A MODEL FOR EXPLORING EVOLUTION OF STRATEGIC ALLIANCES IN PROJECT-BASED INDUSTRIES -THE CASE OF CONSTRUCTION INDUSTRY

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ABSTRACT

A MODEL FOR EXPLORING EVOLUTION OF STRATEGIC ALLIANCES IN PROJECT-BASED INDUSTRIES -THE CASE OF THE CONSTRUCTION INDUSTRY

Organizations should be flexible and responsive to today’s rapidly changing business environment to sustain their long-term competitive advantage. One important alternative to accomplish this is to engage in strategic alliancing with other organizations.

This thesis aims to examine the concept of strategic alliances through networks. It proposes a new configurational model that explores the evolution of strategic alliances in project-based industries with a social network perspective. Here, strategic alliances will be analyzed in terms of configurational network characteristics and alliance project-related characteristics they possess.

Turkish Contractors’ alliance projects will be under investigation to explore the evolution of an alliance network. This study will utilize a mixed-method technique that can rarely found in construction management studies. Social Network Analysis (SNA) and Qualitative Comparative Analysis (QCA) will be combined to strengthen the interpretations of the data and, consequently, give a more holistic view of the alliance network phenomenon in the construction industry.

ÖZET

PROJE TABANLI ENDÜSTRİLERDE STRATEJİK İŞBİRLİKLERİNİN EVRİMİNİ ARAŞTIRMAK İÇIN BİR MODEL - İNŞAAT SEKTÖRÜ ÖRNEĞİ

Günümüzün hızla değişen iş dünyasında, kuruluşların uzun vadeli rekabet avantajlarını sürdürmeleri taleplere duyarlı ve esnek olmaları ile mümkün olabilir. Bunu gerçekleştirebilmenin bir alternatifi ise diğer kuruluşlarla stratejik işbirliği kurmaktır.

Bu tez, sosyal ağlar aracılığıyla stratejik işbirliği kavramını incelemeyi amaçlamakta ve proje tabanlı endüstrilerdeki stratejik işbirliklerinin gelişimini sosyal ağ perspektifiyle araştıran yeni bir konfigürasyon modeli önermektedir. Burada stratejik ittifaklar, ağ özellikleri ve ittifaklı proje özellikleri açısından analiz edilecektir.

Türk Müteahhitlerin ittifak projeleri, bir ittifak ağının evrimini anlamak için araştırılacaktır. Bu çalışmada, inşaat yönetimi çalışmalarında nadiren bulunan bir karma yöntem tekniği kullanılacaktır. Sosyal Ağ Analizi (SNA) ve Niteliksel Karşılaştırmalı Analiz (QCA), verilerin yorumlanmasını güçlendirmek ve sonuç olarak inşaat sektöründe ittifak ağı olgusuna daha bütünsel bir bakış açısı kazandırmak için birleştirilecektir.

To my son, Naci Doruk Olcar.

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CHAPTER 1

INTRODUCTION

1.1. Importance of Alliances and Network Research

Organizations should be flexible and responsive to today's rapidly changing business environment for long-term competitive advantage. Managers should make decisions not only to operate in challenging and competitive environments but also to cooperate with other companies, sometimes with their competitors, to create and sustain a favorable position in the market.

Engaging in alliances creates many benefits for firms, such as combining complementary resources, achieving economies of scale, increasing knowledge and skills, reducing risks, entering new markets, strengthening competitive positioning, and so forth (Kale et al., 2000; Inkpen and Ross, 2001; Ireland et al., 2002; Lee, 2007; Soares, 2007). Firms also use alliances to create value by developing improved knowledge management mechanisms, enhancing internal coordination, increasing external visibility, and eliminating accountability and intervention problems (Anand and Khanna, 2000; Dyer et al., 2001).

Today, many firms are involved in multiple concurrent strategic alliances with different partners (Wassmer, 2010). Alliances have become an essential element of firm strategy. This massive proliferation in alliance formation took the attention of many scholars.

Traditional strategic alliance research considered strategic alliances as dyadic relationships with an under-socialized view and focused on the causes and consequences of these dyadic relations. It paid less attention to the fact that alliances are significantly defined and shaped by the social networks the firms are embedded in (Gulati, 1995).

Scholars realized that a firm's social connections create new alliance opportunities and affect many alliance decisions such as partner choice, frequency to form alliances, type of contracts (Gulati, 1998). The research focus shifted, and network studies have gained much attention among scholars studying inter-organizational relationships as a part of strategic management research (Gulati, 1995; Gulati et al., 2011).

1.2. Motivations of the Study

Since the late 1990s, there have been an increasing interest in social network analysis (SNA) among construction project management (CPM) scholars as they discovered SNA's capability to detect various relationships among project participants (Dogan et al., 2015; Zheng et al., 2016). However, SNA studies in the CPM domain are generally cross-sectional; longitudinal studies are rarely encountered (Zheng et al., 2016). This thesis aims to investigate how alliance network structure in the Turkish construction industry evolves over time with longitudinal data. Thus, the study will fill this gap in the construction management literature.

Both quantitative and qualitative social science methods help understand the complexity of construction organizations. Researchers in the construction management field defend that studies should utilize mixed-method approaches whenever possible to strengthen the interpretations of the data (Loosemore, 1998; Abowitz and Toole, 2010). However, the number of studies using mixed research methods in the construction domain is quite low (Zheng et al., 2016). This study will combine social network analysis (SNA) with qualitative comparative analysis (QCA) as a hybrid research method to get a holistic view of the alliance network phenomenon in the construction industry.

SNA is a quantitative tool used to describe network structures based on quantitative social network data. QCA, on the other hand, is a case-oriented research method used to explore the complex configurations between attributes and outcomes by comparing the similarities and differences of multiple cases (Ragin and Strand, 2008). This thesis will combine SNA and QCA together as a mixed-method research design. There are only a few studies in the literature using the combination of SNA and QCA as a mixed-method research design, and most of them are limited to the field of political science. Therefore, this study will be an early effort to combine SNA and QCA as mixed-method research in the construction management field.

1.3. Aim and Objectives of the Research

This thesis aims to examine the concept of strategic alliances through networks and propose a new configurational model that explores the evolution of strategic alliances in project-based industries with a social network perspective. Here, strategic alliances will be analyzed in terms of configurational network and alliance project-related characteristics they possess.

In this context, the objectives of this study are:

Primary Objectives:

- Develop a configurational model of strategic alliances to comprehend alliance networks' evolution in project-based industries.
- Compare time periods to see how the Turkish Contractors' network evolved over time.

Secondary Objectives:

- Identify strategic alliance network characteristics of project-based industries explained within the strategic alliance literature.
- Develop criteria based on key economic and social changes to define the time periods for the longitudinal network analysis.

1.4. Research Methodology

This thesis will combine social network analysis (SNA) and qualitative comparative analysis (QCA) together as a mixed-method research design. First, the alliance network of contractors and network attributes of each actor will be identified with SNA. QCA will then compare different network configurations for different time periods to give a causal explanation of the evolution of the contractors' alliance network.

1.5. Scope of the Study

This thesis chose the construction industry as an empirical setting for a couple of reasons. First, construction projects are seen as temporary network-based organizations because various social groups are involved in construction projects; correspondingly, many formal and informal relationships grow over time within and across the organization (Taylor and Levitt, 2007). Second, alliancing in construction is considered one of the most prominent methods for increasing productivity and performance regarding time, cost, quality, and other goals (Van den Berg and Kamminga, 2006).

The scope of the study is limited to the alliances of Turkish Contractors who are listed in ENR-Turkey or members of at least one of these institutions; INTES and TCA

(TMB). Partners who are not members of these institutions and foreign partners will also be included in the study to make calculations and get healthy results. EKAP and CSN databases and annual company reports will be used for data collection.

The study will be concentrated on the Turkish Contractors' alliance projects executed both in the homeland and abroad between 1990-2019. A business-to-business inter-organizational collaboration (collaborations between competitors) will be sought since various collaboration types are seen in the construction industry.

For this longitudinal research, time periods will be defined for the analysis to understand the evolution of the Turkish Contractors' network. The study will be carried out within the framework of network theory.

1.6. Contribution of the Study

The main contribution of this thesis to alliance literature will be on network evolution. A longitudinal approach has been chosen to overcome the complex concepts of temporality in the research process. Even though collecting data in a longitudinal study is quite tricky, going "*beyond the snapshot*" will be a significant step in understanding how the Turkish construction alliance network has evolved over time.

The second contribution of the thesis will be on research design. This study will utilize a mixed-method technique that can rarely be found in construction management studies. SNA and QCA combined with strengthening the interpretations of the data and, consequently, give a more holistic view of the alliance network phenomenon in the construction industry.

The third contribution of the study will be to utilize QCA. Analyzing quantitative data in a case-based approach in the construction management domain may open up new knowledge production methods in this field.

1.7. Organization of the Thesis

The second chapter of this study covers the literature review of strategic alliances. The importance of alliances, motives behind them, types of alliances, and the evolution of strategic alliance research will be discussed in this chapter. The third chapter will focus on the concept of social networks and social network analysis.

Chapter four will discuss the key concepts and theories in social network research. In chapter five, the conceptual model and mixed model research will be explained. Chapter six will cover the empirical setting of the study. The construction industry in general and the Turkish construction industry, along with alliance research, will be summarized. The implementation of the proposed model will be discussed in chapter seven. The findings of the study will be discussed in chapter eight. Finally, chapter nine will include the conclusion and recommendations for future research. The below figure shows the layout of the thesis.

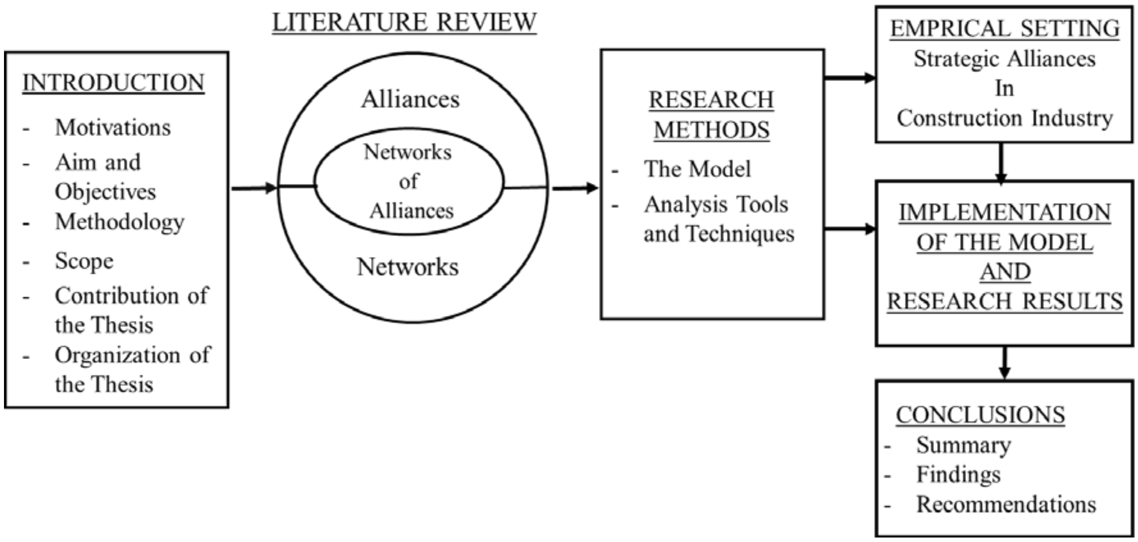

Figure 1: The Layout of the Thesis

CHAPTER 2

STRATEGIC ALLIANCES

Firms often do not possess all the necessary resources and capabilities to compete effectively. Through strategic alliances, firms join forces with other firms to capture opportunities that otherwise be beyond their current capabilities (Das and Teng, 2008). Today, more often, an organization's connections to other organizations critically affect its performance and survival. An increasing number of alliances worldwide is proof of this tendency and took the attention of many strategic and organizational scholars and practitioners. Consequently, rich but also fragmented literature has evolved on how firms develop healthy collaborative relationships.

2.1. Definitions of Strategic Alliances

There are many definitions of alliances in the literature. The word was first used around 1300 BC and came from the French word "alliance," from "alier" to "ally." The meaning *"state of being allied or connected"* started to be used around the 1670s (Source:www.etymonline.com).

Webster's dictionary defines an alliance as *"the state of being allied; the act of allying or uniting; a bond or connection between families, states, parties, or individuals, etc., especially between families by marriage and states by compact, treaty, or league,"* (https://www.merriam-webster.com/dictionary/alliance).

Scholars defined strategic alliances based on their aspect of research. Forrest's (1989) definition of strategic alliance is based on the achievement of strategic goals, *"short-term or a long-term cooperation among enterprises, which might include partial or contractual property in order to implement strategic goals."*

Tsang (1998) defined strategic alliances resting on gaining an economic advantage, *"… a long-term cooperative arrangement between two or more independent firms that engage in business activities for mutual economic gain. Here "long-term" does not refer to any specific period of time, but rather, to the intention of the partners that the arrangement is not going to be a transient one."*

Ireland et al. (2002) outlined strategic alliances focusing on strategic positioning view, *"cooperative arrangements between two or more firms to improve their competitive position and performance by sharing resources."*

Nevertheless, the most widely used alliance definition in the literature is Gulati's (1998) definition based on agreement and exchange of relations, *"voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services."*

This study defines strategic alliances as a formal cooperative agreement between two or more organizations utilized as a key tool for competitive position and growth.

2.2. Motives for Strategic Alliances

Alliances are formed as a result of many motivations and objectives. The motives to form strategic alliances vary depending on the firm-specific characteristics and environmental factors (Todeva and Knoke, 2005). Alliance literature identified an extensive list of motives to form strategic alliances. These include, but are not limited to, cost and risk-sharing (Contractor and Lorange, 1988), access complementary resources and skills (Dyer and Singh, 1998; Dyer et al., 2001), capacity expansion, overcome barriers to entry, reduce uncertainties, facilitate organizational learning (Kogut, 1988; Hitt et al., 2000; Kale et al., 2000), enter into new markets (Soares, 2007), adapt government policies (Killing, 1983), gaining competitive advantage (Dyer and Singh, 1998; Ireland et al., 2002). Strategic alliances are also sometimes used to test the feasibility of a future merger or acquisition between the involved firms (Hitt et al., 2007).

In the theoretical literature, several classification schemes of motivations for alliance formation were also developed. Harrigan (1985) classified motivations to form joint ventures, which can be applied to strategic alliances, in three broad categories (1) *Internal uses* such as cost and risk sharing, obtaining resources, information exchange, innovative managerial practices, etc. (2) *Competitive uses to strengthen current strategic position* such as reduce competitive volatility, capacity expansion, gain excess to global networks, etc. (3) *Strategic uses to augment strategic position* such as creation and exploitation of synergies, technology transfer, and diversification, etc.

Lorange and Roos (1992) offered four generic motivations to form strategic alliances. Their conceptual classification scheme of motives has two dimensions;

strategic importance of particular business in a parent's portfolio (core vs. peripheral business) and parent's market position (leader vs. follower) in this business. Four main motivations for alliance formation proposed by Lorange and Roos are, namely, *"defend,"* *"catch up,"* *"remain,"* and *"restructure."*

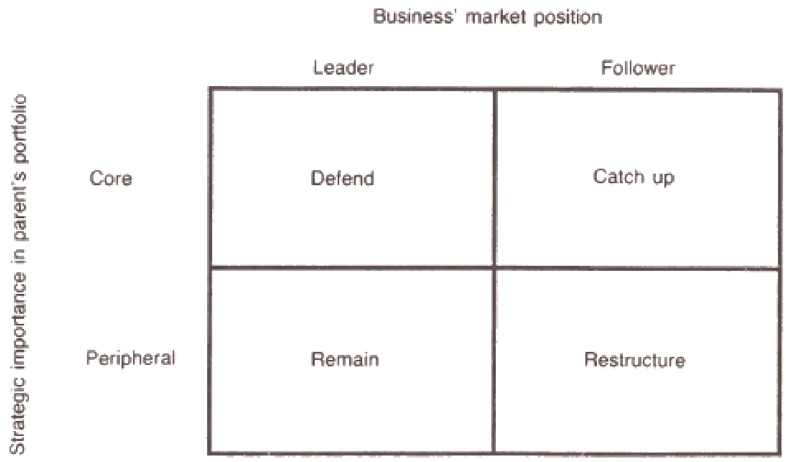

Figure 2: Generic Motives for Strategic Alliances by Lorange and Roos (1992)

When the business is in a core position in the parent's overall portfolio, and the firm is a leader in the business segment, the typical motive to enter into strategic alliances is *defensive*. Here access to markets and/or technology and securing resources become essential motives to enter alliances. When the business is still in the core position in the overall portfolio, and the firm is a follower in the market, the primary motive to enter a strategic alliance is *catch up* where strengthening competitive positioning is vital. Engaging in strategic alliances, in this case, might be the only realistic option.

When the business is in a peripheral position in the overall portfolio, but the firm is a leader in the business segment, the main motive to form a strategic alliance would be to *remain*. The main motive might be getting maximum efficiency out of the firm's position. Suppose the particular business plays a peripheral role in the portfolio and the firm is in a follower position in the market. In that case, the primary motive for the firm's corporate strategy should be to *restructure* its business by undertaking radical changes. Creating strength and adding value should be the goals for the parent.

Todeva and Knoke (2005) classified motivations to form strategic alliances based on internal and external factors; 1) *Business Environmental Factors* such as general economic conditions, institutional frameworks in countries of operation, a complex set of relations among corporations. 2) *Industrial Factors* such as the intensity of industry competition, the social organization of specific product markets, technical or economic rationales. 3) *Organizational Factors* stem from company-specific properties like size, assets, collaborative history, ownership forms, corporate social capital, product range and diversity, market share, and market penetration through distribution channels. 4) *Globalization and Commodity Chains* such as competitive pressures on a global scale, shorter product life cycles, and rapid technological change; the emergence of new competitors; corporate social capital across national boundaries; and increased demand by global firms for systemic solutions.

Hitt et al. (2007) classified motives based on market types; *slow-cycle markets, fast-cycle markets,* and *standard-cycle* markets. In *slow-cycle markets,* imitation is too costly, and firms' competitive advantages stem from the inability to imitate for a long time by others. Examples of these markets include steel manufacturers, financial institutions, utility services. *Fast-cycle markets* are unstable, unpredictable, and complex such as the information technology industry. In *fast-cycle markets,* the competitive advantage comes not from the inability to imitate but from their long-term sustainability. Firms in *standard-cycle* markets are often large and focus on economies of scale, and their alliances depend on complementary resources and capabilities. The airline industry and communication industry are examples of this type of market. The below table by Hitt et al. (2007) shows the motivations to enter alliances based on market cycles.

Table 1: Strategic Alliance Motivations Based on Market Cycles by Hitt et al. (2007)

Market	**Motivations for Engaging in Alliances**
Slow Cycle	* Gain access to a restricted market
	* Establish a franchise in a new market
	* Maintain market stability
Fast Cycle	* Speed up development of new goods or services
	* Speed up new market entry
	* Maintan market leadership
	* Form an industry technology standard
	* Share risky R&D expenses
	* Overcome uncertainity
Standard Cycle	* Gain market power (reduce industry overcapacity)
	* Gain access to complementary resources
	* Establish better economies of scale
	* Overcome trade barriers
	* Meet competitive challenges from other competitors
	* Pool resources for every large capital projects
	* Learn new business techniques

2.3. Types of Strategic Alliances

Strategic alliances are formed by using various configurations based on the level of ownership and activity relations. Joint ventures, consortia, equity participation, research and development agreements, joint marketing agreements, buyer and supplier relationships, and informal cooperation are various forms alliancing can be shaped (Simonin, 1997; Das and Teng, 2000).

Even though alliances can be formed in various types, joint ventures, equity strategic alliances, and contractual alliances are three major types of alliances researchers agreed on (Das and Teng, 1998; Gulati and Singh, 1998; Hitt et al., 2016). A joint venture is a legally separate company jointly owned by at least two parent organizations. Hitt et al. (2015) state that *"typically partners in a joint venture own equal percentages and contribute equally to the venture's operations."* Equal equity sharing, centralized control, and collaboration are the characteristic of joint ventures.

In an equity strategic alliance, partner firms own different percentages of the alliance company they have formed. Comparing to joint ventures, equity alliances have limited equity exchange, less centralized control, and less integrated processes (Das and Teng, 2008). Equity arrangements help partner companies to align their interests (Gulati, 1995). When there is shared equity, coordination and control between partners can be facilitated easier and opportunistic behavior of partners tends to be discouraged (Das and Teng, 2008). On the other hand, trust arises with repeated interactions among alliance partners. Trust helps partners choose less hierarchical and more flexible alliance types for future partnerships, meaning moving from equity-based alliances to contractual agreements (Gulati, 1995).

Contractual alliances do not involve equity sharing or creating a new entity but rather involve an agreement with a contract between partners. They are less formal than the equity-based type of alliances, and varieties include licensing agreements, research and development agreements, cross-licensing agreements, distribution agreements, and supply contracts (Das and Teng, 2008; Hitt et al., 2016). Strategic alliances that are not based on equity sharing are less rigid, and issues such as revising, reorganizing, or terminating alliances can be solved easier than equity-participated alliance models (Varadarajan and Cunningham, 1995).

Outsourcing is also a typical form of non-equity-based strategic alliance. Firms are increasingly using outsourcing to access resources outside of their own boundaries to improve their competitive advantage. Historically, large manufacturing companies tried to produce all required parts for production in-house to maintain control over all stages of the production process (Lau and Hurley, 1997). However, globalization made "*single firm doing all things in-house*" unbearable and outdated (Ngowi, 2007). Harrigan (1985) states that organizational commitment to a particular technology is increased with in-house production, which can limit the flexibility of a firm in the long run. Firms using outsourcing can change suppliers when others offer newer and more cost-effective technologies. In summary, outsourcing helps companies give quick responses to environmental changes (Gilley and Rasheed, 2000).

There are many definitions of "outsourcing" in the management literature. However, most definitions focus on procurement activities, such as Embleton and Wright's (1998) definition of *"the transfer of routine and repetitive activities to an outside source."* However, outsourcing is not all about a "*make or buy*" decision. All firms purchase components for their operations. Outsourcing is a typical form of strategic alliances because outsourcing help companies not only save costs but canalize their resources to perform other activities that differentiate them from their competitors (Zineldin and Bredenlöw, 2003).

Strategic alliances can also be formed across vertical and horizontal borders. Alliances are often formed based on complementary resources and capabilities. A horizontal strategic alliance is a collaboration to conduct a commercial activity between firms operating in the same business (Perry et al., 2004). Horizontal alliances are sometimes challenging to sustain because this type of alliance is often formed between competitors (Hitt et al., 2007). On the other hand, a vertical strategic alliance is formed between a company and its upstream or downstream partners in the value chain, such as partnerships between a company and its suppliers or distributors. Vertical alliances are often formed in reaction to environmental changes and specifically attribute partner firms to develop dynamic capabilities, improve product innovation, and eventually increase their competitive advantage (Hitt et al., 2007; Bouncken et al., 2016).

2.4. Failures and Instabilities of Strategic Alliances

Despite their many potential uses and benefits, the failure rate of strategic alliances is very high since it is challenging to manage an alliance than a wholly-owned business. The literature is full of studies on failures and instabilities of strategic alliances (Beamish, 1985; Makino and Beamish, 1998; Das and Teng, 2000). Empirical studies show that about 50% of the alliances do not meet expectations, the success rate is low (Kogut, 1988; Schilke and Goerzen, 2010).

Lorange and Roos (1991) give three fundamental reasons why alliances fail; (1) *complex decision-making processes due to participation of two or more organizations,* (2) *merging separate corporate cultures,* (3) *different even conflicting strategic intensions of partners*.

De Man and Duysters (2002) identified five main reasons for alliance failure; (1) *Mismatch with partner's strategy,* (2) *Partner unable to deliver expected competencies,* (3) *Operational problems,* (4) *Mismatch of partner's culture,* (5) *Lack of trust*.

Alternatively, Park and Ungson (2001) offered a conceptual framework for primary sources of alliance failure and focused on *interfirm rivalry* and *managerial complexity*. They defend that opportunistic behaviors of partners create threats for the alliance when partners try to maximize their own interests rather than the interest of the collaboration. On the other hand, managerial complications arise during the coordination of two or more independent firms and when alliance-level operations do not comply with parent firms' long-term goals.

Instabilities in alliances arise from conflicts between partners (Das and Teng, 2000). However, instabilities do not always result in the failure of alliances. Alliance instability is defined by (Inkpen and Beamish, 1997)) as *"major changes or dissolutions of alliances that are unplanned from the perspective of one or more partners."*

How equity ownership effect on instability of strategic alliances was studied by several researchers. Some researchers defended the equal ownership of equity in alliances to overcome alliance instability (Beamish, 1985; Dhanaraj and Beamish, 2004). While others defend that a partner should hold the majority of the equity to prevent instability (Killing, 1983). Some other researchers also defended that there is no significant effect of equity on the instability of alliances (Blodgett, 1992).

Das and Teng (2000) studied the instabilities of alliances focusing on internal tensions. They suggest that three competing forces trigger instability in strategic alliances; (1) *cooperation versus competition*, a partner's pursue of its own interest rather than mutual interest and common benefits in an alliance; (2) *rigidity versus flexibility*, this internal tension arises with the wrong choice of the governance structure. Equity-based alliances are preferable when rigidity is needed. On the contrary, contractual agreements are preferable when flexibility is needed; (3) *short-term versus long-term orientation*, partners may have different timetables for an alliance. The duration of a strategic alliance is often unclear.

Other important reasons why alliances do not meet expectations stated in the empirical studies include; lack of strategic fit due to complementary resources (Harrigan, 1985); lack of trust (Bierly III and Gallagher, 2007); inappropriate choice of governance structure (Hennart, 1988); lack of experience in alliances (Anand and Khanna, 2000; Gulati et al., 2009).

Failures and instabilities in strategic alliances have many possible causes in a life cycle of an alliance. As mentioned above, many of them are undoubtedly due to the partner selection process (Bierly III and Gallagher, 2007). Thus, a better understanding of the partner selection process can help reducing high failure and instability rates.

2.5. Critical Success Factors of Strategic Alliances

How is an alliance considered successful? Todeva and Knoke (2005) defend that if the partners achieved their strategic goals and recovered their financial investments, then the alliance is considered "successful." However, scholars found that multiple factors affect alliance success.

Factors affecting alliance success may be categorized based on the phases of an alliance. During the formation stage of an alliance, selecting the right partner and the correct type of alliance governance system could be considered the most critical success factor.

In the alliance management phase, trust and commitment between partners are considered as vital factors for alliance success by many scholars (Bierly III and Gallagher, 2007; Shah and Swaminathan, 2008; Das and Teng, 1998).

Sharing knowledge is another critical factor for success during the management phase of an alliance. Restricting knowledge sharing leads to a decrease in trust between partners, which creates a challenge to the alliance's success. On the other hand, effective information sharing between partners increases innovation, problem-solving skills, and performance; this, in turn, helps create satisfied partners (Hameed and Abbott, 2017). A proper communication strategy needs to be developed between alliance partners.

2.6. Life Cycle of Strategic Alliances

The life of strategic alliances mainly consists of three cycles; alliance formation, alliance management, and alliance termination.

2.6.1. Alliance Formation

The alliance formation is the first phase in forming a strategic alliance. "*Formation*" encompasses decision making, partner selection, and choice of alliance governance type. At this stage, firms first analyze the reasons for forming alliances and possible alliance benefits. Then they choose their partners and the most suitable form of cooperation for alliance management (Russo and Cesarani, 2017). Resource dependence theory has been a source for alliance formation, and mostly dyad level of analysis is used to study the behavior of firms in alliances (Gulati, 1998).

Some early empirical studies on the formation of alliances focused specifically on joint ventures, which requires creating a new entity with shared equity between partners. More recent studies on alliance formation have examined industry and firm-level factors that could explain the frequency of alliance formation (Gulati, 1998). Some of the industry-level factors for alliance formation include the extent of competition, the stage of market development, demand, and competition uncertainty (Harrigan, 1988).

Firm-specific studies have focused on identifying some of the incentives that are likely to lead firms to enter alliances. This has led to a rich research stream that has examined what types of firms in which industries enter what types of alliances for what reasons. Other scholars have looked at firms' attributes, such as size, age, competitive position, product diversity, and financial resources, as important predictors of their inclination to enter strategic alliances with each other (Gulati, 1995).

Experience in forming alliances increases firms' alliance formation capabilities (Gulati, 1999). An essential basis for developing alliance formation capabilities is learning from previous experience. Once firms begin to enter alliances, they can internalize and refine specific routines associated with forming partnerships.

Alliance formation research focusing on material-resource considerations neglects essential social necessities that may also be influential (Gulati, 1999). Moreover, scholars examined the causes and consequences of alliances mostly at the dyadic level (Austor, 1994 cited in Gulati, 1999).

However, alliance formation that focuses solely on the interdependence of partners cannot examine how firms learn about new alliance opportunities. Alliance formation should be examined by looking at the impact of social alliance networks. Participation of firms in alliance networks makes them attractive partners to other firms and helps them develop skills through alliances (Gulati, 1995,1999).

2.6.1.1. Partner Selection

Partner selection is a part of alliance formation. Scholars studying the behavior of firms ask the question, *"who do firms partner with?"*.

The literature on strategic alliances agrees that the leading cause of many failures in strategic partnerships is related to partner selection (Bierly III and Gallagher, 2007; Shah and Swaminathan, 2008; Cummings and Holmberg, 2012). A good partner selection process more possibly generates a more successful alliance. However, if the initial partner selection process is poor, even superior alliance management may not be enough to overcome problems (Cummings and Holmberg, 2012).

The partner selection process starts with screening for prospective partners. Proactive firms continuously scan their environment. For instance, Dow Chemical developed a scanning tool to identify potential alliance partners. The company has created a topographic map that detects the overlap between its patent areas and potential alliance partners' patent areas. With the help of this tool, the company found the possibility of allying with Lucent Technologies in optical communications (Dyer et al., 2001).

Sarkar et al. (2009) define alliance proactiveness as a *"firm's engagement in discovering and acting on new alliance opportunities ahead of competitors."* Firms that are proactive in identifying and acting on partnering opportunities are more likely to enjoy first-mover advantages leading to superior market-based performance (Sarkar et al., 2001). In addition to alliance proactiveness, existing relationships, social connections, and actions of other competing firms are also essential factors for partner selection.

After scanning the environment for prospective partners, firms start their decision-making process based on their set of selection criteria. Early studies on the partner selection process specifically focused on joint ventures (JVs). Tomlinson's (1970) pioneering study created a relationship between partner selection and JV performance. He identified six distinct categories of partner selection criteria for international JVs: (1) *Favourable past association* (single most important criterion); (2) *Convenience of facilities and resources possessed by a potential partner*; (3) *Resources, such as managerial and technical personnel, materials, components or local capital*; (4) *Partner's status, both financial and business reliability, and ability to deal with local authorities and engender good public relations*; (5) *Pressure to select a particular partner, either directly or indirectly by government regulations and/or attitudes*; (6) *Capacity to provide a local identity.*

Geringer (1991) divided partner selection criteria for JVs into two broad typologies; *partner-related* selecting criteria and *task-related* selecting criteria. The skills and resources that a company will look for in its potential partner are categorized as *task-related* selecting criteria. This criterion is more interested in the strategic fit between partners (Lu, 1998). *Partner-related* criteria refer to the potential partner's ability to work efficiently and effectively with the focal firm, such as compatibility of senior management teams, etc. On the other hand, this criterion is more concerned with organizational fit (Lu, 1998). The categorization of partner and task-related selection criteria by Geringer (1991) has been utilized by many researchers in the later partner selection studies (Glaister, 1996; Nielsen, 2003; Das and He, 2006).

After studying more than 40 articles on partner selection, Shah and Swaminathan (2008) identified four key factors that have been consistently analyzed in the literature that affect partner attractiveness and selection, and subsequently strategic alliance performance: (1) *trust*; (2) *commitment*; (3) *complementarity*; and (4) *value, or financial payoff.*

The first factor, trust, is defined by Bierly III and Gallagher (2007) as "… *mutual confidence that no party to an exchange will exploit another's vulnerabilities because opportunistic behavior would violate values, principles, and standards of behavior that have been internalized by parties to an exchange".* As in all relationships, trust is vital when building partnerships. It reduces transaction costs, uncertainties, conflicts, and opportunistic behaviors while increasing cooperation, flexibility, reputation, and image (Bierly III and Gallagher, 2007; Shah and Swaminathan, 2008; Das and Teng, 1998). Hitt et al. (2007) state that trust between the alliance partners is arisen from at least four major terms: *"the initial condition of the relationship, the negotiation process to arrive at an agreement, partner interactions, and external events."*

Trust and commitment are closely related concepts in building successful alliances. Trust provides incentives to be committed to the alliance. Thus trust leads to commitment. Cullen et al. (2000) describe commitment as *"a partner's intention to continue in a relationship."* The authors also divided commitment into two categories. (1) *Calculative commitment* as the rational and economic side of commitment (2) *attitudinal commitment* as the dedication of resources and efforts to make the venture work.

Cullen et al. (2000) also identified factors to be aimed in order to build and sustain trust and commitment in strategic alliances. The authors state that "*companies should select their partners considering trust more than complementary and resource contributions of the potential partners; pursue a level of trust and commitment that is suitable for their strategic goals for partnering; be patient in the development of trust and commitment and invest in direct communication*."

The third factor, complementarity, is considered one of the most crucial drivers for the partner selection process by many researchers with the resource-based view (RBV) (Harrigan, 1985; Hitt et al., 2000; Harrison et al., 2001). RBV examines a firm's strategic partner selection process from an economic perspective regarding complementary resources and alliance efficiency (Zhiang et al., 2009). Bierly III and Gallagher (2007) define resources as "*…capital, technology, capabilities or firm-specific assets, and are frequently key or critical success factors in an industry*". Partners must be diverse enough to provide complementary resources and capabilities that produce synergies in an alliance (Bierly III and Gallagher, 2007).

The strategic and organizational fit between partners can be examined under the complementarity key factor for the partner selection process (Shah and Swaminathan, 2008). The fit between partners is considered one of the essential factors determining alliance success by many researchers (Venkatraman, 1990; Dong and Glaister, 2006; Bierly III and Gallagher, 2007). Similar goals, objectives, and organizational cultures foster alliances. The general strategies of the prospective partners do not have to overlap.

However, they should be close enough at a compromise level without creating an obstacle to set common goals while forming a strategic partnership (Inkpen and Tsang, 2005).

Trust complements strategic fit during the partner selection process; undoubtedly, partnerships cannot be established without mutual trust. However, excessive trust between parties sometimes overshadows strategic incompatibilities; therefore, the management of prospective partner companies should ensure that the fit between parties is strong (Bierly III and Gallagher, 2007).

Value/financial payoff is the fourth factor in Shah and Swaminathan's (2008) study that increases partner attractiveness. The authors state that if the prospective partner has a high degree of ability to increase the alliance's financial value and provide strategic advantages to the alliance, the partner's attractiveness in the selection process rises.

Previous experience in alliances and social relationships are also driving forces for companies to establish new alliances. Simonin's (1997) empirical study demonstrates that firms learn from past collaborations by developing skills in identifying potential partners. The author also states that the experience needs to be internalized and turned into specific know-how to be used in future collaborations. This indicates the importance of building a learning organization that can make the previous experiences useful for future collaborations.

Choosing the right partner is critical for international alliances. Firms in developed and developing economies have different motives and partner selection criteria to ally with each other (Dong and Glaister, 2006). Hitt et al. (2000) studied partner selection criteria for international alliances. They compared desired partner characteristics for firms from emerging and developed economies. Their results reveal that firms from developed countries ally with companies to gain a competitive advantage by leveraging their resources. Thus, they prefer partners with unique resources/capabilities and local market knowledge. On the other hand, learning is significant for firms in developing economies. Consequently, they want partners with high technical capabilities, willingness to share expertise and a high level of tangible and intangible assets.

Alliance Project Types and Partner Selection

Alliance project types have an important effect on partner selection in project-based industries. Shah and Swaminathan's (2008) study focused on the influence of alliance project type on partner selection. They examined the impact of trust, commitment, complementarity, and the financial payoff for determining partner attractiveness. They introduced a framework that addresses when and why managers select partners with certain, specific characteristics. The figure 3 below shows their model of partner selection and attractivemess.

Based on Agency Theory, the authors state that *process manageability* and *outcome interpretability* may be viewed as two dimensions that define the specific alliance project types. They defined *outcome interpretability* as the degree of difficulty to assess or interpret the outcome of an alliance project, *behavior observability* as the degree of transparency of the process in which the alliance is implemented and maintained.

	Process Manageability Low (Difficult)	Process Manageability High (Easy)
Outcome Interpretability Low (Difficult to interpret)	Most Critical: Trust	Most Critical: Complementarity
Outcome Interpretability High (Easy to interpret)	Most Critical: Commitment	Most Critical: Financial Payoff

Figure 3: Contingency Model of Partner Selection and Attractiveness by Shah and Swaminathan, (2008)

How Social Relationships Affect Alliance Partner Selection

Organizations are influenced by their previous relationships. They evaluate the benefits of re-allying with their previous partners and tend to establish new relationships with other organizations in their network since a level of trust has already been fostered within the network (Gulati, 1998).

Gulati (1995, 1998) found in his studies that a company most probably makes its first partner choice from the network of partners it is already in during the partner selection phase. He argues that firms are embedded in social networks and should not be viewed from an atomistic perspective.

Networks are essential information sources for the participants not only to identify the members in a network and but also the patterns of relationships in that network (Gulati, 1995). When organizations choose new partners, they also need to consider new partner's fit to their existing alliance portfolios. Network theory specifically enlightens the partner selection within a network.

2.6.1.2. Alliance Type Selection

For the success of an alliance, selecting the appropriate alliance type during the formation phase is as important as choosing the right partner. Partners' specific motivations, firms' experiences, and expertise in collaboration determine the particular form of strategic alliances (Simonin, 1997).

Lorange and Roos (1992) studied the type of partnership to be chosen during the formation phase. They defend that the alliance type selection should depend on how much of the resources of the potential strategic alliance parents will be transferred to the alliance and how much will be retrieved. Based on these two dimensions, they created a framework of four archetypes of strategic alliances; *ad hoc pool, consortium, project-based joint ventures, full-blown joint ventures,* as shown in figure 4 below.

Parents' Retrieval of Output \ **Parents' Input of Resources**	Sufficient for short-term operations	Sufficient for long-term adaptations
To Parents	Ad hoc pool	Consortium
Retain	Project-based joint venture	Full-blown joint venture

Figure 4: Archetype of Strategic Alliances by Lorange and Roos, (1992)

If parents want to put a minimum of their resources and retrieve the entire output, an *ad hoc pool* type of alliance should be preferred. Contractual agreements often base on a temporary basis are examples of this type.

Suppose prospective partners want to transfer more resources to the alliance comparing to the previous type, and they still want to get all of the output back when the values are created. In that case, the *consortium* type of strategic alliance should be the option. R&D consortium is an example where parents put all of their best technological resources into the alliance, and the benefits go back to the parents when the goals are achieved.

The third archetype of strategic alliance is *project-based joint ventures*. In this type, prospective parents want to transfer a minimum of their resources and establish a joint organization for a shorter time. When the output is generated, except for financial gains, it is not distributed to the parents. Prospective parents choose this type of alliance, for instance, when they want to enter a specific country.

In *full-blown joint ventures*, the fourth archetype, parents put the abundance of their resources and the output generated retains in the alliance itself. An example of this type of alliance would be an entirely new long-term company with its own strategic life (Lorange and Roos, 1992).

2.6.2. Alliance Management

The management phase of alliances starts after formation and continues until the termination. During this phase, partners may face many problems such as cultural differences, variations in motivations, diverse and conflicting goals of partners, and external and internal environmental changes.

The success of an alliance also depends on a firm's ability to adopt appropriate interaction processes to manage coordination and cooperation and develop strong bonds with partners during the management phase of the relationship (Schreiner et al., 2009).

Anand and Khanna (2000) defend that since the management of alliances is not a well-defined process, it is likely that there will be differences across firms in their ability to manage alliances. Some firms have superior skills to manage alliances, and this is called alliance management capability in the literature (Anand and Khanna, 2000). Having alliance management knowledge and skills during the implementation of alliances is vital, but of course, these capabilities are developed with experience.

2.6.3. Alliance Termination

All alliances terminate in time. The early literature on alliance termination defended that alliance termination was due to insufficient value creation within the strategic alliance (Harrigan, 1988). More recent studies claimed that performance differences between partner firms are the key reasons for alliance termination (Sadowski and Duyster, 2008).

On the other hand, the social embeddedness perspective argues that the termination of alliances may create contradictory results for alliance partners. The dissolution of an alliance would reduce the embeddedness of the partners in the social structure. This, in turn, may negatively affect economic activities and future alliance activities such as forming new relationships or harming even existing relationships (Park and Russo, 1996). Therefore, good preparation for alliance termination preserves companies' reputations and secures future opportunities.

2.7. Project-Based Alliances

A project-based organization (PBO) is referred to organizational form that involves establishing temporary systems to fulfill project responsibilities (Hobday, 2000). PBOs work mostly or entirely in projects, and they are capable of responding to complex tasks and changing environments. These organizations are generally utilized in customized industries such as construction, biotechnology, software development, engineering and architectural designs, film production and media, and other industries where complex products, services, or systems are developed (Di Vincenzo and Mascia, 2012; Eriksson, 2013).

Collaboration among PBOs is common. Project-based industry researchers agree that alliancing is critical for firms to be more flexible to react and meet market demands (Sillars and Kangari, 2004). Collaborative project delivery arrangements primarily have three approaches; project partnering, project alliancing, and integrated project delivery. These approaches are discussed in section 6.3.

Project-based alliances are competitive organizational forms. They are frequently used, especially when the projects are too complex and technically innovative solutions are required. Other drivers for establishing project-based alliances include high risks and costs, scope uncertainty due to unpredictable challenges, time and operational constraints requiring flexibility for scheduling, scarcity in terms of materials, skills, or expertise, a source for learning, enhancing reputation, and gaining competitive advantage, (Chen et al., 2012; Walker and Lloyd-Walker, 2016).

Project-based alliances are among the most intense forms of cooperation since they exist during the lifetime of a project. As in all types of collaboration forms, in project-based alliances, trust and cooperation between partners, and commitment to goals, are critical factors affecting alliance success. However, project-based alliances are different from other types of partnerships. Thus, there are exclusive factors that affect a project-based alliance's success.

Effective management practices, including conflict resolution strategies, are fundamental for a project-based alliance's success (Van den Berg and Kamminga, 2006). Organizational learning is also considered a vital performance driver for project-based organizations (Prieto-Pastor et al., 2018). Firms bring their existing knowledge and expertise to alliances. Combining this shared knowledge and expertise held by partners during an alliance's lifetime generates new knowledge. This process is called knowledge integration, one of the critical success factors for project-based alliances. Knowledge integration provides proper coordination and increases project goals' efficiency (Tiwana, 2008; Roussel and Deltour, 2012).

Another success factor for project-based alliances revealed by scholars is the technological diversity between partners. Researchers found an inverted U-shaped effect of technological diversity between partners on project alliances' performance (Petruzzelli, 2011). On the other hand, the technological similarity between partners makes it easy to align and commercialize the combined technological resources and increases collaborative innovation (Raesfeld et al., 2012). However, too much technological similarity between partners inhibits innovation (Nooteboom, 2000).

2.8. Evolution of Strategic Alliance Research

Over the past four decades, the excessive increase of strategic alliances has led researchers with diverse backgrounds to study a wide range of alliance topics. Early empirical studies focused on the preformation phase and performance consequences of strategic alliances as dyadic relationships (Gulati, 1995).

The subjects studied in early empirical studies include motivations for alliance formation (Contractor and Lorange, 1988; Kogut, 1988); joint venture formation as a strategic alliance option (Harrigan 1988; Beamish and Banks 1987); partner selection (Geringer, 1991; Parkhe, 1993; Brouthers et al., 1995); negotiations and contracts, (Contractor, 1985; Brouthers and Bamossy, 1997); control and conflict, (Killing, 1983; Beamish, 1985; Geringer and Hebert, 1989); performance consequences of strategic alliances, (Renforth and Raveed, 1980; Beamish, 1985; Awadzi, 1987).

Theories used in the empirical studies focused on the preformation phase, and the performance consequences of strategic alliances were highly fragmented. Prominent theories applied in these studies are; transaction cost economics (Beamish and Banks, 1987; Geringer and Hebert, 1989; Hennart, 1991), resource-based view, organization theory, agency theory, game theory (Parkhe, 1993), strategic behavior theory (Kogut and Singh, 1988).

More recent studies focused on the post-formation phase of strategic alliances such as performance outcomes (Pearce, 1997; Delios and Beamish, 2001), management and control of alliances (Ireland et al., 2002; Choi and Beamish, 2004), knowledge and learning (Holt et al., 2000; Kale and Singh, 2007; Schilke and Goerzen, 2010) and value creation and capabilities (Kale et al., 2002; Schreiner et al., 2009; Sarkar et al., 2009; Wang and Rajagopalan, 2015).

Theories used in the studies focused on the post-formation phase of strategic alliances were also fragmented. The prominent theories used in these studies are; transaction cost economics (Dussauge and Garrette, 1995), the resource-based view (Ainuddin et al., 2007), organizational learning (Anand and Khanna, 2000; Kale et al., 2000), game theory, competence-based theories, dynamic capabilities theory. Despite such fragmented and numerous theories, the most common theories in the post-formation phase of strategic alliance studies are transaction cost economics and resource-based view.

Within the scope of strategic alliance research, there has been increasing growth in social network-based research over the last twenty years. The dyad level of analysis was essential to study the alliance behavior of firms. However, the increasing number of alliance firms has made them deal with alliance portfolios instead of evaluating each partnership one by one. Developing an alliance strategy became vital for the overall strategic goals of firms. Consequently, current studies focused on alliance networks, network positions (Koka and Prescott, 2008; Gulati et al., 2011), and managing alliance portfolios (Wassmer, 2010; Vapola et al., 2010).

2.9. Alliance Network Research

Traditional strategic alliance research considered strategic alliances as dyadic relationships with an under-socialized view and focused on the causes and consequences of these relations. It paid less attention to the fact that alliances are significantly defined and shaped by the social networks they are embedded in (Gulati, 1998). Alliance networks are a complex phenomenon; still, the network perspective provides a new awareness to the strategic alliance research.

Gulati (1998) developed a social network perspective on strategic alliances providing a new vision on important factors influencing behaviors and performance of firms embedded in networks. Gulati (1998) states that the firms are embedded in social networks. These networks influence firms on many alliancing decisions such as the frequency to enter alliances, partner selection, type of governance system would be used, how the alliance would be developed and evolved over time.

Social connections create opportunities for firms to engage in alliances. Networks are essential information sources for the participants not only to identify the members in a network and but also the patterns of relationships in that network. However, the embeddedness of firms in social networks may both constrain and facilitate a firm to enter new alliancing. Social networks create opportunities for firms to be aware of possible alliance partners. Similarly, potential partners would be aware of a focal firm; thus, this may constrain choices for alliances.

2.10. Managing Alliance Networks (Portfolio)

All strategic alliances of a focal company are defined as *alliance network* or *alliance portfolio*, and the management is referred to as *Alliance Portfolio Management* in strategic alliance literature (Kale et al., 2009).

Wassmer (2010) categorized alliance portfolio research in three general research streams: (1) *the emergence of alliance portfolios*, which questions why and how firms build alliance portfolios, (2) *the configuration of alliance portfolios* concentrates on which configuration choices firms make, and (3) *the management of alliance portfolios* focus on how firms manage their alliance portfolios. See Figure 5 below for Wassmer's (2010) "*Conceptual Map for Alliance Portfolio Research Areas.*"

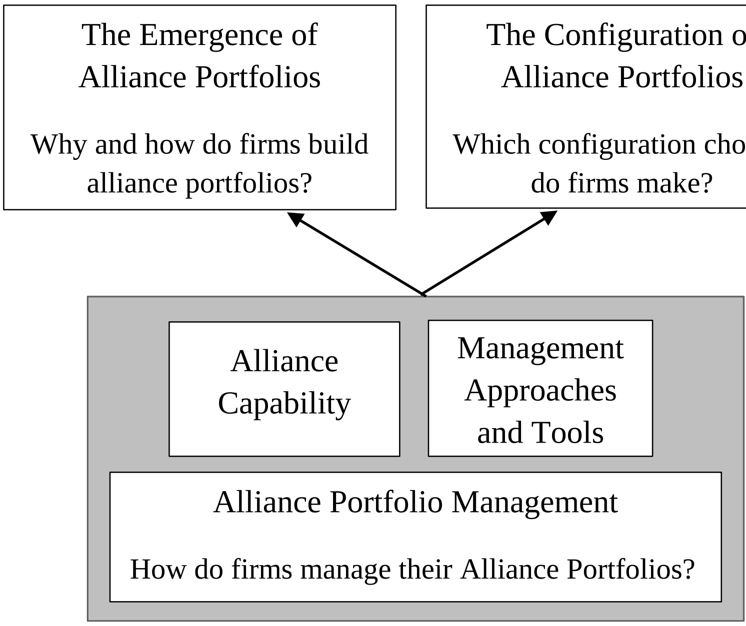

Figure 5: Conceptual Map for Alliance Portfolio Research Areas by Wassmer (2010)

A wide range of theories is utilized in alliance portfolio research. The major theories are as follows; social network theory (Gulati, 1999; Goerzen, 2007; Klijn et al., 2010), organizational learning theory (Anand and Khanna, 2000; Heimeriks et al., 2007; Vasudeva and Anand, 2011), agency theory (Reuer and Ragozzino, 2006), the resource-based view (Bavelas, 1948; Ahuja, 2000; Lavie, 2006), dynamic capabilities theory (Kale et al., 2002), transaction cost theory (Goerzen, 2007).

Motivations for firms to build alliance portfolios go beyond previously reviewed motivations of why firms form individual strategic alliances. Firms gain more benefits from having multiple simultaneous alliances than a single strategic partnership (Wassmer, 2010). With alliance portfolios, firms not only can spread risk and overcome uncertainty but also speed up their learning to design and manage strategic alliances (Anand and Khanna, 2000). From the learning view, having an alliance portfolio allows firms to learn and utilize diverse knowledge from partners better over time (Deeds et al., 2000).

Moreover, firms with alliance portfolios are expected to see a better survival rate of their alliances (Kale et al., 2002).

Koka and Prescott (2002) defend that interfirm relations restrict and shape a company's actions concerning alliance formation and partner selection, which in turn determines the position of that company in the network. The authors also state that companies should go beyond the traditional cost-benefit analysis of their individual alliances and evaluate particular alliances in the context of their other alliances and the context of the entire network of relationships.

As the number of a firm's strategic alliances increases, the ties in the portfolio can create conflicting demands; therefore, the management of an alliance portfolio needs to balance collaboration and flexibility, which is not easy in practice. Recent research on alliance portfolios also explored *alliance portfolio capability*. Heimeriks and Duysters (2007) defined alliance capability as "*a higher-order resource which is difficult to obtain or imitate and has the potential to enhance the performance of the firm's alliance portfolio*." Alliance capabilities explain performance heterogeneities among alliances and firms (Wang and Rajagopalan, 2015). Hoffmann (2005) defines alliance portfolio capability as "*organizational ability to manage a comprehensive alliance portfolio successfully*." This ability enables firms to manage their portfolios in a holistic way and create more value than alliances are managed separately (Sarkar et al., 2009). Alliance portfolio capability plays a key role in deciding which connections to maintain and which connections to pursue (Wang and Rajagopalan, 2015). Alliance portfolio capability, in other words orchestrating alliance portfolios, helps firms enhance their competitiveness and position in the industry (Haider and Mariotti, 2016).

2.11. Theoretical Perspectives of Strategic Alliance Research

Theoretical perspectives have been mainly developed to explain the underlying reasons companies enter strategic alliances, the conditions under which strategic alliances are likely to be established, and the types of strategic alliances that may be formed (Das and Teng, 2000). Das and Teng (2000) identified two theoretical perspectives, transaction cost theory (Williamson, 1975) and resource-based view, which are the most widely used theories under the strategic alliance domain. Organizational learning theory (Argyris et al., 1978) is another theoretical perspective commonly utilized in strategic alliance research. Although these theoretical perspectives focus on different facets and incentives, some points overlap.

This thesis will be carried out within the framework of network theory. A detailed examination of network theory with a literature review is in chapter 4.

2.11.1. Transaction Cost Theory

Transaction cost economics is one of the widely used theories in organizational theory literature and was developed by Williamson (1975). This view suggests that firms want to choose the alternative that minimizes the total cost of production and operation.

According to transaction cost theory, companies ally with each other to minimize transaction costs, production costs, and the sum of fixed costs. The option to select between equity and non-equity governance forms of alliances is emphasized under this view (Casciaro, 2003). The transaction cost view also points out that the main reason for instability in alliances is opportunistic behaviors of partners due to lack of trust and commitment between parties (Das and Teng, 1998).

2.11.2. Resource-Based View

The resource-based view defends that firms engage in alliances as an alternative strategy to access other firms' complementary resources and skills and leverage internal resources better, and increase their value in the long run (Eisenhardt and Schoonhoven, 1996). Alliances provide benefits to partners by pooling resources that result in economies of scale, increased market power, and risk-sharing. The resource-based view has been used extensively to examine the motivations behind alliance formation (Das and Teng, 2000). Under this view, the main reason for the instabilities in alliances is the limitation of resources by partners (Das and Teng, 1998).

2.11.3. Organizational Learning Theory

Firms gain a competitive advantage through the creation and integration of knowledge (Grant, 1996). Learning from alliance partners is an important motivation to form strategic alliances (Inkpen and Beamish, 1997). The organizational learning view has mainly focused on "*what is organizational learning*" and "*how partners learn from each other*" in the strategic alliance research field (Jiang and Li, 2008). This perspective also defends that partners use strategic alliances as a tool to learn or develop critical skills or capabilities (Khanna et al., 1998).

CHAPTER 3

SOCIAL NETWORK ANALYSIS

3.1. What is Social Network Analysis?

As Hampton and Wellman (2009) stated, *"We are living in a paradigm shift, not only in the way we perceive society but even more in the way in which people and institutions are connected. It is the shift from living in "little boxes" to living in networked societies."* Over the last decades, social networks have spread to all domains of our lives with the development of communication technologies. Social networks caused transformations in societies and have been the subject of many studies.

There is no clear definition of "*network*" in social science studies that reached a consensus. However, a widely used definition of social networks in literature by Laumann, Galaskiewicz, and Marsden (1978) is as follows *"a set of nodes (e.g., persons, organizations) linked by a set of social relationships (e.g., friendship, transfer of funds, overlapping membership) of a specified type."*

Social Network Analysis (SNA) includes concepts, theories, and techniques that examine the social structure that rises from the connection of relationships among members of a given population (Hampton and Wellman, 1999; Wellman, 2001; Borgatti and Halgin, 2011) by using both graphical and statistical methods.

The main purpose of SNA is to study both the content and patterns of relationships in social networks to understand the relationships among actors and the consequences of these relationships (Tabassum et al., 2018).

Social Network Analysis (SNA) might be summarized as a way of thinking about the social world and the connections between actors. SNA focuses on social relationships between nodes (actors or vertices), with a relational approach rather than an attribute approach by a mixed method using both qualitative and quantitative techniques.

SNA has a long history dating back to the 1930s (Freeman, 2004) and has been researched and developed by disciplines from sociology to anthropology, psychology to economics. There is a massive literature on social networks; even there are journals that focus entirely on social networks, such as *Social Networks, Connection, Journal of Social*

Structure, International Journal of Networking and Virtual Organisations (Prell, 2012; Borgatti et al., 2009).

The literature on social networks is also diverse. It provides explanations for countless phenomena from physical to social sciences at many different levels of analysis, such as individual, group, firm, industry, and country levels.

Some fundamental terms regarding social networks, particularly the elements that comprise a network, are needed to be covered before going into depth in the literature review of SNA. The following heading covers these terms. Next in this chapter, the types of networks, graphs in networks, and graph theory will be briefly covered. Afterward, the levels of analysis in SNA studies and statistical measures used in these levels will be discussed. Lastly, a brief history of SNA studies will be presented.

3.2. Terminology in Social Network Analysis Research

Network: An interconnected or interrelated chain, group, or system (https://www.merriam-webster.com).

Node: Individual *actors* in a network. *Nodes* are also called *vertices* or *actors* in networks. SNA is developed by many disciplines; multiple terms are used for the same concept. While the *actor* is used in sociology, the terms nodes or vertices are originated from graph theory. A node can be a discrete individual, a corporate unit such as marketing units in a distribution network, or collective social units such as student groups, teams, communities, organizations, or even countries (Prell, 2012). Anything can be defined as a node in SNA if it makes sense to describe it that way in a given research context. However, nodes and node sets must be carefully defined and selected regarding the ideas and theories to answer a scientific question.

Ties: Ties between nodes represent relations, and these relations can include a whole array of types. Ties are represented with lines in networks. Ties, also called *edges* or *arcs*, are connection points within a network. Ties may be directed or undirected. If a tie is undirected, then called *edges*; on the contrary, directed ties are called *arcs* (Prell, 2012).

Direct Ties: If two nodes in a network are directly connected, this tie is considered a direct tie.

Indirect Ties: Two nodes with no direct relations but connected through a third party.

Path: An edge that links consecutive pairs of non-repeating nodes is called a path in a network. The shortest length between two nodes is called geodesic distance (Tabassum et al., 2018).

Actor Attributes: Additional information on each particular actor, for example, age, gender, ethnicity, etc., are called actor attributes (Prell, 2012)**.** Actor attributes may not be necessary for every network study. However, suppose the researcher investigates whether some attributes are related to a specific position in the network or whether similar nodes in the network frequently establish ties with each other. In that case, attributes become necessary in a network study (Frantz, 2017).

Graph: Social networks are represented with graphs. The graph is a set of vertices (nodes or actors) with lines between pairs of vertices. Suppose the lines which are visual representations of relations in SNA are undirected between nodes. In that case, the diagram is called a *graph*, opposing if the lines are directed from one node to another, then it is called a *digraph* (Prell, 2012).

Network Matrix: Even though graphs and digraphs perform the visual representation, the dependence on graph representations can become difficult for researchers when the network gets bigger. For this reason, network matrices are also used to organize data. In network matrices, the data is organized as case-by-case matrices (or called adjacency matrices) or case-by-event matrices (or called incident matrices). Network matrices also make quantitative analysis easier for researchers (Prell, 2012).

If the value in a network matrix's cells is either 0 or 1, the matrix is called a *binary adjacency matrix*. If the lower and upper part of the data is symmetrical in a network matrix, then the data is undirected. Senders and receivers are reciprocal. If the matrix cells contain values greater than 1 or 0, then the matrix is called a *value matrix*. In these matrices, the higher the number value in a matrix's cell, the higher or more intense the relationship gets between two actors. By contrast, asymmetrical matrices may or may not be reciprocal, (Baeldung Computer Science Tutorials and Guides, https://www.baeldung.com).

3.3. Types of Networks

Depending on the relationships, a network can be directed or undirected.

Undirected Networks: Symmetry and reciprocity are assumed between ties (edges) established by nodes (vertices) in undirected networks. Undirected networks accept that if a tie (edge) between node A and node B exists, the tie between node B and node A also exists. The relationships in an undirected network do not have a hierarchy. It is a more common practice in SNA; most real-world relationships are modeled with undirected networks (Baeldung Computer Science Tutorials and Guides, https://www.baeldung.com).

Directed Networks: In directed networks, symmetry and reciprocity are not presumed between ties (edges) established by nodes (vertices). Ties (edges) in a directed network are represented with arrows, from the originated node (vertex) to the destination node (vertex) (Baeldung Computer Science Tutorials and Guides, https://www.baeldung.com).

Depending on the tie strength, a network can also be weighted or unweighted.

Unweighted Networks: Also called a dichotomous network or a binary network, ties (edges) could take two values, either 0 or 1. 0 means no edges, 1 means there is an edge between that two nodes (Newman, 2004).

Weighted Networks: In this type of network, ties (edges) can take infinitive values and tell us how strong the ties are between the nodes (Newman 2004). Stronger or weaker ties between actors may occur in social networks, so many social networks are naturally weighted.

3.4. Graphs in Networks and Graph Theory

Social networks are represented with graphs. Like many important concepts and terms used in social networks, this also has been drawn from Graph Theory (Prell, 2012). Graph theory is the mathematical counterpart of network theory. Graph Theory, a branch of mathematics focusing on measuring networks, played an essential role in helping social scientists arrange and measure social networks. The theory is originated with Euler (1736); however, this branch of mathematics started to gain attention when König's 1936 paper was translated into English in 1956. Horary and Norman (1953) were among the first to determine how graphic theory could be used as a model in the social sciences, especially in social networking studies (Prell, 2012). Graph theorists developed SNA software programs such as UCINET and Pajek.

Table 2: Corresponding Terms between Network Theory and Graph Theory.

Network Theory	**Graph Theory**
Network	Graph
Node	Vertex
Link	Edge

3.5. Levels of Analysis in Networks

The fundamental element of SNA is relationships. In SNA, the examination of relations can be in different levels; between nodes (also called dyad), among small groups (triads, cliques, or clusters), and among all nodes (the entire network) in the network.

Prell (2012) has examined levels of analysis in social networks with a systematic approach. First, she looked at the position of individual actors in the entire network, and then she examined the position of individual actors in their personal network, ego networks. She also enlightens the readers on what measures are used in the analysis at these levels. This study similarly follows the order of levels of social network analysis as Prell does. Concepts and measures used in SNA also will be introduced by levels of analysis.

3.5.1. Actor Level Analysis in Complete Network

A complete network consists of an entire set of nodes and ties within a boundary. For instance, a school and its students can be studied as a network. Some networks naturally form boundaries, such as friendship networks in a school; however, the researcher must clearly define the network's boundaries (Frantz, 2017).

Actor level analysis in entire networks shows an actor's position in that network. How actors are positioned in a network is necessary to understand who is important in that network. Why do we want to find out important nodes in a network? Because important nodes have more resources, reach more nodes than the others, and make things happen in a network. In SNA, centrality measures show an actor's importance in a network and are the most popular measures at actor-level analysis for complete networks (Prell, 2012).

Centrality Measures

Different centrality measures have been introduced by studies on network analysis over the years, such as *degree centrality, betweenness centrality, closeness centrality,* and *Eigenvector centrality.*

In an undirected graph, *degree centrality* measures how many nodes an actor is connected to. Nevertheless, degree centrality ignores the direction and the strength of the tie (Prell, 2012). If an actor has many ties, that actor is considered to have a prominent position or high prestige in the network, and many other nodes in the network pursue direct connections to that actor. This is also viewed as an indication of the importance of that actor in the network. *Degree centrality* measure is criticized by Bonacich (1987) because, as he states, it only considers the direct ties an actor has, or the alters' ties, instead of also considering indirect ties to all others in a network. Bonacich asserted that an actor might have direct ties with many other nodes, but these other nodes may be disconnected from the network as a whole. In such a case, the actor can only be quite central in its local neighborhood. Thus, having the same number of ties does not make the actors equally important.

The *degree centrality* is measured in two ways in directed graphs; *indegree centrality* and *outdegree centrality*. *Indegree centrality* is the number of ties an actor receives from others in the network and is often used to measure an actor's prestige or popularity within the network. On the contrary, outdegree centrality is the number of ties an actor gives to others in the network. This measure shows the expansiveness of an actor (Prell, 2012). Still, indegree and outdegree centralities take first-level neighbors into consideration do not consider the whole of the network (Brodka et al., 2009).

Degree, indegree, and outdegree centralities are the easiest to comprehend and calculate, among other centrality measures (Prell, 2012). However, if the centrality is only related to an actor's own ego network, it is appropriate to use these centrality measures. On the contrary, if the centrality is related to an actor's location in the whole network, these centrality measures would not be appropriate to use as they would ignore other actors and ties in the network.

The *betweenness centrality* measures an actor's positional advantage or power by emphasizing the potential control over the information flow. This centrality measure considers the whole network. The broker role, connecting different parts of the network, becomes important when measuring the *betweenness centrality* score. This centrality score can be calculated for directed or undirected networks, but the data must be binary.

As the name suggests, the *betweenness centrality* investigates how often an actor rests between two other actors. More specifically, the centrality calculates how many times an actor sits on the shortest path (i.e., geodesic distance) connecting the other two actors. It is considered that betweenness centrality can reveal significant differences/variations among actors than degree-based centrality measures (Prell, 2012).

Closeness centrality was first addressed by Bavelas (1948) and is an important network centrality measure on distances from node to all other nodes. *Closeness centrality* can be thought of as distance score. A node's *closeness centrality* is the average length of the shortest path between the node and all the other nodes. *Closeness centrality* considers the entire network of ties when calculating the centrality score of an actor. The node which is closest to all other actors in a network in terms of the shortest average path would have the highest *closeness centrality* (Prell, 2012).

Degree centralities emphasize activity, *betweenness centrality* emphasizes potential control information flow, and *closeness centrality* emphasizes the independence of an actor (Prell, 2012). Degree, betweenness, and closeness centralities measure strictly binary relations between nodes (Bonacich, 2007). However, for *Eigenvector Centrality*, all connections are not equal. *Eigenvector* centrality takes into account the entire pattern in the network. It calculates a weighted sum of not only direct connections of an actor but indirect connections of every length in a network (Bonacich, 2007).

Eigenvector Centrality is a matrix computation that gives more weight to nodes if they are connected to influential actors in a network. This centrality measure considers not only the total number of adjacent nodes but also the importance of those adjacent nodes (Bihari and Pandia, 2015). Such as, a node with few ties may have a very high eigenvector centrality if those few ties are with nodes well-connected to others in the network.

Eigenvector centrality is the backbone technique of Google's Page Rank. For instance, if a webpage is linked to Wikipedia, that link is worth more than it is linked to a personal webpage.

3.5.2. Actor Level Analysis in Ego Networks

Ego network analysis is also called actor-centered analysis. The single node is the focus of attention in ego network analysis. Ego networks consist of a focal actor (called ego) and all other nodes to whom the ego is directly connected. The other nodes to whom the ego is connected are also called *alters* (Prell, 2012)**.** Researchers of ego networks ask the question of *"What is the purpose of this node in the network?"*.

The relations between "*alters*" is an important aspect of ego network analysis, even though many studies are conducted without considering the relations between alters. Still, in that case, the analysis would be just a list or count of alters (Frantz, 2017).

The dimensions used in ego network analysis include; the size of the ego network (how many alters an ego has), *the density of the ego network*, *the strength of ties connecting the ego and the alters*, and *structural holes*.

Structural Holes

Structural holes in social networks exist when there is no direct tie between nodes. Structural holes theory explains how this lack of ties creates benefits to some nodes in a network (Burt, 1992). The betweenness centrality discussed previously has the same idea as structural holes; the focus is on the actor's rests between two disconnected actors. However, the betweenness centrality considers the whole network, whereas structural holes consider an actor's ego network; thus, having a high betweenness centrality score does not mean an actor's structural holes score would be high as well (Prell, 2012).

There is a vast literature on structural holes. A significant benefit of structural holes is the access to diverse information (Burt, 1992), and empirical studies have proved that structural holes in a firm's ego network improve its knowledge creation (Phelps, 2010).

3.5.3. Network Level Analysis

The network level is also called the entire network or global network. Network level analysis considers all nodes in the environment and studies the entire set of actors and ties.

The structural network properties such as *size*, *density*, *centralization*, *connectivity*, and *distance* are significant for social network analysis because these properties help us to understand the roles of an entire set of nodes within the network.

Network Size

Network size is the most straightforward structural property of a social network and measures the total number of nodes in the network. It is an important structural property that reflects the network's boundary and helps us understand what resources are exchanged between actors in explaining what is happening in the network.

Network Density

The density of a network is the ratio of the number of direct ties to the total number of possible ties.

E is the number of observed (direct) ties in the network, and N is the network size. As seen from the formula, network density is directly linked to the network size. If the network gets larger, the density of the network will drop. On the other hand, if this number is close to 1, this indicates that the network is well connected, and all possible connections are present.

For undirected networks, the network density formula is:

$$D = \frac{2E}{N\,(N-1)}, \qquad \textit{Equation } 1:$$

For directed networks, the network density formula is:

$$D = \frac{E}{N\,(N-1)}, \qquad \textit{Equation } 2:$$

Network Connectivity

The degree of connectivity is one of the defining features of networks. Going from a network with low connectivity to high connectivity is not just a quantitative change in the number of edges in the network but also a qualitative change. Because it shows a change from a component-based system to a relational-based one. Basically, connectivity tells us how difficult for a node in the network to connect to other nodes.

Network Centralization

The relations are more focused on more centralized networks. However, this is different from the property of network density which measures the presence of relations and is not focused on actors. In other words, a network can be dense but have low centralization with many relations spread evenly across the network's actors and vice versa, with few relations that are concentrated on a small set of actors.

Network Distance

This property shows how far actors are from one another. Network distance indicates how well resources can move from one part of the network to another. When this value is small, this indicates that there is a cohesive network. Conversely, when this value is high, the network likely has little cohesion, thereby making it difficult for resources to move from one part of the network to another.

3.6. Longitudinal Social Network Analysis and Evolving Networks

Longitudinal Social Network Analysis

Longitudinal network data is now more accessible than ever, and many researchers across different disciplines show great interest in how networks evolve over time. Scholars doing longitudinal network research try to understand the mechanisms under network formation, development, and evolution over time (Uddin et al., 2017).

Longitudinal research is conducted for an extended period of time and may be applied to quantitative, qualitative, or mixed methods**.** Longitudinal studies are often compared with cross-sectional studies. Data are collected for at least two different time points in longitudinal studies. In contrast, data are collected for a distinct moment or a short period of time for cross-sectional studies (Thietart, 2001). Even though the data collection process is time-consuming, there are many benefits of longitudinal studies. The most crucial benefit of longitudinal studies is for researchers to detect changes and developments in the population. Longitudinal studies provide high levels of validity; however, rules and objectives should be well established in longitudinal studies.

Evolving Networks

All real-world networks are dynamic and evolve over time, either by adding or removing nodes or ties. Understanding the evolution of social networks is an attractive topic.

Some studies on inter-organizational network evolution focused on the actor and tie characteristics of networks at ego-network and whole network level (Ahuja et al., 2012). Others have studied the role of the firm's strategic actions and environmental context as causes of inter-organizational network evolution (Gulati et al., 2000).

Inter-organizational network evolution can affect the behavior and performance of firms; thus, further understanding and development of the nature and causes of inter-organizational network evolution is a topic of scientific and practical value (Ahuja et al., 2012).

3.7. Inter-organizational Network Literature

Network research in management studies also increased exponentially over the last few decades. Especially since the 1990s, a large number of empirical studies have been produced on a wide variety of topics in the field of inter-organizational relations and networks (Raab, 2018), including network studies on alliances (Gulati, 1998, 1999; Dyer et al., 2008).

Many researchers also reviewed and classified what has been done in the inter-organizational network field (Borgatti and Foster, 2003; Bergenholtz and Waldstrøm, 2011). The studies on inter-organizational networks are so fragmented that it is impossible to present the main findings of the research's vast body (Bergenholtz and Waldstrøm, 2011).

If we look at which subjects the studies generally focus on periodically, it can be listed as follows. In the late 1980s and early 1990s, scholars focused primarily on defining networks' properties (Raab, 2018). The early studies on inter-organizational network research also covered the examination of the benefits of relations between organizations.

These early studies initially tried to explain inter-organizational networks' mechanisms with traditional perspectives such as resource dependency theory (Zaheer et al., 2010).

Especially before the network perspective has been developed, many theories have been used in inter-organizational network studies. The network approach posits that firms access resources and capabilities through their networks of interfirm linkages.

Even though the different theories used in inter-organizational network research have different domains of interest, these theories overlap. For example, the social capital theory emphasizes power and control; the relational view emphasizes trust, but these two theories argue that networks provide access to resources and capabilities outside the organization (Zaheer et al., 2010).

In the field of inter-organizational research, "*networks*" are studied at different levels, such as whole networks, ego networks, sub-groups (cliques), interlocks, and strictly dyadic relations. In one extreme, some studies focus on networks as a whole. At the other end, some studies only focus on the two companies' dyadic relationship and interim levels in between (Bergenholtz and Waldstrøm, 2011).

Zaheer et al. (2010) categorized organizational research literature on social networks based on theoretical mechanisms and identified four mechanisms and three levels of analysis; *networks as resource access*, *networks as a source of trust*, *networks as tools of power, and control*, *networks as signaling mechanisms*.

Network studies cover multiple levels of analysis by nature, and most research in the field can be classified based on the level of analysis. The difference between an organizational and individual level of analysis also constitutes a relevant distinction.

Through the assistance of network theory and software tools such as UCINET, GEPHI, NETWORKX, SNA helps researchers and practitioners portray various relationships, including knowledge transfer, learning, trust, communication, and collaboration mathematically and visually (Taylor and Levitt, 2004).

3.8. A Brief History of Social Network Analysis Research

Modeling and analysis of social systems are achieved through Social Network Analysis (SNA). It cannot be claimed that SNA was created and developed by a discipline, but it has developed through interactions of many disciplines, sub-disciplines, or unique research groups. As a result, it has become a discipline of its own (Prell, 2012).

Contributions of scientists from different disciplines to social network analysis and how this field has developed over the years are briefly summarized below.

In his seminal book on the development of SNA, Linton C. Freeman (2004) reviews the history of SNA and divides the chronicle into four parts; (1) Prehistoric Era (until the end of the 1920s); (2) The 1930s; (3) Dark Ages (between 1940 to1969); and (4) Modern era (the renaissance in Harvard). Freeman states that even though the socio-environmental perspective dated back to ancient times, the application of SNA has its roots in Moreno's (1934) study on group dynamics.

Jacob Moreno, a psychiatrist, got acquainted with Gestalt Psychology through his studies. Gestalt psychology was established as a reaction to behaviorist theories that emphasize an individual's perception. German psychologists Marx Wertheimer, Wolfgang Köhler, and Kurt Koffka (Prell, 2012) developed this subfield of psychology. They defended the idea as stated in Prell's (2012) book "*human perception could be best understood in the context of a larger structure of the human mind."* Moreno's (1934) study on group dynamics explored how social relations influence psychological health. Moreno and his colleague Helen Jennings developed *"sociometry*," a technique to quantitatively measure and graphically represent social relationships. In sociometry, individuals were represented by points, and the relationships between individuals were represented by lines. Moreno and Jennings had mapped the social network with this technique and made abstract social structure tangible (Borgatti et al., 2009).

However, sociometry began to lose its popularity among scholars because when the network expands to a certain size, it was getting challenging to discover purposeful patterns in sociograms. Thus, scholars had started to work on matrices as an alternative to sociograms. Forsyth and Katz (1946) were the first ones who used matrices to organize sociograms, but their matrices had only graphic value. The data they entered into their matrix could not lead them to do any statistical manipulation. In 1949, social psychologist Leon Festinger accomplished using algebra with matrices to formalize socio-psychological concepts such as connecting actors and the presence of cliques (Prell, 2012).

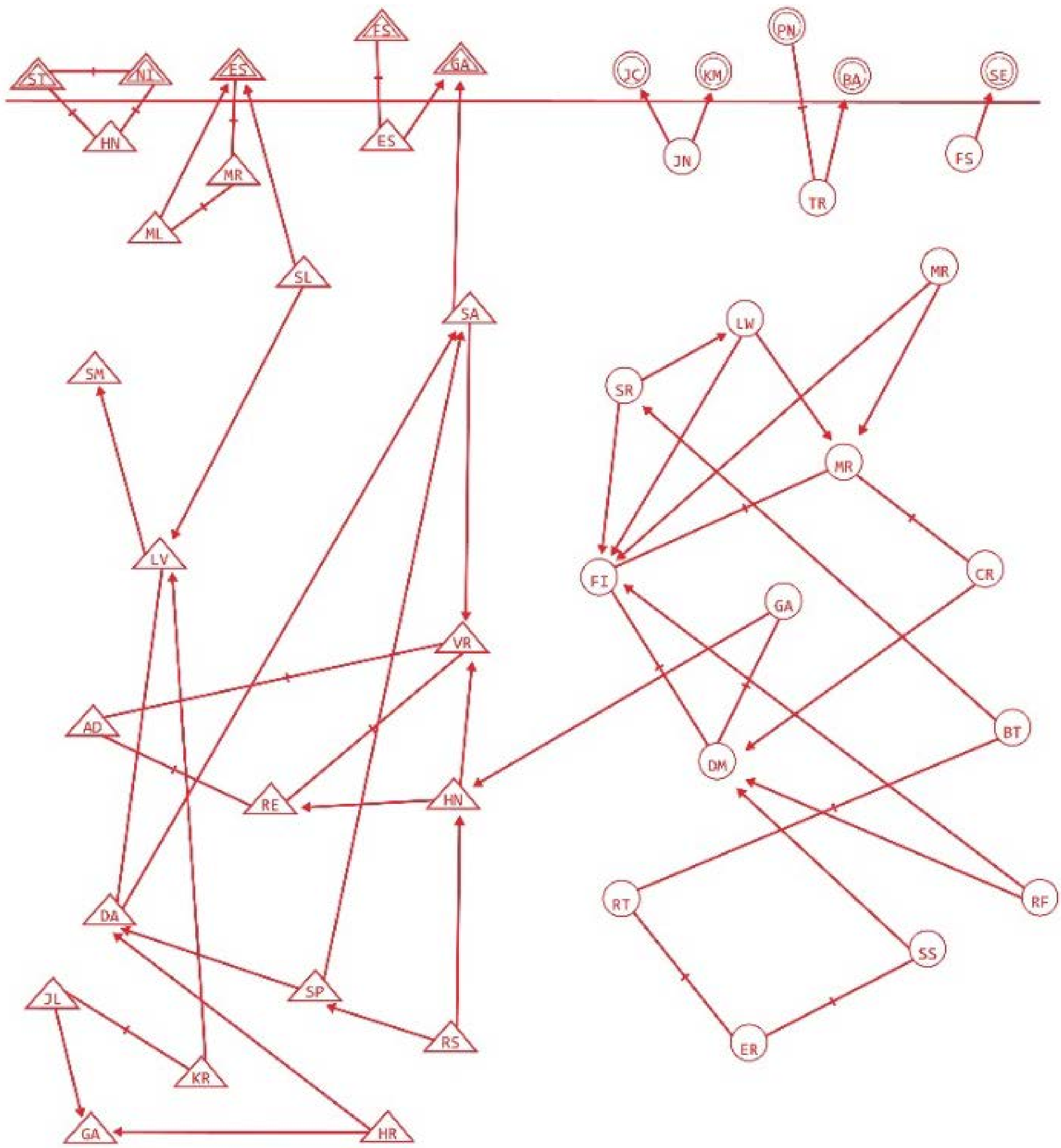

Figure 6: Social Network Map by Moreno (1934). A class structure of 5th grade. Girls are represented with circles and boys with triangles. Links show two best friends, and the top line defines group border.

In 1953, social psychologists Harary and Norman were the first among scholars who considered graph theory, a subfield of mathematics, could be utilized in social sciences, especially in social networks. Consequently, sociometry opened the way for more formal approaches in the 1940s and 1950s. Researchers began to translate sociological concepts into mathematical forms using graph theory and matrix algebra (Prell, 2012; Borgatti et al., 2009).

A psychologist Kurt Lewin grew a structural perspective and studied social network research. This group of researchers, with Lewin called the Lewin Group, moved to MIT in 1945 (Freeman, 2011).

In 1948, Alex Bavelas attempted to describe some of the group structures in his article titled *"A Mathematical Model for Group Structures."* In this article, Bavelas's objective was *"to define a possible geometry for dealing with psychological space"* (Bavelas, 1948). During the 1950s, Alex Bavelas conducted experiments assuming that communication structure can affect the performance of small groups due to the speed and efficiency of the information flow. During these experiments, Bavelas found that problems were solved better within more centralized communication structures than decentralized structures for uncomplicated tasks. These experiments led him to reveal "*centrality*" as an important concept of network analysis. Today, centrality remains one of the most fundamental concepts of network analysis (Prell, 2012; Ofem et al., 2013).

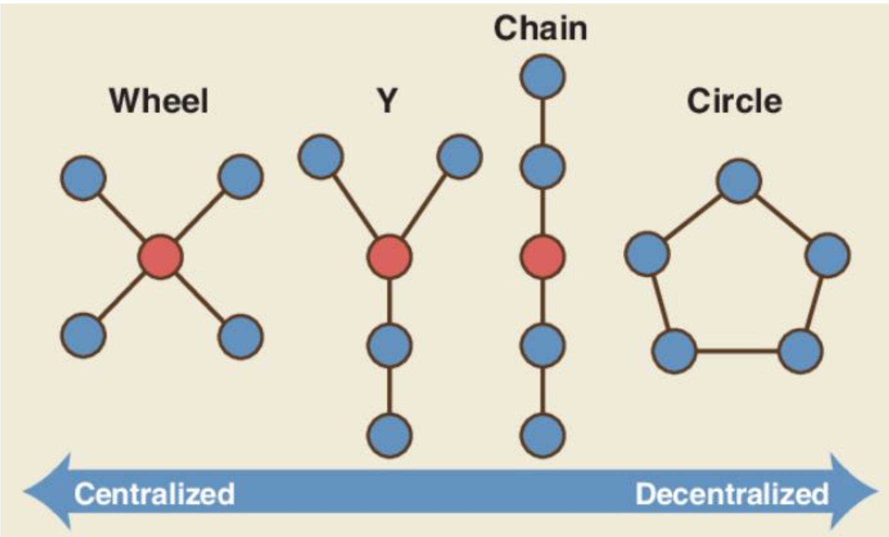

Figure 7: Network Structures by Bavelas. Figure by Borgatti et al. (2009). "Four network structures examined by Bavelas. Each node represents a person; each line represents a potential channel for interpersonal communication. The most central node in each network is colored red."

In 1967, social psychologist Stanley Milgram conducted an experiment to study the direct and indirect communication network patterns among unrelated individuals in a large environment. Known as the *"Small World Method,"* if two persons are randomly selected from a population, what are the chances to know each other, or broadly, how many iterations are necessary from one individual to a specific individual? Milgram found that an average of 5.6 steps is needed to connect a random person to a specific person. This experiment was replicated in different settings and always found around 6 steps. This created the concept of *"six degrees of separation,"* every person would be connected to another person on earth no more than six steps (Scott and Lewis, 2017; Borgatti et al., 2009).

Anthropologists also started to study network perspective in the 1960s. Their influence was Radcliffe Brown's 1957 book called *Natural Science of Society*. In this book, Brown stated that there needs to be a better measurement of relations so that *''relational analysis,''* a new kind of mathematics, would help identify systems (Prell, 2012).

Linton C. Freeman (2004) states that the modern era of SNA begins with Harrison White in 1963. With his diverse background in mathematics, physics, and sociology, White developed new mathematical techniques to discover structures in social relations. White had transformed the social network analysis into a research program by combining and strengthening the previous social network studies (Prell, 2012).

American Sociologist Mark Granovetter, a student of White, during his Ph.D., became interested in the question of *"how people find jobs?"*. He studied networks of several hundred workers. He discovered that most workers find jobs through their contacts, not through ads, and these contacts were not close friends but acquaintances. Granovetter underlined the phenomenon *"strength of weak ties,"* suggesting that one's close associates, strong ties, tend to know each other and make information redundant. In contrast, weak interpersonal relationships provide rich and innovative informational support. His article *"The strength of weak ties"* was published in 1973, and today it is still one of the most cited scientific articles. Twenty years after, his work became the general theory of social capital (Scott and Lewis, 2017; Borgatti et al., 2009)

Philip Bonacich is another important contributor to SNA. His studies on centrality measures are the most recognized contributions to SNA. Bonacich developed two measures for centrality, eigenvector centrality, and the second extension of eigenvector centrality, known as Bonacich power centrality measure (Prell, 2012).

Another contributor to SNA, Barry Wellman, researched community studies, social support, and computer. In 1977, he founded *International Network for Social Network Analysis* (INSNA), a professional association for researchers interested in social network analysis. After all these studies and developments, social network analysis became a recognized field.

The popularization of SNA has increased through social capital and small-world research and developments of stochastic models, and the use of computer simulation. Social capital gained much attention through Robert Putnam's books published in 1993 and 2001. Putnam's 2001 book revealed two distinct social capital; bridging social capital focuses on weak ties and open network structures, whereas bonding social capital focuses on strong ties and dense network structures.

The research on social capital is vast, and this stimulated a new generation of researchers into studying social networks through SNA. Besides social capital, "*small worlds*" research has also generated a great deal of interest in SNA (Milgram, 1967; Watts, 1999, 2003). Early research was empirical and focused on chains of acquaintances. Recent works through computer simulation focus on how networks *evolve and change over time*, giving rise to a small-world structure.

In the 1990s, network analysis spread over a wide range of fields, including physics, biology, public health, and information management (Borgatti et al., 2009). When the internet became accessible in the 1990s, especially for the fields of physics and biology large amount of structural data became accessible, and researchers were faced with data on very large networks. Researchers needed computational and intellectual instruments to deal with these data sets. So, they turned to the field of SNA to solve these problems, and of course, they contributed to the field by re-studying basic social network data sets, developing new tools to analyze social networks, and even producing new computer programs for SNA (Freeman, 2011).

Network studies provide explanations for countless phenomena from physical to social sciences. There is an increasing interest in networks not only in social sciences but in natural sciences as well. Specifically, network research in physics and biology is growing faster than any of the fields since the late 1990s (Borgatti and Halgin, 2011). Major fields of natural sciences such as physics, biology, engineering, and genetics focused on networks to explain the structure of relationships.

CHAPTER 4

Network Theory

4.1. Key Concepts in Network Theory

This study will look into two well-known theories of the social networks in detail; Granovetter's *strength of weak ties theory* (1973) and Burt's *structural holes theory* (1992). These two theories are closely related. In order to explain these theoretical approaches of social networks, the first three concepts from network theory need to be comprehended; *strong and weak ties, triadic closure,* and *local bridges*.

4.1.1. Strong and Weak Ties

In a social network, some ties are stronger, while some ties are weaker. Granovetter (1973) defines the strength of a personal tie as a "*combination of the amount of time, the emotional intensity, the intimacy, and the reciprocal services which characterize the tie*." Based on this definition, in order to characterize a tie as a strong tie, there needs to be a more frequent interaction, more emotional influence, more trust, and more information shared by two actors.

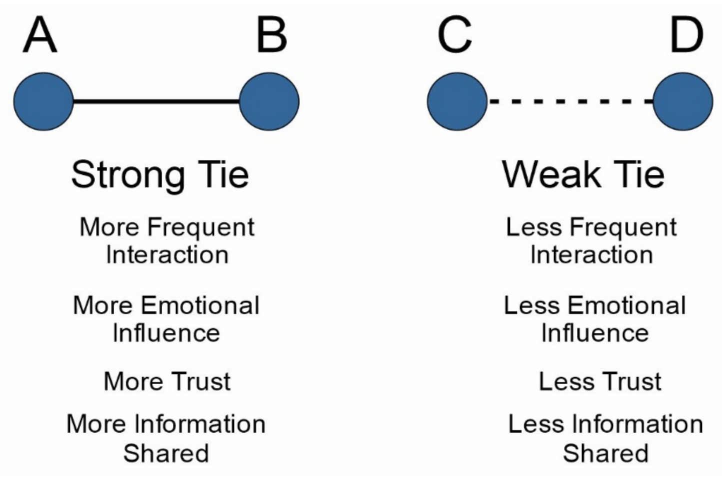

Figure 8: Strong vs. Weak Ties based on Granovetter's (1973) Study.

4.1.2. Triadic Closure - "The Forbidden Triad" Granovetter (1973)

Assume there are three nodes in a network: A, B, and C. There is a strong tie between A and B and between A and C, but the tie between B and C is absent. However, all three nodes have edges connecting each other as a triangular shape in the network. Triadic closure claims that since A-B and A-C have strong ties, it is more likely that B and C have at least a weak tie, as illustrated in Figure 9.

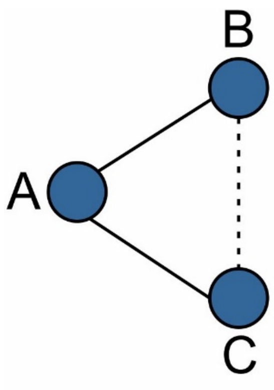

Figure 9: Triadic Closure by Granovetter (1973).

There are many reasons triadic closure happens. One reason B and C are more likely to become friends is that since A spends considerable time with both B and C, so there is a good chance that B and C will meet and become friends. The second reason is that A creates a basis for B and C for trusting each other, unlike disconnected people might not have. The third reason is that if strong ties exist between A and B, and A and C, that means B and C are similar to A and similar to each other; thus, there is a good chance for them to be friends when they meet.

4.1.3. Local Bridges

A bridge is an edge in a network that connects two parts of a network; otherwise would be entirely disconnected. Assume, A is tightly linked to C, D, E, and F. However, A is reaching a different part of the network with its link to B. So, the tie joining A and B is a bridge. Removing the tie from A to B disconnects the network. Bridges are rare in real social networks. A strong tie cannot be a bridge; all bridges are weak ties (Granovetter, 1973).

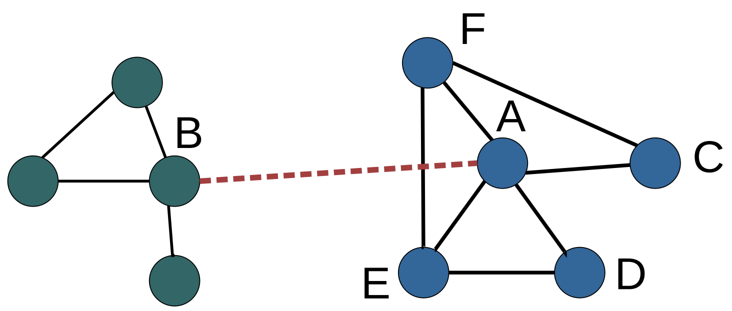

Figure 10: Bridging Ties. Bridging Tie from A to B (Removing the tie from A to B disconnects the network)

A local bridge is an edge that connects parts of the network; otherwise would be very distant from each other. An edge is a local bridge if the nodes at its endpoints have no friends in common. The below figure shows that the tie between A and B is a local bridge because A and B share no friends in common. However, even if the tie between A and B would not exist or be removed, A and B would still be connected but with a longer path through nodes F, G, and H.

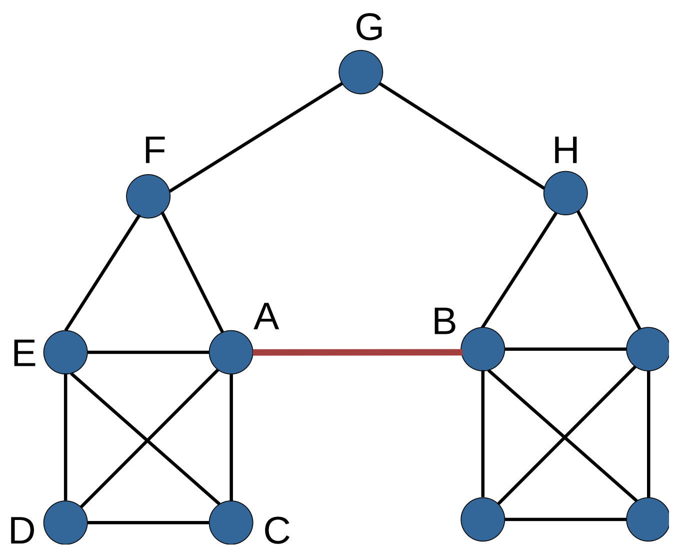

Figure 11: Local Bridge. The tie between A and B, removing the tie from A to B increases the path in the network.

4.2. Key Theories in Social Network Research

There are significant differences between traditional social science inquiry and social network theory. In order to foresee outcomes, the traditional perspective of social science inquiry focus on attributes of entities. Traditional sociological inquiry defends the basic assumption that *"social behavior is a sum of individuals' behaviors."* Unlike traditional social inquiry, social network research does not examine the behaviors of individuals but investigates patterns of relationships between actors (Emirbayer and Goodwin, 1994).

Even though network studies are popular, network theories such as Granovetter's (1985) *social embeddedness theory* and Burt's (1992) *structural holes theory* are exceptionally well known; still, there is significant confusion about network theory formulation (Borgatti and Halgin, 2011). For instance, Salancik (1985), for his review of the structural holes theory of Burt (1992), defends the idea that SNA is just a tool to analyze data about organizations, and theory is borrowed from other fields, especially from organizational theory. On the other hand, Hammond and Glen (2004) classified social network studies under complexity theory since researchers try to explain the nonlinear behavior of living systems by examining interactions between nodes.

This thesis will look into two well-known theories of social networks in detail; Granovetter's (1973) *strength of weak ties theory* and Burt's (1992) *structural holes theory.*

4.2.1. Strength of Weak Ties

Granovetter (1973) defends that there is a weakness in sociological theory that did not explain the relationship between micro-level interactions and macro-level patterns. Micro-level interactions are the smallest units in society, such as interpersonal relationships, whereas the macro level deals with how information flows in society and what causes social mobility. Granovetter believes small-scale interactions turn into large-scale patterns through networks. For his doctoral thesis, Granovetter's gathered data on how professional people use their networks to find new jobs. He categorizes interpersonal ties as strong, weak, or absent. Since stronger interpersonal ties require greater time commitments, he measured the strength of relationships (ties) through respondents' ratings on contact person; if someone they often met, occasionally or rarely. His findings showed that people find jobs, not through their close contacts but acquaintances. This finding led to a simple but important conclusion that information among close associates (strong ties) tends to be redundant since people tend to have stronger bonds with people like them. As a result, their social worlds overlap. However, a person can get new information through a weak tie (an acquaintance) that is not already flowing among his or her close associates. Thus, weak ties are local bridges that create more paths in the networks and tend to provide rich and diverse information. Of course, strong relationships are important and create many benefits in social life, however strong ties are not as advantageous as weak ties or weak relationships. Granovetter also defends that removing the average weak tie would do more damage to the flow of information than the average strong one in a network.

Granovetter (1973) applied this theory to the group level by asking the question of *"why some communities organize mutual goals easily and effectively whereas others seem unable to mobilize resources, even against dire threats?"*. He made the group-level analysis by examining two adjacent neighborhoods in Boston under the urban renewal program. The Italian neighborhood with very strong ties has been assimilated with the urban renewal program, whereas the adjacent neighborhood with scattered and very weak ties has not been assimilated. Granovetter (1973) claims that his case study demonstrates that communities with scattered and many weak ties can create group-level cohesions helping them mobilize resources to achieve common goals.

Granovetter (1973) ends his article by stating that linkage between micro-level interactions and macro-level patterns is important for developing sociological theory. He also suggests that network analysis would be valuable when developing micro and macro-level linkages.

4.2.2. Structural Holes Theory

Burt's (1992) *structural holes theory* is another well-known network theory. Both *strength of weak ties theory* and *structural holes theory* have a similar school of thought**.** However, the structural holes theory is different from the strength of weak ties theory developed by Granovetter (1973) because structural holes theory does not assess the strength of relationships between two nodes but concentrates on the lack of ties between two entities (Burt, 1992).

Structural holes in social networks exist when there is no direct tie between nodes. Structural holes theory explains how this lack of ties creates benefits to some nodes in a network (Burt, 1992).

Burt (1992) defines structural holes as "*the separation between nonredundant contacts. Nonredundant contacts are connected by a structural hole. A structural hole is a relationship of non-redundancy between two contacts. The hole is a buffer as an insulator in an electric circuit. As a result, the hole between them, the two contacts provide network benefits that are in some degree additive rather than overlapping*".

The theory of structural holes is concerned with ego networks—the cloud of nodes surrounding a given node, along with all the ties among them. Burt argues that if we compare nodes A and B in figure 12, the A's ego network is likely to provide novel information to A than B's ego network does for B. Consequently, A most probably perform better than B in a given setting, such as an employee in a firm. Both have the same number of ties, and we can assume that their ties have the same strength. However, because B's contacts are connected with each other, the information B gets from X may well be the same information B gets from Y. In contrast, A's ties connect to three different pools of information (represented by the circles in Figure 12). Burt (1992) argues that, as a result, A is likely to receive more nonredundant information at any given time than B, which in turn can provide A with the capability of performing better or being perceived as the source of new ideas.

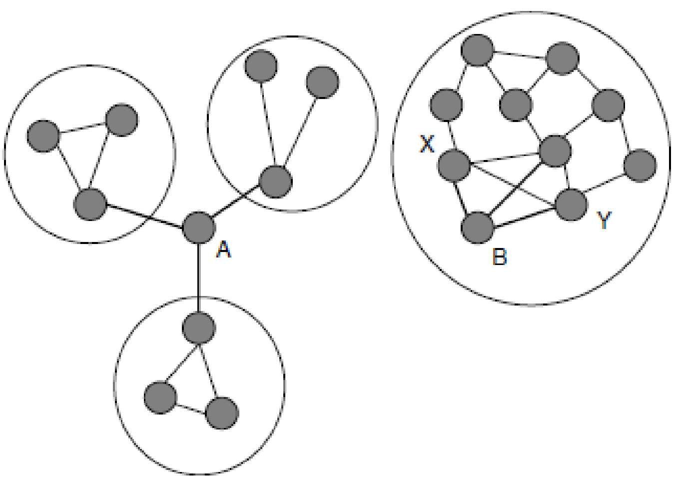

Figure 12: Ego Networks. *Node A's Ego Network Has More Structural Holes than B's*

No measure exists that can detect structural holes; instead, it is assumed that the ability to take advantage of a structural hole diminishes in proportion to the strength of direct and indirect connections between actors. It is unlikely a structural hole will emerge between actors who are similarly positioned in the network (structurally equivalent) and connected by a strong relationship.

4.3. Key Theories for Network Research in Economics and Organizational Studies

4.3.1. Social Embeddedness

Granovetter's (1985) social embeddedness theory has been an important step for the widespread use of social network methodology in economics and management. In his influential paper called *"Economic Action and Social Structure: The Problem of Embeddedness,"* Granovetter (1985) sought to find the middle ground between *"under-socialized"* and *"over-socialized"* explanations of economic action. He states that if we want to understand the cause of economic activity, we need to ask how our social relations affect our economic actions. He further adds that we need to consider the role of the social structure of our social relations because social relations are always present during economic action.

This view of economic action was not common at the time. Granovetter asserts that the explanations of economic action used at the time were at extreme ends, either under-socialized or over-socialized views. Classical and neoclassical economists defend that people follow their self-interest and their social relationships do not affect the economy; this is defined as an under-socialized view by Granovetter. Whereas sociological, or other words, over-socialized view defends that economic action is regulated by the "*norms and values of the people*" that have been observed from the larger society. Granovetter asserted that both perspectives share the *"atomistic actor"* view since they isolate economic actors and ignore social relationships. He supported Polanyi's (1944) view. He argued that people's economic activities are embedded in their networks of social relationships. In the framework of industrial civilization, what determines our economic behavior is the structure of our social relations.

In his paper, Granovetter (1985) additionally examined trust and malfeasance in economic relations. He stated that trust generation would be unable among people who share the under-socialized perspective since they defend economic action driven by people's own interests. On the other hand, under an over-socialized view, people would never take advantage of someone's trust because social forces would determine their behaviors. For Granovetter, these two explanations of trust and opportunism were not accurate. He defended that concrete social relations and structures generate trust and discourage opportunism.

Despite its originality and empirical competence, some authors opposed certain aspects of Granovetter's social embeddedness approach. Scholars criticized the theory as not being fully developed.

Friedland and Alford (1991) argue that the uncertainty about how social networks affect economic exchange remains in Gronavetter's study. Parallel to this criticism, Uzzi (1997) states that "*Granovetter's argument usefully explicates the differences between economic and sociological schemes of economic behavior but lacks its own concrete account of how social relations affect economic exchange*."

Barber (1995), on the other hand, comments on Granovetter's focus on interpersonal networks. He argues that elements such as cultural and political systems in which economic action is embedded are neglected in the study.

Criticism of Granovetter's view of social embeddedness enabled the concept to be further developed by other scholars. Uzzi (1996, 1997) studied 23 apparel firms in New York and investigated how embeddedness and network structure affect economic action. In his study, Uzzi first defined embeddedness as a *rich information exchange* and focused on sources and consequences of embeddedness. His findings in the study reveal that embedded relationships facilitate economic exchange through three mechanisms; trust, fine-grained information transfer, and joint problem-solving arrangements. He finds trust as the most critical factor and a unique governance mechanism as it increases firms' ability to access resources and solve unexpected problems. On the other hand, fine-grained information transfer increases know-how and reduces problems, in the end, helps accelerate the production process in partnerships. Joint problem-solving arrangements enable firms to solve problems and promote learning and innovation (Uzzi, 1996, 1997).

Scholars criticized Granovetter for a too narrow conception. It can similarly be argued that Uzzi's focus is relatively narrow, as it is based on network relations of firms and the logic of exchange. Scholars also have explored other social dimensions that affect economic action and have expanded the concept. Zukin and DiMaggio (1990) identified four types of embeddedness of economic action: *cognitive*, *cultural*, *political*, and *structural*. However, their dimensions of embeddedness have limited use in management studies.

While the original focus of network research was on understanding how the embeddedness of individuals influences their behavior, a similar argument has been extended to organizations (Gulati, 1998). Gulati identified two levels of embeddedness: *relational embeddedness* and *structural embeddedness*.

Relational embeddedness refers to direct (dyadic) ties between partners and investigates how these cohesive ties strengthen collaboration by providing trusted channels for knowledge and information (Gulati, 1998). The frequency and strength of ties between organizations increase relational embeddedness (Greve et al., 2010). Previous ties enable organizations to learn about each other's resources and reliability, reduce uncertainty, and create opportunities for stronger future collaborations(Gulati and Gargiulo, 1999). Prior ties also increase firms' ability to learn from alliances (Lane et al., 2001).

By contrast, *structural embeddedness*, or positional perspective of networks, considers the overall network structure and focuses on an organization's position occupied in a network (Gulati et al., 2011). Gulati (1998) states that "*information travels not only through proximate ties in networks but through the structure of the network itself.*"

In studies of management and economics, dominant research focuses on the structural dimension of embeddedness measured by ego networks (Burt, 1992; Krippner et al., 2004).

In the framework of strategic alliances, embeddedness has a strong impact on a firm's alliance decisions. Gulati (1998) states that a firm's embeddedness in social networks influences several alliancing decisions, such as forming new ties, the frequency to enter alliances, partner selection, type of governance system, and how the alliance would be developed and evolved over time.

4.3.2. Social Capital

Our success is determined by our personal characteristics, such as intelligence, determination, ambition, diligence, experience, etc. However, in addition to our personal characteristics, the value of the network we are in also determines our success. This value creation by the network is called social capital.

A French sociologist, Pierre Bourdieu, is the first one who made a systematic analysis of social capital. Bourdieu (1986) described social capital as "*the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition*."

Social capital often depends on the position we occupy in different social and professional networks. For instance, when a person occupies an advantageous position in a network, it is more likely that person would be more successful.

Social capital has been identified as a concept that can add value to the study of the inter-organizational network (Inkpen and Tsang, 2005). Social capital is an exciting and appropriate construct to study interfirm relations because it provides a way to characterize a firm's complete set of relationships. Furthermore, firms differ in the level of social capital they have, creating the pursuit of different alliance strategies and benefits (Koka and Prescott, 2002).

Empirical studies have identified social capital with some aspects of the firm's structural position. On the other hand, some researchers theoretically suggest that in addition to structural dimensions, social capital should include a relational dimension that is a function of repeated relationship dynamics between the partners.

Dimensions of Social Capital

Koka and Prescott (2002) proposed a three-dimensional model of social capital in terms of the information benefits available to a firm with its strategic alliances; *information volume*, *information diversity*, and *information richness*.

Koka and Prescott explain these dimensions as follows;

Social capital arises because of dense interactions between social actors. The *information volume* emphasizes the quantity of reliable information that a firm can access and acquire by its alliances. The focus is primarily on the number of partners a firm possesses and the number of ties with each partner. Alliance structures that embed the firm within a dense network of relationships provide significant social capital.

The *information diversity* dimension of social capital emphasizes the variety and, to a somewhat lesser extent, the quantity of information that a firm can access through its relationships. Here the focus is on partners' characteristics and relationships. Firms emphasizing this dimension avoid unnecessary contacts and have access to a wider range of information. Alliance structures with high diversity develop social capital by uniting different perspectives.

The *information richness* dimension of social capital emphasizes the quality and nature of the firm's information through its relationships. It focuses on both the firm’s overall alliance experiences and its history with current partners. Firms emphasizing this dimension have access to information that is filled with value, context, and meaning. Firms with considerable alliance experience are more likely to get access to richer information (Koka and Prescott, 2002).

4.4. Social Network Perspective at Interorganizational Level

Social networks of inter-organizational relations also took the attention of many researchers and became a trendy research area (Gulati, 1998; Parkhe et al., 2006). Especially the effect of social interactions on organizations and the adaptability of networks to industry, firm, group, and individual levels has attracted the attention of the business world and many researchers in this field.

How employees find positions (Granovetter, 1973), *how networks affect job performances of individuals and groups* (Sparrowe et al., 2001), *how networks impact human resource development* (Hatala, 2006), or *how trust impacts governance of networks* (Klijn et al., 2010) are the type of questions network studies tried to answer in the management field (Bergenholtz and Waldstrøm, 2011).

The trend of multiple alliances with multiple partners has embedded firms in complex webs of interfirm networks. Recognizing the complex interdependencies between firms, strategy researchers have moved from a dyadic level of analysis to a network level to understand the nature and effect of networks (Koka and Prescott, 2002).

Network research focused on social capital and social embeddedness to explain the nature and benefits to firms through these networks. Even though their origins are different, social capital and social embeddedness perspectives exhibit many similarities (Gulati et al., 2011). The *social embeddedness perspective* holds that the context of social relationships in which actors are embedded influences *organizational behavior* and *economic outcomes* (Granovetter, 1992). By contrast, the notion of *social capital* emphasizes the ability of some actors to *benefit from their positions* in particular *social structures* (Adler and Kwon, 2002).

CHAPTER 5

CONCEPTUAL MODEL

5.1. Key Terms in The Model

Alliance literature has used a wide range of terms and definitions for inter-organizational relationships. The key terms in the proposed model are summarized below.

5.1.1. Strategic Alliance

As a general explanation, Gulati (1998) defines strategic alliances as *"voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services."* This definition includes joint ventures, other equity alliances, and contractual agreements and refers to arrangements between two or more independent firms.

However, as mentioned earlier in the study, collaboration is somewhat different in project-based industries, especially in the construction industry. Therefore, this study defines strategic alliances as a formal cooperative agreement between two or more project-based organizations for a duration of a project and utilized as a key tool for a competitive position.

5.1.2. Alliance Network (Alliance Portfolio)

All strategic alliances of a focal company are defined as *alliance network* or *alliance portfolio* (Kale et al., 2009). Doz and Hamel (1998) use the term "*alliance portfolio*" to refer to a focal firm's set of dyadic alliances. Similarly, other scholars in the field describe an "*alliance portfolio*" as the entire set of (or the aggregate of) strategic alliances of a particular firm (Hoffmann and Schlosser, 2001; Kale et al., 2002). Similarly, this study defines an alliance portfolio as the aggregate of the focal firm's (dyadic and multi-partner) strategic alliances. In this research, the term "*alliance network*" refers to a focal firm's alliance portfolio unless stated differently.

5.1.3. Alliance Network Configuration

Most researchers have only studied dyadic ties, or individual alliances, as their unit of analysis (Anand and Khanna, 2000) rather than looking at the portfolio as a whole. A holistic analysis of a firm's complete set of alliances helps understand how firms configure their alliance networks.

In order to adopt a holistic focus, the focal actor needs to know how to configure its alliance network/portfolio (Hoffmann, 2007; Kale et al., 2009), but this still remains a problem for the majority of firms. Network/Portfolio configuration is a complex concept comprising multiple dimensions that attempt to cover an alliance network's content and arrangements (Wassmer, 2010). However, there is no consensus on what comprises the most important dimensions of the alliance network configuration. Most studies have focused on the structural dimension (network ties and size) and relational dimension (trust, norms, obligations, and identification) of individual networks (Wassmer, 2010). They paid less importance to the partners' dimension covering fundamental aspects such as the partners' technological or cultural characteristics (Goerzen and Beamish, 2005). Moreover, the existing literature focuses on portfolio configuration, particularly on independent dimensions, but these dimensions have not been studied simultaneously as interdependent dimensions.

Hoffman (2007) states that "*the configuration of a focal firm's alliance portfolio determines the quality, quantity, and diversity of information and resources to which it has access, the efficiency o fits access to network resources, and the flexibility or stability of the focal company's position in the inter-organizational field*."

5.1.4. Strategic Alliance Dimensions

Strategic alliance dimensions in this study will be studied under social embeddedness theory with a three-dimensional view. The dimensions will be held with the actor's network characteristics and the actor's attributes. The below figure shows the three-dimensional view of embeddedness and corresponding network characteristics and actor's attributes for each dimension.

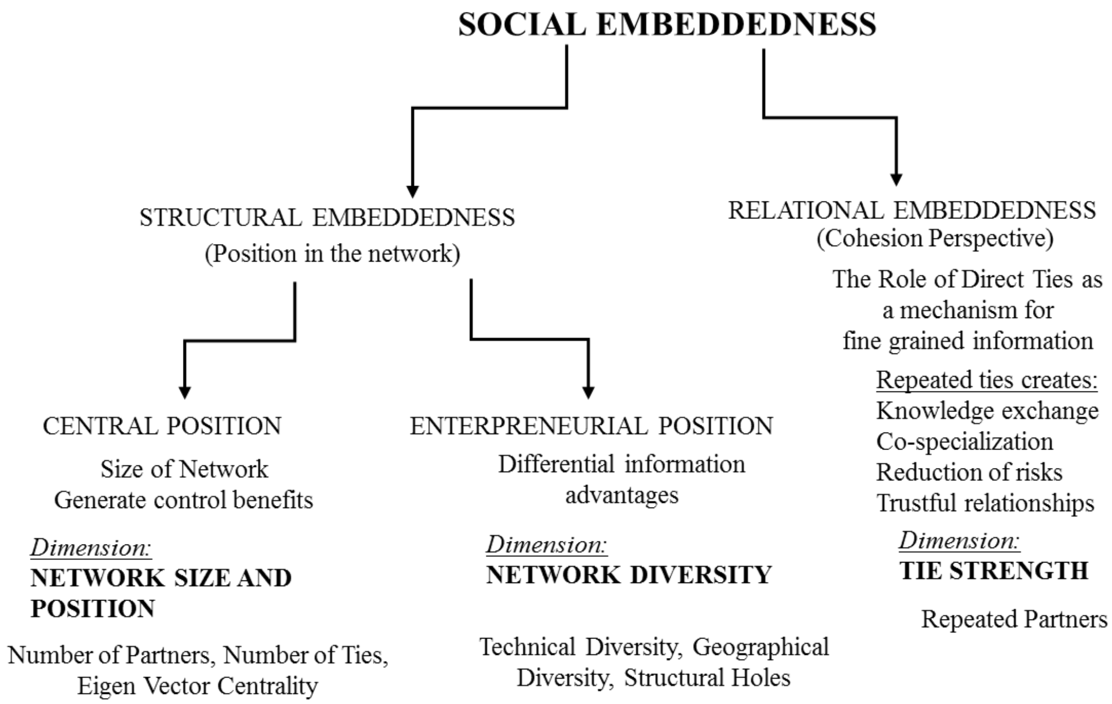

Figure 13: Three-Dimensional View of Social Embeddedness and Corresponding Network Characteristics and Attributes Used in the Proposed Model.

5.1.4.1. Actors' Network Characteristics

Network Size and Position - Number of Partners, Number of Ties, and Centrality Measures

Focal firm's network size and position dimension correspond closely to the network structural concept. The *number of partners* is the count number of partners a focal firm has. Whereas the *number of ties* is the count number of ties that particular firm has.

Centrality measures a node's importance in a network. A centrally located firm is generally well-positioned in a network with its direct ties (partners) and indirect ties with multiple firms. When a firm is centrally located in a network, it may reach many indirect ties through its direct ties and raise its informational access. A firm's direct ties enable the leverage of resources from its partners, while its position in the network, its centrality, indicates its reachability to external information sources (Soh and Roberts, 2005).

Studies on network analysis have introduced different centrality measures over the years to capture the notion of centralities such as *degree centrality*, *closeness* *centrality*, *betweenness centrality*, and *Eigenvector centrality*. Since the *Eigenvector centrality* measure considers not only the total number of adjacent nodes but also the importance of those adjacent nodes, this study suggests utilizing the *Eigenvector centrality* measure.

Network Diversity – Structural Holes

Structural holes are gaps in information flows between partners linked to the same network but not linked to each other and correspond to the network structural concept. *Structural holes* provide connections with so-called weak partners or unusual ties operating in different markets or technologies. Diverse and non-redundant information is the basis for efficiency. Thus, this concept explicitly focuses on the relationship patterns of the firm's partners.

Tie Strength – Repeated Partners

Repeated partners measure corresponds to the relational network concept. *Repeated partners* reflect the partners' satisfaction with their initial collaborative venture, leading them to form other alliances with the same partner to take advantage of their cooperative dynamics.

5.1.4.2. Actors' Attributes

Network Diversity – Geographical Diversity, Technical Diversity

The network diversity dimension of social embeddedness depends on the ego network structure of a firm (Koka and Prescott, 2002). Firms emphasizing diversity can have differential information advantages by establishing partnerships with firms having different technologies or engaging in project alliances of various types.

This study suggests utilizing geographical diversity and technical diversity measures to project-based alliances in order to represent the network diversity dimension.

Geographical Diversity measure could be calculated for each focal firm's different project locations. Blau's Diversity Index is suggested to calculate the geographic diversity.

Technical Diversity could be calculated based on fields of alliance activity of a focal firm. Blau's Diversity Index is suggested to calculate technical diversity.

5.2. Comparative Qualitative Analysis (QCA) – An Overview

Comparative qualitative analysis (QCA) is a research method that requires case-based knowledge and is mainly used in social sciences to evaluate *cause and effect relations*. In QCA, causes are called *conditions*, and the effect is called the *outcome*. QCA explores how the conditions that cause an outcome work together as a causal recipe.

Charles Ragin, an American sociologist, developed QCA as a method and technique in the 1980s. However, QCA got its roots from systematic comparative procedures originating in the natural sciences in the 18th and 19th centuries (Rihoux and Ragin 2009). Method of agreement which refers to "*eliminating all similarities but one,*" and method of difference which refers to "*absence of a common cause or effect, even all other circumstances are identical,*" is the most critical logical foundations of this method in early studies by Hume (1758) and J.S. Mill (1967), (Rihoux and Ragin, 2009).

These early systematic comparative methods had a positivist approach and were appropriate for hard sciences and often impossible to apply to social sciences. However, these early studies became important steps for eliminating irrelevant factors and false hypotheses and approximating causal conditions in the real world (Rihoux and Ragin, 2009).

Ragin (1997) states, QCA integrates " *the best features of the case-oriented approach with the best features of the variable-oriented approach*." The case-oriented approach is typical of qualitative research producing in-depth and rich descriptions of a few instances of a certain phenomenon (Della Porta and Keating, 2008). However, since case-oriented studies generally focus on a few cases, the generalization of findings is limited, and when these studies concern multiple cases, systematic comparison becomes problematic. On the contrary, the variable-oriented approach deals with large samples and systematic cross-case comparisons; however, quantitative research does not give detailed information about cases.

Therefore, QCA is useful for qualitative researchers looking for a more systematic way of comparing and evaluating cases and quantitative researchers who want to evaluate more complex facets of causation, such as how factors work together to create an outcome.

Table 3: Comparison of Research Methods by Stefan Verweij (2014)

Quantitative	QCA	Qualitative
Linear Causality	Complex causality	Holistic causality
Variable-based	Case-based and comparative	Case-based
Large N	Medium N	Small-N
Pattern Recognition	Between generality and complexity	High level of detail
Objectifying	Both – systematic and transparent comparison	Interpretive

QCA was initially used for macro-level analysis (such as countries and organizations) with a small number of cases but many variables (SmallN-ManyVariables). However, QCA is now applied to macro and micro (such as individuals) level studies. In QCA, each individual case is considered as a complex combination of properties; however, a specific whole should not be lost or obscured in the analysis. This is called the holistic approach. Since QCA has a holistic approach, it is considered more case-oriented than variable-oriented.

QCA is mainly used for the research with small and medium-size samples and populations (10-100 cases), but there are examples in the literature showing that it can also be used for larger groups as well (Sehring et al., 2013; Schneider and Wagemann, 2010).

Quantitative research is interested in generalization, whereas qualitative research is case-oriented and interested in complexity. However, QCA's systematic cross-case comparisons allow medium-range generalization without ignoring case complexity (Sehring et al., 2013).

5.2.1. Main Principles of QCA

Two main principles apply to QCA; (1) complex causality, (2) a combination of within-case analysis and cross-case comparison.

Complex Causality

How a particular outcome is produced is the central goal of QCA. It investigates how different combinations of factors affect a phenomenon and which group of cases share the combination of these factors. This approach is different from the regression type of analysis which measures the relationship between two or more quantitative variables.

QCA assumes a phenomenon contains complex causality. Complex causality means;

1. Factors that cause a phenomenon to occur interact and combine with each other.

2. Different combinations of factors can cause a particular event to occur.

3. Causal factors may have opposite effects depending on their combinations with other factors (Mahoney and Goertz, 2006).

QCA's sensitivity to causal complexity gives it an analytical advantage over many statistical data analysis techniques (Schneider and Wagemann, 2010).

A Combination of Within-Case Analysis and Cross-Case Comparison

Systematic cross-case comparisons help to identify causal paths of a phenomenon. QCA is a case-sensitive approach and takes the internal complexity of cases into account by allowing complex causations and counterfactual analysis. Cross-case comparisons without neglecting case complexity also enable medium-range generalization and theorizing (Sehring et al., 2013).

5.2.2. Necessary and Sufficient Conditions

In QCA, causes or factors are called *conditions*, and the effect, the phenomenon, is called the *outcome*. Conditions and outcomes are examined with cases. Identifying different combinations of factors is the central focus of a QCA study. All conditions affect the outcome; however, some conditions are more critical than others. The purpose of the QCA is to diagnose the conditions or combinations of conditions that are necessary or sufficient for the outcome. Some conditions are so critical that the outcome does not happen when they are absent. These conditions by themselves may not be sufficient to generate the outcome. However, the mix always contains those necessary conditions. In summary, if a condition does not exist, the outcome can not be generated, which means that condition is necessary.

Factors can be causally linked to an outcome as necessary or sufficient conditions, either by themselves or in combination (Sehring et al., 2013).

If "A" is a sufficient condition, "A" always leads to "X" (the outcome). Thus, whenever condition A is observed, outcome X is observed as well; condition A is a subset of outcome X (Figure 14). However, according to the logic of multiple causations, outcome X could also be the result of another condition or configuration without the presence of condition A.

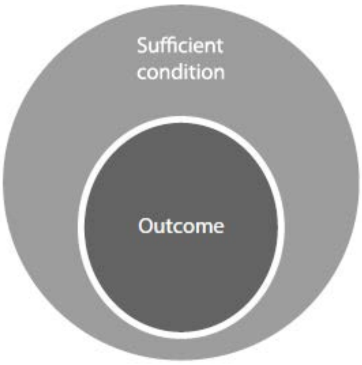

Figure 14: Venn diagram of sufficient conditions by Sehring et al. (2013)

In contrast, if “B” is a necessary condition, “B” has to occur for outcome “X” to occur; the outcome cannot happen without the condition. Therefore, the absence of condition “B” will lead to the absence of result “X” in any case.

However, this does not mean that when B occurs, X always occurs. According to the logic of conjunctural combination, B might have to be accompanied by another condition to be effective (Sehring et al., 2013).

Therefore, outcome X is a subset of condition B (See Figure 15). In other words, A always leads to X, but there can be X without A; B usually leads to X, but there can be B without X. Only if a condition is both necessary and sufficient will it always be observed in every case of the result and vice versa (Sehring et al., 2013).

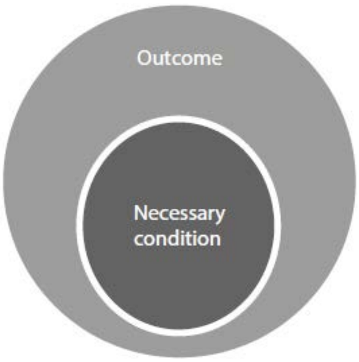

Figure 15: Venn diagram of necessary conditions by Sehring et al. (2013)

Certain conditions might be neither sufficient nor necessary but might nevertheless play a role in the outcome as part of a configuration. Such conditions can also be revealed with QCA. They are called INUS conditions. An INUS condition is an "*insufficient but necessary part of a configuration which is itself unnecessary but sufficient for the result.*" Thus, condition A may by itself be neither sufficient nor necessary but may, as part of a combination, have a causal effect. A SUIN-condition is a sufficient but unnecessary part of a configuration that is insufficient but necessary for the outcome (Schneider and Wagemann, 2012; Sehring et al., 2013).

5.2.3. Software

There are several software tools have been developed for the application of QCA. Tosmana and fsQCA are two well-known QCA applications. Tosmana is developed by Lasse Cronqvist (University of Trier, Germany), Charles Ragin developed fsQCA. (Irvine, California: Department of Sociology, University of California). Other QCA packages are provided as an add-on for mainstream statistical software, such as Rstudio and others.

Both software packages are capable of analyzing crisp and fuzzy data sets. However, in this study, fsQCA is preferred for better-formatted reporting and simplified used interface design.

Few steps have to be completed before feeding data to QCA application fsQCA. The list of steps applied by the study is covered in data processing section 7.6.

5.2.4. Research Process of a QCA Study

The general research process of a QCA study is summarized below.

Theoretical Knowledge

Theories and concepts about the topic of interest in the literature need to be well investigated and understood by the researcher since theoretical knowledge provides input for developing a research design. Theories also guide the selection of cases to add important, typical, and more controversial cases.

Research Design

QCA can be utilized for different purposes, such as testing a theory or developing a new theory by examining how conditions and outcomes related to each other. QCA studies explore conjunctional causation; in other words, it investigates how combinations of conditions produce the outcome.

The knowledge from the literature about the topic provides input for the design of the research. The research model with the causes and effects of the interest is the central part of a QCA research design.

Case Knowledge

The analytic part of QCA begins with building detailed knowledge about the cases. In-depth case knowledge is an essential part of the research process in QCA. This part of the research focuses on the case complexity.

Calibration

The process of designating set membership is called *calibration* (Schneider and Wagemann, 2012). In the calibration step, a QCA researcher should convert data into set membership scores and develop rules for calibration based on theoretical knowledge and empirical evidence (Sehring et al., 2013). Calibration is a critical step for QCA because, with proper calibration, data would be more relevant and purposeful. While crisp sets permit only full membership or non-membership, 0 or 1, fuzzy sets allow for degrees of membership scores. There are several ways to establish and implement calibration rules depending on the data. Calibration can also be performed by using QCA software.

Truth Table

The truth table is the core element in QCA, and the data is structured differently in truth tables. It gives binary scores, ones (1) or zeros (0), and shows the presence or absence of conditions that lead to the outcome. Ones (1) represent the presence of a condition and the outcome; zeros (0) represent the absence. The software handles the operations. The truth table rows show the possible configuration and the outcome. An example of a truth table is shown in the below figure.

		Conditions		Outcome
Cases	A	B	C	Y
X, Y, Z	1	0	1	1
M, N	0	0	1	0

Figure 16: An exemplary truth table

The truth table shows which set of cases share conditions and also share the outcome. These combinations can be regarded as the subset of and sufficient for the outcome. The sufficient combinations leading to the outcome have an outcome value of

"1". These sufficient rows will be included in the next step, the logical minimization. The data in the truth table also helps to identify necessary conditions for the outcome.

The exemplary truth table above shows that the row including cases X, Y, Z share the combinations of the presence of conditions A and C and the absence of condition B leading to outcome 1. This demonstrates that this combination is sufficient for the outcome. On the other hand, the row including cases M, N has the combinations of the absence of A and B, the presence of C, and the outcome is 0 (zero). Therefore this combination (absence of A and B, presence of C) is not sufficient for the outcome.

The truth table can have 2^n combinations; n is the number of conditions. If the table above is taken as an example, since there are three (3) conditions in the table, there can be eight (8) possible configurations. The number of cases in each row shows how many times that configuration occurs and what the outcome is.

The output of the truth table gives three levels of solutions; the complex, the intermediate, and parsimonious. However, the intermediate solution is usually recommended as the main focus to interpreting the results (Ragin, 2008).

Logical Minimization

Logical minimization produces the *minimal formula* by systematically comparing the sufficient combination of conditions in the truth table. In the pairwise comparison, the redundant conditions are eliminated. The remaining sufficient conditions are called the *prime implicants*. This comparison gives an overall sign of which conditions or a combination of conditions produce the outcome. In the formulas, conditions can be absent or present, and combinations of conditions can be absent or present, leading to the outcome. Some prime implicants also can be redundant; therefore, the redundant conditions are also eliminated, giving us the *minimal formula*. The below figure is an exemplary output of truth table analysis, the logical minimization.

Causal Recipe	Raw Coverage	Unique Coverage	Consistency
A*B	0.85	0.33	0.90
A*C*~D	0.59	0.21	0.95
Solution Coverage		0.87	
Solution Consistency		0.91	
The Minimal Formula		A*B + A*C*~D	

Figure 17: An Exemplary Output of the Logical Minimization

Here, the multiplication sign represents the logical "AND," " ~" represents the absence of a condition, and the "+" sign represents the logical "OR." A*B and A*C*~D are the causal recipes listed after the minimization process. These causal recipes are combinations of conditions that are sufficient paths to the outcome. The first column after the causal recipe is the raw coverage. It shows to what degree each recipe can explain the outcome. The unique coverage explains the proportion of cases that can be explained by exclusively that formula. Frequently there is considerable overlap between recipes, so it is usual for the unique coverage scores to be relatively low, most of the time below 0.15 level. The third column shows each recipe's consistency score. As Aversa et al. (2015) state, "*consistency refers to the extent to which cases featuring a given configuration consistently display the outcome of interest.*" Solution consistency at the bottom of the table shows the combined consistency of the minimal formulas. On the other hand, the solution coverage indicates how much of the outcome is covered by the entire solution. The higher the frequency threshold of cases, the lover the solution coverage (Schneider and Wagemann, 2012).

The minimal formula in the example shows the presence of conditions A and B OR the presence of conditions A and C, and the absence of condition B leads to the outcome, both sufficient conditions for the outcome.

The logical minimization process can be handled in various ways based on how *logical remainders* are treated. *Logical remainders* is another concept in QCA studies and occur due to the limited diversity of the conditions. A QCA researcher could use logical remainders in the minimization process, assuming the remainder configurations would have been sufficient for the outcome if they had occurred. The researcher can handle logical remainders in three ways;

(1) she or he can neglect the logical remainders and get the *complex solution*, but often this solution is too complex for interpretation,

(2) use logical remainders to get the most *parsimonious*, the simplest solution; however, this is also difficult to theoretically interpret because it may require theoretically unreasonable assumptions about how conditions relate to the outcome,

(3) use some remainders that are theoretically possible assumptions, and this would give the *intermediate solution* (Ragin, 2008).

Interpretation

Before interpreting the results, the researcher should examine the parameter of fit, consistency scores, and coverage scores. These parameters range from 0 (zero) to 1(one), and the higher values are better for the solution. These parameters are also discussed in the explanation of the minimization process. The configuration consistency of a minimum of 0.75 is suggested for crips sets and 0.80 for fuzzy sets. The frequency threshold is the minimum number of times a configuration has to occur, and by default, this value is set to 1 which means, QCA does not eliminate any cases feed into fsQCA. The researcher needs to select the frequency threshold based on the number of cases analyzed if the case size is large, the frequency should be increased.

Consistency and coverage concepts are needed to be understood by the researcher purposefully since these concepts provide the basis for interpreting the results. When interpreting the results, only the paths with equal to or above the consistency threshold level should be used. A consistency level below 1 (one) means that the sufficient pattern has one or more cases that do not represent the outcome. If the consistency score is below the threshold, there will be more cases that do not fit the results identified by QCA. Regarding the coverage score of causal patterns, a higher coverage score of a pattern among others indicates that more cases are covered by that solution pattern.

As mentioned, QCA produces three levels of solutions; the complex, the intermediate, and the parsimonious solutions. As the reasons explained above, results of the intermediate solution have been generally the focus of QCA studies (Ragin, 2008).

5.3. The Conceptual Model

This study proposes to use quantitative data in a case-based approach to study alliance network social phenomena in project-based industries. Directly applying quantitative data of large-size samples to a case-based method is difficult since case-based studies usually deal with a small number of cases with in-depth case knowledge. However, QCA, a comparative method to assess causation, is useful for quantitative researchers who want to evaluate more complex facets of causation at a level between generality and complexity.

The steps and the components of the proposed model are visualized in figure 18 below. In the next section, the purpose of each step, the explanations of the measures to be used, and the analysis techniques at each step in the proposed model are explained in detail.

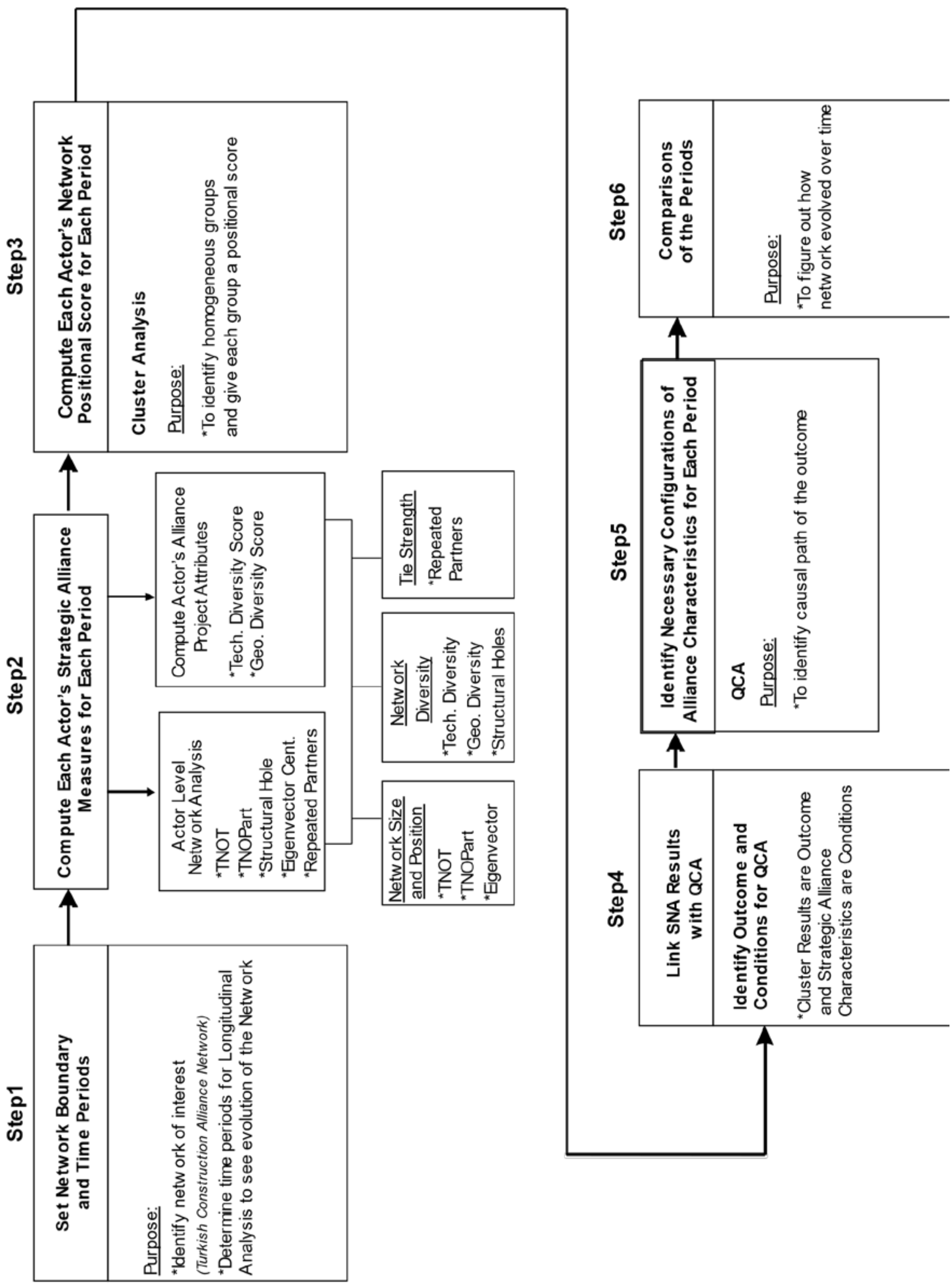

Figure 18: The Proposed Conceptual Model for Exploring Strategic Alliances in Project-Based Industries

5.3.1. Setting Network Boundary

Natural boundaries of networks do not exist most of the time; thus, network boundaries require a delicate study in the SNA. In a networked environment, criteria for boundary decisions should be set clearly. It must be ensured that sample companies have similar environments.

5.3.2. Setting Optimal Time Windows Size

Longitudinal network data is now more accessible than ever, and many researchers across different disciplines show great interest in how networks evolve over time. Scholars doing longitudinal network research try to understand the mechanisms under network formation, development, and evolution over time. They generally pay great attention to the design of their longitudinal studies; however, they usually pay less attention to their research's timing and spacing design (Uddin et al., 2017).

Uddin et al. (2017) define time window size in longitudinal studies as "*time interval between two snapshots.*" They also defend that window size selection in longitudinal studies is considered the center of the research. A poorly chosen window size can cause researchers to infer imprecise conclusions about the variables or hypotheses.

Determining the optimal window size for longitudinal network studies was researched by few scholars. No comprehensive and widely accepted approach has been found for longitudinal networks since SNA studies can be conducted at various actor-level perspectives (Uddin et al., 2017). Time window selection may be utilized before or after data collection.

Raymond et al. (2001) point out three characteristics to be considered while determining time intervals in longitudinal studies;

- the data need to be gathered for at least two distinct periods,
- the subjects are identical or at least comparable from one period to the next,
- the analysis consists of comparing data between two distinct time periods or retracing the observed evolution.

5.3.3. Data Collection

Data collection is a vital and very tough phase for network analysis and longitudinal research. A network researcher collects relational data and should be very careful about the way to collect the data. It is also essential to determine network boundaries, investigate industrial dynamics and carefully examine external factors before the data collection process.

The measures that will be used in such studies need to be determined before the data collection phase. For instance, the strength of ties is an important measure used in most network studies, and measuring the tie strength needs to be considered before the data collection phase.

5.3.4. Computing Each Actor's Strategic Alliance Measures for Each Period

This study developed several measures for structural and relational dimensions of embeddedness. A firm's strategic alliance measures are designed to be calculated under two categories; actor-level network analysis and actor's alliance project attributes. The measures used in the actor-level network analysis are network measures, whereas actor's alliance project attributes are non-network measures.

5.3.4.1. Actor-Level Network Analysis

This study identified three network measures to operationalize the *network size and position* dimension; *total number of partners, total number of ties,* and *eigenvector centrality*. *Structural holes* is a network measure and utilized to operationalize the *diversity measure*. The *tie strength* dimension is operationalized by utilizing another network measure, the *repeated partners*.

Total Number of Partners

The *Total Number of Partners* is the count number of partners a focal firm has for that particular period.

Total Number of Ties

The *Total Number of Ties* is the count number of ties a focal firm has for that particular period. These two measures indicate an actor's (focal firm) network size. The higher the values, the higher the network size.

Eigenvector Centrality

The *Eigenvector centrality* indicates the position of an actor in the network. A high Eigenvector centrality score indicates that an actor has a prominent position in the network with connections to the most influential actors. A network matrix showing the pair of ties needs to be used to calculate this measure using the UCINET 6 or other software programs.

Structural Holes

A firm can access a variety of information through its relations with other firms. Diversity also occurs because of the structure of a firm's ego network (Koka and Prescott, 2002).

Structural holes theory explains how lack of ties creates benefits to some nodes in a network (Burt, 1992). Redundant information is more likely to occur in tightly connected networks. This concept explicitly focuses on the relationship patterns of the firm's partners.

This measure is calculated by using the UCINET 6 or other SNA software.

Repeated Partners

Relational embeddedness perspectives on networks emphasize tie strength and the role of direct links between partners as a means to obtain fine-grained information (Gulati, 1998). Repeated partnerships reflect the partners' satisfaction with their initial collaborative venture, leading them to form other alliances with the same partner to take advantage of their cooperative dynamics. The application of the number of *repeated partners* is determined to represent the tie strength dimension by the study.

This measure will be calculated by using a five-year moving window in this study because the projects in the construction sector are completed in five years on average. For the samples used in this study, the average project duration is five years as well.

A focal firm's number of repeated partners in every five-year will be divided by the total number of partners in this five-year window. Then the repeated partnership proportions for two five-year windows will be summed up to find the repeated partner dimension.

While applying this model to other project-based industry studies, time windows can be revised considering the average project durations.

5.3.4.2. Actor's Alliance Project Attributes

The *actor's alliance project attributes* are non-network measures and utilized to identify the underlying benefits of different dimensions of the social embeddedness concept.

Alliance project attributes are designed to be calculated based on the technical and geographic diversity of the actor's entire alliance projects in the specific periods examined. These two dimensions are utilized to operationalize the *network diversity* dimension.

5.3.4.2.1. Technical Diversity

Project-based sectors produce complex products and services, and technical competencies affect project performance.

When firms undertake different types of alliance projects with diverse technologies, their partners would probably be various with diverse backgrounds. Such ties encourage the integration of different perspectives. Moreover, diversification creates value and increases the performance of organizations (Miller, 2006).

Technical diversity can be calculated with different methods by dividing projects into categories. This study will use Blau's heterogeneity index to calculate this measure.

5.3.4.2.2. Geographic Diversity

Even though firms face coordination and communication difficulties when they operate projects in different geographies, the opportunities they get pay off these difficulties. Greater diversity is also crucial for inter-organizational collaborations.

Many scholars studied the advantages and disadvantages of diversity in collaborative networks and strategic alliances (Nepelski et al., 2019).

This measure will be calculated by this study based on the focal firm's variety of project locations. First, projects will be categorized under domestic and international projects. Afterward, the geographic region index for each country where Turkish contractors executed alliance projects will be determined. This study will use Blau's Diversity Index to calculate geographical diversity for each time period.

5.3.5. Computing Each Actor's Network Positional Score for Each Period

This study will use a clustering method to compute each actor's positional score in the network. First, each actor will be assigned to a cluster, and then each cluster will have a score. This process will be repeated for each time period. The k-means method is found to be an appropriate clustering technique for the proposed model in the study because it is easy to implement and creates effective results. The standard k-means algorithm is included in well-known software packages such as SPSS, Python, R statistical computing software. The features and application steps of the k-means clustering method are detailed below.

In general, clustering is a technique to group raw data into discrete sets so that data in the same group are similar, but data in different groups are dissimilar (Na et al., 2010). Here the idea is to minimize the distance between data points in a cluster and maximize the distance between clusters.

Clustering is a widely used technique in many areas such as artificial intelligence, data mining, image processing, psychology, marketing, biology, medicine, statistics, and so on (Kodinariya and Makwana, 2013). Different clustering methods have been proposed in the literature, such as k-means clustering and agglomerative hierarchical clustering. K-means is one of the most commonly used clustering methods because it is simple, fast, and practical. The method is also proved to give effective clustering results (Na et al., 2010). Moreover, many packages offer the implementation of k-means clustering.

K-means is an unsupervised algorithm. When applying k-means, the first step is to choose the number of clusters, and the "K" indicates the number of clusters. So at this point, the question is, what would be the optimum number of clusters in k-means clustering. As Kodinariya and Makwana (2013) stated, there are several approaches in the literature to determine the number of clusters for k-means clustering. However, this study will apply the most widely adopted criterion, the "elbow method."

The elbow method determines the true number of clusters in a data set. It is a visual method. The distance between points in a cluster is measured as the "sum of squares within clusters" (WCSS). If WCSS is minimized, then the perfect clustering solution will be reached. WCSS is wanted to be as low as possible but not one. It is a decreasing function which is lower for a bigger number of clusters. At some point, it reaches "the elbow," a significant decrease in WCSS.

The second step in k-means clustering is to specify the centroids. It will be chosen randomly or specified by the data scientist based on prior knowledge about the data. The centroids should be placed wisely because different locations may lead to different results. The third step is to associate each data point to the nearest centroid based on proximity. Euclidean distance is often used to determine the distance between each data point and cluster centers. When all data points are included in the clusters, the clustering and the early grouping would be finished. The fourth step is recalculating the centroids for early clustering. K-means is an iterative process and repeatedly continues until reach a situation no further changes are made. In other words, steps 2 and 3 will be repeated until the centroids no longer move (Na et al., 2010; Kodinariya and Makwana, 2013).

One of the cons of the k-means clustering method is being sensitive to initialization. The remedy for this con is to use k-means++. The idea is that a preliminary iterative algorithm is run before k-means to determine the most appropriate centroids for the cluster. Thus, this study will utilize the k-means++ algorithm.

K-means is also sensitive to outliers; if there is a single point that is too far away from the rest, it will always be placed its own one-point cluster. So removing the outliers before clustering will eliminate this issue.

5.3.6. Linking SNA Results with QCA (Using QCA in the Study)

Researchers combined SNA and QCA couple of ways in the literature. Fischer (2011) identified these combinations and summarized them. SNA can be used to identify an actor's position in the network. The actor's network position is then set as a condition in the QCA, along with other conditions that contribute to the outcome. In another alternative, the position of an actor can be used as an outcome. The third alternative is to use SNA tools both as conditions and as the outcome. The fourth alternative is to use

QCA to build network typologies, and the fifth one is to use the network to visualize QCA results.

This study suggests using quantitative network data of actors as dimensions for cluster analysis and as conditions in QCA. In other words, using SNA tools both as conditions and as the outcome.

The following measures are suggested to be used for cluster analysis; the total number of ties, the total number of partners, Eigenvector centrality, structure holes, technical diversity, geographical diversity, and repeated partners. Based on these measures, a clustering method, preferably Kmeans++, will be applied. Afterward, the clusters get values according to the levels of combined measures. The highest of these values is set to full membership, the weakest to low, and the others are set to intermediate values. These cluster values will be the outcomes in Qualitative Comparative Analysis (QCA), whereas measures will be conditions.

5.3.7. Comparisons of the Time Periods

After a systematic cross-case comparison via Qualitative Comparative Analysis (QCA), the configurations of outcome will be discovered for each time period. By comparing different configurations of different periods, researchers will reveal which combination of factors affects the outcome in these particular periods and realize how the network evolved over time.

CHAPTER 6

EMPIRICAL SETTINGS

6.1. Overview of the Construction Industry

The construction industry is considered one of the largest industries in the world and a pillar for economic development in many countries. Construction output grows at a higher rate when economies grow, which means it reaches a higher percentage of GDP (Wells, 1986). The construction industry's contribution to the global GDP has been around ten percent of the total amount (CIC's Global Construction Outlook to 2022 - Q4 2018 Update). The CIC's (Construction Intelligence Center) report points that contraction in the global economy deepens in 2018. However, the global economy is expected to expand in the range of 2.5% to 3% per year in 2018-2022 period, whereas the global construction industry will grow an average annual average rate of 3.4% in the same period (Global Construction Outlook to 2022 - Q4 2018 Update).

The impact of the construction sector on the world economy is tremendous. Many studies have pointed the critical contribution of the construction industry to national economic growth (Myers, 2013). Especially infrastructure projects support the socio-economic development in a country by generating economic activities that would provide services to households and industries. The availability of transport, electricity, safe water and sanitation, and other key facilities such as schools and hospitals, has a tremendous impact on improving the quality of life of households, particularly poor ones. Infrastructure services improve production, transportation, and transactions for businesses. These, in turn, stimulate growth, raise incomes, and reduce poverty (Asian Development Bank Report, 2012).

There are many arguments regarding the role of the construction industry in economic development. Many researchers and economists defend construction industry can be used to regulate the economy. Giang and Peng (2011) reviewed the studies that evaluated the construction sector's role in economic development in the past four decades. These studies showed a positive relationship between the construction industry and economic growth in developing countries. The studies also demonstrate that governments use construction investments as a tool to stabilize economies. This, in turn, confirms the industry's key position in the national development strategy. However, the relationship between the construction industry and economic growth in the developed countries is more complicated. Giang and Peng (2011) also state that if the construction industry expands beyond the adaptive capacity of the economy, this will result in a waste of national resources. The authors concluded their review by conveying that construction might affect the economy positively in the short term but counteract the real growth of the economy in the long term.

The construction market is segmented based on different kinds of products: residential, commercial, and industrial buildings, civil engineering structures and infrastructures, public works and repair, maintenance, and upgrading of existing facilities (Gann and Salter, 2000).

Competition in the construction industry is intense, and the risks are high. Regardless of the size and scope of any project, many stakeholders and disciplines are involved in the construction process. These include clients, designers, contractors, consultants, material manufacturers, and supporting industries.

On the other hand, cost-overruns, delays, inadequate corporation, disputes, customer dissatisfaction, and low productivity are considered as long-existing problems of the industry (Chen et al., 2012).

6.2. Overview of Turkish Construction Industry

When looking at the historical development of Turkey's construction industry, one of the most significant transformations and development has been in the 1980s when neoliberal policies, large-scale tourism and highway investments, investment incentives, privatizations, and build-operate-transfer projects came into force. During this period, large infrastructure projects, especially motorways and dams, were constructed in Turkey. These improvements led Turkish Contractors to gain important experiences they would use in their overseas projects in the following periods (Yagci, 2015).

Turkish contracting firms carrying out large-scale infrastructure projects in cooperation with foreign partners in the domestic market between 1985-2000 gained broad experience in production, project management, and relations with international financial institutions. 2010 is the period when large-scale infrastructure, superstructure, transportation, and highway investments are put into practice within the scope of megaprojects. Simultaneously, the number of countries that Turkish contractors have been doing business has increased significantly. Market diversity and specialization in specific project types have started the global branding period for Turkish construction firms. Turkish contractors now work both in infrastructure projects and in projects to develop superstructures, housing, and real estate. The majority of these projects are operated abroad and recognized globally (Yagci, 2015).

Turkish Contractors started their overseas activities in Libya in 1972. In the early 1990s, Turkish construction companies started to undertake projects in the Russian Federation and the Commonwealth of Independent States, CIS. In the new millennium, Turkish contractors increased the number of countries they work in tremendously. Their international projects shifted from relatively low value-added construction areas such as housing to high value-added construction such as industrial facilities airports. Their business orientation also turned from "*contracting*" to investors and business administrators by investing especially in real estate, such as accommodation facilities, trade centers, factories, and so on.

Today, Turkish Contractors have spread their activities throughout the world. By the end of March 2017, Turkish contractors have undertaken about 9000 projects in 115 countries with a total cost of 350 billion US dollars (Source: Turkish Contractors Association).

The geographies Turkish Contractors work most in foreign contracting are Central Asia, Russia, Middle East, Gulf Countries, and North Africa. The success of Turkish Contractors can be understood from various statistical data. For instance, 46 Turkish Contracting Companies are included in the 2018 ENR Top 250 Global Contractors List and 44 companies in the 2019 ENR list. For these two years, Turkish contractors ranked second after China (Source: www.enr.com, ENR ranks companies according to construction revenue generated outside of each company's home country)

However, the recent economic and social distortions in close geography have caused Turkish Contractors to lose overseas contracting market share. These changes have forced Turkish Contractors to seek new markets. Turkish Contractors have started to take an active role in Sub-Saharan African and Latin American markets in recent years. These new markets are relatively empty and have been seized by Chinese State Firms. Even though the opening to these new markets is a late move for the Turkish Contracting sector, important projects undertaken in recent years indicate that Turkish construction firms can increase their presence in these markets. A new incentive system is needed in this context. Although the incentives for overseas contracting services are inadequate, the Turkish Government aids technical consultancy firms more effectively by legislative amendments (Bora, 2015).

Considering the contribution of other sectors which provide inputs to the construction sector and whose activities continue in line with the developments in this sector, it was seen that the share of the construction sector in the GNP of Turkey was about 30 percent in 2017. The Turkish construction sector in 2017 was in a position to create demand for goods and services produced by more than 200 sub-sectors, and this widespread impact was the most basic indicator of the sector being "*locomotive of the economy*" (INTES Construction Sector Report, April 2017, pg1).

2018 was a challenging year for the global economy. Increased trade barriers, shrinking financial conditions, and the impact of ongoing geopolitical tensions adversely affected the markets. The expectation of a new crisis due to recession is rising globally (TMB Construction Sector Analysis, November 2019, pg1). In addition to these developments globally, rising inflation, shocks on the exchange rates, and fluctuations in interest rates caused a loss of acceleration in Turkey's growth. The Turkish construction sector, which has been the leading industry in the economy, was also affected quickly and deeply by the economic slowdown of the Turkish economy. The Turkish construction sector, which grew by 9.0% in 2017, decreased to 2.1% in 2018 (INTES Construction Sector Report, November 2019, pg5-6).

In 2019, Turkey adopted priority saving policies in public expenditures and policies to balance budget expenditures. Construction projects that have not been tendered and tendered but not started will be suspended. New and longer-term business plans will be developed for the ongoing projects with suitable financing conditions. In this context, in the first quarter of 2019, both the decrease in public expenditures and residential sales led to a negative sector performance (INTES Construction Sector Report, November 2019, pg7).

In the first quarter of 2019, the Turkish GDP shrunk by 2.4 %, while the construction sector showed a negative performance of 9.3 %. Despite the 1.5% contraction in the general economy in the second quarter, the construction sector contracted 12.7 % (INTES Construction Sector Report, November 2019, pg7). Based on the Ministry of Trade data, in the first nine months of 2019, Turkish contractors undertook projects worth 7.5 billion US $ worldwide. The contractors' amount of projects the previous year was 12.4 billion US $ for the same period. This situation shows that in addition to the domestic problems, the sector is facing increasing financing problems abroad and a decline in the global market share (TMB Construction Sector Analysis, November 2019, pg3).

Overall, construction activity in Turkey is undergoing a transformation due to changing lifestyles and needs. While the importance of urban transformation is increasing in the housing market, non-residential commercial buildings are structured around social needs. Public-funded large infrastructure and transformation projects and overseas contracting works also have an important share in the business volume of the sector in Turkey.

Major Problems in the Turkish Construction Industry

1. The Turkish Construction industry has a very high employment capacity. When direct and indirect effects of the construction industry on other sectors are considered, the construction sector's share in non-agricultural employment reaches 10%. As in every sector, the labor force is the key factor in maintaining the competitive power in the construction industry. Nevertheless, there is a serious, qualified intermediate labor vacancy in the Turkish construction sector since there is no strong relationship between educational institutions and corporations. Labor market statistics in Turkey show that a large number of occupational education graduates are unemployed. On the other hand, employers suffer from the financial burden and time lost because they are forced to provide in-service training without finding the workforce with the qualifications they are constantly looking for. The quality degradation observed in the education system leads to severe problems in creating and managing an efficient workforce. This situation is considered a severe threat to the competitiveness of the Turkish construction sector in the future (Yagci, 2015).

2. There is no minimum requirement for entry into the Turkish construction sector. This situation causes image erosion in the sector. Moreover, the large number of contractors causes business volumes to shrink. For this reason, determining the contracting criteria has great importance for the future of the industry. First of all, the definition of a Building Contractor should be established. The legal ground should be prepared for companies with insufficient technical and financial capacities. Defective business should be carried out from the sector (INTES Construction Sector Report, April 2017, pg47; TMB Gündem 2015, Problems and Solution Proposals, pg4).

3. Turkish consulting firms have not reached sufficient sizes. A new incentive system should be established to develop Overseas Contracting and Technical Consultancy Services (INTES Construction Sector Report, April 2017, pg49; TMB Gündem 2015, Problems and Solution Proposals, pg4).

4. R&D activities of Turkish construction firms are not satisfactory. Effective use of sustainable construction techniques and practices should be encouraged (INTES Construction Sector Report, April 2017, pg49; TMB Gündem 2015, Problems and Solution Proposals, pg4).

5. Extremely low proposals that cannot be resolved by the Public Procurement Legislation and its applications prevent sectoral profitability and, hence, capital accumulation (INTES Construction Sector Report, April 2017, pg49). The Public Procurement Law legislation should be rewritten to provide an economical, efficient, competitive, collective, and environmentally friendly, fair, transparent, and sustainable investment environment. Authorities and responsibilities of the Public Procurement Authority should be rearranged (TMB Gündem 2015, Problems and Solution Proposals, pg4).

6. The Public-Private-Partnership (PPP) investment model, which has extensive and different usage globally, has begun to pay attention to projects in Turkey's transportation, energy, and health sectors. Effective implementation of the Public-Private-Partnership (PPP) model should be ensured. The necessary legal infrastructure should be prepared for PPPs. Large Infrastructure Projects should be evaluated together with feasibility, environmental impact, and financing dimensions and tendered within a macro action plan. It is of utmost importance that the PPP projects, which can bring high efficiency and efficiency for the whole national economy, should be evaluated transparently and correctly during the procurement process (TMB Gündem 2015, Problems and Solution Proposals, pg4; Arslan, TMB Gündem 2015, pg16-17).

7. The urban infrastructure, the need for green space, the socio-cultural texture, and the residents' rights should be considered on a holistic basis for livable cities. Urbanization, reconstruction practices, and urban transformation legislations should be handled meticulously (TMB Gündem 2015, Problems and Solution Proposals, pg4).

8. The competitiveness of each market can be changed according to the country where it is located. However, in general, Chinese and Indian firms are the most significant competitors of Turkish contractors since construction firms of these countries get significant financing support from their states. Problems encountered in providing a

guarantee letter for overseas contracting services and heavy taxes on employment abroad limit Turkish construction firms' ability to compete (INTES Construction Sector Report, April 2017, pg47).

9. The most significant competitors of our Turkish contractors can also be Turkish contractors in the overseas construction markets. The entry of many Turkish companies into international tenders leads to excessive price reductions, which sometimes causes unfinished work with the quoted prices. This situation causes the loss of Turkish contractors' reputation (INTES Construction Sector Report, April 2017, pg47).

10. High labor costs, weak financing structure, contract and risk management issues, bureaucratic challenges, lack of private or state funding behind the sector, limited insurance opportunities, and low government support are the other problems the Turkish construction sector faces today (INTES Construction Sector Report, April 2017, pg48).

6.3. Strategic Alliances in the Construction Industry

Globalization is presumed the most crucial rationale behind forming alliances for most industries. Globalization intensified in the late 1980s with the development of economically accessible global transportation and telecommunication systems that removed barriers to access information and new markets worldwide. With globalization, competition increased drastically, and firms started to evaluate their business methods in this competitive environment. Like in other industries, collaboration became one of the most attractive approaches for the construction industry to conquer the challenges of fierce competition caused by globalization (Sillars and Kangari, 1997).

On the other hand, low productivity, delays, disputes, exceeding budgets are considered numerous ongoing problems in the construction sector (Chen et al., 2012). Many CPM scholars and practitioners in the sector agree that alliancing is one of the most prominent methods to overcome sectors' problems and increase efficiency. Alliancing has also been seen as a suitable method for delivering especially complex, risky, and tight timeframe projects (Ngowi, 2007; Chen et al., 2012).

Alliances are generally defined as inter-organizational collaboration in business management, and two broad types are described based on the duration of the collaboration; strategic alliances and project alliances (Rowlinson et al., 2006). "*Project alliancing*" is also referred to as a collaborative project delivery method between the client and one or more service providers in project-based industries. Generally, project alliances are vertical, non-equity partnerships to share risks and responsibilities for a specific project through contracts (Chen et al., 2012).

Many types of cooperation are quite common in the construction industry. Partnering is another term used for collaboration in construction, and Construction Industry Institute (CII) (2019) defines partnering as "*a long-term commitment between two or more organizations as in an alliance, or it may be applied to a shorter period of time such as the duration of a project. The purpose of partnering is to achieve specific business objectives by maximizing the effectiveness of each participant's resources*."

Some construction management researchers made a clear distinction between the terms "*alliancing*" and "*partnering*." According to Hauck et al. (Hauck et al., 2004), alliances are long-term collaborations, not limited to a specific project, and established through legal contracts. Sillars and Kangari (1997) define "*partnering*" as a single project-based relationship between firms where the collaborating parties are independent and responsible for their own services.

Ngowi (2007) identified two types of partnering in the construction alliance literature; (1) *project partnering,* which is generally a non-equity relationship established for a single project, and (2) *strategic partnering,* which is a long-term commitment beyond a particular project. While strategic partnering provides long-term benefits, project partnering aims to provide mutual benefits in a single project (Ngowi, 2007).

Still, "partnering," "strategic partnering," "alliance," "alliancing," and "strategic alliance" are also used interchangeably to define collaborative relationships in construction management studies (Hameed and Abbott, 2017).

When applied to construction management, many findings and theories of alliances in general management need to be reevaluated since alliances in the construction industry are primarily on a project basis. As stated above, even definitions of governance types are different. Thus, it would be beneficial to describe the critical features of project-based firms in construction at this point. According to Gann and Salter (2000), the main characteristics of project-based firms in construction are; (1) their design and production processes are organized around projects; (2) they usually produce one-off, or at least highly customized, products and services; and (3) they operate in diffuse coalitions of companies along with the supplier-customer chain.

Even though the literature on strategic alliances is rich, the literature on construction alliances is very narrow (Ho et al., 2009). The literature review of alliances in the construction industry by Chen et al. (2012) identified three main subjects most researchers focused on at the early stages of alliance studies in construction; (1) Motivations for alliancing, (2) Alliancing features and principles, and (3) Benefits of alliancing.

In an early study, Badger and Mulligan (1995) interviewed 30 international construction industry executives and identified eight dominant motivations to form construction alliances. These are; (1) Access technology, (2) Share risks, (3) Secure financing, (4) Enter new markets, (5) Serve core customers, (6) Improve competitive position, (7) Meet foreign government requirements, (8) Learn local markets.

Other important rationales behind forming alliances in the construction industry obtained from the literature are cost reduction, time constraint, high quality, and innovation requirements, improving profits and market share, developing labor productivity and efficiency, increasing flexibility for development (Chen et al., 2012; Hameed and Abbot, 2017).

Chen et al. (2012) aggregated the principles and critical features of construction alliances from the literature listed below.

Table 4: Principles and features of alliancing in construction by Chen et al. (2012).

Principles	**Features of Alliancing**
Team selection	• Focus on partners' competence, reputation, and attitude
	• Select personnel on a 'best for project' basis
Project proposal development	• Develop the project proposal by alliance partners with the owner's cooperation and involvement
	• Determine the performance targets and commercial arrangements on a negotiation basis or on a competition basis, as the case may be
Risk and reward allocation	• Share risks and rewards collectively
	• Create a win-win or lose-lose situation through a risk/reward regime
	• Align the owner's project objectives with the partner' commercial objectives
Governance and management	• Make project decisions collectively and unanimously
	• Deliver the project by one integrated, no duplication of functions and roles team
	• Perform variations only under very limited circumstances
	• Establish a peer relationship where each partner has an equal say in decisions
	• Share information and knowledge
	• Commit to 'open book' in terms of cost data, documentation, and reporting
Principles of conduct	• Make decisions and act in a 'best for project' manner
	• Open, straight, and honest communication among all partners
	• Commit to cooperation in achieving the objectives
	• Act fairly and reasonably instead of reaping self-interests at the expense of other partners
Dispute resolution	• Commit to 'no fault-no blame' culture to errors, mistakes, or poor performance
	• Resolve conflicts and disputes internally
	• Agree not to litigate or arbitrate

Even though there are numerous benefits an alliance partner firm gains, Badger and Mulligan's (1995) study correspondingly identified eight dominated benefits closely associated with the motivations to form alliances. These are; (1) Enhance competitive position, (2) Increase market share, (3) Obtain new work, (4) Broaden client base, (5) Increase cultural responsiveness, (6) Reduce risk, (7) Increase profits, (8) Increase labor productivity.

Construction management scholars also studied the critical success factors (CSF) for construction alliances and found numerous factors that affect the success of alliances (Hameed and Abbott, 2017; Love et al., 2010). Hameed and Abbot (2017) synthesized the CSF of construction alliances in the literature. They divided these factors into five categories; trust, commitment, knowledge sharing, communication and IT capabilities, and dependency.

They identified trust and commitment as the most crucial CSF for construction alliances. Today, information technology (IT) plays an essential role in sharing efficient and secure information. Managerial IT capabilities of partner firms help alliances to achieve high levels of performance. Effective communication and knowledge sharing are other essential factors for the success of construction alliances since these factors increase trust between partners and help generate innovation. On the other hand, dependency is referred to the exchange of various resources, including economic, social, and financial resources. Dependency between partners reduces the cost of aggregated resources and increases trust and commitment between partners.

Alliance research in the construction management literature has also focused on partner and governance structure selection. Ngowi (2007) identified complementarity, status similarity, prior alliance experience, and reputation as critical factors when selecting alliance partners in construction. His study also revealed the importance of trust while deciding governance structures of construction alliances. Based on the level of trust between partners, equity or non-equity partnership may be preferred as governance forms by partners. It can take different forms of partnerships, from joint ventures to contractual arrangements.

Other important subjects scholars studied in construction alliance literature are the performance and success of alliances. Scholars mainly researched joint venture (JV) performance and success in construction (Sillars and Kangari, 2004; Ozorhon et al., 2010, 2011). Even though there is no consensus on measuring the performance of JVs, some scholars used financial measures, and some used operational measures performance evaluation (Sillars and Kangari, 2004).

It is also often difficult for a single construction company to meet the objectives required for the realization of projects, particularly large-scale ones. To provide these qualifications, companies establish partnerships with domestic or foreign companies based on the nature of projects.

In today's world, industries face many challenges due to rapid technological and conjectural changes. Knowledge and skills are needed to overcome these challenges. Like in other project-based industries, firms in the construction industry access knowledge and skills easier through strategic alliances.

6.4. Strategic Alliances in the Turkish Construction Industry

There are very few studies that examined alliances in the Turkish construction industry. Akiner and Yitmen (2012) studied critical factors for alliance success for the Turkish contracting firms operating internationally. Their findings point out that "*shared risk*," "*trust between parties*," and "*equity*" are the most critical determinants of strategic alliance success for Turkish Contracting firms.

Gurcanli and Mugen studied motivations for Turkish contracting firms to engage in alliances. Their findings reveal that, as in many developing countries, the most challenging matter Turkish Construction Companies face is to provide the necessary financing for the realization of the projects. Sharing risks, technology transfer, client requests, and the social embeddedness of firms are also primary reasons why Turkish construction companies participate in tenders by establishing partnerships, especially for international tenders (Gurcanli and Mungen, 2000).

6.5. Social Network Analysis in Construction Project Management Research

In the beginning, SNA was developed for social science studies in sociology and anthropology. However, its applicability to numerous fields made SNA rapidly grow in the many research fields. Since the late 1990s, there has been an increasing interest in

SNA in construction project management studies since its capability to detect various relationships among project participants was understood by scholars (Zheng et al., 2016).

The construction industry is highly fragmented. Construction projects are temporary in nature and limited to the lifetime of a project. Scholars accept SNA as a suitable approach in CM studies on organizational behaviors because it helps investigate patterns of behaviors and provides a more relational, contextual, and holistic view of project-based organizations (Loosemore, 1998; Zheng et al., 2016).

The early SNA studies in the CM field mainly aimed to understand network characteristics of construction projects at an intra-organizational level rather than an inter-organizational level. Thus, they focused primarily on communication problems among key persons involved in a project network (Zheng et al., 2016).

Pryke (2004) conceptualized a construction project as a network of information exchange relationships. Chinowsky et al. (2008) put great emphasis on SNA application in construction management research. They developed a network model for enhancing knowledge sharing to increase the performance of construction teams and projects.

Park et al. (2009) utilized SNA to explore various collaboration patterns and their impact on the performance of collaborative networks of Korean contractors entering foreign markets. The results of the SNA in their study showed that companies give importance to develop collaborative networks to achieve better performance in risky project conditions.

SNA in the Turkish construction industry is not a widely recognized method both among practitioners and researchers.

CHAPTER 7

IMPLEMENTATION OF THE MODEL – STRATEGIC ALLIANCES OF TURKISH CONTRACTORS

7.1. Defining the Industry Borders

This thesis chose the construction industry as an empirical setting for a couple of reasons. First, construction projects are seen as temporary network-based organizations because various social groups are involved in construction projects. Correspondingly, many formal and informal relationships grow over time within and across the organization (Taylor and Levitt, 2004). Second, alliancing in construction is considered one of the most prominent methods for increasing productivity and performance regarding time, cost, quality, and other goals (Van den Berg and Kamminga, 2006).

7.2. Defining the Time Periods

The alliance network of Turkish contractors is examined for thirty years to comprehend the evolution of the network. Three different time windows are opened in these thirty years based on conjectural changes in the Turkish construction industry summarized below.

Through the new policies and incentives such as privatization and build-operate-transfer projects, many Turkish contractors undertook large-scale infrastructure projects in cooperation with foreign partners in the domestic market between 1985-2000. They gained broad experience in production, project management, and relations with international financial institutions (Yagci, 2015).

From 2000 through 2009, by using the experiences gained in the previous period, Turkish contractors continued to undertake projects both in local and foreign markets in cooperation with domestic and foreign partners. Simultaneously, the number of partners and number of countries that Turkish contractors have been doing business has increased significantly between these years. Considering the 2000-2009 period in Turkey, the sector's growth rate has been above the GDP growth rate almost every year (Source: Turkish Contractors Association).

The effect of the 2008-2009 global economic crisis did not last long in Turkey. The construction sector started to rise rapidly in 2010 and 2011 with the decrease in interest rates and succeeded in becoming the sector that provides the most benefits to the economy. Large-scale infrastructure, superstructure, transportation, and highway investments were put into practice within the scope of mega projects in the local market starting with the year **2010**. Market diversity and specialization in specific project types have started the global branding period for Turkish construction firms in this period, resulting in Turkish contractors' engagement in many alliance projects both in local and foreign markets.

7.3. Samples

The scope of the study is limited to the project alliances of Turkish Contractors who are listed in ENR-Turkey or members of at least one of these institutions; INTES and TCA (TMB). Partners who are not members of these institutions and foreign partners will also be included in the study to make calculations and get healthy results. EKAP and CSN databases and annual company reports will be used for data collection.

The study will be concentrated on the Turkish Contractors' alliance projects executed both in the homeland and abroad between 1990-2019. A business-to-business inter-organizational collaboration (collaborations between competitors) will be sought since various collaboration types are seen in the construction industry.

For this longitudinal research, time periods will be defined for the analysis to comprehend the Turkish Contractors' network evolution. The study will be carried out within the framework of network theory.

This study uses a population of strategic alliances formed by at least one Turkish Construction Company currently listed in ENR-Turkey. ENR-Turkey lists the top 300 construction companies who signed large-scale construction contracts with a price of more than 100 million TL within the last five years, including the current year with public institutions in Turkey.

However, some of the large Turkish construction companies listed in ENR World’s Top 250 International Contractors are TCA (TMB) members and/or INTES members concentrating on international projects and private contracts. They are engaged in many alliances but not listed in ENR-Turkey since they did not sign contracts with public institutions. All INTES and TCA (TMB) members, who are engaged in at least five alliance projects, are included in the study, in addition to ENR-Turkey listed companies, not to disregard these valuable data from the study.

Turkish Contractors Association (TCA) is a non-governmental, non-profit, independent professional organization representing the leading construction companies in Turkey. Almost all TCA member companies work as international contractors, and many are well-known global players.

Turkish Construction Industry Employers Union-INTES was established as a non-governmental organization representing the leading companies in the Turkish construction sector. Its members undertake major infrastructure and superstructure projects in Turkey and abroad are recognized globally.

7.4. Data

This study adopted the criteria to include Turkish Contracting Firms still present in business and involved in at least five alliance projects since the beginning of 1990 to define the boundary of the alliance network. Besides, even if the alliance partners of these firms are not the primary companies under the analysis, they were included in the study as secondary firms to complete SNA calculations.

The current research relies on secondary data drawn from different sources.

This research aggregated micro-level alliance data about the individual cases named as primary contractors. The alliance information was collected from EKAP, ENR-Turkey, INTES, TCA (TMB), and companies' websites. Here, the primary source has been EKAP.

EKAP is a tender tracking system providing access to tenders published by the Public Procurement Authority and hundreds of administrations. EKAP's database includes tender announcements, tender results, and direct procurement and tender specifications.

Additional data and company profiles were extracted from EMIS's database (A Euromoney Institutional Inverter Company database) for each company.

As a result, the construction alliance network of this study is composed of 129 companies listed in ENR-Turkey or members of at least one of the institutions; INTES and TCA (TMB). Partners who are not members of these institutions and foreign partners are also included in the study to make calculations and get healthy results. However, the Qualitative Comparative Analysis of this study will focus on the 129 primary contractors.

This study is restricted to applying social network analysis at the inter-organizational level, which comprises ties between firms in strategic alliances.

7.5. Dimensions

Scholars are utilized different terms as a configuration of a focal firm's alliance network. This study applied "*network size and position*," "*network diversity*," and "*tie strength*" as dimensions of alliance networks.

7.5.1. Network Size and Position

Three measures are used under the network size and position dimension; total number of partners, total number of ties, and Eigenvector centrality.

7.5.1.1. Total Number of Partners, Total Number of Ties, Eigenvector Centrality

The Total Number of Partners is the count number of partners a focal firm has for that particular period. Total Number of Ties is the count number of ties a focal firm has for that particular period. These two dimensions indicate an actor's (focal firm) network size. The higher the values, the higher the network size. Finally, the Eigenvector centrality indicates the position of an actor in the network. The network matrix was used to calculate this measure using the UCINET 6 software program for each period. A high Eigenvector centrality score indicates that an actor has a prominent position in the network with connections to the most influential actors.

7.5.2. Network Diversity

This study extracted three diversity measures used in network studies from the literature and applied them to the study as measures of network diversity dimension; technical diversity, geographical diversity, and structural holes.

7.5.2.1. Technical Diversity

This study used Blau's Diversity Index to calculate technical diversity. Blau's index is defined as where 1- $\sum_{i=0}^{k} pi^2$ corresponds to the proportion of group members' work in the i^{th} category, and k denotes the number of categories for an attribute of interest.

In the scope of this study, 15 categories of construction activities are defined. These designated fields of activities are shown in Table 5 below.

Table 5: Field of Activity Categories.

Technical Category	Field of Activity
1	Infrastructure Projects
2	Dams and HES Projects
3	Industrial Buildings
4	Airports
5	Harbors and Ports
6	Superstructures
7	Maintenance and Renewal Contracts
8	Mining Projects
9	Energy Plants
10	Metro and Light rail systems
11	Irrigation Works and Ponds
12	Land Reconstruction and Land Development Projects
13	Landscaping Projects
14	Mechanical Works
15	Telecommunication Works

A focal firm's each alliance project is numbered between 1 and 15 based on the fields of activity categories. Blau's Diversity index is calculated for each firm in the network for each period. Each contractor firm's value of technical diversity ranges between 0 and 1; the greater the value, the greater the focal firm's diversity.

The Formula is below:

Equation 1: $$1 - \sum_{i=1}^{15} \left(\frac{Focal\ Firm's\ Number\ of\ projects\ for\ i^{th}\ technical\ category}{Focal\ Firm's\ Total\ Number\ of\ Projects} \right)^2$$

7.5.2.2. Geographical Diversity

This measure is calculated based on the focal firm's variety of project locations. A contracting firm would need different resources and capabilities to perform domestic projects and international projects. While determining the geographic region index for each country where Turkish contractors executed alliance projects, the basis taken was the international adventure of Turkish construction companies that began in the 1970s. The table below shows the list for geographical categories.

Table 6: Geographic Categories.

Geographical Category	Region
1	Turkey
2	Middle East, North Africa, and Non-EU-Member European Countries
3	Russian Federation, Turkic Republics, and Central Asia
4	Africa (North Africa is omitted)
5	Ireland and EU-Member European Countries
6	The Continent of America and other Island Countries

This study used Blau's Diversity Index to calculate geographical diversity. Blau's index is generically defined as:

Equation 2: $$1 - \sum_{i=0}^{k} pi^2$$

Here *pi²* corresponds to the proportion of the focal firm's project in ith category to the firm's total number of alliance projects. *K* denotes the number of categories for an attribute of interest which is equal to 6 in this study.

The Blau's index Formula applied to this study is below:

Equation 3: $$1 - \sum_{i=1}^{6} \left(\frac{\text{Focal Firm's Number of projects for i}^{\text{th}}\text{ geographical category}}{\text{Focal Firm's Total Number of Projects}}\right)^2$$

Each contractor firm's value of geographical diversity ranges between 0 and 1; the greater the value, the greater the focal firm's geographical diversity.

7.5.2.3. Structural Holes

This study used the constraint measure (HOLES) to operationalize the concept of the structural hole. A low constraint indicates that the firm's partners are densely connected to one another, while a high constraint measure indicates that the firm's ego network is sparsely connected. The constraint measure was calculated for this measure using the UCINET 6 software program.

7.5.3. Tie Strength

Tie strength represents the relational embeddedness of firms in the study. The number of repeated partners of a focal firm is used to calculate this measure.

7.5.3.1. Repeated Partners

Repeated ties reflect the partners' satisfaction with their initial collaborative venture, leading them to form other alliances with the same partner to take advantage of their cooperative dynamics. This measure is calculated by using a five-year moving window in this study. The formula;

Equation 4:

$$\sum_{i}^{1999}\left(\frac{Focal\ Firm's\ Number\ of\ Repeated\ Partners}{Focal\ Firm's\ Total\ Number\ of\ Partners}\right)$$

Each period (1990-1999; 2000-2009; 2010-2019) is examined with five-year windows. A focal firm's number of repeated partners in every five-year is divided by the total number of partners in this five-year window. Then the repeated partnership proportions for two five-year windows are summed up to find the repeated partner dimension for the study.

The construction alliance projects in the study's dataset were completed in an average of 5 years; thus, this study chose to open five-year windows in the main periods.

The five-year period in the construction sector is an adequate period for companies to evaluate their partnerships and establish new ties with their existing partners.

7.6. Data Processing

Within this thesis, firm information and alliance information is collected from various sources covered in the data collection section. Each of 129 firms engaged in at least five partnerships during their lifetime.

During data processing, tabular excel sheets were combined into a single worksheet. Typo errors in projects and company names were then removed. In the next step, firms in the network are divided into two groups. The 129 firms were named "*primary firms,*" and a number starting from 1001 is assigned to each primary firm. Partners of primary firms that are not listed or not members of these institutions were named "*secondary firms,*" and numbers assigned to them start from 2001. The Turkish construction alliance network between 1990-2019 has 129 primary firms and 607 secondary firms. Seven hundred thirty-six (736) firms in total are included in the study.

The firm names on the combined worksheet were converted to numbers. Then, the ties between two firms were converted into binary pairs, and these pairs were listed using the pivot table in excel. Each firm's Total Number of Partners (TNOPart) and Total Number of Ties (TNOT) were calculated from the pair list.

In another table, the repeated ties between two firms were listed, and by using this table Number of Repeated Partners and the Number of Repeated Ties were calculated.

In the next step, each project is numbered between 1 and 15 according to the fields of activity. These designated fields of activities are shown under the Technical Diversity section, 7.5.2.1

For each focal firm, the total number of projects and the number of projects under each type is calculated. With the help of this data, the Technical Diversity measure is calculated using Blau's Index for diversity.

In order to calculate Geographical Diversity, the total number of projects and different geographic locations of these projects are calculated for each firm.

The table showing a sample data sheet for a sample company in the network is presented below.

Table 7: Sample datasheet for a company in the network. Firm: Alsim Alarko.

	Name of Alliance	Partner 1	Partner 2	Partner 3	Partner 4	Project Type	Proje	Location	Start Date	Completion Date	Owner	Contract Value	Year of Establishment	Year of First Partnership	Year of First International Job	Year of First International Partnership	Member of INTES	Member of TMB	ENR-TR Listed
1	Cenal	Alsim Alarko	Cengiz	0	0	9	Çanakkale Karabiga İthal Kömür Santrali	Çanakkale	2012	2018	Alarko Enerji	1,710,200,000.00 ₺	1954	1997	1992	2002	1	1	1
2	Alsim Alarko- Caf	Alsim Alarko	Caf	0	0	10	Antalya Hafif Raylı Sistem 1.Aşama Yapım İşleri	Antalya	2006	2011	Antalya Büyükşehir Belediyesi	$ 100,000,000.00	1954	1997	1992	2002	1	1	1
3	Alsim Alarko- Garanti Koza- Makyo	Alsim Alarko	Garanti Koza	Makyol	0	10	İstanbul Metrosu 4.Levent-Ayazağa Bölümü	İstanbul	2007	2008	İ.B.B	€ 316,317,214.00	1954	1997	1992	2002	1	1	1
4	Alsim Alarko- Rosneftegazstroy	Alsim Alarko	Rosneftegazstroy	0	0	1	Melen-Kıncıllı Su İsale Hattı	Adapazarı	2005	2008	DSİ	$ 49,566,697.00	1954	1997	1992	2002	1	1	1
5	Alsim Alarko- Obrascon	Alsim Alarko	Obrascon	0	0	1	Ankara-İstanbul Hızlı Tren Projesi 1. Etap Ankara-Eskişehir Arası	Ankara	2003	2009	TCDD	€ 629,000,000.00	1954	1997	1992	2002	1	1	1
6	Alsim Alarko- Garanti Koza	Alsim Alarko	Garanti Koza	0	0	10	Levent Hacıosman Metro Hattı	Türkiye	2004	2009	İ.B.B	70,703,249.00 ₺	1954	1997	1992	2002	1	1	1
7	Alsim Alarko- Doğuş- YDA İnşaat	Alsim Alarko	Doğuş	YDA İnşaat	0	4	Boryspil Uluslararası Havaalanı	Ukrayna	2008	2012	Boryspil International Airport State Enterprise	$ 450,000,000.00	1954	1997	1992	2002	1	1	1
8	Alsim Alarko- Emit	Alsim Alarko	Ermit	0	0	3	İzmit Körfezi Atıksu Arıtma Tesisleri	Kocaeli	2003	2005	İSU	$ 40,497,631.00	1954	1997	1992	2002	1	1	1
9	ABB- Adtranz- Alsim Alarko	Alsim Alarko	Adtranz	ABB	0	10	Adana Hafif Raylı Sistem Projesi	Türkiye	1997	2010	Adana Büyükşehir Belediyesi	$ 533,000,000.00	1954	1997	1992	2002	1	1	1
10	Akfen- Alsim Alarko- Technicas Reunidas	Alsim Alarko	Akfen	Technicas Reunidas	0	3	Tüpraş İzmit Petrol Rafinerisi Yeni Reformer ve Dizel Kükürt Giderme	Kocaeli	2002	2007	Tüpraş	$ 67,750,000.00	1954	1997	1992	2002	1	1	1
11	Alsim Alarko- Laing- Marubeni- Siemens	Alsim Alarko	Laing	Marubeni	Siemens	4	Astana Uluslararası Havaalanı	Kazakistan	2002	2005	R.S.E International Airport Astana	$ 170,000,000.00	1954	1997	1992	2002	1	1	1
12	Alsim Alarko- Hyundai Rotem	Alsim Alarko	Hyundai Rotem	0	0	10	İstanbul Metrosu Yenikapı-Şişhane Bölümü	İstanbul	2001	2010	İ.B.B	$ 593,000,000.00	1954	1997	1992	2002	1	1	1
13	Alsim Alarko- Gama- LG Engineering- Technicas Reunidas	Alsim Alarko	Gama	LG Engineering	Technicas Reunidas	3	Tüpraş Kırıkkale Petrol Rafinerisi Yeni Reformer ve Dizel Kükürt Giderme	Kırıkkale	2005	2008	Tüpraş	$ 390,000,000.00	1954	1997	1992	2002	1	1	1
14	Alsim Alarko- Ansaldobreda	Alsim Alarko	Ansaldobreda	0	0	10	Samsun Hafif Raylı Sistem Projesi	Samsun	2008	2010	Samsun Büyükşehir Belediyesi	€ 105,987,770.00	1954	1997	1992	2002	1	1	1
15	Alsim Alarko- Ansaldobreda	Alsim Alarko	Ansaldobreda	0	0	10	Ankara Metro Projesi Elektro-Mekanik İşleri	Ankara	2012	2014	Ulaştırma ve Denizcilik Bakanlığı	€ 42,368,200.00	1954	1997	1992	2002	1	1	1
16	Cenal	Alsim Alarko	Cengiz	0	0	10	Kaynarca - Pendik - Tuzla Metrosu İnşaat ve Elektromekanik Sistemler	İstanbul	2017	2020	İ.B.B	1,613,815,000.00 ₺	1954	1997	1992	2002	1	1	1
17	Alsim Alarko- Günsayıl- Haustadt Timmermann- Max Streicher KG	Alsim Alarko	Günsayıl	Haustadt Timmerman	Max Streicher KG	1	Bakü- Tiflis Ham Petrol Boru Hattı Projesi – Lot B	Erzurum-Erzincan-	2001	2006	Botaş	$ 116,000,000.00	1954	1997	1992	2002	1	1	1

Each project's contract value has been found during the data collection process. The contract values were in different currencies depending on where the project took place. In the next step, the contract value of each project is converted to $ value for the year project started. Then, these contract $ values are converted to today's $ value using inflation rates. Accordingly, the total tender prices of each primary firm were calculated based on the current dollar value.

In the next step, the adjacency matrix, a square actor-by-actor matrix, was prepared to record who is connected to whom in the network. The network matrix was used to calculate Eigenvector Centrality and Structural Holes measures using the UCINET 6 software.

Data Processing for QCA

Few steps have to be completed before feeding data to the QCA application, fsQCA. Below is the list of steps explained;

Case Name Formatting: fsQCA does not accept Turkish or other language character sets but standard English characters. Unique character names are removed and replace with closest English versions to be recognized by fsQCA.

Data Scaling: All the data should be scaled to feed QCA. If the data set is fuzzy, then data should be converted to the level between 0 to 1. 6 (six) levels are used (0, 0.2, .04, 0.6, 0.8, and 1). Each level represents a level of inclusion in the given condition.

Determining Outcome and Conditions: Outcome and conditions are the key elements for QCA software to determine the solutions. In this study, conditions are the same parameters used for calculating categories previously with Kmeans++. The outcome is the cluster categories calculated by kmeans++. Kmeans++ calculation resulted in a total of four categories. As a result, outcome values represented as 1, 0.66, 0.33, and 0 for each category (cluster).

Selecting Frequency Threshold: The frequency threshold is the minimum number of times a configuration has to occur. By default, this value is set to 1 which means, QCA does not eliminate any cases feed into fsQCA. For the 1990-1999 period, the frequency threshold is set to 1 since there are 30 firms in the period. For the later periods, the frequency threshold is set 2 due to the increased number of firms.

Selecting Consistency Threshold: For fuzzy set QCA studies, the preferred threshold value is 0.8, representing 80% consistency for accepting a configuration in the calculation.

7.7. Descriptive Statistics, Factor Analysis and Reliability Analysis

Abbreviations of Dimensions:

TNOPart: Total Number of Partners of The Focal Firm

TNOT: Total Number of Ties of The Focal Firm

Eigen: Eigenvector Centrality Score of the focal firm

Geo_Div_Blau: Geographic Diversity score based on Blau's Index

Tech_Div_Blau: Technical Diversity score based on Blau's Index

Holes: Structural Holes Score

RepeatedPart: Focal Firm's Repeated Partner Score

Descriptive Statistics, Factor Analysis and Reliability Analysis for 1990-1999

Table 8: 1990-1999 Descriptive Statistics. Sample Size:30.

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
TNOT	8.27	10.215	30
TNOPart	6.20	7.068	30
Eigen	.0947	.1253	30
Holes	.5064	.3224	30
Geo_Div_Blau	.2785	.2628	30
Tech_Div_Blau	.3009	.3292	30
RepeatedPart	.2278	.3105	30

Table 9: Correlation Matrix for 1990-1999 Period.

Correlation Matrix

		TNOT	TNOPart	Eigen	Holes	Geo_Div_Blau	Tech_Div_Blau	RepeatedPart
Correlation	**TNOT**	1.000	.984	.915	.709	.385	.636	.415
	TNOPart	.984	1.000	.918	.726	.387	.669	.308
	Eigen	.915	.918	1.000	.682	.341	.506	.394
	Holes	.709	.726	.682	1.000	.744	.737	.341
	Geo_Div_Blau	.385	.387	.341	.744	1.000	.793	.194
	Tech_Div_Blau	.636	.669	.506	.737	.793	1.000	.110
	RepeatedPart	.415	.308	.394	.341	.194	.110	1.000
Sig. (1-tailed)	**TNOT**		.000	.000	.000	.018	.000	.011
	TNOPart	.000		.000	.000	.017	.000	.049
	Eigen	.000	.000		.000	.033	.002	.016
	Holes	.000	.000	.000		.000	.000	.033
	Geo_Div_Blau	.018	.017	.033	.000		.000	.152
	Tech_Div_Blau	.000	.000	.002	.000	.000		.282
	RepeatedPart	.011	.049	.016	.033	.152	.282	

1st Step of the Factor Analysis - Principal Component Analysis with No Rotation

Table 10: KMO and Bartlett's Test for 1990-1999 Period.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.663
Bartlett's Test of Sphericity	Approx. Chi-Square	253.789
	df	21
	Sig.	.000

If the sample size is less than 300, it is also worth looking at the communalities of the retained items. An average value of 0.6 is acceptable for sample sizes less than 100. An average value between 0.5 and 0.6 is acceptable for sample sizes between 100 and 200, (McCallum et al.,1999)

Table 11: Communalities for 1990-1999 Period.

	Initial	Extraction
TNOPART	1.000	.924
TNOT	1.000	.952
Eigen	1.000	.886
Geo_Div_Blau	1.000	.900
Tech_Div_Blau	1.000	.866
Holes	1.000	.839
RepeatedPart	1.000	.536

Extraction Method: Principal Component Analysis.

Table 12: Total Variance Explained for 1990-1999 Period

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.561	65.160	65.160	4.561	65.160	65.160
2	1.185	16.931	82.091	1.185	16.931	82.091
3	.817	11.670	93.761			
4	.241	3.440	97.200			
5	.133	1.896	99.097			
6	.056	.806	99.903			
7	.007	.097	100.000			

Extraction Method: Principal Component Analysis.

Eigen Value 1 is arbitrary; factor loadings are also important. Tabachnick and Fidell (2014) recommend ignoring factor loadings less than 10% of the shared variance. In the period of 1990-1999, the sample size is 30, and the "communality" scores are high for all dimensions. 3-component share 11.670% of the variance and explain the total variance at the level of 93.7%. Thus, 3 (three) components are fixed for the factor analysis.

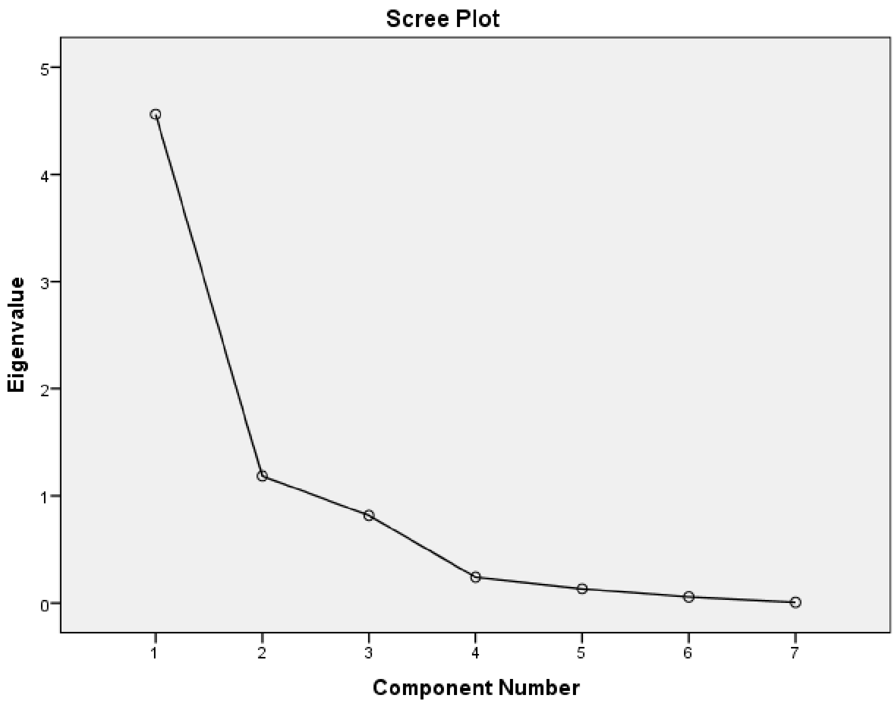

Figure 19: Scree Plot for optimum component selection for 1990-1999 Period

Table 13: Component Matrix for 1990-1999 Period

	Component	
	1	2
TNOT	.925	
TNOPart	.925	
Holes	.889	
Eigen	.874	
Tech_Div_Blau	.810	-.477
Geo_Div_Blau	.674	-.643
RepeatedPart	.432	.472

Extraction Method: Principal Component Analysis.
a. 2 components extracted.

The second step of the factor analysis is principal component analysis with direct oblimin.

Table 14: Structure Matrix for 1990-1999 Period

	Component		
	1	2	3
TNOPart	.991	-.526	
TNOT	.984	-.508	
Eigen	.958	-.428	
Geo_Div_Blau		-.963	
Tech_Div_Blau	.619	-.906	
Holes	.726	-.842	
RepTies_part			.992

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Table 15: Component Correlation Matrix for 1990-1999 Period

Component	1	2	3
1	1.000	-.490	.304
2	-.490	1.000	-.146
3	.304	-.146	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Orthogonal rotations assume factors are not correlated. If components are correlated, then an oblique rotation method, Direct Oblimin, needs to be applied because oblique rotations allow correlation.

The "Direct Oblimin" method is used as a second step to see the correlation between the components. Since the correlations between components are low, an orthogonal rotation method can be used. The “varimax method” is used as step 3 of factor analysis.

The third step of the factor analysis is principal component analysis with varimax.

Table 16: Component Matrix with Varimax for 1990-1999 Period

	Component		
	1	2	3
TNOT	.925		
TNOPart	.925		
Holes	.889		
Eigen	.874		
Tech_Div_Blau	.810	-.477	
Geo_Div_Blau	.674	-.643	
RepeatedPart	.432	.472	.761

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

Table 17: Rotated Component Matrix for 1990-1999 Period

	Component		
	1	2	3
TNOPart	.942		
TNOT	.925		
Eigen	.918		
Geo_Div_Blau		.963	
Tech_Div_Blau	.432	.833	
Holes	.532	.724	
RepeatedPart			.968

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

The below tables show Reliability Analysis for NETWORK SIZE AND POSITION (TNOPart, TNOT, Eigen), and the result shows that Cronbach's Alpha calculated is 0.729. Values above 0.6 are in the acceptable range.

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	TNOT	TNOPart	Eigen
TNOT	1.000	.984	.915
TNOPart	.984	1.000	.918
Eigen	.915	.918	1.000

Item Statistics

	Mean	Std. Deviation	N
TNOT	8.266667	10.2147065	30
TNOPart	6.200000	7.0681412	30
Eigen	.094703	.1252946	30

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.729	.979	3

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
TNOT	6.294703	51.600	.984	.969	.063
TNOPart	8.361370	106.698	.984	.970	.044
Eigen	14.466667	296.395	.920	.847	.959

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		2903.660	29	100.126		
Within People	Between Items	1083.267	2	541.634	19.991	.000
	Residual	1571.462	58	27.094		
	Total	2654.729	60	44.245		
Total		5558.389	89	62.454		

Grand Mean = 4.853790

The below tables show Reliability Analysis for *Network Diversity* (Tech_Div_blau, Geo_Div_Blau, Holes), and the result shows that Cronbach's Alpha calculated is 0.729. Values above 0.6 are in the acceptable range.

Reliability Analysis for NETWORK DIVERSITY (Tech_Div_Blau, Geo_Div_Blau, Holes) displayed below.

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	Geo_Div_Blau	Tech_Div_Blau	Holes
Geo_Div_Blau	1.000	.793	.744
Tech_Div_blau	.793	1.000	.737
Holes	.744	.737	1.000

Item Statistics

	Mean	Std. Deviation	N
Geo_Div_Blau	.278456893317814	.262790954890009	30
Tech_Div_Blau	.300873055706504	.329166664288295	30
Holes	.506391980124953	.322443744905899	30

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.898	.904	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Geo_Div_Blau	.807	.369	.825	.685	.848
Tech_Div_Blau	.785	.299	.816	.678	.843
Holes	.579	.315	.781	.611	.872

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		6.777	29	.234		
Within People	Between Items	.947	2	.473	19.850	.000
	Residual	1.383	58	.024		
	Total	2.330	60	.039		
Total		9.107	89	.102		

Grand Mean = .362

Descriptive Statistics, Factor Analysis and Reliability Analysis for 2000-2009

Table 18: Descriptive Statistics for 2000-2009 Period. Sample Size:67

Descriptive Statistics			
	Mean	Std. Deviation	Analysis N
TNOPart	4.780	5.575	67
TNOT	6.990	8.822	67
Eigen	0.039	0.089	67
Geo_Div Blau	0.290	0.266	67
Tech_Div Blau	0.291	0.289	67
Holes	0.425	0.352	67
RepeatedPart	0.422	0.981	67

Table 19: Correlation Matrix for 2000-2009 Period

Correlation Matrix

		TNOT	TNOPart	Eigen	Holes	Geo_Div_Blau	Tech_Div_Blau	Repeated Part
Correlation	**TNOT**	1.000	.906	.822	.619	.625	.709	.145
	TNOPart	.906	1.000	.821	.660	.618	.635	.411
	Eigen	.822	.821	1.000	.446	.420	.457	.120
	Holes	.619	.660	.446	1.000	.678	.776	.448
	Geo_Div_Blau	.625	.618	.420	.678	1.000	.780	.318
	Tech_Div_Blau	.709	.635	.457	.776	.780	1.000	.171
	RepeatedPart	.145	.411	.120	.448	.318	.171	1.000
Sig. (1-tailed)	**TNOT**		.000	.000	.000	.000	.000	.121
	TNOPart	.000		.000	.000	.000	.000	.000
	Eigen	.000	.000		.000	.000	.000	.166
	Holes	.000	.000	.000		.000	.000	.000
	Geo_Div_Blau	.000	.000	.000	.000		.000	.004
	Tech_Div_Blau	.000	.000	.000	.000	.000		.084
	RepeatedPart	.121	.000	.166	.000	.004	.084	

1st Step of the Factor Analysis-Principal Component Analysis with No Rotation

Table 20: KMO and Bartlett's Test for 2000-2009 Period

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.665
Bartlett's Test of Sphericity	Approx. Chi-Square	494.875
	df	21
	Sig.	.000

If the sample size is less than 300, it is also worth looking at the communalities of the retained items. An average value of 0.6 is acceptable for sample sizes less than 100. An average value between 0.5 and 0.6 is acceptable for sample sizes between 100 and 200, (McCallum et al.,1999)

Table 21: Communalities for 2000-2009 Period

	Initial	Extraction
TNOPART	1.000	.926
TNOT	1.000	.857
Eigen	1.000	.725
Geo_Div_Blau	1.000	.739
Tech_Div_Blau	1.000	.685
Holes	1.000	.714
RepeatedPart	1.000	.870

Extraction Method: Principal Component Analysis.

Table 22: Total Variance Explained for 2000-2009 Period

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.408	62.976	62.976	4.408	62.976	62.976
2	1.107	15.816	78.792	1.107	15.816	78.792
3	.868	12.393	91.186			
4	.318	4.546	95.732			
5	.168	2.403	98.135			
6	.116	1.659	99.794			
7	.014	.206	100.000			

Extraction Method: Principal Component Analysis.

In the period of 2000-2009, the sample size is 67, and the "communality" scores are high for all dimensions. 3-component share 12.393% of the variance and explain the total variance at the level of 91.2%. Thus, 3 (three) components are fixed for the factor analysis.

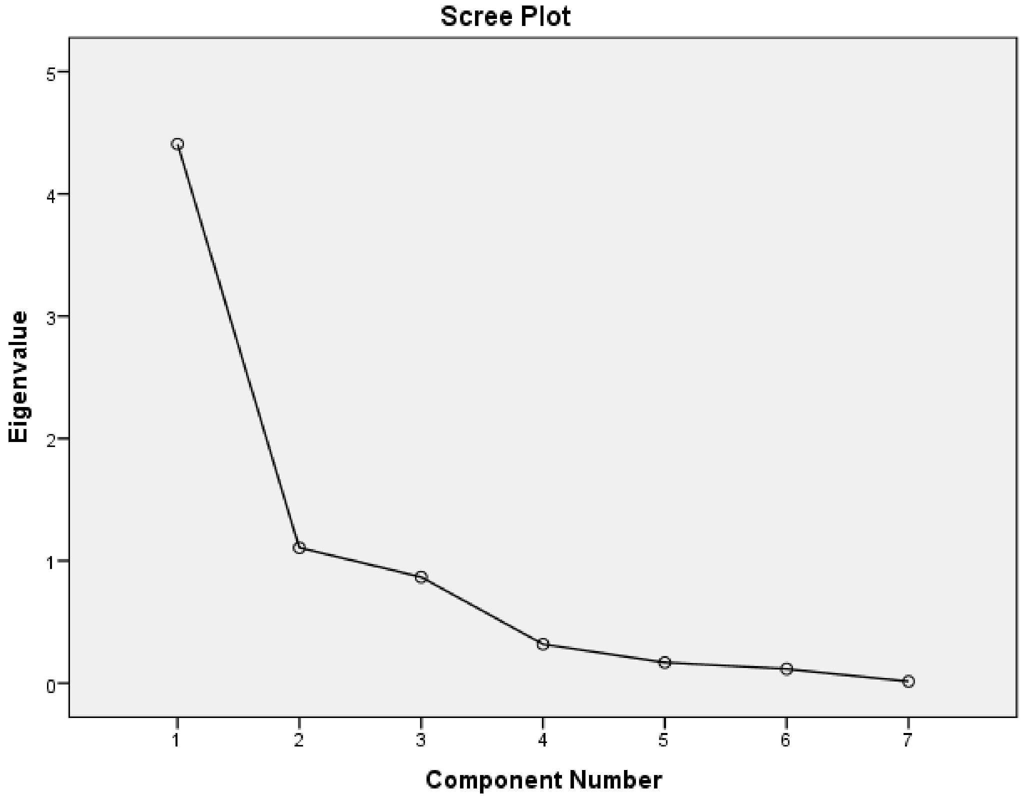

Figure 20: Scree Plot for optimum component selection for 2000-2009 Period

Table 23: Component Matrix for 2000-2009 Period

	Component	
	1	2
TNOT	.925	
TNOPart	.909	
Holes	.844	
Eigen	.826	
Tech_Div_Blau	.810	
Geo_Div_Blau	.768	
RepeatedPart		.885

Extraction Method: Principal Component Analysis.
a. 2 components extracted.

The second step of the factor analysis is principal component analysis with direct oblimin.

Table 24: Structure Matrix for 2000-2009 Period

	Component		
	1	2	3
TNOPart	.943		.567
TNOT	.900		.509
Eigen	.885		.540
Geo_Div_Blau		.996	
Tech_Div_Blau	.455		.956
Holes	.717		.941
RepTies_part	.690		.932

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Table 25: Component Correlation Matrix for 2000-2009 Period

Component	1	2	3
1	1.000	.213	.576
2	.213	1.000	.114
3	.576	.114	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Orthogonal rotations assume factors are not correlated. If components are correlated, then an oblique rotation method, Direct Oblimin, needs to be applied because oblique rotations allow correlation.

The "Direct Oblimin" method is used as a second step to see the correlation between the components. Since the correlations between components are low, an orthogonal rotation method can be used. The “varimax method” is used as step 3 of factor analysis.

The third step of the factor analysis is principal component analysis with varimax.

Table 26: Component Matrix for 2000-2009 Period

	Component		
	1	2	3
TNOT	.925		
TNOPart	.909		
Holes	.844		-.453
Eigen	.826		
Tech_Div_Blau	.810		
Geo_Div_Blau	.768		.451
RepeatedPart		.885	

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

	Component		
	1	2	3
TNOPart	.903		
TNOT	.850		
Eigen	.811		
Geo_Div_Blau		.947	
Tech_Div_Blau	.499	.833	
Holes	.431	.826	
RepeatedPart			.988

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

The below tables show Reliability Analysis for NETWORK SIZE AND POSITION (TNOPart, TNOT, Eigen), and the result shows that Cronbach's Alpha calculated is 0.684. Values above 0.6 are in the acceptable range.

Case Processing Summary

		N	%
Cases	Valid	67	100.0
	Excluded[a]	0	.0
	Total	67	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	TNOT	TNOPart	Eigen
TNOT	1.000	.906	.821
TNOPart	.906	1.000	.822
Eigen	.821	.822	1.000

Item Statistics

	Mean	Std. Deviation	N
TNOT	6.985075	8.8223074	67
TNOPart	4.776119	5.5754356	67
Eigen	.038597	.0892756	67

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.684	.944	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
TNOT	4.814716	31.912	.907	.839	.051
TNOPart	7.023672	79.134	.907	.840	.033
Eigen	11.761194	198.063	.840	.708	.900

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		4404.025	66	66.728		
Within People	Between Items	1687.890	2	843.945	39.998	.000
	Residual	2785.128	132	21.099		
	Total	4473.018	134	33.381		
Total		8877.043	200	44.385		

Grand Mean = 3.933264

The below tables show Reliability Analysis for NETWORK DIVERSITY (Tech_Div_blau, Geo_Div_Blau, Holes), and the result shows that Cronbach's Alpha calculated is 0.892. Values above 0.6 are in the acceptable range.

Case Processing Summary

		N	%
Cases	Valid	67	100.0
	Excluded[a]	0	.0
	Total	67	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	Geo_Div_ Blau	Tech_Div_ Blau	Holes
Geo_Div_Blau	1.000	.678	.776
Tech_Div_blau	.678	1.000	.780
Holes	.776	.780	1.000

Item Statistics

	Mean	Std. Deviation	N
Geo_Div_Blau	.290328255018747	.266369176510022	67
Tech_Div_Blau	.291404986521713	.289223038273423	67
Holes	.424878675802112	.352386329957043	67

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.892	.897	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Geo_Div_Blau	.716	.367	.775	.616	.867
Tech_Div_Blau	.715	.341	.780	.622	.855
Holes	.582	.259	.849	.721	.807

Descriptive Statistics, Factor Analysis and Reliability Analysis for 2010-2019

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		15.135	66	.229		
Within People	Between Items	.802	2	.401	16.222	.000
	Residual	3.264	132	.025		
	Total	4.066	134	.030		
Total		19.202	200	.096		

Table 27: Descriptive Statistics for 2010-2019 Period. Sample Size:67

Descriptive Statistics			
	Mean	Std. Deviation	Analysis N
TNOPart	7.650	4.592	127
TNOT	12.280	8.990	127
Eigen	0.042	0.073	127
Geo_Div Blau	0.516	0.222	127
Tech_Div Blau	0.548	0.315	127
Holes	0.285	0.175	127
RepeatedPart	0.467	0.396	127

Table 28: Correlation Matrix for 2010-2019 Period

Correlation Matrix

		TNOT	TNOPart	Eigen	Holes	Geo_Div_Blau	Tech_Div_Blau	RepeatedPart
Correlation	**TNOT**	1.000	.897	.680	.284	.361	-.618	-.072
	TNOPart	.897	1.000	.732	.322	.355	-.365	.195
	Eigen	.680	.732	1.000	.307	.304	-.257	.119
	Holes	.284	.322	.307	1.000	.563	-.223	.207
	Geo_Div_Blau	.361	.355	.304	.563	1.000	-.287	-.008
	Tech_Div_Blau	-.618	-.365	-.257	-.223	-.287	1.000	.297
	RepeatedPart	-.072	.195	.119	.207	-.008	.297	1.000
Sig. (1-tailed)	**TNOT**		.000	.000	.001	.000	.000	.211
	TNOPart	.000		.000	.000	.000	.000	.014
	Eigen	.000	.000		.000	.000	.002	.092
	Holes	.001	.000	.000		.000	.006	.010
	Geo_Div_Blau	.000	.000	.000	.000		.001	.463
	Tech_Div_Blau	.000	.000	.002	.006	.001		.000
	RepeatedPart	.211	.014	.092	.010	.463	.000	

1st Step of the Factor Analysis - Principal Component Analysis with No Rotation

Table 29: KMO and Bartlett's Test for 2010-2019 Period

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.622
Bartlett's Test of Sphericity	Approx. Chi-Square	533.491
	df	21
	Sig.	.000

If the sample size is less than 300, it is also worth looking at the communalities of the retained items. An average value of 0.6 is acceptable for sample sizes less than 100. An average value between 0.5 and 0.6 is acceptable for sample sizes between 100 and 200, (McCallum et al.,1999)

Table 30: Communalities for 2010-2019 Period

	Initial	Extraction
TNOPART	1.000	.939
TNOT	1.000	.916
Eigen	1.000	.742
Geo_Div_Blau	1.000	.811
Tech_Div_Blau	1.000	.777
Holes	1.000	.717
RepeatedPart	1.000	.821

Extraction Method: Principal Component Analysis.

Table 31: Total Variance Explained for 2010-2019 Period

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.274	46.773	46.773	3.274	46.773	46.773
2	1.346	19.233	66.006	1.346	19.233	66.006
3	1.103	15.758	81.764	1.103	15.758	81.764
4	.554	7.913	89.677			
5	.401	5.732	95.408			
6	.278	3.974	99.382			
7	.043	.618	100.000			

Extraction Method: Principal Component Analysis.

In the period of 2010-2019, the sample size is 127, and the "communality" scores are high for all dimensions. 3-component share 15.758% of the variance and explain the total variance at the level of 81.76%. Thus, 3 (three) components are fixed for the factor analysis.

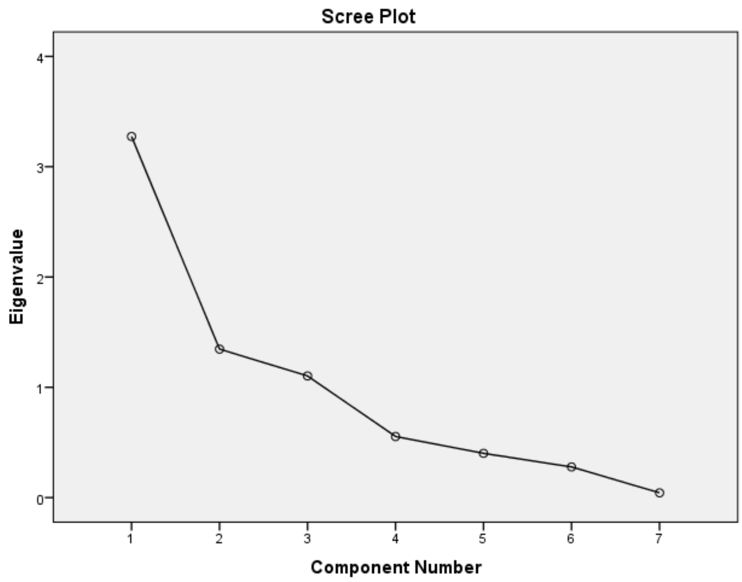

Figure 21: Scree Plot for optimum component selection for 2010-2019 Period

The second step of the factor analysis is principal component analysis with direct oblimin.

Table 32: Component Matrix for 2010-2019 Period

	Component		
	1	2	3
TNOPart	.911		
TNOT	.887		
Eigen	.785		
Holes	-.602	.572	
RepeatedPart		.873	
Tech_Div_Blau	.602		-.628
Geo_Div_Blau	.559	.403	-.580

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

Table 33: Component Correlation Matrix for 2010-2019 Period

Component	1	2	3
1	1.000	-.100	-.406
2	-.100	1.000	.044
3	-.406	.044	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Orthogonal rotations assume factors are not correlated. If components are correlated, then an oblique rotation method, Direct Oblimin, needs to be applied because oblique rotations allow correlation.

The "Direct Oblimin" method is used as a second step to see the correlation between the components. Since the correlations between components are low, an orthogonal rotation method can be used. The “varimax method” is used as step 3 of factor analysis.

The third step of the factor analysis is principal component analysis with varimax.

Table 34: Component Matrix with Varimax for 2010-2019 Period

	Component		
	1	2	3
TNOT	.911		
TNOPart	.887		
Holes	.785		
Eigen	-.602	.572	
Tech_Div_Blau		.873	
Geo_Div_Blau	.602		-.628
RepeatedPart	.559	.403	-.580

Extraction Method: Principal Component Analysis.
a. 3 components extracted.

Table 35: Rotated Component Matrix for 2010-2019 Period

	Component		
	1	2	3
TNOPart	.937		
TNOT	.907		
Eigen	.842		
Geo_Div_Blau		.875	
Tech_Div_Blau		.849	
Holes			.882
RepeatedPart	-.434		.685

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

The below tables show Reliability Analysis for NETWORK SIZE AND POSITION (TNOPart, TNOT, Eigen), and the result shows that Cronbach's Alpha calculated is 0.638. Values above 0.6 are in the acceptable range.

Case Processing Summary

		N	%
Cases	Valid	127	100.0
	Excluded[a]	0	.0
	Total	127	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	TNOT	TNOPart	Eigen
TNOT	1.000	.897	.732
TNOPart	.897	1.000	.680
Eigen	.732	.680	1.000

Item Statistics

	Mean	Std. Deviation	N
TNOT	12.275591	8.9900096	127
TNOPart	7.653543	4.5918803	127
Eigen	.041686	.0733081	127

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.638	.944	3

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		7449.402	126	59.122		
Within People	Between Items	9693.153	2	4846.577	226.535	.000
	Residual	5391.385	252	21.394		
	Total	15084.538	254	59.388		
Total		22533.940	380	59.300		

Grand Mean = 6.656940

The below tables show Reliability Analysis for NETWORK DIVERSITY (Tech_Div_blau, Geo_Div_Blau), and the result shows that Cronbach's Alpha calculated is 0.693. Values above 0.6 are in the acceptable range.

Case Processing Summary

		N	%
Cases	Valid	127	100.0
	Excluded[a]	0	.0
	Total	127	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	Geo_Div_Blau	Tech_Div_Blau
Geo_Div_Blau	1.000	.563
Tech_Div_Blau	.563	1.000

Item Statistics

	Mean	Std. Deviation	N
Geo_Div_Blau	.516	.222	127
Tech_Div_Blau	.547	.315	127

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.893	.720	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Geo_Div_Blau	.548	.099	.563	.317	.
Tech_Div_Blau	.516	.049	.563	.317	.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		14.283	126	.113		
Within People	Between Items	.063	1	.063	1.811	.181
	Residual	4.388	126	.035		
	Total	4.451	127	.035		
Total		18.734	253	.074		

Grand Mean = .531839328819656

The below tables show Reliability Analysis for TIE STRENGTH (RepeatedPart, Holes), and the result shows that Cronbach's Alpha calculated is 0.360. Values are below 0.6 and not in the acceptable range.

Case Processing Summary

		N	%
Cases	Valid	127	100.0
	Excluded[a]	0	.0
	Total	127	100.0

a. Listwise deletion based on all variables in the procedure.

Inter-Item Correlation Matrix

	RepeatedPart	Holes
RepeatedPart	1.000	.297
Holes	.297	1.000

Item Statistics

	Mean	Std. Deviation	N
RepeatedPart	.467221852950199	.395594715239179	127
Holes	.284596336347498	.175212790344301	127

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.360	.458	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
RepeatedPart	.284596336347	.031	.297	.088	.
Holes	.467221852950	.156	.297	.088	.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		14.386	126	.114		
Within People	Between Items	2.118	1	2.118	29.003	.000
	Residual	9.201	126	.073		
	Total	11.319	127	.089		
Total		25.704	253	.102		

Grand Mean = .375909094648849

The low Cronbach's Alpha indicates that these two measures do not belong to the same components. For this reason, structural holes will be evaluated under the diversity dimension as in other periods.

7.8. Cluster Analysis and Cluster Profiling

The initial clustering analysis in the study has been started with SPSS. In order to get the most appropriate centroid locations for clustering, k-means++ was chosen to use. Since k-means++ is not included in SPSS, the dataset was transported to Python. Python is an object-oriented, open-source, general-purpose programming language. Python has a comprehensive standard library which also includes the k-means++ cluster analysis package.

The cluster analysis was performed for three time-periods determined by the study. However, the cluster profiling of 1990-2019 was also included in the study to give a general view of the Turkish Contractor's alliance network.

In order to determine the most appropriate number of clusters, the elbow technique is used. The elbow technique results for each cycle and the profiling of each period are detailed below.

7.8.1. Cluster Profiling Between 1990-2019

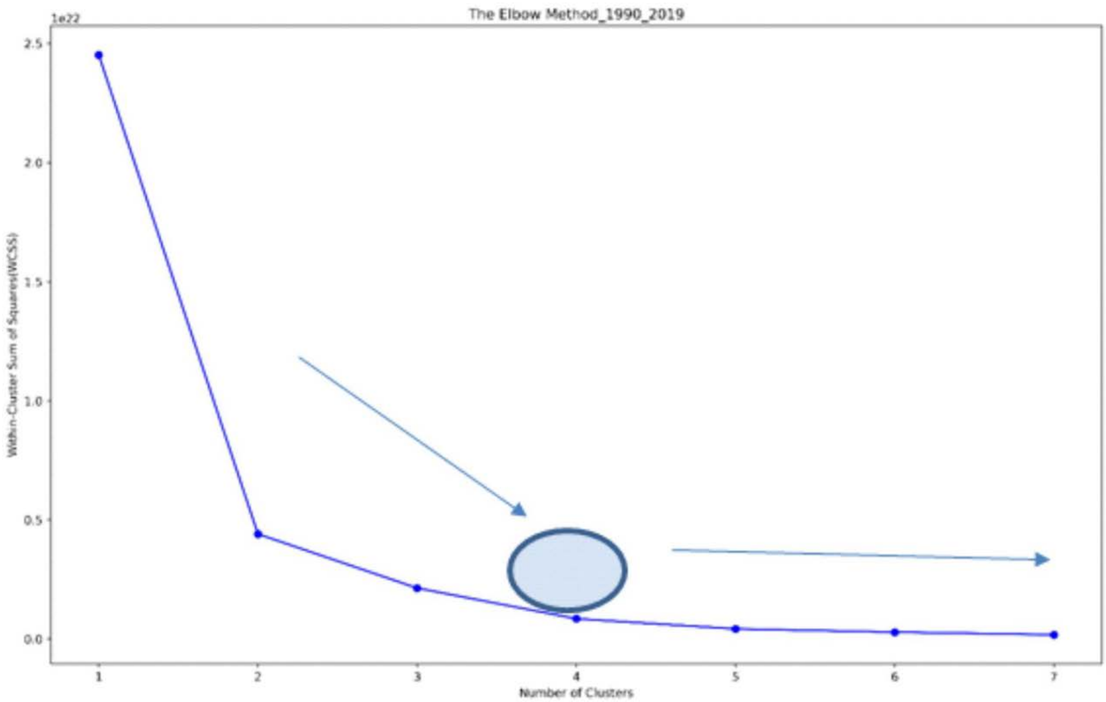

Figure 22: The Elbow Result for 1990-2019 Period

Table 36: Cluster Information in the 1990-2019 Period

	Clusters						
Measures	**1**	**2**	**3**	**4**	**Min**	**Max**	**Mean**
TNOPART	36.43	16.88	8.37	5.41	2	55	10.58
TNOT	76.57	28.92	11.78	8.97	5	109	17.64
Eigen	0.2	0.13	0.01	0.01	0	0.36	0.04
Holes	0.95	0.89	0.84	0.73	0.4	0.97	0.82
Tech_Div_Blau	0.7	0.61	0.53	0.16	0	0.78	0.44
Geo_Div_Blau	0.66	0.5	0.36	0.45	0	0.8	0.43
RepeatedPart	1.69	0.93	0.35	0.74	0	3.67	0.65
Number of Cases in each Cluster	**7**	**24**	**59**	**39**			

Another clustering analysis was also conducted covering three decades, 1990-2019, to see the general positioning established by the Turkish Contracting firms with alliance projects. The table showing the dimensions of clusters and the profiling of these clusters summarized above.

<u>Cluster 1:</u>

Cengiz, Enka, Gama, Güriş, Kolin, Limak, Tekfen, Yüksel

Cluster 1 consists of large and mature construction firms. They are the most experienced firms in forming alliances comparing the other firms in the network.

These firms have denser relationships with numerous partners in the network (Total Number of Ties and Total Number of Partners).

They have prominent positions and are also connected to the most influential actors in the network (Eigenvector Centrality).

They frequently engage in repeated relationships with their existing partners; this, in turn, enhances their capabilities to develop processes and effective routines (Repeated Partners). The projects they undertake with their repeated partners are often megaprojects with extremely high contract values.

Even though these firms undertake numerous projects with different types, they prefer to exploit their existing knowledge and technologies sometimes for short-term profits. They generally prefer to partner with their existing allies for specific project types instead of partnering with new companies. Therefore, these firms are considered more exploitive than explorative.

The firms in **Cluster 1** undertake various project types by utilizing different technologies. Consequently, they are technologically highly diversified (Technical Diversity). They undertake alliance projects in various geographic locations in the world (Geographic Diversity). They have many culturally distant international partners, and these diverse allies encourage the integration of different perspectives.

Cluster 2:

Akfen, Alsim Alarko, Astur, Epik, Gülermak, Günsayıl, Kalyon, Mapa, Makyol, Nurol, Onur Taahhüt, Rönesans, Özaltın, STFA, Tepe, Türkerler, Yapı Merkezi, YDA

Cluster 2 also consists of large and mature construction firms. The majority of these firms have at least two decades of experience in alliancing. They have a moderate number of partners and number of ties in the network comparing to Cluster 1 (Total Number of Ties and Total Number of Partners).

Even though their centrality scores are less than Cluster 1, **Cluster 2** firms are still well-positioned in the network. Correspondingly, many partners of these firms are influential firms in the network (Eigenvector Centrality).

They repeatedly involve in new alliance projects with their existing partners (Repeated Partners). The construction projects undertaken with their repeated partners are often massive, high contract value projects.

Despite their differentiated alliance project types compared to most firms in the network, these firms still prefer to exploit their existing knowledge and technologies with their repeated partners. So, they are also considered as more exploitive than explorative (Repeated Partners).

These firms undertake different types of construction projects with their allies; thus, they are technologically diverse. They have contracts together with their alliance partners in various geographic locations. However, most of these firms' alliance-based operations occur in two or three different geographic locations, mostly in the Middle East, North Africa, Eastern Europe, and Russian Federation. Comparing to Cluster 1, they have moderate culturally distant international partners (Technical Diversity, Geographic Diversity).

Cluster 3: Açılım, Akar, Bahadır Mühendislik, Metgün, etc…

Compared to Cluster 1 and Cluster 2, the majority of these firms are relatively new and medium-sized firms. They have a below-average number of partners and a slightly below-average number of ties (Total Number of Ties and Total Number of Partners).

These companies are not well-positioned in the network, and their partners are not the most powerful actors in the network (Eigenvector Centrality).

They moderately (slightly below average) establish repeated relationships with their existing partners (Repeated Partners). However, the construction projects undertaken with their repeated partners are high contract value projects.

These firms mostly undertake the similar type of projects; however, they try to establish new partnerships. Still, the majority of firms in this cluster are considered as more exploitive than explorative.

These firms mostly undertake one or two project types with their allies. Typically, they are more focused and technologically least diverse in the network (Technical Diversity).

These firms are generally active in the domestic market. They engage in alliances mostly with domestic companies (Geographic Diversity).

Cluster 4: Aga Enerji, Ceylan, Ekon, Ecetur, İntek, Gap İnşaat, etc…

The majority of these firms are small and focused companies. Most of them are established after the year 2000 and engaged in alliance projects typically after 2010. They have a few numbers of alliance projects; consequently, they have the least number of partners and ties (Total Number of Ties and Total Number of Partners).

These companies are not well-positioned in the network, and their partners are not powerful actors in the network. (Eigenvector Centrality)

These firms hardly use repeated ties, and the projects they undertake are relatively small projects with small contract values in the network (Repeated Partners).

Even though they have the least number of alliance projects in the network, they try to undertake different types of projects with their alliance partners (Technical Diversity). They also try new markets by undertaking projects abroad, especially close regions to Turkey such as Middle East, North Africa. Consequently, they engage in alliances with foreign companies (Geographic Diversity).

Since these firms frequently try different project types and new partners, they are considered explorative rather than exploitive.

7.8.2. Cluster Profiling Between 1990-1999

There are 30 firms as the primary contractors in the network between 1990-1999. There are 113 nodes (firms) in the network in this period; the rest of the 83 firms are either foreign companies or secondary companies.

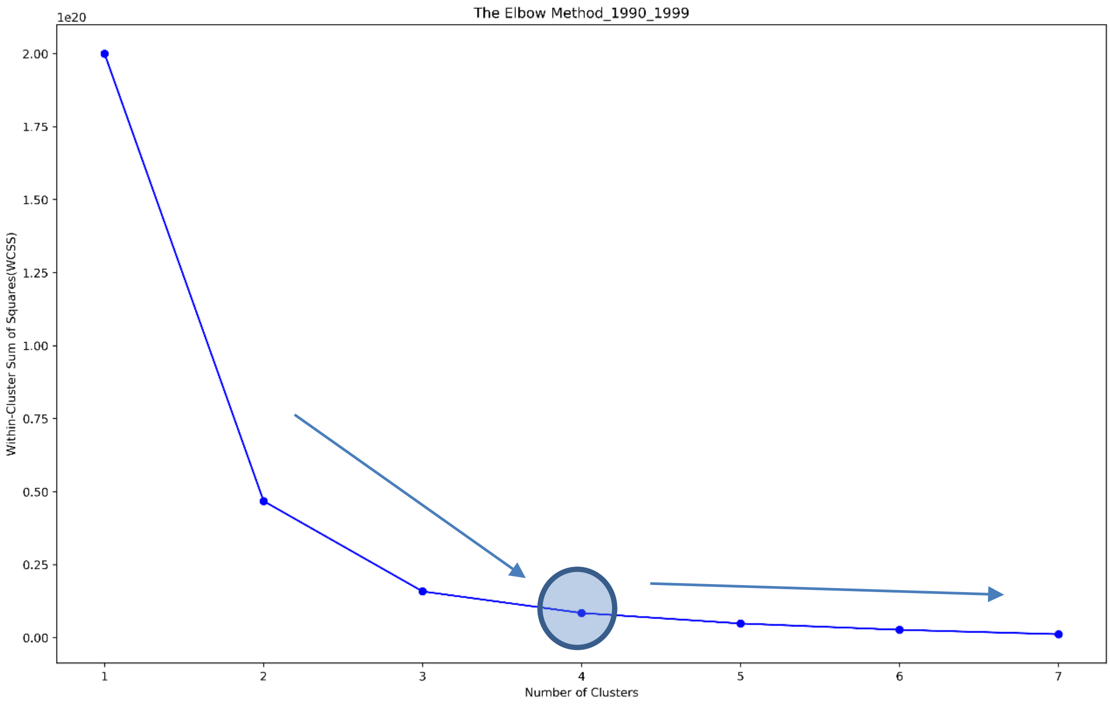

Figure 23: The Elbow Result for 1990-1999 Period

Table 37: Cluster Information in the 1990-1999 Period

	Clusters						
Measures	**1**	**2**	**3**	**4**	**Min**	**Max**	**Mean**
TNOPART	22.00	5.77	2.50	1.64	1.00	28.00	6.20
TNOT	31.75	7.15	5.00	1.64	1.00	39.00	8.27
Eigen	0.35	0.09	0.08	0.01	0	0.41	0.10
Holes	0.92	0.68	0.30	0.18	0	0.95	0.51
Tech_Div_Blau	0.77	0.46	0	0	0	0.86	0.30
Geo_Div_Blau	0.43	0.51	0	0	0	0.67	0.28
RepeatedPart	0.61	0.20	1	0	0	1	0.24
Number of Cases in each Cluster	**4**	**13**	**2**	**11**			

Cluster 1:

Gama, Güriş, Tekfen and Yüksel

In between 1990-1999, Cluster 1 consist of mature contracting firms. The youngest contractor among them, Tekfen, was established in 1968, having more than 50 years of experience in the sector.

The 1990s could be considered as the early years for alliance formation in the Turkish Construction Industry. However, these firms had started to build inter-organizational relationships long before the 1990s, even though they had few alliance projects before this date.

Cluster 1 firms completed a minimum of 12 alliance projects in this period, 22 projects on average. They have formed dense relationships with numerous partners compared to other firms in the network, making their Total Number of Ties and Total Number of Partners the highest. As a result of these dense relationships, they created prominent positions and connected to the most influential actors which are themselves in the network (Eigenvector Centrality).

In the 1990s, the firms in Cluster 1 have mostly partnered with each other and foreign companies for infrastructure projects requiring high technical capacities, such as dams, highways, and metro lines. These firms undertook different project types by utilizing diverse technologies (Technical Diversity). They had many culturally distant international partners with high technological knowledge.

They engage in repeated relationships with their domestic and international partners. Thus, they had the opportunity not only to improve their capabilities but enhance their coordination and trust with their existing partners (Repeated Ties). The projects they completed with their repeated partners during the 1990s were mega projects that newly started to be realized in Turkey.

During the period, Cluster 1 firms often used their existing partners in projects of the same types. They preferred to exploit their knowledge and technologies with the alliance projects they undertook.

Although these firms worked mostly in domestic projects in the 1990s, they carried out most of their international projects in the Turkic republics and countries under the Russian Federation (Geographic Diversity).

Cluster 2:

Akfen, Attila Doğan, Cengiz, Doğuş, Ecetur, Enka, Göçay, İçtaş, Kiska-Kom, Kolin, Limak, Metiş, Nurol

Cluster 2 firms had an average of 15 years of experience in the construction industry in this period. These firms started to engage in alliance projects in the mid-1990s and had four alliance projects on average. Comparing to Cluster 1, these firms had a limited number of partners and number of ties (Total Number of Ties and Total Number of Partners). Thus, their centrality scores were modest in the network (Eigenvector Centrality).

They engaged in repeated relationships with their partners, and projects they undertook with these repeated partners had high contract values (Repeated Ties).

In the 1990s, Firms in Cluster 2 generally realized infrastructure projects with their alliance partners. Their project types are limited during this period (Technical Diversity).

These firms also frequently used their existing partners in projects of the same types. They preferred to exploit their knowledge and technologies with the alliance project they undertook.

Firms in Cluster 2 attempted to expand their overseas operations in the period. Even though their alliance projects were limited in number at the time, these firms executed projects with foreign partners in different geographies (Geographic Diversity).

Cluster 3:

Özdemir, Re-Ha

Firms in Cluster 3 are mature firms having an average of 20 years of experience in the construction sector at the time. However, they had a below-average number of partners and ties compared to other network clusters during the period.

These firms barely had relationships with prominent firms in the network. They frequently used repeated ties, their projects with their repeated partners were mega projects with high contract values. They tried different project types in almost every alliance project they encountered. They explored new technologies, tried different project types and partners, and became exploratory firms between 1990 and 1999.

Firms Cluster 3 typically engaged in alliances with domestic firms, never had foreign partners in this period. They engaged in alliances in domestic projects in general.

Cluster 4:

Alsim Alarko, Ceylan, Eksen, Garanti Koza, Günsayıl, HGG İnşaat, Makyol, Mapa, Polat, STFA, Tepe

Firms in Cluster 4 also were experienced firms in the Turkish Construction Industry at the time. However, engaging in alliance projects was a new phenomenon for these companies during the 1990s. They had the least number of alliance projects among the all clusters. This cluster's average number of alliance projects completed during the period was 1.33, the lowest among the four clusters. Consequently, these firms had the least number of partners and ties, almost no repeated partners, and very scattered relations in the network. They did not have relations with the network's prominent players. Thus, they had insignificant positions in the network

For each project, these firms tried to establish alliances with different partners. They were exploring to start up a new form of doing business during the period.

Most Cluster 4 firms in the period executed only one type of alliance project, primarily focusing on infrastructure projects. These firms executed all of their alliance projects in Turkey, did not attempt to engage in alliance projects abroad.

7.8.3. Cluster Profiling Between 2000-2009

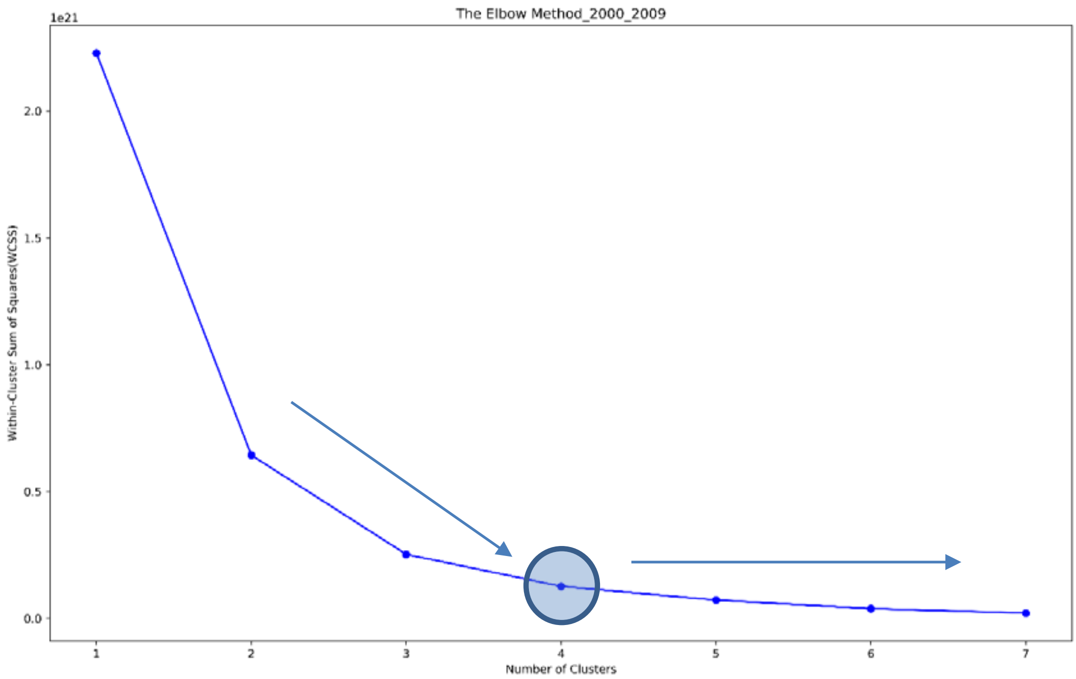

Figure 24: The Elbow Result for 2000-2009 Period

Table 38: Cluster Information in the 2000-2009 Period

Measures	Clusters 1	2	3	4	Min	Max	Mean
TNOPART	19.2	7.05	2.77	1.43	1	27	4.78
TNOT	30	8.62	7.38	1.46	1	42	6.98
Eigen	0.31	0.04	0.01	0.01	0	0.51	0.04
Holes	0.84	0.73	0.3	0.13	-0.12	0.92	0.4
Tech_Div_blau	0.65	0.51	0.39	0.02	0	0.75	0.29
Geo_Div_Blau	0.66	0.48	0.39	0.04	0	0.78	0.29
RepeatedPart	0.44	0.15	0.94	0	0	1.33	0.26
Number of Cases in each Cluster	**5**	**21**	**13**	**28**			

<u>Cluster 1:</u>

Alsim Alarko, Cengiz, Enka, Gama, Tekfen

In between 2000-2009, Cluster 1 consist of mature contracting firms. The youngest contractor among them, Cengiz Insaat, was established in 1969, having more than 50 years of experience in the sector.

These firms realized an average of 20 alliance projects in this period. Comparing to other clusters, these firms have an overwhelming abundance of ties and partners. The size of their networks and the density of their ties made them prominent firms in the network. (Total Number of Ties, Total Number of Partners, Eigenvector Centrality)

In the 2000s, Cluster 1 firms have partnered with foreign companies for industrial projects and energy plants in the Turkic Republics and the Middle East (Geographic Diversity). They had many culturally distant international partners with high technological knowledge.

In this period, the alliance projects they carried out in Turkey were also projects that required high technical capacity, such as metro lines, industrial and energy plants (Technical Diversity).

They engage in repeated relationships with their domestic and international partners. Thus, they had the opportunity to improve their capabilities and enhance their coordination and trust with their existing partners (Repeated Ties).

Although they executed projects with their existing partners, they also searched for new partnerships. They formed new ties with firms new to the network and could do business with the same capacity as themselves. Here, they were able to use the channels in the network to their advantage (Structural Holes).

<u>Cluster 2:</u>

Attila Doğan, Doğuş, Garanti Koza, Gülermak, Günsayıl, Güriş, HGG İnşaat, Kalyon, Kayaoğlu, Kiska-Kom, Kolin, Limak, Makyol, Mapa, Nurol, Onur Taahhüt, Özgün İnşaat, STFA, Yapı Merkezi, YDA İnşaat, Yüksel

Firms in Cluster 2 are highly mature and experienced firms. While the alliance projects STFA and Yüksel date back to the 1970s, the project alliancing of the rest of the companies in this cluster started in the 1990s.

They had an above-average number of partners and ties in the period. They are not as centralized as firms in Cluster 1. Nevertheless, many of them had some joint projects with prominent actors in this period.

On average, their diversity scores, including structural holes scores, were quite high in this period. They have completed diverse alliance projects and carried out these projects in the international arena during the period.

They reformed alliances with their existing partners at a low level but explored the network for new ties. They used the opportunity to tie different parts of the network.

<u>Cluster 3:</u>

Akfen, Astur, Epik, Fernas, Gülsan, Günal, İçtaş, İlci, Metgün, Metiş, STY İnşaat, Tepe, Türkerler

Except for the repeated partner measure, all network characteristics of this group are either slightly above or slightly below average. What makes this group different from the others is that they used existing relationships in almost every project. This group formed many cliques, close cohesive groups, and became highly embedded in the network.

<u>Cluster 4:</u>

Alke, Ceylan, Çelikler, Ecetur, Ermit, Göçay, Gürsesli, Haşemoğlu, Hüsamettin Peker, Makimsan Asfalt, Mesa Mesken, Metag, MSM Altyapı, Özaltın, Özgün Yapı, Özka, Pekintaş, Polat, Rönesans, Sistem Elektromekanik, SMS İnşaat, Söğüt, Taşyapı 2, TAV, Varyap, YP İnşaat, Yıldızlar, YSE Yapı

In this group, some companies are highly mature in the sector and carried out large projects. However, the network characteristics of these companies tell that these companies have recently joined the alliance network at the time and were trying to experience alliancing.

7.8.4. Cluster Profiling Between 2010-2019

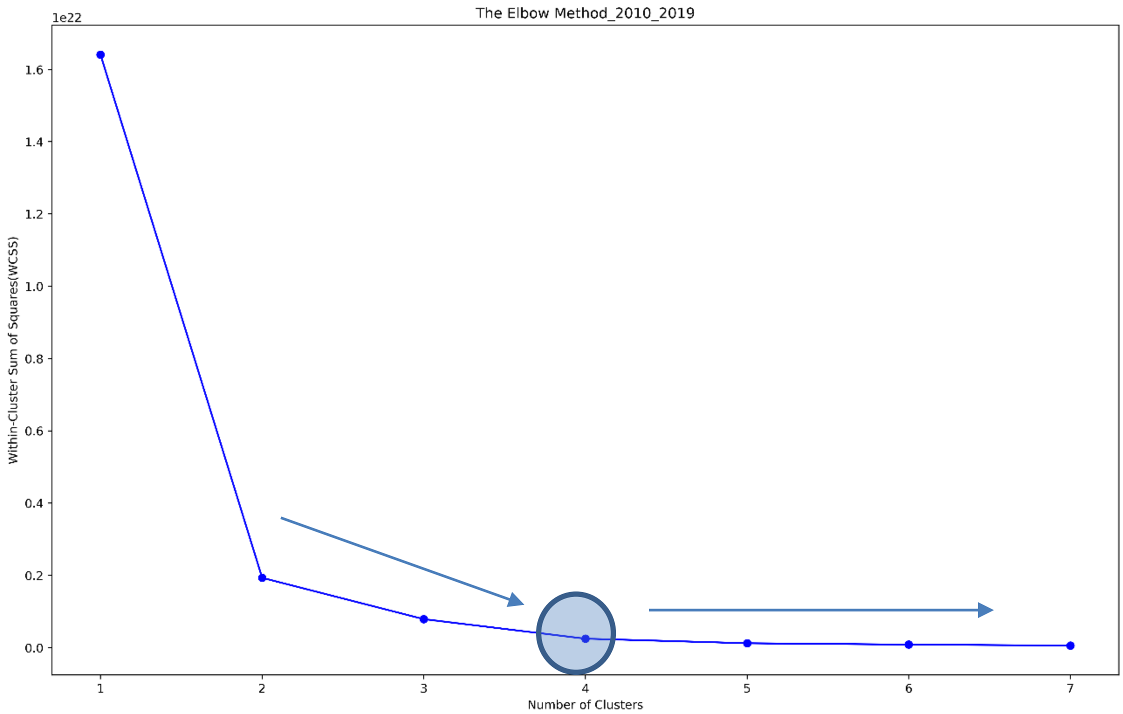

Figure 25: The Elbow Result for 2000-2009 Period

Table 39: Cluster Information in the 2010-2019 Period

	Clusters						
Measures	**1**	**2**	**3**	**4**	**Min**	**Max**	**Mean**
TNOPART	15.53	8.02	3.97	5.83	1	26	7.65
TNOT	28.71	11.29	8.17	8.08	1	53	12.28
Eigen	0.21	0.02	0.02	0.01	0	0.31	0.04
Holes	0.82	0.79	0.55	0.68	0	0.92	0.72
Tech_Div_Blau	0.59	0.52	0.23	0.27	0	0.78	0.41
Geo_Div_Blau	0.46	0.47	0.45	0.12	0	0.74	0.4
RepeatedPart	0.59	0.34	0.86	0.19	0	2	0.47
Number of Cases in each Cluster	**17**	**56**	**30**	**24**			

Cluster 1:

Astur, Cengiz, Göçay, Gülermak, Kalyon, Kolin, Limak, Makyol, Mapa, Nurol, Özaltın, Özdemir, Özgün Yapı, Özka, Türkerler, YDA İnşaat, Yüksel

Large-scale infrastructure, superstructure, transportation, and highway investments were put into practice within the scope of mega projects in the local market starting with the year 2010. Most of these projects were build-operate-transfer models and involved multiple partnerships. Firms in this cluster are the ones that had undertaken the most public tenders. Realizing a large number and various types of projects have made these companies the leading actors in the network between 2010 and 2019.

During the period, these companies carried out majority of their alliance projects in Turkey. However, they did not neglect international alliance projects either.

Cluster 2:

Bahadır Mühendislik, Baytimur, Burkay, Ceylan, Dalgıçlar, Demars, Demce, Dido-Ray, Doğuş, Ecetur, Enka, Ermit, Eskikale, Farsel, Gama, Gürsesli, Haselsan, HGG İnşaat, Hüsamettin Peker, İlci, İntekar, Karaca, Kiska-Kom, KLV İnşaat, KMB Metro, Makimsan Asfalt, M.B.D. İnşaat, Metaleks, MSM Altyapı, Mustafa Ekşi, Nehirsu, Neoray, Nuhoğlu, Öz Aras, Öz Er-Ka, Özkar, Özmert, Öztaş, Peker, Polat, Pramid, Rönesans, Seza, Sigma, Silahtaroğlu, Sistem Elektromekanik, SNH İnşaat, STFA, STY İnşaat, Su-Bar, Şenbay, Taşyapı 2, TAV, Tekfen, Üçer, Yapı Merkezi

This cluster can be named "*the average*." All measure scores of these firms in this cluster are either slightly above or slightly below average. These firms did not use their existing relationships as Cluster 1 and Cluster 3 to form alliances. Instead, they reached new partners in the network with their channels. However, some of the firms in this cluster were the prominent actors of the network in the previous periods. This indicates that these firms did not prefer project alliancing or did not have the opportunity for alliance projects in the period.

Cluster 3:

Açılım, Akfen, Alkataş, Aras, Aydın İnşaat AS, Aydın İnşaat LTD, Çelikler, Diy-mar, Eksen, Ensa, Epik, Fernas, Gülak, Gülsan, Günal, Haşemoğlu, ICC Grup, İçtaş, Kayasan Yapı, Kur İnşaat, Metag, Metro Mühendislik, Onur Taahhüt, Ö.D.F Yılmazlar, Özyurt, Re-Ha, SMS İnşaat, Tepe, YP İnşaat, Yıldızlar

Firms in this cluster differentiated themselves with alliance projects in different geographies and repeated partnerships. They did not focus on different types of projects in their alliances; instead, they preferred few alliance project types in general. They prefer to exploit their existing knowledge and technologies.

<u>Cluster 4:</u>

Alke, Alsim Alarko, Attila Doğan, Caba, Cey Grup, ERK İnşaat, Gaziantep Gold, Günsayıl, Güriş, İnelsan, Kayaoğlu, Mesa Mesken, Metgün, Nas Yapı, Özgün İnşaat, Pekintaş, Rast Madencilik, Serfen, Söğüt, Taş Yapı 1, Uluova, Varyap, Yeni Fidan, YSE Yapı

The network characteristics of these companies tell that some of these companies have recently joined the alliance network and were trying to experience alliancing. However, the average structural hole scores of these firms indicate that these companies can find different channels in the network and have advantageous positions in the future.

Some of the firms in this cluster were the prominent actors of the network in the previous periods. This indicates that these firms did not prefer project alliancing or did not have the opportunity for alliance projects in this period.

7.9. Linking SNA Result with QCA (Using QCA in the Study)

This study used *network data* in the comparative analysis and utilized *fuzzy set scores* in QCA since it allows for gradual data variations. The first step was to define the causes (conditions) of the social phenomena, the alliance network of Turkish contractors. Measures used in cluster analysis are also used in the QCA as *conditions*.

Before using *clustering measures* as conditions in QCA, measures were scaled and adjusted to feed the data to the QCA software. This study applied Z-Score standardization to bring all measures to a similar scale since these measures have different ranges. The Z-Score tells us how many standard deviations a score is from the mean. After the Z-Score standardization, all clustering measures (set as conditions for QCA) were calibrated before feeding them to the QCA software. Calibration rules for the conditions are summarized in the next section, 7.10.

The second step was to define the outcome for QCA. The outcome is defined as the membership scores of clusters produced by K-Means++ cluster analysis in this research. Kmeans++ analysis produced four clusters for each time period. The study utilized fuzzy set scores for the outcomes as well.

The1st cluster includes firms with the overall high combined scores based on dimensions explored. The 4th cluster has the lowest scores, the 2nd and the 3rd clusters fall in between. In order to represent four (4) clusters' membership scores in the QCA as the outcome, each cluster's membership converted to a fuzzy number set, as shown in the below table.

Clusters (produced by kmeans++)	QCA outcome score	Membership
Cluster 1	1	Full
Cluster 2	0.66	Mostly Full
Cluster 3	0.33	Mostly Low
Cluster 4	0	Low

fsQCA software package for QCA calculations is preferred for the current research. QCA software uses combinatorial logic, fuzzy set theory, and Boolean minimization to determine what combinations of case characteristics may be necessary or sufficient to produce an outcome (Kent and Olsen, 2008).

7.10.Conditions, Calibration, and Minimization

This study examined seven different conditions to explain the outcome. The first three conditions, the total number of partners, the total number of ties, and Eigenvector Centrality, are calculated as *network size and positional* dimension. Then, structural holes, technical and geographical diversity are calculated as *network diversity* dimension, whereas the repeated partner is *relational* dimension.

As mentioned before, the study utilized fuzzy set scores for the conditions and the outcomes. Fuzzy set QCA formally analyzes to what degree certain factors or combinations of factors present or absent when a phenomenon of interest occurs or fails to occur. For example, while crisp sets record a value of 1 for membership and 0 for non-membership, alternatively, fuzzy sets allow for degrees of membership of factors. This approach allowed more differentiation and more precise characterization of the cases, thus closer to statistical methods.

Proper calibration of data is critical for set-theoric methods. Six (6) degrees of memberships were applied to the calibration of conditions in the study. Z-Scored measures converted to these 6 degrees of grades; 0.0, 0.2, 0.4, 0.6, 0.8, 1.0. Another reason to keep these scores at 0.2 intervals was not to use the 0.5 membership score. Because, as (Ragin, 2000) states, *"a membership score at 0.5 locates the so-called point of indifference where we do not know whether a case should be considered more a* *member or a non-member of the set."* The six-value fuzzy set of the conditions is listed below;

Z-Score	QCA Condition Score (Fuzzy Value)	Membership
0	0	Fully out
0 < Z-Score ≤ 0.2	0.2	Mostly out
0.2 < Z-Score ≤ 0.4	0.4	More out than in
0.4 < Z-Score ≤ 0.6	0.6	More in than out
0.6 < Z-Score ≤ 0.8	0.8	Mostly in
0.8 < Z-Score ≤ 1.0	1	Fully in

The calibration for the outcome is already defined and covered in the previous section, 7.9. See Appendix A for raw data matrix, calibrated matrix for 1990-2000 data, Appendix B for 2000-2009 data, and Appendix C for 2010-2019 data.

7.11.Configurations of Alliance Network Conditions

QCA assumes that causality in social reality is complex. Therefore, different combinations of conditions can lead to an outcome, and the effect of a condition on the outcome depends on its combination with other conditions (Fischer, 2011).

This study assumes that all conditions positively contribute to the outcome, which is the membership scores of clusters. The presence of the outcome (high performing scores) and absence of the outcome (low performing scores) are analyzed separately for three time periods. A significant insight of QCA is that the conditions related to an outcome's presence can be quite different from those related to its absence (Aversa et al., 2015). Thus, in the first step, all causal conditions are set to be "*present,"* and the outcome set to be "1" to explore high-performing configurations. In the second step, all conditions are set to be *"present,"* and the outcome is set to be "0" to explore low-performing configurations in the fsQCA standard analysis screen for all three time periods, as summarized separately in the following sections.

In the QCA terminology, '*' means the logical 'AND', and '+' represents the logical 'OR'. The tilde sign '~' stands for the absence of a particular condition. The abbreviations of the conditions are also listed as follows. *TNOPart* is the total number of partners, *TNOT* is the total number of ties, *Eigen* is Eigenvector Centrality score, *Repeated_Part* is repeated partners, *Holes* is Structural Holes, *Tech_Div_Blau* is technical diversity, *Geo_Div_Blau* is geographic diversity. *Membership Score* is the outcome for a specific period. For instance, Membership_Score_1990-1999 is the outcome for the period of 1990-1999.

7.11.1. 1990-1999 Period QCA Results

1990-1999 sample consist of 30 contractor firms. The fsQCA software is used for the QCA. The consistency threshold is set to 0.8 as suggested for fuzzy-set QCA. A minimum of 0.8 consistency threshold is also suggested for large-N inquiries (Ragin, 2008). The frequency threshold is the minimum number of times a configuration has to occur. For this period, the frequency threshold is set to "1" since the sample size is small.

Moreover, as stated earlier, the study assumes that all conditions positively contribute to the outcome; this assumption applies to this period as well. Therefore, the directional expectation of conditions to produce the outcome is to be "*present*." The first step is to set the outcome to "1", the presence of the outcome will be analyzed, meaning that the high-performing configurations will be explored. As an alternative, in the second step, the outcome is set to "0", the absence of the outcome will be explored, indicating the low-performing configurations. The QCA software produces three solutions; the complex, the intermediate, and the parsimonious solutions. This study will focus on *intermediate solutions*.

Settings:

Minimizing (Outcome)	Membership_Score_ 1990-1999
Consistency threshold	0.8
Frequency threshold	1
Number of Cases	30
Algorithm	Quine-McCluskey

1990-1999 High-Performing Configurations (The Presence of The Outcome)

The truth table below shows which set of cases share conditions and also share the outcome with consistency scores. These combinations are regarded as the subset of and sufficient for the outcome.

Table 40: 1990-1999 High-Performing Truth Table

CASES		CONDITIONS							OUTCOME
Firms	**CONSISTENCY**	**TNOPart**	**TNOT**	**Eigen**	**Repeated Part**	**Holes**	**Tech_Div Blau**	**Geo_Div_Blau**	**Membership Score 1990_1999**
ceylan, eksen, garanti-koza, hgg-insaat, mapa, polat, stfa, tepe	0.13	0	0	0	0	0	0	0	0
alsim-alarko, gunsayil, makyol	0.42	0	0	0	0	1	0	0	0
metis	1.00	0	0	0	0	1	0	1	1
akfen, attila-dogan, cengiz, dogus, ecetur, enka, gocay, ictas	0.96	0	0	0	0	1	1	1	1
ozdemir	0.70	0	0	0	1	0	0	0	0
re-ha	0.87	0	0	0	1	1	0	0	1
kolin	1.00	0	0	0	1	1	0	1	1
limak	1.00	0	0	0	1	1	1	1	1
nurol	1.00	0	0	1	0	1	0	1	1
kiska-kom	1.00	1	0	1	0	1	1	1	1
gama	1.00	1	1	1	0	1	1	0	1
guris, tekfen, yuksel	1.00	1	1	1	1	1	1	1	1

The purpose of the QCA is to diagnose the conditions or combinations of conditions that are necessary or sufficient for the outcome. A necessary condition must occur for the outcome to occur; the outcome cannot happen without the condition. The truth table analysis shows that there is no necessary condition for this period for the high-performing outcome.

High-Performing Complex Solution for 1990-1999 Period

The fsQCA software produced 6 (six) configurations for the high-performing complex solution with a high consistency level (0.94) and high coverage (0.83). Table 23 below shows the configurations of the complex solution graphically and summarizes coverage and consistency scores for the 1990-1999 period. The black circle (•) indicates the presence of the condition, and the dotted circle (ʘ) its absence. A blank cell is used to indicate the do not care condition.

Table 41: 1990-1999 High-Performing Configurations (The Complex Solution)

1990-1999 High Performing Configurations Identified via fsQCA						
	Configurations					
	1990-1999					
	1	**2**	**3**	**4**	**5**	**6**
Total Number of Partners (TNOPART)	ʘ	ʘ	ʘ	•	•	•
Total Number of Ties (TNOT)	ʘ	ʘ	ʘ	•	•	ʘ
Eigenvector Centrality (EIGEN)	ʘ	ʘ		•	•	•
Structural Holes (HOLES)	•	•	•	•	•	•
Technical Diversity (TECH_DIV_BLAU)		ʘ	ʘ	•	•	•
Geographic Diversity (GEO_DIV_BLAU)	•		•	ʘ	•	•
Repeated Ties (REPEATEDPART)		•	ʘ	ʘ	•	ʘ
Raw coverage	0.59	0.22	0.35	0.18	0.28	0.23
Unique Coverage	0.21	0.04	0.02	0.02	0.02	0.09
Consistency	0.95	0.91	1	1	1	1
Solution coverage	0.84					
Solution consistency	0.94					
Number of cases per analysis	30					

Configuration 1 in the high-performing complex solution for this period has the highest raw coverage (0.59) and unique coverage (0.21) scores among all configurations with a high consistency level (0.95). This configuration can explain 59% of the high-performing outcome. The unique coverage level is also high, and 21% of the cases can be explained exclusively by that formula. Frequently, there is considerable overlap between causal paths, so it is usual for the unique coverage scores to be relatively low, most of the time below 0.15 level. The unique coverage level for other configurations is relatively low. Due to the high coverage and high consistency level, only this configuration and the firms representing this configuration are listed below.

The Formula of Configuration 1:

~TNOPart * ~TNOT * ~Eigen * Holes * Geo_Div_Blau

Cases in Configuration 1:

Attila-Dogan, Gocay, Limak, Akfen, Cengiz, Dogus, Ecetur, Enka, Ictas, Kolin, Metis.

<u>High-Performing Parsimonious Solution for 1990-1999 Period</u>

Table 42: 1990-1999 High-Performing Parsimonious Solution

	raw coverage	**unique coverage**	**consistency**
Geo_Div_Blau	0.86	0.07	0.82
RepeatedPart * Holes	0.51	0.04	0.96
Tech_Div_Blau	0.80	0.07	0.93
solution coverage:	0.99		
solution consistency:	0.83		

Case membership in path *Geo_Div_Blau*:

Akfen, Enka, Gocay, Tekfen, Attila-Dogan, Cengiz, Dogus, Ecetur, Ictas, Kiska-kom, Kolin, Limak, Metis, Nurol, Yüksel, Guris.

Case membership in path *RepeatedPart * Holes*:

Guris, Tekfen, Yüksel, Kolin, Limak, Re-ha.

Case membership in path *Tech_Div_Blau*:

Enka, Gama, Tekfen, Yüksel, Akfen, Attila-Dogan, Gocay, Cengiz, Dogus, Ecetur, Ictas, Kiska-Kom, Limak.

The parsimonious solution reduces the various combinations of conditions to the smallest number of conditions possible. The parsimonious solution, the simplified formula, shows that the "*geographic diversity*" by itself or "*technical diversity*" by itself or "*combination of structural holes together and repeated partners*" are sufficient recipes for developing a high performing alliance network for contractors in the period of 1990-1999 in Turkey. On the other hand, the sufficient solutions "*geographic diversity*" and "*technical diversity*" have higher raw coverage and unique coverage scores than "*the combination of structural holes together and repeated partners*," the number of cases covered by each recipe also shows this result. However, as stated before, this study will focus on intermediate solutions.

<u>High-Performing Intermediate Solution for 1990-1999 Period</u>

The fsQCA software produced 3 (three) sufficient configurations for the high-performing intermediate solution with a high consistency level (0.87) and high coverage

(0.96). Table 25 below shows the configurations of the intermediate solution graphically and summarizes coverage and consistency scores for the 1990-1999 period. The black circle (•) indicates the presence of the condition, and a blank cell is used to indicate the do not care condition. There is no absence of any conditions in the configurations.

Table 43: 1990-1999 High-Performing Configurations of the Intermediate Solution

1990-1999 High Performing Configurations Identified via fsQCA			
(The Intermediate Solution)	**Configurations**		
	1990-1999		
	1	**2**	**3**
Total Number of Partners (TNOPART)			•
Total Number of Ties (TNOT)			•
Eigenvector Centrality (EIGEN)			•
Structural Holes (HOLES)	•	•	•
Technical Diversity (TECH_DIV_BLAU)			•
Geographic Diversity (GEO_DIV_BLAU)		•	
Repeated Partner (REPEATEDPART)	•		
Raw coverage	0.51	0.85	0.42
Unique coverage	0.04	0.33	0.06
Consistency	0.96	0.88	1
Solution coverage	0.96		
Solution consistency	0.87		
Number of cases per analysis	30		

The minimized solution shows 3 (three) sufficient configurations for the presence of the outcome, which is the high-performing alliance network structure of contracting firms.

Case memberships for each path are listed below.

Case membership in path *RepeatedPart * Holes*:

Guris, Tekfen, Yüksel, Kolin, Limak, Re-ha

Case membership in path *Holes * Geo_Div_Blau:*

Enka, Tekfen, Attila-Dogan, Cengiz, Gocay, Ictas, Kiska-Kom, Kolin, Limak, Metis, Nurol, Yüksel, Akfen, Dogus, Ecetur, Guris

Case membership in path *TNOPart * TNOT * Eigen * Holes * Tech_Div_Blau*:

Gama, Yüksel, Guris, Tekfen

Configuration 2, the combination of the presence of *structural holes* and *geographical diversity*, has the highest coverage scores. The consistency score is lowest among others for this configuration but still well above the threshold level. This path in the 1990-1999 period can be interpreted as follow;

Structural Holes theory explains how lack of ties creates benefits to some nodes in a network (Burt, 1992). On the other hand, redundant information is more likely to occur in tightly connected networks. The Turkish construction alliance network is in its infancy in the 1990-1999 period, the network is relatively small, and the relationships are tight. Thus, it became crucial for actors to find paths (structural holes) to connect different parts of the network to create benefits with non-redundant information and resources available in the network during the period.

Figure 26 displays the 1990-1999 construction alliance network in Turkey. The sizes of nodes indicate the nodes' structural holes values. As the structural hole value increases, the size of a node gets bigger. The bridging roles of nodes also can be identified from the figure. Often located in one of the network's structural holes, such nodes work as bridges connecting two or more clusters (sometimes serving as the point of passage between them). The gray areas in the figure below show the structural holes in the network. Considering the overall network, Kiska and Nurol work as bridges in the network. Primarily Kiska-Kom serves as a passage connecting five clusters of firms in the network during the period.

A contracting firm would need different resources and capabilities to perform projects in diverse locations. Even though firms face difficulties when they operate projects in different geographies, the opportunities they get pay off these difficulties. Greater geographic diversity would create greater opportunities for firms, especially gaining diverse perspectives and inter-organizational learning. In this study, geographic diversity measure is calculated based on the focal firm's variety of project locations. In the 1990-1999 period, most alliance projects (roughly 85%) executed by Turkish contractors were in Turkey. Approximately 15% of the alliance projects were completed abroad, mainly in Turkic Republics and Russian Federation. Turkish contractors that have realized alliance projects in different geographies abroad have also been able to differentiate themselves within the network in this period.

Firms Enka, Tekfen, Attila-Dogan, Cengiz, Gocay, Ictas, Kiska-Kom, Kolin, Limak, Metis, Nurol, Yüksel, Akfen, Dogus, Ecetur, Guris are the cases represent this causal path.

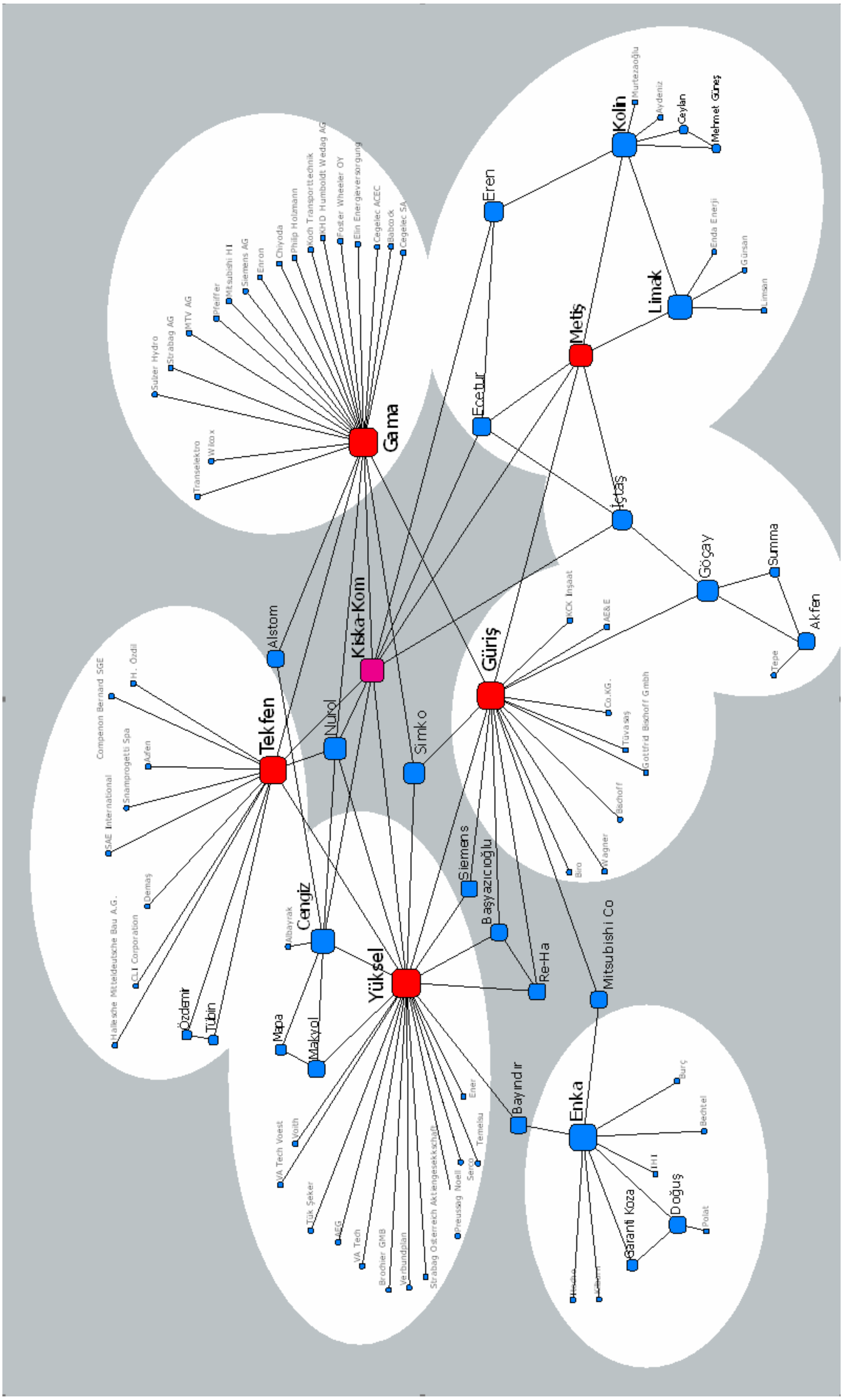

Figure 26: 1990-1999 Construction Alliance Network Based on Structural Holes Values

Configuration 1, the combination of the presence of *structural holes* and *repeated partners,* has the second-highest coverage scores. The consistency score is very high (0.96). This path in the 1990-1999 period can be interpreted as follows;

As stated earlier, the alliance network of Turkish contractors in the 1990-1999 period is relatively small but well connected. It was complex but critical for actors to connect different parts of the network through holes in this period. This, in turn, created benefits through non-redundant information and resources available in the network.

On the other hand, repeated partnerships indicate the partners' satisfaction with their previous collaboration, leading them to form new alliances with the same partner to take advantage of their cooperative dynamics. Trust arises with repeated interactions among alliance partners and provides rich information to partners; as a result, it creates value for partners. However, the negative effect of repeated relations arises when firms get embedded in their networks, their flexibility to form new relations get restricted. Although *structural holes* and *repeated partners* conditions seem opposite concepts, the firms that can achieve both of these conditions could differentiate themselves within the network in the 1990-1999 period. The cases representing this configuration are Guris, Tekfen, Yüksel, Kolin, Limak, and Re-ha.

Configuration 3, the combination of the presence of *total number of ties, total number of partners, Eigenvector centrality, structural holes,* and *technical diversity*, has the least combined coverage scores. The consistency score is highest (1.00) among others. This sufficient path in the 1990-1999 period is directly related to network size and network diversity. Having a large network means that such firms have dense interactions with other firms in the network, providing massive information exchange. Having a centralized position in the network is the result of the actor's network size. More centralized firms can reach information earlier than others; this provides many opportunities for firms such as first-mover advantage.

The second part of the configuration is related to network diversity. Creating benefits through structural holes is significant during the period. Another condition representing diversity in the period is technical diversity. Technical diversity emphasizes the utilization of different technologies by undertaking various project types. The majority of the alliance projects between 1990-1999 period are infrastructure projects. Thus, the construction companies undertook different types of projects other than infrastructure projects such as power plants, metro lines, industrial manufacturing facilities, and airports distinguished themselves in the network in this period.

1990-1999 Low-Performing Configurations (The Absence of The Outcome):

The second step is to explore the absence of the outcome, indicating the low-performing configurations. The outcome is set to "0", the thresholds are kept at the same levels. The QCA software produced two solutions for the absence of the outcome; the complex, the intermediate. The intermediate and parsimonious results are the same for the period. This study will focus on intermediate/parsimonious solutions.

Table 44: 1990-1999 Low-Performing Truth Table:

CASES		CONDITIONS							OUTCOME
Firms	**CONSISTENCY**	**TNOPart**	**TNOT**	**Eigen**	**RepeatedPart**	**Holes**	**Tech_Div_Blau**	**Geo_Div_Blau**	**~Membership Score 1990_1999**
ceylan, eksen, garanti-koza, hgg-insaat, mapa, polat, stfa, tepe	1.00	0	0	0	0	0	0	0	1
alsim-alarko, gunsayil, makyol	1.00	0	0	0	0	1	0	0	1
metis	0.83	0	0	0	0	1	0	1	1
akfen, attila-dogan, cengiz, dogus, ecetur, enka, gocay, ictas	0.56	0	0	0	0	1	1	1	0
ozdemir	0.93	0	0	0	1	0	0	0	1
re-ha	1.00	0	0	0	1	1	0	0	1
kolin	0.81	0	0	0	1	1	0	1	1
limak	0.67	0	0	0	1	1	1	1	0
nurol	0.84	0	0	1	0	1	0	1	1
kiska-kom	0.76	1	0	1	0	1	1	1	0
gama	0.58	1	1	1	0	1	1	0	0
guris, tekfen, yuksel	0.35	1	1	1	1	1	1	1	0

Low-Performing Complex Solution for 1990-1999 Period

The minimized complex solution shows 3 (three) sufficient configurations for the absence of the outcome, which is the low-performing alliance network structure of contracting firms. The Low-Performing complex solution and case memberships for each path are listed below.

Table 45: 1990-1999 Low-Performing Configurations (The Complex Solution)

1990-1999 Low-Performing Configurations Identified via fsQCA			
	Configurations		
	1990-1999		
	1	**2**	**3**
Total Number of Partners (TNOPART)	ʘ	ʘ	ʘ
Total Number of Ties (TNOT)	ʘ	ʘ	ʘ
Eigenvector Centrality (EIGEN)	ʘ	ʘ	
Structural Holes (HOLES)		•	•
Technical Diversity (TECH_DIV_BLAU)	ʘ	ʘ	ʘ
Geographic Diversity (GEO_DIV_BLAU)	ʘ		•
Repeated Partners (REPEATEDPART)			ʘ
Raw coverage	0.76	0.43	0.22
Unique coverage	0.42	0.00	0.01
Consistency	0.99	0.89	0.80
Solution coverage	0.86		
Solution consistency	0.92		
Number of cases per analysis	30		

Case membership in path

~TNOPart*~TNOT*~Eigen*~Tech_Div_Blau*~Geo_Div_Blau:

Eksen, Hgg-Insaat, Stfa, Alsim-Alarko, Ceylan, Garanti-Koza, Gunsayil, Makyol, Mapa, ozdemir, Polat, Tepe, Re-ha

Case membership in path

~TNOPart*~TNOT*~Eigen*Holes*~Tech_Div_Blau:

Alsim-Alarko, Gunsayil, Kolin, Makyol, Metis, Re-ha

Case membership in path

~TNOPart*~TNOT*~RepeatedPart*Holes*~Tech_Div_Blau*Geo_Div_Blau:

Metis, Nurol

Configuration 1 in the low-performing complex solution for this period has the highest raw coverage (0.76) and unique coverage (0.42) scores among all configurations with a high consistency level (0.99). This configuration can explain 76% of the low-performing outcome. In this path absence of network size conditions and the absence of two diversity conditions, structural holes and technical diversity, cause a low-performing alliance network structure for contracting firms in the 1990-1999 period.

<u>Low-Performing Intermediate Solution for 1990-1999 Period</u>

Table 46: 1990-1999 Low-Performing Intermediate Solution

	raw coverage	**unique coverage**	**consistency**
~Tech_Div_Blau	0.95	0.95	0.86

Case membership in path ~*Tech_Div_Blau:*

Alsim-Alarko, Ceylan, Eksen, Garanti-Koza, Gunsayil, Hgg-Insaat, Makyol, Mapa, Metis, Nurol, Ozdemir, Polat, Re-ha, Stfa, Tepe, Kolin

The intermediate and parsimonious results are the same in this period, with high coverage and consistency levels. The absence of *technical diversity* can explain 95% of the low-performing cases. As can be seen in the complex solution table, *technical diversity* is absent in all three configurations. The absence of *technical diversity* in alliance projects ensures that a firm is in a low-membership cluster within the alliance network. However, this result does not mean that these contracting firms do not have technical diversity; it shows that they choose certain types of projects for alliancing.

7.11.2. 2000-2009 Period QCA Results

2000-2009 sample consist of 67 contractor firms. The fsQCA software is used for the QCA. The consistency threshold is set to 0.8 as suggested for fuzzy-set QCA and large-N cases. The frequency threshold is the minimum number of times a configuration has to occur. For this period, the frequency threshold is set to "2" since the sample size is increased to 67, more than doubled the previous period's sample size. Again, the study assumes that conditions positively contribute to the outcome in the period. Therefore, the directional expectation of conditions to produce the outcome is set to be "*present*" in the fsQCA standard analysis screen for the solution.

In the first step, the outcome is set to "1", the presence of the outcome will be analyzed to explore the high-performing configurations. In the second step, the outcome is set to "0", the absence of the outcome will be explored, indicating the low-performing configurations. The QCA software produces three solutions; the complex, the intermediate, and the parsimonious solutions. This study will focus on the *intermediate solutions* in the period of 2000-2009 as well.

Settings:

Minimizing (Outcome)	Membership_Score_ 2000-2009
Consistency threshold	0.8
Frequency threshold	2
Number of Cases	67
Algorithm	Quine-McCluskey

2000-2009 High-Performing Configurations (The Presence of The Outcome)

The truth table below shows which set of cases share conditions and also share the outcome with consistency scores. These combinations are regarded as the subset of and sufficient for the outcome

Table 47: 2000-2009 High-Performing Truth Table

CASES		CONDITIONS							OUTCOME
Firms	**CONSISTENCY**	**TNOPart**	**TNOT**	**Eigen**	**RepeatedPart**	**Holes**	**Tech_Div_Blau**	**Geo_Div_Blau**	**Membership Score 2000_2009**
alke, ecetur, ermit, gocay, gursesli, husamettin-peker, makimsan-asfalt, metag, msm-altyapi, ozgun-yapi, ozka, polat, ronesans, sistem-elektromekanik, sms-insaat, sogut, tav, varyap, yp-insaat, yildizlar, yse-yapi	0.30	0	0	0	0	0	0	0	0
mesa-mesken, ozaltin, pekintas, tasyapi-2	0.54	0	0	0	0	1	0	0	0
celikler, hasemoglu, ozgun-insaat	0.81	0	0	0	0	1	0	1	1
garanti-koza, turkerler	0.89	0	0	0	0	1	1	0	1
attila-dogan, dogus, gulermak, guris, hgg-insaat, kalyon, kayaoglu, kiska-kom, kolin, makyol, mapa, nurol, onur-taahhut, yapi-merkezi, yda-insaat	0.95	0	0	0	0	1	1	1	1
epik, metis	0.78	0	0	0	1	0	0	1	0
fernas, metgun	0.87	0	0	0	1	1	0	1	1
gunal, ictas, ilci, sty-insaat	0.85	0	0	0	1	1	1	1	1
cengiz, limak, stfa, yuksel	1.00	1	1	0	0	1	1	1	1
alsim-alarko, gama	1.00	1	1	1	0	1	1	1	1

The purpose of the QCA is to diagnose the conditions or combinations of conditions that are necessary or sufficient for the outcome. A necessary condition must occur for the outcome to occur; the outcome cannot happen without the condition. The truth table analysis shows that there is no necessary condition for this period for the high-performing outcome.

High-Performing Complex Solution for 2000-2009 Period

The software produced 3 (three) configurations with a 0.80 consistency and 0.83 coverage level for the complex solution. For each configuration, the consistency and coverage levels are also shown in the configuration table below.

In the table below, the black circle (•) indicates the presence of the condition, and the dotted circle (Θ) its absence. A blank cell is used to indicate the do not care condition.

Table 48: 2000-2009 High-Performing Configurations (The Complex Solution)

2000-2009 High Performing configurations identified via fsQCA			
The Complex Solution	**Configurations**		
	2000-2009		
	1	**2**	**3**
Total Number of Partners (TNOPART)	Θ	Θ	•
Total Number of Ties (TNOT)	Θ	Θ	•
Eigenvector Centrality (EIGEN)	Θ	Θ	
Structural Holes (HOLES)	•	•	•
Technical Diversity (TECH_DIV_BLAU)		•	•
Geographic Diversity (GEO_DIV_BLAU)	•		•
Repeated Partners (REPEATEDPART)		Θ	Θ
Raw coverage	0.68	0.64	0.41
Unique coverage	0.09	0.05	0.10
Consistency	0.80	0.90	1.00
Solution coverage	0.83		
Solution consistency	0.80		
Number of cases per analysis	67		

Cases representing each configuration are listed below.

Case membership in path ***~TNOPart*~TNOT*~Eigen*Holes*Geo_Div_Blau***

Hgg-Insaat, Kalyon, Kayaoglu, Kolin, Mapa, Onur-Taahhut, Ozgun-Insaat, Yda-Insaat, Attila-Dogan, Celikler, Dogus, Fernas, Gulermak, Gunal, Guris, Hasemoglu, Ictas, Ilci, Kiska-Kom, Makyol

Case membership in path

~TNOPart*~TNOT*~Eigen*~RepeatedPart*Holes*Tech_Div_Blau:

Dogus, Hgg-Insaat, Kalyon, Makyol, Onur-Taahhut, Yda-Insaat, Attila-Dogan, Garanti-Koza, Gulermak, Guris, Kayaoglu, Kiska-Kom, Kolin, Mapa, Nurol, Turkerler, Yapi-Merkezi

Case membership in path

TNOPart*TNOT*~RepeatedPart*Holes*Tech_Div_Blau*Geo_Div_Blau:

Alsim-Alarko, Cengiz, Gama, Limak, Stfa, Yüksel

Configuration 1 in the high-performing complex solution for this period has the highest raw coverage (0.68) and second-highest unique coverage (0.09) scores among all configurations with a high consistency level (0.80). This configuration can explain 68% of the high-performing outcome. The unique coverage score shows that 9% of the cases are uniquely explained by that recipe, indicating considerable overlap between recipes.

Since complex solutions neglect the logical remainders, intermediate solutions which consider theoretically possible remainders will be used for interpretation.

<u>High-Performing Parsimonious Solution for 2000-2009 Period</u>

Table 49: 2000-2009 High-Performing Parsimonious Solution

	raw coverage	**unique coverage**	**consistency**
Tech_Div_Blau	0.90	0.07	0.70
Holes*Geo_Div_Blau	0.88	0.06	0.78
solution coverage:	0.96		
solution consistency:	0.65		

Case membership in path *Tech_Div_Blau*:

Akfen, Alsim-Alarko, Gunsayil, Dogus, Enka, Gunal, Kalyon, Limak, Makyol, Nurol, Stfa, Sty-Insaat, Tekfen, Tepe, Turkerler, Yda-Insaat, Attila-Dogan, Cengiz, Gama

Case membership in path *Holes*Geo_Div_Blau*:

Yüksel, Enka, Tekfen, Gama, Yapi-Merkezi, Yda-Insaat, Alsim-Alarko, Kolin, Cengiz Limak, Mapa, Nurol, Onur-Taahhut, Ozgun-Insaat, Gunsayil, Guris, Hgg-Insaat, Kalyon, Kayaoglu, Attila-Dogan

The parsimonious solution, the simplified formula, shows that the "*technical diversity*" by itself or "*combination of structural holes and geographic diversity*" are sufficient recipes for developing a high-performing alliance network for contractors in the period of 2000-2009 in Turkey. On the other hand, the sufficient solutions "*technical diversity*" have slightly higher raw coverage and unique coverage scores than "*the combination of structural holes and geographic diversity*." However, the overall consistency scores and consistency score of each path is below the threshold level. This would be another reason for the period to focus on the intermediate solution.

<u>High-Performing Intermediate Solution for 2000-2009 Period</u>

The fsQCA software produced 2 (two) sufficient configurations for the high-performing intermediate solution with 0.78 consistency level and high coverage (0.96). Table 32 below shows the configurations of the intermediate solution graphically and summarizes coverage and consistency scores for the 2000-2009 period. The black circle (•) indicates the presence of the condition, and a blank cell is used to indicate the do not care condition. There is no absence of any conditions in the configurations.

Table 50: 2000-2009 High-Performing Configurations of the Intermediate Solution

2000-2009 High Performing configurations identified via fsQCA		
The Intermediate Solution	**Configurations**	
	2000-1999	
	1	**2**
Total Number of Partners (TNOPART)		
Total Number of Ties (TNOT)		
Eigenvector Centrality (EIGEN)		
Structural Holes (HOLES)	•	•
Technical Diversity (TECH_DIV_BLAU)	•	
Geographic Diversity (GEO_DIV_BLAU)		•
Repeated Partners (REPEATEDPART)		
Raw coverage	0.89	0.88
Unique coverage	0.07	0.06
Consistency	0.80	0.80
Solution coverage	0.96	
Solution consistency	0.78	
Number of cases per analysis	67	

Case memberships for each path are listed below.

Case membership in path *Holes*Tech_Div_Blau*:

Alsim-Alarko, Dogus, Enka, Gunsayil, Kalyon, Limak, Makyol, Nurol, Stfa, Tekfen, Yda-Insaat, Cengiz, Gama, Gunal, Guris, Hgg-Insaat, Mapa, Onur-Taahhut, Sty-Insaat, Akfen

Case membership in path *Holes*Geo_Div_Blau:*

Yüksel, Enka, Tekfen, Gama, Yapi-Merkezi, Yda-Insaat, Alsim-Alarko, Kolin, Cengiz, Limak, Mapa, Nurol, Onur-Taahhut, Ozgun-Insaat, Gunsayil, Guris, Hgg-Insaat, Kalyon, Kayaoglu, Attila-Dogan

Configuration 1, the combination of the presence of *structural holes* and *technical diversity,* has slightly higher coverage scores. The consistency scores of the two configurations are the same at the threshold level. This path in the 2000-2009 period can be interpreted as follow;

The Turkish construction alliance network is expanded in the 2000-2009 period comparing to the previous period. Some of the new firms in the network have partnered with existing firms in the network, while others have established partnerships among themselves. In this period, even cliques, close coherent groups, were formed within the network by these newcomers. Thus, in this period, actors needed to find passages to connect lately established parts of the network to create benefits with non-redundant information and resources newly available in the network. Indeed, the firms that were able to achieve this were those with high structural hole levels.

A total of 350 alliance projects were carried out in this period within the network. One-third of these are infrastructure projects, and also, the new types of projects were realized in the period. The number of power plant, industrial facility, airport, and metro line projects has increased, and the number of companies that have realized such projects has also increased. These projects had high contract values that have usually been realized with more than two partner firms during the period. The importance of technical diversity reveals itself in this period as well.

Firms that could combine these two conditions, structural holes and technical diversity, were able to differentiate themselves within the network and had the high-performing alliance network structure in this period.

Configuration 2, the combination of the presence of *structural holes* and *geographic diversity*, has slightly lover coverage scores than the first configuration. The consistency scores of the two configurations are the same at the threshold level. Overall, the two configurations are equally sufficient for contracting firms to establish a high-performing alliance network structure in this period. The explanation of structural holes condition is already covered for the period. The geographical diversity for the period can be summarized as follows. Almost half of the alliance projects of Turkish contractors between 2000 and 2010 were overseas projects. In the new millennium, Turkish contractors increased the number of countries they work in tremendously. Their international projects shifted from relatively low value-added construction areas such as housing to high value-added construction such as industrial facilities airports. Therefore, contracting firms that could combine these two conditions, structural holes and geographical diversity, were able to differentiate themselves within the network and had the high-performing alliance network structure in this period.

As seen from the high-performing configurations, the structural hole condition is common in both configurations. The below figure shows the 2000-2009 construction alliance network in Turkey. The sizes of nodes indicate the nodes' structural holes values. As the structural hole value increases, the size of a node gets bigger. In addition to the actors that connect different parts of the network, the gaps and the possible bridges in the network can be noticed from the figure.

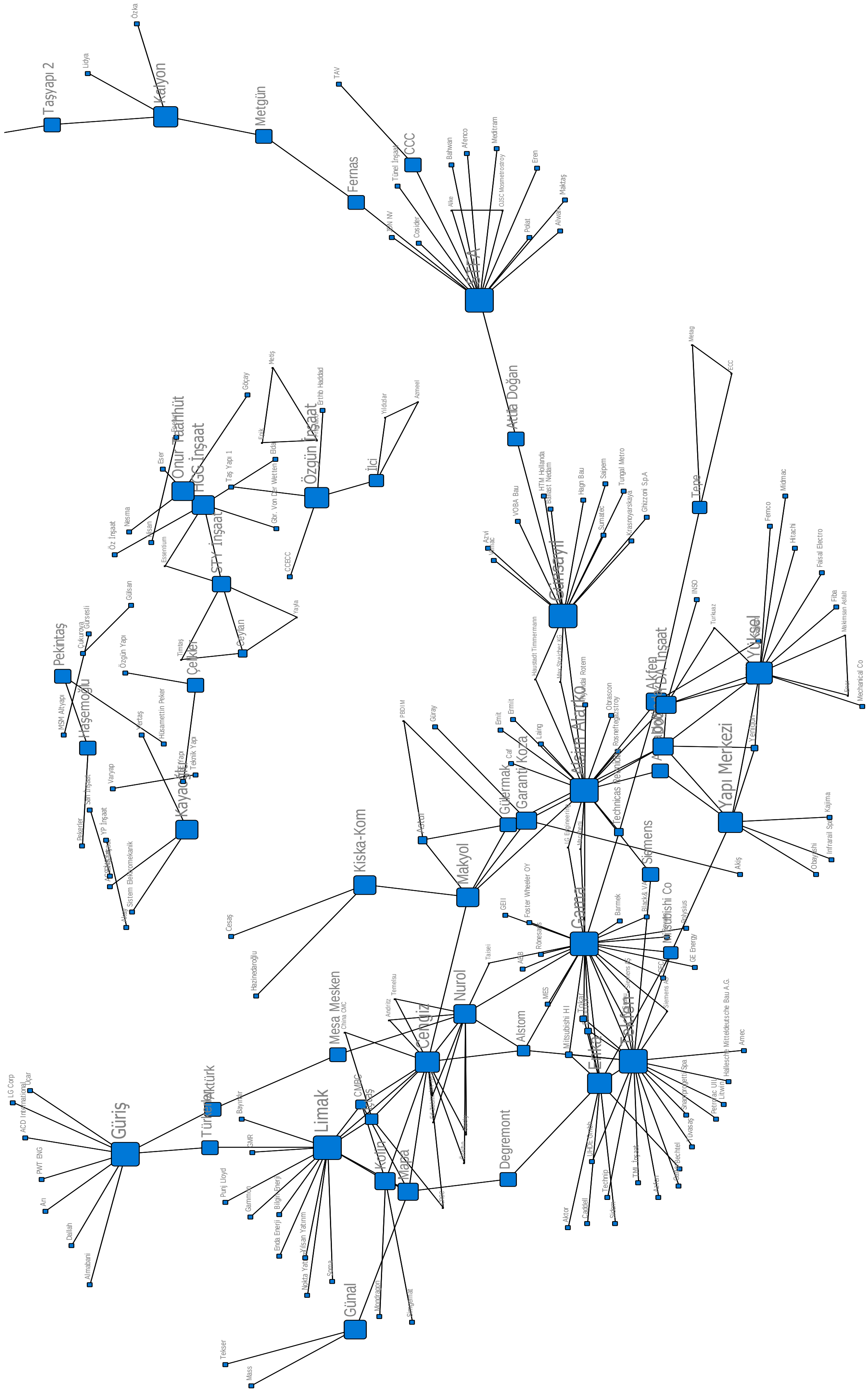

Figure 27: 2000-2009 Construction Alliance Network Based on Structural Holes Values

2000-2009 Low-Performing Configurations (The Absence of The Outcome):

The second step is to explore the absence of the outcome, indicating the low-performing configurations. The outcome is set to "0", the thresholds are kept at the same levels. The QCA software produced two solutions for the absence of the outcome; the complex, the intermediate. The intermediate and parsimonious results are the same for the period. This study will focus on intermediate solutions.

Table 51: 2000-2009 Low-Performing Truth Table:

CASES		CONDITIONS							OUTCOME
Firms	**CONSISTENCY**	**TNOPart**	**TNOT**	**Eigen**	**RepeatedPart**	**Holes**	**Tech_Div_blau**	**Geo_Div_Blau**	**~Membership Score 2000_2009**
alke, ecetur, ermit, gocay, gursesli, husamettin-peker, makimsan-asfalt, metag, msm-altyapi, ozgun-yapi, ozka, polat, ronesans, sistem-elektromekanik, sms-insaat, sogut, tav, varyap, yp-insaat, yildizlar, yse-yapi	1.00	0	0	0	0	0	0	0	1
mesa-mesken, ozaltin, pekintas, tasyapi-2	0.97	0	0	0	0	1	0	0	1
celikler, hasemoglu, ozgun-insaat	0.88	0	0	0	0	1	0	1	1
garanti-koza, turkerler	0.88	0	0	0	0	1	1	0	1
attila-dogan, dogus, gulermak, guris, hgg-insaat, kalyon, kayaoglu, kiska-kom, kolin, makyol, mapa, nurol, onur-taahhut, yapi-merkezi, yda-insaat	0.58	0	0	0	0	1	1	1	0
epik, metis	1.00	0	0	0	1	0	0	1	1
fernas, metgun	0.93	0	0	0	1	1	0	1	1
gunal, ictas, ilci, sty-insaat	0.85	0	0	0	1	1	1	1	1
cengiz, limak, stfa, yuksel	0.70	1	1	0	0	1	1	1	0
alsim-alarko, gama	0.60	1	1	1	0	1	1	1	0

Low-Performing Complex Solution for 2000-2009 Period

The minimized complex solution shows 5 (five) sufficient configurations for the absence of the outcome, which is the low-performing alliance network structure of contracting firms. The Low-Performing complex solution and case memberships for each path are listed below. The first configuration, which is the absence of all conditions except structural holes, has the highest coverage and consistency levels, raw coverage:0.63, unique coverage:0.35, consistency:0.99.

Table 52: 2000-2009 Low-Performing Configurations (The Complex Solution)

2000-2009 LowPerforming configurations identified via fsQCA					
The Complex Solution	**Configurations**				
	2000-2009				
	1	**2**	**3**	**4**	**5**
Total Number of Partners (TNOPART)	ʘ	ʘ	ʘ	ʘ	ʘ
Total Number of Ties (TNOT)	ʘ	ʘ	ʘ	ʘ	ʘ
Eigenvector Centrality (EIGEN)	ʘ	ʘ	ʘ	ʘ	ʘ
Structural Holes (HOLES)		•		•	•
Technical Diversity (TECH_DIV_BLAU)	ʘ		ʘ		ʘ
Geographic Diversity (GEO_DIV_BLAU)	ʘ	ʘ	•	•	•
Repeated Partners (REPEATEDPART)	ʘ	ʘ	•	•	
Raw coverage	0.63	0.34	0.12	0.17	0.16
Unique coverage	0.35	0.05	0.02	0.05	0.04
Consistency	0.99	0.93	0.94	0.87	0.89
Solution coverage	0.84				
Solution consistency	0.94				
Number of cases per analysis	67				

Case membership in path

~TNOPart*~TNOT*~Eigen*~RepeatedPart*~Tech_Div_Blau*~Geo_Div_Blau: *Ecetur, Gocay, Gursesli, Husamettin-Peker, Msm-Altyapi, Ozgun-Yapi, Ozka, Sistem-Elektromekanik, Sms-Insaat, Tav, Varyap, Yp-Insaat, Yse-Yapi, Alke, Ermit, Makimsan-Asfalt, Mesa-Mesken, Metag, Ozaltin, Pekintas*

Case membership in path

~TNOPart*~TNOT*~Eigen*~RepeatedPart*Holes*~Geo_Div_Blau:

Garanti-Koza, Mesa-Mesken, Ozaltin, Pekintas, Tasyapi-2, Turkerler

Case membership in path

~TNOPart*~TNOT*~Eigen*RepeatedPart*~Tech_Div_Blau*Geo_Div_Blau: *Epik, Fernas, Metgun, Metis*

Case membership in path

~TNOPart*~TNOT*~Eigen*RepeatedPart*Holes*Geo_Div_Blau:

Fernas, Gunal, Ictas, Ilci, Metgun, Sty-Insaat

Case membership in path

~TNOPart*~TNOT*~Eigen*~RepeatedPart*Holes*~Tech_Div_Blau:

Celikler, Hasemoglu, Mesa-Mesken, Ozaltin, Ozgun-Insaat, Pekintas, Tasyapi-2

Low-Performing Intermediate Solution for 2000-2009 Period

Table 53: 2000-2009 Low-Performing Intermediate Solution

2000-2009 Low Performing configurations identified via fsQCA			
(The Intermediate Solution)	**Configurations**		
	2000-2009		
	1	**2**	**3**
Total Number of Partners (TNOPART)			
Total Number of Ties (TNOT)			
Eigenvector Centrality (EIGEN)			
Structural Holes (HOLES)			
Technical Diversity (TECH_DIV_BLAU)		ʘ	
Geographic Diversity (GEO_DIV_BLAU)	ʘ		
Repeated Partners (REPEATEDPART)			•
Raw coverage	0.82	0.80	0.25
Unique coverage	0.05	0.06	0.05
Consistency	0.95	0.94	0.73
Solution coverage	0.97		
Solution consistency	0.86		
Number of cases per analysis	67		

***Case membership in path* ~Geo_Div_Blau:**

Alke, Ceylan, Ecetur, Ermit, Garanti-Koza, Gocay, Gulsan, Gursesli, Husamettin-Peker, Makimsan-Asfalt, Mesa-Mesken, Metag, Msm-Altyapi, Ozaltin, Ozgun-Yapi, Ozka, Pekintas, Polat, Ronesans, Sistem-Elektromekanik

***Case membership in term* ~Tech_Div_Blau:**

Alke, Celikler, Ecetur, Epik, Ermit, Fernas, Gocay, Gursesli, Hasemoglu, Husamettin-Peker, Makimsan-Asfalt, Mesa-Mesken, Metag, Metgun, Metis, Msm-Altyapi, Ozaltin, Ozgun-Yapi, Ozka, Pekintas

***Case membership in term* RepeatedPart:**

Akfen, Tepe, Epik, Fernas, Gulsan, Gunal, Ictas, Ilci, Metgun, Metis, Enka, Sty-Insaat, Tekfen

The intermediate and parsimonious results are the same in this period, with high coverage (0.97) and consistency (0.86) levels. The absence of *geographic diversity* or absence of *technical diversity*, or the presence of *repeated partners* are causal paths indicating low-performing alliance network structures in the period.

The absence of geographic diversity can explain 82% of the low-performing cases, the absence of technical diversity can explain 80%. The coverage and consistency levels of the presence of repeated partners are lowest among all low-performing paths, but still, important players in the network are in this cluster. This path can be interpreted especially through Tepe, Akfen, and Enka. Tepe and Akfen partnered in 19 projects during this period, and they had only a few partners apart from each other. On the other hand, Enka had 20 projects during the period and engaged in alliances with its foreign partners Bechtel and Cadell 16 times in international projects. Engaging in repeated partnerships enables firms to gain many benefits, such as enhancing alliance capabilities and developing effective routines to access information resulting in better management of alliances. However, the reverse effect of this dimension occurs when firms are embedded in their existing networks, this will block their flexibility in forming new ties (Koka and Prescott, 2002).

Having geographic and technical diversities in this period is significant for firms. More than half of the firms in the period had at least one project executed abroad. Therefore, firms with no international experience lagged behind other firms in the network. The absence of technical diversity in alliance projects in this period ensured that a firm is in a low-membership cluster within the alliance network. However, this result does not mean that these contracting firms do not have technical diversity or geographical diversity; it shows that they chose certain types of projects for alliancing and executing alliance projects in Turkey.

7.11.3. 2010-2019 Period QCA Results

2010-2019 sample consist of 127 contractor firms. The consistency threshold is set to 0.8 as suggested for fuzzy-set QCA. The frequency threshold is the minimum number of times a configuration has to occur. For this period, the frequency threshold is set to "2" since the sample size increased gradually since the first period.

The study assumes that conditions positively contribute to the outcome in the period. Therefore, all causal conditions are set to be "*present*" in the fsQCA standard analysis for the solutions.

The outcome is set to "1" in fsQCA as the first step to analyze the presence of the outcome in order to explore the high-performing configurations. As an alternative, in the second step, the outcome is set to "0", the absence of the outcome will be explored, indicating the low-performing configurations. *Intermediate solutions* will be the focus for interpreting the results.

Settings:

Minimizing (Outcome)	Membership_Score_ 2010-2019
Consistency threshold	0.8
Frequency threshold	2
Number of Cases	127
Algorithm	Quine-McCluskey

2010-2019 High-Performing Configurations (The Presence of The Outcome)

The truth table below shows which set of cases share conditions and also share the outcome with consistency scores. These combinations are regarded as the subset of and sufficient for the outcome.

Table 54: 2010-2019 High-Performing Truth Table

Firms	CONSISTENCY	TNOPart	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	Membership Score 2010_2019
attila-dogan, guris	0.66	0	0	0	0	0	0	0	0
caba, cey-grup, erk-insaat, gaziantep-gold, kayaoglu, mesa-mesken, ozgun-insaat, sogut	0.61	0	0	0	0	1	0	0	0
acilim, aydin-insaat-as, aydin-insaat-ltd, bahadir-muhendislik, diy-mar, eksen, eskikale, gulak, gulsan, hasemoglu, karaca, mustafa-eksi, nehirsu, odf-yilmazlar, pekintas, sms-insaat, varyap, yeni-fidan	0.72	0	0	0	0	1	0	1	0
alke, alsim-alarko, gunsayil, haselsan, metgun, nas-yapi, rast-madencilik, serfen, tas-yapi-1, uluova, yse-yapi	0.70	0	0	0	0	1	1	0	0
ceylan, dalgiclar, demars, demce, dido-ray, dogus, ecetur, farsel, gursesli, hgg-insaat, husamettin-peker, ilci, inelsan, klv-insaat, kmb-metro, makimsan-asfalt, mbd-insaat, metaleks, msm-altyapi, neoray, oz-er-ka, ozkar, ozmert, peker, polat, re-ha, seza, silahtaroglu, sistem-elektromekanik, snh-insaat, stfa, sty-insaat, su-bar, senbay, tasyapi-2, tav, ucer	0.88	0	0	0	0	1	1	1	1
ensa, kayasan-yapi, kur-insaat, metag, onur-taahhut, yp-insaat, yildizlar	0.79	0	0	0	1	1	0	1	0
alkatas, ozyurt	0.80	0	0	0	1	1	1	0	1
baytimur, celikler, enka, fernas, gama, gunal, icc-grup, oztas, tekfen, tepe	0.86	0	0	0	1	1	1	1	1
astur, gulermak, kiska-kom	0.94	0	0	1	0	1	1	1	1
ictas, ozgun-yapi	0.92	0	0	1	1	1	1	1	1
ermit, intekar, nuhoglu, pramid, ronesans, sigma, yapi-merkezi	0.92	1	0	0	0	1	1	1	1
gocay, nurol	0.94	1	0	1	0	1	1	1	1
oz-aras, ozdemir	0.92	1	1	0	0	1	1	1	1
cengiz, kalyon, limak, mapa, ozaltin, yda-insaat, yuksel	0.95	1	1	1	0	1	1	1	1

High-Performing Complex Solution for 2010-2019 Period

The software produced 3 (three) configurations with a high consistency level (0.85) and a modest coverage (0.72). For each configuration, the consistency and coverage levels are also shown in the configuration table below.

In the table below, the black circle (•) indicates the presence of the condition, and the dotted circle (Ꙩ) its absence. A blank cell is used to indicate the do not care condition.

Table 55: 2010-2019 High-Performing Configurations (The Complex Solution)

2010-2019 High Performing configurations identified via fsQCA			
The Complex Solution	**Configurations**		
	2010-2019		
	1	**2**	**3**
Total Number of Partners (TNOPART)	Ꙩ	•	Ꙩ
Total Number of Ties (TNOT)	Ꙩ		Ꙩ
Eigenvector Centrality (EIGEN)			Ꙩ
Structural Holes (HOLES)	•	•	•
Technical Diversity (TECH_DIV_BLAU)	•	•	•
Geographic Diversity (GEO_DIV_BLAU)	•	•	
Repeated Partners (REPEATEDPART)		Ꙩ	•
Raw coverage	0.63	0.47	0.32
Unique coverage	0.19	0.09	0.00
Consistency	0.86	0.93	0.80
Solution coverage	0.72		
Solution consistency	0.85		
Number of cases per analysis	127		

Case membership in path

~TNOPart*~TNOT*Holes*Tech_Div_Blau*Geo_Div_Blau:

Gama, Gursesli, Ilci, Celikler, Metaleks, Seza, Silahtaroglu, Stfa, Tekfen, Demce, Dogus, Ecetur, Enka, Farsel, Fernas, Gulermak, Hgg-Insaat, Husamettin-Peker, Gunal, Dido-Ray

Case membership in path

TNOPart*~RepeatedPart*Holes*Tech_Div_Blau*Geo_Div_Blau:

Yda-Insaat, Cengiz, Ermit, Gocay, Intekar, Kalyon, Limak, Mapa, Nuhoglu, Nurol, Ozaltin, Oz-Aras, Ozdemir, Pramid, Ronesans, Sigma, Yapi-Merkezi, Yuksel

Case membership in path

~TNOPart*~TNOT*~Eigen*RepeatedPart*Holes*Tech_Div_Blau:

Alkatas, Baytimur, Celikler, Enka, Fernas, Gama, Gunal, Icc-Grup, Oztas, Ozyurt, Tekfen, Tepe

Configuration 1 in the high-performing complex solution for this period has the highest raw coverage (0.63) and unique coverage (0.19) scores among all configurations with a high consistency level (0.86). This configuration can explain 63% of the high-performing outcome. The unique coverage score shows that this path uniquely explains 19% of the cases.

High-Performing Parsimonious Solution for 2010-2019 Period

Table 56: 2010-2019 High-Performing Parsimonious Solution

	raw coverage	**unique coverage**	**consistency**
Tech_Div_Blau*Geo_Div_Blau	0.78	0.39	0.83
RepeatedPart*Tech_Div_Blau	0.39	0.00	0.80
solution coverage:	0.78		
solution consistency:	0.81		

Case membership in path *Tech_Div_Blau*Geo_Div_Blau:*

Limak, Enka, Nurol, Yuksel, Cengiz, Ceylan, Celikler, Gunal, Gursesli, Demce, Hgg-Insaat, Dogus, Oz-er-ka, Ermit, Icc-Grup, Ictas, Gama, Metaleks, Neoray, Akfen

Case membership in term *RepeatedPart*Tech_Div_Blau:*

Akfen, Ictas, Ozgun-Yapi, Alkatas, Baytimur, Celikler, Enka, Fernas, Gama, Gunal, Icc-Grup, Kolin, Oztas, Ozyurt, Tekfen, Tepe

The parsimonious solution, the simplified formula, shows that the presence of the "*combination of technical diversity and geographic diversity*" or "*combination of technical diversity and repeated partners*" are sufficient recipes for developing a high-performing alliance network for contractors in 2010-2019 in Turkey. The first combination has 0.78 raw coverage and 0.39 unique coverage levels. This configuration can explain 78% of the high-performing outcome. The unique coverage score shows that this path uniquely explains 39% of the cases.

High-Performing Intermediate Solution for 2010-2019 Period

Table 57: 2010-2019 High-Performing Configurations of the Intermediate Solution

2010-2019 High Performing configurations identified via fsQCA		
(The Intermediate Solution)	**Configurations**	
	2010-2019	
	1	**2**
Total Number of Partners (TNOPART)		
Total Number of Ties (TNOT)		
Eigenvector Centrality (EIGEN)		
Structural Holes (HOLES)	•	•
Technical Diversity (TECH_DIV_BLAU)	•	•
Geographic Diversity (GEO_DIV_BLAU)		•
Repeated Partners (REPEATEDPART)	•	
Raw coverage	0.38	0.77
Unique coverage	0.03	0.39
Consistency	0.81	0.85
Solution coverage	0.77	
Solution consistency	0.82	
Number of cases per analysis	127	

Case membership in path *RepeatedPart*Holes*Tech_Div_Blau:*

Ictas, Ozgun-Yapi, Alkatas, Baytimur, Celikler, Enka, Fernas, Gama, Gunal, Icc-Grup, Kolin, Oztas, Ozyurt, Tekfen, Tepe

Case membership in term *Holes*Tech_Div_Blau*Geo_Div_Blau:*

Limak, Nurol, Yuksel, Ozdemir, Gama, Cengiz, Celikler, Ictas, Ilci, Demce, Seza, Dogus, Gursesli, Enka, Ermit, Hgg-Insaat, Metaleks, Neoray, Ozaltin, Oz-Aras

Configuration 2, the combination of the presence of *structural holes*, *technical diversity* and *geographic diversity*, has very high coverage scores with a 0.85 consistency level. This configuration can explain the outcome at the %77 level, and 39% of the cases can be explained exclusively by this formula. This path in the 2010-2019 period can be interpreted as follow;

First of all, these three conditions are subsets of the *diversity* measure. Firms that emphasize diversity in their alliance projects had access to a broader range of information. Because they executed different types of projects, worked in different geographies, and thus were able to obtain a variety of information. In the 2020-2019 period, the alliance network has expanded considerably compared to other periods. With the presence of structural holes in their networks, these firms also had opportunities to reach different parts of the network. They had new partners with different resources and skills earlier than their competitors.

Configuration 1, on the other hand, the combination of the presence of *structural holes, technical diversity,* and *repeated partners,* has lower coverage scores than *configuration 1* with a 0.81 consistency level. This configuration can explain the outcome at the %38 level, and 3% of the cases can be explained exclusively by this formula. This path in the 2010-2019 period can be interpreted as follow;

Contracting firms in this configuration benefited from the strength of their ties with their existing partners while also emphasizing differentiation in the period.

Tie strength focuses on recurring relationships since repeated ties provide firms access to fine-grained and rich information. Repeated partnerships reflect the partners' satisfaction with their initial collaborative venture, leading them to form other alliances with the same partner to take advantage of their cooperative dynamics.

2010-2019 Low-Performing Configurations (The Absence of The Outcome):

The second step is to explore the absence of the outcome, indicating the low-performing configurations. The outcome is set to “0”, the thresholds are kept at the same levels. The QCA software produced two solutions for the absence of the outcome; the complex, the intermediate. The intermediate and parsimonious results are the same for the period. This study will focus on intermediate solutions.

Table 58: 2010-2019 Low-Performing Truth Table:

CASES		CONDITIONS							OUTCOME
Firms	**CONSISTENCY**	**TNOPart**	**TNOT**	**Eigen**	**RepeatedPart**	**Holes**	**Tech_Div_Blau**	**Geo_Div_Blau**	**~Membership Score 2010_2019**
attila-dogan, guris	0.98	0	0	0	0	0	0	0	1
caba, cey-grup, erk-insaat, gaziantep-gold, kayaoglu, mesa-mesken, ozgun-insaat, sogut	0.94	0	0	0	0	1	0	0	1
acilim, aydin-insaat-as, aydin-insaat-ltd, bahadir-muhendislik, diy-mar, eksen, eskikale, gulak, gulsan, hasemoglu, karaca, mustafa-eksi, nehirsu, odf-yilmazlar, pekintas, sms-insaat, varyap, yeni-fidan	0.87	0	0	0	0	1	0	1	1
alke, alsim-alarko, gunsayil, haselsan, metgun, nas-yapi, rast-madencilik, serfen, tas-yapi-1, uluova, yse-yapi	0.87	0	0	0	0	1	1	0	1
ceylan, dalgiclar, demars, demce, dido-ray, dogus, ecetur, farsel, gursesli, hgg-insaat, husamettin-peker, ilci, inelsan, klv-insaat, kmb-metro, makimsan-asfalt, mbd-insaat, metaleks, msm-altyapi, neoray, oz-er-ka, ozkar, ozmert, peker, polat, re-ha, seza, silahtaroglu, sistem-elektromekanik, snh-insaat, stfa, sty-insaat, su-bar, senbay, tasyapi-2, tav, ucer	0.66	0	0	0	0	1	1	1	0
ensa, kayasan-yapi, kur-insaat, metag, onur-taahhut, yp-insaat, yildizlar	0.92	0	0	0	1	1	0	1	1
alkatas, ozyurt	0.87	0	0	0	1	1	1	0	1
baytimur, celikler, enka, fernas, gama, gunal, icc-grup, oztas, tekfen, tepe	0.81	0	0	0	1	1	1	1	1
astur, gulermak, kiska-kom	0.74	0	0	1	0	1	1	1	0
ictas, ozgun-yapi	0.75	0	0	1	1	1	1	1	0
ermit, intekar, nuhoglu, pramid, ronesans, sigma, yapi-merkezi	0.76	1	0	0	0	1	1	1	0
gocay, nurol	0.74	1	0	1	0	1	1	1	0
oz-aras, ozdemir	0.78	1	1	0	0	1	1	1	0
cengiz, kalyon, limak, mapa, ozaltin, yda-insaat, yuksel	0.65	1	1	1	0	1	1	1	0

Low-Performing Complex Solution for 2010-2019 Period

The minimized complex solution shows 4 (four) sufficient configurations for the absence of the outcome, which is the low-performing alliance network structure of contracting firms. The Low-Performing complex solution and case memberships for each path are listed below.

Table 59: 2010-2019 Low-Performing Configurations (The Complex Solution)

2010-2019 LowPerforming configurations identified via fsQCA				
The Complex Solution	**Configurations**			
	2010-2019			
	1	**2**	**3**	**4**
Total Number of Partners (TNOPART)	ʘ	ʘ	ʘ	ʘ
Total Number of Ties (TNOT)	ʘ	ʘ	ʘ	ʘ
Eigenvector Centrality (EIGEN)	ʘ	ʘ	ʘ	ʘ
Structural Holes (HOLES)		•	•	•
Technical Diversity (TECH_DIV_BLAU)	ʘ	•	ʘ	
Geographic Diversity (GEO_DIV_BLAU)	ʘ	ʘ	•	•
Repeated Partners (REPEATEDPART)	ʘ			•
Raw coverage	0.41	0.40	0.44	0.41
Unique coverage	0.09	0.10	0.08	0.05
Consistency	0.94	0.87	0.87	0.85
Solution coverage	0.78			
Solution consistency	0.86			
Number of cases per analysis	127			

All of these low-performing configurations in this period are very close in coverage and consistency levels; therefore, the minimization process, including theoretically possible logical remainders, will aid in interpreting results better.

Case membership in path

~TNOPart*~TNOT*~Eigen*~RepeatedPart*~Tech_Div_Blau*~Geo_Div_Blau: Attila-Dogan, Guris, Ozgun-Insaat, Caba, Cey-Grup, Erk-Insaat, Gaziantep-Gold, Kayaoglu, Mesa-Mesken, Sogut

Case membership in path

~TNOPart*~TNOT*~Eigen*Holes*Tech_Div_Blau*~Geo_Div_Blau:

Gunsayil, Tas-Yapi-1, Alkatas, Alke, Alsim-Alarko, Haselsan, Metgun, Nas-Yapi, Ozyurt, Rast-Madencilik, Serfen, Uluova, Yse-Yapi

Case membership in path

~TNOPart*~TNOT*~Eigen*Holes*~Tech-Div_Blau*Geo_Div_Blau:

Eksen, Gulsan, Metag, Acilim, Aydin-Insaat-As, Aydin-Insaat-Ltd, Diy-Mar, Ensa, Bahadir-Muhendislik, Eskikale, Gulak, Hasemoglu, Karaca, Kayasan-Yapi, Kur-Insaat, Mustafa-Eksi, Nehirsu, Onur-Taahhut, Odf-Yilmazlar, Pekintas

Case membership in path

~TNOPart*~TNOT*~Eigen*RepeatedPart*Holes*Geo_Div_Blau:

Baytimur, Celikler, Enka, Ensa, Fernas, Gama, Gunal, Icc-Grup, Kayasan-Yapi, Metag, Kur-Insaat, Onur-Taahhut, Oztas, Tekfen, Tepe, Yp-Insaat, Yildizlar

Low-Performing Intermediate Solution for 2010-2019 Period

Table 60: 2010-2019 Low-Performing Intermediate Solution

2010-2019 Low Performing configurations identified via fsQCA			
The Intermediate Solution	**Configurations**		
	2010-2019		
	1	**2**	**3**
Total Number of Partners (TNOPART)			
Total Number of Ties (TNOT)			
Eigenvector Centrality (EIGEN)			ʘ
Structural Holes (HOLES)			•
Technical Diversity (TECH_DIV_BLAU)		ʘ	
Geographic Diversity (GEO_DIV_BLAU)	ʘ		
Repeated Part (REPEATEDPART)			•
Raw coverage	0.65	0.63	0.45
Unique coverage	0.13	0.11	0.05
Consistency	0.86	0.81	0.84
Solution coverage	0.89		
Solution consistency	0.78		
Number of cases per analysis	127		

Case membership in path ~*Geo_Div_Blau:*

Alsim-Alarko, Attila-Dogan, Caba, Gaziantep-Gold, Gunsayil, Guris, Mesa-Mesken, Metgun, Metro-Muhendislik, Ozgun-Insaat, Rast-Madencilik, Sogut, Tas-Yapi-1, Alke, Yse-Yapi, Turkerler, Alkatas, Aras, Burkay, Cey-Grup

Case membership in path ~*Tech_Div_Blau:*

Acilim, Aras, Attila-Dogan, Aydin-Insaat-As, Aydin-Insaat-Ltd, Mustafa-Eksi, Ozgun-Insaat, Cey-Grup, Pekintas, Eksen, Ensa, Varyap, Yeni-Fidan, Eskikale, Gaziantep-Gold, Yp-Insaat, Gulsan, Guris, Hasemoglu, Yildizlar

Case membership in path ~*Eigen*RepeatedPart*Holes:*

Alkatas, Aras, Baytimur, Celikler, Enka, Ensa, Fernas, Gama, Gunal, Icc-Grup, Kayasan-Yapi, Kur-Insaat, Metag, Onur-Taahhut, Oztas, Ozyurt, Tekfen, Tepe, Yildizlar, Yp-Insaat

The intermediate and parsimonious results are the same in this period, with high coverage (0.89) and moderate consistency (0.78) levels. The absence of *geographic diversity* or absence of *technical diversity,* or the presence of *repeated partners* and *structural holes* and absence of Eigenvector centrality are causal paths indicating low-performing alliance network structures in the period.

Configuration 1 has the highest coverage and consistency levels. This path indicates that the absence of geographic diversity results in a low-performing alliance network structure in the period. In the 2010-2019 period, alliance projects are more common in the domestic market. In this environment, realizing alliance projects in different geographies gives companies an advantage. On the other hand, the absence of this condition made it difficult for companies to compete.

Configuration 2 has the second-highest coverage and 0.81 consistency level. This path indicates that the absence of technical diversity results in a low-performing alliance network structure in the period. In the 2010-2019 period, a large number of companies joint to the network. These newcomers are not experienced in alliance projects and generally focus on one or a few project types. This is not because these companies have less technical capacity but because they are new in the network and preferred to form alliances securely. In general, low technical differentiation in alliance projects made these companies disadvantageous in the network.

Configuration 3 has 0.45 raw coverage and 0.84 consistency levels. 45% of the low-performing cases fall in this cluster. This path indicates that the absence of **centrality** and presence of structural holes and repeated partners results in a low-performing alliance network structure in the period. Firms with enough structural holes to establish new relations but could not use it and remain embedded in their existing relationships are the cases of this configuration. In addition, if these companies were not in contact with the prominent actors in the network, a low-performance alliance network structure was an inevitable result for them in the period of 2010-2019.

7.12.Comparison of the Time Periods

This study aimed to compare alliance networks of Turkish contractors in three time periods,1990-1999, 2000-2009 and 2010-2019, to explore the evolution of the network. These periods were examined one by one both in social network analysis (SNA) and qualitative comparative analysis (QCA). In this section, these results will be combined, and an overview will be made to comprehend how the network has evolved over the years.

First, it will be beneficial to share the whole network analysis. The below table shows the network structure scores in three consecutive periods. Afterward, the combined QCA high-performing and low-performing solutions will be discussed.

7.12.1. Whole Network Analysis

Table 61: Network Structure Scores in Three Consecutive Periods

SNA-NETWORK STRUCTURE ANALYSIS (WHOLE NETWORK)							
Time Period	**Primary Nodes**	**Size (number of nodes)**	**Number of Ties**	**Density**	**Centralization**	**Connectivity**	**Average Distance**
1990-1999	30	113	290	0.0229	0.229	0.769	3.333
2000-2009	67	209	512	0.0117	0.119	0.611	4.822
2010-2019	127	571	1562	0.0048	0.041	0.888	5.961

In this part, this study will answer these questions: What are the general structural properties of social networks, how are these properties measured, and what these properties point out in the real world setting (construction alliance network in Turkey) operationalized by this study.

The structural network properties such as size, density, centralization, connectivity, and distance are significant for social network analysis because these properties help us to understand the roles of the entire set of nodes within the network. The calculation of the network properties in this study is based on undirected and unweighted ties.

Network size is the most straightforward structural property of a network and measures the total number of nodes. It is an essential structural property that reflects the network's boundary and helps us understand what resources are exchanged between actors in explaining what is happening in the network.

When the three time periods of the Turkish contractors' alliance network are examined through the network size, it is seen that the network size increased drastically in consecutive periods;113 nodes, 209 nodes, 571 nodes. It is worth mentioning here that the size of the network includes all nodes in the network; however, this study's scope is limited to the project alliances of Turkish Contractors who are listed in ENR-Turkey or members of at least one of these institutions; INTES and TCA (TMB). Partners who are not members of these institutions and foreign partners are included in the study to make calculations and get healthy results.

If the developments in the Turkish construction sector and the gradually increased network size are evaluated together;

Through the new policies and incentives such as privatization and build-operate-transfer projects, many Turkish contractors undertook large-scale infrastructure projects in cooperation with foreign partners in the domestic market between 1985-2000. They gained broad experience in production, project management, and relations with international financial institutions. From 2000 through 2009, by using the experiences gained in the previous period, Turkish contractors continued to undertake projects both in local and foreign markets in cooperation with domestic and foreign partners. Simultaneously, the number of partners and number of countries that Turkish contractors have been doing business has increased significantly between these years.

Large-scale infrastructure, superstructure, transportation, and highway investments were put into practice within the scope of mega projects in the local market starting with the year 2010. Market diversity and specialization in specific project types have started the global branding period for Turkish construction firms in this period, resulting in Turkish contractors' engagement in many alliance projects both in local and foreign markets. These developments in the sector resulted in gradual network size growth in the consecutive three time periods examined by the study. At the egocentric network level, each firm's (node) total number of partners (TNOPart) and the total number of ties (TNOT) also increased parallel to the network size as expected in three consecutive periods.

The below table shows three periods of the distribution of alliance projects executed by Turkish contractors based on public/private and domestic/international concentrations.

Table 62: Project Types Concentration Through Three Periods

	Number of Alliance Projects	Adjusted Present Value (2019)	Contract Value Percentage	Adjusted Average Contract Value Per Project
1990-1999				
Total Projects	82	$ 36,891,940,622		$ 449,901,715
Public Projects	61 (74%)	$ 27,174,715,317	74%	$ 445,487,136
Private Projects	21 (26%)	$ 9,717,225,305	26%	$ 462,725,015
Domestic Projects	66 (80%)	$ 29,553,634,317	80%	$ 447,782,338
International Projects	16 (20%)	$ 7,338,306,305	20%	$ 458,644,144
2000-2009				
Total Projects	234	$ 142,544,087,552		$ 609,162,767
Public Projects	105 (45%)	$ 55,955,996,586	39%	$ 532,914,253
Private Projects	129 (55%)	$ 86,588,090,966	61%	$ 671,225,511
Domestic Projects	116 (49%)	$ 54,778,649,062	38%	$ 472,229,733
International Projects	118 (51%)	$ 87,765,438,490	62%	$ 743,774,902
2010-2019				
Total Projects	886	$ 215,480,209,110		$ 243,205,654
Public Projects	741 (84%)	$ 140,580,752,229	65%	$ 189,717,614
Private Projects	145 (16%)	$ 74,899,456,882	35%	$ 516,547,978
Domestic Projects	767 (87%)	$ 150,247,603,250	70%	$ 195,889,965
International Projects	119 (13%)	$ 65,232,605,860	30%	$ 548,173,158

In order to make the above table easy to understand, the below charts are created to demonstrate changes in each period in terms of project types, numbers, and values. Each value is adjusted to the 2019 present value of the American dollar to eliminate the differences caused by inflation.

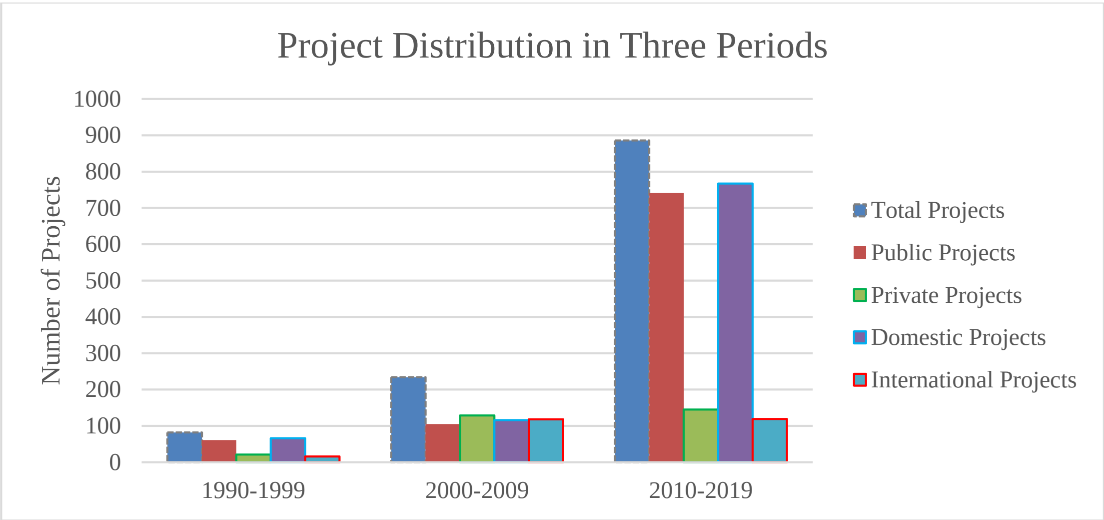

Figure 28: Project Distribution in Three Periods

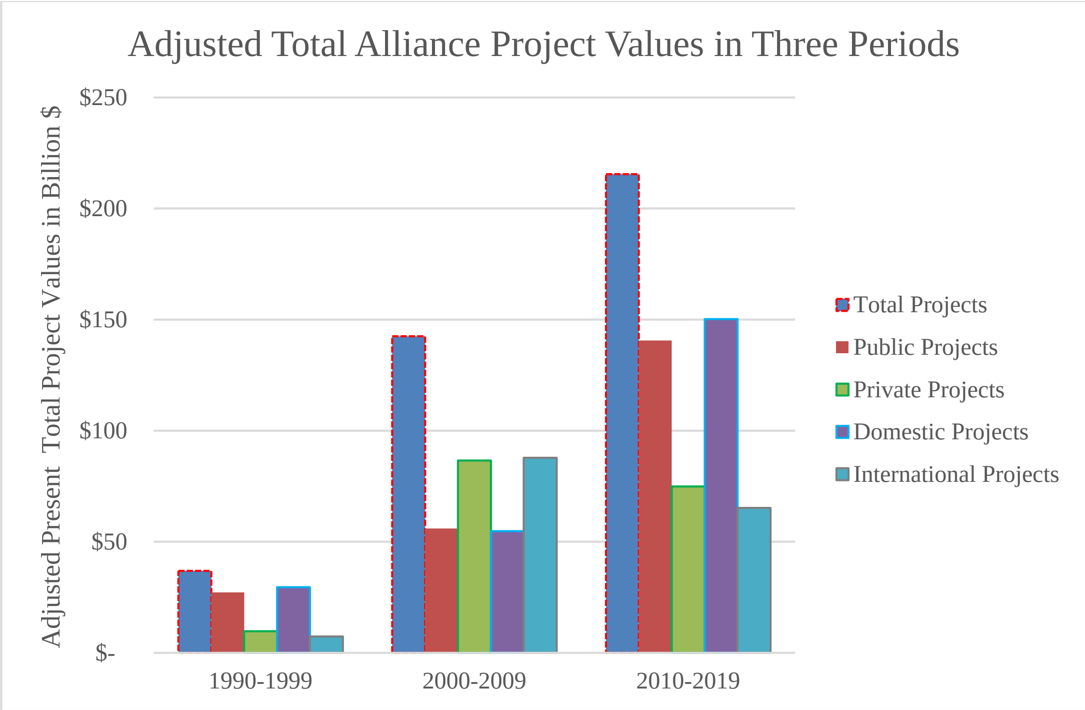

Figure 29: Adjusted Total Alliance Project Values in Three Periods

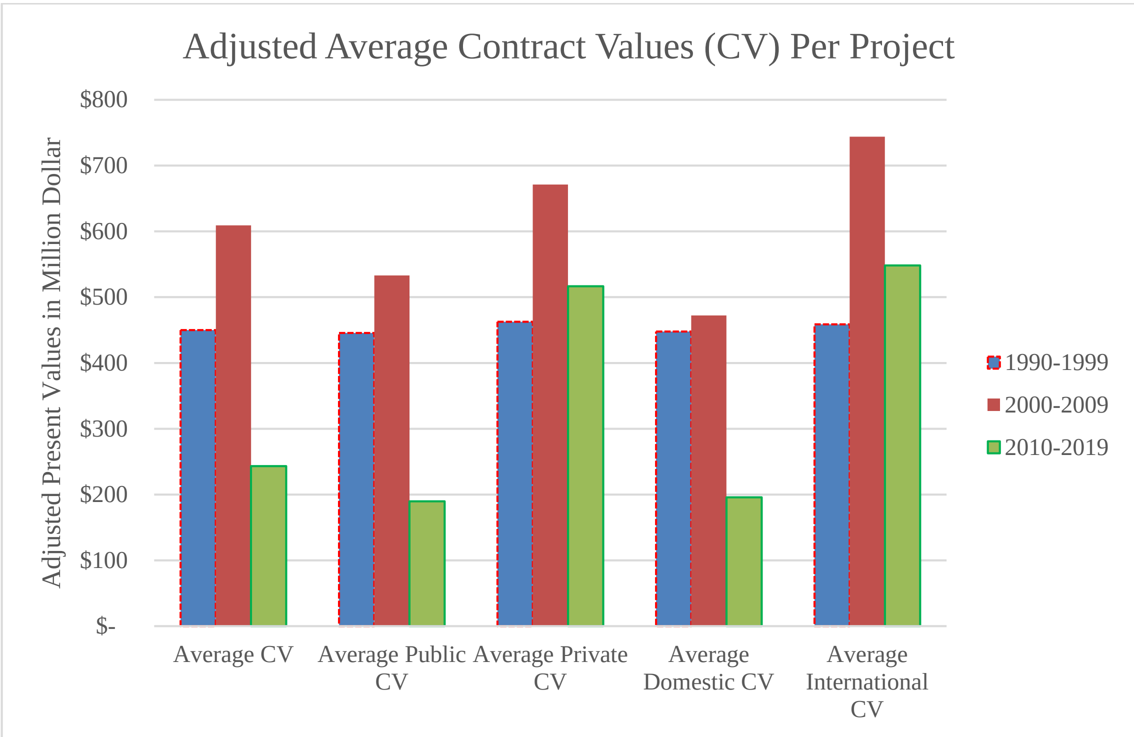

Figure 30: Adjusted Average Contract Values Per Project for Three Periods

Network density is the ratio of the number of direct ties to the total number of possible ties. Network density is directly linked to the network size. If the network gets larger, the density of the network will drop. On the other hand, if this number is close to 1, this indicates that the network is well connected, and all possible connections are present.

As expected, the network density scores dropped as the network size increased in the three successive periods. The network was more tightly connected in the first period (1990-1999) comparing to the following periods. As the number of nodes increased in the network in the successive periods (2000-2009 and 2010-2019), the connections between firms got looser.

The degree of connectivity is one of the defining features of networks. Going from a network with low connectivity to high connectivity is not just a quantitative change in the number of edges in the network but also a qualitative change. Because it indicates a change from a component-based system to a relational-based one. Basically, connectivity tells us how difficult for a node in the network to make connections to other nodes.

Here the question is, "under what conditions are nodes more likely to interact in real-world settings?" Reduced trade restrictions and transportation costs, advances in communication technology made globalization possible. This, in turn, increased the connectivity among firms from one part of the world to the other for every business sector.

The connectivity score is 0.769 in the 1990-1999 period. It dropped to 0.611 level in the 2000-2009 period, and then it increased to 0.888 level in the 2010-2019 period. It was more challenging to make connections to other firms in the 2000-2009 period than in other periods.

Apart from globalization, what were the conditions to make connections easier for firms in the Turkish construction alliance network? Turkish contractors started to undertake major infrastructure projects with foreign partners launched because neo-liberal monetary policy began to be implemented in the 1980s. The main reason why Turkish contractors started to partner with foreign companies was to facilitate organizational learning because these large infrastructure projects required high technical knowledge, and many Turkish construction companies did not have enough technical capacity at the time. They used these experiences in the following periods in the country and different geographies around the world. These conditions let them increase their connectivity both with foreign and Turkish companies in the sector. As a result, it became less difficult for firms in the Turkish contractors' alliance network to connect to other firms in the network.

The other network property is network centralization. The relations are more focused in more centralized networks. However, this is different from the property of network density, which measures relations and is not focused on actors. In other words, a network can be dense but have low centralization with many relations spread evenly across the network's actors and vice versa, with few relations that are concentrated on a small set of actors.

In the network examined by this study, the centralization scores decreased over time. In the periods of 1990-1999 and 2000-2009, a small and exclusive set of actors hold positions of power and control in the network. However, when it comes to the period of 2010-2019, the network became less centralized in which power and control are diffuse and spread over a number of actors.

Network distance shows how far actors are from one another. Network distance indicates how well resources can move from one part of the network to another. When this value is small, this indicates that there is a cohesive network. Conversely, when this value is high, the network likely has little cohesion, making it difficult for resources to move from one part of the network to another. Compared to other periods, the network was more cohesive in the 1990-1999 period; however, this cohesion decreased gradually over time as the network expanded throughout the years.

Below figures (31, 32, 33) show Turkish construction alliance networks for three consecutive periods. The sizes of nodes are based on Eigenvalues. The thickness of lines between nodes represents tie strength which is the repeated ties in the study.

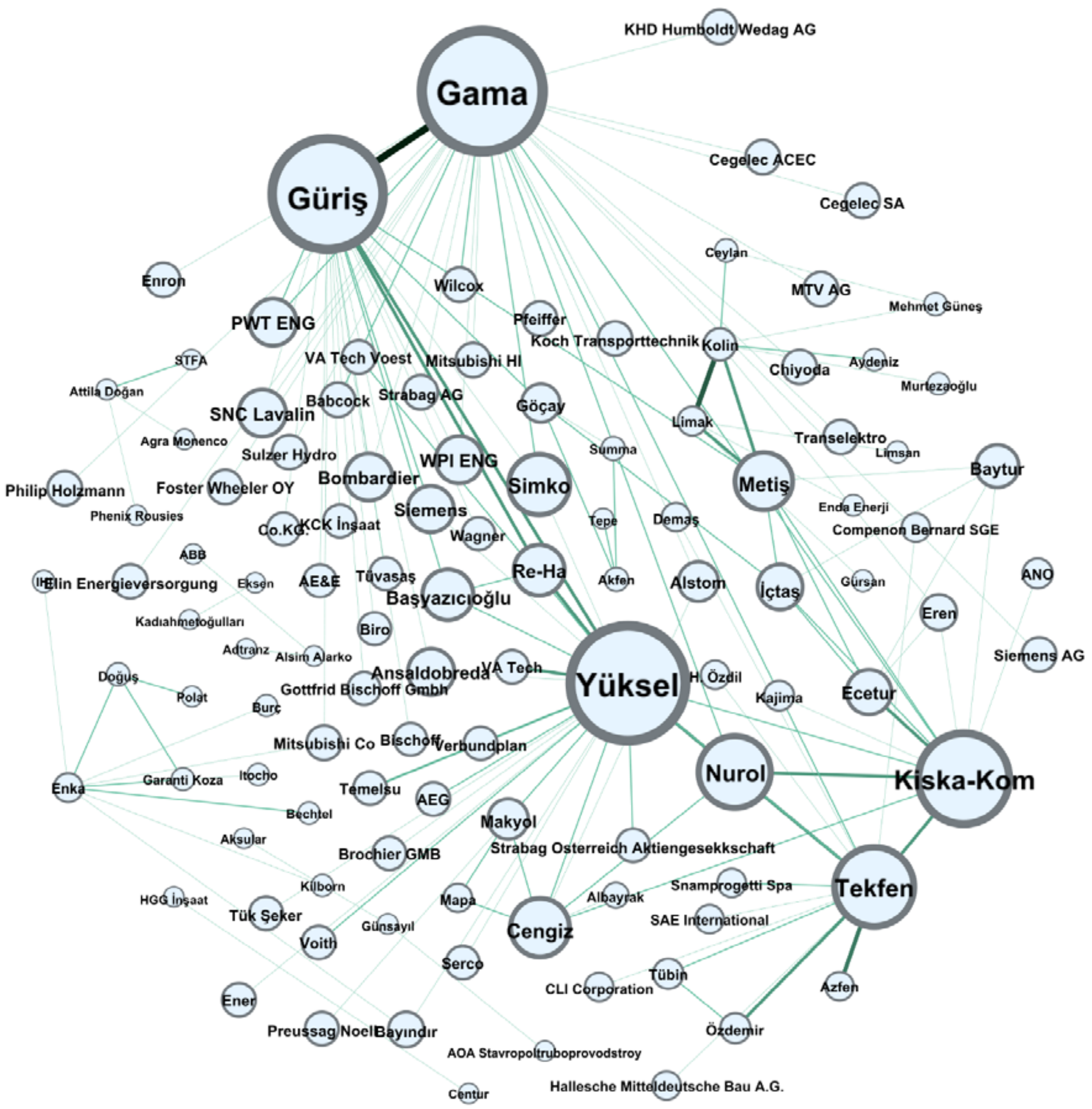

Figure 31: Alliance Network of Turkish Contractors Between 1990 and 1999. The sizes of nodes are based on Eigenvalues. The thickness of lines between nodes represents tie strength.

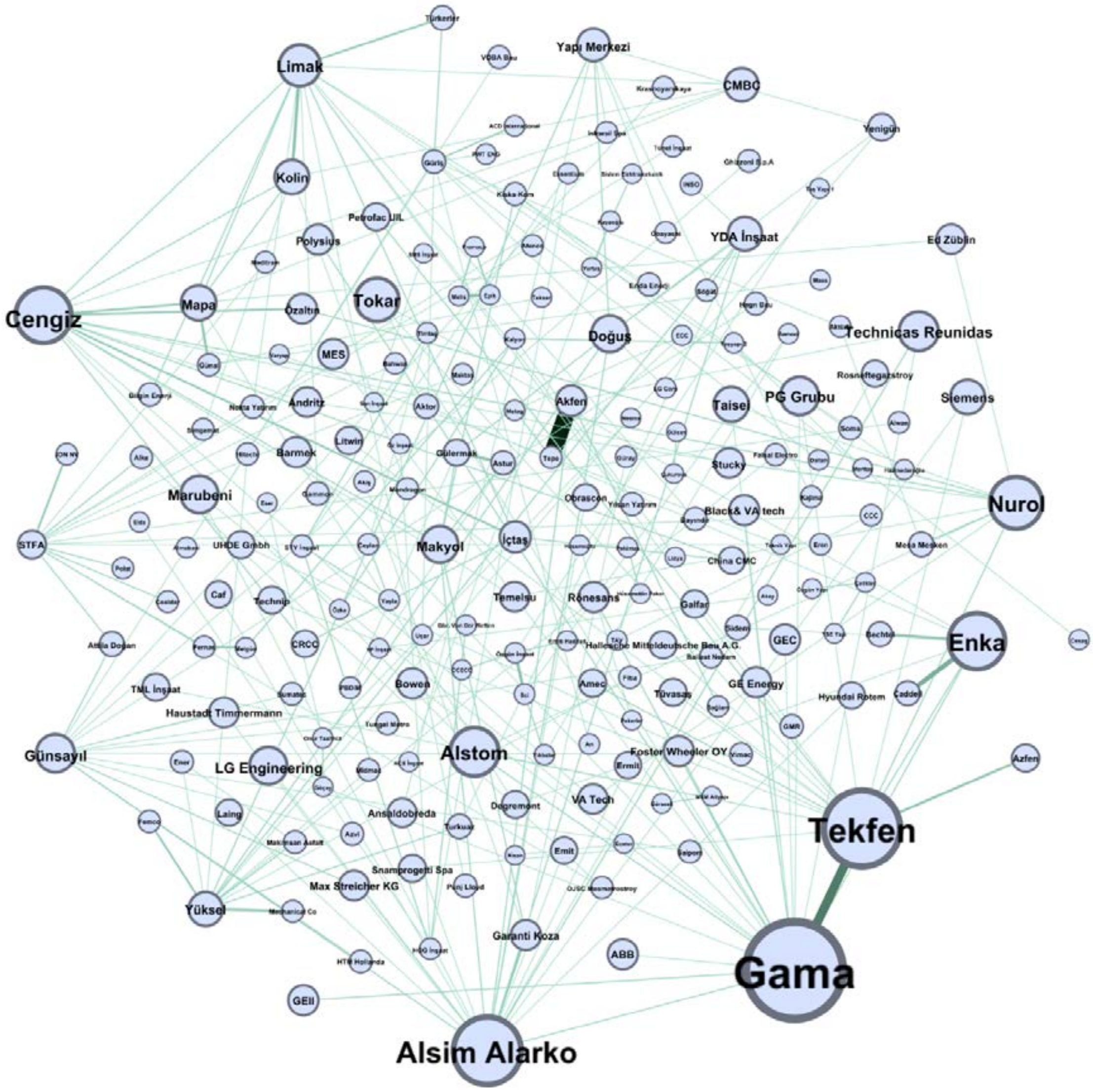

Figure 32: Alliance Network of Turkish Contractors Between 2000 and 2009. The sizes of nodes are based on Eigenvalues. The thickness of lines between nodes represents tie strength.

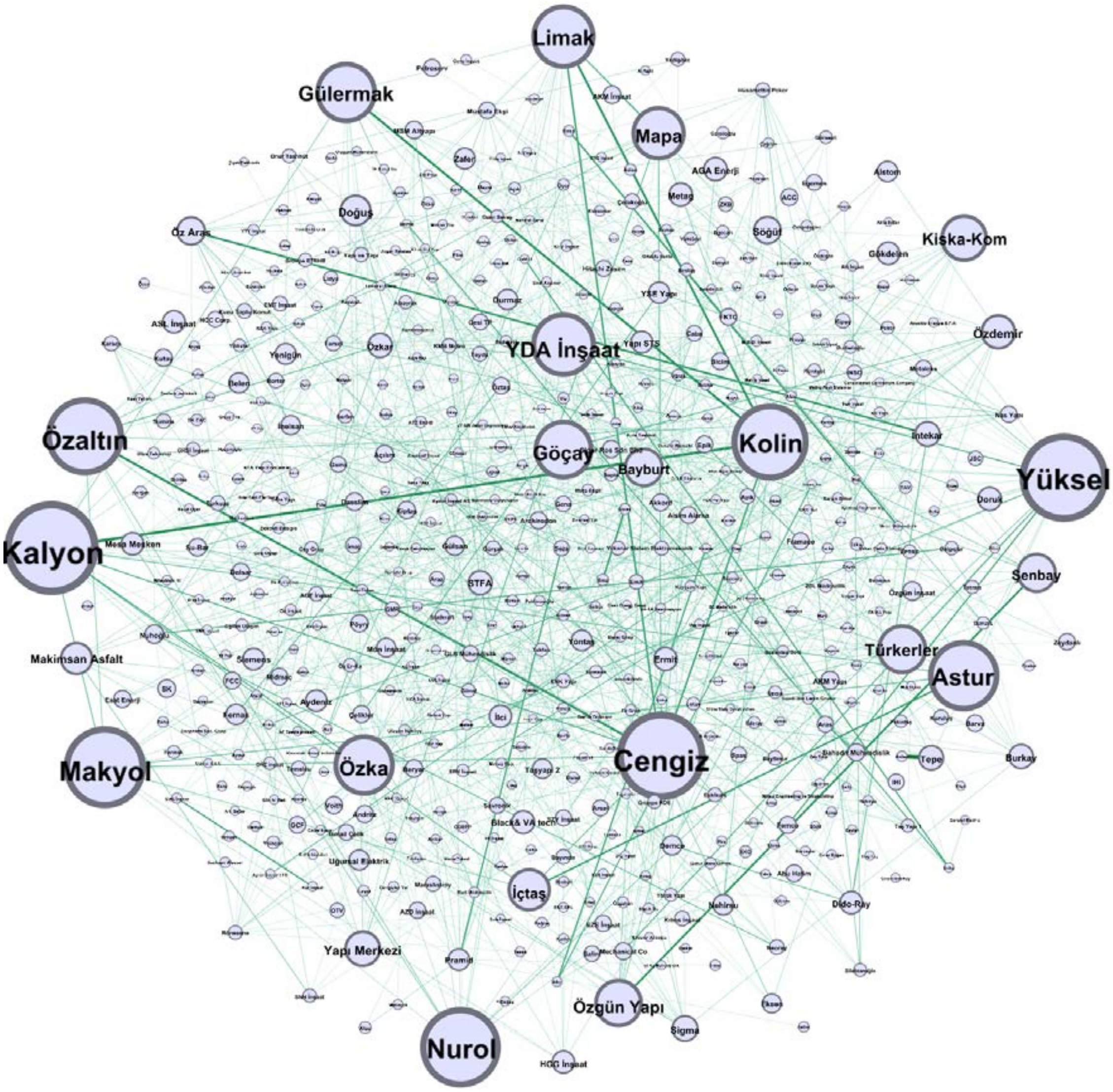

Figure 33: Alliance Network of Turkish Contractors Between 2010 and 2019. The sizes of nodes are based on Eigenvalues. The thickness of lines between nodes represents tie strength.

7.12.2. Combined QCA Solutions

Conditions related to the presence of an outcome can be quite different from those related to its absence. Thus, the presence and absence of a result may require different explanations. Therefore, the presence of the outcome (high performing scores) and absence of the outcome (low performing scores) are analyzed separately for three time periods.

High-Performing Configurations

The table below illustrates the intermediate results of QCA analyses for three periods. The black circle represents the presence of a condition. Configurations of high-performing network structures of Turkish contractors in each temporal window are summarized.

Table 63: High-Performing Configurations of the Intermediate Solution for Three Periods

High Performing Configurations for Intermediate Solutions Identified via fsQCA							
	Configurations						
	1990-1999			**2000-2009**		**2010-2019**	
	1	**2**	**3**	**1**	**2**	**1**	**2**
	a	**b**	**c**	**d**	**b**	**e**	**f**
Total Number of Partners (TNOPART)			•				
Total Number of Ties (TNOT)			•				
Eigenvector Centrality (EIGEN)			•				
Structural Holes (HOLES)	•	•	•	•	•	•	•
Technical Diversity (TECH_DIV_BLAU)			•	•		•	•
Geographic Diversity (GEO_DIV_BLAU)		•			•		•
Repeated Partner (REPEATEDPART)	•					•	
Raw coverage	0.51	0.85	0.42	0.89	0.88	0.38	0.77
Unique coverage	0.04	0.33	0.06	0.07	0.06	0.03	0.39
Consistency	0.96	0.88	1.00	0.8	0.8	0.81	0.85
Solution coverage	0.96			0.96		0.77	
Solution consistency	0.87			0.78		0.82	
Number of cases per analysis	30			67		127	

Through QCA, the study identified seven (7) combinations of conditions for the presence of the outcome. The configuration of the presence of *structural holes* and *geographic diversity* has occurred twice over the periods. This configuration was also combined with the presence of *technical diversity* in the last period. This pattern among configurations is remarkable because it characterizes high-performance configurations over time. This pattern, presence of *structural holes* and *geographic diversity,* has remained the same even though the cases in the time windows have changed. In addition, the raw coverage levels of this combination are high in each period. This combination can explain the high-performing network structures of contracting firms at 85% and 88% levels.

It is also remarkable that some conditions are components of every or many configurations. *Structural holes* is the condition of every combination over the periods.

Technical diversity has been the component of four (4) configurations out of seven (7), whereas *geographic diversity* has occurred three (3) times. Technical diversity exists in every configuration in the 2010-2019 period; geographical diversity exists in one configuration of each period. These findings show that *technical diversity* and *geographic diversity* are complementary to structural holes for high-performing outcomes.

The overall solution coverage scores of the high-performing configurations range between 0.77 to 0.96. This means that these configurations can explain a minimum of 77% of the cases for the high-performance outcome in a time period.

Low-Performing Configurations

The table below illustrates the intermediate results of QCA analyses for three periods for the absence of the outcome. Configurations of low-performing network structures of Turkish contractors in each temporal window are summarized. The black circle (•) indicates the presence of the condition, and the dotted circle (ʘ) its absence. A blank cell is used to indicate the do not care condition.

Table 64: Low-Performing Configurations of the Intermediate Solution for three periods

Low Performing Configurations for Intermediate Solutions Identified via fsQCA							
	Configurations						
	1990-1999	**2000-2009**			**2010-2019**		
	1	**1**	**2**	**3**	**1**	**2**	**3**
	a	**b**	**a**	**c**	**b**	**a**	**d**
Total Number of Partners (TNOPART)							
Total Number of Ties (TNOT)							
Eigenvector Centrality (EIGEN)							ʘ
Structural Holes (HOLES)							•
Technical Diversity (TECH_DIV_BLAU)	ʘ		ʘ			ʘ	
Geographic Diversity (GEO_DIV_BLAU)		ʘ			ʘ		
Repeated Partners (REPEATEDPART)				•			•
Raw coverage	0.95	0.82	0.80	0.25	0.65	0.63	0.45
Unique coverage	0.95	0.05	0.06	0.05	0.13	0.11	0.05
Consistency	0.86	0.95	0.94	0.73	0.86	0.81	0.84
Solution coverage	0.95	0.97			0.89		
Solution consistency	0.86	0.86			0.78		
Number of cases per analysis	30	67			127		

The QCA identified seven (7) combinations of conditions for the absence of the outcome. The path of the absence of *technical diversity* has occurred three times over the periods, the absence of *geographic diversity* has occurred twice. These patterns characterize low-performance results over time. This pattern has remained the same even though the cases in the time windows have changed. In addition, the raw coverage of absence of technical diversity ranges between 0.63-0.95 in three periods. This path can explain the low-performing network structures of contracting firms at a minimum 63% level. The raw coverage of the absence of *geographic diversity* ranges between 0.65-0.82 in three periods, explaining the low-performing network structures at a minimum of 65%.

The presence of repeated partners by itself or as a part of a configuration characterizes low-performance results in the network, even though raw coverage of these paths is low comparing the other configurations in time windows.

The overall solution coverage scores of the low-performing configurations range between 0.89 to 0.95. This means that these configurations can explain a minimum of 89% of the cases for the low-performance outcome in a time period.

Overview of the Results

The systematic cross-case comparison is accomplished in the study via Qualitative Comparative Analysis (QCA). With the help of QCA, it is observed from the time windows that factors creating positional advantages for firms in the network interact with each other and do not depend on a single solution. On the contrary, different configurations of the factors affect the outcome, and configurations of factors are not consistent in time.

The extensive theoretical review revealed that the conditions (factors) analyzed in the study positively affect a firm's performance in general. Consequently, this study assumed that all conditions positively contributed to the outcome, which is the degree of cluster membership in the study. However, particularly low-performing outcomes showed that the presence of a condition (repeated partners) alone or the presence of combinations of conditions (repeated partners and structural holes) could cause low-performing outcomes.

On the other hand, although it was predicted that the presence of diversity dimensions would be more effective in some periods than others, it was an interesting result that the diversity dimension surpassed other dimensions in all periods. *Structural holes* has been the component of every combination of high-performing outcome over the three time periods. The presence of *technical diversity* and *geographic diversity* factors positively affected the high-performing outcomes. Moreover, the absence of these conditions resulted in low-performing outcomes.

Structural Holes provide connections with so-called weak partners or unusual ties operating in different markets or technologies. Diverse and non-redundant information is the basis for structural holes. The QCA results of the alliance network of Turkish contractors between 1990 and 2019 support the following statements from the literature. A significant benefit of structural holes is the access to diverse information, and structural holes in a firm's ego network improve its knowledge creation (Burt, 2002; Phelps, 2010).

CHAPTER 8

SUMMARY AND DISCUSSIONS

8.1. Alliance Network

This thesis aimed to examine the concept of strategic alliances through networks. A new configurational model that explores the evolution of strategic alliances in project-based industries is proposed with a social network perspective.

The study is restricted to applying social network analysis at the inter-organizational level, which comprises ties between firms in strategic alliances. It focused on the alliance network of Turkish contractors and ensured that sample companies have similar environments.

Networks are complex phenomena because of the amount of information that can be used to describe different aspects of their structure. Social network analysis (SNA) is a powerful tool for summarizing that complexity and visualizing network structures. SNA by itself is not a method for evaluating causal relationships between different phenomena. Rather, it is a distinct technique of looking at reality by focusing on the relationships between elements (Fischer, 2011).

SNA is utilized in the study as a quantitative tool to describe the alliance network structure of Turkish Contractors based on quantitative social network data. Alliance network attributes of each actor identified with SNA for three time periods were determined based on conjectural changes in the Turkish construction industry.

After SNA, contracting firms were classified into distinct categories with a clustering method for each time period. Then each cluster was given a score based on the network and project attributes of cluster members. These cluster scores became the outcome membership scores of each case belonging to a particular cluster used in the cross-case comparison analysis.

As a summary, this study applied quantitative network data of actors as dimensions for cluster analysis and as conditions for cross-case comparison. In other words, it used SNA tools as conditions and clustering results as the outcome in comparative analysis.

In addition, the structural properties of the whole network are analyzed for each time period since these properties help us to understand the roles of the entire set of nodes within the network. With the help of this analysis, what the network structural features indicate in the real-world setting (construction alliance network in Turkey) has been operationalized.

8.2. Network Evolution

Understanding the nature and causes of inter-organizational network evolution is essential because this evolution can affect the behavior and performance of firms.

The alliance network of Turkish contractors is examined for thirty years to comprehend the evolution of the network. Three different time windows are opened in these thirty years based on conjectural changes in the Turkish construction industry. Then a cross-case comparison is applied to different periods via Qualitative Comparative Analysis (QCA) to explore the evolution of strategic alliance networks in the Turkish construction industry.

When the alliance network is examined through time windows, it has been observed that the factors creating a positional advantage for the firms in the network interact with each other and do not depend on a single solution. On the contrary, different configurations of the factors affect the outcome, and the configurations of the factors are not consistent over time.

CHAPTER 9

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

9.1. Findings and Contributions of the Study to Alliance Network Literature

The main contribution of this thesis to alliance literature is to examine an alliance network over a long period of time and observe the evolution. This longitudinal study examined the Turkish contractors' alliance network with three different time windows between 1990 and 2019.

The most crucial benefit of longitudinal studies is for researchers to detect changes and developments in the population. Even though collecting data in a longitudinal study was quite tricky, going "beyond the snapshot" has been a significant step in understanding how the Turkish construction alliance network has evolved over time.

This study utilized a mixed-method technique that can rarely be found in construction management studies. Mixed method design increases the comprehensiveness of the study with a broad perspective comparing to mono-method design research.

Social Network Analysis (SNA) and Qualitative Comparative Analysis (QCA) combined to strengthen the interpretations of the data. Quantitative social network data is analyzed in a case-based framework. The systematic cross-case comparison is accomplished in the study via QCA. Consequently, the study gave a more holistic view of the alliance network phenomenon in the construction industry by combining the strengths of both quantitative and qualitative methods. In addition, the visualization of SNA significantly helped the study to understand the dynamics of social relationships in the network through periods.

With the help of QCA, it is observed from the time windows that factors creating positional advantages for firms in the network interact with each other and do not depend on a single solution. On the contrary, different configurations of the factors affect the outcome, and configurations of factors are not consistent in time.

Despite the increasing applications of QCA in management studies, examples in the construction management field are rare. These rare studies are cross-sectional. Within the construction management field, this study represents an early effort to apply QCA to longitudinal data in order to investigate how configurations change over time.

9.2. Practical Contributions

A firm must invest time and resources to establish and develop a network of alliances. For this reason, firms need to give importance to relationship-building activities with other firms. They also need to manage these activities in a goal-based and efficient manner, especially when the resources are scarce. This research may help managers develop the most appropriate network of ties based on evaluating the entire set of alliances and combinations of factors with a more holistic view.

9.3. Limitations and Recommendations for Future Research

The extensive theoretical review reveals that the conditions (factors) analyzed in the study positively affect a firm's performance in general. Consequently, this study assumed that all conditions positively contributed to the outcome, which is the degree of cluster membership in the study. However, particularly low-performing outcomes showed that the presence of some conditions alone or the presence of combinations of conditions could cause low-performing outcomes. In order to better understand these factors or their complementary causes, it will be useful to conduct interviews with the managers of the companies in the alliance network.

Generating financial data for the selected cases, Turkish contractors, could not be achieved by the study. However, the outcome in QCA could be the firm performance via financial data. The proposed model in the thesis is designed for project-based industries. Future studies focusing on the construction sector or any project-based sector could generate financial data or other performance indicators for their samples and utilize this data as the outcome. This will give valuable insight to researchers and practitioners on how collaborative networks affect firms' performances.

This study measured the tie strength of the cases by evaluating repeated relations. The ratio of repeat partners to all partners was calculated within the 5-year moving windows. This measure was the only criterion that measures the tie strength dimension. Future studies may elaborate on the tie strength dimension and introduce a composite measurement criterion.

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APPENDIX

APPENDIX A: 1990-1999 Data Matrix

1990-1999 Raw Data Matrix

	Firms	TNO Part	TNOT	Eigen	Repeated Part	Holes	Tech _Div_ Blau	Geo_ Div_ Blau	cluster _1990_ 1999
1	Akfen	3	4	0.012	0.333	0.447	0.667	0.667	2
2	Alsim Alarko	2	2	0.000	0.000	0.500	0.000	0.000	4
3	Attila Doğan	3	3	0.000	0.000	0.667	0.667	0.444	2
4	Cengiz	7	7	0.158	0.000	0.758	0.444	0.444	2
5	Ceylan	2	2	0.006	0.000	0.140	0.000	0.000	4
6	Doğuş	3	3	0.003	0.000	0.504	0.500	0.500	2
7	Ecetur	5	6	0.096	0.200	0.542	0.500	0.500	2
8	Eksen	1	1	0.000	0.000	0.000	0.000	0.000	4
9	Enka	9	10	0.019	0.250	0.860	0.857	0.612	2
10	Gama	28	35	0.407	0.384	0.924	0.786	0.255	1
11	Garanti Koza	2	2	0.003	0.000	0.253	0.000	0.000	4
12	Göçay	4	4	0.070	0.000	0.561	0.667	0.667	2
13	Günsayıl	2	2	0.000	0.000	0.500	0.000	0.000	4
14	Güriş	22	30	0.368	0.633	0.874	0.778	0.278	1
15	HGG İnşaat	1	1	0.000	0.000	0.000	0.000	0.000	4
16	İçtaş	5	5	0.097	0.000	0.596	0.500	0.500	2
17	Kiska-Kom	12	15	0.281	0.361	0.824	0.449	0.449	2
18	Kolin	7	11	0.036	0.429	0.753	0.245	0.408	2
19	Limak	5	8	0.027	0.500	0.667	0.444	0.500	2
20	Makyol	3	3	0.083	0.000	0.451	0.000	0.000	4
21	Mapa	2	2	0.035	0.000	0.229	0.000	0.000	4
22	Metiş	7	9	0.143	0.286	0.692	0.000	0.500	2
23	Nurol	5	8	0.210	0.250	0.692	0.000	0.444	2
24	Özdemir	2	4	0.039	1.000	0.142	0.000	0.000	3
25	Polat	1	1	0.001	0.000	0.000	0.000	0.000	4
26	Re-Ha	3	6	0.126	1.000	0.430	0.000	0.000	3
27	STFA	1	1	0.000	0.000	0.000	0.000	0.000	4
28	Tekfen	14	23	0.234	0.679	0.868	0.789	0.664	1
29	Tepe	1	1	0.002	0.000	0.000	0.000	0.000	4
30	Yüksel	24	39	0.386	0.750	0.926	0.734	0.521	1

1990-1999 Scaled Data Matrix (Z-Scale)

Firms	TNOPart	TNOT	Eigen	Repeat edPart	Holes	Tech_ Div_B lau	Geo_ Div_B lau	cluster_1990 _1999
akfen	0.16	0.16	0.12	0.24	0.45	0.72	1	0.66
alsim-alarko	0.12	0.11	0	0	0.51	0	0	0
attila-dogan	0.16	0.14	0	0	0.7	0.72	0.51	0.66
cengiz	0.29	0.23	0.44	0	0.81	0.39	0.51	0.66
ceylan	0.12	0.11	0.1	0	0.09	0	0	0
dogus	0.16	0.14	0.1	0	0.51	0.47	0.63	0.66
ecetur	0.23	0.21	0.3	0.09	0.56	0.47	0.63	0.66
eksen	0.09	0.09	0	0	0	0	0	0
enka	0.36	0.31	0.13	0.15	0.92	1	0.88	0.66
gama	1	0.9	1	0.3	1	0.89	0.09	1
garanti-koza	0.12	0.11	0.1	0	0.22	0	0	0
gocay	0.19	0.16	0.25	0	0.58	0.72	1	0.66
gunsayil	0.12	0.11	0	0	0.51	0	0	0
guris	0.8	0.78	0.91	0.58	0.94	0.88	0.14	1
hgg-insaat	0.09	0.09	0	0	0	0	0	0
ictas	0.23	0.19	0.31	0	0.62	0.47	0.63	0.66
kiska-kom	0.46	0.43	0.72	0.27	0.88	0.39	0.52	0.66
kolin	0.29	0.33	0.17	0.35	0.8	0.09	0.43	0.66
limak	0.23	0.26	0.15	0.43	0.7	0.39	0.63	0.66
makyol	0.16	0.14	0.28	0	0.45	0	0	0
mapa	0.12	0.11	0.17	0	0.19	0	0	0
metis	0.29	0.28	0.41	0.19	0.73	0	0.63	0.66
nurol	0.23	0.26	0.56	0.15	0.73	0	0.51	0.66
ozdemir	0.12	0.16	0.18	1	0.09	0	0	0.33
polat	0.09	0.09	0.09	0	0	0	0	0
re-ha	0.16	0.21	0.37	1	0.43	0	0	0.33
stfa	0.09	0.09	0	0	0	0	0	0
tekfen	0.53	0.62	0.61	0.63	0.93	0.9	0.99	1
tepe	0.09	0.09	0.09	0	0	0	0	0
yuksel	0.87	1	0.95	0.72	1	0.82	0.68	1

1990-1999 Calibrated Data Matrix for QCA

Firms	TNOPart	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	Membership_Score 1990_1999
akfen	0.2	0.2	0.2	0.4	0.6	0.8	1	0.66
alsim-alarko	0.2	0.2	0	0	0.6	0	0	0
attila-dogan	0.2	0.2	0	0	0.8	0.8	0.8	0.66
cengiz	0.4	0.2	0.4	0	1	0.6	0.8	0.66
ceylan	0.2	0.2	0.2	0	0.2	0	0	0
dogus	0.2	0.2	0.2	0	0.6	0.6	0.8	0.66
ecetur	0.2	0.2	0.4	0.2	0.6	0.6	0.8	0.66
eksen	0	0	0	0	0	0	0	0
enka	0.4	0.4	0.2	0.4	1	1	1	0.66
gama	1	1	1	0.4	1	1	0.4	1
garanti-koza	0.2	0.2	0.2	0	0.4	0	0	0
gocay	0.2	0.2	0.2	0	0.8	0.8	1	0.66
gunsayil	0.2	0.2	0	0	0.6	0	0	0
guris	0.8	0.8	1	0.8	1	1	0.6	1
hgg-insaat	0	0	0	0	0	0	0	0
ictas	0.2	0.2	0.4	0	0.8	0.6	0.8	0.66
kiska-kom	0.6	0.4	0.8	0.4	1	0.6	0.8	0.66
kolin	0.4	0.4	0.2	0.6	1	0.4	0.8	0.66
limak	0.2	0.2	0.2	0.6	0.8	0.6	0.8	0.66
makyol	0.2	0.2	0.2	0	0.6	0	0	0
mapa	0.2	0.2	0.2	0	0.4	0	0	0
metis	0.4	0.4	0.4	0.4	0.8	0	0.8	0.66
nurol	0.2	0.2	0.6	0.4	0.8	0	0.8	0.66
ozdemir	0.2	0.2	0.2	1	0.2	0	0	0.33
polat	0	0	0.2	0	0	0	0	0
re-ha	0.2	0.2	0.4	1	0.6	0	0	0.33
stfa	0	0	0	0	0	0	0	0
tekfen	0.6	0.6	0.6	0.8	1	1	1	1
tepe	0	0	0.2	0	0	0	0	0
yuksel	1	1	1	0.8	1	1	0.8	1

APPENDIX B: 2000-2009 Data Matrix

2000-2009 Raw Data Matrix

	Firms	TNO Part	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	Cluster 2000_2009
1	Akfen	4	23	0.053	1.333	0.304	0.653	0.562	3
2	Alke	2	2	0.000	0.000	0.160	0.000	0.000	4
3	Alsim Alarko	20	22	0.236	0.000	0.924	0.722	0.485	1
4	Astur	3	5	0.013	0.333	0.282	0.444	0.444	3
5	Attila Doğan	2	2	0.009	0.000	0.500	0.500	0.500	2
6	Cengiz	16	22	0.139	0.333	0.820	0.593	0.617	1
7	Ceylan	3	4	0.000	0.000	0.126	0.500	0.000	4
8	Çelikler	2	2	0.000	0.000	0.500	0.000	0.500	4
9	Doğuş	6	6	0.060	0.000	0.737	0.667	0.444	2
10	Ecetur	1	1	0.000	0.000	0.000	0.000	0.000	4
11	Enka	11	25	0.255	0.722	0.749	0.635	0.775	1
12	Epik	2	6	0.000	1.000	-0.125	0.000	0.444	3
13	Ermit	1	1	0.034	0.000	0.000	0.000	0.000	4
14	Fernas	2	3	0.000	1.000	0.444	0.000	0.444	3
15	Gama	27	42	0.510	0.533	0.854	0.554	0.752	1
16	Garanti Koza	4	5	0.046	0.000	0.685	0.444	0.000	2
17	Göçay	1	1	0.000	0.000	0.000	0.000	0.000	4
18	Gülermak	4	6	0.021	0.250	0.457	0.375	0.375	2
19	Gülsan	1	2	0.000	1.000	0.000	0.500	0.000	3
20	Günal	3	5	0.007	1.000	0.625	0.667	0.444	3
21	Günsayıl	15	17	0.062	0.268	0.914	0.734	0.521	2
22	Güriş	9	11	0.002	0.333	0.860	0.494	0.494	2
23	Gürsesli	1	1	0.000	0.000	0.000	0.000	0.000	4
24	Haşemoğlu	2	2	0.000	0.000	0.500	0.000	0.500	4
25	HGG İnşaat	5	6	0.000	0.200	0.735	0.480	0.480	2
26	Hüsamettin Peker	1	1	0.000	0.000	0.000	0.000	0.000	4
27	İçtaş	4	7	0.035	1.000	0.443	0.444	0.444	3
28	İlci	3	5	0.000	1.000	0.460	0.375	0.375	3
29	Kalyon	4	4	0.000	0.000	0.750	0.750	0.500	2
30	Kayaoğlu	3	4	0.000	0.000	0.625	0.375	0.625	2
31	Kiska-Kom	3	3	0.010	0.000	0.667	0.444	0.444	2
32	Kolin	6	8	0.043	0.200	0.679	0.320	0.480	2
33	Limak	15	19	0.056	0.365	0.892	0.631	0.604	2
34	Makimsan Asfalt	2	2	0.006	0.000	0.163	0.000	0.000	4
35	Makyol	6	6	0.067	0.000	0.724	0.625	0.375	2
36	Mapa	6	8	0.048	0.333	0.722	0.560	0.560	2
37	Mesa Mesken	2	2	0.026	0.000	0.500	0.000	0.000	4
38	Metag	2	2	0.001	0.000	0.163	0.000	0.000	4
39	Metgün	2	3	0.000	1.000	0.444	0.000	0.444	3

40	Metiş	2	6	0.000	1.000	-0.125	0.000	0.444	3
41	MSM Altyapı	1	1	0.000	0.000	0.000	0.000	0.000	4
42	Nurol	11	11	0.176	0.000	0.743	0.625	0.500	2
43	Onur Taahhüt	3	3	0.000	0.000	0.667	0.500	0.500	2
44	Özaltın	2	2	0.046	0.000	0.427	0.000	0.000	4
45	Özgün İnşaat	4	8	0.000	0.500	0.719	0.219	0.500	2
46	Özgün Yapı	1	1	0.000	0.000	0.000	0.000	0.000	4
47	Özka	1	1	0.000	0.000	0.000	0.000	0.000	4
48	Pekintaş	2	2	0.000	0.000	0.500	0.000	0.000	4
49	Polat	1	1	0.000	0.000	0.000	0.000	0.000	4
50	Rönesans	1	1	0.074	0.000	0.000	0.000	0.000	4
51	Sistem Elektromekanik	1	1	0.000	0.000	0.000	0.000	0.000	4
52	SMS İnşaat	1	1	0.000	0.000	0.000	0.000	0.000	4
53	Söğüt	1	1	0.007	0.000	0.000	0.000	0.000	4
54	STFA	15	19	0.002	0.268	0.902	0.631	0.320	2
55	STY İnşaat	5	7	0.000	0.667	0.550	0.667	0.444	3
56	Taşyapı 2	2	2	0.000	0.000	0.500	0.000	0.000	4
57	TAV	1	1	0.000	0.000	0.000	0.000	0.000	4
58	Tekfen	22	39	0.392	0.607	0.828	0.730	0.650	1
59	Tepe	3	21	0.008	1.333	0.171	0.625	0.555	3
60	Türkerler	2	3	0.008	0.500	0.444	0.667	0.000	3
61	Varyap	1	1	0.000	0.000	0.000	0.000	0.000	4
62	Yapı Merkezi	8	8	0.051	0.000	0.834	0.375	0.625	2
63	YDA İnşaat	6	6	0.051	0.000	0.747	0.625	0.625	2
64	YP İnşaat	1	1	0.000	0.000	0.000	0.000	0.000	4
65	Yıldızlar	2	2	0.000	0.000	0.078	0.000	0.000	4
66	YSE Yapı	1	1	0.000	0.000	0.000	0.000	0.000	4
67	Yüksel	13	21	0.034	0.500	0.855	0.375	0.653	2

2000-2009 Scaled Data Matrix (Z-Scale)

Firms	TNOPart	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	Cluster 2000_2009
akfen	0.2	0.58	0.18	1	0.46	0.83	0.57	0.33
alke	0.13	0.11	0.09	0	0.34	0	0	0
alsim-alarko	0.76	0.56	0.51	0	1	0.95	0.42	1
astur	0.16	0.18	0.11	0.2	0.44	0.48	0.34	0.33
attila-dogan	0.13	0.11	0.11	0	0.63	0.57	0.45	0.66
cengiz	0.62	0.56	0.34	0.2	0.91	0.73	0.68	1
ceylan	0.16	0.16	0	0	0.31	0.57	0	0
celikler	0.13	0.11	0	0	0.63	0	0.45	0
dogus	0.27	0.2	0.2	0	0.84	0.86	0.34	0.66
ecetur	0.09	0.09	0	0	0	0	0	0
enka	0.44	0.62	0.54	0.51	0.85	0.8	1	1
epik	0.13	0.2	0	0.73	0.09	0	0.34	0.33
ermit	0.09	0.09	0.15	0	0	0	0	0
fernas	0.13	0.14	0.09	0.73	0.58	0	0.34	0.33
gama	1	1	1	0.36	0.94	0.66	0.95	1
garanti-koza	0.2	0.18	0.17	0	0.79	0.48	0	0.66
gocay	0.09	0.09	0	0	0	0	0	0
gulermak	0.2	0.2	0.13	0.13	0.59	0.36	0.2	0.66
gulsan	0.09	0.11	0	0.73	0	0.57	0	0.33
gunal	0.16	0.18	0.1	0.73	0.74	0.86	0.34	0.33
gunsayil	0.58	0.45	0.2	0.15	0.99	0.97	0.49	0.66
guris	0.37	0.31	0.09	0.2	0.94	0.56	0.44	0.66
gursesli	0.09	0.09	0	0	0	0	0	0
hasemoglu	0.13	0.11	0	0	0.63	0	0.45	0
hgg-insaat	0.23	0.2	0	0.09	0.84	0.54	0.41	0.66
husamettin-peker	0.09	0.09	0	0	0	0	0	0
ictas	0.2	0.22	0.15	0.73	0.58	0.48	0.34	0.33
ilci	0.16	0.18	0	0.73	0.6	0.36	0.2	0.33
kalyon	0.2	0.16	0	0	0.85	1	0.45	0.66
kayaoglu	0.16	0.16	0	0	0.74	0.36	0.7	0.66
kiska-kom	0.16	0.14	0.11	0	0.78	0.48	0.34	0.66
kolin	0.27	0.25	0.17	0.09	0.79	0.26	0.41	0.66
limak	0.58	0.49	0.19	0.22	0.97	0.8	0.66	0.66
makimsan-asfalt	0.13	0.11	0.1	0	0.34	0	0	0
makyol	0.27	0.2	0.21	0	0.83	0.79	0.2	0.66
mapa	0.27	0.25	0.18	0.2	0.83	0.67	0.57	0.66
mesa-mesken	0.13	0.11	0.14	0	0.63	0	0	0
metag	0.13	0.11	0.09	0	0.34	0	0	0
metgun	0.13	0.14	0	0.73	0.58	0	0.34	0.33
metis	0.13	0.2	0	0.73	0.09	0	0.34	0.33
msm-altyapi	0.09	0.09	0	0	0	0	0	0
nurol	0.44	0.31	0.4	0	0.84	0.79	0.45	0.66
onur-taahhut	0.16	0.14	0	0	0.78	0.57	0.45	0.66

ozaltin	0.13	0.11	0.17	0	0.57	0	0	0
ozgun-insaat	0.2	0.25	0	0.33	0.82	0.09	0.45	0.66
ozgun-yapi	0.09	0.09	0	0	0	0	0	0
ozka	0.09	0.09	0	0	0	0	0	0
pekintas	0.13	0.11	0	0	0.63	0	0	0
polat	0.09	0.09	0.09	0	0	0	0	0
ronesans	0.09	0.09	0.22	0	0	0	0	0
sistem-elektromekanik	0.09	0.09	0	0	0	0	0	0
sms-insaat	0.09	0.09	0	0	0	0	0	0
sogut	0.09	0.09	0.1	0	0	0	0	0
stfa	0.58	0.49	0.09	0.15	0.98	0.8	0.09	0.66
sty-insaat	0.23	0.22	0	0.47	0.68	0.86	0.34	0.33
tasyapi-2	0.13	0.11	0	0	0.63	0	0	0
tav	0.09	0.09	0	0	0	0	0	0
tekfen	0.83	0.93	0.79	0.42	0.92	0.97	0.75	1
tepe	0.16	0.53	0.1	1	0.35	0.79	0.56	0.33
turkerler	0.13	0.14	0.11	0.33	0.58	0.86	0	0.33
varyap	0.09	0.09	0	0	0	0	0	0
yapi-merkezi	0.34	0.25	0.18	0	0.92	0.36	0.7	0.66
yda-insaat	0.27	0.2	0.18	0	0.85	0.79	0.7	0.66
yp-insaat	0.09	0.09	0	0	0	0	0	0
yildizlar	0.13	0.11	0	0	0.27	0	0	0
yse-yapi	0.09	0.09	0	0	0	0	0	0
yuksel	0.51	0.53	0.15	0.33	0.94	0.36	0.76	0.66

2000-2009 Calibrated Data Matrix for QCA

Firms	TNOPart	TNOT	Eigen	Repeated Part	Holes	Tech_Div_Blau	Geo_Div_Blau	Membership Score 2000_2009
akfen	0.2	0.6	0.2	1	0.6	1	0.8	0.33
alke	0.2	0.2	0.2	0	0.4	0	0	0
alsim-alarko	0.8	0.6	0.6	0	1	1	0.8	1
astur	0.2	0.2	0.2	0.4	0.4	0.6	0.6	0.33
attila-dogan	0.2	0.2	0.2	0	0.6	0.8	0.8	0.66
cengiz	0.6	0.6	0.4	0.4	1	0.8	0.8	1
ceylan	0.2	0.2	0	0	0.4	0.8	0	0
celikler	0.2	0.2	0	0	0.6	0	0.8	0
dogus	0.2	0.2	0.2	0	1	1	0.6	0.66
ecetur	0	0	0	0	0.2	0	0	0
enka	0.4	0.6	0.6	0.6	1	1	1	1
epik	0.2	0.2	0	0.8	0	0	0.6	0.33
ermit	0	0	0.2	0	0.2	0	0	0
fernas	0.2	0.2	0.2	0.8	0.6	0	0.6	0.33
gama	1	1	1	0.4	1	0.8	1	1
garanti-koza	0.2	0.2	0.2	0	0.8	0.6	0	0.66
gocay	0	0	0	0	0.2	0	0	0
gulermak	0.2	0.2	0.2	0.2	0.6	0.6	0.6	0.66
gulsan	0	0.2	0	0.8	0.2	0.8	0	0.33
gunal	0.2	0.2	0.2	0.8	0.8	1	0.6	0.33
gunsayil	0.6	0.4	0.2	0.2	1	1	0.8	0.66
guris	0.4	0.4	0.2	0.4	1	0.8	0.8	0.66
gursesli	0	0	0	0	0.2	0	0	0
hasemoglu	0.2	0.2	0	0	0.6	0	0.8	0
hgg-insaat	0.2	0.2	0	0.2	1	0.8	0.8	0.66
husamettin-peker	0	0	0	0	0.2	0	0	0
ictas	0.2	0.2	0.2	0.8	0.6	0.6	0.6	0.33
ilci	0.2	0.2	0	0.8	0.6	0.6	0.6	0.33
kalyon	0.2	0.2	0	0	1	1	0.8	0.66
kayaoglu	0.2	0.2	0	0	0.8	0.6	1	0.66
kiska-kom	0.2	0.2	0.2	0	0.8	0.6	0.6	0.66
kolin	0.2	0.2	0.2	0.2	0.8	0.6	0.8	0.66
limak	0.6	0.6	0.2	0.4	1	1	0.8	0.66
makimsan-asfalt	0.2	0.2	0.2	0	0.4	0	0	0
makyol	0.2	0.2	0.2	0	1	1	0.6	0.66
mapa	0.2	0.2	0.2	0.4	1	0.8	0.8	0.66
mesa-mesken	0.2	0.2	0.2	0	0.6	0	0	0
metag	0.2	0.2	0.2	0	0.4	0	0	0
metgun	0.2	0.2	0	0.8	0.6	0	0.6	0.33
metis	0.2	0.2	0	0.8	0	0	0.6	0.33
msm-altyapi	0	0	0	0	0.2	0	0	0
nurol	0.4	0.4	0.4	0	1	1	0.8	0.66

onur-taahhut	0.2	0.2	0	0	0.8	0.8	0.8	0.66
ozaltin	0.2	0.2	0.2	0	0.6	0	0	0
ozgun-insaat	0.2	0.2	0	0.4	0.8	0.4	0.8	0.66
ozgun-yapi	0	0	0	0	0.2	0	0	0
ozka	0	0	0	0	0.2	0	0	0
pekintas	0.2	0.2	0	0	0.6	0	0	0
polat	0	0	0.2	0	0.2	0	0	0
ronesans	0	0	0.2	0	0.2	0	0	0
sistem-elektromekanik	0	0	0	0	0.2	0	0	0
sms-insaat	0	0	0	0	0.2	0	0	0
sogut	0	0	0.2	0	0.2	0	0	0
stfa	0.6	0.6	0.2	0.2	1	1	0.6	0.66
sty-insaat	0.2	0.2	0	0.6	0.8	1	0.6	0.33
tasyapi-2	0.2	0.2	0	0	0.6	0	0	0
tav	0	0	0	0	0.2	0	0	0
tekfen	1	1	0.8	0.6	1	1	1	1
tepe	0.2	0.6	0.2	1	0.4	1	0.8	0.33
turkerler	0.2	0.2	0.2	0.4	0.6	1	0	0.33
varyap	0	0	0	0	0.2	0	0	0
yapi-merkezi	0.4	0.2	0.2	0	1	0.6	1	0.66
yda-insaat	0.2	0.2	0.2	0	1	1	1	0.66
yp-insaat	0	0	0	0	0.2	0	0	0
yildizlar	0.2	0.2	0	0	0.2	0	0	0
yse-yapi	0	0	0	0	0.2	0	0	0
yuksel	0.6	0.6	0.2	0.4	1	0.6	1	0.66

APPENDIX C: 2010-2019 Data Matrix

2010-2019 Raw Data Matrix

	Firms	TNO Part	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	cluster 2010_2019
1	Açılım	7	10	0.005	0.400	0.671	0.000	0.480	3
2	Akfen	1	13	0.006	2.000	0.000	0.497	0.462	3
3	Alkataş	3	8	0.000	1.000	0.402	0.490	0.245	3
4	Alke	6	18	0.000	0.500	0.669	0.695	0.117	4
5	Alsim Alarko	2	3	0.034	0.000	0.444	0.444	0.000	4
6	Aras	2	6	0.022	2.000	0.394	0.000	0.278	3
7	Astur	9	18	0.229	0.767	0.711	0.667	0.370	1
8	Attila Doğan	1	1	0.000	0.000	0.000	0.000	0.000	4
9	Aydın İnşaat AS	5	9	0.002	0.600	0.539	0.000	0.480	3
10	Aydın İnşaat LTD	4	6	0.000	0.333	0.667	0.000	0.444	3
11	Bahadır Mühendislik	7	13	0.023	0.400	0.752	0.142	0.473	2
12	Baytimur	9	16	0.003	1.000	0.829	0.561	0.337	2
13	Burkay	13	15	0.036	0.250	0.912	0.667	0.278	2
14	Caba	8	8	0.009	0.000	0.821	0.278	0.000	4
15	Cengiz	19	45	0.292	0.767	0.837	0.653	0.541	1
16	Cey Grup	6	9	0.006	0.167	0.681	0.000	0.219	4
17	Ceylan	2	2	0.000	0.000	0.500	0.500	0.500	2
18	Çelikler	4	6	0.027	1.000	0.609	0.480	0.480	3
19	Dalgıçlar	6	9	0.005	0.167	0.620	0.778	0.444	2
20	Demars	7	9	0.004	0.400	0.781	0.568	0.346	2
21	Demce	8	12	0.001	0.600	0.799	0.562	0.496	2
22	Dido-Ray	10	15	0.002	0.222	0.761	0.500	0.420	2
23	Diy-mar	4	7	0.000	0.500	0.665	0.278	0.500	3
24	Doğuş	10	11	0.069	0.333	0.891	0.617	0.716	2
25	Ecetur	4	4	0.005	0.000	0.750	0.667	0.444	2
26	Eksen	4	5	0.029	0.250	0.708	0.000	0.625	3
27	Enka	6	22	0.000	1.067	0.686	0.698	0.739	2
28	Ensa	6	12	0.001	0.833	0.614	0.000	0.397	3
29	Epik	2	8	0.031	0.500	0.175	0.245	0.408	3
30	ERK İnşaat	9	12	0.001	0.222	0.821	0.180	0.180	4
31	Ermit	13	21	0.026	0.400	0.863	0.539	0.461	2
32	Eskikale	9	13	0.002	0.222	0.716	0.000	0.500	2
33	Farsel	6	9	0.009	0.333	0.784	0.370	0.494	2
34	Fernas	3	5	0.045	1.000	0.544	0.375	0.625	3
35	Gama	6	11	0.020	0.900	0.777	0.579	0.711	2
36	Gaziantep Gold	10	13	0.000	0.583	0.888	0.000	0.000	4
37	Göçay	12	19	0.173	0.000	0.732	0.444	0.444	1
38	Gülak	5	18	0.000	0.500	0.519	0.204	0.401	3
39	Gülermak	11	20	0.178	0.450	0.709	0.658	0.418	1

40	Gülsan	4	5	0.038	0.500	0.720	0.000	0.640	3
41	Günal	2	4	0.019	1.000	0.375	0.625	0.625	3
42	Günsayıl	6	8	0.000	0.200	0.781	0.750	0.000	4
43	Güriş	1	1	0.001	0.000	0.000	0.000	0.000	4
44	Gürsesli	6	6	0.000	0.000	0.833	0.625	0.500	2
45	Haselsan	5	6	0.001	0.250	0.778	0.611	0.278	2
46	Haşemoğlu	3	4	0.000	0.500	0.625	0.000	0.375	3
47	HGG İnşaat	8	9	0.044	0.143	0.834	0.571	0.490	2
48	Hüsamettin Peker	11	16	0.001	0.333	0.853	0.497	0.426	2
49	ICC Grup	2	5	0.000	1.000	0.480	0.640	0.480	3
50	İçtaş	5	15	0.132	1.300	0.591	0.593	0.494	3
51	İlci	4	5	0.041	0.333	0.698	0.480	0.480	2
52	İnelsan	7	8	0.001	0.000	0.581	0.320	0.320	4
53	İntekar	13	22	0.001	0.397	0.780	0.568	0.426	2
54	Kalyon	20	41	0.311	0.697	0.825	0.558	0.310	1
55	Karaca	8	11	0.005	0.429	0.852	0.165	0.397	2
56	Kayaoğlu	4	6	0.002	0.333	0.667	0.278	0.278	4
57	Kayasan Yapı	5	7	0.000	1.000	0.735	0.000	0.408	3
58	Kiska-Kom	11	12	0.137	0.091	0.853	0.494	0.444	2
59	KLV İnşaat	8	8	0.003	0.000	0.875	0.688	0.375	2
60	KMB Metro	5	7	0.004	0.200	0.687	0.722	0.444	2
61	Kolin	21	53	0.238	0.813	0.846	0.714	0.314	1
62	Kur İnşaat	3	7	0.001	1.000	0.449	0.245	0.571	3
63	Limak	21	38	0.191	0.486	0.845	0.715	0.674	1
64	Makimsan Asfalt	8	10	0.069	0.500	0.827	0.469	0.469	2
65	Makyol	14	22	0.269	0.450	0.815	0.694	0.153	1
66	Mapa	12	23	0.163	0.600	0.835	0.367	0.500	1
67	M.B.D. İnşaat	6	6	0.000	0.000	0.795	0.320	0.480	2
68	Mesa Mesken	9	10	0.042	0.000	0.865	0.000	0.000	4
69	Metag	6	8	0.049	1.000	0.717	0.000	0.560	3
70	Metaleks	6	7	0.001	0.167	0.729	0.611	0.500	2
71	Metgün	3	6	0.004	0.333	0.611	0.375	0.000	4
72	Metro Mühendislik	3	8	0.000	1.000	0.322	0.000	0.000	3
73	MSM Altyapı	10	11	0.016	0.500	0.883	0.540	0.320	2
74	Mustafa Ekşi	9	13	0.001	0.600	0.856	0.000	0.486	2
75	Nas Yapı	8	13	0.006	0.450	0.765	0.397	0.165	4
76	Nehirsu	9	12	0.034	0.333	0.875	0.153	0.486	2
77	Neoray	9	12	0.003	0.222	0.650	0.560	0.480	2
78	Nuhoğlu	14	22	0.003	0.500	0.802	0.622	0.444	2
79	Nurol	14	17	0.252	0.100	0.881	0.660	0.620	1
80	Onur Taahhüt	5	8	0.011	1.167	0.781	0.219	0.656	3
81	Ö.D.F Yılmazlar	4	7	0.000	0.333	0.612	0.278	0.500	3
82	Özaltın	15	30	0.247	0.523	0.833	0.526	0.549	1
83	Öz Aras	14	24	0.001	0.325	0.784	0.648	0.492	2
84	Özdemir	17	26	0.061	0.625	0.839	0.556	0.497	1
85	Öz Er-Ka	10	15	0.000	0.533	0.828	0.651	0.497	2

86	Özgün İnşaat	5	6	0.035	0.000	0.788	0.000	0.000	4
87	Özgün Yapı	10	21	0.141	1.300	0.768	0.547	0.457	1
88	Özka	10	18	0.179	0.952	0.809	0.272	0.497	1
89	Özkar	7	10	0.052	0.500	0.820	0.660	0.480	2
90	Özmert	4	5	0.001	0.333	0.720	0.320	0.480	2
91	Öztaş	6	10	0.025	1.000	0.797	0.691	0.444	2
92	Özyurt	4	9	0.000	0.833	0.519	0.667	0.198	3
93	Peker	8	8	0.004	0.000	0.875	0.688	0.500	2
94	Pekintaş	4	4	0.003	0.000	0.664	0.000	0.444	4
95	Polat	4	5	0.000	0.250	0.720	0.320	0.480	2
96	Pramid	14	19	0.003	0.200	0.852	0.735	0.500	2
97	Rast Madencilik	7	9	0.000	0.286	0.812	0.449	0.000	4
98	Re-Ha	3	5	0.006	0.500	0.560	0.320	0.320	3
99	Rönesans	12	14	0.003	0.333	0.916	0.430	0.545	2
100	Serfen	6	7	0.005	0.167	0.774	0.408	0.245	4
101	Seza	5	10	0.001	0.250	0.618	0.719	0.469	2
102	Sigma	12	17	0.037	0.525	0.855	0.500	0.375	2
103	Silahtaroğlu	6	10	0.000	0.250	0.675	0.611	0.500	2
104	Sistem Elektromekanik	8	10	0.002	0.167	0.845	0.667	0.444	2
105	SMS İnşaat	5	9	0.003	0.750	0.642	0.198	0.444	3
106	SNH İnşaat	5	7	0.013	0.200	0.776	0.408	0.408	2
107	Söğüt	6	7	0.066	0.000	0.781	0.278	0.000	4
108	STFA	5	6	0.058	0.000	0.688	0.625	0.500	2
109	STY İnşaat	6	6	0.023	0.000	0.770	0.375	0.375	2
110	Su-Bar	10	14	0.010	0.200	0.849	0.357	0.459	2
111	Şenbay	10	18	0.102	0.733	0.752	0.500	0.541	2
112	Taş Yapı 1	6	10	0.005	0.200	0.791	0.667	0.000	4
113	Taşyapı 2	4	4	0.042	0.000	0.750	0.625	0.375	2
114	TAV	6	7	0.005	0.000	0.816	0.320	0.560	2
115	Tekfen	6	9	0.011	1.000	0.815	0.653	0.449	2
116	Tepe	7	19	0.054	1.143	0.502	0.469	0.578	3
117	Türkerler	11	15	0.150	0.667	0.855	0.627	0.142	1
118	Uluova	7	10	0.000	0.286	0.763	0.370	0.198	4
119	Üçer	9	14	0.000	0.667	0.839	0.512	0.496	2
120	Varyap	5	5	0.000	0.000	0.800	0.000	0.320	4
121	Yapı Merkezi	12	13	0.091	0.000	0.864	0.617	0.568	2
122	YDA İnşaat	22	33	0.165	0.313	0.919	0.628	0.590	1
123	Yeni Fidan	7	10	0.000	0.333	0.818	0.000	0.346	4
124	YP İnşaat	3	4	0.000	1.000	0.625	0.000	0.375	3
125	Yıldızlar	5	8	0.005	1.000	0.682	0.000	0.408	3
126	YSE Yapı	7	10	0.029	0.500	0.756	0.494	0.000	4
127	Yüksel	26	49	0.275	0.567	0.908	0.702	0.667	1

2000-2019 Scaled Data Matrix (Z-Scale)

Firms	TNOPart	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	Cluster 2010_2019
acilim	0.31	0.25	0.1	0.24	0.7	0	0.62	0.33
akfen	0.09	0.3	0.11	1	0	0.6	0.59	0.33
alkatas	0.16	0.21	0	0.52	0.37	0.59	0.28	0.33
alke	0.27	0.39	0	0.29	0.69	0.88	0.09	0
alsim-alarko	0.13	0.13	0.19	0	0.42	0.52	0	0
aras	0.13	0.18	0.15	1	0.36	0	0.33	0.33
astur	0.38	0.39	0.76	0.41	0.75	0.84	0.46	1
attila-dogan	0.09	0.09	0	0	0	0	0	0
aydin-insaat-as	0.24	0.23	0.1	0.33	0.53	0	0.62	0.33
aydin-insaat-ltd	0.2	0.18	0.09	0.21	0.69	0	0.57	0.33
bahadir-muhendislik	0.31	0.3	0.16	0.24	0.8	0.09	0.61	0.66
baytimur	0.38	0.35	0.1	0.52	0.89	0.69	0.41	0.66
burkay	0.53	0.34	0.2	0.17	0.99	0.84	0.33	0.66
caba	0.35	0.21	0.12	0	0.88	0.29	0	0
cengiz	0.75	0.86	0.94	0.41	0.9	0.82	0.71	1
cey-grup	0.27	0.23	0.11	0.13	0.71	0	0.24	0
ceylan	0.13	0.11	0	0	0.49	0.6	0.65	0.66
celikler	0.2	0.18	0.17	0.52	0.62	0.57	0.62	0.33
dalgiclar	0.27	0.23	0.11	0.13	0.63	1	0.57	0.66
demars	0.31	0.23	0.1	0.24	0.83	0.7	0.42	0.66
demce	0.35	0.28	0.09	0.33	0.85	0.69	0.64	0.66
dido-ray	0.42	0.34	0.1	0.15	0.81	0.6	0.53	0.66
diy-mar	0.2	0.2	0	0.29	0.69	0.29	0.65	0.33
dogus	0.42	0.27	0.29	0.21	0.97	0.77	0.97	0.66
ecetur	0.2	0.14	0.11	0	0.79	0.84	0.57	0.66
eksen	0.2	0.16	0.18	0.17	0.74	0	0.83	0.33
enka	0.27	0.46	0	0.56	0.71	0.89	1	0.66
ensa	0.27	0.28	0.09	0.44	0.63	0	0.5	0.33
epik	0.13	0.21	0.18	0.29	0.09	0.24	0.52	0.33
erk-insaat	0.38	0.28	0.09	0.15	0.88	0.15	0.18	0
ermit	0.53	0.44	0.17	0.24	0.93	0.66	0.59	0.66
eskikale	0.38	0.3	0.1	0.15	0.75	0	0.65	0.66
farsel	0.27	0.23	0.12	0.21	0.84	0.42	0.64	0.66
fernas	0.16	0.16	0.22	0.52	0.54	0.42	0.83	0.33
gama	0.27	0.27	0.15	0.48	0.83	0.72	0.96	0.66
gaziantep-gold	0.42	0.3	0	0.33	0.96	0	0	0
gocay	0.49	0.41	0.6	0	0.77	0.52	0.57	1
gulak	0.24	0.39	0.09	0.29	0.51	0.18	0.51	0.33
gulermak	0.45	0.42	0.61	0.26	0.74	0.83	0.53	1
gulsan	0.2	0.16	0.2	0.29	0.76	0	0.85	0.33
gunal	0.13	0.14	0.15	0.52	0.33	0.78	0.83	0.33
gunsayil	0.27	0.21	0	0.14	0.83	0.96	0	0
guris	0.09	0.09	0.09	0	0	0	0	0

gursesli	0.27	0.18	0.09	0	0.9	0.78	0.65	0.66
haselsan	0.24	0.18	0.09	0.17	0.83	0.76	0.33	0.66
hasemoglu	0.16	0.14	0.09	0.29	0.64	0	0.47	0.33
hgg-insaat	0.35	0.23	0.22	0.12	0.9	0.7	0.64	0.66
husamettin-peker	0.45	0.35	0.09	0.21	0.92	0.6	0.54	0.66
icc-grup	0.13	0.16	0	0.52	0.46	0.8	0.62	0.33
ictas	0.24	0.34	0.48	0.67	0.6	0.74	0.64	0.33
ilci	0.2	0.16	0.21	0.21	0.73	0.57	0.62	0.66
inelsan	0.31	0.21	0.09	0	0.59	0.35	0.39	0
intekar	0.53	0.46	0.09	0.24	0.83	0.7	0.54	0.66
kalyon	0.78	0.79	1	0.38	0.89	0.69	0.37	1
karaca	0.35	0.27	0.1	0.25	0.92	0.12	0.5	0.66
kayaoglu	0.2	0.18	0.1	0.21	0.69	0.29	0.33	0
kayasan-yapi	0.24	0.2	0	0.52	0.77	0	0.52	0.33
kiska-kom	0.45	0.28	0.49	0.09	0.92	0.59	0.57	0.66
klv-insaat	0.35	0.21	0.1	0	0.95	0.87	0.47	0.66
kmb-metro	0.24	0.2	0.1	0.14	0.72	0.92	0.57	0.66
kolin	0.82	1	0.79	0.43	0.91	0.91	0.38	1
kur-insaat	0.16	0.2	0.09	0.52	0.43	0.24	0.75	0.33
limak	0.82	0.74	0.65	0.28	0.91	0.91	0.9	1
makimsan-asfalt	0.35	0.25	0.29	0.29	0.89	0.56	0.6	0.66
makyol	0.56	0.46	0.88	0.26	0.87	0.88	0.14	1
mapa	0.49	0.48	0.57	0.33	0.9	0.41	0.65	1
mbd-insaat	0.27	0.18	0	0	0.85	0.35	0.62	0.66
mesa-mesken	0.38	0.25	0.21	0	0.93	0	0	0
metag	0.27	0.21	0.23	0.52	0.75	0	0.74	0.33
metaleks	0.27	0.2	0.09	0.13	0.77	0.76	0.65	0.66
metgun	0.16	0.18	0.1	0.21	0.62	0.42	0	0
metro-muhendislik	0.16	0.21	0.09	0.52	0.27	0	0	0.33
msm-altyapi	0.42	0.27	0.14	0.29	0.96	0.66	0.39	0.66
mustafa-eksi	0.38	0.3	0.09	0.33	0.92	0	0.63	0.66
nas-yapi	0.35	0.3	0.11	0.26	0.81	0.46	0.16	0
nehirsu	0.38	0.28	0.19	0.21	0.95	0.11	0.63	0.66
neoray	0.38	0.28	0.1	0.15	0.67	0.69	0.62	0.66
nuhoglu	0.56	0.46	0.1	0.29	0.86	0.78	0.57	0.66
nurol	0.56	0.37	0.83	0.1	0.95	0.83	0.83	1
onur-taahhut	0.24	0.21	0.12	0.6	0.83	0.2	0.88	0.33
odf-yilmazlar	0.2	0.2	0.09	0.21	0.62	0.29	0.65	0.33
ozaltin	0.6	0.6	0.81	0.3	0.9	0.64	0.72	1
oz-aras	0.56	0.49	0.09	0.2	0.83	0.82	0.64	0.66
ozdemir	0.67	0.53	0.27	0.35	0.9	0.68	0.65	1
oz-er-ka	0.42	0.34	0.09	0.3	0.89	0.82	0.65	0.66
ozgun-insaat	0.24	0.18	0.19	0	0.84	0	0	0
ozgun-yapi	0.42	0.44	0.5	0.67	0.82	0.67	0.59	1
ozka	0.42	0.39	0.62	0.5	0.87	0.28	0.65	1
ozkar	0.31	0.25	0.24	0.29	0.88	0.83	0.62	0.66

ozmert	0.2	0.16	0.09	0.21	0.76	0.35	0.62	0.66
oztas	0.27	0.25	0.16	0.52	0.85	0.88	0.57	0.66
ozyurt	0.2	0.23	0	0.44	0.51	0.84	0.21	0.33
peker	0.35	0.21	0.1	0	0.95	0.87	0.65	0.66
pekintas	0.2	0.14	0.1	0	0.69	0	0.57	0
polat	0.2	0.16	0.09	0.17	0.76	0.35	0.62	0.66
pramid	0.56	0.41	0.1	0.14	0.92	0.94	0.65	0.66
rast-madencilik	0.31	0.23	0	0.18	0.87	0.53	0	0
re-ha	0.16	0.16	0.11	0.29	0.56	0.35	0.39	0.33
ronesans	0.49	0.32	0.1	0.21	1	0.5	0.72	0.66
serfen	0.27	0.2	0.1	0.13	0.82	0.47	0.28	0
seza	0.24	0.25	0.09	0.17	0.63	0.92	0.6	0.66
sigma	0.49	0.37	0.2	0.3	0.92	0.6	0.47	0.66
silahtaroglu	0.27	0.25	0.09	0.17	0.7	0.76	0.65	0.66
sistem-elektromekanik	0.35	0.25	0.1	0.13	0.91	0.84	0.57	0.66
sms-insaat	0.24	0.23	0.1	0.4	0.66	0.17	0.57	0.33
snh-insaat	0.24	0.2	0.13	0.14	0.82	0.47	0.52	0.66
sogut	0.27	0.2	0.29	0	0.83	0.29	0	0
stfa	0.24	0.18	0.26	0	0.72	0.78	0.65	0.66
sty-insaat	0.27	0.18	0.16	0	0.82	0.42	0.47	0.66
su-bar	0.42	0.32	0.12	0.14	0.91	0.4	0.59	0.66
senbay	0.42	0.39	0.39	0.4	0.8	0.6	0.71	0.66
tas-yapi-1	0.27	0.25	0.1	0.14	0.84	0.84	0	0
tasyapi-2	0.2	0.14	0.21	0	0.79	0.78	0.47	0.66
tav	0.27	0.2	0.1	0	0.87	0.35	0.74	0.66
tekfen	0.27	0.23	0.12	0.52	0.87	0.82	0.58	0.66
tepe	0.31	0.41	0.25	0.59	0.49	0.56	0.76	0.33
turkerler	0.45	0.34	0.53	0.37	0.92	0.78	0.13	1
uluova	0.31	0.25	0.09	0.18	0.81	0.42	0.21	0
ucer	0.38	0.32	0.09	0.37	0.9	0.62	0.64	0.66
varyap	0.24	0.16	0	0	0.85	0	0.39	0
yapi-merkezi	0.49	0.3	0.36	0	0.93	0.77	0.75	0.66
yda-insaat	0.85	0.65	0.57	0.2	1	0.79	0.78	1
yeni-fidan	0.31	0.25	0	0.21	0.88	0	0.42	0
yp-insaat	0.16	0.14	0	0.52	0.64	0	0.47	0.33
yildizlar	0.24	0.21	0.11	0.52	0.71	0	0.52	0.33
yse-yapi	0.31	0.25	0.17	0.29	0.8	0.59	0	0
yuksel	1	0.93	0.89	0.32	0.99	0.89	0.89	1

2010-2019 Calibrated Data Matrix for QCA

Firms	TNOPart	TNOT	Eigen	RepeatedPart	Holes	Tech_Div_Blau	Geo_Div_Blau	Membership Score 2010_2019
acilim	0.4	0.2	0.2	0.2	0.8	0	0.8	0.33
akfen	0	0.4	0.2	1	0	0.8	0.8	0.33
alkatas	0.2	0.2	0	0.6	0.6	0.8	0.4	0.33
alke	0.2	0.4	0	0.4	0.8	1	0.2	0
alsim-alarko	0.2	0.2	0.2	0	0.6	0.6	0	0
aras	0.2	0.2	0.2	1	0.6	0	0.4	0.33
astur	0.4	0.4	0.8	0.4	0.8	1	0.6	1
attila-dogan	0	0	0	0	0	0	0	0
aydin-insaat-as	0.2	0.2	0.2	0.4	0.6	0	0.8	0.33
aydin-insaat-ltd	0.2	0.2	0.2	0.2	0.8	0	0.6	0.33
bahadir-muhendislik	0.4	0.4	0.2	0.2	1	0.2	0.8	0.66
baytimur	0.4	0.4	0.2	0.6	1	0.8	0.6	0.66
burkay	0.6	0.4	0.2	0.2	1	1	0.4	0.66
caba	0.4	0.2	0.2	0	1	0.4	0	0
cengiz	0.8	1	1	0.4	1	1	0.8	1
cey-grup	0.2	0.2	0.2	0.2	0.8	0	0.4	0
ceylan	0.2	0.2	0	0	0.6	0.8	0.8	0.66
celikler	0.2	0.2	0.2	0.6	0.8	0.8	0.8	0.33
dalgiclar	0.2	0.2	0.2	0.2	0.8	1	0.6	0.66
demars	0.4	0.2	0.2	0.2	1	0.8	0.6	0.66
demce	0.4	0.4	0.2	0.4	1	0.8	0.8	0.66
dido-ray	0.4	0.4	0.2	0.2	1	0.8	0.6	0.66
diy-mar	0.2	0.2	0	0.4	0.8	0.4	0.8	0.33
dogus	0.4	0.2	0.4	0.2	1	0.8	1	0.66
ecetur	0.2	0.2	0.2	0	1	1	0.6	0.66
eksen	0.2	0.2	0.2	0.2	0.8	0	1	0.33
enka	0.2	0.4	0	0.6	0.8	1	1	0.66
ensa	0.2	0.4	0.2	0.6	0.8	0	0.6	0.33
epik	0.2	0.2	0.2	0.4	0.2	0.4	0.6	0.33
erk-insaat	0.4	0.4	0.2	0.2	1	0.4	0.4	0
ermit	0.6	0.4	0.2	0.2	1	0.8	0.8	0.66
eskikale	0.4	0.4	0.2	0.2	0.8	0	0.8	0.66
farsel	0.2	0.2	0.2	0.2	1	0.6	0.8	0.66
fernas	0.2	0.2	0.2	0.6	0.6	0.6	1	0.33
gama	0.2	0.2	0.2	0.6	1	0.8	1	0.66
gaziantep-gold	0.4	0.4	0	0.4	1	0	0	0
gocay	0.6	0.4	0.6	0	0.8	0.6	0.6	1
gulak	0.2	0.4	0.2	0.4	0.6	0.4	0.6	0.33
gulermak	0.4	0.4	0.6	0.4	0.8	1	0.6	1
gulsan	0.2	0.2	0.2	0.4	0.8	0	1	0.33
gunal	0.2	0.2	0.2	0.6	0.6	0.8	1	0.33
gunsayil	0.2	0.2	0	0.2	1	1	0	0

guris	0	0	0.2	0	0	0	0	0
gursesli	0.2	0.2	0.2	0	1	0.8	0.8	0.66
haselsan	0.2	0.2	0.2	0.2	1	0.8	0.4	0.66
hasemoglu	0.2	0.2	0.2	0.4	0.8	0	0.6	0.33
hgg-insaat	0.4	0.2	0.2	0.2	1	0.8	0.8	0.66
husamettin-peker	0.4	0.4	0.2	0.2	1	0.8	0.6	0.66
icc-grup	0.2	0.2	0	0.6	0.6	1	0.8	0.33
ictas	0.2	0.4	0.6	0.8	0.8	0.8	0.8	0.33
ilci	0.2	0.2	0.2	0.2	0.8	0.8	0.8	0.66
inelsan	0.4	0.2	0.2	0	0.8	0.6	0.6	0
intekar	0.6	0.4	0.2	0.2	1	0.8	0.6	0.66
kalyon	0.8	0.8	1	0.4	1	0.8	0.6	1
karaca	0.4	0.2	0.2	0.4	1	0.4	0.6	0.66
kayaoglu	0.2	0.2	0.2	0.2	0.8	0.4	0.4	0
kayasan-yapi	0.2	0.2	0	0.6	0.8	0	0.6	0.33
kiska-kom	0.4	0.4	0.6	0.2	1	0.8	0.6	0.66
klv-insaat	0.4	0.2	0.2	0	1	1	0.6	0.66
kmb-metro	0.2	0.2	0.2	0.2	0.8	1	0.6	0.66
kolin	0.8	1	0.8	0.6	1	1	0.6	1
kur-insaat	0.2	0.2	0.2	0.6	0.6	0.4	0.8	0.33
limak	0.8	0.8	0.8	0.4	1	1	1	1
makimsan-asfalt	0.4	0.2	0.4	0.4	1	0.6	0.8	0.66
makyol	0.6	0.4	1	0.4	1	1	0.4	1
mapa	0.6	0.6	0.6	0.4	1	0.6	0.8	1
mbd-insaat	0.2	0.2	0	0	1	0.6	0.8	0.66
mesa-mesken	0.4	0.2	0.2	0	1	0	0	0
metag	0.2	0.2	0.2	0.6	0.8	0	0.8	0.33
metaleks	0.2	0.2	0.2	0.2	0.8	0.8	0.8	0.66
metgun	0.2	0.2	0.2	0.2	0.8	0.6	0	0
metro-muhendislik	0.2	0.2	0.2	0.6	0.4	0	0	0.33
msm-altyapi	0.4	0.2	0.2	0.4	1	0.8	0.6	0.66
mustafa-eksi	0.4	0.4	0.2	0.4	1	0	0.8	0.66
nas-yapi	0.4	0.4	0.2	0.4	1	0.6	0.4	0
nehirsu	0.4	0.4	0.2	0.2	1	0.2	0.8	0.66
neoray	0.4	0.4	0.2	0.2	0.8	0.8	0.8	0.66
nuhoglu	0.6	0.4	0.2	0.4	1	0.8	0.6	0.66
nurol	0.6	0.4	1	0.2	1	1	1	1
onur-taahhut	0.2	0.2	0.2	0.6	1	0.4	1	0.33
odf-yilmazlar	0.2	0.2	0.2	0.2	0.8	0.4	0.8	0.33
ozaltin	0.6	0.6	0.8	0.4	1	0.8	0.8	1
oz-aras	0.6	0.6	0.2	0.2	1	1	0.8	0.66
ozdemir	0.8	0.6	0.2	0.4	1	0.8	0.8	1
oz-er-ka	0.4	0.4	0.2	0.4	1	1	0.8	0.66
ozgun-insaat	0.2	0.2	0.2	0	1	0	0	0
ozgun-yapi	0.4	0.4	0.6	0.8	1	0.8	0.8	1
ozka	0.4	0.4	0.6	0.6	1	0.4	0.8	1

ozkar	0.4	0.2	0.2	0.4	1	1	0.8	0.66
ozmert	0.2	0.2	0.2	0.2	0.8	0.6	0.8	0.66
oztas	0.2	0.2	0.2	0.6	1	1	0.6	0.66
ozyurt	0.2	0.2	0	0.6	0.6	1	0.4	0.33
peker	0.4	0.2	0.2	0	1	1	0.8	0.66
pekintas	0.2	0.2	0.2	0	0.8	0	0.6	0
polat	0.2	0.2	0.2	0.2	0.8	0.6	0.8	0.66
pramid	0.6	0.4	0.2	0.2	1	1	0.8	0.66
rast-madencilik	0.4	0.2	0	0.2	1	0.6	0	0
re-ha	0.2	0.2	0.2	0.4	0.8	0.6	0.6	0.33
ronesans	0.6	0.4	0.2	0.2	1	0.6	0.8	0.66
serfen	0.2	0.2	0.2	0.2	1	0.6	0.4	0
seza	0.2	0.2	0.2	0.2	0.8	1	0.8	0.66
sigma	0.6	0.4	0.2	0.4	1	0.8	0.6	0.66
silahtaroglu	0.2	0.2	0.2	0.2	0.8	0.8	0.8	0.66
sistem-elektromekanik	0.4	0.2	0.2	0.2	1	1	0.6	0.66
sms-insaat	0.2	0.2	0.2	0.4	0.8	0.4	0.6	0.33
snh-insaat	0.2	0.2	0.2	0.2	1	0.6	0.6	0.66
sogut	0.2	0.2	0.4	0	1	0.4	0	0
stfa	0.2	0.2	0.2	0	0.8	0.8	0.8	0.66
sty-insaat	0.2	0.2	0.2	0	1	0.6	0.6	0.66
su-bar	0.4	0.4	0.2	0.2	1	0.6	0.8	0.66
senbay	0.4	0.4	0.4	0.4	1	0.8	0.8	0.66
tas-yapi-1	0.2	0.2	0.2	0.2	1	1	0	0
tasyapi-2	0.2	0.2	0.2	0	1	0.8	0.6	0.66
tav	0.2	0.2	0.2	0	1	0.6	0.8	0.66
tekfen	0.2	0.2	0.2	0.6	1	1	0.8	0.66
tepe	0.4	0.4	0.2	0.6	0.6	0.6	0.8	0.33
turkerler	0.4	0.4	0.6	0.4	1	1	0.2	1
uluova	0.4	0.2	0.2	0.2	1	0.6	0.4	0
ucer	0.4	0.4	0.2	0.4	1	0.8	0.8	0.66
varyap	0.2	0.2	0	0	1	0	0.6	0
yapi-merkezi	0.6	0.4	0.4	0	1	0.8	0.8	0.66
yda-insaat	1	0.8	0.6	0.2	1	1	0.8	1
yeni-fidan	0.4	0.2	0	0.2	1	0	0.6	0
yp-insaat	0.2	0.2	0	0.6	0.8	0	0.6	0.33
yildizlar	0.2	0.2	0.2	0.6	0.8	0	0.6	0.33
yse-yapi	0.4	0.2	0.2	0.4	1	0.8	0	0
yuksel	1	1	1	0.4	1	1	1	1

VITA

Çisil Özçekici Olcar received her Bachelor’s degree in architecture from Yıldız Technical University in 2000 and a Master’s degree in Business Administration (MBA) from Auburn University in the USA in 2003.

As an architect, Çisil worked for architectural offices in the US until the end of 2008. In 2009, she founded her own architectural office in İzmir, and since then, her design practice continues. Her primary work areas include design and renovation of educational facilities, retail centers, office buildings, and residential communities.

She also works as a lecturer at the Faculty of Fine Arts and Design at İzmir University of Economics since 2009. The courses given by her in the architectural department are in building knowledge and construction management fields.