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Innovation performance and partnerships in manufacturing firms in Turkey

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Abstract

Purpose – This paper aims to shed light on the relationship between partnerships and innovation efforts of the firms. The goal is to understand whether Turkish firms collaborate for innovation or not and, if they do, what is the impact of partnerships on the innovation performance of firms?

Design/methodology/approach – In this research, a survey methodology is employed. The questionnaire is implemented through structured interviews conducted with 135 Turkish companies from the textile, chemical, food and machinery industries.

Findings – The findings show that Turkish firms have high-collaboration ties with other companies in particular but the existing partnerships have a weak impact on innovation performance.

Research limitations/implications – As only one country is studied and data come from one year, the findings of this study are limited in terms of generalizing the results for a wide variety of developing countries.

Practical implications – Non-materialized performance is to a degree due to low quality of relationships, but more importantly Turkish firms need to find ways to improve their partnerships and in-house capabilities, particularly their absorptive capacities, if they want to improve their innovativeness through partnerships.

Originality/value – This paper is one of the early examples empirically investigating the relationship between technology collaborations and innovation performance of firms in a developing country context.

Keywords Innovation, Performance levels, Manufacturing industries, Partnership, Turkey

Paper type Research paper

Introduction

The recognition of the paramount importance of networks for innovation management leads to the concept of open innovation systems. This approach is consistent with former studies that argue that innovations are increasingly the result of a joint effort of a number of parties involved in the process (Chesbrough, 2003; Noteboom, 1999). European Innovation Scoreboard defines "innovation" as the process leading to the adoption and diffusion of new technologies, aimed at creating new processes, products and services (Sajeva *et al.*, 2005). However, innovations are not limited to technical innovations but include non-technical process innovations such as team work and

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continuous improvement processes (Armbruster *et al.*, 2005). This paper will treat innovation from this broader perspective. The reasoning behind innovation partnerships come from two main theories. Resource-based view highlights that the way scarce innovation resources are utilized within firms might have influential power over decisions in forming partnerships (Grant, 1991; Eisenhardt and Schoonhoven, 1996). The network theory expands the discussion by indicating the possibility of tapping into resources available in a network through collaborations/external partnership (Gulati, 1998; Saxenian, 1994). By studying both individual dyadic links and environment features of networks, it becomes possible to understand the factors influential in inter-firm collaborations in technology and innovation development (Osborn and Hagedoorn, 1997).

Innovation models are changing and in advanced countries, companies use alternative external sources of innovative competencies such as strategic technology alliances, mergers and acquisitions, or a mix of these (NSF, 2004). Benefits range from resource sharing and risk reduction to increased competitive power.

Given the global trends, the practice of partnerships experienced in developing country context is worth investigating. If theories are right, the impact of partnerships on innovation performance of firms in developing countries will be overwhelming, as these countries have scarce resources and lacking competitive edge compared to advanced countries particularly in technology-based products.

This paper is an empirical investigation of collaborations among Turkish manufacturing companies in order to shed light on the relationship between performance and innovation efforts of the firms in a developing country context. Two questions are interlinked in this research: do Turkish firms collaborate for innovation and if they do, what is the impact of partnerships on the innovation performance of these firms.

Turkey has an established manufacturing system comparable to many developing countries. However, the level of innovativeness of its manufacturers is relatively low compared to many countries in European Union, of which it aspires to become a full member. Although existing production value chains would benefit from low-labor cost, its manufacturers cannot continue competing without developing capabilities in research and development, design, and innovation. That is why new models such as open innovations and building technological partnerships might take Turkey into a new development track. Based on this paper's findings, Turkish firms and policy makers might learn about the existing structure and the problems behind innovativeness of manufacturing firms.

Technology alliances

Facing with the increased uncertainty and cost in R& D as well as heightened competition, firms consider not only in-house development but also collaboration or acquisition to increase their innovativeness (Pisano, 1990). Besides many advantages, some studies show the positive impact of partnering companies on innovation (Ahuja, 2000). That is why firms tend to establish overseas operations, form strategic technology alliances with international partners, and engage in both divestiture and acquisition of strategic technology units (Gulati, 1998).

There are many indicators showing the increase in technology alliances (see detailed examples in Organization for Economic Cooperation and Development

(OECD), 2004). For example, partnerships account for a growing share of R& D funding in the OECD. Another indicator of increased international collaboration in R& D activities is the total number of international strategic technology alliances formed in the 1990 s as shown in Table I.

However, these developments are geographically limited to North America, Europe and Japan. The US-based companies have a prominent role in international alliances: the bulk of these strategic technology alliances have a US-based firm as the ultimate parent company.

Collaboration takes place among researchers of advanced countries leaving others out of networks. The only exceptions might be China and India, two largest emerging markets and some other newly industrializing countries such as South Korea and Brazil (Kotabe *et al.*, 2005).

Since, the available studies are limited geographically to a few countries, it is a challenge to understand the technology management practices in developing countries, particularly the technology collaborations. Considering that the majority of developing countries have limited capital and highly skilled labor resources, they would be in need of getting into collaborations to tap into these resources. So, firms in developing countries might form innovation partnerships similar to their counterparts in advanced countries. But then what?

Although it is not easy to establish technological collaborations, it is even more important to successfully manage the cooperation after it has been established (Gulati, 1998; Noteboom, 1999). These knowledge-seeking alliances create potential challenges to developing country managers in managing the process such as developing strong technological absorption capabilities and learning mechanisms (Davenport and Miller, 2000). A study on New Zealand's semiconductor alliances indicate that social processes, such as the development of trust and social embeddedness between the partners, which can, in turn, result in increased co-specialization, allow the risk of such alliances to be reduced (Davenport and Miller, 2000). These type of studies need to be done for developing countries due to their structural differences from advanced countries. By studying their specific context, useful knowledge might be accumulated that will help managers in managing their technological collaborations to get successful innovation results.

The innovation-oriented collaborations are studied by a number of theories (Osborn and Hagedoorn, 1997) but two of the main theories, namely resource-based view and network theory will be the subject of this paper. Literature on resource-based view emphasizes the role of not only limited resources within an organization but also company strategies in making a decision for collaborations (Barney, 1991;

Table I.
The total number of international technology alliances, by regional ownership and technology focus: 1991–2001

Ownership categories	Information, bio and other technologies	Information technology	Biotechnology
Alliances by companies from all countries	5,892	2,471	1,829
Alliances by US companies	4,646	2,067	1,491
Alliances by European companies	2,604	815	918
Alliances by Japanese companies	779	430	139

Source: NSF, Science & Engineering Indicators – 2004

Mowery *et al.*, 1998). Even though the companies might have similar resources, the way those resources are employed are determined in line with the company strategy, resulting in different business outcomes. As put forward by the resource-based theory of competitive advantage, the competitive advantage of a firm is increasingly dependent on valuable, rare, non-substitutable and unique resources, where innovation is one of these special resources (Barney, 1991; Christensen, 1995). Innovation is an intangible resource but it is not only important for becoming competitive but also for the sustainability of a firm's competitive advantage. The pool of resources of a company might underline the opportunity set as well as the potential innovation trajectories in collaborations. That is why having complementary resources with partners is considered as one of the reasons of successful collaboration (Mowery *et al.*, 1998).

The second theory dealing with collaborations is network theory. Cooperation for innovation is increasingly seen as a means for lowering development costs, accelerating product and process development, and maximizing commercialization opportunities in innovation projects. The capability of building and maintaining inter-organizational networks, such as joint ventures, license agreements, (supplier-customer) co-development and strategic alliances has led to increased number of product and process innovations (Ritter and Gemunden, 2003). The availability of technological opportunities in the region a company operates might determine the partnership decisions of firms as well as the innovation outcome (Saxenian, 1994; Rothwell, 1994). Firms might form both formal and informal relationships with local organizations to speed up their technological development. The recognition of the paramount importance of networks for innovation management leads to the concept of open innovation systems, which are characterized by a flexible way of firms to coordinate a large number of innovation projects and to assess their value (Chesbrough, 2003). Geographical proximity is of particular interest in network theory due to its goal of understanding and measuring the role of informal relationships in innovation generation. The learning dynamics of these formal and informal network relationships widely affect the performance of partnerships (Angel, 2002; Verspagen and Duysters, 2004).

It is worthwhile to observe whether firms in developing countries get into innovation partnerships. But more importantly, it is worth exploring the performance of companies that form innovation partnerships. The findings related to the innovative performance of firms resulting from partnerships might help to understand the critical issues behind the mechanism of partnerships.

Research design

Background

The study is conducted in Turkey, the 17th largest economy with a Gross National Product of US $459 billion (purchasing power parity value) in 2000 (UNDP, 2002). Turkey is also one of the 20 most populous countries in the world with a population of 72 million that is increasing at an annual rate of 1.6 percent, the highest among OECD countries. Although Turkey does not have a strong technological base, it is a developing country with heavy industry infrastructure and Turkey can highly benefit from the diffusion of technologies and innovations. Even though the study is limited due to its coverage mainly to Turkish manufacturing companies, many developing

countries might draw some policy conclusions from the observations of Turkish firms and their behavior regarding the innovation and partnerships.

R&D measures clearly indicate that Turkey does not invest in technological development (Elçi, 2005). The share of R&D in Gross Domestic Product is only 0. 67 percent, which is far below from the average of EU countries, namely 1. 5 percent. Another resource in technological development is the share of scientists and researchers in total employment. R&D personnel are 3,634 in a population of 72 million while this number is 41,636 in Sweden, where population is only 8 million. As a result of low investment in R&D, the scientific and technological output in Turkey is considerably low. For example, the local patent applications in Turkey are around 200 per year, the lowest among OECD countries.

Besides poor R&D performance, another concerning point regarding the R&D structure in Turkey is the distribution of R&D funds. The major source of R&D funding is government and the use of these funds is dominated by universities. For example, government provides only 31 percent of R&D funds in the USA, only 26 percent of total funds are spent by government and university combined, while Turkish government finances 51 percent of R&D and spends 45 percent of those funds together with universities (OECD, 2004). This structure combined with the low level of patenting activity leads to the conclusion that the limited R&D activities are in the domain of scientific community rather than business. This, in turn, indicates low utilization of existing knowledge for economic and social purposes.

As technological development is weak in Turkey, technologies are mainly imported. Turkey is ranked number one importer among non-EU Mediterranean countries for its high-technology products, totaling €3.1 billion in 2002 (World Bank, 2006).

Data

The data were originally gathered during the period of June-December 2004 for the European Manufacturing Innovation Survey study that has been developed originally by the Fraunhofer Institute Systems and Innovation Research in Germany. Besides Turkey, the original survey included the following countries: Germany, Austria, England, France, Croatia, Switzerland, and Slovenia. This paper will focus on collaboration, consisting of a small set of data of the original survey that investigates different dimensions of manufacturing companies with a greater focus on their innovations (Armbruster *et al.*, 2005).

The survey covers four manufacturing sectors: textile, chemical, food, and metal, which are the leading sectors of the manufacturing industry in Turkey. Once the manufacturing sectors are decided upon, then regions that have concentration in those sectors are selected. Owing to time and budget constraints, interviews are conducted only in four regions, whose total employment in selected sectors is more than half of the manufacturing employment in the region. As Table II shows, each region's employment in those four sectors represents at least 72 percent of total local manufacturing employment. Region 1 has the highest concentration in those four sectors. In total, four regions together constitute 48 percent of employment in the machinery industry in Turkey, 45 percent of employment in the chemical industry, 41 percent of employment in the textile industry and 27 percent of employment in the food industry. Overall, these four regions constitute 41 percent of total manufacturing employment in Turkey. The sample consists of 135 manufacturing firms distributed

Table II. The employment distribution of sample firms over regions

	Food sector employment	Textile sector employment	Chemical sector employment	Machinery sector employment	Total of four sector employment/total local manufacturing employment (percent)	Total local manufacturing employment/total manufacturing employment (percent)
Region 1 (Ist-Kirklareli)	51,151	304,909	83,068	166,729	86	28
Region 2 (Koc-Sak-Balikesir)	26,322	19,909	35,375	60,834	78	7
Region 3 (Konya)	16,799	8,948	8,253	21,328	80	3
Region 4 (Kay-Kar-Nev)	16,156	21,576	5,173	17,871	72	3
Total of 4 regions employment/total sector employment in Turkey	27%	41%	45%	48%		

over nine different cities (Istanbul, Kırklareli, Kocaeli, Sakarya, Balıkesir, Konya, Kayseri, Karaman, Nevşehir) located in these four regions.

For data collection, the database created by TOBB (The Union of Chambers and Commodity Exchange of Turkey) is employed. Firms are selected randomly from the list given by TOBB. The decision criteria for selection are industry type, employment size, and region. The survey is conducted through face to face interviews due to the complex nature of the survey. The concepts in the survey related to innovation, modernization, and collaboration are explained to the interviewee whenever it is needed. The interviews are mainly done with production managers and in some cases with general managers.

Measures

As indicated in the discussion of technology alliances, this paper aims to understand the innovative performance of a firm based on resource-based view and network theory. The paper argues that both theories complement each other; hence they suggest a number of potentially additive determinants of firms entering into partnerships. The measures that are used in the operationalization of the theory constructs are briefly discussed below.

The innovative performance of companies might be measured in many ways such as the number of patents or the number of new products (OECD, 2004). In this study, the percentage of total sales coming from the new products developed in the last three years is utilized as the performance criterion. The main reason is the fact that firms in developing countries have much less patents compared to advanced countries due to lack of proper intellectual property right institutions and expenses of getting and managing patents.

Based on resource-based view, two variables are developed (Angel, 2002). Firstly, the employment of a company is used to measure the size of the company to indicate richness of internal resources. Since, a large number of companies failed to report their sales, the employment figure is used to measure the size. The second variable represents the company's product strategy indicated by being leader, follower, or quality oriented.

Variables driven from the network theory are two types: measures used to track the formal partnerships as well as measures to capture the informal network relationships. Formal partnerships might be measured by checking whether a company has partnerships with companies or universities. The geographical dispersion of partners is also questioned by classifying the partners as regional, national and international to see the role of proximity of partners in developing relationships. The informal relationships are related to the general localization of manufacturing and sectoral activities (Angel, 2002). Hence, two variables are developed. One of them measures local manufacturing employment and the second one is the share of local sector employment in total local employment. In order to normalize the local manufacturing employment variable, its logarithm is taken.

The model tested in this study then turns out to be as follows. Innovation performance (the ratio of sales generated from new products) is a function of both resources (size and product strategy) and networks (company partnerships, university partnerships, local manufacturing employment, and the share of local sector employment in total local employment).

For control variables, this paper uses the size of companies, the type of industry involved and the region of the firm as adopted in many studies in the literature (OECD, 2004). The expectation is that large firms will have higher innovation due to their larger set of resources. High technology based industries such as machinery is expected to have higher innovation. Regions that are hubs of science and technology are more likely to supply inputs for firms operating in the region, leading higher innovation performance.

SPSS Version 11 is used for statistical analysis. Multiple regression methods are used to analyze the model. In addition, cross tabulations are used to see whether product or process innovators have differences. The statistically significant results are given in the analysis section.

Results of the analysis

The descriptive statistics

Machinery firms constitute 36 percent of the sample, followed with textile (34 percent), chemical (16 percent) and food processing firms (15 percent). Almost half of the firms employ in the range of 50-150 employees. Firms employing more than 250 employees are 16 percent of firms, while firms having less than 50 employees constitute 22 percent of total firms. About 36 per cent of firms are established during the 1990s, the recently established firms that are less than five-years old are 9 percent of firms.

In the survey, 72 companies declared their sales. The sample is equally distributed in the following sales categories (respectively 14 percent of firms): sales less than 0.7 million USD, sales between 0.7-2 million USD, 2-4 million USD, 4-10 million USD and more than 10 million USD. Data show that 61 of firms have quoted export figures. Accordingly, 31 percent of firms export less than 0.4 million USD, 23 percent of firms export between 0.4-2 million USD, another 23 percent of firms export between 2-5.5 million USD, and another 23 percent of firms export between 5.5-15 million USD.

The technology indicators for sample firms are given in Table III. More than half of the firms do not respond to the question about their R&D budget. Only 59 firms report their R&D intensity, i.e. the percentage of their R&D expenses in their total sales, where 28 of them report zero R&D spending. Ten firms have an R&D intensity of less than 1 percent, 15 firms spend around 1-5 percent, and five firms dedicate between 5 and 10 percent of their sales to R&D. One firm mentioned that they spend more than 10 percent of their sales for R&D activities. Only 29 firms report to have independent R&D departments. The majority of companies perform these activities through their

R&D intensity	No. of firms	Patent	No. of firms	Trademark	No. of firms	Utility model	No. of firms
0	28	0	56	0	48	0	85
<1	10	1	21	1	24	1	7
1-5	15	1-5	14	1-5	17	1-5	4
5-10	5	5-10	5	5-10	5	5-10	1
>10	1	10-50	8	10-70	4	10-12	2
Total	59	Total	104	Total	98	Total	99

Table III. Technology related indicators for sample firms

production engineers in an *ad hoc* manner. This can be considered as an indication that the firms are interested more with the D-part of R&D rather than the R-part.

As the majority of sample firms do not have R&D budgets, not surprisingly they do not hold intellectual property rights in the forms of patent, trademark or utility model. As seen in Table III, 56 firms have no patent, 48 firms have no trademark, and 85 firms have no utility model. Among the companies holding patents, 44 percent of them have only one patent, and 73 percent of them have less than five patents. About 16 percent of patent holding companies have between 10-50 patents. Similar picture holds for trademark and utility model ownership. Almost half of trademark holding firms have just one trademark and half of the utility model holding companies have one utility model.

Regarding the companies' innovation performance, there are a few indicators to pay attention. One of them is direct information whether the company has introduced any product innovation in the last three years. Out of 135 firms, 94 firms indicate that they have product innovation as shown in Table IV. The number of new products launched in the last three years is quite low. About 55 percent of firms have less than five new products, another 24 percent have between 5 and 10 new products. Firms having more than 100 new products are 6 percent of the firms. Although the number of new products launched is not so high, it seems that the new product sales represent an important share in total sales. New products constitute more than half of sales for 12 percent of firms, while 26 percent of firms indicate that between a quarter to half of sales are generated by new products. About 4 percent of firms have less than 5 percent of total sales coming from new products, while 34 percent of firms have between 5 and 10 percent of their sales from new products.

Out of 135 firms, 103 companies have relationships with other companies, while 94 of them have relationship with universities. This result answers the first question of this paper: firms in developing countries form technological collaborations. Now comes the second question, does collaboration bring performance? To answer this, a few general data can be helpful in sketching the background or content of collaborations.

The comparison of Tables V and VI indicates that company collaborations have more variety than university relationships. The depth of collaborations with companies is significantly higher compared to university relations. About 21 percent of firms cooperating with other companies have one collaboration activity, while 44 percent of companies collaborating with universities have one activity with universities. Another 21 percent of firms have between 4 and 7 collaboration activities with other companies.

Table IV.
Sales from new products and the number of new products

Sales from new products/total sales (percent)	No. of firms	Number of new products launched in the last three years	No. of firms
<5	3	<5	52
5-9.99	26	5–10	23
10-24.99	18	11–25	8
25-50	20	26–100	5
>50	9	>100	6

Collaboration activity[a]	Yes[b]	Regional partners	National partners	International partners
Training	49	24	9	13
R&D with customer/supplier	73	30	17	22
R&D with competitors	7	6	0	1
Sales and distribution	43	15	16	9
After sales service	25	8	12	5
Procurement	36	18	9	6
Bidding	30	15	6	5
Production	41	31	5	4

Notes: [a]Companies can have more than one collaboration activity; [b]the sum of regional, national, and international partners might not add up to the number of "Yes" answers due to some locality data missing in some answers

Table V. Collaborations with companies

Collaboration activity[a]	Yes	Regional partners	National partners	International partners
Training	46	26	13	4
R&D	34	14	15	3
Test and laboratory services	80	39	30	6

Note: [a]Companies can have more than one collaboration activity

Table VI. Collaborations with universities

The collaboration themes and whether they are conducted with local, national or international partners are also given in Tables V and VI. The main activity with company collaboration is performing R&D. Customers, suppliers and even competitors become partners for R&D development. This is a confirmation of resource-based view, since the low R&D budgets indicate scarce resources, thus motivating collaborations. The majority of partners are selected from the region with two exceptions; partners to carry out activities for sales and distribution and for after sales service collaborations are selected mostly at the national level. With respect to the activities with foreign partners, 23 firms indicate that they conduct R&D together. As Turkish firms are importing their technologies, it is not a surprise that suppliers bring technology to the sample firms.

The majority of firms have collaboration with universities but university collaboration is mainly focused on test and laboratory services followed with training support. Again regional institutions are the major partners except in R&D, where national partners take the lead slightly from regional ones. At least, 14 companies mention that they have collaborations with foreign universities where six of them have indicated that their collaboration is related to test and laboratory services.

The regression analysis

The statistical results do not show strong impact of collaborations on innovation performance. Even though the model consisted of variables coming from two

sets of theories, only new product strategy, company partnerships and the share of local sector in total local manufacturing had a significant effect over innovation performance. University partnerships do not appear as an effective factor in innovation performance. This is not surprising as the content of university relationships is limited to test and laboratory services rather than R&D activities. The model has high-statistical significance ($p = 0.001$) but its adjusted R^2 is equal to 0.16, in other words, these three variables explain 16 percent of the variance in the model. In short, the model does not include important variables that seem to explain the innovation performance of firms:

$$\begin{aligned}&\text{Share of new product sales} =\\&54.9 + 0.23\ \text{new product strategy} + 0.22\ \text{company partnerships}\\&\qquad\qquad (p = 0.03)\\&+ 0.23\ (\text{local sector/local manpower}) + \text{residual}\\&\quad (p = 0.04)\qquad\qquad (p = 0.03)\end{aligned}$$

Note: Beta values are standardized values.

When corporate partnerships are divided into regional and national partnerships, then the new model explains 24 percent of variance of innovation performance (adjusted R^2) with high-statistical significance ($p = 0.000$). The coefficients indicate that regional partnerships have double impact on innovative performance compared to the impact of national ones. International partnerships do not appear as a significant factor. This confirms the network theory argumentation that regional network partners have more relevance for innovation performance:

$$\begin{aligned}&\text{Share of new product sales} =\\&62 + 0.3\ \text{new product strategy} + 0.4\ \text{company partnerships at the region}\\&\quad (p = 0.01)\qquad\qquad (p = 0.00)\\&+ 0.2\ \text{national partnership} + 0.2\ (\text{local sector/local manpower}) + \text{residual}\\&\quad (p = 0.05)\qquad\qquad (p = 0.05)\end{aligned}$$

As an extension of analysis, the role of firm size, type of industry, and the region on innovation performance are also investigated. No statistically significant results is found.

Concluding remarks

Technology partnerships are widely adopted by advanced country companies. Increasing innovation capabilities through partnerships might be of high importance to firms in developing countries, too. Thus, there is a need to observe the collaboration practices in developing countries. This study attempted to see the collaboration activities of Turkish manufacturing firms and particularly interested in understanding its impact on innovation performance.

The majority of sample companies have partnerships with both companies and universities. The main partners tend to be suppliers and customers. This result is in

line with the national survey conducted to observe the sources of innovation that turned out to be mainly supply chain partners (TSI, 2004). Our analysis shows that the impact of partnerships with universities on innovation performance can be ignored while company partnerships influence innovation performance in a modest manner.

The main theories dealing with the relationship of partnerships and innovation performance are resource-based view and networks theory. According to our data, they both have low-explanatory power in explaining the relationship between innovation performance in Turkish firms and their partnering activities. The data show that new product strategy, the size of local sector, and having local or national partners might explain up to almost one fourth of the relationship of partnerships and innovation performance. There is a need to investigate further to find other factors that will help to explain the relationship. One factor for having low-innovation performance in partnerships might be the low level of collaboration. As indicated in the Turkish data, the number of partners is low and the type of activities in relationship is highly restricted with few R&D activities. Another potential explanatory factor might be the learning capabilities of companies but this is not studied in this paper. Companies might enter into partnerships but if they cannot absorb and transfer the knowledge to its employees, then the impact of partnerships might be low. The problem of internal competencies and learning is well documented for developing countries (Lall, 1990). This absorptive capacity problem seems to be valid also for our sample companies, since they do not provide for enough resources devoted to R&D and do not have institutional structures that provide for potential mechanisms for learning.

As one country is studied and data come from one year, the findings of this study are limited. Similar studies need to be conducted in many developing countries to see how their technology partnerships affect their performance in technology. Studies need to consider also longitudinal studies to observe the partnership effects over the years.

Technology partnerships seem to be popular but the way they are constructed and managed require good understanding of how they might be utilized fully to increase innovative performance of companies. In this regard, Turkey and many developing countries having similar industrial development seem to have a long way to go.

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