TO CONTINUE INVESTMENT IN A COLLABORATIVE INNOVATION PROJECT: A GOOD DECISION?

Maarten E.J. Rutten[1] , André G. Dorée [2] and Johannes I.M. Halman[2]

[1] *School of Built Environment, Avans University of Applied Sciences, PO Box 732, 5201 AE, 's-Hertogenbosch, The Netherlands*

[2] *Department of Construction Management and Engineering, University of Twente, PO Box 217, 7500 AE, Enschede, The Netherlands*

Collaborative innovation projects are projects in which firms come together to jointly develop and commercialize a new building product, system or service. They are an example of the type of inter-firm relationships that are said to enhance construction innovation. Organisational behaviour research, however, suggests that firms participating in collaborative innovation projects run the risk of escalating commitment and may continue to invest for irrational reasons. The current study examined whether firms in the Dutch construction industry participating in such projects are susceptible to this escalation. Two escalation effects were investigated: the effect of expected loss of sunk costs, and the effect of perceived project stage. The study surveyed 154 firms participating in 25 collaborative innovation projects. The hierarchical nature of the data (i.e. the firms are all nested within innovation projects) meant a hierarchical linear model was used to examine the effects. A statistically significant association was found between expected loss of sunk costs and the likelihood of a firm continuing investment. However, contrary to what escalation theory would predict, the association was found to be negative, rather than positive. No statistically significant association was found between perceived project stage and the likelihood of a firm continuing investment. These results suggest that, when deciding whether or not to continue to invest in a collaborative innovation project, firms in the construction industry are unlikely to fall victim to either of the two escalation effects. Rather, the negative association identified raises the question as to whether firms are abandoning collaborative innovation projects too early.

Keywords: decision theory, innovation, inter-organisational relation.

INTRODUCTION

When it comes to innovation, it has been suggested that the construction industry is characterized by a low rate of innovation; also described as "zephyrs of creative destruction" (Winch 1998). A review of the literature on construction innovation highlighted six main factors which either drive or hinder construction innovation (Blayse and Manley 2004). One factor is the type of relationship between firms in the industry. For example, a study by Dubois and Gadde (2002: 629) indicated that tighter relationships between firms beyond individual construction projects could enhance the

[1] mej.rutten@avans.nl , m.e.j.rutten@utwente.nl

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opportunities for innovation. Miozzo and Dewick (2004: 71) observations on the relationship between inter-firm collaboration and construction innovation commented: "In a complex systems industry, such as construction, firms must rely on the capabilities of other firms to produce innovations and this is facilitated by some degree of continuing cooperation between those concerned with the development of products, processes and designs." When considering how relationships between firms may foster construction innovation Dubois and Gadde suggested that what is needed are tighter relationships between firms beyond the level of individual construction projects or, as Miozzo and Dewick saw it, developing relationships between firms with some degree of continuing cooperation. The current study focuses on collaborative innovation projects which are a good example of this type of relationship between firms.

A collaborative innovation project is a project in which firms join forces to cooperate in the development and commercialization of a new building product, system, or service for a range of potential customers or clients (Blindenbach-Driessen *et al.* 2010: 577). Examples from the literature include the joint development and commercialization of a new modular housing system (Hofman *et al.* 2009) and the joint development and commercialization of a new environmentally friendly window (Rutten *et al.* 2009). For a collaborative innovation project to exist and to achieve success, firms must be willing to commit resources to the project. Therefore, given the industry's generally low rate of innovation, is the decision to allocate resources to a collaborative innovation project a good decision, or not?

The so-called Radar-Blank Plane (RBP) experiments conducted by organisational behaviour researchers provide relevant results. These experiments suggest that, once a firm starts to participate in a collaborative innovation project it may escalate commitment (for examples, see Arkes and Blumer 1985; Conlon and Garland 1993). A firm is said to escalate commitment when it, for reasons that are not economic, decides to allocate additional resources to continue the project (Staw 1976; Schmidt and Calantone 2002). Although escalation of commitment is a widespread phenomenon present in various contexts (Brockner 1992), research indicates that the tendency to escalate commitment may vary between populations (Tan and Yates 1995; Van Putten *et al.* 2010). This raises the question of whether firms in construction industry that do participate in collaborative innovation projects are likely to escalate commitment.

The current study aim, building on the findings of the RBP experiments, was to examine whether firms in the construction industry that participate in collaborative innovation projects are susceptible to two escalation effects: a). the effect of expected loss of sunk costs, and b). the effect of perceived project stage. It would be unfortunate if firms were susceptible to these escalation effects as the resources available to firms to invest in the development and commercialization of new building products, systems and services are limited. In these scenarios, escalation of commitment would be an undesirable phenomenon.

THEORETICAL BACKGROUND AND HYPOTHESES

The first RBP experiments were conducted in the 1980s (Arkes and Blumer 1985) as part of research into the influence of sunk costs (i.e. resources already spent) on the escalation of commitment behaviour. The participants first had to read a scenario of an innovation project in which a radar-blank plane was being developed. They then had to decide whether to abandon the innovation project, or to allocate additional

resources to continue the innovation project. The results showed that, once an innovation project had incurred costs, the participants were more willing to continue investing in the project compared with a project that had not yet incurred any costs. These findings were remarkable since microeconomic theory posits that only the variation in future revenues and costs between alternative courses of action are relevant when making choices, i.e. that, effectively, sunk costs are deemed to be irrelevant (Horngren *et al.* 2007).

Since then, researchers have continued to use the RBP scenarios to study various effects (Rutten *et al.* 2013). The sunk cost effect has become the most studied. 18 RBP experiments have shown the following results. Ten experiments found a significant positive relationship suggesting that sunk costs make it more likely that firms continue to invest in an innovation project (Arkes and Blumer 1985; Garland 1990; Garland and Newport 1991; Arkes and Hutzel 2000; Moon 2001b, a; Van Dijk and Zeelenberg 2003). Three experiments were ambiguous and, depending on the type of participant or the measure of the dependent variable, either a positive significant relationship or no significant relationship was found (Conlon and Garland 1993; Tan and Yates 1995; Van Putten *et al.* 2010). Four experiments found no significant relationship suggesting that sunk costs are not influential on whether firms continue to invest in an innovation project (Conlon and Garland 1993; Tan and Yates 1995; Garland and Conlon 1998; Moon *et al.* 2003). And one experiment found a significant negative relationship suggesting that sunk costs make it less likely that firms continue to invest in an innovation project (Garland and Conlon 1998). Overall, the most common finding was that sunk costs were positively associated with the likelihood of continuing investment.

Various scholars have explained these positive associations by drawing on loss aversion theory (Arkes and Blumer 1985; Garland and Newport 1991). This theory states that people have a strong desire to avoid losses and are particularly averse to losses that are certain. It has been argued that this tendency underlies the sunk cost effect as decision-makers may think that to abandon an ongoing innovation project will result in "a certain loss of the amount already invested (Arkes and Blumer 1985: 132)" and, as a result, it is more attractive to choose to continue investing in the innovation project. This line of reasoning is also referred to as a "sunk cost fallacy" in the literature (Arkes and Ayton 1999). This research may be relevant for firms in the construction industry that participate in collaborative innovation projects as they also could fall victim to this same fallacy. Consequently, we hypothesize that:

> Hypothesis 1. The loss of sunk costs that a firm participating in a collaborative innovation project expects if it would abandon the collaborative innovation project is positively associated with the firm's likelihood of continuing their investment.

The second effect most studied in the RBP experiments is the project completion effect first reported by Conlon and Garland (1993). The term project completion refers to how close an innovation project is to completion. In general, innovation projects are really only completed when the newly developed product or service has become profitable in the market place. Conlon and Garland had noticed that, in previous RBP experiments, the level of sunk costs was confounded with the degree to which a project was completed. Therefore, they sought to separate out the variables by conducting two experiments. Both experiments showed a significant positive relationship between the degree to which a project was completed and the likelihood

of continuing investment. This confirmed their expectation that a firm's desire to complete an innovation project actually does increase as project completion gets nearer (Conlon and Garland 1993: 410). Since then, the project completion effect has been examined in eight other RBP experiments (Garland and Conlon 1998; Moon 2001b, a; Moon *et al.* 2003; He and Mittal 2007; Harvey and Victoravich 2009). The results of these experiments were similar to the results of the two experiments by Conlon and Garland. This means all 10 experiments have observed a significant positive relationship which strongly suggests that the closer an innovation project is to completion the greater the likelihood is that a firm will continue to invest in it. Once again, findings from the field of organisational behaviour are relevant to firms in the construction industry that participate in collaborative innovation projects. As such, we would expect, for example, that firms working with innovation projects already in the market introduction stage would be more likely to continue to invest in them as when compared with firms with projects that are still in the earlier development stage. Consequently, we hypothesize that:

> Hypothesis 2. The stage of a collaborative innovation project, as perceived by a firm that participates, is positively associated with the firm's likelihood of continuing to invest.

METHOD

In order to test these two hypotheses we conducted a survey among Dutch firms participating in a collaborative innovation projects developing and commercializing new building products, systems, or services. By studying firms in real-world settings, rather than university students in laboratory settings (which is the case with most RBP experiments), we have added a field study to a research stream otherwise dominated by laboratory studies. From a methodological perspective, this represents a form of triangulation (Colquitt 2008).

Sample and data collection

A two-stage sampling procedure was used to select firms. First, we contacted organisations in the Netherlands familiar with collaborative innovation projects and the firms involved. This included two construction industry associations and three semi-governmental organisations promoting innovation. This led to the identification of 32 collaborative innovation projects eligible for the study. For 25 of these collaborative innovation projects, involving in total 154 firms, we received the names and email addresses of the individuals who on behalf of the firms participated in the collaborative innovation projects. The number of firms in a collaborative innovation project ranged from 3 to 10.

The survey was constructed using online survey software (Unipark EFS Survey). An invitation email with a link to the survey was sent to each firm between April 2009 and March 2010. Non-responders were sent a reminder after two weeks and a second reminder after four weeks. Of the 154 firms, 122 responded to the survey which represents a response rate of 79%. 15 firms were excluded as they did not complete the survey. Four other firms were excluded as, in fact, they had not invested in a collaborative innovation project. Thus, the final sample included 103 firms.

Variables

Likelihood of continuing investment (dependent variable)
The likelihood that a firm continues to invest was measured by asking the question: "How likely it is that your firm continues to invest in the collaborative innovation project?" The response scale ranged from 1, very unlikely, to 7, very likely.

Expected loss of sunk costs (independent variable)
The loss of sunk costs that a firm expects if it would abandon the collaborative innovation project was measured by asking: "If your firm would decide to quit now, would that lead to a great or small loss of investments for your firm?" The response scale ranged from 1, very small, to 7, very great.

Perceived project stage (independent variable)
The stage of the collaborative innovation project as perceived by a firm was measured by asking: "In what stage is the collaborative innovation project?" Responses were coded 0, for exploratory or development stage, and 1, for market introduction or market growth stage.

Control variables
Two more variables were included since, based on previous research (Conlon and Garland 1993; Moon 2001b), we thought that they may have a causal effect on the dependent variable and could be correlated with at least one of the independent variables. This makes them important variables to be controlled for (Allison 1999). These were: the "perceived enthusiasm among potential customers or clients"; and, the "length of participation".

The former control variable was measured by asking respondents to indicate their level of agreement with the following statement, "Potential customers or clients are enthusiastic about the new product, system, or service." The response scale ranged from 1, strongly disagree, to 6, strongly agree.

The latter control variable was measured by asking, "Since when is your firm involved in the collaborative innovation project? Please select quarter and year," and subtracting the respondent's answer from the quarter and year in which the respondent completed the survey.

Method of analysis

The analysis is based on the notion that the data have a nested structure, i.e. the firms involved are all nested within collaborative innovation projects. We adopted hierarchical linear modeling (HLM; Raudenbush and Bryk 2002) to investigate our hypotheses as have other studies involving nested data (Hitt *et al.* 2007). HLM has an important benefit in examining nested data when compared with analysis using ordinary least squares regression (OLS). In nested data observations are not independent. However, OLS assumes that observations are independent. Violation of this assumption leads to underestimation of the standard errors of regression coefficients and this increases the risk of type I errors. A type I error occurs when "we believe that there is a genuine effect in the population when, in fact, there isn't (Field 2005: 31)." HLM, on the other hand, takes into account the nested structure of data. It reduces the risk of type I errors by partitioning the residual variance into a 'between-group' component and a 'within-group' component (in this study the groups correspond to the collaborative innovation projects). An online video presentation from the Centre for Multilevel Modeling (Rasbash 2006) provides further information on how this works.

RESULTS

Table 1 presents the descriptive statistics and correlations for the variables used in this study. The survey found that 88% of the firms in the sample employ less than 250 employees and that the sample consists of a variety of firms: architectural and engineering firms (15%); construction firms (33%); suppliers (21%); and, other types (31%). The survey also found that 79% of the respondents rated his or her influence on their firm's decision to continue investment as either large, or very large.

Table 1: Means, Standard Deviations, and Correlations

Variable	Mean	s.d.	1	2	3	4
1 Likelihood of continuing investment	5.17	1.45				
2 Expected loss of sunk costs	3.95	1.78	–.19†			
3 Perceived project stage	0.42	0.50	.20*	–.11		
4 Perceived enthusiasm among potential customers or clients	4.59	0.86	.19†	.22*	.01	
5 Length of participation	2.25	2.51	.14	.03	.38**	–.18†

Firms' n = 103, collaborative innovation projects' n = 25.

† $p < .10$

* $p < .05$

** $p < .01$

Two-tailed tests.

In running the HLM model and in order to calculate the intraclass correlation coefficient (ICC), we first ran a "null" model in which no independent or control variables were entered. The null model resulted in an ICC of 0.14, indicating that 14% of the variance in a firms' likelihood of continuing investment is due to differences between collaborative innovation projects. In contrast 86% of the variance in the likelihood of a firm continuing investment is due to differences between firms. Second, we added the independent and control variables to the HLM model. Adding the independent and control variables shows that these variables explain 11% of the variance in the likelihood of a firm continuing to invest ($R^2 = .11$). Table 2 presents the results of the HLM model.

The tests of the two hypotheses gave the following results. Hypothesis 1 predicted that the expected loss of sunk costs when abandoning the collaborative innovation project will be positively associated with a firms' likelihood of continuing investment. The results in Table 2 do not support this hypothesis. On the contrary, the results show a statistically significant negative relationship which the coefficient of -0.196 being significant at the .05 level. This is a complete contradiction of Hypothesis 1.

Hypothesis 2 predicted that the perceived stage of the collaborative innovation project will be positively associated with firms' likelihood of continuing investment. The results do not support this hypothesis either. The coefficient for perceived project stage is positive (0.338) but this is not statistically significant since the p-value is greater than .05.

Table 2: Results of Hierarchical Linear Modeling for Likelihood of Continuing Investment

Variable	Predicted effect	Coefficient	s.e.	p	R^2
Null model					
Intercept		5.175***	0.175	<.001	
Random-intercept model					
Intercept		5.024***	0.185	<.001	.11
Expected loss of sunk costs	H1 (+)	–0.196*	0.079	.016	
Perceived project stage	H2 (+)	0.338	0.302	.266	
Perceived enthusiasm among potential customers or clients		0.452**	0.167	.008	
Length of participation		0.087	0.060	.155	

Firms' n = 103, collaborative innovation projects' n = 25.

Expected loss of sunk costs, perceived enthusiasm among potential customers, and length of participation have been centered around the grand mean.

* $p < .05$

** $p < .01$

*** $p < .001$

Two-tailed tests.

DISCUSSION

The present study set out to investigate the behaviour of firms in the construction industry participating in collaborative innovation projects. The aim was to test whether these firms are likely to escalate their commitment in such projects given two possible influencing factors. First, the thought that abandoning the project will lead to a large loss of sunk costs. Second, the notion that the project is at an advanced stage. The results of this study suggest not. We now discuss potential explanations for the (somewhat surprising) results and their implications and limitations.

The results indicate that firms that expect a large loss of sunk costs, if they would abandon a collaborative innovation project, are less likely to continue to invest than firms expecting a small loss of sunk costs. This is a remarkable finding since, based on loss aversion theory and the results of the RBP experiments, one would expect the opposite. The question is how to explain the negative relationship found? Contrary to most RBP experiments one showed a negative sunk cost effect. The researchers involved argued that the negative effect might be explained by the participants' relatively high "sensitivity to expenditures" (Garland and Conlon 1998: 2035). The idea here is that a heightened sensitivity to expenditures can lead people to behave more cautiously when deciding whether or not to invest future resources. This might be a characteristic of the negative relationship we found. In our sample, 88% of the firms had less than 250 employees and, thus, the sample is dominated by small and medium-sized firms (SMEs). This is not surprising since the construction industry is well-known for its high percentage of SMEs (Dainty *et al.* 2005). It has been argued also that, in order to understand the innovation dynamics in construction industry, one needs to take account of the dynamics of how SMEs innovate (Sexton and Barrett 2003a, b) when the resources available to them "to innovate in parallel with normal business" are very scarce (Barrett and Sexton 2006: 331). Therefore, the negative

relationship found in this study might not be so surprising. SMEs in the construction industry that expect a large loss of sunk costs, if they would abandon a collaborative innovation project, are likely to have been spending a relatively large share of the scarce resources they have available to innovate. This may heighten their sensitivity to spending future resources and make them more cautious to continue investment when compared with firms that have spent fewer resources.

This line of reasoning prompts a further question. In which of the two situations might firms' investment decisions be flawed - when they have spent a small amount or a large amount of resources? Since we controlled for the perceived enthusiasm of potential customers and clients, firm's likelihood of continuing to invest seems, from an economic point of view, to be either irrationally high in the first situation, or irrationally low in the second situation. These are considerations that firms might want to be aware of.

Furthermore, the results suggest that firms that consider a collaborative innovation project to be at an advanced stage are not more likely to continue to invest when compared with firms that consider such projects to be at a less advanced stage. The project-based nature of the construction industry may explain why we did not find the same positive relationship as that found in the RBP experiments. Whereas the RBP experiments involved student participants, our survey engaged with "professional experts at doing projects" who, as a collaborative innovation project progresses, might be less inclined to substitute the project's goal with the goal of completing what was started. This explanation is supported by a study on the endowment effect (List 2003). This is an escalation effect found in other contexts which states that owning a good increases its value to the owner. List's study showed that professional experience eliminated the endowment effect. Overall, the results suggest that it would not be necessary to warn firms involved in collaborative innovation projects against a project stage effect.

CONCLUSION

When firms come together and collaborate in developing and commercializing a new building product, system or service, then organisational behaviour research suggests they may escalate commitment. This would be an undesirable phenomenon, particularly when the resources which firms in the construction industry have available for innovation are often limited. In this respect the current study brings good news. The effects we studied do not seem to suggest that firms are more willing to continue investing in a collaborative innovation project, either when a firm expects a large loss of sunk costs if it would abandon the collaborative innovation project, or when a firm realises that the collaborative innovation project has reached an advanced stage. In fact, we conclude that firms that expect a large loss of sunk costs if they would abandon a collaborative innovation project, are less likely to continue to invest than firms that expect a small loss of sunk costs. This represents a de-escalation effect (instead of an escalation effect).

The main limitation of this study, as is the case with most studies on firms (Short *et al.* 2002), is that our data comes from a non-random and not a random sample. Non-random sampling procedures may bias results. Therefore, our study results do need to be interpreted with caution.

We can conclude with some practical implications of our study and, in particular, the implications of the de-escalation effect found. The de-escalation effect suggests that a

firms' willingness to continue to invest is either irrationally high when little has been spent, or irrationally low when a lot has been spent. In other words, the results seem to offer the following advice to firms in the construction industry: "Participating in a collaborative innovation project? Take care not to continue just because you have spent a little, or to quit just because you have spent a lot."

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