An Actor-Network Theory (ANT) Research in the Context of Building Production: Istanbul International Financial Center BDDK Building

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Abstract

Actor-Network Theory(ANT) has been suggested by Latour in 1980s as a criticism of classical sociology. ANT is an interdisciplinary methodology that handles the heterogeneous rallying of human and non-human actors' relationships, their effects to each other within a non-technical network and their on a par affects to network. ANT can be applied to all disciplines with collectible data regarding a study, given ANT's ability to analyze the network and estimate the success of a project. Architecture discipline is suitable for applying ANT, since the network includes both human actors and non-human actants such as documents, materials, etc.

This study aims to explain how various factors such as building production tools, legislations, user requests, contracts between contractors, architects, employers and other actors can alter and shape relationships within a network, by applying the ANT.

The main source of problems in the process is each actor's desire to manipulate relationships for its own interests. It is possible to reach the targets regarding administration, planning and finance with risk-mitigating and predictable building production processes. As increasing complexity and rising number of actors brings along new risks to building production, ANT aims to foreshadow possible risks in the process by interpreting the relationship between actors. Within this context "Istanbul International Finance Center-BDDK Building Project" has been studied as research object due to its multi-actor, dynamic, large scale processes. For this research, interviews had been conducted with actors of the process in order to understand

their approach to process and general state of affairs, documents had been studied and an actor-network had been mapped out. In conclusion section, the interaction of actors and actants, their influences on network and the risks has been discussed with the help of mapped actor-network.

Keywords: Actor-Network Theory (ANT); Black-Box; Actor-Actant; Building Production

1. Introduction

In present conditions of Turkey, the value of real property of the structures serving for diversified functions (shelter, health, education, commerce, culture...) comes from their prestige value rather than their value of exchange. By 2000, several developments took place that had impact on building production mechanisms particularly in large cities like decrease in volume of urban land stock, shift in high income group's investment and housing preference from apartments to housing estates, emergence of new life styles that arise the need to combine sheltering function with multiple functions, which eventually lead to mix-use projects becoming popular. This new building production mechanism surfacing in Istanbul like the other large cities of the world has led to widespread of major mix-use projects that started taking place of production of single function buildings, and on the other hand it has led to commodification of urban land, transforming these lands into most significant real estate investments, thus turning the city's into an investment area where all kinds of structures are perceived as an economic value.

And it has become the primary objective of the state to ensure economic growth by developing regulations that fully support the production of buildings as a means of raising funds for construction investments. This position is crowned with a series of facilitating legislative regulations and mega projects thanks to the government that set its 2023 vision as great economy, a strong society, advanced democracy, habitable environment and trademark cities. In this respect, major projects developed by the government like 3rd Airport, 3rd

Bridge and access roads, Marmaray, Istanbul Park, Istanbul International Finance Center(Ataşehir)(IIFC) and Kanal Istanbul basically brought with them the attainability of other projects, hence numerous investment opportunities.

2. Objective

Uncontrollable rise of the construction sector(with the support of the state) considered as the locomotive of economy, expansion of building scales, complexification of design and implementation processes; thereby involvement of almost infinite number of actors and actants in the process(contracts, materials; and even aesthetic, ethical, commercial, technological, social factors etc.) and dynamic interaction of all living-non-living actors, which lead to modification and transformation of the process itself, can become obstacles impeding the completion of the projects according to cost and time planned. This more complex relations of actor-network in the building production process cannot be studied only on basis of the relations between the actors, it is also necessary to make detailed analysis of both the relations of the actors with one another and with actants (non-human).

Within this context Actor-Network Theory (ANT) is the tool for demonstrating the network of associations among heterogeneous components that exist together, that can be changed and combined, in other words ANT is the sociology of associations, not the sociology of social.

In other words the purpose in the theory of ANT is the amalgamation of human and non-human components (not humans contrary to classical sociology).It is believed that when using ANT, it is possible to go back and correct mistakes whenever required or to continue until the correct result is achieved in cases when mistakes are not realized. Also when analyzing the relations between human and non-humans and the effects of these relations, it becomes possible to make sense of the conflicts that arise and the consensus reached.

Thus the desired level can be attained by determining the degree of change the actor and actant makes in many areas like planning, finance and management through projects that

anticipate and mitigate the risks and that facilitate the process by overcoming risk factors such as dynamic and complex relations in today's complex building production processes which involve multi actors and materials, revisions, the obligation of the actors to work together; difficulties experienced in sharing of information.

Especially the transformation experienced in building production in the last decade and the fact that projects are getting more complex makes ANT an essential. Despite all the complexity of the construction process, ANT brings numerous benefits; however considering the lack of sufficient resources and awareness in the field of building production and architecture, this study aims to lead the way to further studies and construction practices.

3. Scope

In addition to the literature discussing the ANT in conceptual frame, this study attempts to clarify how this theory can be implemented in practice. Within this context, it was aimed to set up the relations of actor-network between the actors and actants involved in the "Rough-Construction" phase throughout the entire production process of BDDK Building within the scope of the state supported mega project, Istanbul International Finance Center(IIFC) project. IIFC BDDK Building was chosen as the topic of this study since the project involves multiple actors and the processes are composed of extremely dynamic phases.

Within this scope, interviews were made with actors that had active roles in this process, all actors-actants having a part in each process were listed in line with information shared and correspondence-documents collected, and understanding what has been experienced throughout the process, the factors that were effective in decision making were ascertained.

This study sets forth how the actor-network mapped with the data compiled under sections stated below, and how this network can be used to analyze the associations between actors and actants;

i. Determining the basic concepts of ANT(actor-actant) in terms of real persons-entities involved in a project,

ii. Demonstrating actors-actants' roles as identifiers and transformers in the process of bulding an actor-network,

iii. Overcoming these challenges using ANT and determining and finding solutions for risk factors(problems)

4. Problems

The goal in building production is to finalize a project in planned time and the level of quality desired, using the resources required. Considering especially the developments in the sector during last decade, we see a quiet complex structure due to involvement of multiple participants from various disciplines (architecture, engineering, procurement, contractor, designer, bankers, consultants, politicians, economists) with different perceptions and knowledge. There is a direct relation between the increase in number of participants (multi-actor) and problems encountered in the process.

While resources used and persons involved in the process(actors and actants in terms of ANT) impact the decisions being made, these actors and actants vary according to the quality and size of the project (in other words: unique). Participants to be included in the project in accordance with the objectives are directly or indirectly affected from the success or failure of project, and they eventually affect the project. (Tuna 2011)

In area with so many ambiguities, as each different actor believes in fighting its own corner so does various risks, disagreements and conflicts arise in project processes with multi-actors. Both the actor itself and other actors are affected and changed by unique risks inherent in each project. It is possible to minimize and even eliminate these kinds of disagreements and conflicts using ANT. When we go through thesises, articles and other resources within last decade in this respect, while presenting the relations in building production, there are actors

that play a part in the process encounter with below risks.(Problems are listed in Table1;Annex1 can be reviewed for details of how problems handled in resources).

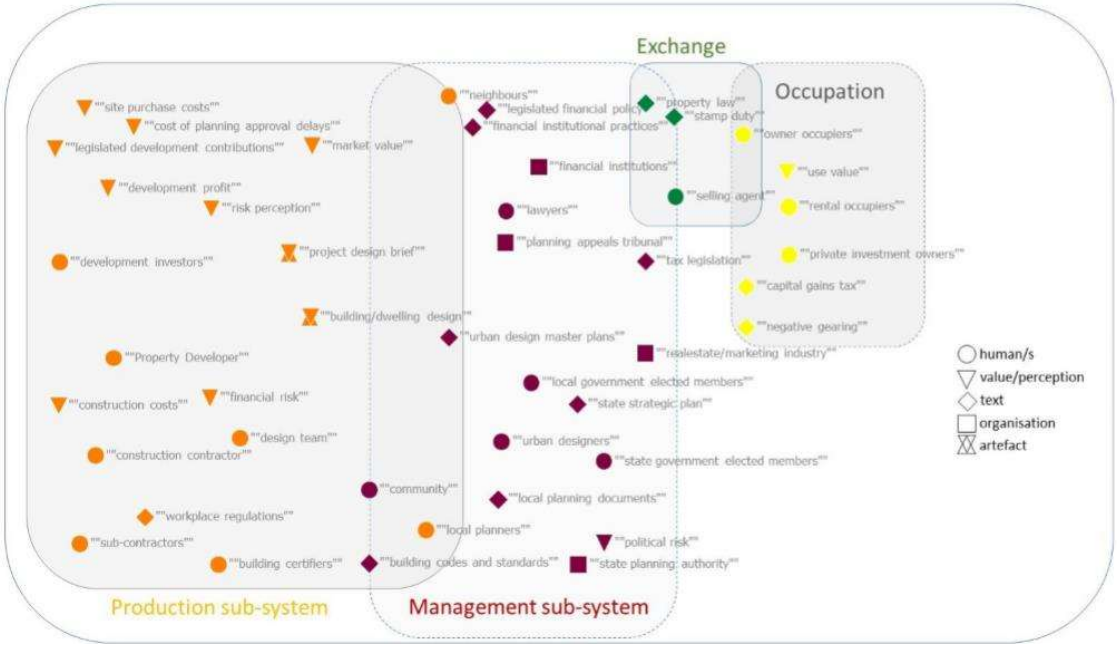
Table1. Problems encountered by actors in building production according to resources in last decade (Developed by Author).

PROBLEM/RESEARCHER	AMANI SULIMAN BU-QAMMAZ	GÜRSEL GÜLER	DENİZ İLTER	GÜL BAŞAK CEBE	NUR ATAKUL	BEGÜM SERTYEŞİLIŞIK	BARIŞ KAPLAN	TUĞBA PAŞALI TUNA	MEHMET ZEKİ PESTİL	SELİN MERSİNKAYA	HAKAN KUŞAN	GÖKÇE DENİZ GÜL	KATHLEEN M.J. HARMON	SİBEL AKDOĞMUŞ	DOÇ. DR. E. TAŞ&Y. ARICI	E.KATERİNA OSİPOVA A & PER ERİK ERİKSSON
Employer	X		X	X	X	X		X	X	X				X	X	
Adviser Firm			X												X	
Designer				X												
Third Party	X		X												X	
Engineer / Architect						X		X	X	X					X	
Contractor	X		X	X	X	X		X	X	X				X	X	
Sub Contractors	X		X	X	X	X	X	X	X	X				X	X	
Supplier			X		X		X	X	X	X					X	
Consultant				X				X	X	X						
Client			X						X							
Building Inspection Authority									X							
Financial Provider								X								
Education Committees / Universities								X	X							
Socio-Cultural Differences		X	X	X			X								X	
Team Spirit			X									X				
Labor Force / Staff	X		X	X	X	X	X						X		X	
Communication		X	X	X								X	X		X	X
Project Management			X	X	X				X	X				X	X	X
Construction Process		X	X		X		X				X			X	X	X
Due Date			X		X								X		X	

Working Schedule	X			X			X								X	
Economical / Financial	X	X	X		X		X				X		X		X	X
Materials / Machines	X	X	X	X	X	X	X		X				X			
Design / Details / Project	X		X	X	X	X	X	X			X		X		X	X
Technology		X			X											
Environment	X	X			X		X				X					X
Site Conditions	X	X		X	X										X	
Access to Site	X		X													
Weather Conditions	X		X	X			X				X				X	
Force Majeur	X	X	X	X		X	X				X		X			X
Risk Diversification / Responsibility			X			X						X				
Accident / Security / Insurance	X			X		X			X							
Approval Delays	X		X	X		X	X						X		X	
Political Developments / Municipality	X	X			X		X		X		X					X
Codes / Legislations / Legal System		X	X	X			X		X		X				X	X
Regulations	X															
Commitment														X		
Bid (Documents)			X				X							X	X	
Specifications			X	X			X		X			X			X	
Contract	X		X	X	X	X	X					X	X		X	
Documentation			X													
Quantities	X															
Inflation / Rate Fluctuation / Tax Increase	X			X												
Cash Flow / Progress Payment	X		X	X		X	X					X		X	X	
Market Conditions							X									
Job Definition and Content	X		X			X									X	
Unreal Expectations			X									X				
Cost			X												X	
Revisions	X		X	X		X						X			X	
Quality / Standarts	X		X	X		X	X					X			X	
Compensation				X												
Controversy						X										

It is possible to say that listed risks are determinative and transformative among actors and actants that play a role in building production and they have equal impact and action. All these factors are included under 'Black-Box', which is one of the basic concepts of ANT where all components of the system can be analyzed without making distinction between human and non-human. The relations of all actors with actants and the effects of these relations are examined. Understanding the complexities and the roles of actors-actants in the process it is possible to restructure and revise the process. In this respect Palmer has tabulated risk factors in the process as follows. (Figure.1)

Figure1. Risk factors for various processes in the building production (Palmer 2014).



5. ANT in terms of Building Production

ANT is a concept originally used in sociological researches. Along with its use in various fields like medical science, economy, information, recently ANT has come into use in architecture and urban design. The foundations of the theory was laid by Latour, Callon and Law's studies on science, technology and society in 80s. However to our regret, most Turkish resources on ANT in the field of building production and architecture are the result of urban scale studies and remains only as theoretical information. For this reason, in Turkey, awareness on this method and its application is so little to mention. Seçilmişler & Yenen (2011), Çelikel (2013), Geçkili (2015), Gündüz (2014) are the few names in our country who studied this topic.

According to Law, even though of ANT included the word "Theory" in it, this concept can be regarded as an approach or a method of analysis. Sociology defined as science of society is the scientific study of society, but ANT (as the title of Latour's book on this subject states) can

be considered as 'Reassembling the Social'. ANT explores the stabilized relations. ANT is a criticism of social science studies and an action taken to complete shortcomings.

Under its book with the title of Reassembling the Social, Latour (2005) refers to the word social in respect of ANT as associations and defines classic sociology as ‘Sociology of Social’ and ANT as ‘Sociology of Associations’. It emphasizes that these associations seen in ANT exist between human and non-human. Appaduari says objects are also a part of social network just like humans and that this network can be shaped with the associations. Latour (2005) expresses that social sciences tracks the traces of only a single social bond whereas contrary to classical sociology ANT explores many bonds together with human and non-human.

In this sense, contrary to modern philosophy, ANT claims both humans and non-humans determinative and at the center of everything in theory.

So it is clear that ANT is not a term used in architecture and building production, and according to Latour, ANT arises from societies not being diluted(heterogeneous) nor strong(homogeneous). For Latour and Law, human and non-human actors are the focal points of ANT, and they define ANT as a heterogeneous network. These associations (connections) between the actors and actants form the network;also network and actor/actants form the Black-Box. At this point it is important to keep in mind that the word 'Network' is different from the word ‘Technical Network’ used in engineering and ANT explores the social relation between the entities. The most important quality of ANT is that it can address humans (actor) and non-human (actants) within the same network. According to Latour, methods, new associations can be observed whereby all entities are applied by monitoring all these actors and actants.

5.1 Actor Network

Network is addressed as a series of nodes created by these actors; these nodes are connected to one another via networks and these networks can be integrated with new nets and expand infinitely.

Actors and actants within the network should continuously strive to maintain the current status of networks and to transit to new statuses. Therefore actor and actant must influence the network and definitely make a difference. According to Latour, some new actors will become part of the network while some leaves the network during the discussion and alliances that arise until the systems are balanced. These discussion and alliance processes experienced may originate from human and non-human. Law suggests that by analyzing all elements of the system without making distinction between human/non-human, it is be possible for all disciplines to use ANT, whereby the researchers can obtain all studies made in this respect

Architecture may be included within the scope of ANT as well since the actor-network is not composed only of humans but also of non-humans like artefacts (contracts, laws) Also these artefacts shape the network and have a determinative role. For all these reasons stated, the necessity to use ANT comes from the fact that challenging drivers like continuous information sharing, revision of studies and complex processes are at the same time the consolidating drivers.(Adam, A.&Gluch,P.& Julin,J.2014)

As non-humans like artifact drivers are part of the network in design applications, trying to find a solution with the help of ANT will make it possible to resolve problems experienced in this complex process. To understand the function of actor-actant in terms of ANT in building production, it is necessary to observe whether this actor-actant has influence on the other participants.

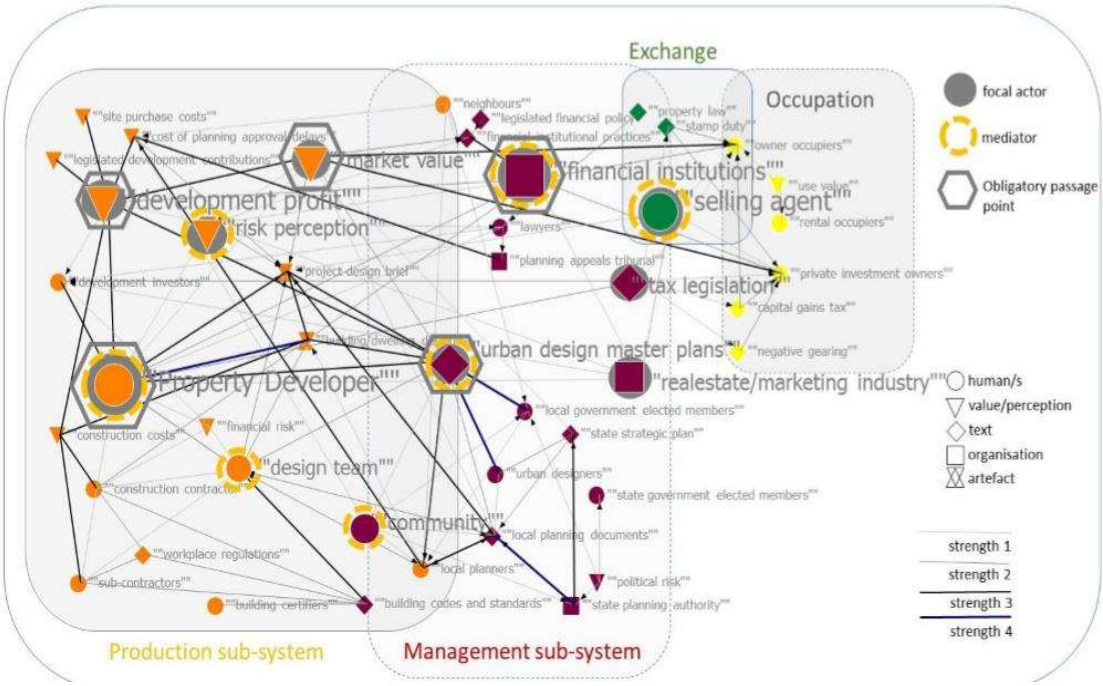
It is assumed that all entities that are human(architect, engineer, designer) and non-human(technology, materials, machinery) have equal action. Mahmoud(2015,p.7)

According to Callon, buildings are not totally products of architecture, many actors-actants are also involved in production process.

Adam and et.al(2014) suggest that structures are not just the result of works of a good designer, also the result of the relations to be established with a human/non-human society. Within this scope Latour states that artifacts may be designed to replace humans. These artifacts may be changed with actor's actions and decisions. However problems may be experienced as each actor tries to protect it's own interest. Therefore without making any hierarchical pre-assumption about the members of network, we need to check associations that these members establish with other members.

Palmer(2014) includes the factors like delays,financial risk, construction cost, contractor, architecture, engineer, public, political risks, in the actor-network mapped.

Figure2. Actor-Network in Building Production Processes (Palmer 2014)



According to Seçilmişler&Yenen(2011), ANT is explanatory theory,especially in the production process of disordered structures. ANT may help understanding the problems among groups, and any conflict and settlement of these conflicts, which arise since each different actor tries to shape the relationship based on its own interest.

6. Network Participants: Actor/Actant

According to Black-box, networks determine the relations between actor and actants.

Network: Association(relation-connection) formed

Actor: Human entities that effect the network(e.g.manager)

Actant: Non-human entities that effect the network.(As actants become part of the network, materials do no longer cause a problem and are considered as equal with the actors(human). Accordingly it will be possible to examine how relations of actor-actant are shaped and changed) (e.g.:contracts, all artifact objects)

While emphasizing in theory that objects are not different from humans; it is also highlighted that artefact, i.e. human made things (e.g.laws) can replace actions. This way, non-humans can perform equally, in other words humans are not superior to other objects. In this respect; the main question here should be 'Whether the actor has any effect on the action of another actor'. In short the actor is the actuator. ANT is a theory that explores which consequences cause these interactions (being influenced by other things) and what kind of effect these interactions have. The important thing here is to observe (objectively) how something progresses.

7. Black-Box

Black-box is formed by stablyzing the actor-network for a while. This helps understanding the roles of actors in the network and the complications experienced. Also as errors arise in the network of complex social relations, feedbacks on network may be possible to reach desired level in various topics.Some figures who worked on ANT specify that the color of the

network is directly proportional to the strength of the bond between the elements in black-box.(Figure.2)

According to Latour there are many inputs-outputs and unknowns in Black-Box. At this point Yaneva and Heaphy states that these actors which exist in the network must expedite the process over the network and among each other or must make differences like changing their opinion on a specific issue. Nevertheless all actors are equally accepted to the network without bias.Latour emphasizes that the act of "Opening the Black Box" helps to understand which actor-actants' influence shapes the products produced during this process.

In building production, Black-Box can be interpreted as the actor's communication with the outside world during the process. Opening of 'black box' can be specified as the act whereby other participants(actor-actant) take into consideration the actor or actant factors included in the process like employer, designer, specification, contract, progress payment and revise the processes based on these factors. This way it may be possible to achieve facilitating, foreseeable and risk mitigating processes.

Palmer (2014) lists these actors that exist in the black box as contractor, architecture, engineer, political risks, private investment owners and local authority policies. (Figure.1)

When we list all the actors in the black box for the building production, we see that they are extremely compatible with the risk factors. And in our field survey we tried to opening this black-box.

8. Field Survey:BDDK Building

In the meeting of Council of Ministers dated 17.01.2012 the decision for Istanbul International Finance Center(IIFC) investment was reached(the meeting held with participation of Deputy Prime Minister Minister of Environment and Urbanization, Chairman of TOKİ(Housing Development Administration of Turkey), Emlak GYO General Director and president of other institutions specified). Accordingly it was stated that within the scope

of IIFC there will be the buildings of Vakıfbank, Halkbank, Ziraat Bankası, BDDK, IMKB and SPK. Following this meeting, a 4-year IIFC Preparation works phase took place and upon completion of the preparation works, in October 2016 started the construction of BDDK Building, which we used as basis in our field survey. The completion date for construction works of all buildings of IIFC is anticipated as 2020. BDDK Building, is one of the building within the scope of IIFC, and the construction site is 127,809m2. The 28-floor building constructed over 7-basement floors is located in the city of Istanbul, county of Umraniye.

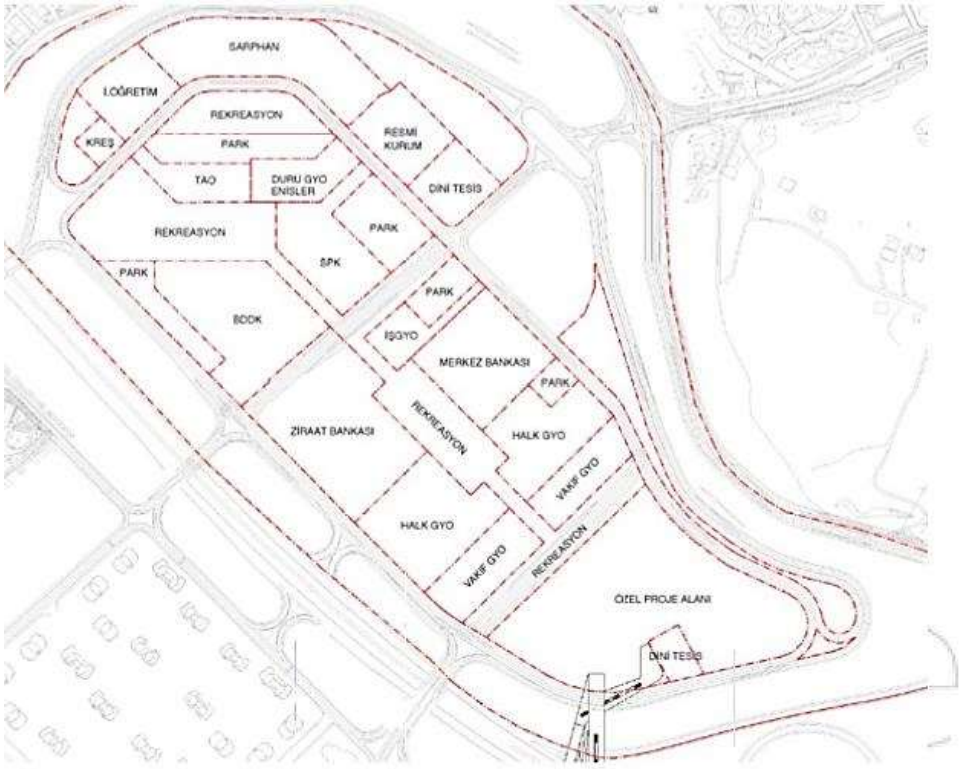


Figure3.IIFC Layout-plan(ARUP)

It is believed that due to following reasons BDDK Building has ideal data regarding mapping networks in terms of ANT:

-there are multi-actors(the Prime Ministry presented the main theme, the project is shaped according to requirements of BDDK, the building is constructed with the partnership of the state-private sector.

-numerous laws, institutions, actors, materials and various systems are involved in the process

-it is a large scale mixed-use project

-composed of many detached sections

-a mega project

-revised frequently

-complex processes

8.1. Method Applied

Following the literature research, a field survey was organized and interviews are made with YDA İnş. San. ve Tic. A.Ş.(Contractor-actor) employees who played an active role in the process, and general information was collected about the general situation, approaches in respect of the project, factors that affect decision changes and the processes carried out. Data were collected and correspondences between individuals, institutions and companies were examined. Following, we tried to map an actor-network with the help of these data.

i. Tables were prepared about the work items, actor-actants that took part and the documents required to be followed; and the actants were represented with vectors.

ii. Subsequently an actor-network is created in the clearest way possible.

8.2. BDDK Building Investment Decision

Regarding the BDDK Building, for which field survey was carried out, on 18.03.2017 and 25.03.2017, interviews were made with BDDK Building Project Manager-Civil Engineer Fethi Evren Oytun (actor) and Deputy Project Manager-Master Architect Ahmet Emre Başar(actor) from YDA İnşaat(actor). In interviews, information were collected about BDDK Building investment decision, tender process, design and construction process. In addition to these informations that company shared (specifications, contracts, projects, reports, guides, organization chart). Later again on 15.01.2018, 18.01.2018 and 22.01.2018 interviews were made with DPM M.Arch Ahmet Emre Başar (actor) about items of work and documents were

handed out on 16.01.2018 and 19.01.2018. At this point it would be useful to mention that the actor-network is created according to the information disclosed by the company and it is perfectly natural that there may be documents forgotten or missed out.

In the Council of Ministers (actor) meeting, the decision of investment was reached for (IIFC) located in Istanbul-Ataşehir, promoted as 'Mega Project',and all design criteria(actant) for the buildings within the scope of IIFC were determined. In this meeting,locations of each buildings are determined by Emlak GYO(actor) protocols and the PROJECT COORDINATOR is appointed to ensure completion of work on time and EMPLOYER is assigned to prepare the concept projects(actant) of IIFC.

Figure4.IIFC Concept Project Image(ARUP)

Along with this, since the parties who will own the buildings of public institutions at IIFC are not specialized in the business of construction, TOKI (actor) was appointed for the construction of the buildings of these institutions according to concept projects determined by EMLAK GYO. Following this, TOKİ put out a tender as the EMPLOYER-ADMINISTRATION for each public institution building and has contracted (actant) with various construction companies. At the end of the tender process EMLAK GYO (EMPLOYER-actor) has selected ARUP (actor) as DESIGNER for IIFC concept project and AKDENIZ İNŞAAT (CONTRACTOR-EXCAVATION WORKS) (actor) was awarded for of all IIFC Land Preparation. AKDENIZ (actor) subcontracted ERGÜ (SUBCONTRACTOR-actor) for excavation works and TERRA (SUBCONTRACTOR-actor) for revetment works.

(Normally rough-construction process are carried out by the same employer, so the land preparation process made in advance is an exception for this project)

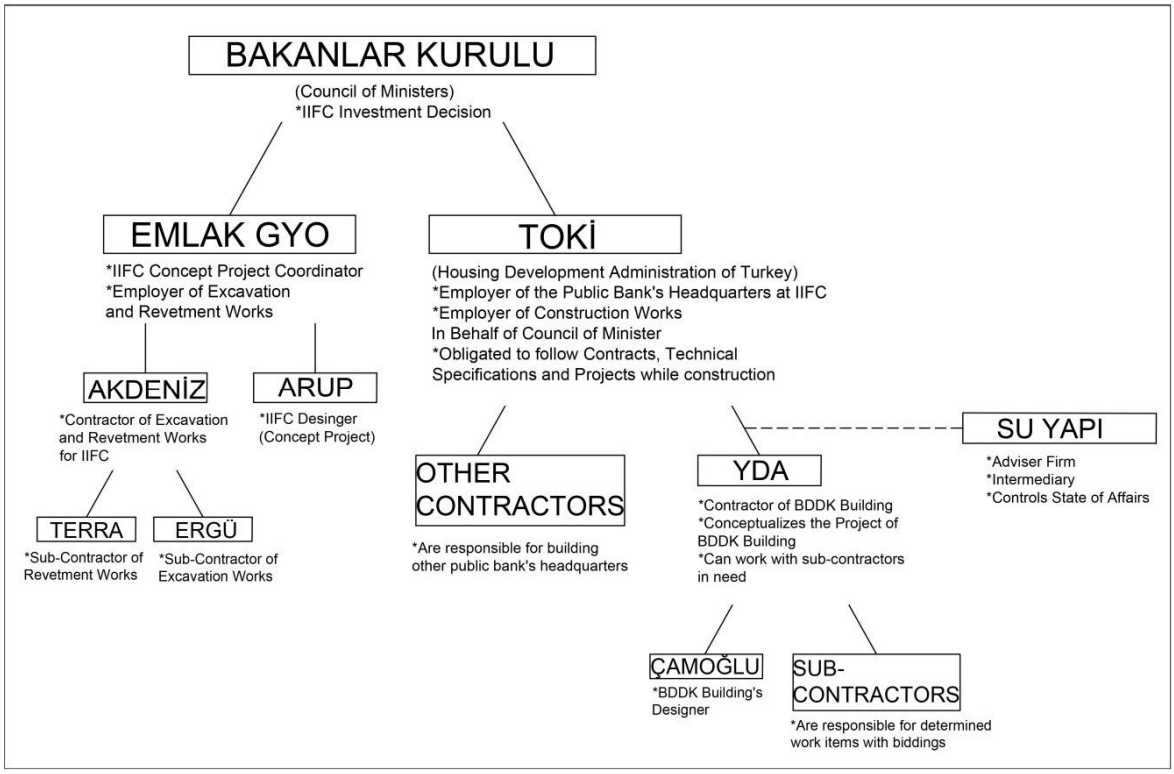


Figure 5.IIFC Investment Decision and Organization Chart for Tender Processes (Developed by Author).

YDA (actor) was awarded the tender for the BDDK Building.

'It will be easier to handle the subject by considering BDDK as the user of a state-owned building, instead of treating BDDK as the employer.' TOKI (actor) is the employer in the construction process.'(A.E.Başar,Voice Call, 25March2017)

YDA(Contractor-actor) is responsible for preparing the project(actant) for the BDDK Building pursuant to design criteria(actant) set forth under the concept project(actant),for obtaining approvals-permit(actant) and for meeting the tender conditions(actant) pursuant to the Specifications(actant)prepared by TOKI(actor) and for completing the construction within the time set(actant).

Figure6. Image of BDDK Building (ÇAMOĞLU MİMARLIK)

After tender,Su Yapı(actor) was appointed as the Adviser Firm to ensure the communication between TOKI(actor) and YDA(actor).As the BDDK Building is a state owned building, there will not be an extra Audit Firm(actor) like there is in a normal project.

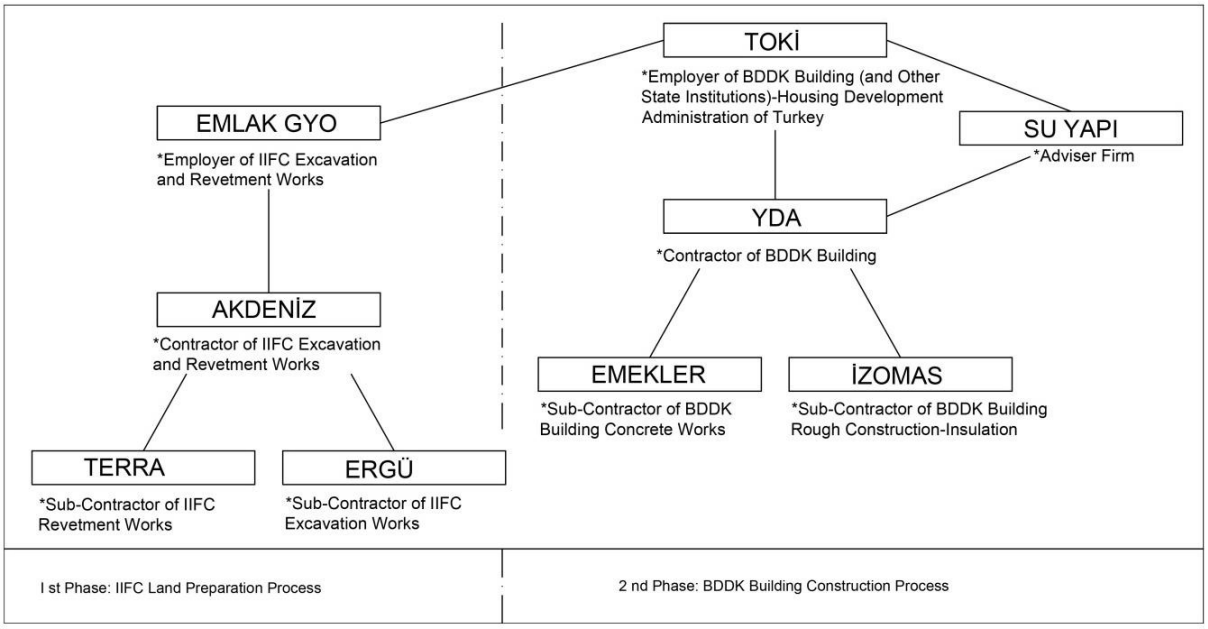


Figure7.BDDK Building Rough-Construction Organization Chart(Developed by Author)

8.3. BDDK Building Design Process & Permit etc. Approvals

YDA (actor) made an agreement with Çamoğlu(actor) as Designer.(At this point Çamoğlu(actor) is responsible for architectural design according to the concept project

prepared by ARUP on behalf of Emlak GYO. Also, who is responsible for designing the project starting from obtaining the permit to implementation of the project on behalf of YDA). Furthermore, advisers stepped in whenever required during the design phase.

The relevant project were made to check compliance of the project with main design criteria and the concept project by TOKI (actor) and Emlak GYO(actor).

Also, Ministry of Environment and Urbanization Committee of Aesthetics (actor) checked the compliance of the project to Building Law (actant).

Soon after this, the relevant municipality (actor) granted the building permit.

Subsequently YDA (actor) selected the materials pursuant to the Technical Specification (actant) prepared by TOKI and the Approved Construction Drawings.(actant)

8.4. Construction Phase

Since the building is within the scope of IIFC, YDA(actor) specified the BDDK Building construction phase work items for the Rough-Construction work of BDDK Building where excavation works had been carried out in advance(this is an exception for this project). Some work items were completed by YDA(actor) and also subcontractors(actor) were assigned for the construction of approved work items(At this point it should be kept in mind that due to uniqueness of each project or due to reasons like urgency, disagreements or expertise requiring works, different actors-actants may be required for each work item, and sometimes these actors may be responsible for more than one work item as is due under the contract and specifications or vice versa multiple actors may be responsible for one work item. Contracts signed by YDA(Contractor-actor) with Subcontractors cover all Technical Specifications within the scope of contracts that TOKI(Employer-actor) signed with YDA(Contractor-actor).(As work items are performed by way of subcontracting)

9. Mapping Actor-network during Rough-Construction

We tried to explore the 'Rough-Construction' stage of the BDDK Building, the subject of the field survey, in terms of Actor-network Theory. The reason why only one stage of the project is explored is to reflect the most simplified form of the 'Actor-network' which is a highly complex structure. For this purpose actor-network is built based only on documents; actants like materials, interviews are not included in the network. As can be seen in Table2, work items of Rough-Construction stage, actors, documents(actant), that regulate the relations between actors, all specification-norm-standards(actant) included in documents are listed.

Table2.BDDK Building Rough-Construction Work Items, Actors-Actants (Developed by Author)

			Work Items	Actor	Document	Specifications / Norm / Standard	
ROUGH CONSTRUCTION	IIFC Land Preparation Process	Excavation Works	Revetmant	*EMLAK GYO (Employer of Excavation and Revetment Works) *AKDENİZ İNŞAAT (Contractor of Excavation and Revetment Works) *TERRA ZEMİN (Sub-Contractor of Revetment Works)	•IIFC Soil Investigation Report *IIFC Design Guide •IIFC Reports for Engineers *Contract of Revetment *Contract of IIFC BDDK Building	•Technical Specifications of Geotechnical Desig Criterias •Guide of General Directorate of Highways •TSE •Performance Based Design Regulation for High Rise Buildings in Istanbul •General Specifications of the Construction Affairs	
			Excavation	*EMLAK GYO (Employer of Excavation and Revetment Works) *AKDENİZ İNŞAAT (Contractor of Excavation and Revetment Works) *ERGÜ HAFRİYAT (Sub-Contractor of Excavation Works)	•IIFC Soil Investigation Report *IIFC Design Guide •IIFC Reports for Engineers *Contract of Excavation *Contract of IIFC BDDK Building		
	BDDK Building Rough Construction Process	Concrete Works	Reinforcing Bar	*EMEKLER (Sub-Contractor of Concrete Works) *YDA (Contractor of BDDK Building) *TOKİ (Employer of BDDK Building- Housing Development Administration of Turkey) *SU YAPI (Adviser Firm)	•Structural Design Criteria Report •IIFC Reports for Engineers •IIFC Soil Investigation Report *IIFC Design Guide *Contract of Concrete Works *Contract of IIFC BDDK Building *Advising Contract of IIFC BDDK Building *Nonconformity Report *Daily Reports *Monthly Reports	•Technical Specification of Statics •Turkish Association for Bridge and Structural Engineering-Specification of Concrete Works-Steel-Wooden •Turkish Association for Bridge and Structural Engineering-Specification of Structural Loads •Specification of Building Construction at Disaster Areas •General Specifications of the Construction Affairs *Specification of Concrete *Specification of Reinforcing Bar •Specification of Wind for Building Construction at Seismic Zones •Specification of High-Rise Buildings at Istanbul •High-Rised Buildings Earthquake Regulations at Istanbul • Tall Building Initiative, Design Guidlines for Performance-Based Design of Tall Building	• TSE • IBC • UBC • AISC • ACI • ASCE • San Francisco Tall Building Code • Los Angeles Tall Building Code • ASTM • CTBUH • NBCC • EUROCODEs'
			Formwork				
			Concrete				
		Insulation Works	Sealing	*İZOMAS (Sub-Contractor of Rough Construction-Insulation) *YDA (Contractor of BDDK Building) *TOKİ (Employer of BDDK Building- Housing Development Administration of Turkey) *SU YAPI (Adviser Firm)	•IIFC Reports for Engineers •IIFC Soil Investigation Report *IIFC Design Guide *Contract of Insulation Works *Contract of IIFC BDDK Building *Advising Contract of IIFC BDDK Building *Nonconformity Report *Daily Reports *Monthly Reports	•TSE •Architectural Specification •Technical Specifications of Employer •General Specifications of the Construction Affairs •Specification of Energy Performance for Buildings •Specification of Fire Protection for Turkey •Specification of Building Construction at Disaster Areas	
		Mechanical Works	Reservations	*YDA (Contractor of BDDK Building-Obligated for Rough Construction Mechanical Works) *TOKİ (Employer of BDDK Building- Housing Development Administration of Turkey) *SU YAPI (Adviser Firm)	•IIFC Reports for Engineers *IIFC Design Guide *Contract of IIFC BDDK Building *Advising Contract of IIFC BDDK Building *Nonconformity Report *Daily Reports *Monthly Reports	•Technical Specification of Mechanics •General Specifications of the Construction Affairs *Application Guide for Plant Engineers	•ASTM •ASHRAE •ARI •AMCA •ANSI •EN •EUROVENT •ISO •NFPA •SMACNA •TSE •CIBSE
			Waste Water Discharge Connections (Inside Foundations)				

		Electrical Works	**Static Grounding**	***YDA** (Contractor of BDDK Building-Obligated for Rough Construction Electrical Works) ***TOKİ** (Employer of BDDK Building- Housing Development Administration of Turkey) ***SU YAPI** (Adviser Firm)	•IIFC Reports for Engineers *IIFC Design Guide *Contract of IIFC BDDK Building *Advising Contract of IIFC BDDK Building *Nonconformity Report *Daily Reports *Monthly Reports	•Technical Specification of Project •General Specifications of the Construction Affairs	•Electrical Installation Regulations •Specification of Lightning Protection •Specification of Static Grounding of Ministry of Energy and Natural Resources *TSE
		Infrastructural Works	**Wastewater System**	***YDA** (Contractor of BDDK Building-Obligated for Rough Construction Infrastructure Works) ***TOKİ** (Employer of BDDK Building- Housing Development Administration of Turkey) ***SU YAPI** (Adviser Firm)	*Contract of IIFC BDDK Building *Advising Contract of IIFC BDDK Building *Nonconformity Report *Daily Reports *Monthly Reports •IIFC Reports for Engineers	•TSE •Technical and Administrative Specifications •General Specifications of the Construction Affairs •Specifications of Ministry of Environment and Urbanisation Directorate General for Construction Affairs •Specification of External Waste Water Network •Specification of Internal Waste Water Network •Technical Specification of Infrastructural Works •Technical Specification of Project	
			Drenaj System (Foundation)				
			Storm Water System				
			Technical Infrastructure Connections and Recirculate				

In Table 3 we see vectors assigned to 'Rough-Construction' phase's actors in order to prevent complications on Actor-network caused by actants(contract, specification-norm-standards-other documents) which actors have in respect of relations they establish with other actors so a simple actor-network can mapped. Otherwise a highly complex actor-network would have been achieved. (Figure.2)

Table3. Assigning vectors to actors for the actants that are part of the BDDK Building Rough-Construction process (Developed by Author)

	VECTOR	ACTOR	CONTRACTS	SPECIFICATIONS	STANDARDS	LAWS AND REGULATIONS	OTHER RESOURCES	
Excavation Works	A1-K	•EMLAK GYO •AKDENİZ İNŞ.	•Contract of IIFC BDDK Building	•Technical Specifications of Geotechnical Desig Criterias •General Specifications of the Construction Affairs	•TSE	•Performance Based Design Regulation for High Rise Buildings in Istanbul	•IIFC Reports for Engineers •IIFC Soil Investigation Report •IIFC Design Guide •Guide of General Directorate of Highways	
	A2-K	•AKDENİZ İNŞ. •TERRA ZEMİN	•Contract of Revetment					
	B1-K	•EMLAK GYO •AKDENİZ İNŞ.	•Contract of IIFC BDDK Building					
	B2-K	•AKDENİZ İNŞ. •ERGÜ HAF.	•Contract of Excavation					
Concrete Works	C1-K	•YDA •TOKİ	•Contract of IIFC BDDK Building	•Technical Specification of Statics •Specification of Reinforcing Bar •Turkish Association for Bridge and Structural Engineering-Specification of Concrete Works-Steel-Wooden •Turkish Association for Bridge and Structural Engineering-Specification of Structural Loads •General Specifications of the Construction Affairs •Contract of Concrete Works	•TSE •IBC •UBC •AISC •ACI •ASCE •San Francisco Tall Building Code •Los Angeles Tall Building Code •ASTM •CTBUH •NBCC • EUROCODEs' •TBI	•Specification of Building Construction at Disaster Areas •Specification of Building Construction at Seismic Zones •Specification of Wind for Building Construction at Seismic Zones •High-Rised Buildings Earthquake Regulations at Istanbul		•Structural Design Criteria Report •IIFC Reports for Engineers •IIFC Soil Investigation Report •IIFC Design Guide
	C2-K	•EMEKLER •YDA	•Contract of Concrete Works					
	C3-K	•TOKİ •SU YAPI	•Advising Contract of IIFC BDDK Building					
	C4-K	•YDA •SU YAPI					•Nonconformity Report •Daily Reports •Monthly Reports	

	VECTOR	ACTOR	CONTRACTS	SPECIFICATIONS	STANDARDS	LAWS AND REGULATIONS	OTHER RESOURCES	
Insulation Works	D1-K	•YDA (1) •TOKİ	•Contract of IIFC BDDK Building	•Architectural Specification •Technical Specifications of Employer •General Specifications of the Construction Affairs	•TSE			•IIFC Reports for Engineers •IIFC Soil Investigation Report •IIFC Design Guide
	D2-K	•İZOMAS •YDA	•Contract of Insulation Works					
	D3-K	•TOKİ •SU YAPI	•Advising Contract of IIFC BDDK Building					
	D4-K	•YDA (1) •SU YAPI					•Nonconformity Report •Daily Reports •Monthly Reports	
Mechanical Works	E1-K	•YDA (2) •TOKİ	•Contract of IIFC BDDK Building	•Technical Specification of Mechanics •General Specifications of the Construction Affairs •Application Guide for Plant Engineers	•CIBSE •ASTM •ASHRAE •ARI •AMCA •ANSI •EN •EUROVENT •ISO •NFPA •SMACNA •TSE	•Specification of Energy Performance for Buildings •Specification of Fire Protection for Turkey •Specification of Building Construction at Disaster Areas		•IIFC Reports for Engineers •IIFC Design Guide
	E2-K	•TOKİ •SU YAPI	•Advising Contract of IIFC BDDK Building					
	E3-K	•YDA (2) •SU YAPI					•Nonconformity Report •Daily Reports •Monthly Reports	
Electrical Works	F1-K	•YDA (3) •TOKİ	•Contract of IIFC BDDK Building	•Technical Specification of Project •General Specifications of the Construction Affairs	•TSE	•Electrical Installation Regulations •Specification of Lightning Protection •Specification of Static Grounding of Ministry of Energy and Natural Resources		
	F2-K	•TOKİ •SU YAPI	•Advising Contract of IIFC BDDK Building					
	F3-K	•YDA (3) •SU YAPI					•Nonconformity Report •Daily Reports •Monthly Reports	
Infrastructural Works	G1-K	•YDA •TOKİ (1)	•Contract of IIFC BDDK Building	•Technical Specification of Infrastructural Works •Advising Contract of IIFC BDDK Building •General Specifications of the Construction Affairs •Specifications for Construction of Affairs Ministry of Environment and Urbanisation Directorate General for Construction Affairs •Specification of External Waste Water Network •Specification of Internal Waste Water Network •Technical Specification of Project	•TSE			•IIFC Reports for Engineers
	G2-K	•TOKİ (1) •SU YAPI	•Advising Contract of IIFC BDDK Building					
	G3-K	•YDA •SU YAPI					•Nonconformity Report •Daily Reports •Monthly Reports	
Relation just for Conceptual Project	H1-K	•EMLAK GYO •TOKİ (2)			•TSE	•Performance Based Design Regulation for High Rise Buildings in Istanbul •Specification of Building Construction at Disaster Areas •Specification of Building Construction at Seismic Zones •Specification of Wind for Building Construction at Seismic Zones •High-Rised Buildings Earthquake Regulations at Istanbul •IIFC Concept Project	•IIFC Design Guide •Structural Design Criteria Report •IIFC Reports for Engineers •IIFC Soil Investigation Report	

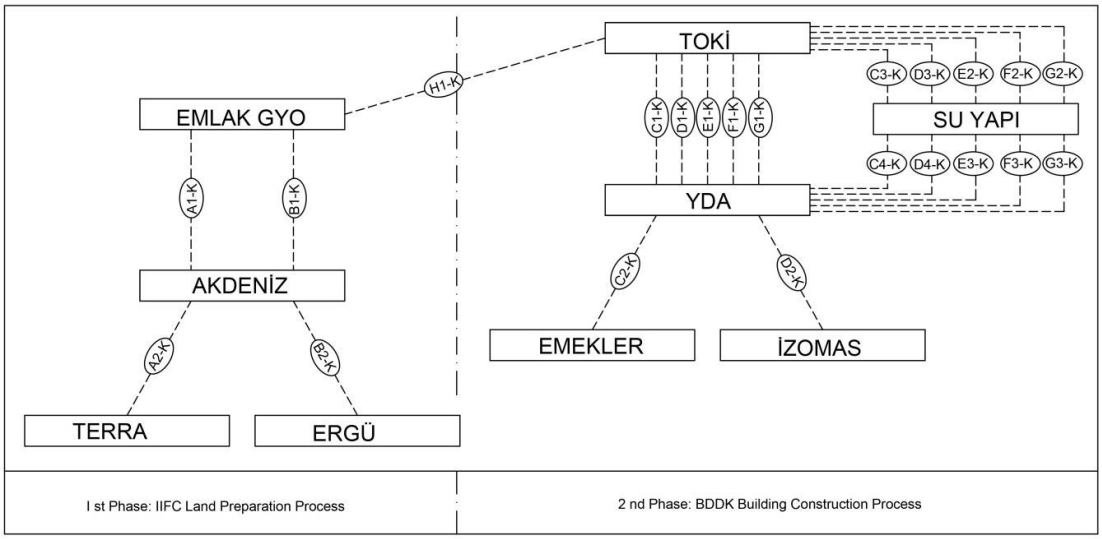
We can see Table4 which vectors (actants) will use to contribute for mapping the network (which actant a vector encompasses) by actants. Actor-Network (Table.5) is formed by adding to organization chart composed of actors, the actants we symbolized with vectors.

Table4. Vectors according to actor's associations during the BDDK Building Rough-Construction process (Developed by Author)

	SU YAPI	TOKİ	EMLAK GYO	YDA	AKDENİZ İNŞAAT	EMEKLER	TERRA	ERGÜ	İZOMAS
VECTOR			A1-K		A1-K, A2-K		A2-K		
			B1-K		B1-K, B2-K			B2-K	
	C3-K, C4-K	C1-K		C1-K, C2-K, C3-K, C4-K		C2-K			
	D3-K, D4-K	D1-K		D1-K, D2-K, D3-K, D4-K					D2-K
	E2-K, E3-K	E1-K		E1-K, E2-K, E3-K					
	F2-K, F3-K	F1-K		F1-K, F2-K, F3-K					
	G2-K, G3-K	G1-K		G1-K, G2-K, G3-K					
		H1-K	H1-K						

To explain the actor-network seen in Table5, first it should be stated that actors who are part of the 2-stage BDDK Building rough-construction process are laid out in the form of an organization chart. Than the actors that have connections are coupled up with the help of network (shown with dotted lines). Since the actants that determine relations between these actors will be connected to network, group of actants shown with vectors (e.g. all actants that A1-K vector encompasses are given in Table3) are included in this network mapping.

Table5. Actor-network Mapping in BDDK Building Rough-Construction Process (Developed by Author)



In the 1st Stage, which is the (Land Preparation Stage), the employer EMLAK GYO actor contracts out the Excavation& Revetment works to AKDENİZ İNŞAAT(Contractor) together with actants within the scope of A1-K(Table.3) and B1-K(Table.3) vectors. Akdeniz İnşaat accepts the actants added to A1-K vector determined for revetment work as A2-K vector and

via these vectors it subcontracts the revetment works to TERRA. Likewise it takes the excavation works from AKDENIZ İNŞAAT via B1-K vectors and subcontracts these works together with B2-K vectors to ERGÜ.When passing from 1st Stage of the Rough-Construction to the 2nd Stage, we see that H1-K vector establishes a bond with TOKI between EMLAK GYO via IIFC concept-project actants. After that,as the employer of BDDK Building, TOKI assigns to YDA the BDDK Building for rough-construction works through contracts signed(actant), specifications made (actant) and standard-regulation-other sources(actant)(C1-K, D1-K, E1-K, F1-K, G1-K vectors). So C1-K,D1-K,E1-K,F1-K,G1-K vectors encompass the actants that will determine the relations between actors. When YDA (contractor-actor) assigned the work to EMEKLER (subcontractor-actor) within the scope of C1-K vector,new actors(subcontractor) creates the C2-K vector together with the new actants(specification, contract, standard-regulation-other sources). At this point it is important to mention that the reason why we see the C2-K vector and EMEKLER actor in addition to the C1-K vector and TOKI-YDA actors is that the work is subcontracted (no relation between TOKI and EMEKLER). YDA, has individually undertaken work items that require expertise.(Via actants determined with E1-K, F1-K, G1-K vectors) and subcontracted other work items that are outside the scope of its area of expertise and has assigned reinforced concrete works to EMEKLER via C2-K vector and insulation works to İzomas via D2-K vector.

In some projects as there is no need for subcontractors,so number of networks established may be less. Or quite the opposite, when a single work item requires multiple areas of expertise, relations with much more actors may be required(For example in this project, Revetment works shown with A1-K and A2-K vectors and Excavation Works shown with B1-K and B2-K are being carried out by different actors and actants as such works require expertise). So the number of these vector (accordingly the actants) and actors-actants depends

directly on the method of work and this may be different in each project.So,in the work performance process, actants have as important function as the other actors.

Along with this SU YAPI(adviser-actor) renders consultancy services under C3-K vector between actors YDA&TOKI, while auditing the progress of the work(accordingly to ectors-actants and the method of application) on behalf of TOKI(employer-actor) since YDA(contractor-actor) is the contractor. Here C4-K vector is between YDA and SU YAPI. According to C4-K vector, SU YAPI will be inspecting the reports kept about the progress of work and the conformance to specifications, contracts, standard-regulation-other sources, which constitute the entire actants determined in respect of performance of work, so these reports will be included in actor-network as an actant. So there may be multiple vectors between same actants in different vectors. This may create problems between actors. So, opening the black-box and analyzing the actor-network will help to find where the problem cause.

Since only the rough-construction phase was explored, the actor-network is extremely simple. Naturally we would have a highly complex network if we applied the actor-network to the entire project (Figure.2). It should be kept in mind that there are many actors and actants in network. However actor-network mapping according to data provided by the company and it is also extremely simplified to explain the subject much more easily.

10. Conclusion

According to outcome of the literature review made regarding Actor-Network Theory, an attempt was made to demonstrate by applying this theory on a project, that actors(humans) and actants(non-humans), in other words all entities that affect the production process, may have transformative effects on another. The form of relations between actor and actants were explored on the basis of black-box concepts.

Applying the ANT on a real project helped us to see how actors and actants can change and transform relations. Problems experienced during the construction process does not necessarily arise directly from actors or actants with whom a bond is established, such actor-actant may be acting under the influence of other actor-actants.(For example subcontractor must comply with the specifications set forth by the contractor.However the employer is the one that really sets forth this specifications in the first place)

This study reads into how the relations of actor and actants with the actor-network are shaped by other actor(s)-actant(s) and sets forth the origin of the problems that may be experienced during rough-construction stage.(Vector-actants determined in Table.3)

Considering that it will provide many solutions, ANT can be used in building production projects with such complicated relations. In Turkey,whenever ANT is mentioned it is usually associated with theoretical discussions.This study may set a good example to studies that will be made in the future.

As the result of the highly complex chain of actor-actants included in the BDDK Building Project,we deliberated on the issue of having a more simplified actor-network. We tried to resolve this by assigning vectors to actants and eventually mapping a very clear actor-network. In case of any problem, one simply needs to check the actor and vectors(and the actants under vectors) on the actor-network to understand which actor-actant causes the problem. It is clear that vectors and actors on the actor-network are influenced from each other and that sometimes one vector influences the decisions of another vector.(For example, since the work is subcontracted, in addition to actants under C1-K vector, C2-K vector is formed with the new actor and actants determined)

Hereunder an actor-network mapping for 'Rough-Construction' process of BDDK Building, which is the subject of our field survey. Thanks to this actor-network, it is possible to easily detect which actors make associations with one another through which vectors.It was seen

that specially for the BDDK Building production process, the rough-construction stage was a two-staged process and different actors-actants were involved in each stage.It is understood that there were two employers for the Rough-Construction stage(EMLAK GYO&TOKI) and that these two employers were associated with each other only in terms of compliance with the concept project(via H1-K vector) and besides this, the work done is completely different. As these two employers both subcontracted the construction works during the rough-construction phase, new actors(and actants) are in the network. So for example one of the actants under B2-K vector may be the cause of the problem that may be experienced in excavation works but it may be possible that these actants are determined by Akdeniz, B1-K vector and EMLAK GYO actors. But when we check the actor-network once again to resolve the problems experienced in excavation works, it is understood that IInd stage has nothing to do with the excavation works so it would be irrelevant to check these actors-vectors to find the cause of the problem. In a sense,this helps with the time management. By simply checking this actor-network, the root of the problem is easily figured out and it becomes possible to resolve the problem experienced.

ANT may help identifying the problem clearly by explicitly showing all the factors(actors-actants) in the system of relations where this problem underlies, and thus it may help overcoming problems experienced, which will eventually lead to achievement of targets set for many processes like management, finance, planning, construction.

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List of Appendices

Appendice1. How problems handled in literatures that addressed in Table1 (Developed by Author)

'RISK ASSESSMENT OF INTERNATIONAL CONSTRUCTION PROJECTS USING THE ANALYTIC NETWORK PROCES' -Ms. Thesis-AMANI SULIMAN BU-QAMMAZ	·Priorities and risk factors could be applied to other projects.
	·Actors could be directly effected by risks. Increasing in number of actors are in direct proportion to problems.
	·Employer, codes, contracts, working schedules, payments and majeur forces are important risk factors.
	·Risk levels could be effected by actors' previous experiences. All associations are unique since each actor are different.
	· Elements of risks and previous experiences may effect following decissions, as well as project success. Element of risks are complicated.
'İNŞAAT PROJELERİNDEÇALIŞANLARIN RİSK YÖNETİMİ VE RİSK AZALTICI TEDBİRLER KARŞISINDAKİ TUTUMLARI: ANTALYA ÖRNEĞİ'-Ms. Thesis-GÜRSEL GÜLER	·Process of building construction are so complicated since there are various actors. So that, eliminating the risks are not possible but may minimize.
'İNŞAAT PROJELERİNDE UYUŞMAZLIK ÇÖZÜM YÖNTEMİ SEÇİMİ İÇİN ÇOK KRİTERLİ KARAR VERME MODELİ' -Ms. Thesis-DENİZ İLTER	·Analysing just client's expectations may cause controversies in process of building construction.
'TÜRKİYE'DE YAPILAN İNŞAAT PROJELERİNDE YAPIM AŞAMASINDA MALİYET VE SÜRE AŞIMINA NEDEN OLAN FAKTÖRLERİN İNCELENMESİ' -Ms. Thesis-GÜL BAŞAK CEBE	·Process of building construction are multi-actor and they includes both consecutive and intersecting phases. So this complex network causes various problems.
	·Each actor in a construction project (Contractor, employer, project manager, etc.) look from one's aspect the underlying reason (for the problem).
	·Studies about these problems shows as each problem has an effect on other factors.
'İNŞAAT PROJELERİNİN UYGULAMA AŞAMASINDAKİ RİSKLERİN YÖNETİMİ' -Ms. Thesis-NUR ATAKUL	·Due to it's long-termed, complex phased and unique phases in process building constructions includes various risks.
	·Economical and political uncertainities (So that cost and due dates) may occour controversies between actors.
'AN INVESTIGATION ON THE APPLICATION OF STANDARD CONTRACTS IN THE TURKISH CONSTRUCTION INDUSTRY' -Phd. Thesis-BEGÜM SERTYEŞİLIŞIK	·The main point is to get to the root of the problem at the process of building construction.
	·A problem at the process may effect other problem occur (Directly or indirectly)

'YAPI ÜRETİMİNDE ZAMAN YÖNETİMİNİN ÜRÜN KALİTESİNE ETKİSİ' **-Ms. Thesis-TUĞBA PAŞALI TUNA**	·The aim of the building construction process is that to complete the project at due date with determined cost.
	·Time, quality and cost are effecting by each other at building construction processes. So scheduling (working schedule) must be realistic.
'KENTSEL DÖNÜŞÜM SÜRECİNDE NİTELİKLİ YAPI ÜRETİMİ' **-Ms. Thesis-MEHMET ZEKİ PESTİL**	·Different actors at process means various opinions, criticism, experiences and advices. These factors effects design and planning process.
	·Actors who play roles at process of building construction are effecting by political, economical, environmental and technological factors. Well organized actors causes qualified buildings .
'YAPI ÜRETİMİ KAPSAMINDA İNŞAAT SÖZLEŞMELERİNDE TARAFLAR ARASINDAKİ ANLAŞMAZLIKLAR VE ÇÖZÜM ÖNERİLERİ' **-Ms. Thesis-SELİN MERSİNKAYA**	·The product of process is quite complex and large-scale. So this processes means production series (also different actors and materials may be entegrated to processes)
	·Contracts, specifications and projects prevents conflicts, controversies, uncertainities, risks and disagreements between actors.
'İNŞAAT PROJELERİNDE RİSKLERİN BULANIK MANTIK MODELİ İLE DEĞERLENDİRİLMESİ' **-Phd. Thesis-HAKAN KUŞAN**	·Building trade is effecting by external factors and it includes various risks.
	·Risk level is a subjective characteristic in process of building construction for each actor.
'CONFLICTS BETWEEN OWNER AND CONTRACTORS: PROPOSED INTERVENTION PROCESS' **-Article-KATHLEEN M.J. HARMON**	·Since each process of building construction is unique, each association will be unique according to project. Previous experiences effects new associations.
'KAT KARŞILIĞI İNŞAAT İŞLETMELERİNDE MALİYET MUHASEBESİ VE UYGULAMALARI' **-Ms. Thesis-SİBEL AKDOĞMUŞ**	·Process of building construction is multi-tasked action. So various of actor and creature are be in touch with each other efficiently.
'İNŞAAT SEKTÖRÜNDE ADR KULLANIMI VE SEÇİM KRİTERLERİNİN KAMU VE ÖZEL SEKTÖR AÇISINDAN İNCELENMESİ' **-Article-DOÇ. DR. E. TAŞ&Y. ARICI**	·Complex, large scaled and multi actored projects may cause problems. Project scale and number of actors are be directly proportionate to controversies.
	·There are sources, procedures and legislative regulations which regulates and prevents these controversies. Various actors and institutions are repsonsible for controlling and implementation of these actants
'HOW PROCUREMENT OPTİONS İNFLUENCE RİSK MANAGEMENT İN CONSTRUCTİON PROJECT' **-Article-EKATERİNA OSİPOVA A & PER ERİK ERİKSSON**	·Contracts are the most important factor for forming relations between actors. Contract articles are providing expected performance at process of building construction.
	·Associations and alliances formed by contracts between actors reveal opportunities.
	·Good communication is also a key for problem solving and financial gain.