The Institutional Arrangements of Innovation: Antecedents and Performance Effects of Trust in High-Tech Alliances

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ABSTRACT In this study we investigate the institutional arrangements of innovation processes in high-tech alliances, focusing on the role of trust. A major strength of the research is the opportunity to address antecedents as well as performance effects of trust. The antecedents of interorganizational trust include a shared past, detailed interfirm contracts, relational openness and mutual dependence. We control for the size and cooperative culture of the focal firm and the knowledge value of the partner firm. Data from a field study of 391 Dutch firms in high-tech industries generally support the research model. The results provide convincing evidence to support the value of interorganizational trust in durable business relationships that strive for the development of new technological knowledge.

KEY WORDS: Interorganizational trust, high-tech cooperation, alliance performance

Introduction

In this study we investigate the institutional arrangements of innovation processes in high-tech alliances. These arrangements concern the particular contractual and institutional set-up in an interfirm dyad (North and Thomas, 1973) that drive as well as facilitate interorganizational cooperation that aims for the development of new knowledge. Our focus of research is on the role of trust. Without trust high-tech alliances would not be able to survive. We explain how partners to innovative collaboration develop trust and, in turn, how trust determines alliance performance.

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In recent decades, interfirm collaboration has become increasingly important (Contractor and Lorange, 2002). This also applies to the development of new knowledge in high-tech industries (Duysters and de Man, 2003). In these industries, innovation requires a combination of products, markets, technologies and organizational capabilities that most companies do not have in-house, and therefore need to cooperate with complementary specialists. However, the management of high-tech alliances is a challenge that needs to balance between realizing benefits and safeguarding risks (Nooteboom, 2000, 2004). On the one hand, business relationships in high-tech industries may offer substantial future benefits. Turnover and net profits can grow for many years in succession if companies join forces and manage to introduce new products in global consumer markets. On the other hand, such relationships may involve risks. For example, the exchange of specialist knowledge is a prerequisite for the development of new knowledge. However, specialist knowledge is often highly confidential because it offers competitive advantages. Firms therefore have a strong incentive to manage the risks of spillover, particularly when the existing or potential partner firm is or could be a competitor.¹ Many firms who are, or will soon be, involved in high-tech collaborative efforts focus on the latter while often ignoring the former. It is one of the reasons why many high-tech alliances fail (cf. Inkpen and Beamish, 1997).

Much of the literature on interfirm collaboration has focused on governance mechanisms that reduce risk, and consider trust as one of them. In this paper we intend to move away from this point of view as we are not mainly interested in how partners prevent opportunism and failure, but in the prerequisites that lead to success: which governance mechanisms actually contribute to the successful performance of interorganizational relationships? After all, the goal of collaborating is value creation and not all governance mechanisms that firms apply may equally contribute to that. Firms in an alliance can use different “mechanisms” to manage the relationship such as shared ownership, power or contracts (Bachmann, 2001). Often, a combination of these will be applied because each has advantages and disadvantages. For example, the use of power in alliances is omnipresent particularly when there are differences in size or dependence. Power may solve short-term issues but the misuse of power can be harmful in the long term—a misused partner may attempt revenge when conditions eventually change. Also, the design, implementation and maintenance of contracts might prevent relationship failure but might also be a time-consuming effort that distracts attention away from value creation and reaping benefits due to the alliance.

This paper intends to contribute to the understanding of the effects of governance mechanisms on the performance of high-tech alliances. More in particular, we focus on interorganizational trust. Interorganizational trust is the level of trust placed in the partner organization by an alliance manager of a focal organization. For alliances in general, and high-tech collaboration in particular, the behaviour and performance of the partner organization rather than an individual is often the object of reference. Managers perceive to have an alliance with another firm that is supported but not determined by the

¹ Up to half of the alliances in the Merit-Cati database involved competitors, according to the firms in the database (Hagedoorn and Duysters, 2002).
accompanying manager from that firm. It is the partner firm that needs to show its competencies, sign the contract and keep the agreements.

Another contribution concerns our empirical analysis of Dutch high-tech alliances. From a population of 572 business managers we obtained 391 usable responses, giving an effective response rate of 68.5 per cent. This rate is considerably higher than those observed in prior studies on interfirm relationships (Poppo and Zenger, 2002; Subramani and Venkatraman, 2003). Business relationships in high-tech industries are characterized by uncertainty and interdependence (cf. Hagedoorn and Duysters, 2002). It is especially under these circumstances that trust has been argued to be meaningful because here a leap of faith has to be made, that is, risk has to be accepted. Uncertainty is not only inherent to the innovation process, but also to the relationship risk. Innovation requires durable relationships that will result in interdependence, changing expectations and conflicting interests. As none of the partners has formal authority over the other, the collaborating firms may need to rethink and renegotiate contested issues during the relationship. This requires trust in the other’s intentions and competences to reach good agreement. Also, a free and timely exchange of ideas and information is crucial for innovation, which openness can only be achieved if trust is present.

A case in point is the Netherlands. The Dutch business culture is often stereotyped as a Rhineland model. It is characterized by a stakeholder economy with a focus on sustainability and coordination involving risk-avoiding behaviour and government interventions. Unlike Anglo-Saxon countries (cf. Sako, 1992; Fukuyama, 1995), it is this institutional environment where interorganizational trust might work. Hence, our data allows us to evaluate the fostering of interorganizational trust in Dutch high-tech alliances with uncertain circumstances in a Rhineland context, and, in turn, how interorganizational trust affects interfirm performance. This contributes to insights into the antecedents and workings of trust in situations where it matters most.

The research is rooted in the many studies on trust in the organization literature (for an excellent and recent review, see Nooteboom, 2002). It is widely acknowledged that interpersonal trust works as a lubricant in economic transactions by smoothing relations between actors and reducing transaction costs relating to control. Prior studies, for example, have found that interpersonal trust facilitates joint action (Zaheer et al., 1998), reduces the need for hierarchical control (Gulati, 1995) and solves conflicts (Larson, 1992). Also, interpersonal trust is identified as a key condition for the development of new knowledge and learning within (Herting, 2002; Smid et al., 2005) and between organizations. Recent studies include related concepts such as social trust to understand dynamics of networks and clusters (Lorenzen, 2002).

The present paper does not deny the importance of these studies but takes another perspective. Our level of analysis is the interfirm alliance. For that reason, we focus on interorganizational trust, its antecedents in terms of characteristics of the interfirm relationship and alliance performance in terms of relational satisfaction. The measurement of dyadic performance in terms of objective, financial indicators is challenging because the period of pay-offs and the underlying goals may vary (cf. Olk, 2002). We therefore focus not

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2 We exclude information on the respondent, such as personality traits, in terms of the inclination to trust. Aside from our focus on the interfirm and organizational level, these personality traits are inherently unstable and very sensitive to recent experiences of the respondent.
so much on ultimate outcomes of high-tech alliances—which tend to be hidden in the future and are difficult to determine—but on the perceived satisfaction of the relation that is indicative of positive future outcomes. Our approach also circumvents a multi-level issue that hinders a clear analysis of trust and performance.

The outline of this paper is as follows. In the next section, we will be explaining further the theoretical foundations of our study. Subsequently, we will then introduce this paper’s research methods. Following that, we will present our empirical evidence. Finally, we will conclude with an appraisal and offer opportunities for future research.

Theory and Hypotheses

Defining Interorganizational Trust

Before we continue, we need to find a working definition of interorganizational trust. Over the years, the number of studies on interpersonal and interorganizational trust has mushroomed (Nooteboom, 2002).

A key challenge is the applicability of the concept of “trust” to different contexts and levels of analysis, which easily creates confusion (Inkpen and Currall, 2003). Hence, the first issue to be considered in developing a working definition of trust is the level of analysis, given that the referent of trust may vary (Dirks and Ferrin, 2002). For this paper, the distinction between interpersonal and interorganizational trust is relevant. Dyer and Chu (2003), following Zaheer et al. (1998), explain this as follows. Trust is a micro-level phenomenon and has its basis in individuals. Organizations, as such, are not able to trust each other. Nevertheless, interorganizational trust is not a tautological use of a psychological phenomenon to organizations. It clearly goes beyond that. One individual can place trust in another individual, or in a group of individuals such as a team within a firm or a partner organization. Interorganizational trust describes the extent to which the members of an organization have a collectively held trust orientation towards the partner firm. Therefore, by interorganizational trust we mean that a person from organization A (the trustor) trusts partner organization B (the trustee) or, in other words, the level of trust placed in the partner organization by the member of a focal organization (see Figure 1).

The reason for choosing the subject of interorganizational trust is threefold. First, it directly aligns with the context of interfirm alliances, which is the key focus of our research. Second, although interpersonal trust has a long history, from a comparative perspective, little is known about interorganizational trust and we aim to contribute to this lack of knowledge (cf. Dyer and Chu, 2003). Third, Zaheer et al. (1998) show that there is a strong correlation between interpersonal and interorganizational trust and that, although conceptually different, it is the latter in particular that improves interfirm performance. The implication is that the measurement of interorganizational trust should include the partner firm as the referent or objective to trust.

3 In addition to the key articles referred to throughout this paper, the organizational literature on trust now includes several edited volumes of papers (e.g. Gambetta, 1988; Kramer and Tyler, 1996; Lane and Bachmann, 1998; Nooteboom and Six, 2003; Bijlsma-Frankema and Klein Woolthuis, 2005), dedicated journal editions (e.g. Rousseau et al., 1998; Bachmann et al., 2001; McEvily et al., 2003) and monographs (e.g. Sako, 1992; Nooteboom, 2002).
Our working definition of interorganizational trust defines it as a positive perception of the partner’s behaviour, that is, the perception by the respondent of the focal firm that a partner organization will not engage in opportunistic behaviour, even in the face of opportunities and incentives to do so (cf. Hosmer, 1995). We can expect this confidence or perception (trust) to emerge in situations where (1) the trustee in the business relationship shows forbearance from opportunism and (2) is known to behave carefully and with concern (integrity, goodwill and benevolence), (3) the trustor shows a lack of monitoring behaviour. Hence, our definition characterizes interorganizational trust as a multi-component construct based on three related components: forbearance from opportunism, care and concern, and lack of monitoring.

Two remarks should be made. First, our conceptualization of interorganizational trust explicitly denominates interorganizational trust as a relational rather than a dispositional feature. Relational trust is likely to be based on experience and interaction with a particular exchange partner. Some researchers consider trust to be a personality trait that reflects expectancies about the trustworthiness of others in general. The characteristics of individuals are outside the scope of this paper, given our unit of analysis. Second, in this study we consider the trust between partners in high-tech industries. This is a good research setting because alliances in high-tech industries are characterized by high levels of environmental uncertainty and therefore offer a context in which trust might be important. The need for trust only arises in an uncertain, that is, risky, situation.4

Antecedents of Interorganizational Trust

The possible antecedents or determinants of trust can be categorized in different ways, such as micro-level and macro-level factors (Lane and Bachmann, 1998), individual, relational and organizational factors (Whitener et al., 1998), or dispositional, interpersonal and situational factors (Payne and Clark, 2003). In line with our unit of analysis, we classify

4 Trust is often related to risk, but it is not the same. Trust increases the willingness to become vulnerable, that is, to take risks (Mayer et al., 1995). This risk is a result of uncertainty with regard to potential opportunism, relationship characteristics and contingencies. Trust is meaningless if these risks are absent. If opportunism can be eliminated, and/or if actors are completely rational and fully informed, trust would not be necessary because all future circumstances can be predicted with great certainty.
our antecedents of interorganizational trust into characteristics that mark stages in a
business relationship: a shared past, detailed contracts, interfirm openness and mutual
dependence (cf. Sheppard and Sherman, 1998; Das and Teng, 2003).

Our first antecedent of interorganizational trust concerns the shared past between the
business partners of the interfirm alliance. Interorganizational trust may result from past
experience or prior successful, common relationships. Trust earned from prior engagement
serves as evidence for justifying subsequent risky steps beyond the accumulated
experience (Ariño et al., 2001). In this case, interorganizational trust is the result of a
rational extrapolation of trustworthy behaviour and competences in previous relationships. It
comes close to the concept of cognition-based trust (McAllister, 1995). Cognition-based
trust follows from knowledge of the other party’s capability to perform the negotiated tasks
(Larson, 1992; Mayer et al., 1995). This can be based on previous experience or familiarity
with the partner in which the capabilities of the other party have become evident, on the
reputation of the partner, or on institutional indicators such as certification. The knowledge
may include information with respect to competences as well as the partner’s goodwill or
intentions. Larson (1992) indicates that prior experience plays an important role in the first
stages of the relationship, that is, when partners are selected and initial agreements are
established. This brings us to our first hypothesis:

Hypothesis 1: A shared past between business partners of the interfirm alliance will have a
positive effect on interorganizational trust.

The development and signing of a detailed interfirm contract is our second antecedent of
interorganizational trust (cf. Klein Woolthuis et al., 2005). Formal contracts are written and
legally binding agreements between the business partners of the interfirm alliance. They
form a basis on which to fall back in the event of difficulties (Six, 2004). Contract theory
(Hart, 1995) and transaction-cost economics (Williamson, 1996) focus on formal contracts
as a mechanism for mitigating opportunistic behaviour. Indeed, there is a rich empirical
literature that supports the negative relationship between the use (Batenburg et al., 2003),
completeness (Blumberg, 2001) and explicitness (Allen and Lueck, 1992) of formal
contracts and opportunism. Specifying the agreements in a written document, supported by
a legal system, removes the incentives and scope for opportunism. Therefore, contracts are
a rational basis for interorganizational trust (Zucker, 1986). Additionally, by negotiating and
specifying, for example, tasks, investments, responsibilities, planned outcomes, timeframes
and accountability, the partners obtain information on each other’s competences and
intentions by which process the development of trust and detailed contracts will go hand-in-
hand. This brings us to following hypothesis:

Hypothesis 2: Detailed interfirm contracts will have a positive effect on interorganizational trust.

Relational openness is the third antecedent of interorganizational trust. Once the partner is
selected and an agreement has been signed, trust will be furthered and tested. Open and
honest communication is the cement that holds together the channel of exchange.

5 For presentation purposes, we present the antecedents in a chronological sequence in line with common knowledge
of business relationships. Of course, this sequence is open to debate.
Relational openness goes beyond the exchange of information per se—it includes the sharing of relevant, comprehensive, accurate and timely information and an open environment for sharing ideas, comments and criticism. This feature has been identified as a prerequisite for successful relationships in general, and for inter-firm collaboration in particular (Zand, 1972; Anderson and Narus, 1990; Luo, 2002). The effect of relational openness is that it deepens interorganizational trust (Lane and Beamish, 1990). Developing an alliance involves a search and identification process with the business partner, whereby differences and complementarities need to be recognized and articulated. Different perspectives do not necessarily lead to conflict and the subsequent dismantling of trust, but this is more likely if there is a lack of openness between the partners. Relational openness fosters trust because it helps to resolve disputes and align perceptions and expectations. Partners in a business alliance who adopt an open approach expose themselves more readily to risk (Six, 2004) and have less of a need to control the other party (Sabel, 1993). It is therefore less likely that they will misinterpret each other’s behaviour. As a result, problems are more likely to be identified and openly examined, and solutions are more likely to be appropriate and creative. We therefore hypothesize as follows:

Hypothesis 3: A high level of relational openness will have a positive effect on interorganizational trust.

Interdependence is characteristic for an alliance because the goals of one partner can only be obtained depending on the cooperating partner’s choice of means. Resource dependence theory suggests that the extent to which a firm is dependent on another firm influences the nature of interorganizational relationships and, therefore, is also likely to be influential in determining the nature of governance mechanisms and alliance performance (Pfeffer and Salancik, 1978). Thus, a focal firm’s dependence on the knowledge of a partner firm is likely to influence the focal firm’s governance choices within the relationship. This also implies that a lack of dependence makes firms less vulnerable to opportunistic behaviour, thereby rendering trust (and other interfirm features such as contracts) unnecessary or even meaningless. When both partners are highly dependent on each other, it may become difficult for firms to replace one another (Berger et al., 1995). The outcome of both parties depends upon the actions of each other leaving little opportunities than to trust. The “deterrent” of mutual dependence also has beneficial aspects: mutual dependence will induce cooperation because of the mutuality of interests (Kumar et al., 1995; Aulakh and Madhok, 2002). When both parties are highly dependent on each other, they have an incentive to make the relationship work (Ring and Van de Ven, 1994). They are likely to interact more and build a mutual understanding with regard to obligations and outcomes. Firms that are more dependent are more sensitive to each other’s needs and preferences, and demonstrate greater forbearance from opportunism. Thus, the importance of interorganizational trust stems from the interdependence of cooperating partners. This leads to the following hypothesis:

Hypothesis 4: Mutual dependence will have a positive effect on interorganizational trust.
To summarize, we hypothesize that four antecedents are important for the fostering of interorganizational trust in high-tech alliances: prior relationship, contract, openness and mutual dependence. Contracts and dependence can be characterized as antecedents of trust that work through deterrence: they prevent opportunism, either by private or legal ordering. Prior relationships and openness are antecedents that work more through the direct relationship between actors: parties that know each other, establish durable relationships and share ideas and information in an open atmosphere. Next, we address the relationship between trust and performance.

Interorganizational Trust and Alliance Performance

Despite the “obvious” advantages of interfirm alliances, many of these have limited success (Beamish and Delios, 1997). The literature suggests that the degree of trust is one of the most critical factors in determining alliance performance (Madhok, 1995; Inkpen and Beamish, 1997). That is, the key obstruction to alliance success is the lack of trust (Nielsen, 2004). Trust has been shown to increase cooperation, improve flexibility, lower the cost of coordinating activities and increase the level of knowledge transfer. However, only a few studies deal explicitly with the antecedents of interorganizational trust in conjunction with alliance performance (the notable exceptions to this are Aulakh et al., 1996; Zaheer et al., 1998; Lane et al., 2001; Dyer and Chu, 2003).

Despite the persistent hesitation of some economists (e.g. Williamson, 1993), researchers who favour trust often point to the economic (i.e. transaction-cost minimizing and efficiency enhancing) value of trust. In this respect, Dyer and Chu (2003) argue that trust lowers transaction costs. For example, when there is a high level of trust, transactors will spend less time on ex ante contracting because they are confident that pay-offs will be fairly divided. Moreover, the arguments in favour of trust usually include the claim that trust allows for greater flexibility in responding to changing market conditions, and facilitates investments in transaction or relation-specific assets that enhance productivity (Nooteboom et al., 1997).

Research on the performance of business relationships generally focuses on two types of indicator: objective and affective (Bensaou and Venkatraman, 1995). In this paper we use the affective indicator because, as argued previously, objective indicators of alliance performance are difficult to establish, particularly when the form of the alliance is intangible. The affective indicator we use is the level of satisfaction with the interfirm relationship that resembles whether the relationship was satisfactory, whether it has improved over time and whether the partners intend to continue their collaborative efforts in the future. We hypothesize that interorganizational trust improves alliance performance as trust promotes the belief that the partner will not take advantage of the vulnerability of the focal firm; that an exchange partner actually cares about the relationship and is attentive to the needs of the partner. Trust therefore enhances cooperation and goal congruence that

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6 It is likely that both sets of performance indicators are correlated and, likewise, may be difficult to disentangle by business partners in a high-tech alliance. We expect that high levels of relational satisfaction go together with a high level of economic performance, whereas the opposites are difficult to understand (low levels of satisfaction with high levels of economic performance or vice versa).
leads to better alliance performance, which is reflected in greater satisfaction regarding the relationship (Lewicki and Bunker, 1996; Fryxell et al., 2002). Thus, we hypothesize:

Hypothesis 5: Greater interorganizational trust will result in improved alliance performance.

Control Variables

Any model with a set of focused relationships requires that rival hypotheses be discounted. We therefore incorporate three variables that are recognized as having an influence on interorganizational trust and relationship performance, that is, the size of the focal firm, the cooperative culture of the focal firm and the value of the business partner. We include focal firm size as a variable in our model to control for extraneous factors such as bargaining power and resource base. These factors may influence the governance and performance of business relationships. Large firms have more resources and may be more successful in directly extracting hostages than smaller firms. Therefore, they will be less dependent on bilateral governance mechanisms such as trust to protect their confidential, proprietary knowledge and their business interests. Second, we assess the cooperative culture of the focal firm. Individuals (such as our respondents) do not operate in a vacuum. They are influenced by shared values and beliefs about what works within an organization and the approaches used to reach their goals. Some organizations have a strong “outward” orientation and inclination towards interfirm cooperation. Others have a more “inward” orientation and prefer a stand-alone business model. Third, we consider the value of the business partner or more specifically the value that the focal firm places on the knowledge that the partner firm has to offer. Knowledge is a key asset for high-tech companies for which technology development is a core activity. The purpose of a business relationship is to benefit from these firm-specific, path-dependent competencies and resources as they complement the firm’s own specialist knowledge and know-how (Nooteboom, 1999).

Research Model

Our research model is shown in Figure 2.

We acknowledge that the direction of causality between our antecedents, trust and performance is open to debate (cf. Dyer and Chu, 2003). Our theoretical model is predicated on the assumption that interorganizational trust directly affects relationship performance. Although most scholars perceive trust as a determinant rather than a consequence of performance (e.g. Anderson and Narus, 1990; Claro et al., 2003), alliance performance might also influence interorganizational trust. Ring and Van de Ven (1994) emphasize that interfirm collaboration is a process in which feedback mechanisms play a crucial role. They argue that performance and trust are continuously evaluated against norms of fair dealing and efficiency. The more successful a relationship is in terms of satisfaction, the more each partner appreciates the other’s fairness, trustworthiness and competencies. Additionally, indirect or moderating effects of trust may exist as well (cf. Dirks, 1999). These dynamic mechanisms explain the continuation of a business relationship. However, it is well known that cross-sectional databases such as ours do not allow the analysis of reciprocal causal relationships (although this is technically possible within LISREL). We will elaborate on this issue in the discussion section.
Methods and Results

Data Collection and Sample

This study focuses on business relationships between two or more firms and/or research institutes that operate in high-tech industries (biotechnology, new material development, information technology, maritime technologies and environmental technology). The life cycle of R&D in these industries is very short. Much of the new technological knowledge quickly becomes outdated, often even before it has been incorporated in new products and/or services. In addition, R&D activities require substantial investments that are almost impossible to cover by an individual firm. Hence, in the high-tech industries in particular, we find many collaborative efforts between firms, including rival firms. Furthermore, given environmental uncertainty, we expect interorganizational trust to operate in this context.

In the preparatory phase of the fieldwork, we conducted 25 semi-structured interviews with consultants who had been involved in R&D alliances. This provided us with a wealth of information on the high-tech industries, interfirm relationships and the development of new technological knowledge. We used this information to design our survey and select the respondents. The survey was field-tested using a sample of 10 companies involved in R&D alliances. This resulted in a number of modifications to the questionnaire. A research team conducted telephone interviews with 572 business managers. Prior to these interviews, all managers received an explanatory letter inviting them to participate. We briefed the team on the features of R&D, high-tech industries and interfirm relationships. The answers were all measured on a 5-point Likert scale. During the interview main topics such as the history and

![Research model diagram]

Figure 2. Research model. The three control variables—size of the focal firm (ζ5), cooperative culture of the focal firm (ζ6) and value of the partner (ζ7)—were modelled as distinct independent constructs but are not shown individually in the diagram in the interests of presentation clarity.
purpose of the alliance as well as contracts, power, investments, industry dynamics and third party mediation were discussed. Some open questions were added to enliven the interview and to enable the respondents to tell their own story to some extent. In total 50 main questions (often divided into several sub-questions) were asked. An outcome of this was that the interviews that were designed to take half an hour would sometimes take up to 1 hour depending on the respondent. The team made three attempts to identify and interview the selected respondents. The case firms were identified from a database of Dutch interfirm high-technology alliances published by the Dutch Ministry of Economic Affairs. This database enabled us to identify the business managers who were responsible for interfacing with the partner firms. They were considered to be the most knowledgeable informants about the interfirm relationships. One of the first questions required the respondents to identify the business partner in the alliance in question. We used this information to cross-validate the information from the database. Because high-tech alliances are typically concerned with specific projects and goals, we also asked the respondents to identify one project that was the most important to the interfirm alliance. By focusing on interfirm collaboration within one sector (high-tech industries), we reduced the range of extraneous variations that might influence the constructs of interest.

We obtained 391 usable responses, giving an effective response rate of 68.5 per cent (see Table 1). This rate is considerably higher than those observed in prior studies on interfirm relationships (Poppo and Zenger, 2002; Subramani and Venkatraman, 2003).7

The non-response is low (31.6 per cent) especially considering that only 10.5 per cent actually refused to be interviewed. A total of 20.1 per cent could not be contacted within the three attempts that the interviewers used to try to get in touch with the respondent. To investigate whether the non-response incurs a bias, the non-cooperating respondents (10.5 per cent) were asked for their reasons not to participate. The reasons for refusal were on the one hand a lack of time and interest (I have not time, I am not interested, I do not feel like it, I am too busy), and on the other hand, irritation because they had recently cooperated in another telephone survey. Although these reasons can hide their true motive for not cooperating (such as an unsuccessful cooperation), the low non-response and the reasons given for non-cooperation do not raise serious doubts on the implications of non-response.

Table 1. Response rates

<table>
<thead>
<tr>
<th>Total basis for response</th>
<th>572</th>
<th>100.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviewer has not been able to contact respondent</td>
<td>115</td>
<td>20.1%</td>
</tr>
<tr>
<td>Respondent only wants to answer in written form</td>
<td>6</td>
<td>1.0%</td>
</tr>
<tr>
<td>Respondent does not want to cooperate in the research</td>
<td>60</td>
<td>10.5%</td>
</tr>
<tr>
<td>Total sample response</td>
<td>391</td>
<td>68.4%</td>
</tr>
</tbody>
</table>

7 The average response rate for business surveys via (e)mail or the Internet in the Netherlands is 5–8 per cent. This means that large research populations need to be available (which is often not the case) or other methods such as telephone or personal interviews need to be used in order to obtain a sufficiently large sample. Following a rule of thumb, about 20 observations per construct in the research model are needed to obtain reliable estimates.
Operational Measures

The design of our survey was inspired by related studies (Anderson and Narus, 1990; Heide and John, 1992; McAllister, 1995; Nooteboom et al., 1997) and our questionnaire included similar items that were adapted to our research context, that is, in line with our unit of analysis (interfirm alliances), firm-level antecedents and control variables. Table 2 gives an overview of the items we used for a particular construct. Without discussing these at length, we ensured that the content of each item—the wording and phrasing of the particular question in the survey—directly relates to the construct it is designed to measure (“face validity”).

We used five items to measure interorganizational trust. Two items measure the benevolence component of trust, two items measure forbearance from opportunism and one item measures the lack of control. We used three items to measure the shared past between the interfirm partners. Apart from a neutral statement, this includes two items that capture the possible affective nature of the past relationship. The measure for interfirm contracts was developed using the knowledge and advice of legal experts on R&D agreements. This resulted in 13 contractual clauses that together comprise a complete contract for interfirm relations in high-tech industries. We used three items to measure relational openness, relating not only to the actual exchange of information, but also to the context and nature of the communication process. We used two items to measure mutual dependence—one item refers to the position of the focal firm and the other refers to the partner’s position. Alliance performance was measured using three items that all indicate the level of satisfaction with the interfirm relationship. Two items were used to measure the size of the focal firm, that is, the number of employees and annual turnover. We used three items to measure the cooperative culture of the focal firm. The value of the partner to the focal firm was measured by one item that directly relates to the sharing of knowledge.

The scales and the Cronbach alpha of the different constructs are shown in Table 2. We tested the unidimensionality of each construct by conducting an exploratory factor analysis (EFA) using SPSS. The results of the EFA indicated that the items underlying a single construct loaded on the same factor. The EFA results are included in Table 2. We also performed a confirmatory factor analysis (CFA) using LISREL 8, that is, we estimated the measurement models for the different variables of our study. The constructs displayed statistically significant item loadings ($t$-values $>2$) that exceeded the threshold value for CFA (factor loadings $>0.60$). The composite reliability for each construct is above the critical value of 0.60 (Bagozzi and Yi, 1988) except for “mutual dependence”. Nevertheless, given the satisfactory EFA results—that were in turn confirmed by CFA—we decided to retain this construct in our analysis.

Tests of the Hypotheses

We used PRELIS 8 to calculate the appropriate product–moment correlation coefficients between the constructs and the maximum likelihood procedure of LISREL 8 to estimate the research model (Jöreskog and Sörbom, 1993, 1996). The means, standard deviations and correlations among composite indicators are shown in Table 3. Table 4 presents the fit estimates as well as the parameter estimates for the structural model.
The LISREL 8 results of the research model suggest acceptable model specification. Values for the goodness-of-fit index (GFI) and the adjusted goodness-of-fit index (AGFI) are 0.992 and 0.914, respectively. The value of the comparative fit index (CFI) is 0.973 and that of the normed fit index (NFI) is 0.965. These values suggest that the data support the research model because they are all above the threshold value of 0.900 (Jaros et al., 1993). The value of the chi-square statistic is significant, indicating a less optimal fit ($\chi^2 = 13.70, p=0.01$). The root-mean-square error of approximation (RMSEA) is 0.079 is just below 0.080 and therefore indicates a good fit (Bagozzi and Yi, 1988; Browne and Cudeck, 1992).

The findings from the tests of the hypotheses follow. First, Table 4 shows that the estimate of the path coefficient between interorganizational trust and relationship satisfaction is positive and significant ($b_{21} = 0.55, t=13.04, p<0.01$). The sample thereby confirms the fifth key hypothesis from our study. This provides evidence for the value of interorganizational trust in durable business relationships that strive for the development of new technological knowledge. As predicted, a shared past between business partners is positively related to interorganizational trust. The estimate of the path coefficient between shared past and trust is positive and significant ($\gamma_{11} = 0.08, t=1.80, p<0.05$). The first hypothesis is thus accepted. Contrary to our predictions, interfirm contracts do not foster trust. On the contrary, the estimate of the path coefficient between contracts and trust is negative and significant ($\gamma_{12} = -0.11, t=-2.51, p<0.01$). This result suggests that a more detailed contract between partners in an interfirm relationship dismantles interorganizational trust. Hypothesis 2 is therefore rejected. Table 4 shows that the estimate of the path coefficient between relational openness and interorganizational trust is positive and significant ($\gamma_{13} = 0.55, t=12.67, p<0.01$). Our third hypothesis is thus accepted. The estimate of the path coefficient between mutual dependence and trust is negative but non-significant ($\gamma_{14} = -0.01, t=-0.21, n.s.$). Hypothesis 4 is rejected.

We obtained mixed results with regard to the control variables. The size of the focal firm seems to be irrelevant for the relationships between trust, its antecedents and performance. The estimates of the path coefficients between size and trust, and between size and relational satisfaction, are non-significant ($\gamma_{15} = 0.01, t=0.02, n.s.$; and $b_{22} = -0.04, t=-0.95, n.s.$). This suggests that the research model works irrespective of the size of the focal firm. That is, the core relationship between trust, its antecedents and performance is the same for small, medium and large firms. The other two control variables do have implications for high-tech alliances. Interestingly, the implications are stronger for trust than for performance. The results in Table 4 show that the value of the partner—in terms of providing access to technological knowledge—has a positive and significant effect on trust ($\gamma_{17} = 0.12, t=2.79, p<0.01$) and a positive but non-significant effect on relational satisfaction ($b_{24} = 0.06, t=1.40, n.s.$). The same applies to the cooperative culture of the focal firm: the effect on trust is positive and significant ($\gamma_{16} = 0.09, t=2.22, p<0.01$) and the effect on relational satisfaction is positive but non-significant ($\gamma_{17} = 0.07, t=1.55, n.s.$). What we learn from the results for the control variables is that interorganizational trust plays a pivotal role in the management of relational performance. The direct effects on performance of all three control variables are non-significant, whereas (except for size) the effects on

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8The $\chi^2$, however, is very sensitive to sample sizes, especially in cases where the sample size exceeds 200 respondents: large samples produce large $\chi^2$ values and thus “bad” fit, and small samples produce small $\chi^2$ values and thus “good” fit (Boomsma, 1996).
Table 2. Constructs, items and scales

<table>
<thead>
<tr>
<th>Constructs, items and scales</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interorganizational Trust, alpha=0.78</strong></td>
<td></td>
</tr>
<tr>
<td>1. We did not feel that we constantly had to keep an eye on [name partner].</td>
<td>0.76</td>
</tr>
<tr>
<td>2. During the relationship, [name partner] treated our problems constructively and with care.</td>
<td>0.76</td>
</tr>
<tr>
<td>3. I never had the feeling of being misled by [name partner].</td>
<td>0.77</td>
</tr>
<tr>
<td>4. [Name partner] tried to reap disproportional gains from the cooperation relative to its input.</td>
<td>0.71</td>
</tr>
<tr>
<td>5. [Name partner] withheld important information from us.</td>
<td>0.74</td>
</tr>
<tr>
<td><em>(For all items: 1=strongly disagree, 5=strongly agree)</em></td>
<td></td>
</tr>
</tbody>
</table>

| **Relational Satisfaction, alpha=0.79** | |
| 1. Can you indicate how satisfied you are with the working relationship with [name partner]. | 0.79 |
| *(1=strongly dissatisfied, 5=strongly satisfied)* | |
| 2. Over the course of time, the relationship with [name partner] has improved and become more intense. *(1=strongly disagree, 5=strongly agree)* | 0.77 |
| 3. Do you think you will continue your cooperation with [name partner] in the future. *(1=yes, definitely, 5=definitely not)* | 0.80 |

| **Shared Past, alpha=0.81** | |
| 1. Our current alliance is a continuation of a previous, long-term relationship. | 0.92 |
| 2. We only knew each other for a short while but thought we could manage the alliance together. | 0.87 |
| 3. Before this alliance a friendly relationship had already been established. *(For all items: 1=strongly disagree, 5=strongly agree)* | 0.77 |

| **Interfirm contract** | |
| Please indicate whether one or more of the following arrangements are present in the contract with your partner. | n.a. |
| 1. Goal and outcomes of the relationship | |
| 2. Duration of the relationship | |
| 3. Project plan (with sequential steps) | |
| 4. Investments by all parties (human, material and financial resources) | |
| 5. Accountability for risks (internally as well as externally to possible customers) | |
| 6. Project management (responsibility, communication) | |
| 7. Confidentiality | |
| 8. Ownership of the product or technology | |
| 9. Ownership of the method | |
| 10. License agreement | |
| 11. Patent rights | |
| 12. Arrangement for relationship adjustments or termination | |
| 13. Arrangement for conflict resolution *(for example, via a third party)* | |
| *(1=no arrangement indicated, 13=all arrangements indicated)* | |

| **Relational Openness, alpha=0.76** | |
| 1. We talked openly and informally with our partner about our ideas, feelings and interests. | 0.72 |
| 2. We provided each other with all the information that was relevant to the project. | 0.81 |
| 3. Criticisms could openly be aired if this contributed to the completion of the project. *(For all items: 1=strongly disagree, 5=strongly agree)* | 0.79 |

| **Mutual Dependence, alpha=0.51** | |
| 1. Without this partner the project could not have been executed. | 0.82 |
| 2. Our partner would not have been able to complete the project without our help. *(1=strongly disagree, 5=strongly agree)* | 0.82 |
trust are positive and significant. Given the strong relationship between trust and performance, the results suggest that, via interorganizational trust, the value of the partner and a cooperative culture have an indirect effect on performance.

Discussion and Conclusions

Conclusions

The aim of this research is to test the hypothesis whether and how interorganizational trust contributes to the performance of high-tech alliances in the Netherlands. We do not deny the importance of personal relationships between managers of collaborating organizations but take into account that personal relationships may end whereas the interfirm alliance continues. This particularly applies to high-tech industries, at least in the Netherlands, where the average turnover of managers and specialized personnel is much higher than in other sectors of the economy. As a result, many different persons are involved in high-tech innovation between organizations over the years. For that reason, the interfirm context becomes important and the partner organization the object of reference. We therefore take this as our unit of analysis.

Our research incorporates high-tech alliances. They are different from other forms of alliances such as supply relationships in the automobile industry that incorporate the purchase and delivery of parts. Although these components are often customized, they are also often produced and delivered in batches. Purchase alliances are usually driven by cost-efficiency motives. High-tech alliances, on the other hand, do not produce and deliver standard products; they time and again create and invent new knowledge that may or may not be embedded in patented products. By definition, much is unknown and these alliances have high levels of uncertainty. These conditions allow interorganizational trust to work.

In general, our results are consistent with the theoretical predictions. Interorganizational trust fosters the performance of high-tech alliances in terms of relational satisfaction. Our
Table 3. Descriptive statistics and correlations

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean</th>
<th>s.d.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interorganizational Trust</td>
<td>22.37</td>
<td>3.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Relational Satisfaction</td>
<td>12.55</td>
<td>2.58</td>
<td>.57</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Shared Past</td>
<td>11.17</td>
<td>3.98</td>
<td>.13</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Interfirm Contract</td>
<td>9.81</td>
<td>3.22</td>
<td>-.04</td>
<td>.05</td>
<td>-.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Relational Openness</td>
<td>14.04</td>
<td>1.59</td>
<td>.29</td>
<td>.20</td>
<td>.01</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Mutual Dependence</td>
<td>5.16</td>
<td>2.71</td>
<td>-.07</td>
<td>-.13</td>
<td>.03</td>
<td>-.15</td>
<td>-.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Size</td>
<td>6.71</td>
<td>2.29</td>
<td>.02</td>
<td>-.03</td>
<td>.03</td>
<td>.13</td>
<td>.01</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cooperative Culture</td>
<td>7.87</td>
<td>2.40</td>
<td>.12</td>
<td>.09</td>
<td>-.01</td>
<td>.08</td>
<td>.23</td>
<td>-.13</td>
<td>-.08</td>
<td></td>
</tr>
<tr>
<td>9. Value of the Partner</td>
<td>3.80</td>
<td>1.39</td>
<td>.16</td>
<td>.15</td>
<td>-.01</td>
<td>.12</td>
<td>.09</td>
<td>-.21</td>
<td>.10</td>
<td>.08</td>
</tr>
</tbody>
</table>

*a n=391, *p<0.05, **p<0.01.
model also allows to identify antecedents of interorganizational trust. It appears that a shared past and an open relationship are particularly important for building trust. Additionally, a valuable partner and a corporate culture that embraces interfirm cooperation help to build and sustain trust and, albeit indirectly, improve the level of satisfaction with the relationship. We therefore contribute to the understanding of how high-tech business partners can develop and use interorganizational trust to improve the performance of an alliance.

The contradictory and non-significant findings are also notable and offer valuable information. First and foremost, why do interfirm contracts dismantle interorganizational trust? We interpret this result as follows. It is possible that our measurement of interfirm contracts is too crude. Contracts may serve different functions, some of which might induce trust while others may harm it (Poppo and Zenger, 2002). Business partners have certain intentions and motives when negotiating and drawing a contract. These intentions become visible in the proposed clauses that in turn will be interpreted and acted upon during the alliance. If, for instance, a partner focuses most on safeguarding clauses such as conflict resolution, the other party may interpret this as a signal of distrust. If partners focus on clauses that ensure good collaboration such as project management, this might elevate trust (Klein Woolthuis et al., 2005). Hence, our construct measures the overall outcome of a negotiating process, but does not reflect the process itself. Apparently, this negotiating process yielded unwanted side effects—such as disputes (Ghoshal and Moran, 1996) and defensive behaviour (Lyons and Mehta, 1997)—that for this sample resulted in a negative effect on interorganizational trust.
Second, why is interdependence and size of the focal firm not important, given the lack of significant support for their estimated path coefficients (despite the fact that the signs of the path coefficients are in line with our predictions)? To some extent, the lack of significant support may have a statistical explanation. This may apply to our “mutual dependence” construct, for which we reported a low Cronbach alpha. Nevertheless, it may also mean that, a priori, we overestimated the value of interdependence as a resource for interorganizational trust. Alliance partners may take interdependence as a given, and that interdependence consequently ceases to foster trust. Partners may therefore rather respond to asymmetrical differences in dependence. The same applies to the lack of support for size of the focal firm. Again, size as such may be too crude a measure for the hypothesized reasons as to why size should matter in the management of interfim relationships. In that respect, more work should incorporate the “fit” between partners in terms of differentials of size, cognition or culture (cf. Nooteboom, 1996). Size may also have an indirect effect, for example, via contracts: the larger the firm, the more detailed the contracts are.

Limitations

We would emphasize that many improvements could and should be made in future empirical research that aims to understand the role of interorganizational trust in the management of interfim alliances and performance. Some of the limitations of our research are generic, and have also been identified in other, related organization research. We collected cross-sectional data from business relationships in high-tech alliances in the Netherlands. This choice limits the generalizability of our results. Also, we interviewed one respondent for each interfim collaboration. Although our respondents were the best-informed parties because they were the managers of the business relationship, this means that we did not explore other perceptions of the relationship from the perspective of the focal firm and the partner firm.

Other limitations are more specific to our research setting. Of course, in line with common preferences in research into businesses organizations, we prefer to use scales that are either statistically validated (in large-scale samples with appropriate sets of respondents) or have been used in similar research settings. Although some convergence in terms of constructs and scales within the recent trust research can be observed, the heterogeneous nature of empirical research prevails. This makes any choice of items and scales subject to debate. The usual solutions that we report in this paper warrant a safeguard—albeit a minimal one—against confusing the conclusions from empirical research that applies relatively new scales. In addition, we used our survey to measure all constructs for our research model because no other sources of information were available. A self-reporting bias may therefore exist (Podsakoff et al., 2003).

A final limitation concerns the dynamic nature of interfim alliances vs. the analysis thereof using cross-sectional databases. It is well known that cross-sectional databases prevent intertemporal, causal analysis of processes that determine the outcomes observed with the use of a questionnaire (Blossfeld and Rohwer, 2002). A cross-sectional sample may or may not provide a substantial “picture” of a substantive process. Therefore, the current research design must assume that the process that determines the relationship between the antecedents, interorganizational trust and alliance performance is in some kind
of statistical equilibrium. Although this might be valid—in the sense that we currently measure a Nash equilibrium and that hence, alliances are more inert than generally is claimed—a dynamic approach towards trust and alliances is interesting by itself. Given the robust empirical results, our model offers an important point of departure for this.

Future Research

Taking these limitations into account, we envisage the following opportunities for future research into interorganizational trust. First, given the lack of empirical research on interorganizational trust, any new sample study would add to our understanding of this increasingly important phenomenon. There are various related opportunities for this. A replication of our study with similar data from the same sample of high-tech alliances would help to test the consistency of our findings over time. Although the age of our data per se does not bring methodological implications—they meet the econometric requirements to test our theoretical model—it might be that the Dutch institutional context changes. Moreover, such a new Dutch sample enables panel data regressions. Of course, the construction of time-series for our theoretical constructs offers the best opportunity for a dynamic analysis. This, however, is beyond the scope of regular alliance research. Nonetheless, a second and more recent data-set is a first step towards disentangling dynamics in the theoretical framework. In line with this, an international setting would allow an explicit study of variations in the institutional context. Testing our model with data from Anglo-Saxon countries such as the UK or the USA would provide opportunities for analysing the effects of institutions on the creation and maintenance of interorganizational trust. These data may cover separate samples of alliances in different industries—to determine industry-specific effects—or, in the vein of Hofstede’s (2001) seminal work, a single multinational company. The latter would allow to cover many nations and by doing so, determine, with the help of one data-set, whether and how international performance differences of interorganizational trust exist.

Second, following Powell (1990) and Hodgson (1998), a key premise of our research is that interfirm alliances create incentives for innovation. That is, social interactions facilitate learning and the creation of collective knowledge in firms and industries. This knowledge creation process is driven in part by interorganizational trust in particular when this form of trust becomes routinized. Here, the proximity between alliance partners matters—both cognitively (Nooteboom, 2000) and spatially (Maskell and Malmberg, 1999)—because innovation is facilitated through face-to-face contact and when there is a shorter cultural distance between agents. Future research needs to address the important relation between interorganizational trust, alliance performance and innovation (Lorenzen and Foss, 2002). We predict that interorganizational trust directly will influence innovation because it ensures the predictability of a business partner and because it provides a reliable mechanism for transmitting and receiving various forms of information (cf. Murphy, 2002).

Third, any theoretical model is, at best, a (biased) representation of reality, and our model is no exception. Nonetheless, more variables can be added to our research model. Also, other measurements such as objective indicators for alliance performance need to be taken into account. Whether relational satisfaction really equates with, for example, superior financial performance is a debate that will continue. The current controversies in the studies of contracts in alliances plea for more in-depth research into the exact content and functions
of contracts, and the subsequent effect on trust development and relationship outcomes. Our study only partly addresses intrinsic motivations as antecedents of interorganizational trust. Like personal relationships, affection towards a partner firm may be an important antecedent of interorganizational trust. Affection in this respect may be based on kinship or similarity: the more similar partner firms are, the more likely it is that they will intuitively understand each other and be confident in their expectations of each other’s behaviour.

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References


