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An Investigation of Key Parameters Affecting the Successful Management of a Knowledge-Based Organization

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Abstract. This study aims at evaluating the key parameters affecting the success of parent-reliant knowledge-based companies in Iran, considering apparent decline in the rate of knowledge transfer success among the organizations, especially parent-reliant ones. A questionnaire-based investigation was conducted along with social network analysis and financial evidence cross-checking. This research conducts a survey to more than 140 respondents from two dependent and four independent organizations as well as five client companies. After a comprehensive literature review and based on a theoretical framework, we define nine variables for measuring the organizations' success. We have found that an organization's success significantly depends on the quantitative and qualitative strength of connections created between a knowledge-based organization and others. Detailed examinations shows that some of the measured variables were affected by the type of the organization. Within this context, success in achieving client satisfaction is considerably different between autonomous and subsidiary companies. We suggest that the way subsidiaries foster a pattern of profitability in business is not the same as that of autonomous organizations. We also discuss key parameters affecting successful management especially regarding connection with others, considering the dissimilarities between self-reliant and dependent knowledge-based organizations.

Keywords: self-reliant organization, knowledge-based organization, questionnaire-based survey, social network analysis

Abstrak. Penelitian ini bertujuan untuk mengevaluasi parameter kunci yang mempengaruhi keberhasilan perusahaan-perusahaan berbasis pengetahuan yang masih mengandalkan perusahaan induknya di Iran, mengingat penurunan yang nyata dalam tingkat keberhasilan transfer pengetahuan di antara organisasi-organisasi, terutama yang bergantung pada induknya. Investigasi berbasis kuesioner dilakukan bersama dengan analisis jaringan sosial dan pemeriksaan silang bukti keuangan. Penelitian ini melakukan survei terhadap lebih dari 140 responden dari dua organisasi dependen dan empat independen serta lima perusahaan klien. Setelah tinjauan literatur yang komprehensif dan berdasarkan pada kerangka teoretik, kami mendefinisikan sembilan variabel untuk mengukur keberhasilan organisasi. Kami telah menemukan bahwa keberhasilan organisasi secara signifikan tergantung pada kekuatan kuantitatif dan kualitatif dari koneksi yang dibuat antara suatu organisasi berbasis pengetahuan dan yang lainnya. Pemeriksaan terperinci menunjukkan bahwa beberapa variabel yang diukur dipengaruhi oleh jenis organisasi. Dalam konteks ini, keberhasilan dalam mencapai kepuasan klien sangat berbeda antara perusahaan otonom dan anak perusahaan. Kami menyarankan bahwa cara anak perusahaan mengembangkan pola profitabilitas dalam bisnis tidak sama dengan organisasi otonom. Kami juga membahas parameter kunci yang memengaruhi manajemen yang sukses, terutama yang berkaitan dengan organisasi lain, mengingat perbedaan antara organisasi yang mandiri dan yang bergantung pada pengetahuan.

Kata kunci: organisasi mandiri, organisasi berbasis pengetahuan, survei berbasis kuesioner, analisis jejaring sosial

INTRODUCTION

In today's economic context, a knowledge-based perspective is anticipated to be a more appropriate, acceptable, and even essential strategy for companies. Changing companies' viewpoint from resource-based to knowledge-based is such a major strategic update that discussions about its effects on companies' success are still ongoing (Balogun and Jenkins, 2003). In this innovative view, knowledge is considered as an organization's most important asset and resource (Child and McGrath, 2001). According to the knowledge-based view, the organization is responsible for creating knowledge and applying it to achieve competitive outcomes. This is carried out mainly by concept designers, technology developers, financial experts, and managers as an indispensable function of a company (Zack, 2003). To strengthen their knowledge-based views, some large companies decide to reconfigure

their capacities to adapt more dynamically with any new changes in client requirements. One such reconfiguration method is establishing new knowledge-based subsidiaries, including new capacities and capabilities designed specifically to address the parent company's needs especially in concept design and technological development (Andersson et al, 2002).

The effects of knowledge-based subsidiaries on the success of parent companies have a strong connection with the distance between the two in various aspects, such as geographic distance, cultural principles, and alignment of interests (Omondi, 2015). A knowledge-based organization, as a "daughter" of a large parent company, can foster effective collaboration to innovate technologies according to the parent company's requirements. The roles of technology-based daughter companies include generation, prevention, acquisition, and distribution of knowledge to enable the parent

company to globalize its market. Most studies focused on the role of subsidiaries in their parent companies and investigated the main factors affecting the parent company's success (Cantwell, 2001; Minbaeva et al, 2003; Baglieri et al, 2010). Various strategies are scrutinized to properly disperse knowledge and technologies and make them efficient for the parent company's use. It is strongly recommended that knowledge-based subsidiaries be strictly bound and controlled by their parent firms (Birkinshaw, 2002). However, more than providing direct services to their mother companies, it would seem necessary for subsidiaries to foster knowledge-based relationships with others and develop operational systems and procedures to compete and survive even without the direct support of the parent company (Achcaoucaou et al, 2014).

Commercializing knowledge and innovations by subsidiaries is an essential rather than routine and ordinary predefined role in connection with the parent, and this has been thoroughly investigated in multinational companies and their subsidiaries (Foss and Pederson, 2004). Neglecting the relation between an organization and its parent company and solely focusing on knowledge-based organizations surviving in a science park, some studies examined the main factors affecting a science-based organization and found interesting results. An investigation of collaborations between science-based organizations and purely academic organizations indicated that in focused science parks, organizations with more centrality and stronger ties have a better chance for survival and faster growth (Malairaja and Zawdie, 2008). It was also concluded that increasing proximity among organizations through clustering can accelerate knowledge transfer and increase the rate of commercialization of any technological innovation (Alvandi et al, 2010; McKelvie and Wiklund, 2010). Considering again the daughter-parent relationship, some studies also investigated science-based organizations from several viewpoints to create strong ties with others to collect and apply knowledge for their parent (Mudambi et al, 2014; Franko et al, 2017). However, the survival of daughter companies shall be investigated when there is no reliable or permanent support from their mother firms; this is true especially in developing countries where subsidiaries are also tasked to develop their own business and are expected to improve their financial status (Hansen and Gwozdz, 2015).

For science-based subsidiaries, technological knowledge ranks first in importance especially in regional innovation circumstances (Ashiem and Coenen, 2005). This is mostly dependent on the field of industry and expectations defined by their parent companies. In general, when subsidiaries are not completely bounded by their mother firms, they may generate more ties and improve their proximity to other science-based organizations in the same technological field. Research and innovations created by an organization will be fully effective when they indeed help evolve its collaboration with other companies such as clients and sisters as well as its parent. Evidence of this principle has been presented by studies on the special working field of parents and subsidiaries (Balland, 2012; Balland et al, 2015; Ibert and Muller, 2015). Subsidiaries have also undergone investigation by some studies for special conditions in their host countries (Lin C.P., 2013). The appropriate condition for a science-based organization is inspected and studied to build networks and develop its dynamic capabilities. However, the results do not seem provide much insight especially with respect to

local markets and the self-fostering of daughter organizations. Particularly in cleantech industries, which are one of the main fields of innovation studies for science-based organizations, decreasing cultural or geographical distance can be complicated (Hansen, 2014). Some recent studies suggested some integrated frameworks to implement innovation processes in knowledge-based organizations to enable the organization to upgrade and improve both technologically and commercially (Davids and Frenken, 2018).

Regarding the parameters affecting organizational success, studies have shown that knowledge transfer is an essential process that must be carried out by a science-based organization. The competitive advantages of a parent company are strongly dependent on the effective knowledge transfer between subsidiaries and parents (Arsawan et al, 2018). However, from an organizational point of view and for long-term success, more than this transmission, it is also essential to develop new innovative connections with other science-based organizations. Some direct methods have been recommended to improve the knowledge transfer rate, including sending expatriates from the parent company to the subsidiaries (Chang et al, 2012; Yang and He, 2014). Nevertheless, for interorganizational connection and transfer between subsidiaries, the adequacy of this method needs to be validated. Based on the theory of absorptive capacity, an organization needs to identify, acquire, apply, and transfer valuable knowledge from and to all external bodies that can be recognized as reliable resources. This is especially critical as a complementary driver for an organization's innovation capability (Morant et al, 2018). The knowledge resources used by a parent company and any other science-based organization may work in the same context as a subsidiary. Internal processes are required to assimilate and customize acquisitive knowledge according to an organization and its parent firm (Fosfuri and Tribo, 2008).

Primary determinants need to be recognized and developed to accelerate knowledge transfer between a knowledge-based organization and all other bodies including its parent company. In this regard, parameters such as geographical and cultural positions are significant (Tsai, 2001). Detailed analysis on the pros and cons of various methods and instructions for improving absorptive capacity shows that knowledge management skills and models need to be considered (Mariano and Walter, 2015). Some recent studies considered knowledge transfer as one of the main project management processes and presented some applicable tactics to highlight innovation in project outcomes (Leal-Rodriguez et al, 2014). A professional field of work is also considered one of the main factors that define and implement appropriate schemes for higher organizational performance owing to better knowledge transfer especially in green technologies (Chen et al, 2012). Business size is also a determinant of appropriate models to develop the absorptive capacity of small and medium-sized businesses (Hair et al, 2014; Limaj and Bernroider, 2017).

According to the literature review, analysis can be made on recent approaches to companies' knowledge-based perspectives as well as the knowledge transfer pattern between organizations. As Table 1 shows, even though it is not explicitly stated, the main context of the related literature mostly moves from a conventional resource-based view to a knowledge-based view. Afterward, the main issue would be an investigation of transfer knowledge connections and routes between a parent company and its daughter. Table 1 also

shows the lack of focus on a parent company's development of a separate knowledge-based organization, but the roles of organizations and parent firms in the knowledge transfer process are thoroughly investigated. It can be easily stated that the establishment of a separate organization dedicated solely to the transfer and management of required knowledge, something that currently occurs at least in Iran, is rarely investigated. Moreover, using organizational success as the

axis of study seems to require further examination especially regarding defining various transfer paths between an organization and others rather than its parent. Therefore, the main contribution of this work is to fill gaps in data that are directly related to the success of a knowledge-based organization that is strictly bound to its parent but also has to survive in competitive circumstances by establishing strong and effective connections with other science-based organizations or clients.

Table 1. Analysis and categorization of literature on the knowledge-based perspective and the relevant considerations in parent-subsidiary relationships

No.	Reference	Knowledge-based view (KBV) rather than resource-based view (RBV)	Developing a separate knowledge-based organization for a parent company	Parent-organization knowledge transfer; focus on parent success	Parent-organization knowledge transfer; focus on organization success	Organization-others knowledge transfer
1	Cantwell, 2001			x		
2	Child & McGrath, 2001	x	x			
3	Tsai, 2001	x			x	
4	Andersson et al, 2002	x	x			
5	Birkinshaw, 2002	x		x		
6	Balogun & Jenkins, 2003	x				
7	Minbaeva et al, 2003			x		
8	Zack, 2003		x			
9	Foss & Pederson, 2004	x		x		
10	Ashiem & Coenen, 2005	x		x	x	
11	Fosfuri & Tribo, 2008	x			x	
12	Malairaja & Zawdie, 2008				x	
13	Alvandi et al, 2010				x	
14	Baglieri et al, 2010	x		x		
15	McKelvie & Wiklund, 2010				x	
16	Balland, 2012			x	x	
17	Chang et al, 2012				x	
18	Chen et al, 2015	x			x	
19	Lin C.P., 2013	x	x	x		
20	Achcaoucaou et al, 2014	x		x		
21	Hair et al, 2014	x			x	
22	Hansen, 2014					x
23	Mudambi et al, 2014	x		x	x	
24	Leal-Rodriguez et al, 2014				x	x
25	Yang & He, 2014	x			x	
26	Balland et al, 2015			x	x	
27	Ibert & Muller, 2015			x	x	
28	Mariano & Walter, 2015				x	x
29	Omondi, 2015	x		x		
30	Franko et al, 2017	x		x	x	
31	Limaj & Bernroider, 2017				x	x
32	Arsawan et al, 2018	x		x		
33	Davids & Frenken, 2018					x
34	Morant et al, 2018					x

Source: Processed by the author (2019)

This manuscript is structured as follows: following the literature review and the recognition of potential for improvement, the theoretical framework of the research is explained by defining objective as well as independent variables. Next, the research methodology is described, including the sample companies, respondent profiles, questionnaire structure, data-gathering procedure, and the basis for data analysis. Research findings as well as their reasons and study results is discussed using data analysis and mining methods, and finally, a summary as well as the main conclusions will be presented.

To define the theoretical framework of the research, it would help to determine first the main issues that were not clearly addressed by the literature: how are knowledge-based subsidiaries of large companies managed? How can the relation between organization and parent company be optimized to accelerate the commercialization of the former's innovations? Based on these fundamental questions, a theoretical framework is developed to provide insights into the pros and cons of creating a knowledge-based organization as a subsidiary of a large company and to show how a knowledge-based firm strengthens and consolidates its functions in such a condition. The objective variables of the study are defined, which consider the distinctiveness of a knowledge-based organization when it serves as a subsidiary of a large company. Dependent variables are also selected in detail to contribute to the ongoing debate about the advantages and disadvantages of establishing an innovative organization based on new and applicable ideas from a large company staff in their professional functions. These research variables are measured to determine whether they constitute a preferential approach to accelerate a knowledge-based organization's evolution. Insightful results can be achieved based on this theoretical framework but only through a thorough assessment of whether connecting an innovative knowledge-based organization to a mother company would be beneficial and how to manage these two companies to foster a mutually successful and reciprocal relation. The evolution of a knowledge-based organization caused by endogenous forces is also considered when defining the research variables.

The relations between the dependent and independent variables in this framework are determined based on figuring out how an organization creates a new social context by connecting itself to a large company and asserting its preference to be a first-priority client. The framework also focuses on how this special circumstance, in which the organization is embedded, influences its behavior from a knowledge exchange and transfer perspective. This method of defining the theoretical framework can provide the main route of this manuscript, from the literature on self-reliant innovative organizations to how new needs are addressed whenever large companies intend to launch a knowledge-based daughter company. As with most studies, defining the variables would require the consideration of the effects of the direct transfer of knowledge and experience from parent company to organization. In a straightforward approach, improvement in the client satisfaction and financial success of a knowledge-based organization can be assumed as a main-response variable.

Within that scope, the first dependent variable is the improvement of an organization's financial status compared with that of similar science-based organizations that operate

in a science park. This parameter is defined as financial progress based on the organization's total assets in the middle of study period (A_m). The second is a similar measure but is based on the organization's assets at the final stage of assessment. These define the financial improvement of organizations based on final assessment (A_f) at the end of the study period. Evaluation of these two objective variables considered the following: measurements of the financial health of the organizations in the final stage of data gathering, financial status during middle-stage data gathering, and two other measurable variables, including net cash flow in the middle and final stages of the survey. Thus, these two variables were included in the questionnaires given to the respondent financial managers. Moreover, the responses were cross-checked with the organizations' financial documents. However, this was not possible for all the organizations; nevertheless, this was done for more than half of the gathered data.

The definition of the main independent variables considered how a parent-reliant knowledge-based organization's connections with others can improve its status. Based on this main question and the main types of relations generally found in a science park, an organization's connections to others were divided into three main categories: trust-based cooperation agreements, friendly relations, and commercial transactions. Data gathered from respondents via questionnaires determined these types of relations as well as their effect on the improvement of an organization's financial status. The Methodology section will provide further details. Based on this classification, the three main independent variables pertain to the level of effectiveness that an organization feels in each relationship type with others including its parent, other clients, and other knowledge-based organizations in the same science park. The effectiveness level of each type of connection, including trust-based cooperation agreements (E_t), friendship relations (E_f), and commercial transactions (E_c) on the success of the central knowledge-based organization was assessed. To evaluate the general effectiveness of such connections on the success of the knowledge-based organization independently from the type of connection, an extra independent parameter was also defined (E), which is a summarized interpretation of the three previously defined variables.

To cross-check the measured dependent variables, some items in the questionnaires were conveyed to client participants to indicate the continuing improvement of the studied organizations. Clients were asked to rate the improvement, one of the objective dependent variables, using a nine-point Likert scale at several time intervals. Continuous improvement, based on data gathered from all respondents including science-based organizations and their clients, is observed as an objective dependent variable (C_i). Therefore, all respondents assessed one another. To evaluate the evolution and development of the organizations during the study period, the questionnaires were distributed and gathered at several time points. The total time of field investigations is two financial years with a total length of about 19 months. Six steps of data gathering were carried out, including at the beginning and the end of the study as well as four internal gathering stages. Thus, another research variable can be defined: the time elapsed from the start of the study (t). This value is approximately the same as an organization's survival

time in the studied science park.

To cross-check and validate the questionnaire results, the success rate of each knowledge-based organization was determined based on social network analysis (SNA) outputs. The organizations in the science park were also investigated based on the status of their connection pattern with others using SNA (Minguillo, and Thelwall, 2012). Regardless of the type of relationship, only the number of connections that an organization can generate with others, including direct clients and other clients or sisters, was considered in this analysis. The main dependent variable measured, based on SNA outputs, is the centrality of each organization as a member of the network. Well-known criteria were applied to indicate this centrality: degree centrality, Eigenvector centrality, closeness or farness centrality, and betweenness centrality. To rank all the organizations in the science park as a network, including parent-reliant and autonomous organizations, each member of the network was named as a vertex. According to the first criterion, degree centrality, the following exterior product was calculated:

$$DC=A \times U$$

where DC is the degree of centrality matrix as the output of the exterior product, which is applied to calculate an organization's level of importance in SNA based on centrality. This is a vector with an $n \times 1$ column array dedicated to each of the vertices (organizations, as the members of the network) from 1 to n and can be applied to rank the vertex IDs from a centrality perspective. A is an $n \times n$ adjacency matrix based on the relationship pattern among the organizations within the network due to their being located in the same science park. We named all the studied organizations as a vertex, with n being the total number of organizations including those with mother companies or those that are self-reliant. Thus, if any relation exists between vertices i and j, $A_{i,j} = 1$; it will be zero if no relation is found between two organizations. All the main diagonal components of the adjacency matrix are zero. U is the unit for the $n \times 1$ column vector, and all of its components are 1. This criterion has a main weakness: some vertices (knowledge-based organizations) may be ranked as being on the same level, and it would be impossible to assign different rankings to all of them.

Eigenvector centrality is the second criterion for ranking the participant organizations and to compare success between self-reliant and subsidiary knowledge-based organizations. To investigate this, we have to calculate the eigenvectors of the adjacency matrix and select the eigenvector that corresponds to the maximum eigenvalue of this matrix from the following formula:

$$\sum_{j=1}^n A_{i,j} \cdot \langle B_{j,1} \rangle_l = \langle EV_{i,1} \rangle_l$$

where $A_{i,j}$ is the adjacency matrix element at row i and column j, EV is the eigenvector at iteration l, and B is the normalized column vector which shall be calculated using the following formula at iteration l:

$$B_{j,1} = \frac{\langle DC_{j,1} \rangle_l}{\left(\sum_{k=0}^n \langle DC_{k,1}^2 \rangle_l \right)^{\frac{1}{2}}}$$

where B is previously defined and DC is the degree centrality vector at the beginning condition and shall be normalized at all the next iterations. The final iteration,

named l here, is achieved when the denominator value in the above equation, which is the normalization value, converges. Last, at the end of using these equations, the column vector EV was used to rank the n vertices, including all organizations participating in the research. Therefore, EV is the organization's importance level in SNA based on eigenvector centrality. Only the ranking of knowledge-based organizations was clearly applicable here; however, in the SNA, some clients with permanent offices in the science park were also considered.

The third criterion, closeness centrality (FS), is applied to rank the organizations and to compare these rankings based on their success as presented by the questionnaires. Thus, FS is defined as the importance level of an organization in SNA based on farness centrality. In this parameter, instead of the adjacency matrix, the farness matrix was applied, and the results were used to rank the organizations in reverse order. For this purpose, $D_{i,j}$ is defined as the cumulative number of paths that shall be swept to connect vertex (organizations) i to j. Vertex ranking was made by putting the results in transverse order, which is the eigenvector of D. All the other details of the calculation procedure for this criterion are the same as previously. The organization staff were also asked about how frequent they received scientific and technological knowledge from all the other bodies. The respondents answered by selecting 1 (no knowledge transfer) to 9 (maximum knowledge received). The quantitative level of a knowledge-based organization's success can be measured by the following equation:

$$QN = \sum_{i=1}^n F(B_f, B_i)$$

where QN is an organization quantitative success in creating connection with others, $F(B_f, B_i)$ is the average answer to the above question on the relation between a centralized knowledge-based organization (B_f) and other bodies (B_i), and n is the total number of other bodies considered in the questionnaires.

A similar question was set up regarding the intensity and applicability of knowledge received by the organization from other bodies. The answers ranged from 1 (nonapplicable and useless advising) to 9 (very practical and targeted advice and knowledge). Similarly, the qualitative level of a knowledge-based organization's success can be measured using the following equation:

$$QL = \sum_{i=1}^n I(B_f, B_i)$$

where QL is the organization's qualitative success in creating strong and applicable connections with others, $I(B_f, B_i)$ is the average answer to the above question regarding the relation between the centralized knowledge-based organization (B_f) and other bodies (B_i), and again, n is the total number of other bodies considered in the questionnaires.

Client satisfaction in all the studied companies was measured through a series of questions through which all participants evaluated one another. Therefore, not only respondents with client affiliation but also all organizational staff were asked about how the organizations satisfied their clients. The collected data were based on a nine-point Likert scale and applied in the following formula to measure client satisfaction:

$$CS = \sum_{i=1}^n S(B_f, B_i)$$

where CS is the client satisfaction level that an organization achieved during the study period, $S(B_f, B_i)$ is the average answer to questions indicating client satisfaction with the centralized knowledge-based organization (B_f) as assessed by other bodies (B_i) including clients as well as organizational staff, and again, n is the total number of other bodies considered in the questionnaires. All the participants evaluated all the others and filled out the questionnaires. A nine-point Likert scale was applied to define $F(B_f, B_i)$ and $I(B_f, B_i)$ in the questionnaires. While patent

level was considered as an indicator that measures the centralized knowledge-based organization's success, it was concluded that its effect was significantly low, as it did not change noticeably during the study period. Therefore, it was deleted from the theoretical framework. As mentioned previously, to measure an organization's innovation or success, we looked into its financial improvement. The extent to which an organization depended on its parent company varied during the study period and influenced its success. This is discussed in the following sections. Based on the aforementioned theoretical basis, the summarized framework of the defined research variables is presented in Table 2.

Table 2. Summarized list for main dependent variables defined in the theoretical framework as measurable objectives of experiments

No.	Parameter	Definition
1	Am	Financial improvement of the organization based on its total assets at the middle stage of the survey
2	Af	Financial improvement of the organization based on its total assets at the final stage of the survey
3	Et	Organization's tendency to develop trust-based cooperation agreements with others
4	Ef	Organization's tendency to develop friendly relations with others
5	Ec	Organization's tendency to develop commercial transactions with others
6	E	General tendency of organization to make connections with others
7	Ci	Continuing general improvement of an organization's reputation based on data gathered from all respondents
8	DC	Importance level of a knowledge-based organization in SNA based on degree of centrality
9	EV	Importance level of a knowledge-based organization in SNA based on eigenvector centrality
10	FS	Importance level of a knowledge-based organization in SNA based on closeness/farness centrality
11	QN	Number of win-win deals that an organization can make in connection with others; quantitative reinforcement
12	QL	Strength of win-win deals that an organization can make in connection with others; qualitative reinforcement
13	CS	Client satisfaction level that can be achieved by an organization

Source: Processed by the author (2019)

The six parameters of organizational success as described in the theoretical framework, Am, Af, Ci, QN, QL, and CS, came from questionnaire-based data processing while three parameters, DC, EV, and FS, came from SNA. In addition, the tendency of an organization to create effective connections with others such as knowledge-based companies or clients is measured by four parameters as explained in the theoretical framework: Et, Ef, Ec, and E. Based on these variables and considering the relation between objective and independent variables, the main hypotheses are as follows:

Hypothesis 1: A significant relation exists between the success of a knowledge-based organization and its tendency to develop connections with other organizations in a science park.

Hypothesis 2: Connection to a mother company has no significant effect on hypothesis 1 for subsidiary organizations.

RESEARCH METHOD

Data was collected from a total of 13 organizations (hereinafter "studied company[/-ies]") located in a science and technology park in Southwest Tehran, Iran. Concern was raised when preliminary studies showed a decline in the rate of knowledge transfer success among the organizations, especially parent-reliant ones. Based on support received from the park management, a study was set up to investigate the reasons for the decline and to determine remedial methods to improve the conditions. To collect data, a random sampling method was applied to indicate the real conditions of the respondent organizations. To develop the appropriate methodology for the research, some main axes were selected to approach the studied sample. First, the study had to recognize which organizations were on the decline and how such a condition interrupted their science-based financial progress. Second, it also considered how a

studied company's connection to its parent company can affect its progress. Figure 1 shows the general layout of

the Omidnegar Science and Technology Park located in Southwest Tehran.

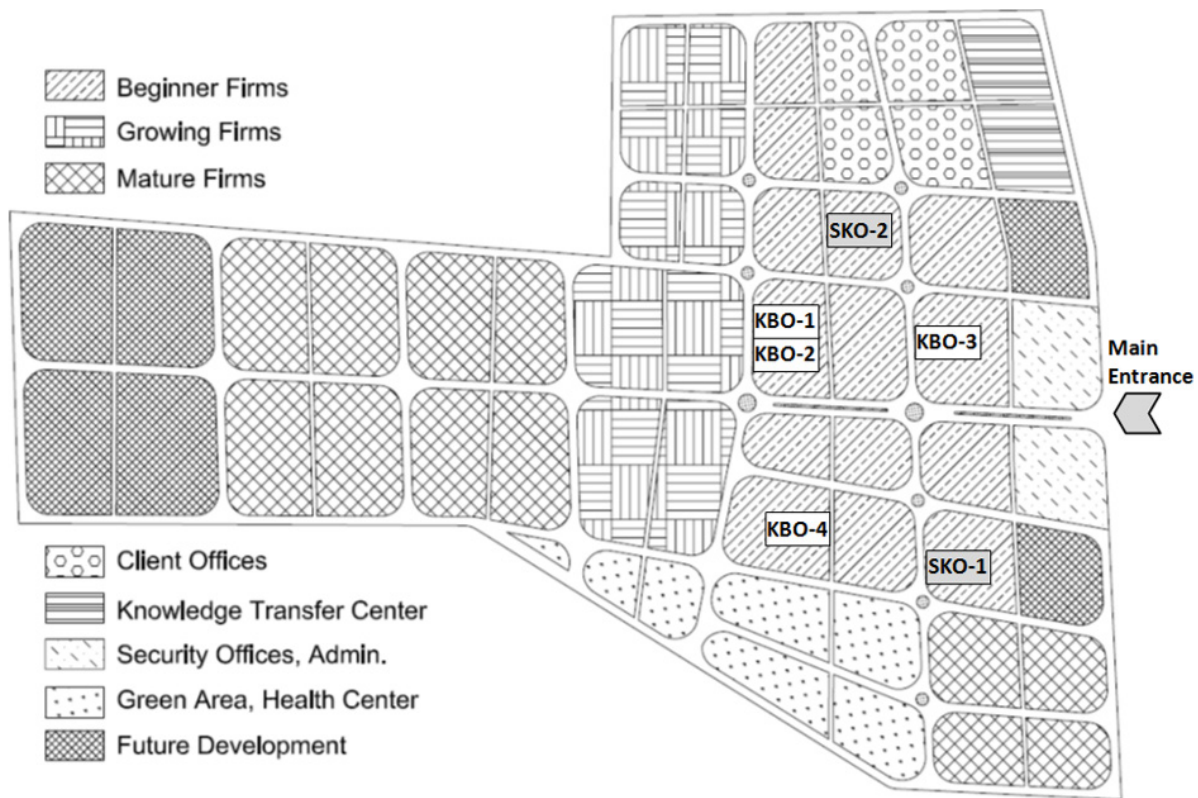


Figure 1. General layout of the Omidnegar Science and Technology Park, Southwest Tehran

Source: Processed by the author (2019)

Because the survival time is less than three in all the studied companies except the clients, all the nonclient organizations were situated in the beginner companies in the science and technology park. The arrangement of studied companies was as follows: two centralized, parent-reliant knowledge-based organizations (SKO-1 and SKO-2); two large companies that are parent or mother companies of SKO-1 and SKO-2 (PCO-1 and PCO-2, respectively); four independent, self-reliant, and autonomous knowledge-based organizations located at the science park along with the centralized knowledge-based organizations (KBO-1 to KBO-4). The opening balance for all the five knowledge-based organizations studied here are relatively similar. Last,

the study selected five client companies that used various products or engineering services from the studied knowledge-based companies in the park (CLN-1 to CLN-5). There were a total of 143 individuals selected as participants. The distribution of participants who answered the questionnaires on the studied companies is as follows: 25 persons from the SKO-1 staff, 10 from the SKO-1 stakeholders, 22 from the SKO-2 staff, 4 from the SKO-2 stakeholders, 15 from PCO-1, 10 from PCO-2, 32 from KBOs, and 25 from CLNs. Figure 2 illustrates the connection patterns among all studied companies as well as the type of relations among organizations and clients according to variables Et, Ec, and Ef.

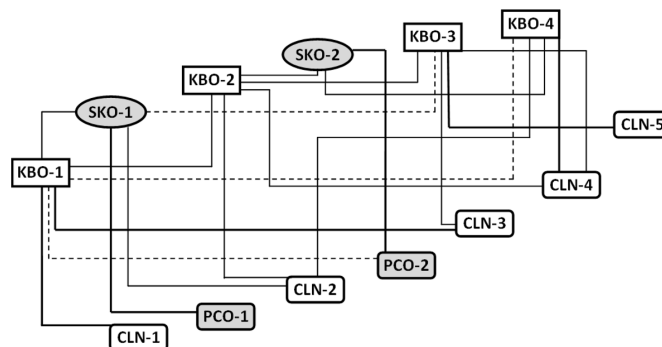


Figure 2. Types of relationship among studied companies; friendship (dashed line), trust-based cooperation agreements (continuous line), and commercial transactions (bold line)

Source: Processed by the author (2019)

A questionnaire was prepared to gather data from organization and client staff members. The first part of the questionnaire was designed to recognize the main issue that disrupts the normal condition of the organization. The context of the questions here sought to interpret the organization's concerns from each respondent employee's perspective. The questions were designed to differentiate among organizations suffering from real ongoing conditions due to the low rate of knowledge transfer and any other reasons that may lead to organizational failure.

Several main questions were considered at the first part of the questionnaire:

1. How would you describe the success of your company in fulfilling its parent's expectations?
2. How effective is the knowledge-based friendship between your organization and others?
3. How important are commercial transactions between your organization and others?
4. How important are trust-based cooperation agreements between your organization and others?
5. Generally, what is the effect of your organization's connection to others on its success?
6. How much does your organization's financial success depend on its knowledge transfer with your mother company?
7. How much does your organization's financial success depend on its knowledge transfer with companies other than your parent?

8. How would you quantify your organization's success in creating connections with others?

9. How would you qualify your organization's success in creating strong and applicable connections with others?

10. From your point of view, what is the client satisfaction (CS) level that your organization can achieve with the direct parent client and other client companies in the science and technology park?

11. How much does your organization improve in terms of total assets?

12. Generally, what is your idea of your organization's continuous improvement considering the financial concerns as well as scientific duties of knowledge-based organizations in the science and technology park?

13. What is your organization's level of success in product commercialization, knowledge transfer quality and quantity, staff satisfaction, CS, and vendors/supplier satisfaction?

We note that all these questions were included in all the questionnaires distributed to the respondents. This means all the participants evaluated not only their organization but also other organizations. Even the questions on CS were asked not only to client staff members but also to employees of the knowledge-based organizations, and they answered based on their own interpretations. As can be seen in the sample questions above, the questionnaires were designed according to the defined theoretical framework, considering the independent and dependent variables.

Table 3. Participant features including organizations and their specific roles in the project

Participant's Role	Frequency	Percentage
Organizational Staff (Autonomous/Dependent)	93	100
Engineering Dept.	41	44.1
Junior Designer	9	9.7
Senior Designer	12	12.9
Lead Engineer	8	8.6
Group Manager	12	12.9
Research and Development Dept.	21	22.6
Officer	5	5.4
Development Planner	4	4.3
Senior Researcher	10	10.8
Group Manager	2	2.2
Market Development Dept.	31	33.3
Officer	5	5.4
Market Strategy Planner	4	4.3
External Financing Specialist	4	4.3
Economic Science Expert	4	4.3
Technical Proposal Coordinator	6	6.5
Financial Proposal Coordinator	4	4.3
Knowledge Transfer Coordinator	2	2.2
Group Manager	2	2.2
Client Staff	50	100
Client Representative in Science Park	12	24.0
Management Consultant Supervisor	32	64.0
Group Manager	6	12.0

Source: Processed by the author (2019)

First, measuring the independent variables was included in the context of the questions. Table 3 shows the general feature of respondents. More than the questionnaire-based data, SNA was conducted using the connections among organizations as well as between organizations and clients. The SNA outputs were verified and cross-checked with the questionnaire-based data. An organization's success was defined in SNA as having more centrality. To calculate the main parameters indicating centrality, as explained in the theoretical framework, an adjacent matrix was prepared in which the number of connections between each two members of the science park organizations was calculated regardless of type. To determine the number of connections, the number of each type of contract or duration of collaboration between two bodies were considered. These values mostly relied on data presented by the authorized respondents and were partly checked through document review if possible and available. The distribution and data gathering based on questionnaires were carried out in six time steps in two years. This means that time is a main parameter in this study. Regarding SNA details, the connection patterns of companies were considered according to how they were presented in questionnaires. Each member's importance level and centrality were analyzed based on the monitored connections' quantity and quality. The connection patterns among members were first requested from them and were drawn based on questionnaire data. These connection drawings were also rechecked based on the monitored connection patterns among members. A verified version of these connection patterns were applied in SNA as described in the theoretical framework. It was noted that the number of connections, regardless of whether they are received or sent during knowledge transfer, was verified using the monitoring system of the network. The type and strength of connections and applicability of data transferred via social networks were only estimated based on questionnaire data. Table 3 lists all participant specifications and categorizations. One of the main independent variables that seems to influence the

results is an organization's survival time in the science park. Different roles and positions are other independent variables that can affect the research output. Table 3 shows participant categorizations, based on the range of these independent variables, as well. To generate the same media for output parameters for comparison and assessment, the results of organization ranks based on outputs calculated from the SNA centrality check were also categorized in a nine-point scale.

RESULTS AND DISCUSSION

More than 140 distributed questionnaires were gathered after they were fully or partially filled out by the participants. The results can be categorized into two main parts. First, the reliability of received data via questionnaires was evaluated and verified using standard methods. Second, the research hypotheses were assessed using the correlation factor method as well as visualizing the gathered data through graphs.

Data Reliability Check

At the first stage of results presentation, and to verify and validate the questionnaire responses, it is noted that some questions were not answered by the respondents. To evaluate that how this gap in data may affect the results' reliability, Cronbach's alpha was applied. The number of useful and applicable data for each of output or objective variable was determined. Cronbach's alpha was then calculated using these values to check for reliability. Table 4 shows the number of applicable questionnaire data used to evaluate output parameters in the research. These effective numbers were named Ne in this table. Because data gathering was repeated at several time steps, the number of useful and applicable data to calculate each objective parameter was according to the minimum reliability level based on Cronbach's alpha. The objective variables that were designed based on SNA (DC, EV, and FS) are not included in Table 4.

Table 4. Reliability check for responses gathered for questionnaire-based objective variables using Cronbach's alpha calculated based on only effective received data (Ne) in each parameter

Objective variable	Ne	Cronbach's alpha	Objective Variable	Ne	Cronbach's alpha
Am	90	0.699	E	91	0.912
Af	89	0.685	Ci	86	0.901
Et	91	0.732	QN	87	0.803
Ef	91	0.784	QL	85	0.930
Ec	91	0.894	CS	88	0.861

Source: Processed by the author (2019)

Although the total number of client staff respondents was about 50, all the employees, even in the organizations, were asked for their opinions about their companies' CS. Thus, the total effective number of answers to verify parameter CS was more than 50. As seen in Table 4, all the Cronbach's alpha values were relatively higher than 0.7 and can be assumed as acceptable. The correlation coefficient method was applied to assess the hypotheses by evaluating relations between independent and dependent or objective variables. Correlation coefficient in this study was defined

as the covariance of the variables divided by the product of their standard deviations. To illustrate the schematic conditions for the variation scheme in dependent variables by changing the independent variables, appropriate graphs were also drawn for better recognition.

Assessment of Hypothesis 1

Based on this method, the first hypothesis was assessed according to the results indicated in Table 5. In this table, only for questionnaire-based objective variables, the

correlation coefficient of each dependent variable was calculated and listed. Here, the six main dependent variables that measure the objectives were listed in the first column. At the first row, the four main independent variables were listed that measured the tendency of an organization to create new, more, and stronger connections with other firms in the science park. Each value in the table was a correlation factor between two variables located in the intersection of the columns and rows, one independent and the other dependent. For example, in Table 5, the continuing general improvement of organizational reputation, based on a nine-point Likert data gathered from all respondents, was correlated with the organization's tendency to develop commercial transactions with others, with a correlation coefficient of 0.814.

Table 5. Correlation coefficient values between each double variable based on gathered data

	Et	Ef	Ec	E
Am	0.721	0.811	0.829	0.798
Af	0.744	0.832	0.816	0.802
Ci	0.877	0.832	0.814	0.813
DC	0.878	0.964	0.834	0.894
EV	0.921	0.927	0.976	0.943
FS	0.864	0.843	0.826	0.841

Source: Processed by the author (2019)

Here, all the correlation coefficients were higher than 0.7, which clearly proves hypothesis 1. Detailed investigation of the correlation factors listed in Table 1 showed that SNA-based variables were more correlative with objective variables.

Assessment of Hypothesis 2

To assess the second hypothesis, which refers to the comparison among organizations' behaviors regarding the effects of their connections to others, we focused on CS as one of the objective parameters, which has a minimum

correlation coefficient, as shown in Table 5. This parameter seems to show differences in the answers of respondents from parent-reliant organizations and independents. To investigate hypothesis 2, the effects of quantitative and qualitative reinforcement of organizations' relationships, measured by QN and QL as independent variables, on CS as the objective variable was monitored. Figure 3 illustrates the results.

The responses were divided based on the type of organization, KBO or SKO; however, since all the organizations were assessed by everyone else, the total number of data in both graphs in this figure was relatively similar. As can be seen in this figure, hypothesis 2 was found not to be completely true because of the differences in the general trend of data variation in Figure 3. For self-reliant organizations, the trend is completely as defined in hypothesis 1 as evident in other objective parameters in Table 3. However, for dependent organizations, at least for CS as an objective parameter, hypothesis 1 showed a significant negative effect of mother companies.

It also seems that CS in parent-reliant companies is mainly defined by mother-company satisfaction, and the organization is not mainly blamed when its connections to others are lower quantitatively or qualitatively. No rational and clear downtrend in CS was observed for parent-reliant organizations as QN and QL gradually decreased. Therefore, at least for the studied companies, hypothesis 2 was not completely proven. To investigate hypothesis 2 more, the time history of the gathered data was inspected. Responses were received at six time steps along an organization's one-year survival in the science park. Time series of gathered data were separately created for autonomous and parent-reliant organizations. All the data for four independent and two dependent knowledge-based organizations were considered in each group. Figure 4 shows a change in CS along the organization's survival time for self-reliant and parent-reliant knowledge-based organizations in the science park. All the data from four self-reliant knowledge-based organizations (KBOs) and two knowledge-based subsidiaries (SKOs) are shown in Figure 4.

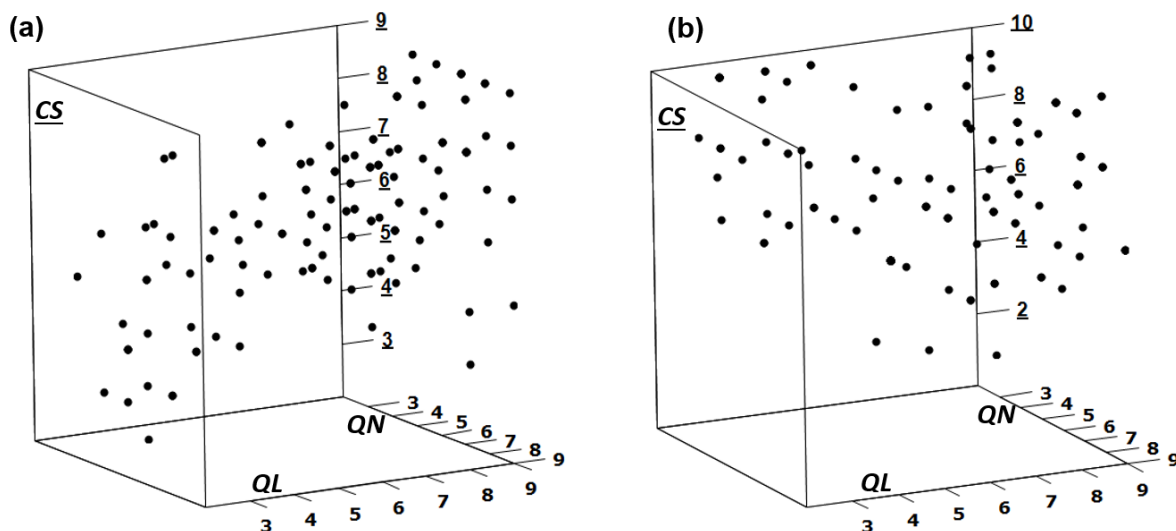


Figure 3. Simultaneous effects of quantitative and qualitative reinforcement in organizational relations (QN and QL, respectively) on client satisfaction (CS) for self-reliant organizations (a) and parent-reliant organizations (b)

Source: Processed by the author (2019)

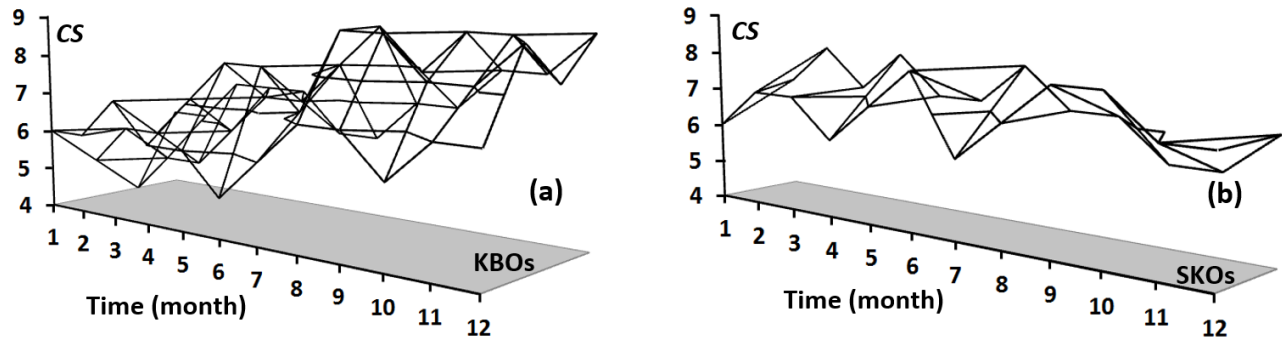


Figure 4. Change in client satisfaction (CS) with time in the second year of the organization's survival for (a) self-reliant and (b) parent-reliant knowledge-based organizations

Source: Processed by the author (2019)

In Figure 4, the trend of CS variation generally increased with time for autonomous KBOs. However, for dependents, a clear and significant rational trend cannot be found. The difference in the depth of the graphs in Figure 4 is due to the differences between the total numbers of independent and dependent KBOs. Based on this detailed investigation, it seems that the reliability of hypothesis 2 was not evident. Through cross-checking, data on the profitability of each studied organization and its variation with time were extracted separately from the companies' financial managers. This data was only based on an approximate determination of organizational profitability that was conveyed orally by the companies' financial departments. Therefore, profitability rate (PR) was not included in the theoretical framework and only served as cross-checking data for evaluating hypothesis 2. Figure 5 illustrates the data for one year of the present study and one year after it, which were only estimated by the financial representatives of the organizations. The data was again divided into two main categories: autonomous and parent-reliant KBOs.

Some main differences in business PRs can be seen between autonomous and parent-reliant organizations in Figure 5, and these differences can be assumed as evidence for the failure of hypothesis 2. The first difference is on the profitability of the business at its beginning. The values for parent-reliant organizations were significantly higher than those of self-reliant ones. It seems that a connection with the mother company provides a safer financial condition for the organization even at the commencement of its business. The second difference pertains to a varying trend across time. Although the data on these graphs for the second year is only based on estimations, they show the opinion of authorized financial staff in each organization. As can be seen in Figure 5, the rising trend in PRs of parent-reliant organizations was significantly higher than that of autonomous knowledge-based companies. Some fast local changes can also be seen on the graphs, which can be neglected because the reliability level of estimated data on PRs does not affect the main results and changing trends.

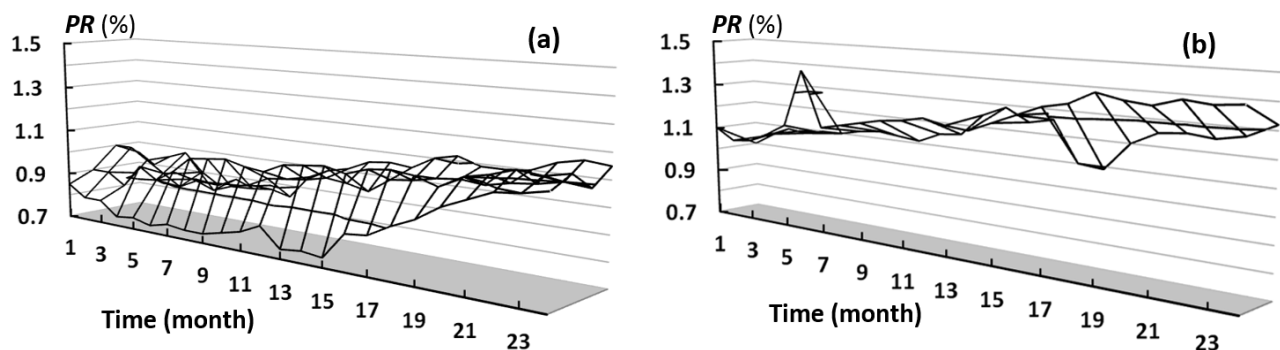


Figure 5. Change in profitability rate (PR) with time in two years of organizational survival for (a) self-reliant and (b) parent-reliant knowledge-based organizations

Source: Processed by the author (2019)

CONCLUSION

A questionnaire-based survey accompanied by SNA and cross-checking financial documents was carried out to investigate the differences between autonomous and parent-reliant companies working as KBOs in a science park in Iran. More than 140 respondents participated, which came from two dependent and four independent organizations as well as five client companies. Organizational success was defined and measured using nine variables. Four variables were also

defined to measure organizations' tendency to forge new and strong connections with other bodies, including other KBOs or clients. Based on a theoretical framework, two main hypotheses were defined and tested. It was found that the success of a knowledge-based organization is significantly dependent on the quantitative and qualitative strength of connections it creates with other bodies in the science park. This conclusion is proven to be generally true regardless of organization type, whether self-reliant or parent-reliant. However, detailed investigations showed that some of the

measured variables were affected by the type of organization. For example, the average level of CS was strongly different between autonomous and subsidiaries companies. It was also found that the fostering pattern of subsidiaries regarding PR is significantly different from that of autonomous organizations. It seems that subsidiaries dilute their connection with their parent company or develop parallel connections with other clients to survive well and compete with others in similar economic conditions.

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