ANALYZING THE COMMUNICATION AND COORDINATION PROCESSES IN SABİHA GÖKÇEN INTERNATIONAL AIRPORT'S NEW TERMINAL BUILDING WAYFINDING PROJECT

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ABSTRACT

ANALYZING THE COMMUNICATION AND COORDINATION PROCESSES IN SABİHA GÖKÇEN INTERNATIONAL AIRPORT'S NEW TERMINAL BUILDING WAYFINDING PROJECT

Coordination is the third main function following design and construction in the building process. It is a sensitive managerial activity involving well-defined procedures and smooth flow of communication in all directions to achieve project objectives.

This study builds on existing coordination theory and utilizes the four key coordination processes defined by Malone and Crowston (1994): (1) Managing shared resources (2) Managing producer-consumer relationship (3) Managing simultaneity constraints (4) Managing task/subtask dependencies. Four processes were interpreted and operationalized for the study of the e-mail data obtained from the wayfinding project coordination of new terminal building of Sabiha Gökçen International Airport. The organizational schema of the wayfinding project defined the e-mail communication analysis to be among the contractors, consultant and the design firm. Social network analysis is conducted for network centrality measures. Degree, betweenness and closeness centrality values are calculated for each project participant.

There are three major findings from these analyses. First finding suggests that centrally positioned Wayfinding and Signage Design Project Contractor in the organization schema shows more coordination. Second finding suggests that task/subtask dependencies, producer-consumer relationship, simultaneity constraints and shared resources need respectively more coordination effort to manage in a wayfinding project. Third finding shows e-mail communication has a profound effect on coordination. The implications of these findings mean that companies involved in design and construction process may consider providing new approaches affecting day-to-day interactions depending on the power of new technological coordination mechanism.

ÖZET

SABİHA GÖKÇEN ULUSLARARASI HAVALİMANI YENİ TERMİNAL BİNASI YÖNLENDİRME PROJESİNDE İLETİŞİM VE KOORDİNASYON SÜREÇLERİNİN ANALİZİ

Koordinasyon, bina yapım sürecinde tasarım ve yapımı takip eden üçüncü ana fonksiyondur. Koordinasyon, projenin hedeflerine ulaşmak için iyi tanımlanmış yöntemler ve iletişimin her yöne sorunsuz akışını içeren hassas bir yönetsel aktivitedir.

Bu çalışma varolan koordinasyon teorisi üzerine kurgulanır ve Malone ile Crowston'ın (1994) tanımladığı dört anahtar koordinasyon sürecinden yararlanır. Bu süreçler (1) Paylaşılan kaynakların yönetilmesi (2) Üretici-tüketici ilişkisinin yönetilmesi (3) Eşanlı kısıtların yönetilmesi (4) Görev/alt-görev bağımlılığının yönetilmesidir. Bu dört süreç yorumlanarak Sabiha Gökçen Uluslararası Havalimanı yeni terminal binası yönlendirme projesi koordinasyonundan elde edilen e-posta bütünü çalışması için hazır hale getirildi. Yönlendirme projesinin organizasyon şeması e-posta iletişim analizinin yüklenici, danışman ve tasarım firması arasında gerçekleştiğini belirledi. Ağ merkeziyet ölçümleri için sosyal ağ analizi yöntemi kullanıldı. Derece, arada olma ve yakınlık merkeziyet değerleri her proje katılımcısı için hesaplandı.

Bu analizlerden üç önemli bulgu elde edildi. İlk bulgu organizasyon şemasında merkezi olarak konumlanan ana yüklenicinin daha fazla koordinasyon içinde olduğunu gösterdi. İkinci bulgu, görev/alt-görev bağımlılığı, üretici-tüketici ilişkisi, eşanlı kısıtlar ve paylaşılan kaynakların yönlendirme projesinin yönetilmesinde sırasıyla daha fazla koordinasyon çabası gerektirdiğini gösterdi. Üçüncü bulgu, e-posta iletişiminin koordinasyon üzerinde yoğun etkisi olduğunu gösterdi. Bu bulguların çıktıları göstermektedir ki mimarlık-mühendislik-inşaat işlerinde olan firmalar aktörler arasında etkin bir etkileşim sağlayabilmek adına teknolojik koordinasyon iletişim araçlarının gücüne göre yeni teknolojileri benimseyebilirler.

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LIST OF ABBREVIATIONS

SGIA	: Sabiha Gökçen International Airport
E-Mail	: electronic mail

CHAPTER 1

INTRODUCTION

In this ‘Introduction’ chapter, first the problem area where this thesis work proposes to make a contribution and the framework of the study are clarified. Arguments of previous research are reviewed. Objectives are listed as primary and secondary. The procedure of the study is presented under ‘Research Methodology.’ Finally the limitations of the study are briefly explained under the subtitle ‘Limitations.’

1.1. Argument

Coordination is an important function in the building process. It is one of the significant activities for accomplishing the project goals. Saram and Ahmed (2011) emphasized referring by Higgin and Jessop (1965), ‘Looking at the building process, we can distinguish three main functions. Two are obvious: design and construction. The third is coordination.’

Coordination can be seen as a process of managing resources in an organized manner so that a higher degree of operational efficiency can be achieved for a given project (Hossain, 2009). It also refers to well-defined policies and procedures and smooth flow of communication in all directions to achieve project objectives (Chitkara, 1998). Coordination is essential both within and among the various departments to fill up the voids created by changing situations in the systems, procedures and policies (Chitkara, 1998). It is an important and sensitive managerial activity.

Building design represents a collective effort from specialists who come from various disciplines. These specialists, who are usually geographically separated, make autonomous design decisions, with respect to their own discipline. These decisions, nevertheless, are interdependent and therefore need to be coordinated so as to sustain compatibility among the various systems and components in the building under design (Mokhtar, Bédard, and Fazio 1998). Close to the end or after the design phase, construction begins.

Construction is defined as the process of putting together all the materials in an orderly and timely manner by utilizing relevant resources to complete a structure as per designed specifications and quality standards (Hossian, 2009). The process of construction, depending on the complexity of the finished structure, requires a high level of coordination among all the professionals from design office to the construction site until the project is completed.

Saram and Ahmed (2011) stated that referring by Higgin and Jessop (1965) in the construction industry, the central problem of coordination arose from the fact that the basic relationship between the parties to a construction project has the character of an 'interdependent autonomy.' There is a lack of match between the technical interdependence of the work and the organizational independence of those who control the work. The construction industry has been struggling to reconcile this technical interdependence and organizational independence.

Recent research has shown that coordination in the building industry is carried out quite informally (Saram and Ahmed, 2001). The process of design and construction, depending on the complexity of the finished structure, requires a high level of coordination among all the firms and thus professionals from design office to the construction site until the project is completed. The building industry currently lacks research work that aims to improve cross-disciplinary coordination so as to help ensure the smooth flow of information and thus product quality. (Mokhtar, et al. 1998)

Focusing on the necessity of coordination and communication flow in design and construction projects, this study analyses such issues in the case of the wayfinding project of the new terminal building of Sabiha Gökçen International Airport.

1.2. Objectives

The most common types of project delivery methods are design-bid-build, design-build; and management contracting. In the design-bid-build arrangement, the architect or engineer acts as the project coordinator. In the design-build approach, the owner performs the required coordination. In the management contracting arrangement, the construction or project manager provides the active role of managing and coordination. Coordination ensures all parties in the project organization network work smoothly and effectively together. Coordinator position is directly related to the

organization network schema. During the execution of project delivery methods, it is observed that central actors to take on the coordinator role.

The focus of the thesis is to determine the effects of organizational network on coordination. Building upon established coordination theories and Social Network Analysis and centrality measures, the thesis also investigates differences in coordinative activity between actors with respect to their positions in the organization network and the communication effort required for each distinct activity. The central research question may thus be phrased as: 'Are centrally 'well-connected' actors able to exercise greater coordination within the organization network structure? Does an actor's 'potential for e-communicative activity' become reflected in its actual coordination effort?

1.3. Research Methodology

This study was built on existing coordination theory which utilizes sentence and phrase extraction for exploring coordinative activities. Social network methodology is also utilized for network centrality measures of project participants. Weighted coordination scores and three centrality (degree, betweennes, closeness) measures for each project actor are evaluated.

The underlying assumptions of coordination theory are accepted. These assumptions involve the creation, dissemination and processing of information. The process of coordination was broken down into four key coordination processes as defined by Malone and Crowston (1994). The four processes were then interpreted and operationalized for the study of the e-mail corpus. The four processes along with the interpretations are shown below (Further clarifications regarding coordination theory are included in Chapter 2):

(1) Managing shared resources

- Instructing or suggesting a person to perform a task

(2) Managing producer-consumer relationship

- The creation or dissemination of information

(3) Managing simultaneity constraints

- Synchronizing tasks between actors

- Taking possible times for an event
- Allocating a time for a particular event
- Passing information about the time of an event

(4) Managing task/subtask dependencies

- Planning tasks and strategy to achieve a higher-level overall goal.

The analysis phase to compile the list of key phrases was broken down into three steps. The first of these steps was the extraction of sentences indicative of one of the four processes of coordination. Each sentence was categorized into the specific coordination process and catalogued. In the second step, the list of sentences was sorted and the key phrases that underlie the coordinative action were identified and marked. These key phrases then put into the distinct type of coordination appropriate. These key phrases are then given weights regarding their frequency of use. Weighted key phrases are summed to determine the coordination score of project actors. Network centrality analysis is done by Social Network Analysis software UCINET (Borgatti, Everett, and Freeman, 2002). Centrality measures are calculated for three centrality types: 1) Degree Centrality 2) Betweennes Centrality 3) Closeness Centrality. Centrality measures and coordinative scores are ranked for each actor and the concluding remarks are made.

1.4. Limitations

The motivation for studying the coordination in Sabiha Gökçen International Airport (SGIA) wayfinding project is to capture the coordinative activities as the actors work towards a common goal. This definition of project scope goes beyond the pattern of messaging and takes into account the reason for messaging. The e-mails are more likely to support messages that were useful, meaningful and oriented toward the project goal. However, other communication tools of phone conversations, face-to-face interactions and meeting minutes are as well likely to be used in such a complex SGIA project. One distinct project as SGIA is not competent enough to examine coordination and its determinants from a single organization network. Data gathered from Yönsis office which limits the e-mails collected to be only the ones where Yönsis is included in “CC”; however any e-mail flow from directly one actor to another excluding Yönsis in “CC” could not be recorded.

1.5. Outline

In the 1st chapter, argument, objectives, limitations and the organization of the thesis are explained respectively. In the 2nd chapter, coordination theory, social network analysis and project delivery methods are reviewed. A literature review of coordination and communication in building design and construction industry is conducted. In the 3rd chapter, SGIA project information with the coordination data and their analysis procedure are briefly summarized. In the 4th chapter, findings and the analyses are presented. Finally in the 5th chapter, concluding remarks are made. Further research areas are recommended.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a literature review on coordination and communication in construction industry is conducted. Following sections include the coordination theory, dependency types, communication networks, actor centrality, and their appearance in construction coordination as project delivery systems and project communication instruments.

2.1. Coordination theory

Thomas Malone established The Coordination Theory in 1988 (Malone, 1988). He referred the Coordination Theory to be "about how the activities of separate actors can be coordinated" (Malone, 1988). In order to explain the Coordination Theory, he defined coordination as "the additional information processing performed when multiple, connected actors pursue goals that a single actor pursuing the same goals would not perform" (Malone, 1988). According to this definition, coordination needs components. These components and the coordination processes associated with them are summarized by Malone and Crowston (1990) shown in Table 2.1.

Table 2.1. Components of Coordination
(Source: Malone and Crowston, 1990)

Components of coordination	**Associated coordination processes**
Goals	Identifying goals
Activities	Mapping goals to activities (e.g., goal decomposition)
Actors	Selecting actors (e.g., assigning activities to actors)
Interdependencies	Managing interdependencies

Malone (1988) stated that these components could only be analyzed with observation. Thus "an observer must have some idea of what goal the activities help to achieve." Malone and Crowston (1990) explained the importance of being aware of the goal: "We may sometimes analyze everything that happens in a manufacturing division as one activity, while at other times, we may want to analyze each station on an assembly line as a separate activity." Malone (1988) defined Coordination Theory "as a body of principles about how the activities of separate actors can be coordinated." Malone and Crowston (1990) suggested that there exist some common problems with The Coordination Theory. These problems could be outlined as "How can overall goals be subdivided into actions? How can actions be assigned to groups or to individual actors? How can resources be allocated among different actors? How can information be shared among different actors to help achieve the overall goals?" In this study, they also redefined coordination theory as "a body of principles about how the activities can be coordinated, that is, about how actors can work together harmoniously." They emphasized the word harmoniously as it pointed out that the activities are not independent at all. Accordingly, they referred to "goal-relevant relationship between activities as interdependencies." Depending on this argument, Malone and Crowston (1990) extended the Theory of Coordination by focusing on the kind of possible interdependence between activities and on the possible management of different interdependence types. Table 2.2 presents a preliminary list suggested by Malone and Crowston (1990) for types of interdependencies and coordination processes that can be used to manage them.

Table 2.2. Example of types of interdependencies
(Source: Malone and Crowston, 1990)

Kinds of dependencies	**Common object**	**Example of coordination process for managing interdependencies**
Prerequisite	Output one activity which is required by the next activity	Ordering activities, moving information from one activity to the next
Shared resources	Resource required by multiple activities	Allocating resources
Simultaneity	Time at which more than one activity must occur	Synchronizing activities

2.1.1. Dependency Types

Malone and Crowston (1990, 1993, 1994) further explained the dependency types of the Theory of Coordination by characterizing kinds of dependencies and identifying the coordination processes that can be used to manage them (Table 2.3). Below are the descriptions of general dependency types suggested by Malone and Crowston (1990):

1. **Managing Shared Resources**: It is defined as the control of resources to be intimately connected with personal and organizational power. Hossain (2009) summarized this *Resource Allocation* type as instructing or suggesting a person to perform a task. Task Assignments are defined as allocating the scare time actors to the tasks they are required to perform.
2. **Managing Producer/Consumer Relationship:** It is defined to be the usage of the product of one activity by another activity. Hossain (2009) considered the dependency type in their study as the creation or dissemination of information. Malone and Crowston (1990) explained producer/consumer relationships are to lead three kinds of dependencies:
    a. **Prerequisite constrains:** It is a very common dependency between a "producer" activity and a "consumer" activity is that the producer activity must be completed before the consumer activity can begin.
    b. **Transfer:** It becomes when one activity produces something that is used by another activity, the thing produced must be transferred from the "producer" activity to "consumer" activity.
    c. **Usability:** It is a dependency that must often be managed in a producer/consumer relationship is that whatever is produced should be usable by the activity that receives it.
3. **Managing simultaneity constrains:** This type of dependency between activities exists as long as they occur at the same time. Hossain (2009) also defined as synchronising task between actors. Taking possible times for an event(s). Allocating time for a particular event(s). Passing information about the time of an event(s).

4. **Managing task/subtask dependencies** It is a common kind of dependency among activities is that a group of activities are all "subtask" for achieving some overall goal.

Table 2.3. Examples of Dependencies Between Activities and Alternative Coordination Processes for Managing them (Source: adopted from Malone and Crowston, 1993)

Dependency	**Examples of coordination processes for managing dependency**
Shared resources	"first come/ first serve", priority order, budgets, managerial decision, market-like bidding
Task assignments	(same as for "shared resources")
Producer/ consumer relationships	
Prerequisite constraints	Notification, sequencing, tracking
Transfer	Inventory management (e.g., "Just In Time", "Economic Order Quantity")
Usability	Standardization, ask users, participatory design
Design for manufacturability	Concurrent engineering
Simultaneity constraints	Scheduling, synchronization
Task/ subtask	Goal selection, task decomposition

Malone and Crowston (1990) established coordination mechanism for overcoming coordination problems. According to coordination mechanism, actors must perform additional work. Crowston, Rubleske, and Howison (2004) suggested that "given an organization performing some task, one way to generate alternative processes is to first identify the particular dependencies and coordination problems faced by that organization and then consider what alternative coordination mechanisms could be used to manage them." Based on this suggestion, Crowston (1997) analyzed software change process of a large mini computer manufacturer. He explained his study "the case presented does not formally test coordination theory. It does illustrate the potential of

coordination theory for exploring the space of organizational process." Crowston (1997) suggested focusing on a particular process in all organizational processes for analyzing the coordination theory. He emphasized his approach "in this view, the design of a process depends on the coordination mechanisms chosen to manage dependencies among tasks and resources involved in the process." In the study Crowston (1997) defined organizational process by an interview. According to this data he designed organizational process and analyzed dependencies considering coordination theory. Finally Crowston (1997) found out unmanaged dependencies which cause coordination problems. His study suggested alternative coordination mechanism for solving coordination problems. In this case Pentland, Osborn, Wyner, and Luconi (1999) designed a "process handbook". The handbook of organizational process could be implemented for a wide variety of business process. They describe handbook's aim as "1) redesign existing organizational processes, 2) invent new organizational processes, and 3) share ideas about organizational practices" (Pentland et al., 1999). Pentland et al., had also designed data collection methodology for The Process Handbook. Pentland et al., represented three basic concepts to create taxonomy of processes: 1) *Decomposition*: processes are decomposed into activities, which may in turn be further decomposed into subactivities. 2) *Specialization:* processes (activities) are also specialized in a manner similar to a traditional type hierarchy. 3) *Dependencies:* The handbook represents dependencies between activities in order to suggest ways in which these dependencies can be better managed through the use of information systems." For collecting data they suggested to use semi-structured interviews, observation, and iterative verification and triangulation. Pentland et al., (1999) created activity representation tools by using these collected data. "This methodology recommends two tools for developing activity representation. The first is referred here as and activity list; the second as a candidate activity hierarchy." The elements of activity list are considered as activity, actor, goal, and artifacts (input, output, and tools). Activity lists are broken down into subactivities for understanding activities hierarchy. After creating Process Map, Pentland et al., (1999) defined the analysis of dependencies in processes as "whenever there is a dependency between two production activities (for example, one activity uses the output of another), coordination is required." Regarding its definition, Pentland, et al. (1999) identified several dependency types as *flow, sharing, and fit.* They claimed that "expressing dependencies between activities, this method provides a window onto the

critical coordination problems (and coordination opportunities) that constrain and enable every business process" (Pentland, et. al., 1999). Lui, and Wyner (2009) considered these dependencies for their study and aimed to indicate connection between a theoretical connection between use cases and dependencies among activities within process. Theoretical approach was based on coordination theory. Different from activity list, their analysis method presented dependency diagram. They explained their methods' steps as: "1) draw a dependency diagram of the business process to be supported by the proposed information system. 2) For each activity in the dependency diagram, identify zero or more use cases by considering how the proposed information system could be used to automate or support that activity. 3) For each dependency in the diagram, identify zero or more use cases by considering possible coordination mechanism for managing that dependency and then considering how the proposed information system could be used to automate or support each coordination mechanism. 4) Draw a use case diagram incorporating the use cases identified in steps 2 and 3 which are to be included in the system scope." Although they suggested representing a process using dependency diagram, they emphasized the needs for applying in a full-scale business environment.

2.2. Communication in Coordination

In order to more precisely characterize different coordination processes, Malone and Crowston (1990) found it useful to describe them in terms of successively deeper levels of underlying processes, each of which depends on the levels below it. Table 2.4 shows a preliminary diagram of the levels that they suggested.

Table 2.4. Processes Underlying Coordination
(Source: Malone and Crowston, 1990)

Process Level	**Components**	**Examples of Generic Processes**
Coordination	Goals, activities, actors, resources, interdependencies	Identifying goals, ordering activities, assigning activities to actors, allocating resources, synchronizing activities

(Cont. on next page)

Table 2.4. (cont.)

Group decision making	Goals, activities, actors, alternatives, evaluations, choices	Proposing alternatives, evaluating alternatives, making choices (e.g., by authority, consensus, or voting)
Communication	Senders, receivers, messages, languages	Establishing common languages, selecting receiver (routing), transporting message (delivering)
Perception of common language	Actors, objects	Seeing same physical objects, accessing shared database

According to Table 2.4., they suggested that most of coordination processes require that some decision be made and accepted by a group. Group decisions, in turn, require members of the group to communicate in some form about the goals to be achieved, the alternatives being considered, the evaluations of these alternatives, and the choices that are made. This communication requires that some form of "messages" be transported from senders to receivers in a language that is understandable to both. Finally, the establishment of this common language and the transportation of message depend, ultimately, on the ability of actors to perceive common objects such as physical objects in a shared situation or information in a shared data base (Malone and Crowston, 1990).

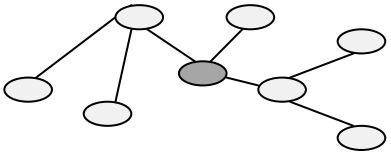
This study considered communication process level which is a deeper level of underlying coordination processes. The study therefore referred Hossain (2009) research which was studied network centrality concepts and coordination theory to explain how project team members interact when working towards a common goal. He discussed SNA as a methodology for studying coordination theory. Hossain (2009) and Hossain, Wu, and Chung (2006) built on his study assumptions of coordination theory to study organizational processes.

2.2.1. Social Network Analysis

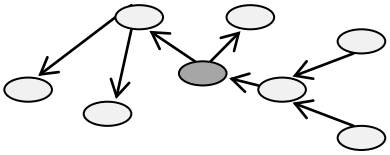
Bonacich (1987) emphasized power of Social Network Analysis (SNA) method for analyzing the nature and pattern of relationships among members of a particular

domain. It is a collection of graph analysis methods developed to analyze networks in social sciences, communication studies, economics, political science, computer networks, etc. Thus Bonacich (1987) argued that SNA provides mathematical definitions of certain characteristics of the actors and the network itself: cohesion, equivalence (role-groups), power of actors, range of influence, and brokerage. By refering to Kotter (1996) Chinowsky, Diekmann, and O'Brien (2010) defined that the social network model contains two basic components, the dynamics and the mechanics. The dynamics focuses on the motivators for individuals to increase performance on a project. The rationale behind this component is based on the research that high-performance teams require trust and shared values to achieve the knowledge sharing which results in enhanced solutions. The second component in the social network model, the mechanics, focus on the information and knowledge that is exchanged during the completion of the project. The overall concept behind these components is that the greater the level of communication in the mechanics and the greater the move toward trust and shared values in the dynamics will ultimately lead to a greater focus on knowledge sharing and high performance (Chinowsky et al., 2010). These characteristics are expressed in terms of corresponding network-structure parameters derived from the relations among the actors. Actors are one of the components of project organization network. Li and Lu (2010) established components of project organization network which are actors, actors' relationships and the relationships network, and the network behaviors with social network's characters. A social network is a social structure made of actors (nodes) that are connected by one or more specific type of relations (ties), such as friendship, firm alliance, or international trade. Refering to Wasserman and Faust (1997), Park, Rojas, Son, and Jung, (2011) consider two tie types: nondirectional (symmetric) and directional (nonsymmetric). Figure 2.1. shows that an actor (dark circle) is directly connected to its three neighbors. It is also indirectly connected to its other four neighbors through its two neighbors. In cases where there are directional relationships among nodes, a relationship could be classified as either inward or outward. Figure 2.2. shows an actor with an inward tie (input) and two outward ties (output). A directed network is useful when directional relationships between an active and a passive actor are worth investigating (e.g., prime contractor–subcontractor, knowledge diffusion–acquisition, among others). In this study, SGIA

Wayfinding and signage desing project's actors are directly connected to each other by incoming and outgoing e-mails.



Base
Actor
Figure 2.1. Undirected network
(Source: Park et al., 2011)



Base
Actor
Figure 2.2. Directed network
(Source: Park et al., 2011)

Social Network Analysis (SNA) method is used for various studies in the construction management domain. Pryke (2010) found that Social Network Analysis (SNA) has an important role to play in the inter-firm relationships that comprise the construction project coalition. An analytical model is proposed, using social network analysis, which enables the analysis intra-coalition networks of relationships, classified according to the principal functions of the project coalition (Pryke, 2010). Early works of network studies in the construction domain primarily focused on the industrial network issues at the interpersonal level in specific conditions, including bidding competition, crisis condition, and information exchange (Loosemore 1998; Pryke 2004). Pryke (2005) also investigated the managerial attributes of UK construction projects with regard to procurement modes. The social network model for construction focuses on altering the emphasis of construction project management from efficiency of projects to high-performance projects. Since this introduction, the model has been applied to project teams in a broader sense, including management teams (Chinowsky, et. al. 2010).

2.2.1.1. Communication Networks

One of the primary objectives of this study is "Are centrally 'well-connected' actors able to exercise greater coordination within the organization network structure?"

Before looking at the strengths and weaknesses of different networks, it is useful to identify the main types of communication networks and their characteristics (Emitt, and Gorse 2003):

1. **The wheel model of communication**

It represents a highly centralized configuration with all information chanelled through, or to one person. (Emitt and Gorse, 2003)

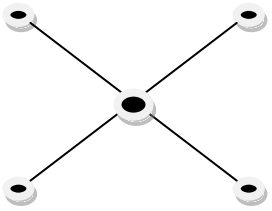


Figure 2.3.The wheel model of communication
(Source: Emitt and Gorse, 2003)

2. **The chain model of communication**

It includes parties who receive information from more than one source, no one person has direct access to all the others in the network or receives all of the information. (Emitt and Gorse, 2003)

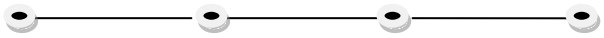


Figure 2.4. The chain model of communication
(Source: Emitt and Gorse, 2003)

3. **The comcon model of communication**

It represents the most decentralized model of communication. All parties in the comcon structure have access to information from all other parties in the communication network. (Emitt and Gorse, 2003)

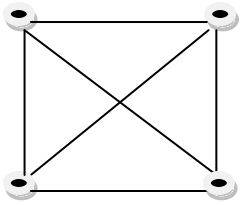


Figure 2.5. The comcon model of communication model
(Source: Emitt and Gorse, 2003)

Emitt and Gorse (2003) claimed that the wheel provides a useful model to explain much of the formal communication flow during the construction phase. The project manager occupies the central position and the other contributors are to be found at the end of the wheel spokes. The only adaptation needed to this model is to provide two central nodes that represent the architect and the contractor in more traditional arrangements (Figure 2.6.). They accepted an advantage of centralized communication network as the formal lines of communication are clear, those on the periphery are aware of who contact for information and decisions.

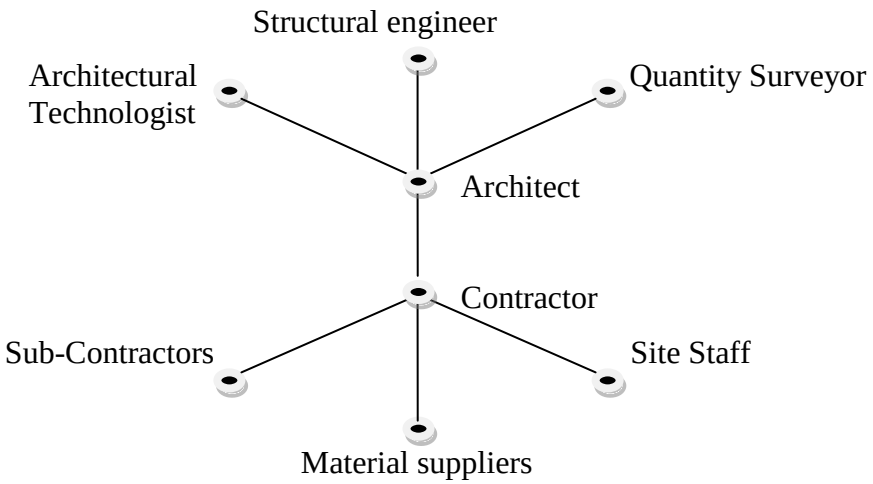


Figure 2.6. Model of centralized network occurring during the construction phase. (Source: Emitt and Gorse, 2003)

2.2.2. Actor Centrality in Coordination

Social Network Analysis (SNA) arises from Sociometrics and Graph Theory, and its research mainly covers two topics: position-orientation and relationship orientation. The position-orientation studies the actor's position influences, including centrality, closeness, roles, and structure holes, etc; the relationship orientation focuses on network relationship characters, including relationship strength, density and, contents, etc. (Li and Lu, 2010). This study concentrates on position-orientation in SNA research. Hossain et al. (2006) accepted that coordination is abstract and difficult to quantify. It has been measured by using combination of other factors, such as centrality and the strength of social ties. Pryke (2010) emphasised that importance of the point

centrality method for quantifying relationship. Pryke (2010) stated that it is posited that point centrality (a measure of prominence within a network) values for project actors within the principal function networks, provide quantitative prominence data, as well as accessible graphical representations of the changes in project author roles and relationships. Thus Pryke (2010) advised the use of SNA for the ability to identifying and quantifying changes in actor roles and relationships through the analysis of point centrality data for the actors within the project coalition. This study uses centrality for quantifying coordination processes. In addition, centrality has been defined by leading social network researchers as a measure of potential importance, influence, and prominence of an actor in a network (Freeman, 1979). Centrality is a rough indicator that describes the social power and the influence of a node based on how well connected the node is in the network. There are three primary measure of network centrality:

1. Degree Centrality

Latora, and Marchiori (2008) defined that degree centrality focuses on most visible actors in the network. An actor with a large degree is in direct contact to many other actors and being very visible is immediately recognized by others as a hub, a very active point and major channel of communication. Freeman (1979) explained conception of the degree of a point, p_i, is simply count of the number of other points, p_j ($i \neq j$), that are adjacent to it and with which it is, therefore, in direct contact. The central point, p_3, in Figure 2.7., is adjacent to four other points; its degree four. The degree centrality of i can be defined as (Freeman, 1979):

$$C_i^D = \frac{k_i}{N-1} = \frac{\sum_{j \in \mathbf{G}} a_{ij}}{N-1} \qquad (2.1.)$$

where k_i is the degree of point i. Since a given point i can at most be adjacent to $N - 1$ other points, $N - 1$ is the normalization factor introduced to make the definition independent of the size of the network.

Hossain et al. (2006) referring to Tushman (1977) argued that people with a high degree centrality have significantly more communication than those with a lower degree

centrality, with professional, technical, and operational areas inside and outside of the organization. Hannemn and Riddle (2005) argued that actors who have more ties to other actors may have advantageous positions. Because they have many ties, they may have alternative ways to satisfy needs, and hence are less dependent on other individuals. Because they have many ties, they may have access to, and be able to call on more of the resources of the network as a whole. Directed data, however, it can be important to distinguish centrality based on in-degree from centrality based on out-degree.

Degree is classified as indegree or outdegree depending on the direction of the relationship as follows which were defined by Park et al., (2011). Indegree centrality is the number of nodes that supply directed relationships to a given node. Outdegree centrality is the number of nodes that accept directed relationships from a given node. Intuitively indegree is the number of incoming-relation partners a firm has whereas outdegree is the number of out-going-relation partners.

Degree centrality denotes the extent of homogeneity or heterogeneity in structural position, which is defined as the range and variability of degree (Freeman 1979). Thus, degree centrality is used in this study for analyzing descriptive views of networks at the macro level. It also describes the extent of centrality in a hierarchical network.

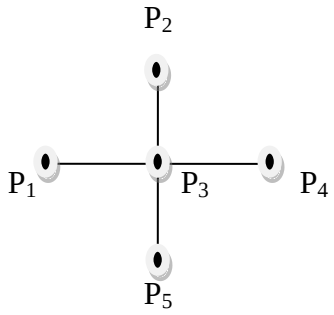


Figure 2.7. A star or wheel with five points
(Source: Freeman 1978)

2. Closeness Centrality

Hossain et al. (2006) defined closeness centrality as the distance of an actor to all others in the network by focusing on the geodesic distance from each actor to all others. Freeman (1979) defined the geodesics. According to the explanation the shorthest paths linking a given pair of points are called geodesics. Freeman (1979) explained conception of the closeness centrality regarding the Figure 2.7. $P_{3,}$ is at a distance of one from each of the four other points. Each of the others, however, is at a distance of one only from p_3, and at distance of two from each of the remaining points. Point $P_{3,}$ therefore, is closest to all other points. The minimum number of edges traversed to get from *i* to *j*. The closeness centrality of point *i* is (Freeman, 1979):

$$C_i^C = (L_i)^{-1} = \frac{N-1}{\sum_{j \in \mathbf{G}} d_{ij}} \qquad (2.2.)$$

Minumum distance or geodesic d_{ij}, i.e. the minimum number of edges traversed to get from *i* to *j*. The closeness centrality point *i* is where L_i is the average distance from actor *i* to all the other actors (Latora and Marchiori, 2008).

3. Betweeness Centrality

Betweenness centrality was introduced by Freeman (1979), it signifies the extent to which a node lies between other pairs of nodes, it is defined as the proportion of all the shortest paths (i.e., geodesic) between pairs of other nodes that pass through the node. Latora and Marchiori (2008) defined betweenness centrality as interactions between two non-adjacent points might depend on the other actors, especially on those on the paths between the two. Therefore points in the middle can have a strategic control and influence on the others. The important idea at the base of this centrality measure is that an actor is central if it lies between many of the actors. Hossain et al. (2006) explained as the beetweeness centraliy of a node *i* is the number of shortest paths between pairs of other nodes which run through *i*. If n_{jk} is the number of geodesics linking the two actors j and k, and $n_{jk}(i)$ is the number of geodesics linking the two

actors j and k that contain point *i*, the betweenness centrality of actor i can be defined as (Freeman, 1979):

$$C_i^B = \frac{\sum_{j<k \in \mathbf{G}} n_{jk}(i)/n_{jk}}{(N-1)(N-2)} \quad (2.3.)$$

Nodes that occur on many shortest paths between other nodes have higher betweeness than those that do not. The center of a star has the maximum possible degree; it falls on the geodesics between the largest possible number of other points and, since it is located at the minimum distance from all other points, it is maximally close to them (Figure 2.5.).

Hossain et al. (2006) criticisied degree centrality measures as they only take into accont the immediate ties that an actor has, rather than indirect ties to all others. One actor might be tied to large number of others, but those others might be rather disconnected from the network as a whole.

2.3. Coordination in Construction Projects

Construction projects' scope have extended and got complex in recent years. Researchers have used different kinds of approaches for focusing on coordination in various construction projects. Hossain (2009) and Hossain et al. (2006) built his study on existing coordination theory and suggested a new approach for studying organizational processes. Four key coordination processes which were defined by Malone and Crowston (1990, 1993, 1994) and Crowston et al. (2004) were considered for breaking down the process of coordination. He used process action approach as he combined the original process oriented coordination approach with the study of action oriented key phrases (Hossain, 2009). Hossain (2009) argued that coordination theory allows for the application of Social Network Analysis (SNA). He also emphasized that this analysis method provides to measure coordination quantitatively. Cheng, Su, and You (2003) created a quantitative modeling used for the evaluation of a project's communication efficiency. The study based on trend model for establishing the organizational framework. Cheng et al. (2003) explained the functions of trend model as to "(1) clearly define the relationship between different members of the project team

during the execution of the project; (2) predict the interface and mutual relationships between the project team and the probable problems that will be encountered during the project execution; and (3) establish the project control system within the required time frame." According to trend model that Cheng et al. (2003) developed new analysis model by using activity relationship model for defining relationship between different members and they used activity relationship matrices and communication resistance matrices for showing resistance between the members of project team. Cheng et al. (2003) found out that "due to the numerous working interfaces, complicated networks, and diversified team members of a large construction project, coordination efficiency among members of the construction team is vital to the project's success." Mokhtar et al. (1998) considered coordination of design information during the detailed design stage. Mokhtar et al. (1998) focused on detailed design process. Mokhtar et al. (1998) emphasized that "the process also becomes critical because detailed design is the final stage before project expenditures increase dramatically during the construction." Mokhtar et al. (1998) indicated errors, if the process could not be managed successfully. According to the study the errors were listed as inconsistency in design information, mismatch between connected parts, component malfunctioning (Mokhtar et al. 1998). Thus Mokhtar et al. (1998) developed an information model to provide the coordination of design information process. Research listed above (Hossain, 2009; Hossain et al., 2006; Cheng et al., 2003; (Mokhtar et al., 1998) commonly analyzed the organizational process before creating a model, since they basically aimed to find out coordination process problems for improving a model. Malone and Crowston (1990, 1993) recommended this analysis method in coordination theory. Following these studies, Saram and Ahmed (2001) focused on how day-to-day coordination is achieved on a construction project. They inquired the answers of the questions of which coordination activities are the most important and which coordination activities are the most time-consuming by using the questionnaire method. Jha and Misra (2007) studied the coordination activities by considering different aspects such as schedule, cost control, quality control and occurrence of disputes for completing the construction project successfully. Project managers were classified and ranked according to these criteria (Jha and Misra, 2007).

Many different disciplines including computer science, sociology, political science, management science, systems theory, economics, linguistics and psychology

have all dealt with fundamental questions about coordination (Malone, 1988; Malone et al., 1999; Pentland et al., 1999). Construction industry also adopted coordination theory for better management outputs (Mokhtar et al. 1998; Saram and Ahmed 2001; Hossain 2009; Cheng et al. 2003). Hossain (2006) suggested that theories about coordination are important for building design and construction process. However, published research work on design and construction coordination is limited.

Coordination in construction industry is directly related to the effective management of project delivery methods. The most common types of project delivery methods are design-bid-build, design-build and management contracting. In the design-bid-build arrangement, the architect or engineer acts as the project coordinator. In the design-build approach, the owner performs required coordination. In the management contracting arrangement, the construction or project manager has an active role of managing and coordination. Coordination ensures all parties in the project organization network work smoothly and effectively together. Coordinator position is directly related to the organization network schema. Implementation of project delivery methods claim central actors to take on the coordinator role. Below sections review the project delivery system types with regard to leading to better analyses of actor centrality and communication networks particular to the case study findings revealed in Chapter 4.

2.3.1. Project Delivery Sytems

The topic of project delivery methods addresses 'the organization or the development of the framework relating the organizations required to complete or deliver project and the establishment of the formal (i.e., contractual) and the informal relationships between these organizations' (Halpin and Senior, 2011). Project Delivery process is defined by Jackson (2010) to be all the procedures and components of designing and building a facility getting organized and put together in an agreement that results in a completed project. There are basically three project delivery methods: 1) design-build 2) design-bid-build, and 3) construction mangement. These three project delivery methods differ in five fundamental ways:

- The number of contracts the owner executes

- The relationship and roles of each party to the contract
- The point at which the contractor gets involved in the project
- The ability to overlap design and construction
- Who warrants the sufficiency of the plans and specifications

Regardless of the project delivery method chosen, the three primary players the owner, the designer (architect and/or engineer), and the contractor- are always involved in the project delivery process (Jackson, 2010).

2.3.1.1. Design-Build

According to the explanation of Jackson (2010), in the design-build method, the owner contracts with a design-build entity which will be responsible for both the design and construction of the project. The design-build process has linear sequencing of the work. Design-build often integrates and overlaps design and construction and allows for fast tracking (Figure 2.8).

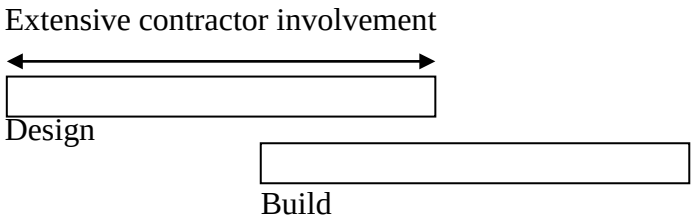


Figure 2.8. Overlap design and construction
(Source: Jackson, 2010)

Halpin and Senior (2011) pointed out that in this method, coordination between design and construction is also enhanced by having both functions within the same firm. This system improves the communication between designers and the field construction force and assists in designing a facility that is not only functional but also efficient to construct.

Design-Build has variations. According to Günhan (2009), owners expect more services from design-build providers and design-build providers are expected to go beyond designing and building and provide services in the areas of finance, facilities

management, and environment, legal, social, economic, political and cultural issues. Sophisticated design-build options might include public private partnership (PPP), build-operate-transfer (BOT), design-build-operate-own (DBOO), design-build-operate-own-transfer (DBOOT), design-build-finance-operate (DBFO), and design-build-operate-maintain (DBOM). All these variations can be classified under funding option variations, turnkey, developer financed projects and turnkey variations (Wayne State University, 2011).

A recent study on design-build delivery method by Damli (2006) indicates that design-build delivery method is not a common delivery method in Turkish construction project industry. In a smaller scale, this type of delivery is heavily practiced without formally calling it design-build. It is quite common for architectural-engineering design firms to be involved with construction practices in addition to their core design services.

The delivery method that has been used in Sabiha Gokcen International Airport is build-operate-own-transfer method which is a form of turnkey delivery method.

2.3.1.2. Design-Bid-Build

Halpin and Senior (2011) stated the methods of DBB the owner holds a contract with the designer or architect/engineer (A/E) for the development of the construction documents (plans and specifications) and a separate contract with the construction contractor for the building of the facility. Jackson (2010) basicly summarized that in this scenario, the owner first hires the architect or the engineer to design the building and the structure (Figure 2.9).

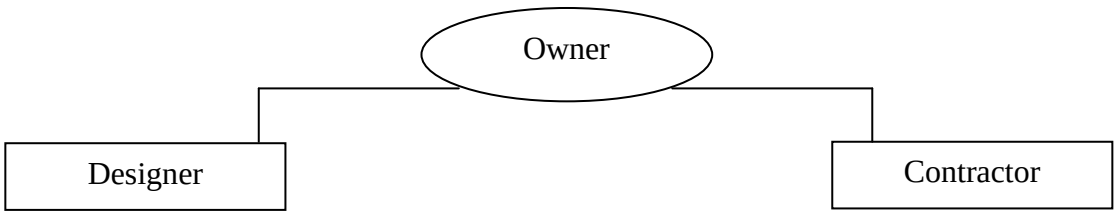


Figure 2.9: Design-Bid-Build
(Source: Jackson, 2010)

In this arrangement, all dealings between the designer and the contractor go through the owner (Figure 2.10).

Figure 2.10. Design-Bid-Build
(Source: Jackson, 2010)

Design-bid-build is conventional project delivery method which is mainly used in government projects in Turkey.

2.3.1.3. Construction Management

Construction-management (CM) is explained by Halpin and Senior (2011) that one firm is retained to coordinate all activities from concept design through acceptance of the facility. This method suggests construction management services are provided to the owner independent of the construction work itself (Jackson, 2010). There are two options for the owner to consider under this method:

2.3.1.3.1. Agency Construction Managament (CM)

In this case, the construction manager offers advise uncolored by any conflicting interest because the construction manager does not perform any of the actual construction work and is not financially at risk (Jackson, 2010) Agency Construction Managers are coordinators working on behalf of the client and are not contractually liable for the successful completion of the work (Halpin and Senior 2011) (Figure 2.11).

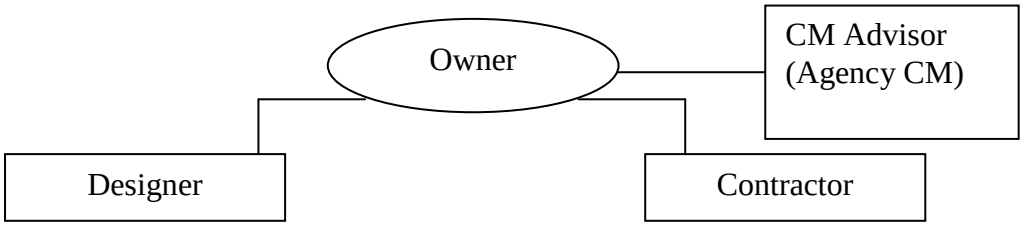


Figure 2.11. Agency CM
(Source: Jackson, 2010)

2.3.1.3.2 At-Risk Construction Managament (CM)

Jackson (2010) explained the contractual bonding relation in this scenario (Figure 2.12). There are only two contracts, one between the owner and designer and one between the owner and the CM.

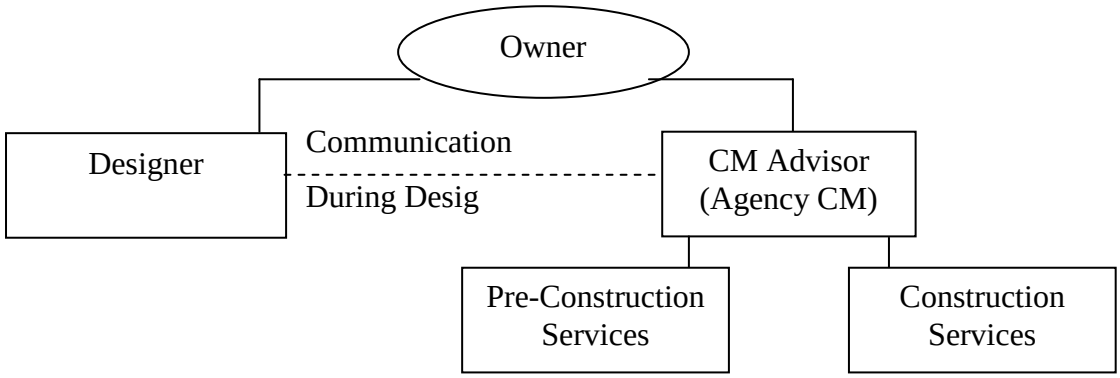


Figure 2.12. At Risk CM
(Source: Jackson, 2010)

2.3.4.1. Owner Provided Delivery

Projects with limited scope which can be delivered with owners' own resources can be delivered without contracting with other parties such as designers and contractors. Non-complex modifications of the owners' facilities and repetitive projects can be accomplished with owners' in house design and construction resources.

Contracts are executed by considering the interrelationships amongst project actors which are defined by project delivery systems. There are different communication protocols amongst actors since there are different contract types. Therefore it is important to analyze communication and coordination issues in construction projects within the context of project delivery methods.

2.4. Communication in Construction Projects

Emmitt, and Gorse (2003) summarized important characteristics of the communication concept as fallows:

1. Communication usually involves the transfer of information, a generic term that embraces meanings such as knowledge, processed data, skills and technology. Within construction, information is exceptionally diverse given the huge number of parties involved with construction operations.
2. To communicate is to bridge a distance of some description, which can range from being short and simple (e.g. between two people) to long and complex (e.g. across the world). Again, in construction the separate location of many of those involved with projects regularly necessitate communication over longer distance than in, for example, manufacturing environments.
3. Communications do not only occur between individuals, but can occur between groups or organizations. Construction is inherently a team activity involving the concurrent involvement of many specialists in order to successfully deliver project objectives.
4. Communication can be seen as a transactional process where something is exchanged between the parties involved. Construction can be seen as series of transaction between involved parties. Facilitating these transactions has been widely recognized as a key issue for the industry to address if it is to improve its performance in the future.

Emmit, and Gorse, (2003) define common object of people who commission building projects, who do the design, schedule programs, design the project's culture and work together thru a variety of communication media towards a common goal, a completed building, either a small domestic extension or multi-million pound development. Emmit, and Gorse (2003) point out that construction is not a homogeneous industry, it is made up of a fascinating mixture of companies and professional consultants, entrepreneurs and tradespeople, all competing to make a living, and usually drawn together for one specific project, never work together again.

Importance of the communication during the construction process is emphasized by Emmitt, and Gorse, (2003) that it will help individuals to establish a degree of trust, help to achieve empathy and thus influence the synergy between them. The faster they

are able to communicate effectively, the faster they will establish good working relationships. Xue, Wang, Shen, and Yu, (2007) emphasized that timely and accurate information is important for all project participants as it forms the basis on which decisions are made and physical progress is achieved. Thus, communication is always the key factor leading to the success or failure of a construction project. Emmitt, and Gorse, (2003) are combined, the factors identified above will influence the manner in which organizations and individuals interact during the course of a particular project. There are, however, more essential characteristics that are fundamental to all design and construction projects.

- The client and the site: the type of procurement route chosen will determine formal communication routes and the responsibility of the various organizations contributing to the project.
- The individual organizations employed to design and assemble the constructed works: organizational communication has tend to focus on aspects of vertical communication, communication traveling up and down the company's hierarchy system. The project requires effective interorganizational communication, in addition to effective organizational communication. Communication across organizations will be affected by contractual arrangements because different procurement routes place slightly different responsibilities on individuals and hence colour how they interact.
- The individuals within the various organizations: it follows that both interdisciplinary and interoganizational communication needs careful consideration.

Kotzé BG, Verster JJP, and Berry FH (2008) emphasized that the performance of the coordination between the parties involved related with the system of communication, the culture of the project, the staff members and the communication structure.

2.5. Project Communication Instruments

For achieving common goals, project actors have to communicate with internal and external individuals. Internal communication defined to communicate or interact at

various levels of the organization. External communication referred communication with individuals or groups who are not members of the project. Different methods of instruments of internal communication were summarized by Kotzé et al. (2008):

- Oral communication occurs in the form of meetings, discussion groups, talks including grapevine, interviews, announcements and conversations, both face to face and over the telephone
- Written communication takes place by means of letters, circulars, memoranda, manuals, reports, seminars, and minutes of meetings.
- Non-verbal communication can convey powerful messages in the business world by means of gestures, appearance or attitudes.
- Electronic communication. Message can be sent and received using computer terminals, electronic mail and fax.

The use of Internet as the communication platform can help information transfer more effectively during the construction project. Besides its speedy transmission, open, easy to use, it also saves money in communication compared to the traditional information handling methods. Middleton (1997) pointed out the new communication networks. The facility by which people using new communication technologies can communicate with individuals they might otherwise never meet is a significant innovation, as it renders geographic location irrelevant. For businesses, this opportunity alone may justify the establishment of new communication networks. But the rapid speed of electronic communication, coupled with its relatively low cost, also differentiates from previous technologies, where information or documents could not be simultaneously transmitted to multiple recipients (Middleton, 1997).

CHAPTER 3

RESEARCH METHODOLOGY

This chapter involves two subsections, namely, the case study and the procedure. Case study is the wayfinding and signage project of Sabiha Gökçen International Airport (SGIA)'s New Terminal Building. Procedure is the coordination and communication analyses involving frequency distributions of electronic mails (e-mails), sentence extraction and phrase cataloguing according to dependency types of coordination theory.

3.1. Sabiha Gökçen International Airport Project

Sabiha Gökçen International Airport Project is delivered by build-operate-transfer method, which is a form of design-build project delivery method. It is an up to date delivery method employed particularly for airport projects in Turkey. The build-operate-transfer model enables the collaboration of public and private sectors. The public sector requires the designer-builder to provide financial funding, operation and maintenance, etc. in addition to the design-build services.

Sabiha Gökçen International Airport Project is located on the north section of Advanced Technology Industrial Park Project (İTEP) territory which is the property of Undersecretariat for Defense Industries in Pendik-Kurtköy, İstanbul. Zones of terminal building, parking garage, VIP building, airport hotel, apron extensions, viaducts, access roads and landscaping reveal proper application architectural design projects and design management applications (Can, 2010). The complex program of this project of 320000 m^2 utilizes applications of advanced technology and presents itself as a prestigious project involving unique specialties as topics of scientific research (Sabiha Gökçen Terminal, n.d.)

Istanbul Sabiha Gökçen Airport is one of the two major airports, located on the Asian side of Istanbul. The construction of the SGIA's new terminal aimed to expand passenger flow which plans for serving 10 million passengers annually (GMR-Limak-

MAHB consortium signs implementation agreement for Istanbul Sabiha Gokcen International Airport, n.d.).

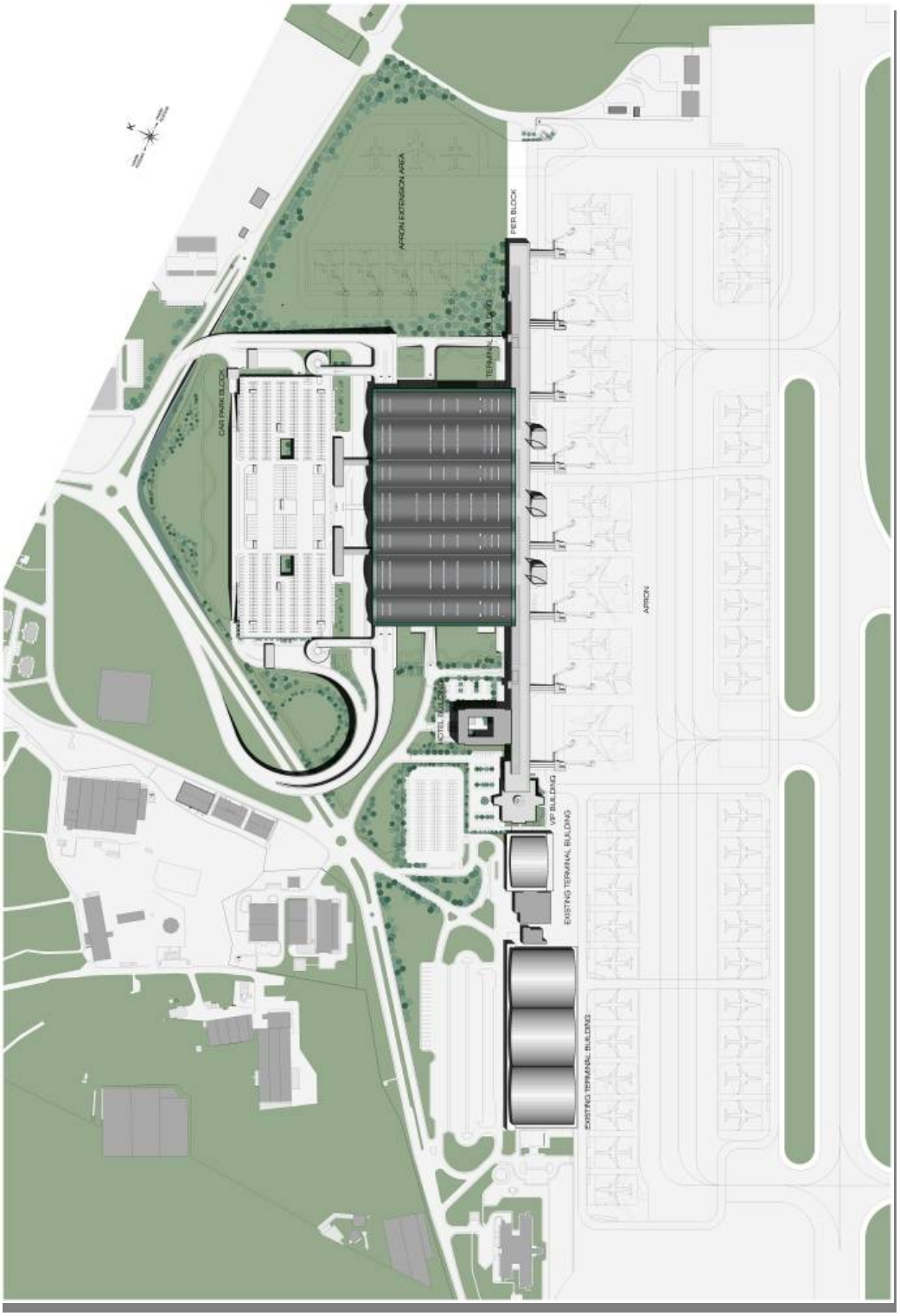


Figure 3.1. Site plan of “Sabiha Gökçen International Airport”
(Source: Sabiha Gokcen Airport New Terminal Building, n.d.)

SGIA new terminal project includes (Sabiha Gökçen has a new management, n.d.):

- Twelve shops, three duty-free stores, three pubs and two restaurants
- Two runways with a capacity of 45 planes
- Twenty-eight passport desks, 16 in departures and 12 in the arrivals terminal.
- It was used by approximately 2.2 million domestic and 800,000 international passengers in 2006.
- It has annual capacity to serve 3.5 million passengers. The capacity will reach 10 million with the investment

3.1.1. Development of SGIA Project

Sabiha Gökçen International Airport Project is within the scope of the Advanced Technology Industrial Park Project (İTEP) which is the second largest sizable investment of Turkey following Southeastern Anatolia Project (GAP).

Advanced Technology Industrial Park Project (İTEP) is initiated in 1987 by Defence Industry Executive Committee and 13 million m^2 property in Pendik Kurtköy was expropriationed by parliamentary mandate for the construction of the project. The original project of SGIA has come into use in January 8, 2001. The project had a 6.6 million m^2 site including a 3 million passanger/year capacity of International Terminal Building; a 500.000 passanger/year capacity of Domestic Terminal and a 90.000 ton/year capacity of Cargo Building. This constituted the completion of the first stage of Advanced Technology Industrial Park Project (İTEP).

Due to the increased air traffic in domestic airlines incapacitated existing terminal buildings and in 2006 Defence Industry Executive Committee settled for the construction requirement of a new terminal building of 10 million passanger/year capacity, an additional apron, multi-storey car park and its complementaries by a build-operate-transfer model (Can,2010).

Declared construction requirements of the new terminal building of SGIA are listed below:

- Increasing passanger traffic over the past ten years on the Anatolian side of İstanbul due to the economic and industrial development
- Interconnection of SGIA to primary sea and ground transportation lines
- In the scope of Marmaray project, SGIA is planned to be linked to the city center by the rail system and subway as part of the İstanbul transportation infrastructure project.
- Limiting boundaries of the site and the services of Atatürk International Airport and the potential of Sabiha Gökçen International Airport to expand on the site allocated
- Increasing demand of customers to SGIA owing to the sales in ticket prices and the luxoury and comfort in air travel
- Expectation of greater demand for air traffic and passenger capacity in consequence of the new investments on the Anatolian side of İstanbul
- Raising support fund from Defense Industry by the build-operate-transfer model for 'the new terminal building, additional apron, multi-storey car park and its complementaries' project

3.1.2. SGIA Project Schedule

The implementation process of SGIA project is scheduled as follows:

Table 3.1. SGIA Project Schedule
(Source: Can,2010)

… June 2006	Airport Management and Aviation Industry (HEAŞ) organized an architectural design project contest and invited four architectural firms. The jury agreed on the construction project prepared by Tekeli-Sisa Architectural Partnership.
July 9, 2007	Operation of SGIA and SGIA international terminal building project construction went out to tender and Limak-GMR-MAHB Joint Venture won the tender for 1 billion 932 million Euro (vat excluded)
February 4, 2008	Planning Council approved Undersecretariat Defense Industries tendering of the transfer to SGIA

(Cont. on next page)

Table 3.1. (Cont.)

February 20, 2008	SGIA Invest-Build-Operate Inc. is established. Limak and GRM got 80% share of the company and Malaysia Airports Holdings Berhard got 20% share.
April 2, 2008	The EPC (Engineering, Procurement, Construction)-Turnkey contract based 'EPC Contract for Realization of the Project on Sabiha Gökçen Airport New Terminal building and Complementaries thereof within the Framework of Build-Operate-Transfer Model' is signed between Limak-GMR-MAHB Joint Venture. It is a turnkey fixed-price contract. Acoording to this contract signed on April 2, 2008, the construction period was 24 months and turnkey lump sum price was 330.857.195 €.
October 31, 2009	The opening date of the International Terminal of SGIA.

3.1.3. SGIA Project Participants

The SGIA project had thousands of construction workers, hundreds of sub-contractors and purchasing companies. The main project participants are listed below. Table 3.2. shows contractual bounding ties for all project participants.

Table 3.2. SGIA Project Participants
(Source: Can, 2010)

#	**Position**	**Project Participants**
1	1st Employer	Turkish Republic Ministry of Defense Undersecretariat for Defense Industries
2	Authority on behalf of the 2nd Employer	Airport Management and Aviation Industry
3	Project Author: Architectural Design Office	Tekeli-Sisa Architectural Partnership
4	Investor	SGIA Invest-Build-Operate Inc. (Limak Holding Company, GMR Infrastructure Limited, Malaysia Airports Holdings Berhad ortaklığı)

(Cont. on next page)

Table 3.2. (Cont.)

5	Design-Build Contractor Firm	Limak-GMR Unincorporated Company
6	Design Teams	- Multi-Storey Car Park Project Design Team - New International Terminal Building Project Design Team - Airport Hotel and VIP Building Project Design Teams - Specialized Systems Design Teams - Extension of Apron Area Project Design Teams - Infrastructure Project Design Teams - Access Roads and Viaduct Project Design Teams - Fuel Hydrant Systems Design Teams - Landscape Project Design Teams
7	Consultancy Services	
8	Superintendancy Services	

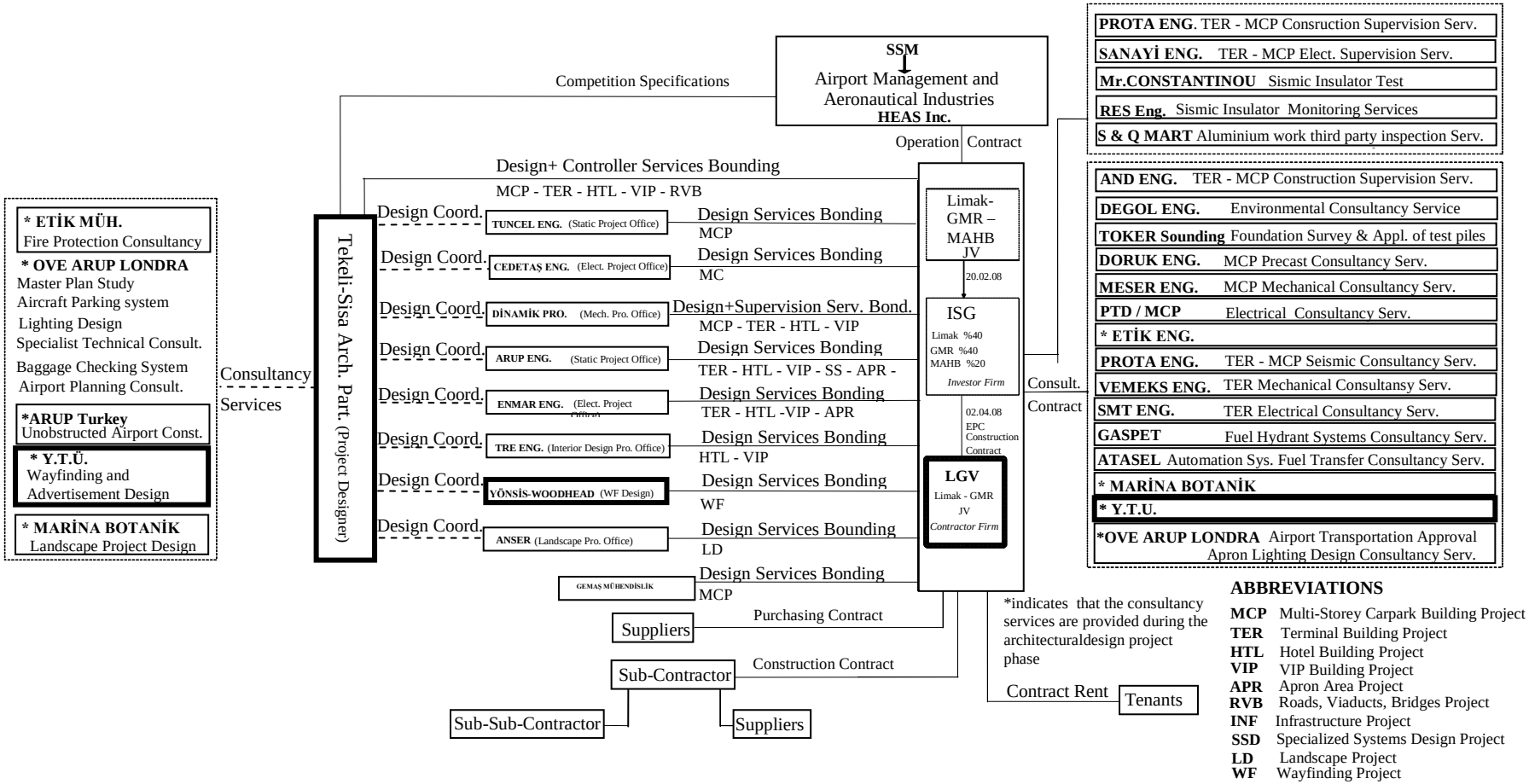


Figure 3.2. Sabiha Gökçen International Airport's organizational schema
(Source: adopted from Can, 2010)

3.2. Wayfinding and Signage Project of SGIA

Construction project specifications in the U.S. mainly use the format of Construction Specification Institute (n.d.). The CSI MasterFormat which is published in 2004 has 50 sections. Section 10 which is called Specialties includes signage trade package. Signage which is used for wayfinding purposes is the regular trade item in building construction projects. The scope of the wayfinding (signage) project is normally very large in airport project. Informational electronic panels in airports are technologically complex and provision of these items needs sophisticated communication and coordination (Figure 3.3).

The case study is the Wayfinding and Signage Project of the New Terminal Building and its complementaries of SGIA. The wayfiding project included all wayfinding design works and signage pertaining to the New Terminal Building and its complementaries externally, landside and airside, and internally. Service agreement was signed on 18.03.2009 between Limak & GMR JV (General Contractor) and Yönsis (Wayfinding and signage project Contractor). The project took 6 months to complete.

Figure 3.3. Interior view from SGIA new terminal building showing signange panels

3.2.1. Project Participants of Wayfinding and Signage Project of SGIA

Wayfinding and signage project contractor, Yönsis, was responsible for developing each sign type and defining materials and fabrication detail, as well as establishing font styles, colours, and fixing methods. In addition, presented documents by Yönsis should contain the location of each sign type on supplied plans. Sub-Contractor to Yönsis (Woodhead) was basicly responsible for developing preliminary design for each sign type. In addition to, Woodhead was a consultant to the Wayfinding and signage project contractor (Yönsis) during the project process. Consultant to Yönsis (RGB Consult) was responsible for improving the coordination among all the participant on behalf of Wayfinding and signage project contractor (Yönsis). (Consultant to Limak & GMR JV) User-friendly wayfinding and signage design was supervised by Yıldız Technical University.Wayfinding and Signage Project participants are listed in Table 3.3. Figure 3.4 shows contractual bonding between Wayfinding and signage project participants.

Table 3.3. Wayfinding and Signage Project Participants

#	**Position**	**Project Participants**
1	General Contractor	Limak & GMR JV
2	Wayfind and signage project contractor	Yönsis
3	Sub-Contractor to Yönsis	Woodhead
4	Project Author: Architectural Design Office	Tekeli-Sisa Architectural Partnership
5	Consultant to Yönsis	RGB Consult
6	Consultant to Limak & GMR JV	Yıldız Technical University

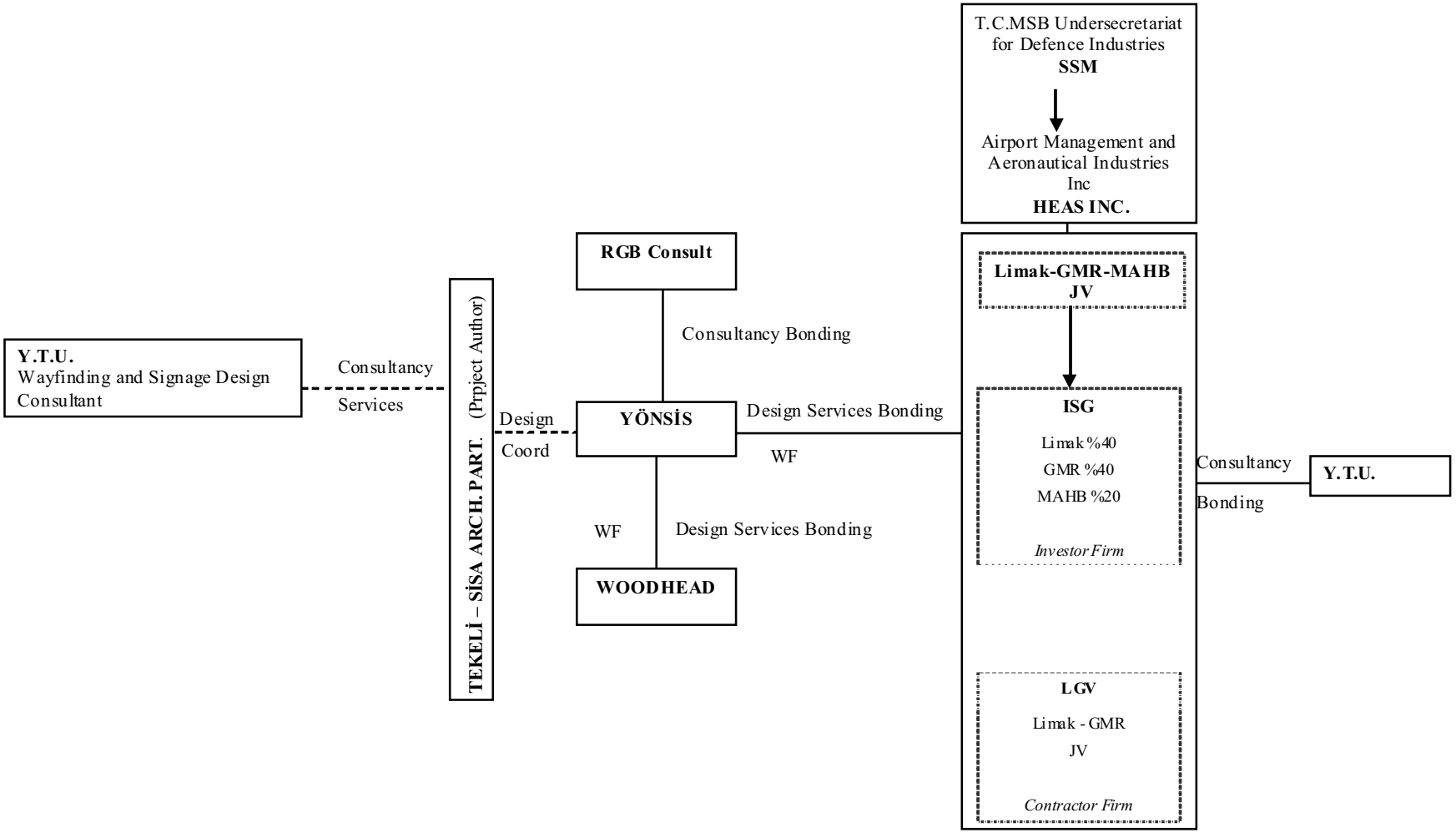


Figure 3.4. Sabiha Gökçen International Airport Wayfinding and Signage Project organizational Schema (Source: adopted from Can, 2010)

3.2.2. Scope of Services of Wayfinding and Signage Project of SGIA

Service agreement defined scope of the services, regarding collaboration with Wayfinding and signage project contractor (Yönsis) and Sub-Contractor to Yönsis (Woodhead), as following:

- **Preliminary Signage Design By Woodhead**

  Preliminary design for each sign type and the development of a sign hierarchy is proposed within the New International Terminal Building and its Complementaries by Woodhead Company.

- **Sign Suite Desing Development Together With Yonsis**

The design of each sign type is developed and expanded and defined the materials and fabrication detail, as well as establishing font styles, colors and fixing methods in the development of a suite of sign types to present a hierarchy of information to the user.

- **Artwork and Specification Documentation Yonsis with the Basic Artwork and Supervision of Woodhead**

Documentation includes finalization of all information relating to the fabrication of each sign type including fascia detailing, font, and type style usages and layout conventions, color coding, icons use and the standardization of directional arrows and other graphic elements at this stage.

- **Finalisation of Location Plan and Schedule Yonsis Supervised by Woodhead**

The Location Plan and Schedule Documents which are issued specify the location of each sign type on supplied plans is completed at this stage. The documents include finalization of all information content for each sign and confirmation of all icons, graphic and directional information.

3.3. Procedure

E-mail communication is observed between the General Contractor (Limak & GMR JV), the Wayfinding and signage design project contractor (Yönsis), the Sub-Contractor (Woodhead), the Project Author (Tekeli-Sisa Architectural Partnership,

Consultant to Yönsis (RGB Consult), and Consultant to Limak & GMR JV (Yıldız Technical University). The considered e-mails communication traffic had been began on 13.04.2009 and finished on 09.09.2009. E-mail traffic of the wayfinding and signage project of SGIA lasted for 6 months. Two hundred fifty six e-mails were taken into consideration for the research (Appendix A). The e-mail communication data are only obtained from the company e-mail accounts of the project participants. The procedure of the study comprised three steps which were sentence extraction process, key phrase extraction process, and assigning coordination weights.

3.3.1. Sentence Extraction Process

The first step to the build model was the extraction of sentences indicative of one of the four processes of coordination defined by Malone (1988). Each sentence was categorized into the specific coordination process and catalogued. The list of sentences was sorted out and the key phrases that underlined the coordinative action were identified and marked. Sentence extraction model is shown Figure 3.5.

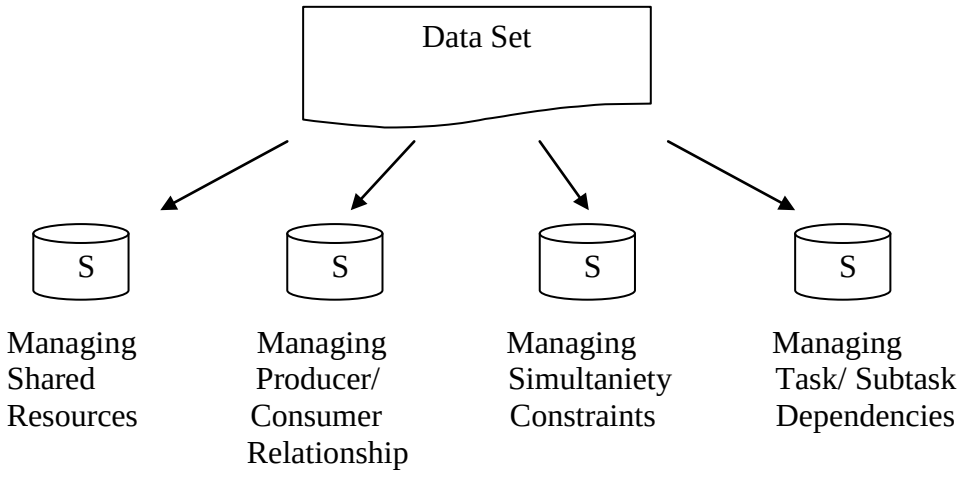


Figure 3.5. Sentence extraction
(Source: Hossain, 2009)

3.3.2. Cataloguing of Coordination Key Phrases

Second step is the cataloguing of coordination key phrases. Hossain et al. (2006) by referring to Pentland (1994) explained that it is difficult to imagine an institutional, technological, cultural, or coordination constraints that does not vary with context and is not subject to revision with the passage of time. The lack of organizational language faculty eliminates the possibility of a universal grammar for the organizational processes, which is a single set of universal rules or principles that govern the syntactic structure of all organising processes. Due to the lack of a universal grammar Hossain et al. (2006) used a context specific taxonomy by interpreting Malone and Crowston's (1994) four coordination key processes. This study both utilized interpretations of Hossain et. al. (2006) and further included key phrases specific to a wayfinding and signage design project (listed in Tables 3.4, 3.5, 3.6, 3.7). Marked key phrases from the sentences extracted are put into a distinct bucket for each type of coordination (Figure 3.6).

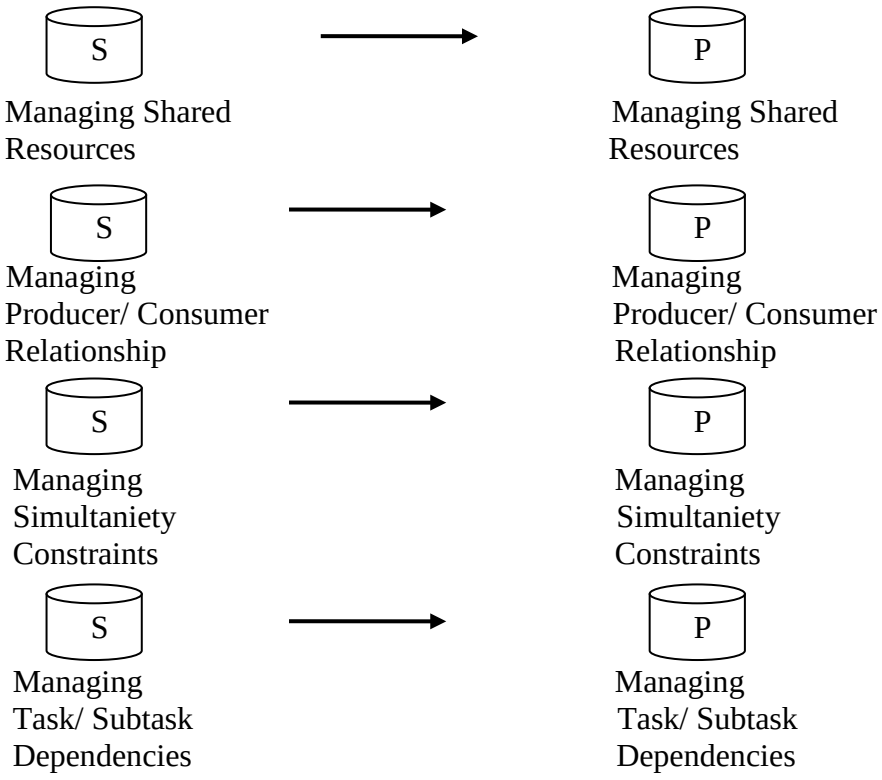


Figure 3.6. Key phrases extraction
(Source: Hossain, 2009)

3.3.3. Assigning Coordination Weight

In the third step, each of the coordination phrases was assigned a weight based on its level of significance. The method used for assigning coordination weight was formulated referring to Hossain's study (2009). According to this method, the weight was determined by the number of people that use the keyword and the frequency with which they use it. The weight of the words is equal to the base two log of the sum of the usage frequency of the words. A word used more commonly was assigned a greater weight. The reason for using the base two log of the frequency was to capture the effect of words with higher frequency without creating substantial outliers. This creates a normal distribution of the coordination weights and reduces outliers. The weights of the words varied from 0.30 to 6.55. Table 3.4. shows assigned weights for Resource Allocation dependency type phrases. Table 3.5. shows assigned weights for Producer/ Consumer Relationship dependency type phrases. Table 3.6 shows assigned weights for Simultaniety Constraints dependency type. Table 3.7. shows assigned weights for Task/Subtask Relationship dependency type.

Table 3.4. Coordination Key Phrases of Resource Allocation Dependency Type

Dependency Type	Coordination Key Phrase	Weight
	Please send (have to)	4.95
	Please advice	4.25
	Want sb to do sth	4.25
	Waiting for	4.09
	Please inform	3.70
	Please give (have to)	3
	Please check	2.80
	Please answer	2.58
	Look forward	2.58
	Please confirm	2.32
	Please update	2
	Kindly ask you to (have to)	2
	Start	2
	Is expecting	2
	Please speak (have to)	2
	Please update	2
	Should revise (have to)	1.58
	Should be designed	1.58
	Don't forget	1.58
	Confirm	1.58
	Please consider (should)	1.58

(Cont. on next page)

Table 3.4. (Cont.)

Dependency Type	Coordination Key Phrase	Weight
Resourse Allocation	Should clarify (have to)	1.58
	Please upload	1
	Please use (should)	1
	Please note	1
	Point out	1
	State	1
	Should define	1
	Should prepare (have to)	1
	Should change (have to)	1
	Should allow	1
	Let me know	1
	Please recommend	1
	Kindly ask you to bring	1
	Please revise (have to)	1
	Ask (have to)	1
	Please sumbit	1
	Please keep (should)	1
	Please evaluate	0.30
	Can we solve	0.30
	Can you suggest	0.30
	Should mark	0.30
	Should replace	0.30
	Should be known	0.30
	Should begin	0.30
	Please help	0.30
	Should be copied	0.30
	Should replicate	0.30
	Should remain	0.30
	Should support	0.30
	Request by	0.30
	Have to include	0.30
	Should issue	0.30
	Please ask	0.30
	Please write Kindly ask you	0.30
	to take	0.30
	Have to finish	0.30
	Please get	0.30
	Please call me	0.30
	Please be here	0.30
	Respond	0.30
	Have to extend	0.30
	Have to develop	0.30
	Have to manage	0.30
	Please receive	0.30

Table 3.5. Coordination key phrases of Producer/ Consumer Relationship Dependency type

Dependency Type	Coordination Key Phrases	weight
Producer/ Consumer Relationship	Sent	6.55
	Attached	5.95
	Upload	4.95
	Receive	4.64
	Access	4
	Present	3.46
	Inform	3
	Given	2.80
	Download	1.58
	Take	1
	As you see	1
	Available	1
	Represent	0.30

Table 3.6. Coordination key phrases of Simultaniety Constraints Dependency type

Dependency Type	Coordination Key Phrases	weight
Simultaneity Constraints	Meeting note	3
	Asap	3.46
	Converse	4.32
	Meeting	4.75
	Organize	2.32
	To meet	2.58
	Participate	2.58
	Get in touch	2.58
	To see you	2.58
	Cooperate	2.32
	Exact day	2
	Arrange	1.58
	Meeting day	1
	Contact	1
	Consolidate	1
	Proper date	0.30
	Submit day	0.30
	Given time	0.30
	Required time	0.30
	Meeting call	0.30

Table 3.7. Coordination key phrases of Task/ Subtask Relationship Dependency type

Dependency Type	Coordination Key Phrases	weight
	Need	4.23
	Mention	3.90
	Prepare	3.70
	Need to	3.70
	Recommend	3.58
	Think	3.46
	Check	3.32
	Applied	3

(Cont. on next page)

Table 3.7. (cont.)

Dependency Type	Coordination Key Phrases	weight
Task/ Subtask Relationship	Add	3
	Know	3
	Finish	2.80
	Include	2.80
	Provide	2.80
	Change	2.58
	To be sure	2.58
	State	2.32
	Used	2.32
	Comment	2.32
	Confirm	2.32
	Allow	2.32
	Revised	2.23
	Marked	2
	Had trouble	2
	Understand	2
	Working	2
	Start	2
	Continue	2
	Find	1.58
	Resolve	1.58
	Combine	1.58
	Define	1.58
	Update	1.58
	Advice	1
	Summarized	1
	Consider	1
	Translate	1
	Redesign	1
	Fabricate	1
	Solve	1
	Noted	1
	Concern	1
	Required	1
	Addressed	1
	Clarified	1
	Buy	1
	Suggest	1
	Evaluated	1
	Replay	1
	Listed	1
	Help you	1
	begin	1
	Design	1
	Overviewed	1
	Adopted	1
	Located	1
	Appreciated	0.30
	Prefer	0.30
	Confused	0.30
	Exclude	0.30
	Progress	0.30
	Selected	0.30
	Redefined	0.30

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Table 3.7. (cont.)

Dependency Type	Coordination Key Phrases	weight
Task/ Subtask Relationship	Looking	0.30
	Want	0.30
	Demand	0.30
	Remind	0.30
	Forget	0.30
	Complain	0.30
	Redraw	0.30
	Avoid	0.30
	Incure	0.30
	Assume	0.30
	Explain	0.30
	Bring	0.30
	Lose	0.30
	Create	0.30
	Fixed	0.30
	Accept	0.30
	Wonder	0.30
	Advance	0.30
	Expect	0.30
	Issued	0.30
	Proceed	0.30
	Request	0.30
	Decide	0.30
	Make	0.30
	Submit	0.30
	Prevent	0.30

3.3.4. Total E-mail and Phrase Distribution of Actors

A total of 256 emails are sent and a total of 219 emails are received by the six project actors. Table 3.8 shows distribution of total emails for each actor in terms of sending and receiving. Figure 3.7 shows percentage distribution of total sent emails for each actor. Figure 3.8 shows percentage distribution of total received emails for each actor.

Table 3.8. Distribution of Total E-mails for Each Actor

Actors		Number of Total e-mail	
Position	Company Name	Sent	Received
General Contractor	Limak & GMR JV	35	46
Wayfinding and signage design contractor	Yönsis	76	69
Sub-Contractor to Yönsis	Woodhead	21	65
Project Author	Tekeli-Sisa Architecture	5	4
Consultant to Yönsis	RGB Consultant	81	35
Consultant to Limak & GMR JV	Y.T.U	3	0
	Total	256	219

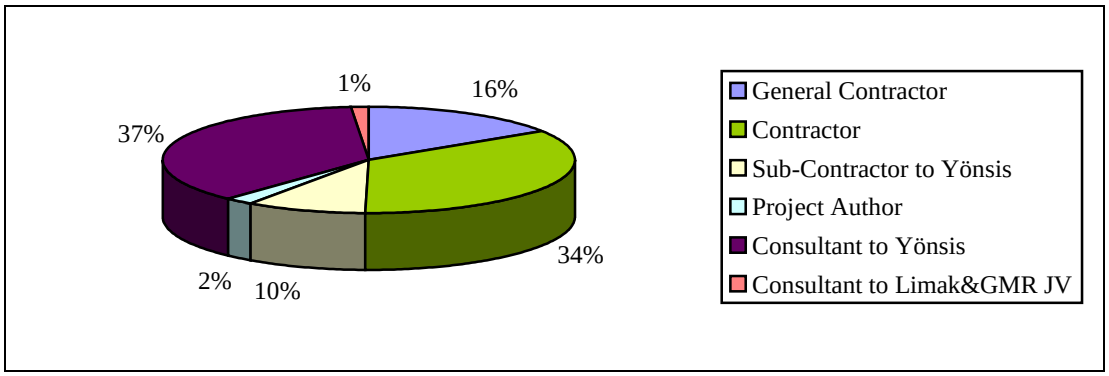


Figure 3.7. Distribution of total sent e-mail for each actor

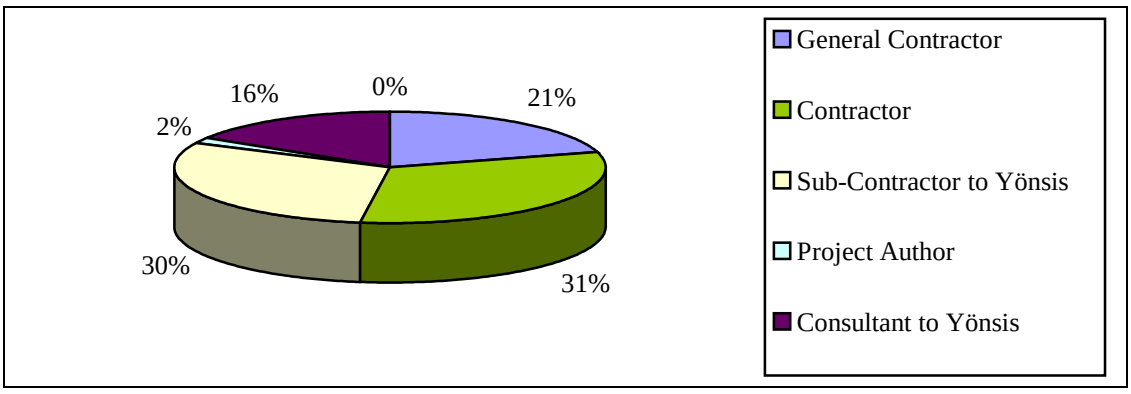


Figure 3.8. Distribution of Total Received E-mail for Each Actor

A total of 929 phrases are used in emails sent and received by the six project actors. Table 3.9 shows number of total phrases for each dependency type. Figure 3.9 shows percentage distribution of total phrases for each dependency type.

Table 3.9. Distribution of Total Phrases for Each Dependency Type

Dependency Types	Number of Total Phrases
Resource Allocation Dependency	223
Producer/ Consumer Relationship Dependency	269
Simultaneity Constraints	124
Task/ Subtask Dependency	313

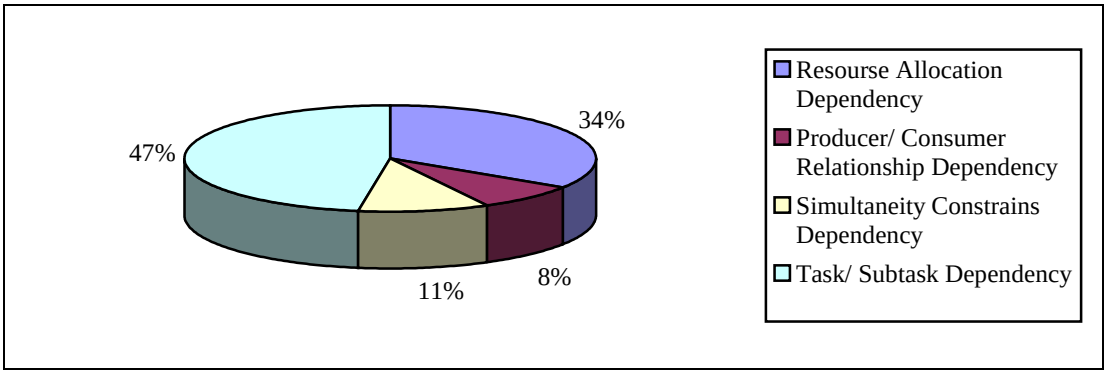


Figure 3.9. Distribution of total phrases for each dependency type

3.3.4.1. E-mail Distribution and Phrase Analysis of Actor 1

The General Contractor (Limak & GMR JV) has 35 e-mails sent to other actors; and 48 e-mails received from other actors. Table 3.10 shows the e-mail flow of the General Contractor.

The General Contractor (Limak & GMR JV) sent 17 of 35 e-mails to the Wayfinding and signage design project contractor (Yönsis); and the remaining 18 e-mails to the Consultant to Yönsis (RGB Consulting). Figure 3.10 shows the percentage distribution of sent e-mails by the General Contractor.

The General Contractor (Limak & GMR JV) received 25 of 48 e-mails from the Wayfinding and signage design project contractor (Yönsis), 19 of 48 e-mails from the

Consultant of Yönsis (RGB Consulting) and 3 of 48 emails from Yıldız Technical University and 1 of 48 emails from Sub-Contractor Woodhead. Figure 3.11 shows the percentage distribution of received e-mails by the General Contractor (Limak & GMR JV).

Table 3.10. E-mail flow of the General Contractor

	Position	Company Name	Profession	
Actor1	**General Contractor**	**Limak & GMR JV**	**Engineering Firm**	
E-mail correspondents			Number of Total emails	
	Position	Company Name	Sent	Received
Actor2	Wayfinding and signage design project contractor	Yönsis	17	25
Actor3	Sub-Contractor	Woodhead	0	1
Actor4	Project Author	Tekeli-Sisa Arch. Part.	Out of scope	
Actor5	Consultant to Yönsis	RGB Consulting	18	19
Actor6	Consultant to Limak&GMR JV	Yıldız Technical University	0	3
		Total	35	48

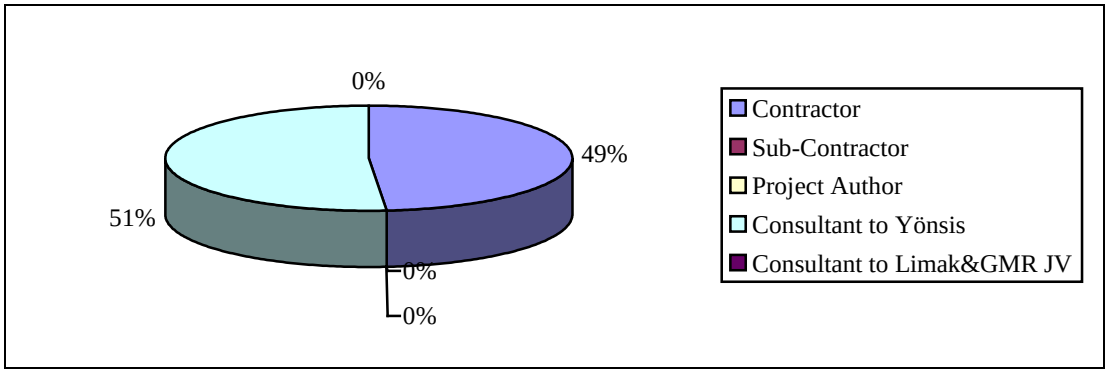


Figure 3.10. Distribution of e-mails sent by the General Contractor

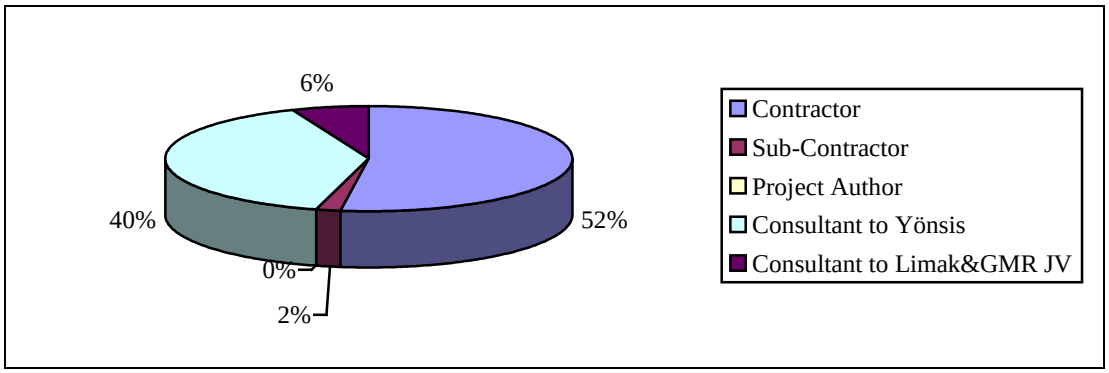


Figure 3.11. Distribution of e-mails received from the General Contractor

The General Contractor (Limak & GMR JV) has 17 e-mails sent to the Wayfinding and signage design project contractor (Yönsis). 35 phrases were extracted from these 17 sent e-mails. Table 3.11 shows the distribution of phrases for each dependency type in emails sent from Actor 1 to Actor 2.

19 of 35 phrases were related to Producer/Consumer Relationship Dependency type (Figure 3.12).

"Send" and "attached" phrases which focus on Producer/ Consumer Relationship Dependency type were the most commonly used phrases (Figure 3.13). Remaining each related phrase was used once and a total sum of 10 was calculated (Figure 3.13). Below are the examples of sentences from which 'send' and 'attached' phrases were extracted:

- You can find attached the related document.
- I am sending VIP images attached to 3 separate emails.
- Interior view of SGIA passenger waiting lounges is attached.
- You can find attached sketches for the incomplete parts.

Table 3.11. E-mail flow between Actor 1 and Actor 2

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor1	**General Contractor**	**Limak & GMR JV**	**Actor2**	**Wayfinding and signage design contractor**	**Yönsis**	**17**
Distribution of Phrases for Each Dependency Type in Emails sent from Actor 1 to 2						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency	Total # of Phrases in Sent emails		
8	19	0	8	35		

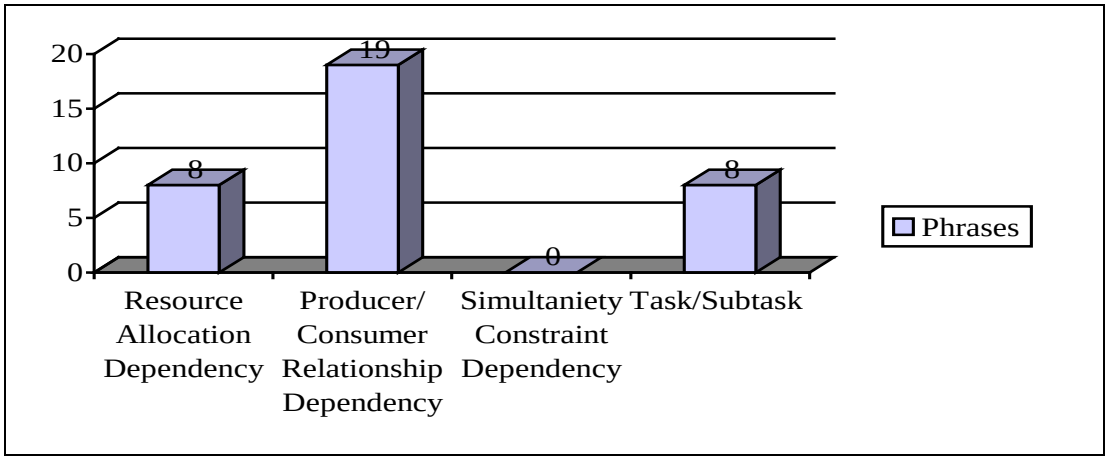


Figure 3.12. Distribution of total phrases for each dependency type

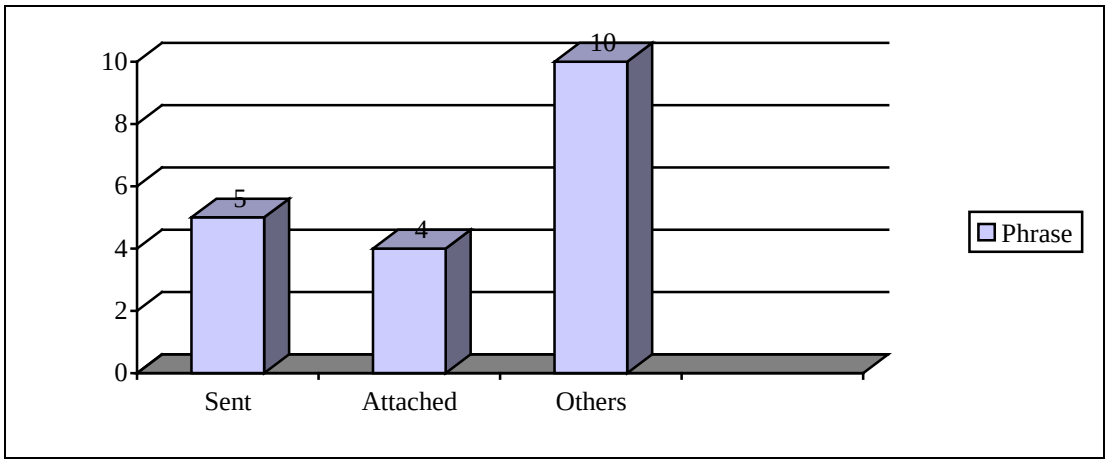


Figure 3.13. Distribution of producer/ consumer relationship dependency phrases

The General Contractor (Limak & GMR JV) has 18 e-mails sent to the Wayfinding and signage design project contractor (Yönsis). 31 phrases were extracted from these 18 sent e-mails. Table 3.12 shows the distribution of phrases for each dependency type in emails sent from Actor 1 to Actor 5. 11 of 31 phrases were related to Simultaniety Constraints Dependency type (Figure 3.14).

"Meeting" and "conversation" phrases which focus on Simultaniety Constraints Dependency type were the most commonly used phrases (Figure 3.15). Remaining each related phrase was used once and a total sum of 5 was calculated (Figure 3.15). Below are the examples of sentences from which 'meeting' and 'conversation' phrases were extracted:

- The report will be prepared and finished by Mr. Oğuzhan by July the 2nd and we will be meeting on the same day as of planned previously after the phone conversation
- I didn't send a meeting call for you since we decided on the time and date of the meeting together.
- As I explained in detail on the phone conversation, we need urgently a quantity survey list for each location on the final plans of the wayfinding project.
- As a result of our phone conversation with Mrs. Dilgün, it is decided that the drawings I sent over should be exactly the same as the ones I got from you.

Table 3.12. E-mail flow between Actor 1 and Actor 5

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor1	**General Contractor**	**Limak & GMR JV**	**Actor5**	**Consultant to Yönsis**	**RGB Consulting**	**18**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency		Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency		Task/Subtask Relationship Dependency	Total # of Phrases in Sent emails
8		18	12		11	49

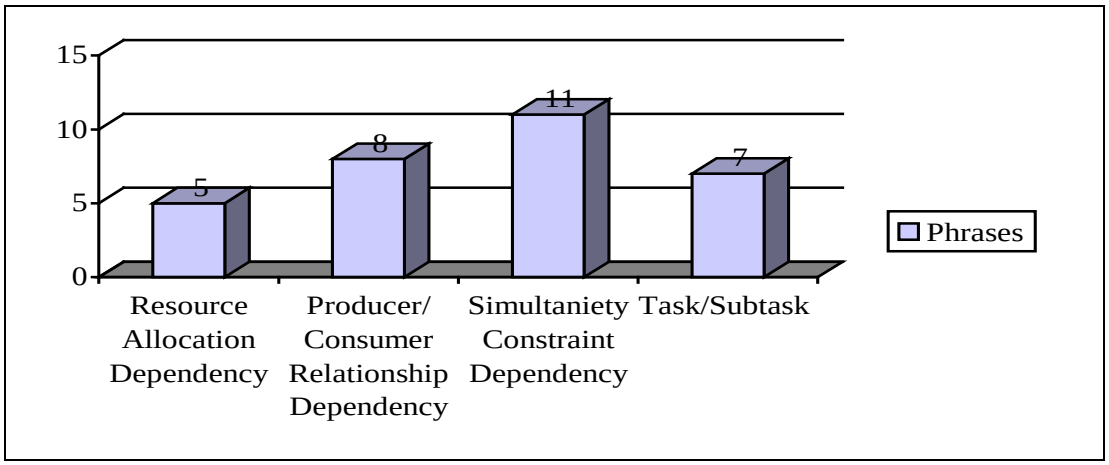


Figure 3.14. Distribution of total phrases for each dependency type

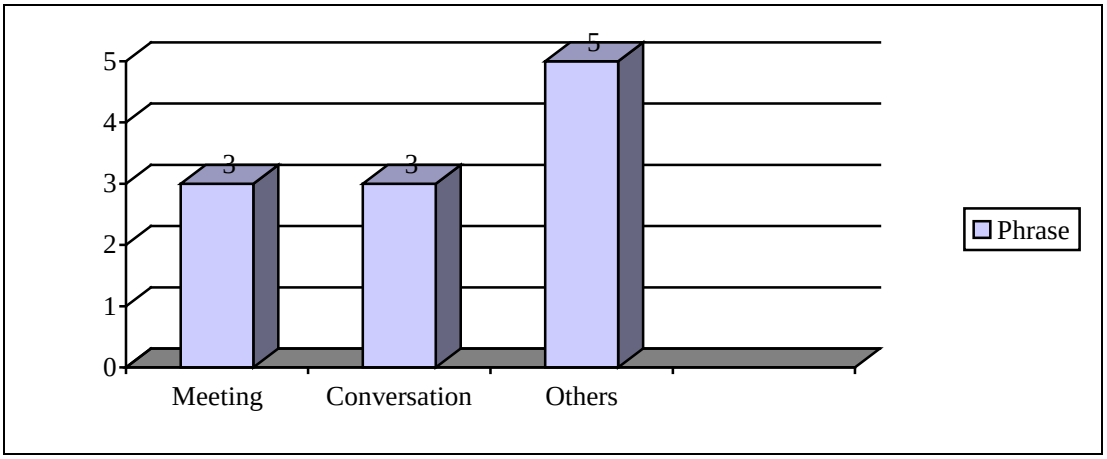


Figure 3.15. Distribution of Simultaniety Constraint Dependency Phrase

3.3.4.2. E-mail Distribution and Phrase Analysis of Actor 2

The Wayfinding and signage design project contractor (Yönsis) has 76 e-mails sent to other actors; and 69 e-mails received from other actors. Table 3.13 shows the e-mail flow of the Wayfinding and signage design contractor.

The Wayfinding and signage design project contractor (Yönsis) sent 40 of 76 e-mails to the Sub-Contractor (Woodhead), 25 of 76 e-mails to the General Contractor (Limak & GMR JV), 9 of 76 e-mails to the Consultant to Yönsis (RGB Consulting) and 2 of 76 e-mails to the Project Author (Tekeli-Sisa Architectural Partnership). Figure 3.16 shows the percentage distribution of e-mails sent by the Wayfinding and signage project contractor (Yönsis).

The Wayfinding and signage design project contractor (Yönsis) received 36 of 69 e-mails from the Consultant to Yönsis (RGB Consulting), 17 of 69 e-mails from General Contractor (Limak & GMR JV), 12 of 69 e-mails from the Sub-Contractor (Woodhead), and 4 of 69 e-mails from the Project Author (Tekeli-Sisa Architectural Partnership). Figure 3.17 shows the percentage distribution of e-mails received by the Wayfinding and signage design project contractor (Yönsis).

Table 3.13. E-mail flow of the Wayfinding and signage design contractor

	Position	Company Name	Profession	
Actor2	**Wayfinding and signage design contractor**	**Yönsis**	**Wayfinding Project Developer**	
E-mail correspondents			Number of Total emails	
	Position	Company Name	Sent	Received
Actor1	General Contractor	Limak & GMR JV	25	17
Actor3	Sub-Contractor	Woodhead	40	12
Actor4	Project Author	Tekeli-Sisa Architecture	2	4
Actor5	Consultant to Yönsis	RGB Consulting	9	36
Actor6	Consultant to Limak&GMR JV	YTU	0	0
		Total	76	69

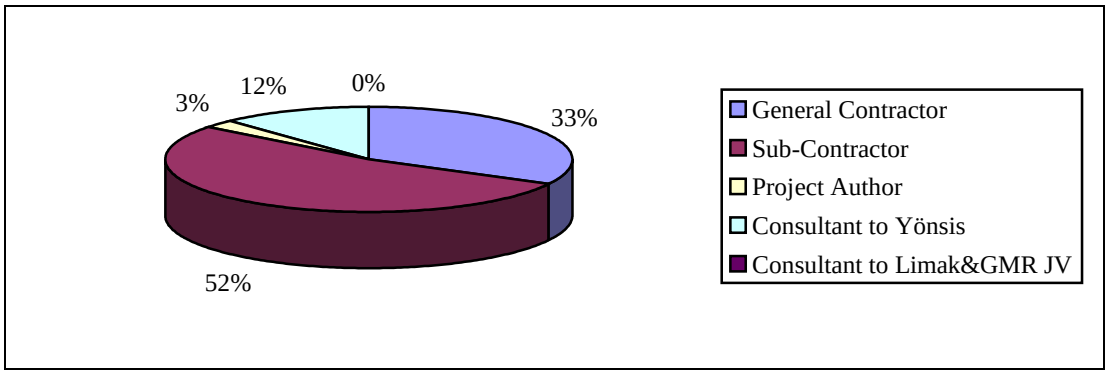


Figure 3.16. Distribution of sent e-mails by the Wayfinding and signage design Contractor

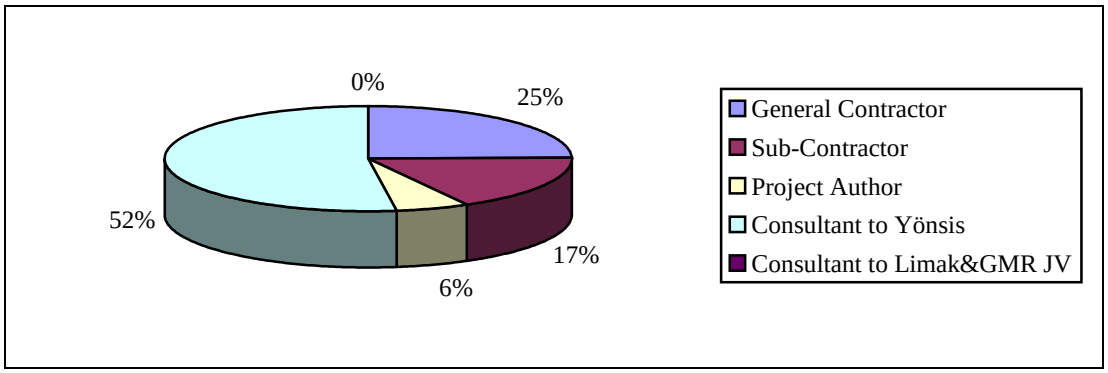


Figure 3.17. Distribution of received e-mails by the Wayfinding and signage design Contractor

The Wayfinding and signage design project contractor (Yönsis) has 25 e-mails sent to the General Contractor. 57 key phrases were extracted from these sent 25 e-mails Table 3.14 shows the distribution of phrases for each dependency type in emails sent from Actor 2 to Actor 1. 40 of 57 phrases were related to Producer/Consumer Relationship Dependency type (Figure 3.18).

"Attached" key phrase which focuses on Producer/ Consumer Relationship Dependency type was the most commonly used phrase (Figure 3.19). Below are the examples of sentences from which 'attached' phrase was extracted:

- Attached is the BOQ list you requested for the quantity survey.
- Attached is the work product including revised colours.
- Attached is the wayfinding project of SGIA for VIP.
- Attached is the technical specification for guiding signs.
- Attached is the revised file including exterior identification panels.

Table 3.14. E-mail flows between Actor 2 and Actor 1

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor2	**Wayfinding and signage design contractor**	**Yönsis**	**Actor1**	**General Contractor**	**Limak & GMR JV**	**25**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency	Total Phrase in Sent emails		
6	40	4	7	57		

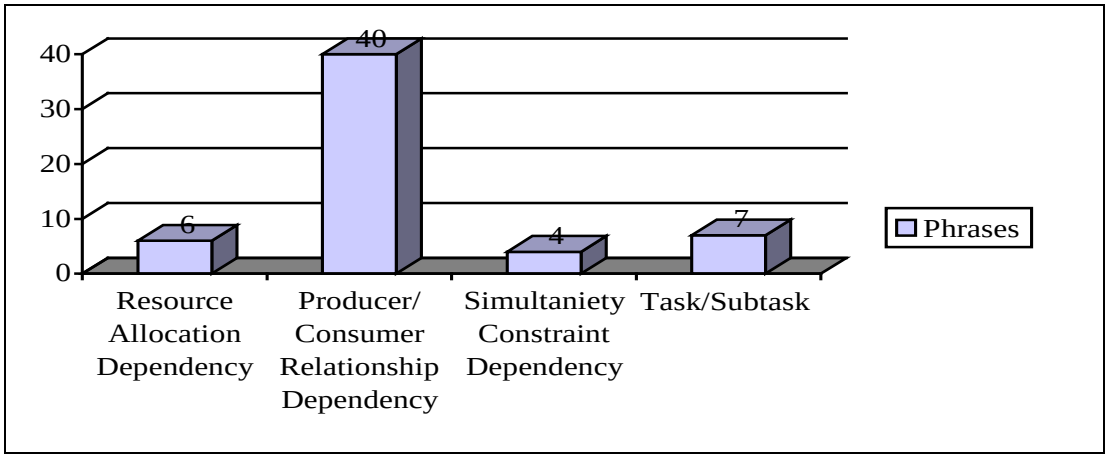


Figure 3.18. Distribution of total phrases for each dependency type

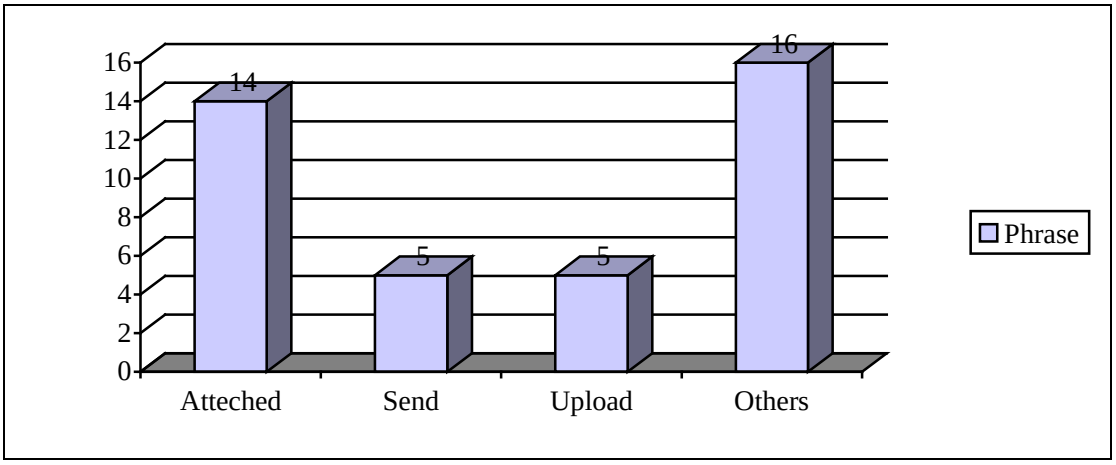


Figure 3.19. Distribution of producer/ consumer relationship dependency phrase

The Wayfinding and signage design project contractor (Yönsis) was the most active e-mail sender regarding total e-mail distribution among all actors. Among all of the sent e-mails of the Wayfinding and signage design project contractor (Yönsis), the Sub-Contractor (Woodhead) is the primary receiver with a percentage of 52%. Figure 3.16 and 3.17 show distribution of sent and received e-mails of the Wayfinding and signage design project contractor. The Wayfinding and signage design project contractor (Yönsis) has 40 e-mails sent to the Sub-Contractor (Woodhead). 259 phrases have been extracted from these 40 e-mails (Table 3.15). Producer/ Consumer Relationship Dependency type phrases are used 96 times. Resource Allocation Dependency Phrases are used 70 times and the Wayfinding and signage design project contractor (Yönsis) orders tasks to the Sub-Contractor (Woodhead) with 81 related phrases of Task/ Subtask Dependency. Figure 3.20 shows distribution of total phrases used by the Wayfinding and signage design project contractor (Yönsis) for each dependency type.

"Want you to send" and "please advice" phrases which focus on Resource Allocation Dependency type were the most commonly used phrases (Figure 3.21). Remaining each related phrase was used once and a total sum of 55 was calculated (Figure 3.21).

- Regarding ease of use, we want you to send us the presentation's ai,dxf or dwg format
- On the other hand, we want you to send your preliminary design file immediately.
- SGIA Operation wants us to send praying room icon.
- Regarding our last evaluation we need your advice urgently.
- We need your advise for integrating 3 types of pannels.
- Can you advice about the location of 'you are here' sign?
- Tekeli-Sisa wants you to advice about emergency exits locations used in airports.

"Uploaded" and "send" phrases which focus on Producer/Consumer Dependency type were the most commonly used phrases (Figure 3.22). Remaining each related phrase was used once and a total sum of 47 was calculated (Figure 3.22).

"Can use" and "can send" phrases which focus on Task/Subtask Dependency type were the most commonly used phrases (Figure 3.23). Remaining each related phrase was used once and a total sum of 61 was calculated (Figure 3.23).

- You considered only the last presentation uploaded to rapidshare, didn't you?
- We have uploaded the final project.
- I have uploaded in the ftp.
- I had uploaded ftp passport cabinet drawings almost ten days ago, can you check it?
- I have uploaded in ftp entry (North) facade drawings again for helping to design 'Sabiha Gökçen corporate identification'.
- I have uploaded site layout again and also attached to this e-mail.

Below are the examples of sentences from which most commonly used phrases were extracted:

- I can send them by e-mail.
- We sent a first aid icon that you can use or you can use another icon similar to it.
- When we adopt it, we will send you.

Table 3.15. E-mail flows between Actor 2 and Actor 3

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor2	**Wayfinding and signage design contractor**	**Yönsis**	**Actor3**	**Sub-Contractor to Yönsis**	**Woodheaad**	**40**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency		Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency		Total # Phrase in Sent emails
70	97		11	81		259

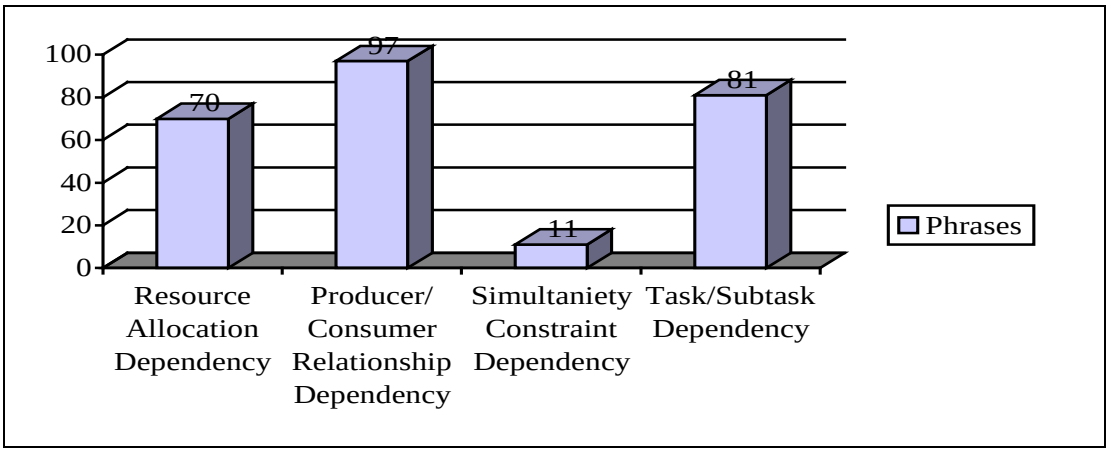


Figure 3.20. Distribution of total phrases for each dependency type

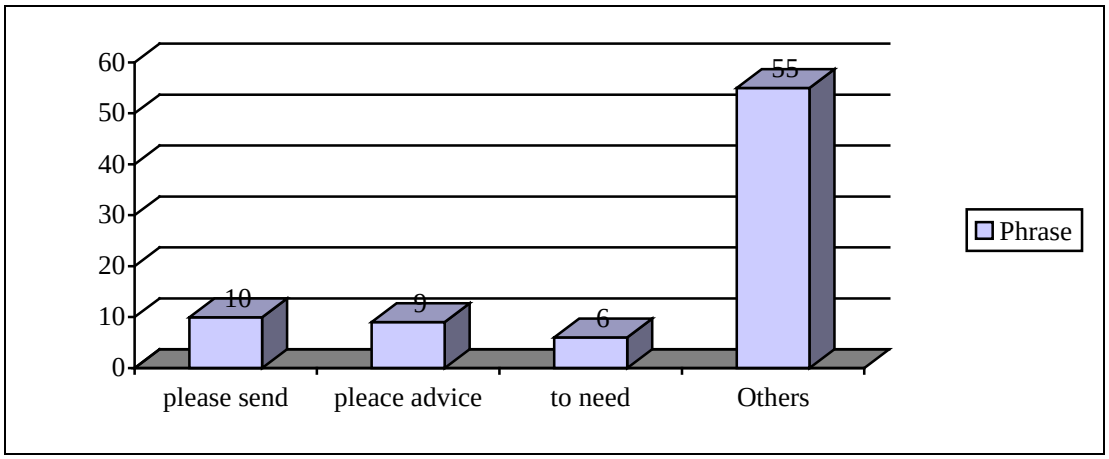


Figure 3.21. Distribution of resource allocation dependency phrases

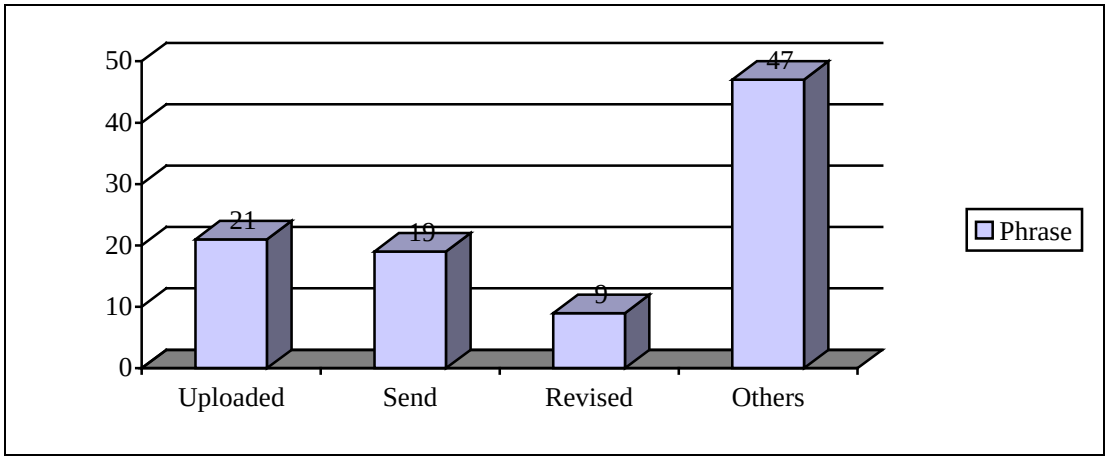


Figure 3.22. Distribution of producer/ consumer relationship dependency phrases

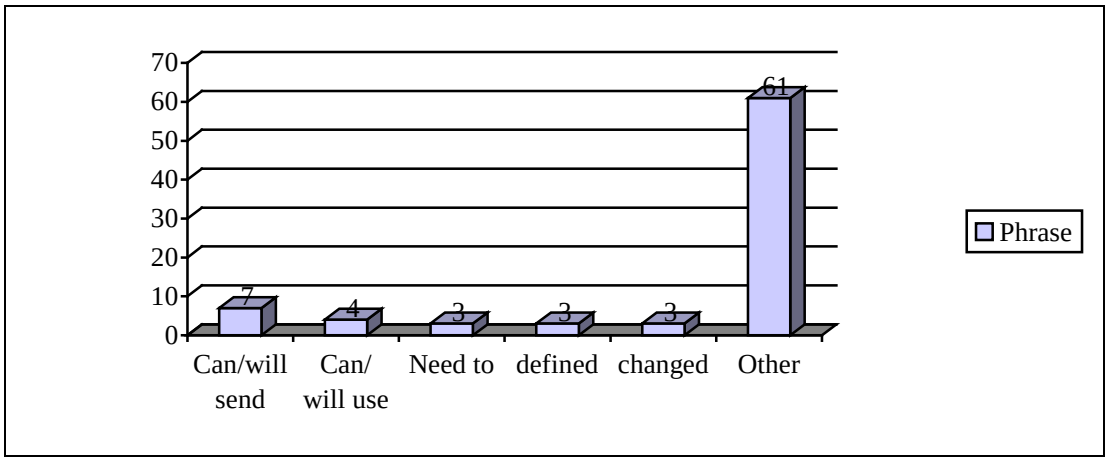


Figure 3.23. Distribution of task/ subtask relationship dependency phrases

Almost no e-mail communication between the Wayfinding and signage design project contractor (Yönsis) and the Project Author (Tekeli-Sisa Architecture) is observed (Table 3.16).

The Wayfinding and signage design project contractor (Yönsis) has 2 e-mails sent to the Project Author (Tekeli-Sisa Architectural Partnership). 8 key phrases of different coordinative processes were extracted from these 2 e-mails (Table 3.16).The Wayfinding and signage design project contractor (Yönsis) used phrases which focus on Producer/ Consumer Relationship Dependency type (Figure3.25). “Prepared”, “sent”, “received”, and “attached” phrases were used once (Figure 3.25). Below are the examples of sentences from which most commonly used phrases were extracted:

- Attached you can find color samples prepared by us.

Table 3.16. E-mail flows between Actor 2 and Actor 4

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor2	**Wayfinding and signage design contractor**	**Yönsis**	**Actor4**	**Project Contractor**	**Tekeli- Sisa Arch. Part.**	**2**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency	Total Phrase in Sent emails		
2	4	0	2	8		

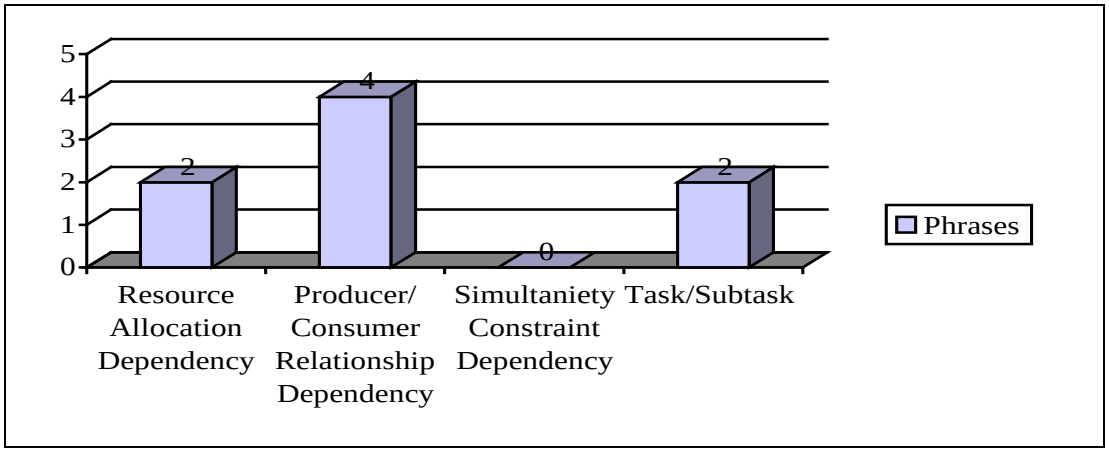


Figure 3.24. Distribution of total phrases for each dependency type

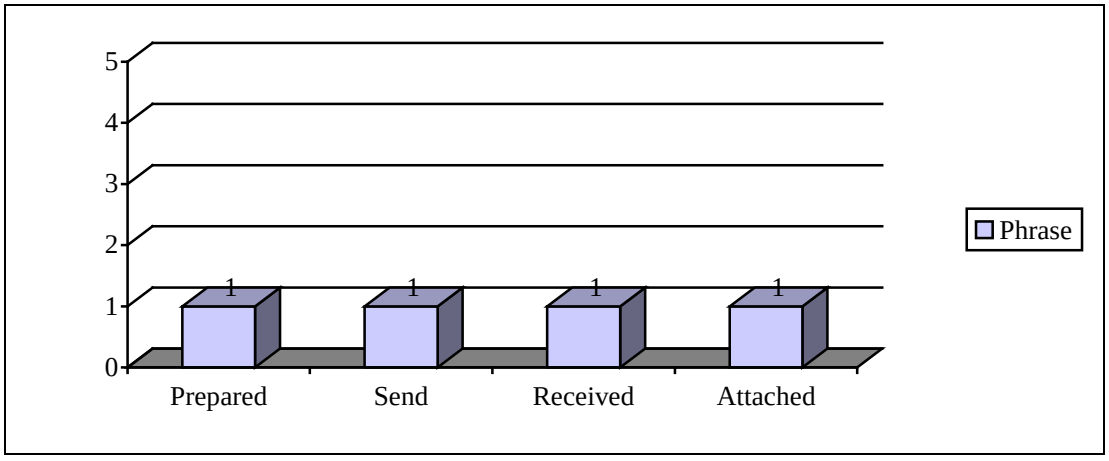


Figure 3.25. Distribution of producer/ consumer relationship dependency phrases

The Wayfinding and signage design project Contractor (Yönsis) has 9 e-mails sent to the Consultant to Yönsis (RGB Consulting). 39 phrases were extracted from these 9 sent e-mails (Table 3.17). Figure 3.26 shows the distribution of phrases for each dependency type in emails sent from Actor 2 to Actor 5.

"Could you please send" phrase which focus on Resource Allocation dependency type was used 4 times. "Sent" key phrase which focuses on Producer/ Consumer Relationship dependency type was used 5 times. Figure 3.27 shows distribution of phrase usages. Below are the examples of sentences from which 'could you please send' and 'sent' phrases were extracted:

- Attached I sent you the meeting minutes in English.
- I sent the e-mail again after your warning of not receiving.

"Meeting" key phrase which focus on Simultaniety Constraints dependency type was used 4 times (Figure 3.28). Below are the examples of sentences from which this phrase was extracted:

- Below are the names of the participants to that meeting.
- Could you please schedule the meeting for the 3rd of June?
- Attached you can find the meeting minutes edited and revised by Mr. Aron.

"Need", "mentioned", and "inform" key phrases which focus on Task/ Subtask dependency type were used 2 times (Figure 3.29). Below is the example of a sentence from which 'mentioned' phrase was extracted.

- We got the document you have mentioned.

There was no sent e-mail from Actor 2 (Yönsis) to Actor 6 (YTU).

Table 3.17. E-mail flows between Actor 2 and Actor 5

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor2	**Wayfinding and signage design contractor**	**Yönsis**	**Actor5**	**Consultant to Yönsis**	**RGB Consulting**	**9**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency	Total Phrase in Sent emails		
4	11	11	13	39		

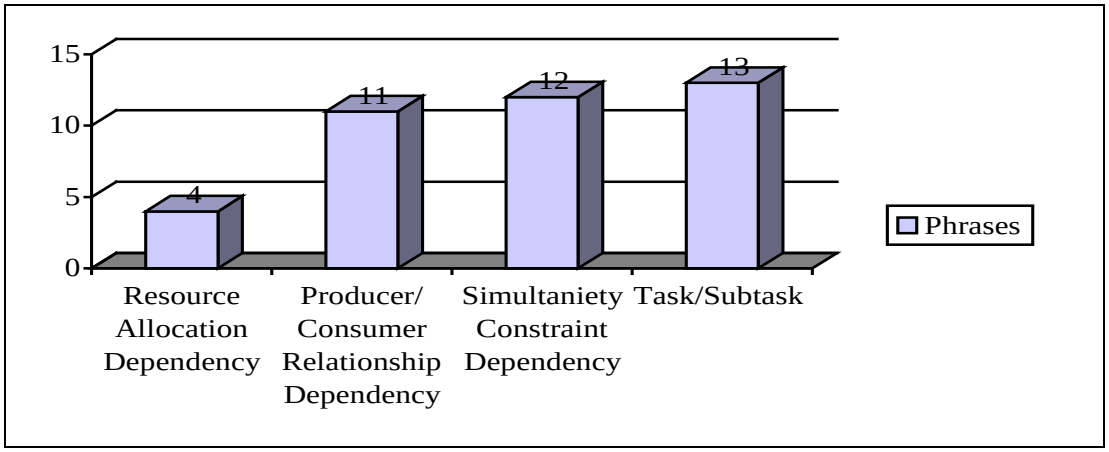


Figure 3.26. Distribution of total phrases for each dependency type

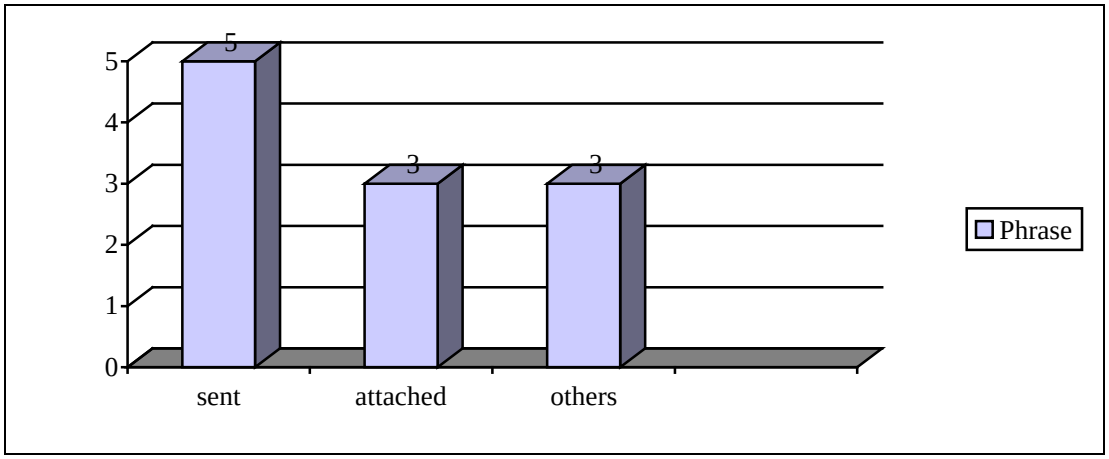


Figure 3.27. Distribution of producer/ consumer relationship dependency phrases

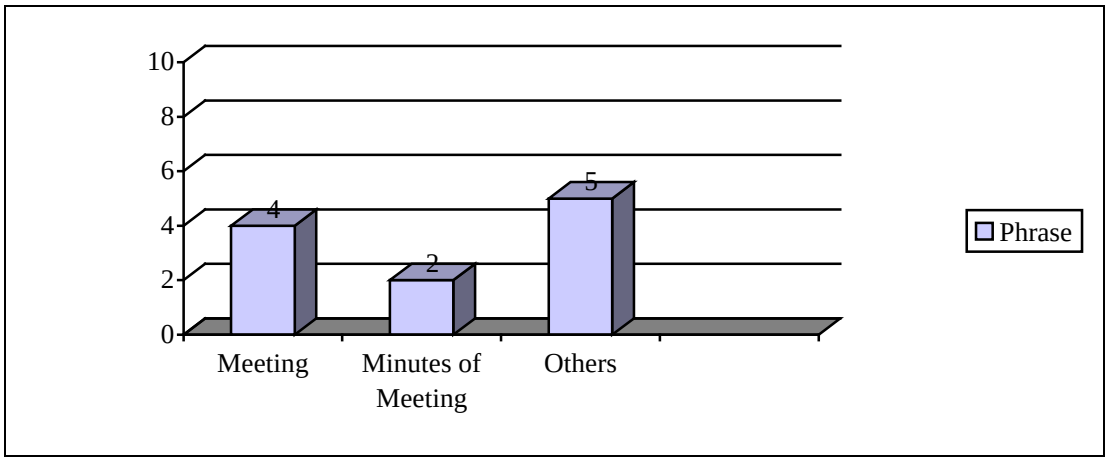


Figure 3.28. Distribution of simultaniety constraint dependency phrases

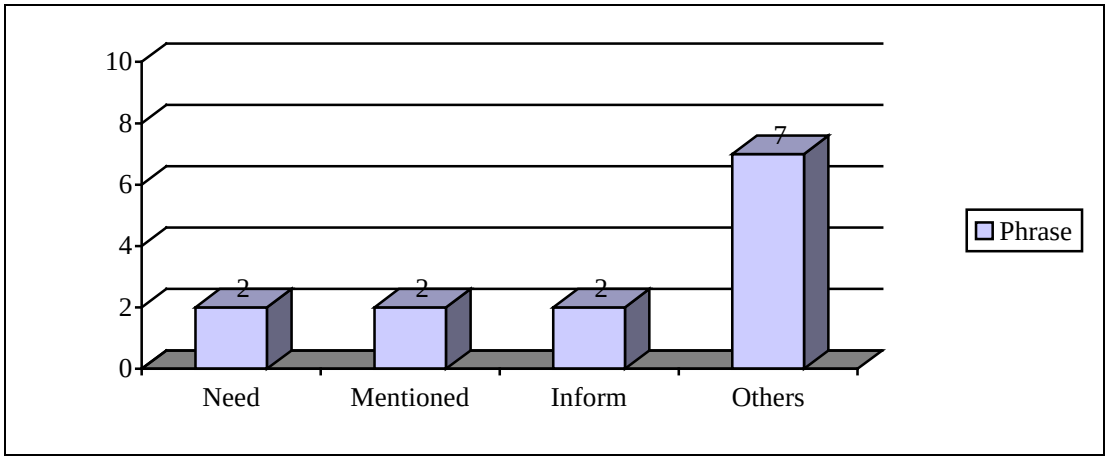


Figure 3.29. Distribution of task/ subtask dependency phrases

3.3.4.3. E-mail Distribution and Phrase Analysis of Actor 3

The Sub-Contractor to Yönsis (Woodhead) has 15 e-mails sent to other actors; and 65 e-mails received from other actors. Table 3.18 shows the e-mail flow of the Sub-Contractor to Yönsis (Woodhead).

The Sub-Contractor to Yönsis (Woodhead) sent 12 of 15 e-mails to the Wayfinding and signage design project Contractor (Yönsis), 1 of 15 e-mails to the General Contractor (Limak & GMR JV), 7 of 15 e-mails to the Consultant to Yönsis (RGB Consulting), and the remaining 1 e-mail to the Project Author (Tekeli-Sisa Architectural Partnership). Figure 3.30 shows the percentage distribution of sent e-mails by Sub-Contractor toYönsis (Woodhead).

The Wayfinding and signage design project Contractor (Yönsis) received 40 of 65 e-mails from the Wayfinding and signage design project Contractor (Yönsis); and the remaining 25 e-mails from the Consultant to Yönsis (RGB Consulting). Figure 3.31 shows the percentage distribution of received e-mails by The Sub-Contractor to Yönsis (Woodhead).

Table 3.18. E-mail flow of the Sub-Contractor to Yönsis

	Position	Company Name	Profession	
Actor3	**Sub-Contractor to Yönsis**	**Woodhead**	**Wayfinding Project Designer**	
E-mail correspondents			Number of Total emails	
	Position	Company Name	Sent	Received
Actor1	General Contractor	Limak & GMR JV	1	0
Actor2	Wayfinding and signage design contractor	Yönsis	12	40
Actor4	Project Author	Tekeli-Sisa Architecture	1	0
Actor5	Consultant to Yönsis	RGB Consult	7	25
Actor6	Consultant to Limak&GMR JV	YTU	0	0
		Total	15	65

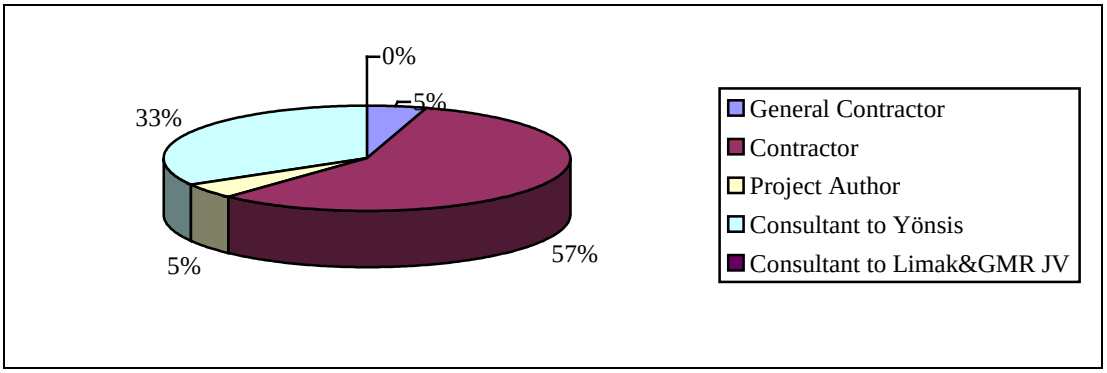


Figure 3.30. Distribution of sent e-mail by the Sub-contractor to Yönsis

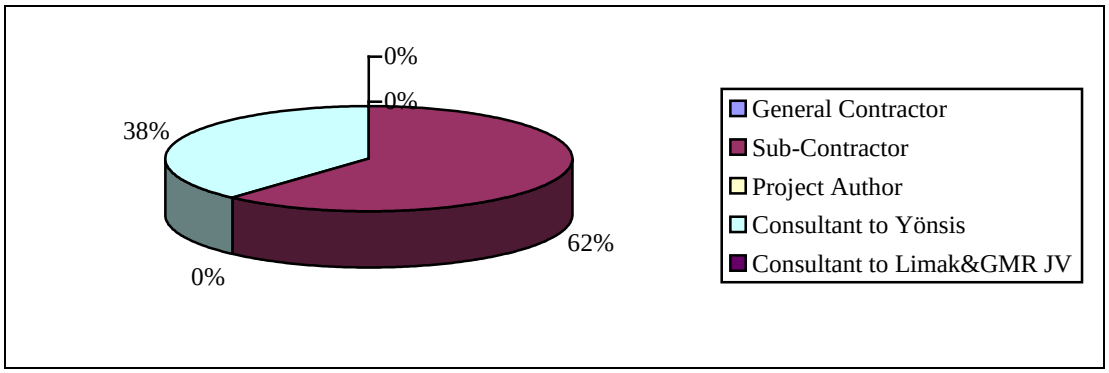


Figure 3.31. Distribution of received e-mail from the Sub-contractor to Yönsis

The Sub-Contractor to Yönsis (Woodhead) has 1 e-mail sent to the General Contractor (Limak & GMR JV). 4 phrases were extracted from this 1 e-mail. Table 3.19 shows the distribution of phrases for each dependency type in this email sent from Actor 3 to Actor 2. 2 of 4 phrases were related to Task/Subtask dependency type (Figure 3.32). 'Needed' and 'provide' were the phrases used (Figure 3.33).

Table 3.19. E-mail flow between Actor 3 and Actor 1

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor3	**Sub-Contractor to Yönsis**	**Woodhead**	**Actor1**	**General Contractor**	**Limak & GMR JV**	**1**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency		Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency		Total Phrase in Sent email
1	1		0	2		4

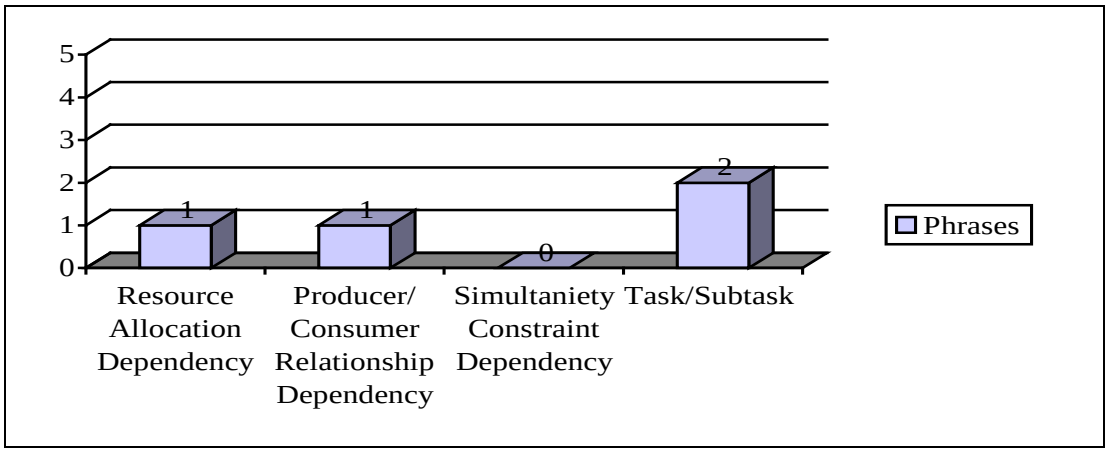


Figure 3.32. Distribution of total phrases for each dependency type

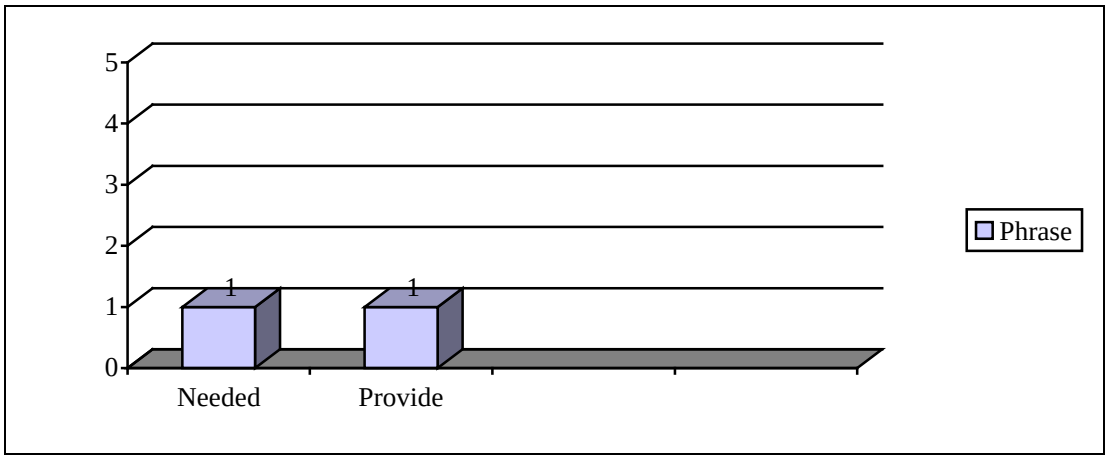


Figure 3.33. Distribution of task/ subtask dependency phrases

The Sub-Contractor to Yönsis (Woodhead) has 12 e-mails sent to the Wayfinding and signage design project contractor (Yönsis). 63 phrases were extracted from these 12 e-mails (Table 3.20). Phrases which were focus on task/subtask dependency used 30 times (Figure 3.34). Below are the examples of sentences from which these phrases were extracted:

- If needed we can provide high resolution renders.
- I am also concerned that people may hurt themselves by hitting if the signs do have only one post.
- We recommend a post version.
- I think we need to make A2 series (25-A2, 26-A2 , 27-A2 and 28-A2) taller.
- Transaction stamp was not included.

Task/ Subtask dependency type employs various phrases and thus repeating phrases are rarely observed (Figure 3.35).

Table 3.20. E-mail flows between Actor 3 and Actor 2

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor3	**Sub-Contractor to Yönsis**	**Woodhead**	**Actor2**	**Wayfinding and signage design contractor**	**Yönsis**	**12**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency		Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency		Total Phrase in Sent emails
14	17		2	30		63

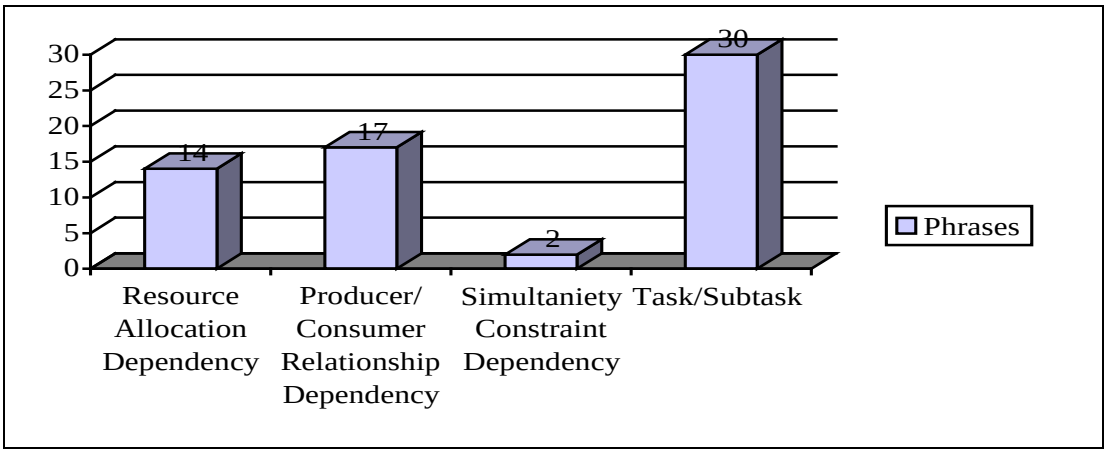


Figure 3.34. Distribution of total phrases for each dependency type

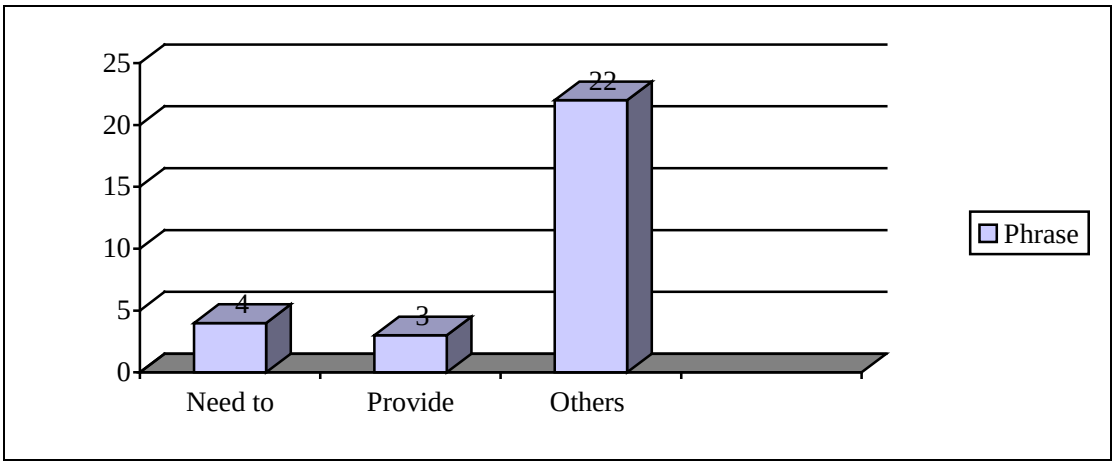


Figure 3.35. Distribution of task/subtask relationship dependency phrases

The Sub-Contractor to Yönsis (Woodhead) has 1 e-mail sent to the Project Author (Tekeli-Sisa Architectural Partnership). 4 phrases were extracted from this 1 e-mail. Table 3.21 shows the distribution of phrases for each dependency type in this email sent from Actor 3 to Actor 4. 2 of 4 phrases were related to Task/Subtask relationship dependency type (Figure 3.36). “Needed” and “provide” phrases which focus on Task/Subtask relationship dependency were used (Figure 3.37).

Table 3.21. E-mail flow between Actor3 and Actor 4

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor3	**Sub-Contractor to Yönsis**	**Woodhead**	**Actor4**	**Project Author**	**Tekeli- Sisa Architecture**	**1**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency	Total Phrase in Sent e-mail		
1	1	0	2	4		

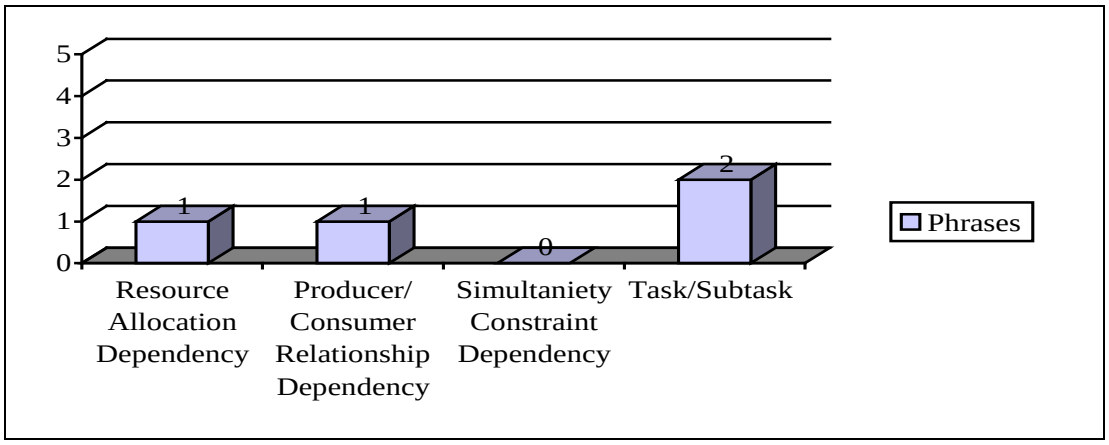


Figure 3.36. Distribution of total phrases for each dependency type

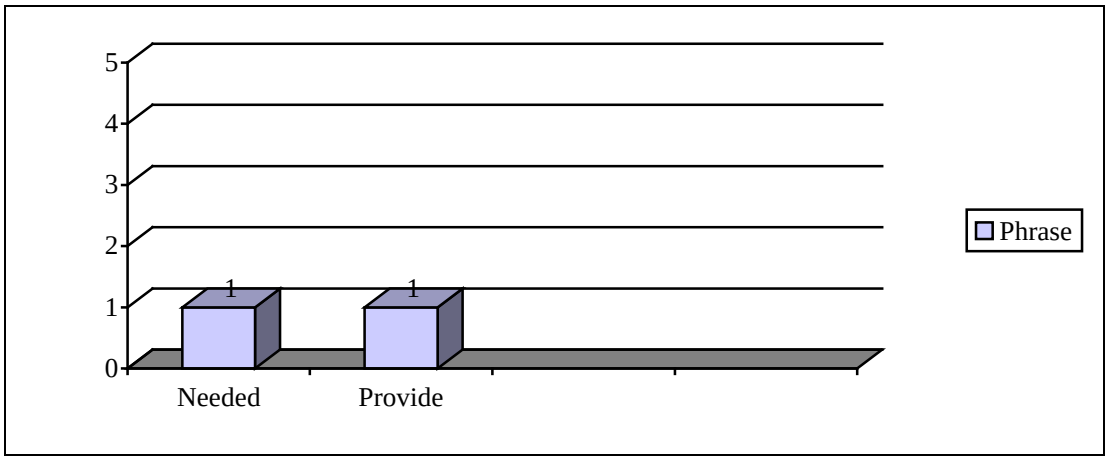


Figure 3.37. Distribution of task/ subtask dependency phrases

The Sub-Contractor to Yönsis (Woodhead) has 7 e-mails sent to the Consultant to Yönsis (RGB Consulting). 49 phrases were extracted from these 7 sent e-mails. Table 3.22 shows the distribution of phrases for each dependency type in emails sent from Actor 3 to Actor 5.

26 of 49 phrases were related to Task/Subtask Dependency type (Figure 3.38). "Need to" and "include" phrases which focus on task/subtask dependency were the most commonly used phrases (Figure 3.39). Remaining each related phrase was used once and a total sum of 16 was calculated (Figure 3.39). Below are the examples of sentences from which task/subtask dependency phrases were extracted:

- I try to act flexible as I know how hard it is to conduct organizations.
- They may have not included some signage elements.
- Yönsis could use the file we sent to include details of sign types.

- I am currently working on the revised designs of the men's and women's toilets.
- Finally, attached is a revised pole based design for external roadside vehicle signtype Z2.

There is no e-mail sent from Actor 3 to Actor 6.

Table 3.22. E-mail flows between Actor 3 and Actor 5

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor3	**Sub-Contractor to Yönsis**	**Woodhead**	**Actor5**	**Consultant to Yönsis**	**RGB Consult**	**7**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency		Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency		Task/Subtask Relationship Dependency	Total Phrase in Sent emails
8		6	9		26	49

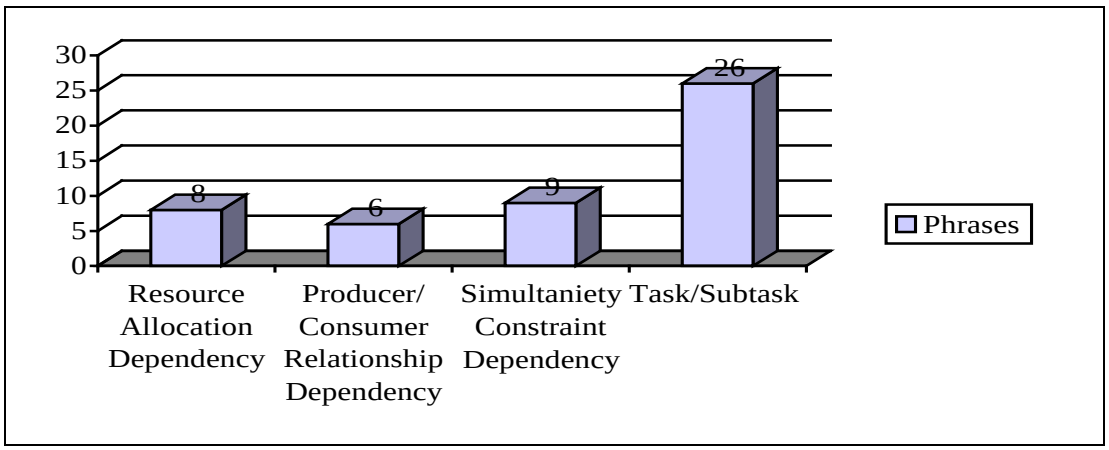


Figure 3.38. Distribution of total phrases for each dependency type

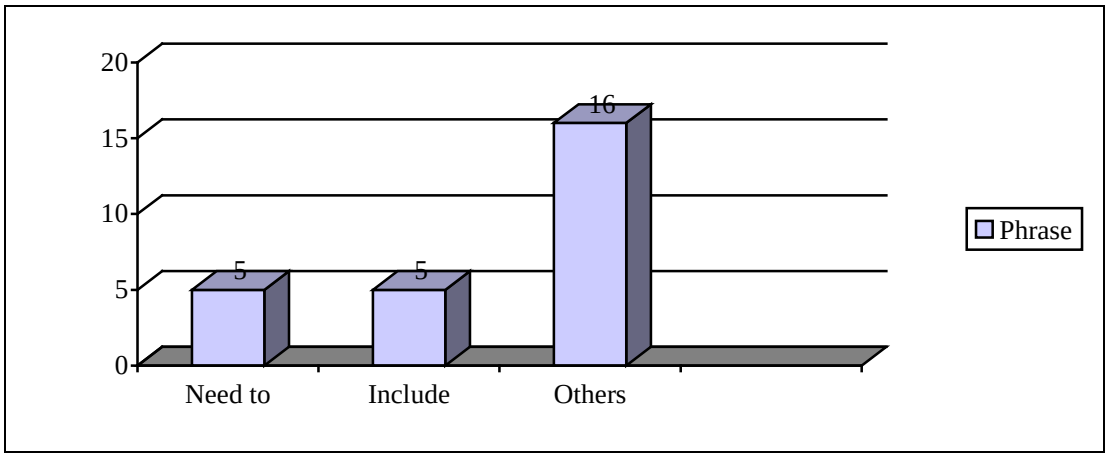


Figure 3.39. Distribution of task/ subtask dependency phrases

3.3.4.4. E-mail Distribution and Phrase Analysis of Actor 4

The Project Author (Tekeli- Sisa Architectural Partnership) has 5 e-mails sent to other actors and 4 e-mails received from other actors. Table 3.23 shows the e-mail flow of the Project Author (Tekeli- Sisa Architectural Partnership).

The Project Author (Tekeli-Sisa Architectural Partnership) sent 4 of 5 e-mails to the Wayfinding and signage design project contractor (Yönsis) and the remaning one e-mail to the Consultant to Yönsis (RGB Consulting). Figure 3.40 shows the percentage distribution of sent e-mails by the Project Author (Tekeli-Sisa Architectural Partnership).

The Project Author (Tekeli-Sisa Architectural Partnership) received 2 of 4 e-mails from the Wayfinding and signage design project contractor (Yönsis), 1 of 4 emails from the Consultant of Yönsis (RGB Consulting) and the remaining 1 email from the Sub-Contractor (Woodhead). Figure 3.41 shows the percentage distribution of received e-mails by the Project Author (Tekeli-Sisa Architectural Partnership).

The e-mail data gathered were not analyzed and classified by “CC” entries, which might have most probably revealed some part of the e-mail communication between the Project Author (Tekeli-Sisa Architectural Partnership) and the General Contractor (Limak & GMR JV.). However, for the data of this study gathered from “TO” entries, that flow is indicated by “out of scope” in Table 3.23.

Table 3.23. E-mail flow of the Project Author

	Position	Company Name	Profession	
Actor4	**Project Author**	**Tekeli-Sisa Architectural Partnership**	**Architectural firm**	
E-mail correspondents			Number of Total emails	
	Position	Company Name	Sent	Received
Actor1	General Contractor	Limak & GMR JV	out of scope	
Actor2	Wayfinding and signage design contractor	Yönsis	4	2
Actor3	Sub-Contractor	Woodhead	0	1
Actor5	Consultant to Yönsis	RGB Consult	1	1
Actor6	Consultant to Limak&GMR JV	Y.T.U	0	0
		Total	5	4

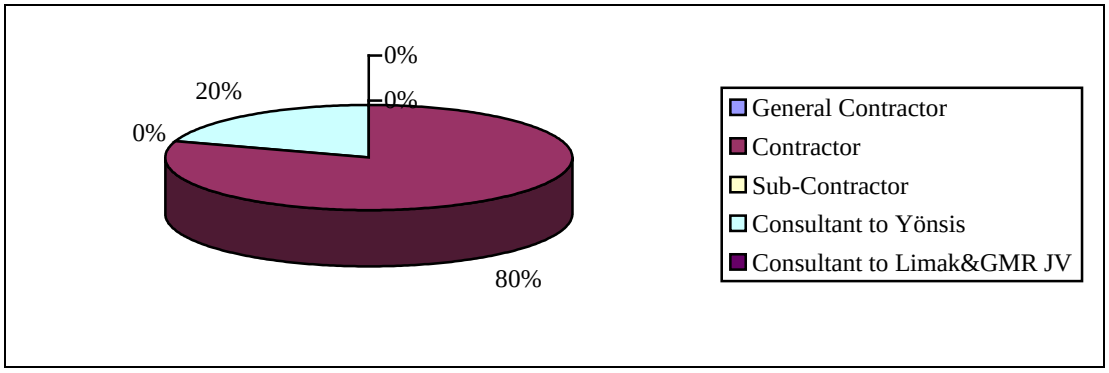


Figure 3.40. Distribution of sent e-mails by the Project Author

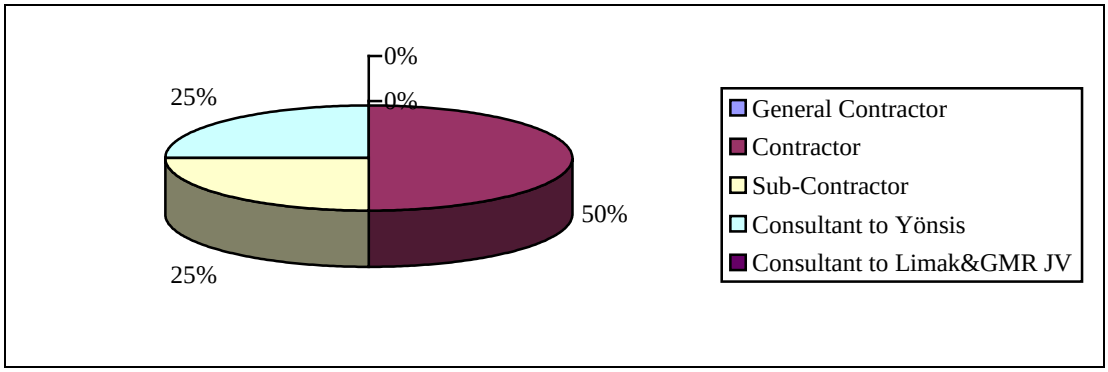


Figure 3.41. Distribution of received e-mails by the Project Author

The Project Author (Tekeli-Sisa Architectural Partnership) has 4 e-mails sent to the Wayfinding and signage design project contractor (Yönsis). 7 phrases were extracted from these 4 sent e-mails. Table 3.24 shows the distribution of phrases for each dependency type in emails sent from Actor 4 to Actor 2. 5 of 7 phrases were related to Producer/Consumer Relationship Dependency type (Figure 3.42).

"Attached" phrase which focuses on Producer/ Consumer Relationship Dependency type was the most commonly used phrase (Figure 3.43). Remaining each related phrase was used once. Below is the example of a sentence from which 'attached' phrase was extracted:

- Interior view showing SGIA passenger waiting lounges is attached.

Table 3.24. E-mail flows between Actor 4 and Actor 2

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor4	**Project Author**	**Tekeli- Sisa Architecture**	**Actor2**	**Wayfinding and signage design contractor**	**Yönsis**	**4**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency	Total # of Phrases in Sent emails		
1	5	0	1	7		

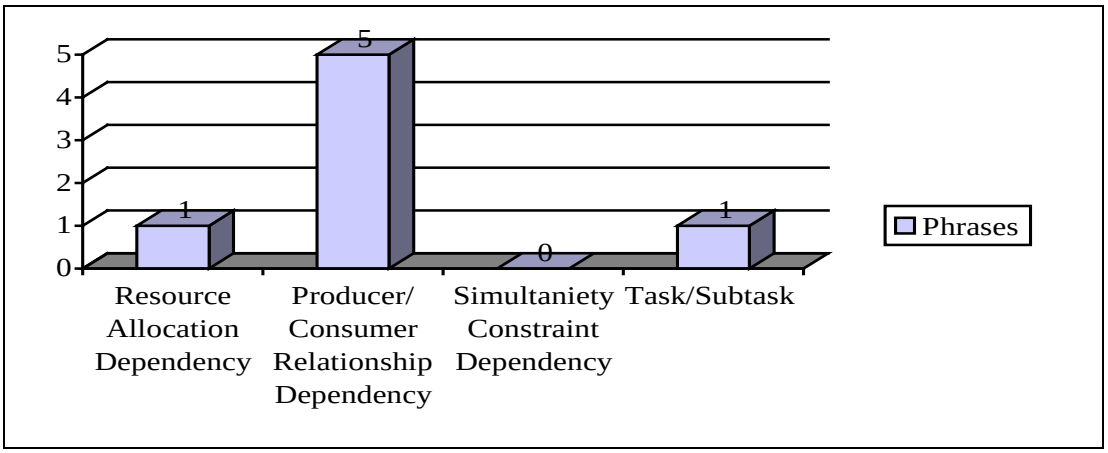


Figure 3.42. Distribution of total phrases for each dependency type

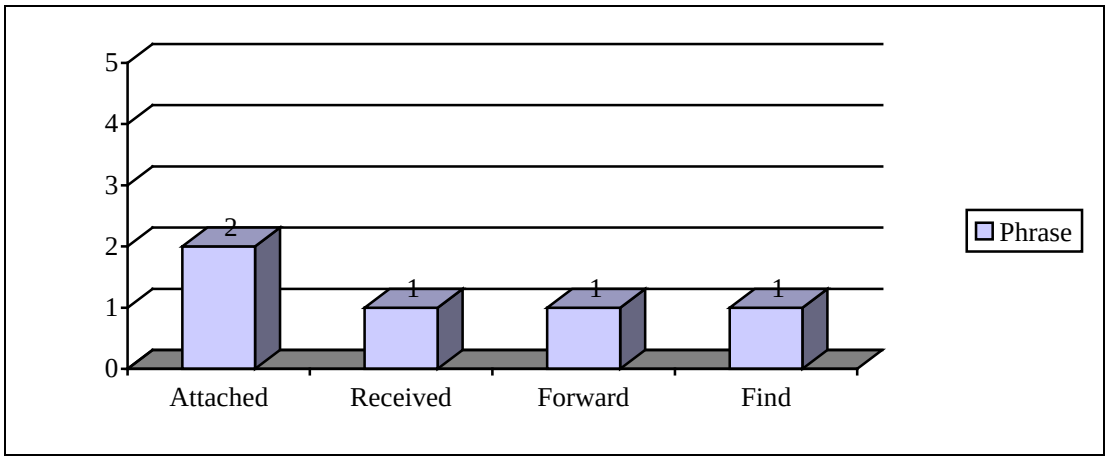


Figure 3.43. Distribution of producer/ consumer dependency phrases

The Project Author (Tekeli- Sisa Architectural Partnership) has 1 e-mail sent to the Consultant to Yönsis (RGB Consulting). 3 phrases were extracted from this 1 sent e-mail. Table 3.25 and Figure 3.44 show the distribution of phrases for each dependency type in the email sent from Actor 4 to Actor 5. "Please forward," "forwarded," "need" phrases were used once (Figure 3.45).

Table 3.25. E-mail flow between Actor 4 and Actor 5

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor4	**Project Author**	**Tekeli- Sisa Architecture**	**Actor5**	**Consultant to Yönsis**	**RGB Consulting**	**1**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency		Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency		Task/Subtask Relationship Dependency	Total Phrase in Sent emails
1		1	0		1	3

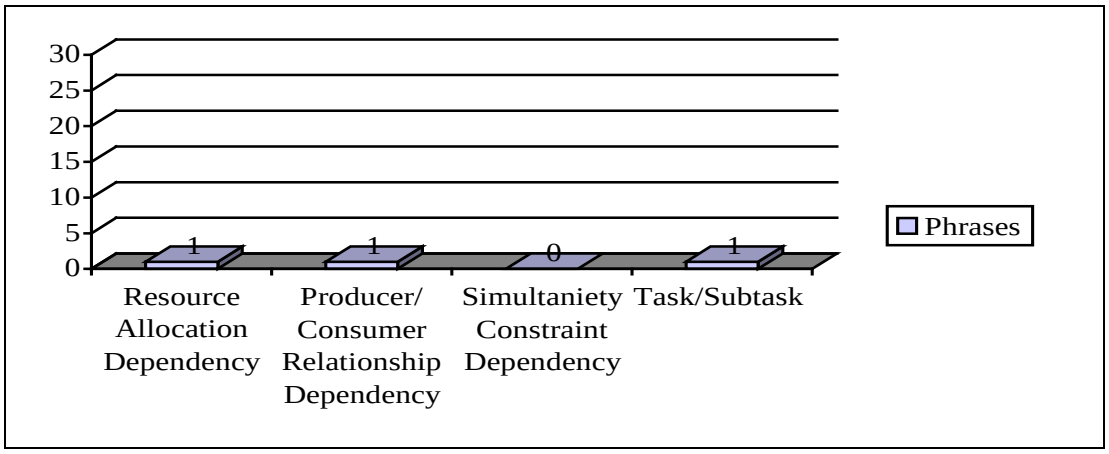


Figure 3.44. Distribution of total phrases for each dependency type

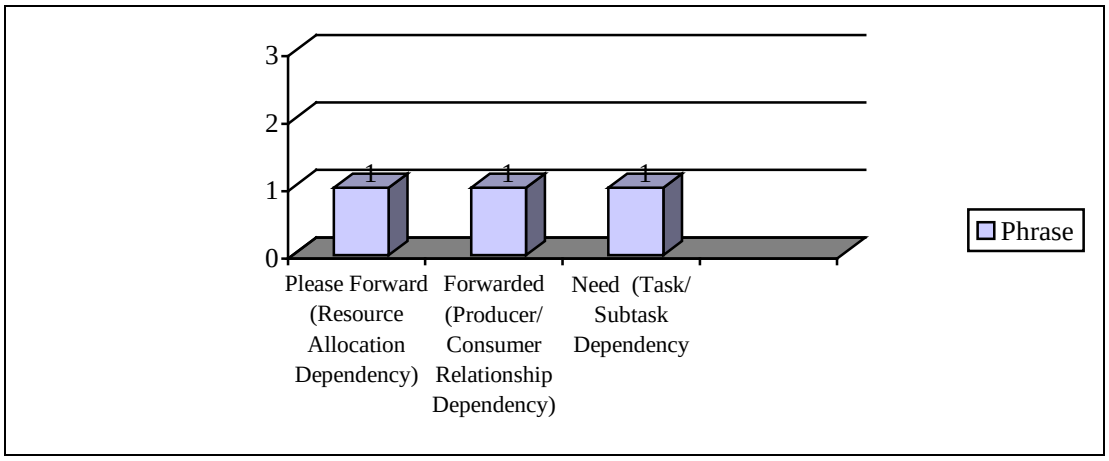


Figure 3.45. Distribution of resource allocation, producer/consumer relationship, and task/ subtask dependency phrases

3.3.4.5. E-mail Distribution and Phrase Analysis of Actor 5

The Consultant to Yönsis (RGB Consulting) has 81 e-mails sent to other actors; and 35 e-mails received from other actors. Table 3.26 shows the e-mails flow of the Consultant to Yönsis (RGB Consulting).

The Consultant to Yönsis (RGB Consulting) sent 36 of 81 e-mails to the Wayfinding and signage design project contractor (Yönsis), 25 of 81 e-mails to the Sub-Contractor to Yönsis (Woodhead), 19 of 81 e-mails to the General Contractor (Limak & GMR JV), and the remaning 1 e-mail to the Project Author (Tekeli-Sisa Architectural

Partnership). Figure 3.46 shows the percentage distribution of sent e-mails by the Consultant to Yönsis (RGB Consulting).

The Consultant to Yönsis (RGB Consulting) received 18 of 35 e-mails from the General Contractor (Limak & GMR JV), 9 of 35 e-mails from the Wayfinding and signage design project contractor (Yönsis), 7 of 35 e-mails from the Sub-Contractor to Yönsis (Woodhead), and the remaning 1 e-mail to the Project Author (Tekeli-Sisa Architectural Patnership). Figure 3.47 shows the percentage distribution of received e-mails by the Consultant to Yönsis (RGB Consulting).

Table 3.26. E-mail flow of Consultant to Yönsis

	Position	Company Name	Profession	
Actor5	**Consultant to Yönsis**	**RGB Consulting**	**Consultant for Yönsis**	
E-mail correspondents			Number of Total emails	
	Position	Company Name	Sent	Received
Actor1	General Contractor	Limak & GMR JV	19	18
Actor2	Wayfinding and signage design contractor	Yönsis	36	9
Actor3	Sub-Contractor	Woodhead	25	7
Actor4	Project Author	Tekeli-Sisa Architecture	1	1
Actor6	Consultant to Limak&GMR JV	Y.T.U	0	0
		Total	81	35

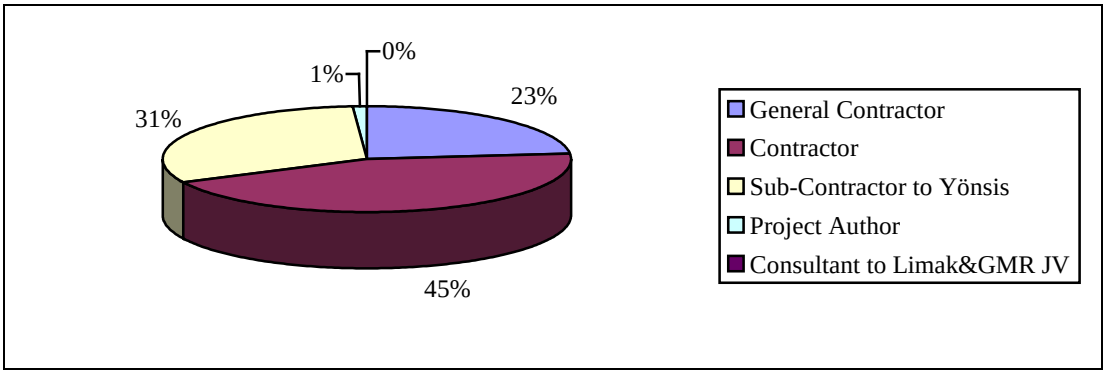


Figure 3.46. Distribution of sent e-mail by the Consultant to Yönsis

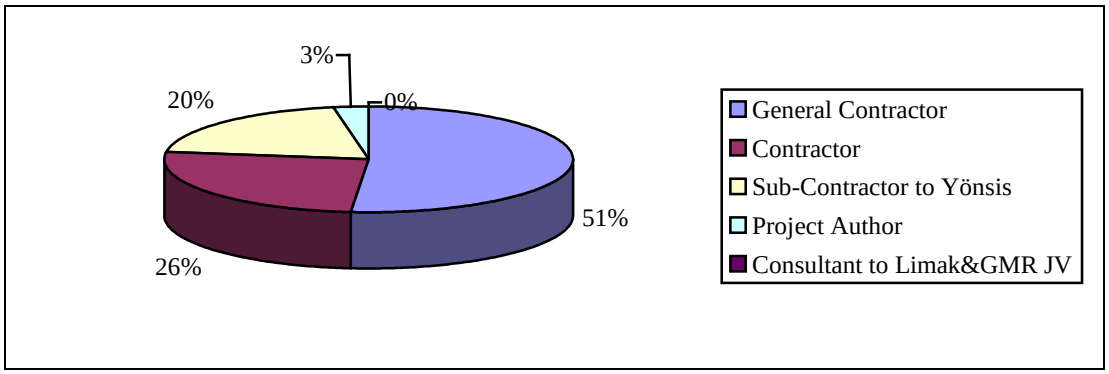


Figure 3.47. Distribution of received e-mail from the Consultant to Yönsis

The Consultant to Yönsis (RGB Consulting) has 19 e-mails sent to the General Contractor (Limak & GMR JV). 129 phrases were extracted from these 19 sent e-mails. Table 3.27 shows the distribution of phrases for each dependency type in emails sent from Actor 5 to Actor 1. 44 of 129 phrases were related to Simultaneity Constraints dependency type (Figure 3.48).

"Meeting" phrase which focus on Simultaniety Constraints dependency type was the most commonly used phrase (Figure 3.49). Usage frequency of remaining simultaneity constraints dependency phrases are shown in Figure 3.59. Below are the examples of sentences from which 'meeting' phrase was extracted:

- We hope you show up in Thursday's meeting.
- Regarding the meeting held in your office on the 4th of May 29,…
- … meeting with the related departments, meeting with Tekeli-Sisa Arch. Part.

Table 3.27. E-mail flows between Actor 5 and Actor 1

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor5	**Consultant to Yönsis**	**RGB Consulting**	**Actor1**	**General Contractor**	**Limak & GMR JV**	**19**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency		Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency		Task/Subtask Relationship Dependency	Total Phrase in Sent emails
23		24	44		38	129

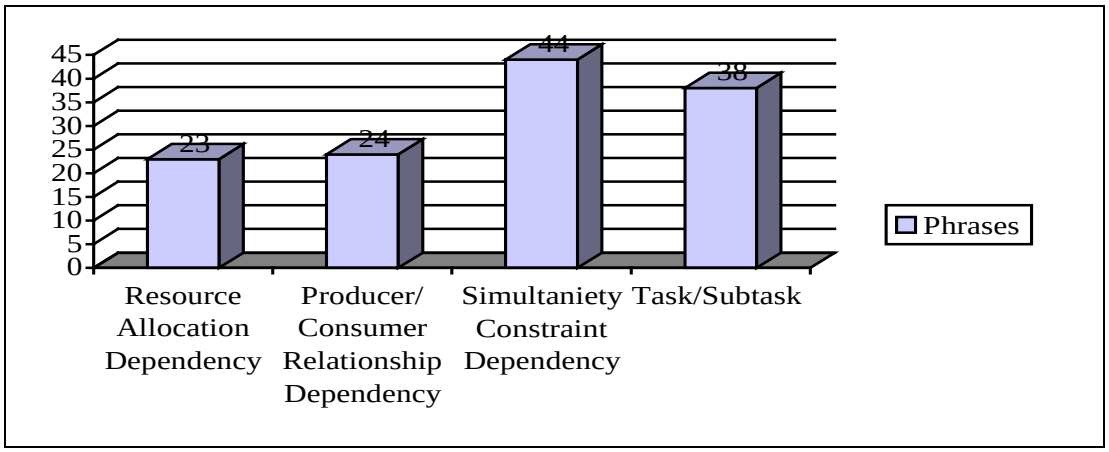


Figure 3.48. Distribution of total phrases for each dependency type

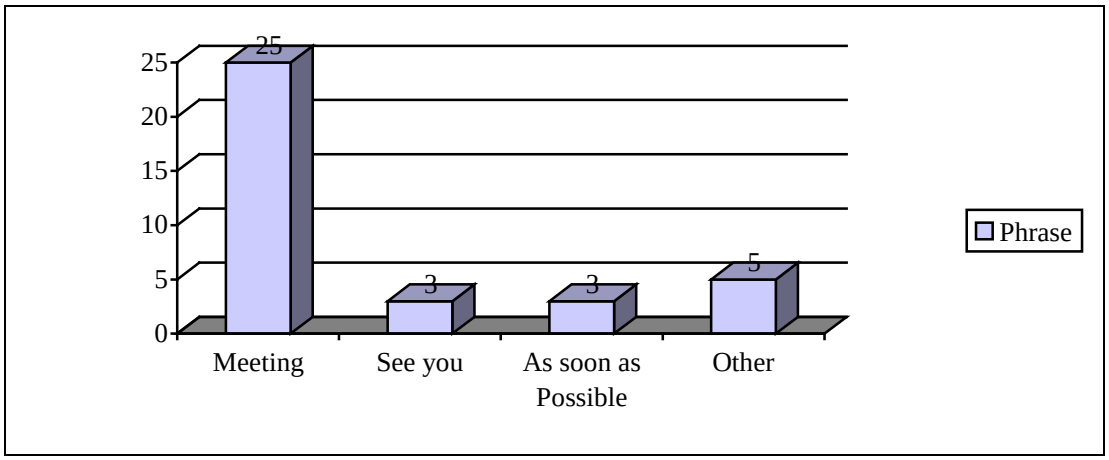


Figure 3.49. Distribution of simultaniety constraint dependency phrase

The Consultant to Yönsis (RGB Consulting) has 36 e-mails sent to the Wayfinding and signage design project contractor (Yönsis). 214 phrases were extracted from these e-mails. Table 3.28 shows the distribution of phrases for each dependency type in emails sent from Actor 5 to Actor 2. 76 of 214 phrases were related to Resource Allocation dependency type (Figure 3.50).

"Could you please send" phrase which focus on Resource Allocation Dependency type was the most commonly used phrase (Figure 3.51). Other phrases used for resource allocation dependency are shown in Figure 3.51. Below are the examples of sentences from which 'could you please send' phrase was extracted:

- Could you please send the meeting minutes (dated May 4) as soon as possible?
- Could you please send it with a .doc extension?
- Could you please (re)send the trip plan to Tim Blackshaw?
- Could you please send it immediately as we urgently need it before the other meeting's arrangement?

Table 3.28. E-mail flows between Actor 5 and Actor 2

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor5	**Consultant**	**RGB Consulting**	**Actor2**	**Wayfinding and signage design contractor**	**Yönsis**	**36**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency		Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency		Task/Subtask Relationship Dependency	Total Phrase in Sent emails
76		48	28		62	214

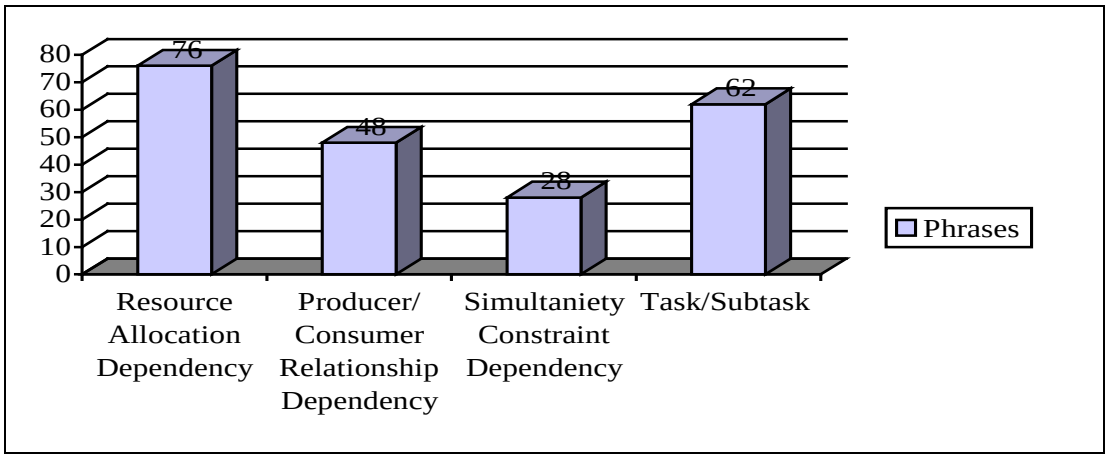


Figure 3.50. Distribution of total phrases for each dependency type

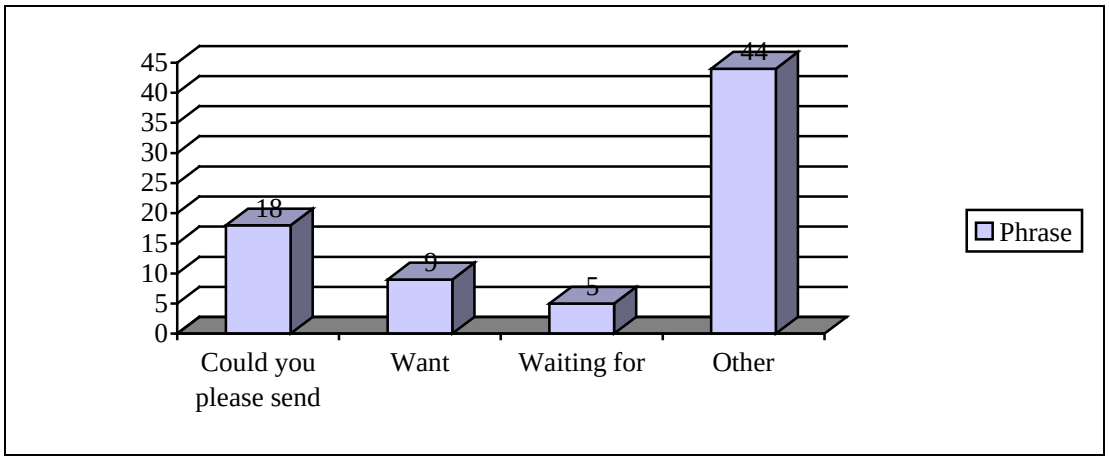


Figure 3.51. Distribution of resource allocation dependency phrase

The Consultant to Yönsis (RGB Consult) has 25 e-mails sent to the Sub-Contractor to Yönsis (Woodhead). 244 phrases were extracted from these 25 sent e-mails. Table 3.29 shows the distribution of phrases for each dependency type in emails sent from Actor 5 to Actor 3. 101 of 244 phrases were related to Task/Subtask Relationship dependency type (Figure 3.52). “Need to” phrase which focuses on Task/Subtask Relationship Dependency type was the most commonly used phrase (Figure 3.53). Other phrases used for task/subtask relationship dependency are shown in Figure 3.53. Below are the examples of sentences from which ‘need to’ phrase was extracted:

- You need to speak with the project author and the consulting firm.
- I personally think that we need to get a writen confirmation from SGIA for the delay duration.

- Of course, they need your help.
- For further information you need for that specific detail, please get in touch with Yönsis and myself.
- All he needs are the invoices and the indicated name changes of the companies.

Table 3.29. E-mail flows between Actor 5 and Actor 3

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor5	**Consultant to Yönsis**	**RGB Consulting**	**Actor3**	**Sub-Contractor to Yönsis**	**Woodhead**	**25**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency		Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency		Total Phrase in Sent emails
60	33		50	101		244

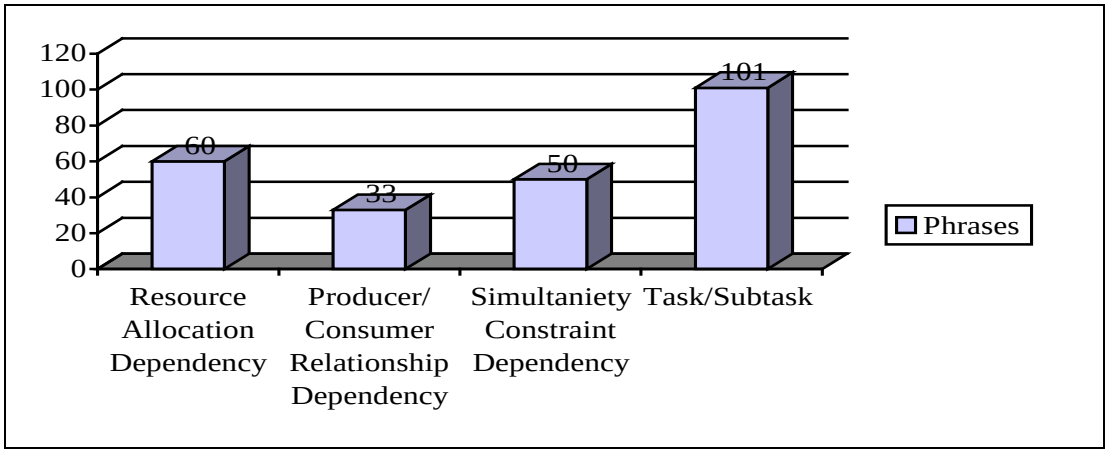


Figure 3.52. Distribution of total phrases for each dependency type

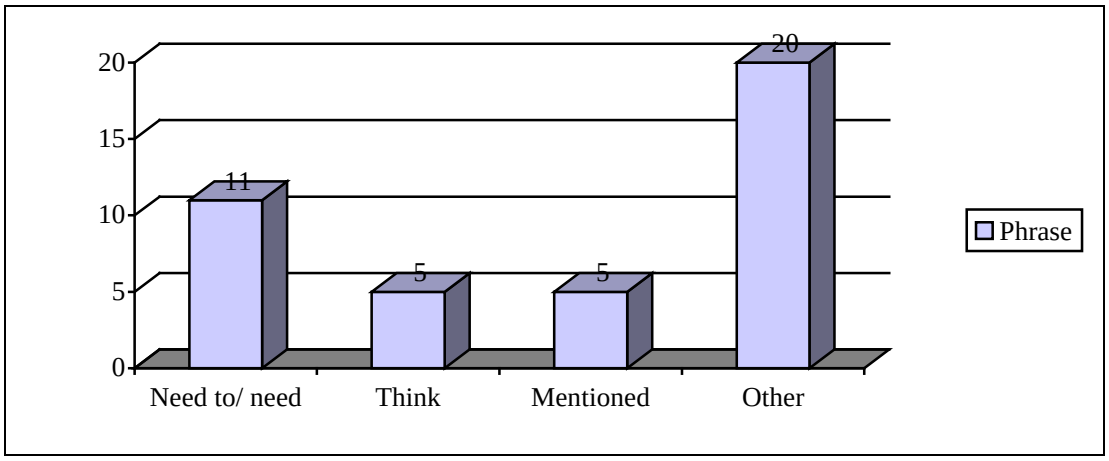


Figure 3.53. Distribution of task/subtask relationship dependency phrase

The Consultant to Yönsis (RGB Consulting) has 1 e-mail sent to Tekeli-Sisa Architectural Partnership. 2 phrases were extracted from this 1 sent e-mail. Table 3.30 shows the distribution of two phrases. “Send” phrase which focuses on resource allocation dependency was used 2 times (Figure 3.55).

Table 3.30. E-mail flows between Actor 5 and Actor 4

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor5	**Consultant to Yönsis**	**RGB Consulting**	**Actor4**	**Project Author**	**Tekeli- Sisa Architecture**	**1**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	**Producer/ Consumer Relationship Dependency**		**Simultaniety Constraint Dependency**		**Task/Subtask Relationship Dependency**	**Total Phrase in Sent emails**
0	**2**		**0**		**0**	**2**

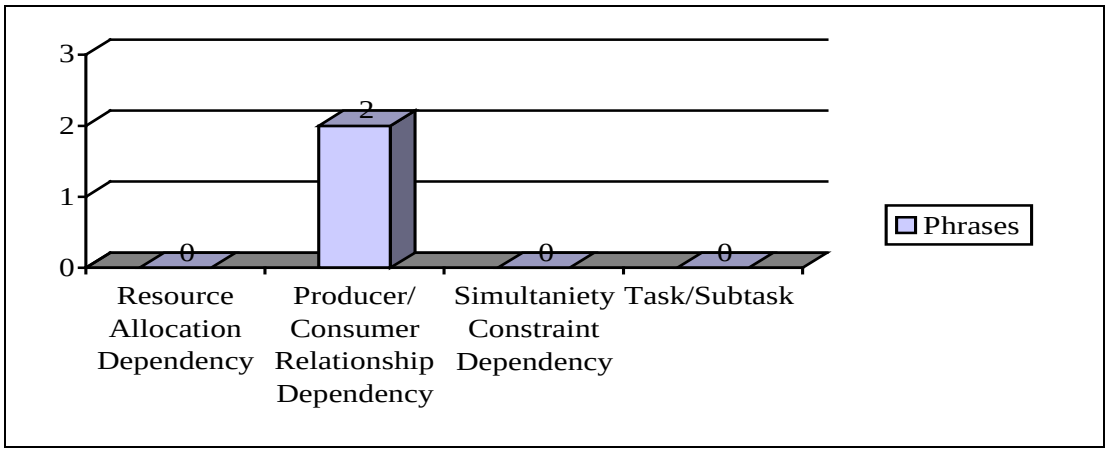


Figure 3.54. Distribution of total phrases for each dependency type

Figure 3.55. Distribution of task/subtask relationship dependency phrases

3.3.4.6. E-mail Distribution and Phrase Analysis of Actor 6

Consultant to Limak & GMR JV (Y.T.U -Yıldız Technical University-) has 3 e-mails sent to other actors; and none received from other actors. Table 3.31 shows the email flow of the Consultant to Limak & GMR JV (Y.T.U). Consultant to Limak & GMR JV (Y.T.U) sent all 3 emails to the General Contractor Limak & GMR JV. Figure 3.56 shows this 100 percent distribution of sent e-mails by Consultant to Limak & GMR JV (Y.T.U).

Table 3.31. E-mail flow of the Consultant to Limak & GMR JV

	Position	Company Name	Profession	
Actor6	**Consultant to Limak&GMR JV**	**Yıldız Technical University**	**Controller of Wayfinding Project**	
E-mail correspondents			Number of Total e-mail	
	Position	Company Name	Sent	Received
Actor1	General Contractor	Limak & GMR JV	3	0
Actor2	Wayfinding and signage design contractor	Yönsis	0	0
Actor3	Sub-Contractor to Yönsis	Woodhead	0	0
Actor4	Project Author	Tekeli-Sisa Architecture	0	0
Actor5	Consultant to Yönsis	RGB Consult	0	0
		Total	3	0

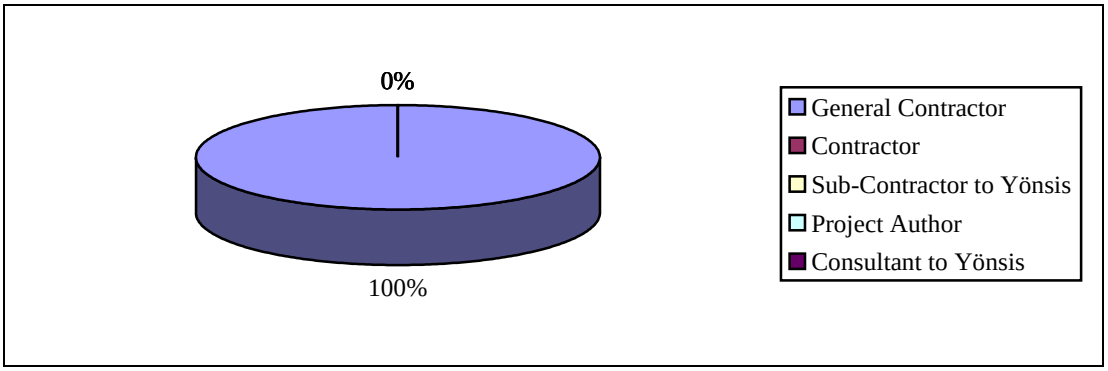


Figure 3.56. Distribution of sent e-mail by the Consultant to Limak & GMR JV

Consultant to Limak & GMR JV (Yıldız Technical University) has 3 e-mails sent to the General Contractor (Limak & GMR JV). 27 phrases were extracted from these 3 sent e-mails. Table 3.32 shows the distribution of phrases for each dependency type in emails sent from Actor 6 to Actor 1.

15 of 27 phrases were related to Task/Subtask Relationship dependency type (Figure 3.57). “Recommended” phrase which focuses on Task/Subtask Dependency

type was the most commonly used phrase (Figure 3.58). Below is the example of a sentence from which 'recommended' phrase was extracted:

- PS: In the presentation there was no recommendation for design types particular to handicapped.

Table 3.32. E-mail flows between Actor 6 and Actor 1

From			**To**			**Total # of emails**
	Position	**Company Name**		**Position**	**Company Name**	
Actor6	**Consultant to Limak & GMR JV**	**YTU**	**Actor1**	**General Contractor**	**Limak & GMR JV**	**3**
Distribution of Total Phrases for Each Dependency Type						
Resource Allocation Dependency	Producer/ Consumer Relationship Dependency		Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency		Total Phrase in Sent emails
5	6		1	15		27

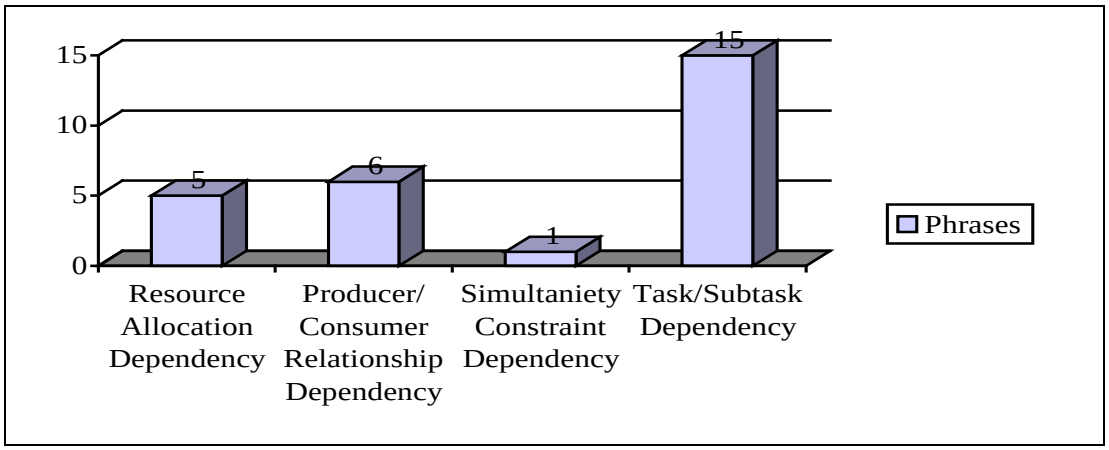


Figure 3.57 Distribution of total phrases for each dependency type

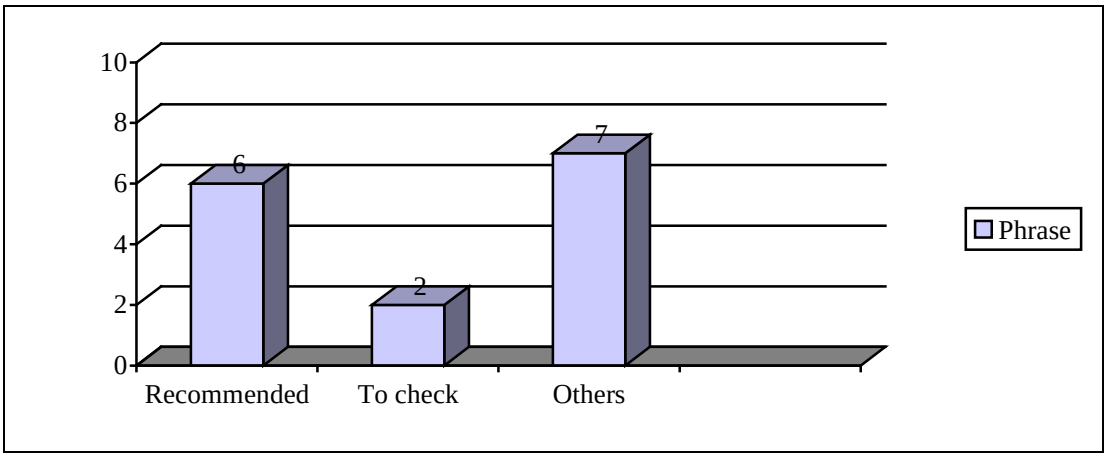


Figure 3.58 Distribution of task/subtask relationship dependency phrases

CHAPTER 4

FINDINGS AND ANALYSIS

The use of the internet as the communication platform can help information transfer more effectively throughout the project life cycle. Besides its speedy transmission, openness, ease to use, it also saves money in communication compared to the traditional information handling methods (Xue, et al. 2007). According to the study of Wang, (2000) among the numerous technologies used in construction today, it seems that information and communication technologies will have the most profound impact on this industry in the future. For projects carried out by participants from different countries, digital and internet-enabled information and communication technology (e-mail, videoconferencing, group work tools, etc.) will be more promising – the owner can select architects through Web sites; the architect can supply 3D drawings for the owners' approval; and cameras or sensors on building site would enable the designers who are not present to observe the progress of work.

Wayfinding and Signage Design Project of SGIA is a collaborative work for designing the product and developing the project. The construction site was located in İstanbul. The General Contractor (Limak & GMR JV) and the Project Author (Tekeli-Sisa Architectural Partnership) were local project participants. However, the Wayfinding and Signage Desing Project Contractor (Yönsis) was located in Izmir, and the Sub-Contractor to Yönsis (Woodhead) was located in Adelaide, Australia. Consulting firms were also located in İstanbul. Thus, e-mail communication had significant importance during the implementation of the project. This study analyzes e-mail communication traffic which began on April 13, 2009 and finished on September 09, 2009. 256 sent and 219 received e-mails collected from the e-mail communication of project participants. All the project participants could physically get together for only two times in İstanbul. According to the author's observation who worked during that period in Wayfinding and Signage Design Project Contractor's (Yönsis) office, communication via telephone was rarely used.

4.1. Communication Performance

A directed and weighted graph of information exchange network was visualized using UCINET 6 for Windows. UCINET is a Social Network Analysis program developed by Steve Borgatti, Martin Everett and Lin Freeman (2002). The UCINET software (Borgatti et. al., 2002) provides the mathematical measurements as well as the graphical representations required to conduct a SNA. A directed graph of information exchange network is visualized in UCINET's (Borgatti et. al., 2002) Netdraw module (Figure 4.1).

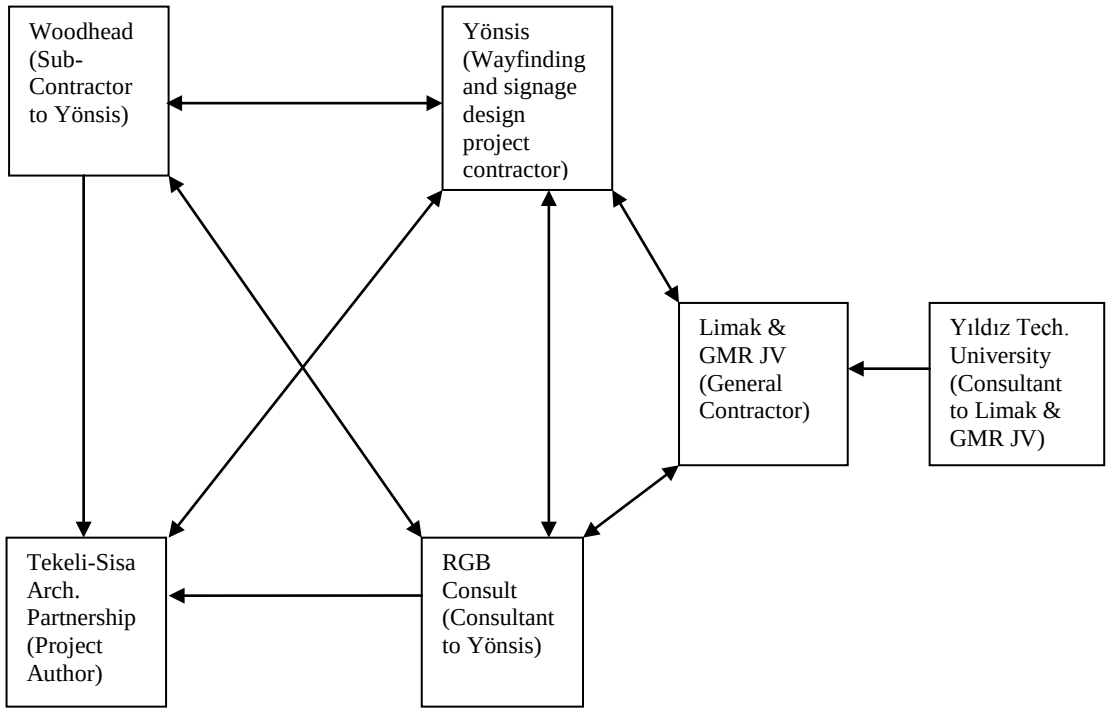


Figure 4.1. A directed graph of information exchange network

Communication performance was measured by the number of e-mails sent and received by each actor as part of the wayfinding and signage design project of SGIA. The list of senders and receivers were based on the recipient type "TO". Figure 4.2 shows weighted directional graph revealing communication performance of SGIA wayfinding project actors.

An adjacency matrix is formed in UCINET's data loading editor (Figure 4.3). The matrix relationships were used by the UCINET software (Borgatti et al., 2002) to analyze the network from a series of graph theory perspectives. Centrality calculations are done by UCINET (Borgatti et al., 2002). Three types of centralities as degree, betweenness and closeness are analyzed.

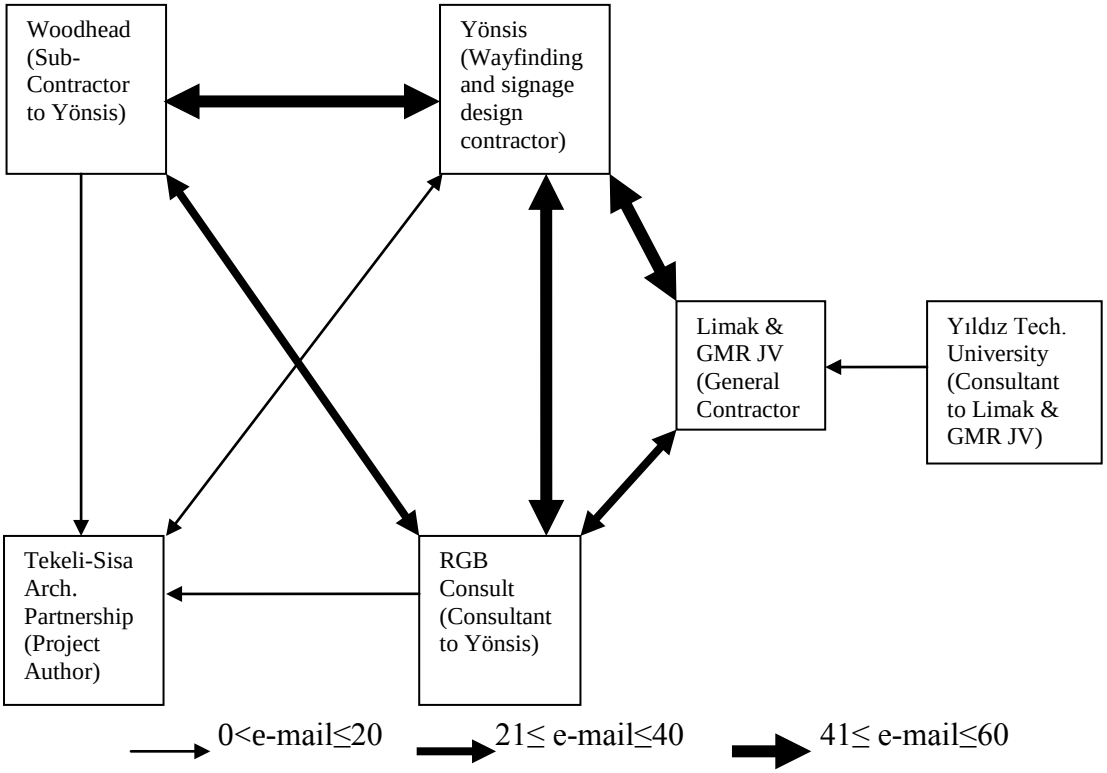
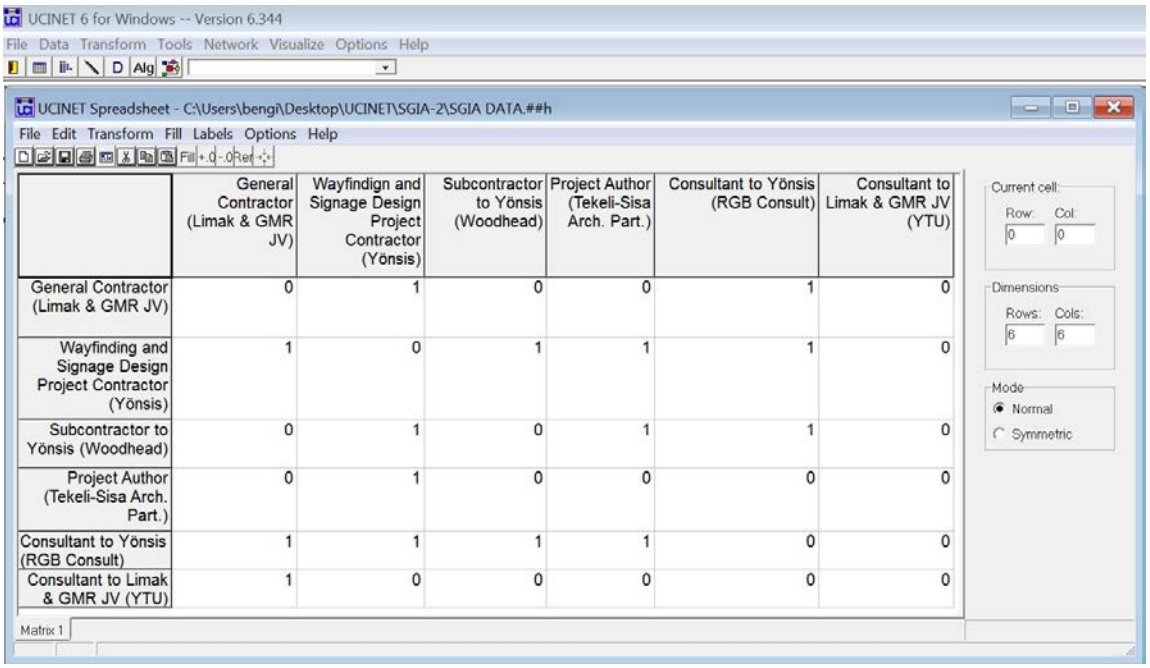


Figure 4.2. Weighted directional graph



	General Contractor (Limak & GMR JV)	Wayfindign and Signage Design Project Contractor (Yönsis)	Subcontractor to Yönsis (Woodhead)	Project Author (Tekeli-Sisa Arch. Part.)	Consultant to Yönsis (RGB Consult)	Consultant to Limak & GMR JV (YTU)
General Contractor (Limak & GMR JV)	0	1	0	0	1	0
Wayfinding and Signage Design Project Contractor (Yönsis)	1	0	1	1	1	0
Subcontractor to Yönsis (Woodhead)	0	1	0	1	1	0
Project Author (Tekeli-Sisa Arch. Part.)	0	1	0	0	0	0
Consultant to Yönsis (RGB Consult)	1	1	1	1	0	0
Consultant to Limak & GMR JV (YTU)	1	0	0	0	0	0

Figure 4.3. UCINET screen of adjancency matrix

4.2. Network Centrality

Network centrality was measured by the number of e-mails sent and received by each actor as part of the wayfinding and signage design project of SGIA. Centrality calculations are done by UCINET. Three types of centralities as degree, betweenness and closeness are analyzed.

4.2.1. Degree Centrality Findings

UCINET (Borgatti et al., 2002) gives the option of whether to treat data as symmetric and asymmetric while computing degree centrality. Asymmetric data means the sending and receiving of e-mails are treated as distinct activities. For the study of directional analysis, the data were treated as asymmetric.

Using directed data, UCINET (Borgatti et al., 2002) calculates in-degree and outdegree centralities. Directed data analysis requires distinguishing centrality based on in-degree from centrality based on out-degree (Hanneman and Riddle, 2005).

Degree centrality findings produced by UCINET (Borgatti et. al., 2002; Appendix B) are shown in Table 4.1. First two columns show outdegree and indegree measures, respectively following two columns show normalized outdegree and indegree measures. Normalized degree counts are expressed as percentages of the number of actors in the network (Hanneman and Riddle, 2005). Findings show that the Wayfinding and Signage Design Project Contractor (Yönsis) has the highest degree of 4 for both outdegree and indegree centrality. Consultant to Yönsis (RGB Consulting) has also the highest outdegree which is 4 and the following highest indegree of 3. Sub-Contractor to Yönsis (Woodhead) has an outdegree of 3 and an indegree of 2. The General Contractor (Limak & GMR JV) has an outdegree of 2 and an indegree of 3. The Project Author (Tekeli-Sisa Arch. Part.) has an outdegree of 1 and an indegree of 3. The consultant to Limak & GMR JV (Y.T.U) has an outdegree of 1.

Indegree and outdegree of a node provide meaningful information about a node's position. Indegree or outdegree values represent how many potential actors a firm has communicated; thus, a high degree implies that a firm is favorably positioned in the organization schema (Park et al. 2011). In this case, The Wayfinding and Signage Design Project Contractor (Yönsis) is favorably positioned accordingly in the organization schema hierarchical structure. In addition to this comment, Hanneman and Riddle (2005) stated that if an actor receives many ties, they are often said to be *prominent,* or to have high prestige and actors who display high out-degree centrality are often said to be *influential* actors. Thus, the Wayfinding and Signage Design Project Contractor (Yönsis) is found to be prominent and influential among other actors of the SGIA wayfinding and signage design project. Latora and Marchiori (2007) argued that an actor with a large degree is in direct contact to many other actors and being very visible he is immediately recognized by others as a hub, a very active point and major channel of communication. The Wayfinding and Signage Design Project Contractor (Yönsis) is the major channel of communication in the information exchange network for this project.

Table 4.1. Degree Centrality Measures

Actor	Out-Degree	In-Degree	Normalized Out-Degree	Normalized In-Degree
Yönsis (Wayfinding and signage design project contractor)	4.00	4.00	80.00	80.00
RGB Consulting (Consultant to Yönsis)	4.00	3.00	80.00	60.00
Woodhead (Sub-Contractor to Yönsis)	3.00	2.00	60.00	40.00
Limak & GMR JV (General Contractor)	2.00	3.00	40.00	60.00
Tekeli-Sisa Arch. Partnership (Project Author)	1.00	3.00	20.00	60.00
Yıldız Tech. University (Consultant to Limak & GMR JV)	1.00	0.00	20.00	0.00

4.2.2. Betweenness Centrality Findings

Betweenness centrality measures can also be calculated by UCINET (Borgatti et al., 2002; Appendix C). For this study, produced results are shown in Table 4.2. First column gives the betweenness values; second column indicates normalized betweenness values. Normalized betweenness values are also expressed as percentages of the number of actors in the network as in the case of normalized out and in degree measures (Hanneman and Riddle, 2005; Table 4.1). It is found that the Wayfinding and Signage Design Project Contractor (Yönsis) has the highest betweenness value of 5.5. The General Contractor (Limak & GMR JV) has the following highest betweenness value of 4. Consultant to Yönsis (RGB Consulting) has a betweenness value of 2.5. Other actors do not show betweenness centrality.

Chinowsky, et al. (2010) defined that betweenness centrality ratings reflect the total number of loops within the network in which a particular actor is included. For this analysis, the Wayfinding and Signage Design Project Contractor (Yönsis) has the greater number of loops that are inclusive of himself; accordingly it can be concluded that Yönsis shows the greatest level of participation in the discussions. The Sub-Contractor to Yönsis (Woodhead), the Project Author (Tekeli-Sisa Arch. Part.), and the Consultant to Limak & GMR JV (Y.T.U) have betweenness centrality degrees of zeros.

Hanneman and Riddle (2005) explained that having a betweenness degree zero means that there existed no tie at all for that actor, or if a tie was present for him, it was not at all part of any geodesic paths.

The Wayfinding and Signage Design Project Contractor (Yönsis) has the most centralized position in terms of betweenness. Hossain (2009) stated that this centralized position is likely to emerge as the leader, to be more satisfied, and to participate more in the task solution. Hossain et al. (2006) also argued that this position in the network structure allows for a more balanced view of the influential control of each node. Accordingly, for this study it can be concluded that the Wayfinding and Signage Design Project Contractor (Yönsis) has the most influential control and could be accepted as the leader of the communication network.

Table 4.2. Betweenness Centrality Measures

Actor	**Betweenness**	**Normalized Betweenness**
Yönsis (Wayfinding and signage design project contractor)	5.50	27.50
Limak & GMR JV (General Contractor)	4.00	20.00
RGB Consulting (Consultant to Yönsis)	2.50	12.50
Woodhead (Sub-Contractor to Yönsis)	0.00	0.00
Tekeli-Sisa Arch. Partnership (Project Author)	0.00	0.00
Yıldız Tech. University (Consultant to Limak & GMR JV)	0.00	0.00

4.2.3. Closeness Centrality Findings

Closeness centrality measures were also produced by UCINET (Borgatti et al., 2002; Appendix D). The closeness centrality measure is based on the sum of the geodesic distances from each actor to all others (Hanneman and Riddle, 2005). It is converted into a measure of farness by taking the reciprocal of the closeness value and normalizing it relative to the greatest closeness observed in the graph produced by

UCINET (Hossain et al., 2006; Hanneman and Riddle, 2005). In this study, normalization is done relative to the most central actor Wayfinding and Signage Design Project Contractor (Yönsis). Since the information network is directed, closeness and farness values can be computed separately for sending and receiving. Out and in closeness and farness centrality measures for this study are shown in Table 4.3.

Results show that the Wayfinding and Signage Design Project Contractor (Yönsis) has the highest in-closeness centrality degree; thus the lowest in-farness degree. General Contractor (Limak & GMR JV) and Consultant to Yönsis (RGB Consulting) have the second highest degrees. Following in-closeness degree ratings are the Project Author (Tekeli-Sisa Arch. Part.), the Sub-Contractor to Yönsis (Woodhead), and the consultant to Limak & GMR JV (Y.T.U), respectively.

Results show that the the Wayfinding and Signage Design Project Contractor (Yönsis) and Consultant to Yönsis (RGB Consulting) have the highest out-closeness centrality degree; thus the lowest out-farness degree. Following out-closeness degree ratings are the Sub-Contractor to Yönsis (Woodhead) and the consultant to Limak & GMR JV (Y.T.U). Then respectively General Contractor (Limak & GMR JV) and the Project Author (Tekeli-Sisa Arch. Part.) follow.

Hanneman and Riddle (2005) argue that actors who are able to reach other actors at shorter path lengths, or who are most reachable by other actors at shorter path lengths have favored positions. In this case, the Wayfinding and Signage Design Project Contractor (Yönsis) have structural advantage. Hanneman and Riddle (2005) suggested that this structural advantage can be translated into power. According to Hossain et al. (2006), closeness represents the potential for independence and efficiency, and signifies a group member who can avoid influence from others. It is also argued that closeness indicates nodes that can spread a message to others in the group in a minimal amount of time (Hossain et. al., 2006). Loosemore (1998) emphasized that a person who is close to many others finds it difficult to act independently without others' knowing, although he has the capacity to directly monitor and control more people, and to quickly disseminate decisions and ideas to a wider range of people.

The Wayfinding and Signage Design Project Contractor (Yönsis) has the highest measures regarding degree, betweenness and closeness centrality types. This indicates that this actor is the most prominent and influential one by being the leader of the communication network in where structurally positioned to coordinate efficiently.

Table 4.3. Closeness Centrality Measures

Actor	In-Closeness	Out-Closeness	In-Farness	Out-Farness
Yönsis (Wayfinding and signage design project contractor)	83.33	50.00	6.00	10.00
Limak & GMR JV (General Contractor)	71.43	41.67	7.00	12.00
RGB Consulting (Consultant to Yönsis)	71.43	50.00	7.00	10.00
Tekeli-Sisa Arch. Partnership (Project Author)	62.50	38.46	8.00	13.00
Woodhead (Sub-Contractor to Yönsis)	55.56	45.45	9.00	11.00
Yıldız Tech. University (Consultant to Limak & GMR JV)	16.67	45.45	30.00	11.00

4.3. Coordination Performance

Coordinative performances of actors are evaluated depending on the frequency of key phrases indicative of four coordination processes, (1) managing shared resources, (2) managing producer/consumer relationships, (3) managing simultaneity constraints, (4) managing task/subtask dependencies. Table 4.4 lists the total number of key phrases of four coordinative processes used by each actor. It also lists the total sum of phrase count for determining the total coordination score (Table 4.4). Each coordination phrase was assigned a weight based on its level of significance. The method of assigning coordination weights is described in detail in Chapter 3. Weighted coordination score of each actor is calculated by the sumproduct of the actor's usage frequence of that phrase and its assigned weight.

Table 4.5 lists the weighted coordination score of each actor. Key phrase cataloguing showed that managing task/ subtask coordination process was the most

frequent referred by all of the actors. On the other hand, simultaneity constraints coordination process was the least referred by all the actors.

Table 4.4. Coordinative Key Phrase Distribution and Coordination Scores

Project Actors	**Total Number of Coordinative Key Phrases**				**Total Coordination Score**
	Resource Allocation	**Producer/ Consumer Relationship**	**Simultaniety Constraints**	**Task/ Subtask**	
Limak & GMR JV (General Contractor)	21	28	15	15	**79**
Yönsis (Wayfinding and signage design contractor)	82	152	26	103	**363**
Woodhead (Sub-Contractor to Yönsis)	24	25	11	60	**120**
Tekeli- Sisa Arch. Part. (Project Author)	2	6	0	2	**10**
RGB Consulting (Consultant to Yönsis)	159	107	122	201	**589**
YTU (Consultant to Limak & GMR JV)	5	6	1	15	**27**
Total Sum	293	324	175	396	**1188**

Total coordination score of the Consultant to Yönsis (RGB Consult) is 589. This score has shares in dependency types of resource allocation as 159, producer/consumer relationship as 107, simultaniety constraints dependency as 122, and task/ subtask dependency as 201 (Table 4.4). Total coordination score of the Wayfinding and Signage Design Project Contractor (Yönsis) is 363. This score has shares in dependency types of resource allocation as 82, producer/consumer relationship as 152, simultaniety constraints dependency as 26, and task/ subtask dependency as 103 (Table 4.4). Total coordination score of the Sub-Contractor to Yönsis (Woodhead) is 120. This score has shares in dependency types of resource allocation as 24, producer/consumer relationship

as 25, simultaniety constraints dependency as 11, and task/ subtask dependency as 60 (Table 4.4). Total coordination score of the General Contractor (Limak & GMR JV) is 79. This score has shares in dependency types of resource allocation as 21, producer/consumer relationship as 28, simultaniety constraints and task/subtask dependencies as 15 and 15 (Table 4.4). Total coordination score of the Consultant to Limak & GMR JV (YTU) is 27. This score has shares in dependency types of resource allocation as 5, producer/consumer relationship as 6, simultaniety constraints as 1 and task/subtask dependencies as 15 (Table 4.4). Total coordination score of the Project Author (Tekeli- Sisa Arch. Part.) is 10. This score has shares in dependency types of resource allocation as 2, producer/consumer relationship as 6, task/subtask dependencies as 2 (Table 4.4).

Table 4.5. Weighted Coordination Scores

Actor	**Coordinaton Score**
RGB Consulting (Consultant to Yönsis)	1329.48
Yönsis (Wayfinding and signage design contractor)	1068.94
Woodhead (Sub-Contractor to Yönsis)	362.80
Limak & GMR JV (General Contractor)	327.82
YTU (Consultant to Limak & GMR JV)	90.66
Tekeli- Sisa Arch. Part. (Project Author)	35.77

The highest weighted coordination score is 1329.48 and belongs to the consultant to Yönsis (RGB Consulting). The wayfinding and signage design contractor (Yönsis) has the second highest score which is 1068.94. The Sub-Contractor to Yönsis (Woodhead) has a score of 362.80. The General Contractor (Limak & GMR JV) has a score of 327.82. The Consultant to Limak & GMR JV (YTU) has a score of 90.66 and the Project Author (Tekeli- Sisa Arch. Part.) has the lowest score of 35.77 (Table 4.5).

4.4. Association between Network Centrality and Coordination Score

Freeman (1979) defined three measures - degree, betweeness and closeness – of centrality and explained their structural implications for the study of centrality and information flow in organisations. Freeman (1979) suggests that the degree of a point seemed to be an index of that position's potential for activity in the network. Betweeness can be taken to be an index of potential for control of communication. Closeness measures the distance of a point to all others. Centrality measures and their social implications are shown in Table 4.6.

Table 4.6. Centrality Measures and Their Social Implications
(Source: Hossain et al. 2006)

Measure	Social Implications
Betweenness	Control
Degree	Activity
Closeness	Independence

The total coordination score of each actor was calculated by the summation of the number of key coordination phrases extracted from their sent emails (Table 4.4). The weighted coordination score of each actor was calculated by the sumproduct of the phrase frequency and its assigned weight (Table 4.5). The phrase summations output a list of coordinators and their weigthed coordination score (Table 4.5). Table 4.7 shows coordination rankings of the actors based on their total and weighted coordination scores given in Table 4.4 and 4.5.

Table 4.7 shows centrality rankings of the actors based on directed centrality measures given in Tables 4.1, 4.2 and 4.3. Table 4.7 and the rankings of actors based on total and weighted coordination scores given in Table 4.4 and 4.5.

Using these ranked weighted coordination scores and ranked centrality measures, the aim was to determine if there is a substantial difference in coordination between people with high and low centrality. Degree centrality implicating comunication activity is found to be most related to coordination score rankings (Table 4.7). The strength of other centrality measurements varied. It is found that centrality has an effect on coordination. The implications of these results mean that organizations

should consider structural position in an organizational network designing and mapping coordinated groups.

Table 4.7. Coordination Score and Centrality Values

Weighted and Total Coordination Score	**Degree Centrality**	**Betweenness Centrality**	**Closeness Centrality**
RGB Consulting (Consultant to Yönsis)	Yönsis (Wayfinding and signage design project contractor)	Yönsis (Wayfinding and signage design project contractor)	Yönsis (Wayfinding and signage design project contractor)
Yönsis (Wayfinding and signage design project contractor)	RGB Consult (Consultant to Yönsis)	Limak & GMR JV (General Contractor)	Limak & GMR JV (General Contractor)
Woodhead (Sub-Contractor to Yönsis)	Woodhead (Sub-Contractor to Yönsis)	RGB Consult (Consultant to Yönsis)	Woodhead (Sub-Contractor to Yönsis)
Limak & GMR JV (General Contractor)	Limak & GMR JV (General Contractor)	Woodhead (Sub-Contractor to Yönsis)	Tekeli- Sisa Arch. Part. (Project Author)
YTU (Consultant to Limak & GMR JV)	Tekeli- Sisa Arch. Part. (Project Author)	Tekeli- Sisa Arch. Part. (Project Author)	RGB Consult (Consultant to Yönsis)
Tekeli- Sisa Arch. Part. (Project Author)	YTU (Consultant to Limak & GMR JV)	YTU (Consultant to Limak & GMR JV)	YTU (Consultant to Limak & GMR JV)

CHAPTER 5

CONCLUSION

Formerly the construction industry focused on optimizing the project management processes with planning technical components of the project. This approach neglected to appreciate the importance of knowledge sharing to the overall project success. Project communication is strategic and integral to corporate strategy. This study emphasizes social science concepts to develop high performing participants by recognizing the importance of information exchange network. Such recognition is formalized in the analysis of coordination processes and social network model of a construction project.

This study analyzes the communication and coordination in Sabiha Gökçen International Airport's new terminal building wayfinding and signage design project. Electronic communication used as the project communication instrument is the focus. Project participants' email communication data are used for analysis. Analysis revealed the coordination and communication performance depending on the coordination theory and the social network method.

5.1. Concluding Remarks

Common sense definition of coordination is that of its being the act of working together harmoniously. Coordination theory is used to understand how project actors interact when working towards a common goal. In today's information age, coordination processes recorded mainly in messages of electronic mails sent all over to the world at a very high speed. Text extraction is conducted based on the constructs of coordination theory. The study adopted a three-phased methodology for coordination measure: (1) sentence extraction, (2) key phrase cataloguing – (3) weighted score assignment. Results revealed the coordinative activity of each project actor.

Social network perspective views an organization as a system of actors joined by a variety of relationships. It is concerned with the structure of those relationships in time and investigates their causes and consequences. Relational structure can be recognized

in communication flows such as electronic mailing. Thus, adopting the social analysis methodology this study also investigated the network centrality of the project actors and revealed their degree, betweenness and closeness centrality coding in the organizational structure.

It can be concluded that the Wayfinding and Signage Design Project Contractor (Yönsis) was found to be the most centrally positioned actor in the organization network depending on degree betweenness, and closeness centrality measures. Yönsis also showed the second most coordinative activity. Consultant to Yönsis (RGB Consulting) scored the highest coordination. RGB Consulting was found to be the second central actor in the degree centrality network. Among all centrality types, degree centrality implicating comunication activity is found to be the most related to coordination score rankings.

SGIA wayfinding project-based analyses showed a significant relationship between degree centrality and coordination. It was found that degree centrality and coordination had a strong tie. Actors centrally tied in a network show more coordination and actors who coordinate more show degree centrality in a network organization.

The implications of these results mean that organizations may reflect on central position in a network in designing and mapping coordinated groups. These findings are also a strong verification for the power of social networks in affecting the building design and construction proceses.

Findings might have come out differently hadn’t it been for below listed issues:

- The findings of this study were only limited with the communication data which were extracted from the wayfinding subcontractor's incoming-outgoing e-mail data (where Yonsis is included in CC), however any e-mail flow from directly one actor to another excluding Yönsis in CC could not be included.
- The study analyzed the coordination and communication issues in the context of a build-operate-own-transfer method. Different project delivery methods can normally create different circumstances in the project coordination and communication dynamics. It is necessary to analyze coordination and communication issues within different project delivery environments.

- English is the common business language in international projects. The wayfinding project of SGIA has Woodhead, an Australian company as the project participant (subcontractor to Yönsis). The e-mail communication data have demonstrated that the Turkish companies use diverse phrase types during the e-mail communication as opposed to a company which is from an English speaking country. The results might be different in terms of phrase diversity if all companies belong to same language speaking country.

5.2. Futher Research

Coordination and communication performances are analyzed depending on email data. Other data coming from various communication instruments potentially utilized may be taken into account for further analysis. This study investigated coordinative activities of participating firms in SGIA wayfinding project. Coordination and centrality in design and construction projects could be investigated and coordinative activities of individuals could be analyzed for evaluating performances of project manager, architect, engineer, etc. Besides, this is an example from a subcontractor case. Researchers can create or can come up with new hypotheses and analyze the case of other actors. Accordingly, this is an example of a build-operate-own-transfer delivery method. Any other type of delivery may come up with same or different results. Different project delivery types need to be investigated.

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APPENDIX A

TABLES OF E-MAIL DATA

Table A.1 E-mail Data of General Conractor (Limak & GMR JV)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			Preliminary Design Version 03	13 04		Servere koydum		Revize edilen
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			yönlendirme projesi ile ilgili tanımlamalar	25 05		Gönderilen Ekte bulabilirsiniz		
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consultin	RE: SGIA paftalar	29 05		Gönderdiği zaman Yükleyip Haber vereceğim		
General Contractor	Limak & GMR JV	Wayfinding and Signage Design Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting	RE: SGIA Preliminary Signage Design	29 05	Tekrar yükleyebilir misiniz	Dosyayı alabildik İndiremiyoruz		Problem var
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			yeni terminal isimlendir-merine ait tutanaklar	29 05		Gönderilen Ekte bulabilirsiniz		
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			Yeni terminal alan isimlendirmeleri	05 06		Gönderilen Ekte bulabilirsiniz		

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Table A.1(Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			Fw: lmk-lmk 16.06.2009 tarihli yönlendirme projeleri - yönsis	05 06	Bilgi verebilir misiniz			
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis						Gönderiyorum Sunabilmek		Yapılan degişiklik
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			FW:	23 07		Ekte bulabilirsiniz		
General Contractor	Limak & GMR JV	Wayfinding and Signage Design Project Contractor	Yönsis			RE: Otel ve VIP yönlendirme	01 09				
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			FW: Sağlık Bakanlığı tabelası	02 09	Önerinizi alabilir miyim lütfen			

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Table A.1(Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting	RE: SGIA otel yönlendirme projesi 1/2	05 09	Gönderir misiniz lütfen			
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			Terminal yazıları	05 09				Yardım alacagız Çalışıyor Uygun görülmüştür x2
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			VIP #1/3	08 09		Gönderiyorum		
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			RE: Otel ve VIP yönlendirme projeleri	08 09	Degerlendirme alabilir miyiz Önerilerinizi alabilir miyiz Degerlendirilmesini rica ederiz	Verilmektedir verilmiştir		İnceledik
General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis			RE: Otel ve VIP yönlendirme projeleri	09 09	verebilir misiniz	Ulaşmadı		

(Cont. on next page)

Table A.1(Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting			Preliminary Design Version 03	13 04		Servere koydum		Revize edilen
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consultin			FW: Yönsis Firması ile Yönlendirme Toplantısı	04 05		Göndermemiştim	Toplantı çagrısı Toplantı gunu Görüşmek üzere	
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Design Project Contractor	Yönsis	RE: YONSIS-WOODHEAD Minutes of meeting 28-29/04/09	09 05		Görebilirsiniz	Toplantı tutanagı	Düzeltmeler yaptık
				Sub-Contractor to Yönsis	Woodhead						
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting			Yönlendirme Projesi ile İlgili Tanımlama	25 05		Gönderilen Ekte bulabilirsiniz		
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting			Yeni Terminal Gate, Check-In, Karusel vb. isimlendirmelerine ait tutanaklar	29 05		Gönderilen Ekte bulabilirsiniz		

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Table A.1(Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting			yeni terminal alan isimlendirmeleri	05 06		Gönderilen Ekte bulabilirsiniz		
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting			fw: lmk-lmk 16.06.2009 tarihli yönlendirme projeleri - yönsis	05 06	Bilgi verebilir misiniz			
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	lmk-yon 08.06.2009 isg'den yönlendirme dizayni ile ilgili gelen mektup	20 06		Ektedir		
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	FW: Yönlendirme Projeleri 03-06-2009 1/3	10 06	İletmenizi rica ederiz			
				Project Author	Tekeli-Sisa Arch. Part.						

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Table A.1(Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	RE: Yönlendirme Projeleri 03-06-2009 1/3	11 06		Göndermiştik Yollamış	Toplantının	Tamamlat Hızlandıracak. İnceleyerek
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	RE: Yönlendirme Projeleri 03-06-2009 1/3	11 06		Ektedir		
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	RE: Yönlendirme Projeleri 03-06-2009 1/3	12 06	Beklemekteyiz	Ektedir Gelen		
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	Yönlendirme Tabelaları Metraj Listesi	11 06	Bekliyoruz		Yapmış oldugumuz konuşmada	Çıkartılacak listeye İhtiyacımız var
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	RE: Woodhead-Yonsis Revize Dizayn Toplantisi	18 06			Toplantıyı Kesin tarih	Bitiremeyebilir Bildirecek Düşünüyoruz
				Project Author	TEKELİ-SİSA Arch. Part.						
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	RE: Woodhead-Yonsis Revize Dizayn Toplantisi	22 06			Organize edebilirsiniz Toplantıyı yapacağız Konuştugumuz gibi	Bitirecek
				Project Author	TEKELİ-SİSA Arch. Part.						

(Cont. on next page)

Table A.1(Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting			SGA-NIT Yönlendirme	05 06	Yanıtlar mısınız			Belirttigimiz
General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Design Project Contractor	Yönsis		15 07	Kullanmanızı rica ediyorum	Gelmiştir Gönderdiğimiz Gönderecegim	Görüşme	Söylemiştir Hazırlamış

Table A.2. E-mail Data of the Wayfinding and Signage Project Contractor (Yönsis)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	FW: NEW FTP OF SGIA	15 04		Vermiş oldugunuz Girebiliyoruz İndirmek Verdiğiniz Yüklediğiniz Ulaşamadık		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Rev 02	23 04		Has uploaded		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Rev 02	24 04		Has uploaded		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	RE: Yönlendirme Toplantısı	21 05			Verilen tarih Katılacaktır Toplantı	
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Signage Design	29 05		Yükledik		Güncelleyerek
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Signage Design	29 05	Bilgi verebilir misiniz	Yüklediniz mi	Toplantı	Belirtildigi üzere Hazırlanacak

(Cont. on next page)

Table A.2 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Yönlendirme Projesi part	15 06	Eklenmesini rica ediyoruz			
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Yönlendirme Projesi part2	15 06		Yolluyoruz		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Yönlendirme Projesi	15 06	Bildirmenizi rica ediyoruz	Ulaşıp		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Yönlendirme Projesi	22 06		Yüklemiş oldugumuz Gönderiyorum		Bahsetmiş
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Yönlendirme Projesi Revizyonu	23 06		Göndermiş oldugunuz Sunuyoruz Ulaşmadıgı Gönderilecektir		Uygulanmadı dagıtılmak Tamamladıgım Düzelttigimiz Hazırlanmış olan
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	rotunda IdD sign revize 02	06 07		Sunulmuştur		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Sgia yönlendirme projesi teknik şartnamesi	08 07		Ektedir		

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Panel Renk Önerileri	17 07	Uygulanmasını istediği Degerlendirme bekliyoruz	Ektedir		Uygulanmış Önermiş Hazırlamış oldugunuz
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	FIDS rev çalışmalar 4/5	23 07		Ektedir		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	FIDS rev çalışmalar 3/5	25 07		Ektedir		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV			FIDS rev çalışmalar 4/6	01 09		Gönderecegiz		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	SGIA otel yönlendirme projesi 1/2	05 09		Ektedir		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	SGIA VIP yönlendirme projesi	05 09		Ektedir		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	OTEL yönlendirme projesi 1/2	07 09		Ektedir		

(Cont. on next page)

Table A.2 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	VIP yön proje	07 09		Ektedir		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	RE: Otel ve VIP yönlendirme projeleri	08 09		Ektedir		Revize edilen
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV			RE: Otel ve VIP yönlendirme projeleri	09 09		Ektedir		Revize edilen
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV			RE: Otel ve VIP yönlendirme projeleri	09 09		Ektedir		Revize edilen
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV			otopark terminal bağlantı noktaları yönlendirme projesi 1/2	12 09		Ektedir		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV			otopark terminal bağlantı noktaları yönlendirme projesi 1/3	12 09		Ektedir		

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	yonsis revision 01 (sgia)	13 04				
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	revision 02	23 04		Has uploaded		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Rev 02	24 04		Has uploaded		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead			RE: Rev 02	04 05	Could you please advice	Access		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	FIDS	06 05		Have uploaded Have attached	You can contact	Applied
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE:FIDS layout	07 05				Can used Used
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor toYönsis	Woodhead	Consultant to Yönsis	RBG Consulting	corporate identity	07 05		Have sent İnformed		If you check Will help you If you need

(Cont. on next page)

Table A.2 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE: Praying room icon	08 05	Should advice Want us to use	Have attached		Haven't used
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Preliminary Design	14 05	Can you give Want you to send			
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Zone definition table	14 05	Want you to send	Have uploaded Can send		Have prepared
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Re: sabiha gokçen airport -	16 05	Are waiting for Look forward	Presentedx3 Sent		Can use Had commented have translated Commented
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead			Re: sabiha gokçen airport -	18 05		Sent		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead			Preliminary Design Version 03	19 05	Want to revise Should send			Don't need to
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Re: sabiha gokçen airport - preliminary design	19 05		Recieved Have downloaded Have uploaded Didn't add		Will comment

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Preliminary Design Version 03	20 05	Want you to check Can you send us Can you give Can we solve			Need your We need
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE: SABIHA GOKÇEN Airport -	20 05	Please advice Please update look forward	Please see attached See attachedx2		Revised Have combined
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Preliminary Design Version 03	21 05	Please noted	Uploaded Attached Have attached Have shown		Will need to As mentioned Marked
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor toYönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE:Preliminary Design Version 03	21 05		Have sent Will upload	Meeting	Will consider Will inform
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Design	22 05	Waiting for Can you send Can you give Should add Should replace	Have uploaded Sent		Will upload Will see Will revise Will add Cannot sure Cannot understand Checked Changed Advised Applied

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Design	26 05	Can you checked	Attached Sent Have uploaded Uploaded	Organized	Didn't give Applied revised
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE: SABIHA GOKÇEN Airport - External Roadside Design	26 05	Want us to	Have uploaded Have accessed Will send Will give	Presented	
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Design	28 05		Have uploadedx2 Couldn't access	Meeting notes	Will consider
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA comments	30 05	Point out stated Want us Pointed out Should be revised Waiting for Should be desinged Should define Should be begin	Will send Will showx2	Meeting notes	Would be definedx2 Can fabricate Will define No need to Should use Have clarified Define Should be known Agree

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA	01 06	Can you send			
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE: Lift Icon - eps	02 06		Have uploaded Attached		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA Final Design Stage	08 06	Should clarify Can you send Wants to see Can you give Can you suggest Should be design	If you send	Meeting Submit time	Can begin need need to know
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Re: 04.06.09 yonsıs toplantı tutanagı /the minutes of meetıng	10 06	Need your advice How should be designed Need your advice Is expecting x2	Sent Have upload Will send		Have overviewed Try to design Cannot solve Adopt Had checked Had marked Applied
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA final	11 06	Can you advice Can you send	Have uploaded		

(Cont. on next page)

Table A.2 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE: SGIA final	11 06	Could you please give Can you check			
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Re: 04.06.09 yonsıs /the mınutes of meetıng	11 06	Looking forward	Have marked Have send		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA final	11 06	Can you advice Can you send	Have uploaded		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	FW: emergency exit	17 06	Are you able to Can this please be updated	Have updated		Had not been changed Can provided Have commented Need to x2
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	SGIA reqirements	25 06	Should prepare Need your advice	Can see Have attached		
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead			comments	29 06		Access Have attached		Not sure

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	RE: comments urgent!	30 06	Want do you advice Should we change			Will not use Are revising
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead		SGIA		02 07				Prepared
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	passport cabinet	03 07		Sent	Meeting day	
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	final design	07 07	Want you to check Wants that			Can change Revised
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Tactile ındıcators	07 07	Wanted us Can you give	Send Will send Can you access		Revisedx2
Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RBG Consulting	Redesıgn	14 07	Waiting for	Have attached Send		Applicate Will redesign Working on

(Cont. on next page)

Table A.2 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Wayfinding and Signage Project Contractor	Yönsis	Project Author	Tekeli-Sisa Architecture	Consultant to Yönsis	RGB Consulting	RE: SGH Uçuş salonları	28 05		Göndermiş oldugunuz Aldık		
Wayfinding and Signage Project Contractor	Yönsis	Project Author	Tekeli-Sisa Architecture	Consultant to Yönsis	RGB Consulting	Panel Renk Önerileri	17 07	Uygulanmasını istediği Degerlendirme bekliyoruz	Ektedir		Uygulanmış Önermiş Hazırlamış oldugunuz

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			Re: sabiha gokçen project - istanbul	07 05	Yollayabilir misiniz Yardımcı olmanızı rica ediyoruz x2	Eklenen	Minutes of meetings Contact times Konuşmak istediğinden	Bahsedilen Kontrol etmek
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			Re: sabiha gokçen project - istanbul	08 05		Elimize geçti	En kısa zamanda Toplantıya Katılanlar	Bahsettiğiniz Deneyeceğim
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			RE: corporate identity	08 05		Ulaştırdığınız		
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			Preliminary Design	13 05			Toplantıda	Düzenlenmiştir
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			25 05 2009 toplantı notları	26 05	Bildirmenizi bekliyoruz		Toplantı Kesin tarih	
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			SGIA Toplantı	29 05		Yolluyorum	Toplantı notları	

(Cont. on next page)

Table A.2 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			0406 Meeting notes	0806	Should be worked	Ekteki	Toplantıda x2	Bildirmek x2 Düşünüyoruz Cevap vermek
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			ıcons	1006		Göndermiş Ekliyorum		
Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RBG Consulting			FW: Panel Renk Önerileri	1807		Ilettiğim mail Ulaşmamış Yeniden yolluyorum		

(Cont. on next page)

Table A.2 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Sub-Contractor to Yönsis	Woodhead	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	SABIHA GOKÇEN Airport - Preliminary Design	12 05	Look forward to	Please find attached		Can provide Needed

Table A.3 E-mail Data of the Sub-Contractor to Yönsis (Woodhead)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	FW: NEW FTP OF SGIA	15 04		Vermiş oldugunuz Girebiliyoruz İndirmek Verdiğiniz Yüklediğiniz Ulaşamadık		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Rev 02	23 04		Has uploaded		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	Rev 02	24 04		Has uploaded		
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	RE: Yönlendirme Toplantısı	21 05			Verilen tarih Katılacaktır Toplantı	
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Signage Design	29 05		Yükledik		Güncelleyerek
Wayfinding and Signage Project Contractor	Yönsis	General Contractor	Limak & GMR JV	Consultant to Yönsis	RBG Consulting	SGIA Preliminary Signage Design	29 05	Bilgi verebilir misiniz	Yüklediniz mi	Toplantı	Belirtildigi üzere Hazırlanacak

(Cont. on next page)

Table A.3 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting	Preliminary Design Version 03	21 05	Please noted	Uploaded Attached Have attached Have shown		Will need to As mentioned Appreciated Marked Have combined
Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis			Lift Icon - eps	02 06	Please find attached			
Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting	re: 04.06.09 yonsis toplanti tutanagi /the minutes of meeting	10 06	Is expecting x2 If you could provide If you could advice	Have attached	Meeting minutes	We provide Will allow us Resolve x2 Noted x2 Revised
Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting	RE: emergency exit	17 06	Can this please be updated	See attached		Had not been changed Can provided Need to x3 Concerned Not included Can provided Have commented have updated
Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Design Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting		22 06	Can you please advice Can you please confirm	Please see attached		Has changed Was confused Concerned Recommending

(Cont. on next page)

Table A.3 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis			RE: Pending issues for SGIA	06 08		Recieved you have		Want to confirmx2 I wasn't sure
Sub-Contractor to Yönsis	Woodhead	Project Author	Tekeli- Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis	SABIHA GOKÇEN Airport - Preliminary Design	12 05	Look forward to	Please find attached		Can provide Needed

(Cont. on next page)

Table A.3 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting			Re: FIDS layout	07 05	could someone please advice			
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	Re: URGENT!! !!! !!! !!! Last stage in SGIA	09 06	should remain should allow x2 should support request by	could take x2 have access attached will send represent	given time time required last meeting asap	included x5 will ask excluded need x4 agreed allow to be fabricated to be added x2 progress recommended selected working
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	re: urgent!! !!! !!! !!! ! meeting in istanbul	12 06	have to include			
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor		RE: SGIA final	15 06		please find the attached		revised
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	re: urgent!! flight details of emirates	16 06				would prefer to take

(Cont. on next page)

Table A.3 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	Re: the changes in the dates	19 06	Let me know		To organize	I know You need
Sub-Contractor to Yönsis	Woodhead	Consultant to Yönsis	RGB Consulting	Wayfinding and Signage Project Contractor	Yönsis	re: important!!! Trip to Turkey	29 06			I meet To meet Meeting To arrange	

Table A.4. E-mail Data of the Project Author (Tekeli-Sisa Architectural Partnership)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Project Author	Tekeli-Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting	SGH Check-in bankoları	26 05		Ektedir		
Project Author	Tekeli-Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting	Re: SGH Uçuş salonları	27 05		Ektedir		
Project Author	Tekeli-Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis	Consultant to Yönsis	RGB Consulting	RE: FIDS rev çalışmalar 1/5	24 07		Bulabilirsiniz Elimize ulaşmadı		
Project Author	Tekeli-Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis			FW: LET-ISG-LGV-000272 / YÖNLENDİRME PROJESİ / ISG	24 07	Iletmenizi rica ederiz	Iletilen		Ihtiyacım var

(Cont. on next page)

Table A.4 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Project Author	Tekeli-Sisa Arch. Part.	Consultant to Yönsis	RGB Consulting			FW: LET-ISG-LGV-000272 / YÖNLENDİRME PROJESİ / ISG	24 07	iletmenizi rica ederiz	iletilen		ihtiyacım var

Table A.5. E-mail Data of the Consultant to Yönsis (RGB Consulting)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	RE: 03.04.2009 FIDS Revizyonu	08 04	Ricam yüklemeniz	Göndermiş olduğunuz Açmış olduğunuz		
				Project Author	Tekeli- Sisa Archi. Part.						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Minutes of the meeting: SGIA Wayfinding Yonsis 06-04-09	10 04	Please find the attached We kindly ask you to bring		The meeting Participation Please to cooperate	
				Sub-Contractor to Yönsis	Woodhead						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Minutes of the meeting: SGIA Wayfinding Yonsis 06-04-10	10 04	Please be so kind to inform Should isssue	Send Would be please to recieve	Get in touch with Consolidated	Replay enable you to check Required Mentioned
				Sub-Contractor to Yönsis	Woodhead						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Woodhead toplanti talebi	23 04	Onaylamanızı rica ediyoruz		Telefon görüşmeleri görüşmek x3	Sunacaklar Değişiklikleri tamamlamış
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Woodhead toplanti talebi	24 04			Görüştüğümüz görmek niyetindeler görülebilir mi	

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV			RV: Sabiha Gokcen Airport - Signage and Wayfinding Consultancy	28 04		Send Please recieve	To see you	In order to allow
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	WOODHEAD-YONSIS TOPLANTI	28 04	Bilgilendirmenizi rica ederim	Vermiş olduğunuz	Arkadaşlar olacak x3 Görüşme saha gezisi gerçekleştirilecek Toplanti gerçekleşecek	Prepared to be solved
				Consultant to Yönsis	Woodhead						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Consultant to Yönsis	Woodhead	YONSIS-WOODHEAD Minutes of meeting 28-29/04/09	05 05	Please you can write	Can find	Meeting was held	To be added will be sent
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	YONSIS-WOODHEAD Minutes of meeting 28-29/04/09	17 05				
				Consultant to Yönsis	Woodhead						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	RE: YONSIS-WOODHEAD Minutes of meeting 28-29/04/09	17 05		Please find here	To meet together	Have redefined
				Consultant to Yönsis	Woodhead						

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	YONSIS Toplanti Talebi	29 05	Bilgilendirmenizi rica ederim		Görüşmek isteriz	Değerlendirdiğim belirtmek isteriz
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	25.05.09 tarihli YONSIS Toplanti Tutanagi	03 06	Please be so kind to add	Can find	Hope to see	
Consultant to Yönsis	RBG Consulting	General Contractor Wayfinding and Signage Contractor	Limak & GMR JV Yönsis			RE: YENİ TERMİNAL ALAN İSİMLENDİRMELERİ	05 06		Elimize ulaştı		
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV			RE: SGA-NIT Yönlendirme	05 06		Gönderebiliriz		Kısmına ulaşmıştır Revizyonlar Mevcut Onay alması Devam etmeniz
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor Sub-Consultant to Yönsis	Yönsis Woodhead	RE: SGA-NIT Yönlendirme	09 06		Ektedir Ulaştığını	Minutes of Meeting	Belirtmek isteriz Ekleme yapılabilir

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	RE: Yönlendirme Projeleri 03-06-2009 1/3	09 06		Göndereceğiz Göndermeye Çalışacağız	Minutes of Meeting Toplantının En kısa zamandax2	Biliyorsunuz ki Bahsedildiği üzere Değişiklik Dizaynı tamamlayıp Hızlandırır Çalışıyoruz
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	re: lmk-all 11.06.2009 yönsis'ten gelen son yönlendirme dizayni toplantisi notlarinda alinmasi gereken aksiyonlar hakkinda	15 06		Göndereceğiz	Görüştüğümüz gibi	Sonlandırıp
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV	Wayfinding and Signage Project Contractor	Yönsis	Woodhead-Yonsis Revize Dizayn Toplantisi	18 06			Görüşmek üzere bulunacak Meeting dates	Bahsettiğim gibi
Consultant to Yönsis	RBG Consulting	General Contractor	Limak & GMR JV			SGIA Terminal Binası FIDS Yerleşimleri 8/12	15 07	Tekrar gönderebilir misiniz	Elime ulaşmadı		

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			SGIA TOPLANTI	08 04	Gönderebilirse	Göndermeye çalışacagım	Gerçekleşen toplantı Zamanım olmayabilir	Hazırlayıp
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: RE: Minutes of the meeting: SGIA Wayfinding Yonsis 06-04-09	10 04	Bildirmek zorunda Unutmayalım	Gönderildi	Haberleşiriz	
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Woodhead - banka detaylari	10 04	Gönderirseniz sevinirim	Gönderiyorum gönderdiginiz Göndereceklerini belirttiler	Yapmış olduğum görüşme	
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: NEW FTP OF SGIA	20 04	Ask them to bring Ask to come Ask to start Please ask Please check Please inform Should advice			Would like to finish To be ready Will be looking To start To prepare Can start
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: Woodhead toplanti talebi	23 04		Vermiş oldugu asagıda görebilirsiniz		

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Woodhead bilet detaylari-rv: blackshaw/timothy edwardmr 26apr adl sin	2404	Belirtin lutfen haber bekliyorum	Bulabilirsiniz	Görüşeceksiniz	
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Woodhead toplanti-Hotel ucreti	2404	Haberdar etmek zorundayım		Görüşün	Istemiyor
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: REV 02	2404				Beraber çalışıyoruz
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Sabiha Gokcen havalimani-sahaya cikis icin gerekli evraklar	2504	Acil istiyorlar Gönderirseniz sevinirim	Bilgi gelmedi		Belirtti

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Consultant to Yönsis	RBG Consult	Wayfinding and Signage Project Contractor	Yönsis	rv: lmk-all 30.04.2009 malzeme onay toplantısı ve yönlendirme dizaynı prezentas yonu / material approval meeting & way-finding presentation	27 04	Cumleyi okuyun Acıklık getırmek zorunda	Maili aldık Mail atmak gerekecek		Söylemedik
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: Sabiha Gokcen Airport - Signage and Wayfinding Consultancy	28 04		Send to have Please recieve	To see you	In order to allow
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Sabiha Gokcen Havalimani-Pasaport cikis pullari	04 05		Bulabilirsiniz Gönderecek yollayacaklar	Görüsebılırsınız	İhtiyacım var Dusunuyorum
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			rv: sabiha gokçen project - istanbul	05 05		Bulabilirsiniz		

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: toplantı notları	0605	Gönderirseniz sevinirim cevaplandırma-nız önemli	Göndermiş göndermiştim Elinize ulaştı mı? Mail atarsa	Zaman kaybetmemek	
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			rv: sabiha gokçen airport - fids	0605	Cevap yazıldı mı	Gönderilen		
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Toplanti raporlari	0705	Göndermenizi rica ederim göndermeniz gerekli			
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: SABIHA GOKÇEN PROJECT - Istanbul	0805		Göndermiştim elinize ulaştı mı? Gönderecek	Irtibattayım Görüşürüm	Haber alır almaz
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: Toplanti raporlari	0805	Bildirebilir misiniz			
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: corporate identity	0805	Göndermeniz mumkun mu	Bilmiyorum Açamıyorum		

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: corporate identity	08 05	Please be informed Please would you be so kınd to send Reclaim sb to send Should inform Should send Should check	Recieved x2	As soon as possible Asap	Remind you Addressed Can demand Plan to be
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: SABIHA GOKÇEN Airport - Preliminary Design	12 05	Göz atsanız iyi olur	Gönderilmiş Yolluyorum		Unutmuş
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	RV: SABIHA GOKÇEN Airport - Preliminary Design	17 05	Is not to forget to copy So kind to confirm	To send copy	Delaying	To complain about Redraw Can continue

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			Deniz hanim ile gorusme	26 05	Calışmaya başlamalı Bekleniyor Haber bekliyorum Dikkat etmelıyız Hazırlanmalı	Göndermek Gönderilecek Mail atılacak Mail atabiliriz Göndereceğimiz	Görüsülmedi Görüşelim	Özetliyorum Yapılacak Bahsettiginizx2 Örnek yapılabilir Karara varıldı Düşünmüştümx2 Onay alabiliriz Kontrol edebilsin Haber verecegım Begenmemişti
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: Sabiha Gokcen Havalimanı asansörleri kat ve kabin kasetleri	01 06		Göndermiş Aktarıyorum		
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			SGIA Toplanti	08 06	Göndermeniz mümkün mü			
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			SGIA dan gelen Yonlendirme Dizayn calismasi Notlari-YORUM	08 06	Istemişlerx2 göndermemiz lazım gönderelim açıklayabilir misiniz düzeltme yapmalıyız	Göndermiş oldugum yollayacagım gönderebiliriz		İnceledim Açıklamak istiyorum Bahsettiginz Yapılabilir Tercih etmeyecek Yapacak Hazırlayıp

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: ıcons	10 06	Gönderin Degişiklik istenirse Görmek isteyecek Görüşmeniz gerekli Lutfen en kısa Zamanda dönün	Göndermiştim Gelen	Göreceginiz	Halledilebilir Duşunuyorum
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			oguzhan ozcan dan gelen mail rv: cok acil	10 06		Gönderdiği Gönderiyorum		
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			prayer room ve diger	10 06	Mail atmam gerekiyordu	Göndereceğinizi	Görüştügümüzde	Söylediniz
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			rv: lmk-all 11.06.2009 yönsis'ten gelen son yönlendirme dizaynı toplantısı notlarında alınması gereken aksiyonlar hakkında	15 06		Gelen Gönderiyorum		

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			re: lmk-lmk 16.06.2009 tarihli yönlendirme projeleri - yönsis	21 06	Irtibat kursanız iyi olacak			
Consultant to Yönsis	RBG Consultin	Wayfinding and Signage Project Contractor	Yönsis	Sub-Contractor to Yönsis	Woodhead	Woodhead Planning	22 06	Please take under consideration Have to give Please get be so kind to Resend Waiting for	Didn't recieve Dont have	As soon as possible In order not to delay	To continue Required
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RV: Analizler	25 06		Gelen Aşağıdaki gibidir		
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			TIM HOTEL	01 07	Ödemenizi bekliyorlar İstiyorlar Unutmayın lutfen			Anlaşmıştık
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			re: sgia yönlendirme projesi teknik şartnamesi	08 07	Gönderir misiniz			Düzeltip

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Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RBG Consulting	Wayfinding and Signage Project Contractor	Yönsis			RE: SGIA YÖNLENDİRME PROJESİ TEKNİK ŞARTNA-MESİ	09 07	Göndermeniz mümkün mü?	Açamıyoruz		

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	NEW FTP OF SGIA	08 04		Have upload As above you see Will send	Had a meeting	Will continue Can continue Have a problem
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	RE: NEW FTP OF SGIA	09 04	Should confirm Should be kept Let us know I kindly ask to start Please all confirm	Can upload Access	Will have to Present	I think I recommend Is changing Mentioned Can put To be evaluated Commented Addressed
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	MEETING IN SABIHA GOKCEN	22 04	If you give me ok Inform me Have to change Want to get Have to come To take give them Waiting for	sent Will send	Trying to arrange Will arrange Please get in touch Will contact	To find Will buy Can do I know You need x2 Mentioned
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	RV: URGENT	22 04	Please call me	If you have	Cant postpone Will meet Meeting with x2 Will see construction	Replay Will answer Due to slow start up

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Rv: lmk-all 30.04.2009 / material approval meeting & way-finding presentation	28 04	Please be so kind to answer Please to be here Send your claim	Are available	To participate Meet x2	I suggest We think To bring Need to obtain Need to conclude Would like to clear
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Follow up - RE: SGIA COMMENTS	01 05	Would like to get Please confirm	Send	Please not to delay As soon as possible Should organize	Will be paid Get approved iIs needing Wonder May expect Ready to advance Will be issued Will add Need to solve
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead			RV: Follow up - RE: sgia comments	05 05	Please be so kind to inform Have to take Dont forget please Waiting for x2 Had to give	Dont have	Asap x2	We understand Mentioned Cannot proceed Dont know To prepare

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	urgent!! rv: follow up - re: sgia comments	08 05	Are waiting Kindly ask you		Asap	Dont understand We understand
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	URGENT!!! !!!!!!!!!!!!last stage in SGIA	09 05	Has to prepare has to be develop has to be extend has to be define has to submit please be so kind to inform	Has send Will send	Have only 1 week Cooperate	need To be revised
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	re: 04.06.09 yonsis toplanti tutanagi /the minutes of meeting	10 05			Asap	Mentioned
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead			urgent!!!!!!!! !!flight details	12 05		Can find		
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	urgent!!!! flight details of emirates	14 06	Has to revise Please find Please be so kind to inform	Not available	This meeting As soon as possible Will come Will organize	We think Requested Will do
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	RE: SGIA final	15 06	Have to use Have to clarify	You gave		Will turn back

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	**Company Name**	**Position**	**Company Name**	**Position**	**Company Name**						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Design Project Contractor	Yönsis	RV: URGENT!!! !!!!!!!FLIGHT DETAILS	16 06	Wanted you to get Gave me ok			Mentioned Will do You need
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Design Project Contractor	Yönsis	FLIGHT DETAILS	16 06		Send you		Are doing Will decide We make
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Design Project Contractor	Yönsis	URGENT!!! !!!!!RV: FLIGHT DETAILS-	18 06	Please be so kind to check			We thought Will answer Will lose Revised
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Design Project Contractor	Yönsis	the changes in the dates!!!!	18 06	Please be so kind to inform Have to inform	Will inform	To speak Conversation Have spoken to Proper dates Exact dates This dates	Needs Not accepting To check

(Cont. on next page)

Table A.5 (Cont.)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Design Project Contractor	Yönsis	RE: the changes in the dates!!!!	18 06	Should be clearly stated Have to manage	Informs	Delay x3	I think Need to get Will answer Are incuring In order to avoid Can assume I suggest
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	re: blackshaw/timothymr 30jun adl sin	23 06		Bought Explained	The meeting See you	Will not create
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Re: blackshaw/timothymr 30jun adl sin	24 06		See you		
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Meeting with SGIA	01 07	Please get in touch		Meeting coming will come all together you can To participate	As i informed To translate you
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	RE: Signage Colour	06 07	Waiting Please so kind to keep with			We understand we are sure Didn't support We know To make it sure adapted Try to include Fixed

(Cont. on next page)

Table A.5 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	URGENT!!! !!!!!!!! meeting in istanbul	10 07	If you give me ok Have to speak		Meeting asap	We found Need
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Pending issues for SGIA	29 07	Are waiting kindly ask you take Please be so kind to send		Cooperate with Cooperation	Has a problem
Consultant to Yönsis	RGB Consulting	Project Author	Tekeli-Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis	RV: SABIHA GOKÇEN Airport	04 05		Gönderilen Göndereceğiz		

(Cont. on next page)

Table A.5 (Cont.)

From:		**To:**		**Cc:**		**Subject**	**Date**	**Resource Allocation Dependency**	**Producer/ Consumer Relationship Dependency**	**Simultaniety Constraint Dependency**	**Task/Subtask Relationship Dependency**
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	URGENT!!! !!!!!!!! meeting in istanbul	10 07	If you give me ok Have to speak		Meeting asap	We found Need
Consultant to Yönsis	RGB Consulting	Sub-Contractor to Yönsis	Woodhead	Wayfinding and Signage Project Contractor	Yönsis	Pending issues for SGIA	29 07	Are waiting kindly ask you take Please be so kind to send		Cooperate with Cooperation	Has a problem
Consultant to Yönsis	RGB Consulting	Project Author	Tekeli-Sisa Arch. Part.	Wayfinding and Signage Project Contractor	Yönsis	RV: SABIHA GOKÇEN Airport	04 05		Gönderilen Göndereceğiz		

Table A.6 E-mail Data of Consuştant to Liamk & GMR JV (Yildiz Technical University)

From:		To:		Cc:		Subject	Date	Resource Allocation Dependency	Producer/ Consumer Relationship Dependency	Simultaniety Constraint Dependency	Task/Subtask Relationship Dependency
Position	Company Name	Position	Company Name	Position	Company Name						
Consultant to Limak & GMR JV	YTU	General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Cok acil	10 07	gönderilmeli gönderirse	dosya gelmedi gelecek dosya veremeyeceğim	ivedilikle	önlememiz teslim etmemiz işleme koymak hazırlanan
Consultant to Limak & GMR JV	YTU	General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	Re:Cok acil	10 07	gönderin gönderirseniz	ulaşmadı gönderilmiş		değerlendirme kontrol edebiliriz
Consultant to Limak & GMR JV	YTU	General Contractor	Limak & GMR JV	Consultant to Yönsis	RGB Consulting	eksikler	11 07	iletilmesini rica ederim			başlayacağız tamamlandığı inceledik denetim yapmak önerilmemiş x6

APPENDIX B

DEGREE CENTRALITY OUTPUT OF UCINET

```
FREEMAN'S DEGREE CENTRALITY MEASURES
------------------------------------------------------------------------------

Diagonal valid?                   NO
Model:                            ASYMMETRIC
Input dataset:                    SGIA DATA (C:\Users\bengi\Desktop\UCINET\SGIA-2\SGIA DATA)

                                      1          2          3          4
                                OutDegree   InDegree  NrmOutDeg  NrmInDeg
                            ------------ ---------- ---------- ----------
  2  Wayfinding and Signage Design Project Contractor (Yönsis)      4.000      4.000     80.000     80.000
  5                  Consultant to Yönsis (RGB Consult)          4.000      3.000     80.000     60.000
  3                  Subcontractor to Yönsis (Woodhead)          3.000      2.000     60.000     40.000
  1                  General Contractor (Limak & GMR JV)         2.000      3.000     40.000     60.000
  4                Project Author (Tekeli-Sisa Arch. Part.)      1.000      3.000     20.000     60.000
  6                        Consultant to Limak & GMR JV (YTU)    1.000      0.000     20.000      0.000

DESCRIPTIVE STATISTICS

                                      1          2          3          4
                                OutDegree   InDegree  NrmOutDeg  NrmInDeg
                            ------------ ---------- ---------- ----------
  1  Mean                          2.500      2.500     50.000     50.000
  2  Std Dev                       1.258      1.258     25.166     25.166
  3  Sum                          15.000     15.000    300.000    300.000
  4  Variance                      1.583      1.583    633.333    633.333
  5  SSQ                          47.000     47.000  18800.000  18800.000
  6  MCSSQ                         9.500      9.500   3800.000   3800.000
  7  Euc Norm                      6.856      6.856    137.113    137.113
  8  Minimum                       1.000      0.000     20.000      0.000
  9  Maximum                       4.000      4.000     80.000     80.000
 10  N of Obs                      6.000      6.000      6.000      6.000

Network Centralization (Outdegree) = 36.000%
Network Centralization (Indegree) = 36.000%
```

APPENDIX C

BETWEENNESS CENTRALITY OUTPUT OF UCINET

FREEMAN BETWEENNESS CENTRALITY

Input dataset: SGIA DATA (C:\Users\bengi\Desktop\UCINET\SGIA-1\SGIA DATA)

Important note: this routine binarizes but does NOT symmetrize.

Un-normalized centralization: 21.000

		1 Betweenness	2 nBetweenness
2	Wayfinding and Signage Design Project Contractor (Yönsis)	5.500	27.500
1	General Contractor (Limak & GMR JV)	4.000	20.000
5	Consultant to Yönsis (RGB Consult)	2.500	12.500
3	Subcontractor to Yönsis (Woodhead)	0.000	0.000
4	Project Author (Tekeli-Sisa Arch. Part.)	0.000	0.000
6	Consultant to Limak & GMR JV (YTU)	0.000	0.000

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1 Betweenness	2 nBetweenness
1	Mean	2.000	10.000
2	Std Dev	2.179	10.897
3	Sum	12.000	60.000
4	Variance	4.750	118.750
5	SSQ	52.500	1312.500
6	MCSSQ	28.500	712.500
7	Euc Norm	7.246	36.228
8	Minimum	0.000	0.000
9	Maximum	5.500	27.500
10	N of Obs	6.000	6.000

Network Centralization Index = 21.00%

APPENDIX D

CLOSENESS CENTRALITY OUTPUT OF UCINET

```
CLOSENESS CENTRALITY
-------------------------------------------------------------------------------

Input dataset:                SGIA DATA (C:\Users\bengi\Desktop\UCINET\SGIA-1\SGIA DATA)
Method:                       Geodesic paths only (Freeman Closeness)
Output dataset:               Closeness (C:\Program Files (x86)\Analytic Technologies\Closeness)

Note: Data not symmetric, therefore separate in-closeness & out-closeness computed.

The network is not connected. Technically, closeness centrality
cannot be computed, as there are infinite distances.

Closeness Centrality Measures

                                                          1           2           3           4
                                                  inFarness   outFarness  inCloseness outCloseness
                                                 ----------- ----------- ----------- -----------
  2  Wayfinding and Signage Design Project Contractor (Yönsis)       6.000      10.000      83.333      50.000
  1                  General Contractor (Limak & GMR JV)         7.000      12.000      71.429      41.667
  5                  Consultant to Yönsis (RGB Consult)          7.000      10.000      71.429      50.000
  4                Project Author (Tekeli-Sisa Arch. Part.)      8.000      13.000      62.500      38.462
  3                  Subcontractor to Yönsis (Woodhead)          9.000      11.000      55.556      45.455
  6                  Consultant to Limak & GMR JV (YTU)         30.000      11.000      16.667      45.455

Statistics

                                1           2           3           4
                        inFarness   outFarness  inCloseness outCloseness
                       ----------- ----------- ----------- -----------
  1  Mean                  11.167      11.167      60.152      45.173
  2  Std Dev                8.474       1.067      21.250       4.165
  3  Sum                   67.000      67.000     360.913     271.037
  4  Variance              71.806       1.139     451.552      17.349
  5  SSQ                 1179.000     755.000   24418.975   12347.633
  6  MCSSQ                430.833       6.833    2709.311     104.096
  7  Euc Norm              34.337      27.477     156.266     111.120
  8  Minimum                6.000      10.000      16.667      38.462
  9  Maximum               30.000      13.000      83.333      50.000
 10  N of Obs               6.000       6.000       6.000       6.000
```