the length of evaluation period also affects the relationship between level of project completion and the willingness to continue a project. The slope of the line in Figure 1 represents the association between level of project completion and the

willingness to continue a troubled project. The impact of degree of project completion on willingness to continue a troubled project is larger when the evaluation period is longer, thus, the relationship of linearity between them is steeper and the slope is significantly larger. Relatively, the impact of degree of project completion on willingness to continue a troubled project is smaller when the evaluation period is shorter, thus, the relationship of linearity is flatter and the slope is significantly smaller.

Figure 2 is also presented to explain the strong and weak relationship of degree of project completion on willingness to continue a troubled project. The impact of degree of project completion on willingness to continue a troubled project is strongly enhanced when the evaluation period is longer, whereas the impact of degree of completion on willingness to continue a troubled project is weakly enhanced when the evaluation period is shorter.

These results are in line with our hypothesis that the effect of a short evaluation period (myopic condition) on the willingness to continue a troubled project is negative. And the effect of the degree of R&D expenditure completion on the willingness to continue a troubled project is also weaker than it is for a longer evaluation period.

	Low degree of expenditure completion	High degree of expenditure completion
Short evaluation period	Willingness weakly enhanced	
Long evaluation period	Willingness strongly enhanced	

Figure 2. The impact of the evaluation period on the relationship between degree of project completion and the willingness to continue an R&D project.

Conclusions

The analysis of the results of this study indicates that continuing a risky investment is less likely in the context of a shorter evaluation period (myopic condition) because decision-makers will experience more frequent losses, leading to the tendency of decision-makers to avoid risk. Shortening the evaluation periods of a project could prevent the continuation of a troubled or questionable research and development expenditure; therefore, the theory of 'myopic loss aversion' is useful in explaining this phenomenon. Additionally, another possible reason for the early abortion of a troubled project may be that, in the myopic conditions, by providing more frequent information feedback, reduction of the information asymmetry between managers with decision-making authority and other organizational members, makes it possible for troubled projects to be successfully turned around or sensibly abandoned. We believe the results of this study can provide managers of R&D projects with a way of bringing troubled projects under control, and of reducing the losses caused by such troubled R&D expenditure. While finding the viability of R&D projects is questionable, the most common actions managers can use to turn questionable projects around are (1) redefining the project, (2) improving project management, and (3) changing project leadership. Which ways are used depends on the assessment of the competitive environment of business at that time.

Based on the research presented here, managers should be more easily informed about when to abort such projects in order to prevent troubled or questionable projects from continued investment. Overcoming the "mum" and "deaf" effects is not easy, according to many of the respondents. Nor are the actions useful in turning projects around easy to initiate. However, continuing to invest in a troubled or questionable project is a serious problem that prevents much of the potential benefits from R&D expenditure from ever being realized. Consequently, it is essential for managers of R&D projects to direct attention to this interesting phenomenon, understand it, and take the actions necessary to regain control of troubled projects. The research in this paper may support management's quest for more successful R&D projects.

As with any research, there are limitations to the work described here. Since these results are based on laboratory experiments, the experiments conducted here take a necessarily narrow focus in order to achieve a high degree of control. There are many organizational and political factors that may also affect an individual's willingness to proceed with a project. These factors have not been investigated here and may not lend themselves to laboratory study. Despite the limitations discussed above, the findings reported here may have important ramiflcations for managing R&D projects. Future research could also address the question of when the action to abandon or redirect troubled project should be taken. The present study does not address the question of the timing of the de-escalation effort, but it provides the necessary groundwork for examining such questions in the future.

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Appendix 1.

Period evaluated	1st to 3rd month	4th to 6th month	7th to 9th month	10th to 12th month
Grade	Low-grade	High-grade	High-grade	Low-grade
Change in performance score	minus 30	plus 30	plus 30	minus 30

Appendix 2.

Period evaluated	1st to 12th month
Grade	Middle-grade
Change in performance score	plus 0 (no increase and no decrease)