

**A MODEL FOR EVALUATING THE ABSORPTIVE  
CAPACITY OF ARCHITECTURAL DESIGN TEAMS**

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**by  
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# **ACKNOWLEDGMENT**

In memory of Poti, my lovely and smart cat.

## ABSTRACT

### A MODEL FOR EVALUATING THE ABSORPTIVE CAPACITY OF ARCHITECTURAL DESIGN TEAMS

The primary challenge facing social actors (i.e., individuals, groups and firms) operating in the Architectural Construction and Engineering (AEC) industry has been delivering value to their stakeholders. The research presented herein addresses this primary challenge in the context of the architectural design teams. It develops a conceptual framework that builds on the concept of absorptive capacity, value theory and activity based theory. The conceptual framework proposes that the absorptive capacity of architectural design teams has significant influence on project outcomes. It also proposes that power relationships, knowledge search mechanisms and social integration mechanisms and of architectural design teams significantly influence their absorptive capacity. These research propositions were empirically tested by a survey of 121 architects operating in Turkey. Research findings based on multiple regression analysis provided mixed support to the research propositions. Research findings suggest that three out of four dimensions of absorptive capacity (i.e., acquisition, transformation and exploitation) have significant impact on project value outcomes but not assimilation. Research findings also suggest that power relationships (i.e., support for innovative/novel design, resource supply and team autonomy), social integration mechanisms (i.e., relationship, structural and cognitive dimensions) and knowledge search mechanisms (i.e., search breadth and depth) have varying degrees of influence on the four dimensions of absorptive capacity.

**Keywords:** Absorptive capacity, architectural design team, social integration, power relationships and knowledge search

## ÖZET

### MİMARİ TASARIM EKİPLERİNİN MASSETME KAPASİTELERİNİ DEĞERLENDİRMEK İÇİN BİR MODEL

Mimarlık, Mühendislik ve Yapım endüstrisinde faaliyet gösteren sosyal aktörleri bekleyen birincil görev paydaşlarına değer sunmak olmuştur. Bu çalışma, bu birincil görevi mimari tasarım ekipleri bağlamında incelemektedir. Çalışmada, massetme kapasitesi kavramı ile değer kuramı ve eylem tabanlı kuram üzerine inşaa edilen kavramsal çerçeve geliştirilmektedir. Bu bağlamda oluşturulan kavramsal çerçeve mimari tasarım ekiplerinin massetme kapasitelerinin, projenin çıktıları üzerine anlamlı bir etkisi olduğunu ortaya koymaktadır. Nitekim mimari tasarım ekiplerinin bilgi araştırma süreçleri, sosyal bütünleştirme süreçleri ve güç ilişkilerinin massetme kapasitesi üzerine de anlamlı bir etkisi olduğu önerilmektedir. Çalışmanın önermeleri 121 mimara uygulanan bir anket çalışması ile ampirik olarak incelenmektedir. Çoklu regresyon analizi sonuçlarına dayalı araştırma bulguları, araştırma önermelerini kısmi olarak desteklemektedir. Araştırma bulguları mimari tasarım ekiplerinin, bilgi emilim kapasitesinin dört boyutundan üçünün projenin değer çıktıları üzerine anlamlı etkisi olduğunu göstermektedir. Araştırma bulguları ayrıca sosyal bütünleştirme süreçlerinin (ilişkisel, yapısal ve bilişsel boyutlar), güç ilişkilerinin (yenilikçi tasarımı destelemek, kaynak sağlama ve proje ekibinin özerliği) ve bilgi arama süreçlerinin (arama derinliği ve genişliği) bilgi massetme kapasitesinin dört boyutu üzerine değişen düzeylerde etkilerinin olduğunu göstermektedir.

**Anahtar Kelimeler:** Massetme kapasitesi, mimari tasarım ekipleri, sosyal bütünleştirme, güç ilişkileri ve bilgi arama stratejisi.

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# CHAPTER 1

## INTRODUCTION

AEC (Architectural Engineering and Construction) industry, like any other industries, has been growing in complexity mainly due to sophistication of client needs and requirements, increasing concerns for health, occupational safety and environmental issues, unprecedented developments in information and communication technologies (ICT), innovations in design and construction operations/processes, increasing size of projects and the involvement of multiple professionals from different disciplines. This increasing complexity in the AEC industry presents new and significant challenges to the practitioners of AEC industry. Different perspectives have been proposed to explore these challenges and in turn guide the practitioners of the AEC industry on how to address these challenges. Each perspective has its own, epistemological and ontological assumptions, conceptual foundations, rules of evidence and unit of analysis. Yet the common theme in these competing and even conflicting perspectives is to *create and/or propose value* to the stakeholders of the AEC industry. The research presented in this thesis addresses this common theme by (1) building on the concepts developed in the built environment literature (e.g., project life cycle, architectural design process), (2) borrowing the concepts from different research streams (e.g., activity based theory, absorptive capacity, organizational learning, ill-defined problem solving process, social capital, innovation and value theories) of different disciplines (e.g., management, economics, sociology, psychology) and (3) adapting them to the context of the AEC industry.

Architectural Engineering and Construction industry (AEC) is a *project-based industry*. *Project-based industry* is one in which the project is the primary unit for production, organization, innovation and competition (Hobday, 2000). The demand for a project based industry's products/services (i.e., projects) commonly takes the form of pre-demand purchase (e.g., before the design and/or construction project has begun). The process of meeting the expectations, needs and requirements of the stakeholders the AEC industry is composed of a series of interdependent sub-processes (i.e., different phases of a project). The primary activity underlying each one of these sub-processes is *problem solving*. Yet each sub-process presents varying degrees of opportunities for

creating and/or proposing value to the stakeholders of AEC industry. There is a strong consensus in the built environment literature that opportunities for creating and/or proposing value is higher at the earlier phases of a project, in particular architectural design process, compared to the later phases of a project such as construction. The research presented herein addresses the issue of creating and/or proposing value in architectural design process.

Architectural design process is a kind of *ill-defined, complex and collaborative* problem solving activity. Each architectural design project is a unique solution to a specific design/construction problem reflecting the needs, expectations and requirements of a client and constraints (e.g., physical, spatial, social economic, cultural, legal and technological). For the most part, the knowledge requirements for an architectural design project are dynamic processes that change from one project to another. The changes are necessary because each project requires its own design needs, requirements and expectations and in turn generates new problems regarding the integration and coordination of the outputs of specialized project team members that conduct interdependent tasks.

It is clear from the above pointed features that architectural design process, like other types of problem solving process, is based knowledge and information. In this process knowledge provides a basis for interpreting information. Architectural design process is commonly viewed as a knowledge-intensive process that requires the generation and processing of enormous volumes of knowledge and information. Yet generating new and novel architectural design solutions solely on the basis of existing knowledge is not impossible but severely limited. This existing knowledge must be (1) recombined and reorganized or (2) it must be combined and reorganized with new external knowledge in order to produce the new knowledge that allows for the generation of novel ideas for creating/proposing value to the stakeholders.

Architectural design process is a complex collaborative process in which different professionals from different disciplines and/or organizations share their knowledge about the both design process and design content. The main rational behind collaboration is to share expertise, ideas, information, knowledge, resources or responsibilities. This feature of architectural design process points out that it is a social process.

Combining insights from design as a kind of ill-defined problem solving perspective and design as collaborative problem solving perspective reveals that

architectural design process is *socio-cognitive process*. The growing complexity in the AEC industry has overarching implications on this socio-cognitive process – architectural design process. The research presented in thesis adopts a socio-cognitive framework for exploring architectural design process and proposes a conceptual model for exploring value creating/proposing activities in the context of the architectural design process. The proposed conceptual model builds on the concept of absorptive capacity models. The concept of absorptive capacity is an ability of a social actor to (i.e., individual, unit, organization, industry) acquire new external knowledge, assimilate it and transform it and exploit it to create value to his/her stakeholder. It points out the importance of new knowledge from external environment and knowledge processing activities in creating and/or proposing value.

## **1.1 Objectives and Scope**

The primary objective of the research study presented in this thesis is to explore value creating/proposing activities in the context of architectural design process. The specific objectives are as follows:

1. To explore the applicability of the concept of absorptive capacity to the architectural design process
2. To explore the influence of absorptive capacity of architectural design teams on creating/proposing value to the stakeholders of built environment.
3. To explore the influence moderators of absorptive capacity of architectural design teams

The scope of research is delineated by addressing issues on three levels (i.e., levels of theory, measurement and analysis) in order to ensure validity and reliability of research findings. The research presented in this thesis builds on multilevel concepts (i.e., absorptive capacity and architectural design process). The concept of absorptive capacity is a multilevel concept (i.e., individual, intra-organizational, organizational, inter-organizational). Similarly architectural design process is also a multilevel concept (i.e., individual level, team level, firm level, and industry level ). The research presented herein uses the concept of absorptive capacity to explore architectural design process at design team. Therefore, the level of theory, level of measurement and level of analysis for the research presented herein are architectural design team.

## **1.2 Significance of the Research**

The research presented in this thesis differs from previous research studies on a number of grounds: (1) the concept of *absorptive capacity* has been predominantly conceptualized and empirically tested in the context of firms operating in manufacturing industries, (2) the concept of *absorptive capacity* has not been used to conceptualize the knowledge and information processing activities underlying architectural design process, (3) the concept of *absorptive capacity* has not been used to explore the knowledge processing activities of architectural design teams, (4) the concepts of *value* and *value outcomes* in the built environment are contested subjects – competing and conflicting perspectives prevail for defining the concepts of value and value outcomes. The research presented herein reconciles the competing and conflicting perspectives of value and value outcomes. Architectural design process is also another contested topic addressed in this research study. Research on architectural design process is primarily driven by competing and conflicting perspectives. The research study presented reconciles these as well. Previous research studies on architectural design process has implicitly adopted individual (i.e., architect as a master builder) as a unit of analysis and focused on the cognitive activities of architects. The growing complexities surrounding the AEC industry transformed traditional master builder role of architects to a “system integrator”. Operating under the conditions of growing complexity, architecture design process has become a complex collaborative process. Yet studying architectural design process at the team level remains a relatively unexplored research issue.

## **1.3 Organization of the Research**

The research presented in thesis consists of seven chapters. Chapter I provided information related to the background of the study, objectives and scope and significance of the research. Chapter II builds on value theories and provides a critical review and discussion of value, value creation process and value outcomes concepts in the context of built environment. Chapter III provides a succinct review and synthesis of the concept of absorptive capacity and its dimensions, determinants and outcomes. Chapter IV proposes a conceptual model for exploring the absorptive capacity of architectural design teams. The proposed conceptual model includes three moderators

of absorptive capacity (i.e., *knowledge search strategies, social integration mechanisms* and *supportive power relationships*), four dimensions of absorptive capacity (i.e., *acquisition, assimilation, transformation* and *exploitation*) and one outcome of absorptive capacity (i.e., *creating and/or proposing value*). It develops four research propositions regarding the model variables. Chapter V provides a research design, a delineation of levels of theory, measurement and analysis, a method of data collection, sampling frame, a selection of key informants, survey design and measurement of the proposed model variables. Chapter VI provides a summary of the research findings. Chapter VII provides a discussion of the research findings, implications for future research and recommendations, significance of the study, limitations, and a summary and conclusion of the study.

## CHAPTER 2

# THE CONCEPT OF VALUE AND VALUE PROPOSITION/CREATION PROCESS

### 2.1 Introduction

The process of value creation and/or proposition in AEC industry, like in any industry, has been at the central stage of the academic research studies and at the top of the agenda for business practitioners and executives for quite a long time. Several perspectives have been proposed to answer how firms operating AEC industry can propose or create value to its stakeholders. Yet there is no universal consensus on “*what is value creation or proposition is*” and “*how value is proposed or created*”. Each perspective addresses this complex and challenging phenomena from a different conceptual foundation and research method. Lepak et al. (2007) argues that the lack of consensus on these issues can be attributed to (1) the multidisciplinary nature of the process of value creation (e.g., economy, sociology, ecology, organization theory, management, strategic management, organizational behavior, human resource management, construction management, architectural management), (2) the multilevel nature of value creation (e.g., individuals, organizations, society) and (3) the diversity in targets or users of value (e.g., customers, clients, organizations, government, society).

### 2.2 The Concept of Value

Classical economists such as Adam Smith and Karl Marx propose that the sole source of value creation is human labor and any object or commodity produced by human labor has two different types of values: *exchange value* and *use value*. Exchange value refers the “monetary amount realized at a certain point in time, when the new task, good, service, or product takes place, or the amount paid by the user to the seller for the use value of the focal task, job, product or service” (Lepak et al., 2007). Use value “refers to the specific quality of a new job, task, product, or service as perceived by users in relation to their needs, such as the speed or quality of performance on a new



task or the aesthetics or performance features of a new product or service” (Lepak et al., 2007). Lepak et al. (2007) propose that the level of new value creation is jointly determined by the beneficiary’s perceptions with regard to the appropriateness (i.e., fitness for purposes) and the novelty dimensions of the product or service under consideration. They also point a positive relationship between the beneficiary’s perceptions regarding the appropriateness and novelty dimensions of the product or service under consideration and its use value and/or exchange value: the greater beneficiary’s perception that the product or service that is under consideration has novelty and appropriateness, the greater the use value and/or exchange value of it.

Le Ber and Branzei (2010) criticize the mainstream conceptualizations of value and value creation/proposition process and argue that it is unclear in these conceptualizations “*for whom, for what and to what effect value is created*”. They suggest that this limitation of previous conceptualizations can be addressed by borrowing concepts from critical theories (i.e., Marxism, Pragmatism and Frankfurt School). Le Ber and Branzei (2010) raise three fundamental questions (i.e., for whom, for what and to what effect value is created) and propose the concept “beneficiary’s voice” to explore the concepts of value and value creation process. The concept *beneficiary’s voice* refers to the extent power is controlled or possessed by the beneficiary. The power relationship between beneficiary (i.e., target unit - individual, organization or society) and the unit (i.e., individual, organization or society) which provides the object or service leads to the emergence of three different states: (1) *voice receiving* (2) *voice making* and (3) *voice taking*. *Voice receiving* is grounded in Marxist perspective and points to the presence of asymmetrical power relationship between beneficiary and unit providing product or service to the beneficiary. In this state, it is proposed that beneficiary has low bargaining power whereas providing unit has high bargaining power. As a direct result of this power asymmetry, the providing unit dominates the value creation process by ignoring, controlling, refraining or inappropriately defining the role that the beneficiary could play in value creation process. The primary governing mechanism in voice receiving state is imposing constraints to beneficiary. *Voice making* which has its roots in Pragmatist perspective suggests the presence of a symmetrical power relationship between beneficiary and unit providing product or service to the beneficiary. In this state, it is proposed that both parties have equal bargaining power. The equal distribution of powers between parties enables them to question, negotiate, define, revise and/or clarify the role played by the

beneficiary in the value creation process. The primary mechanism in voice making state is consensus developing through open dialogue which leads to collaboration. Voice taking is grounded in the Frankfurt School of thought and proposes that the value creation is contingent on a subjective process. Voice-taking involves (1) informing, adjusting and reconfiguring the value creation roles of parties, (2) accommodating and supporting the role the beneficiary chooses to play and (3) searching for an alignment between beneficiary's and other parties' roles in the value creation process.

Gummerus (2013) suggests that two major research streams prevail on the concept of value: (1) value creation process and (2) value outcome determination. First research stream focuses on parties, activities and resources involved in the value creation process. Second research stream focuses on the perceptions of customers/clients about the outcomes of the value creation process. Gummerus (2013) uses this classification scheme and proposes the above mentioned main research streams on the concept of value can be further decomposed into sub research streams. He decomposes value creation process into (1) *value creation by firm*, (2) *value co-creation* and (3) *value creation by customer/client*. Value creation by firm has been the conventional perspective for studying how firms create value for their customers/clients. The unit level of analysis in this perspective is the firm. The fundamental assumption in this perspective is that the firm is the sole creator of value – value creation process is solely driven by the firm. It focuses on activities, processes, resources, capabilities and interactions located within the boundary of the firm. *Value co-creation* is a more recent perspective which challenges the conventional perspective on value creation process by arguing that value is jointly created with other constituents (i.e., customers/clients) located outside the boundary of the firm. The unit level of analysis in this perspective is on firm-customer/client dyad. *Value co-creation* involves a collaborative process where the constituents (i.e., customers/clients) located outside the boundary of the firm can act as a resource for sharing information about their experiences, requirements, needs and expectations and in turn improving and enhancing their perceived benefits. *Value creation by customer/client* perspective proposes that customers/clients are socially embedded in a set of complex social practices (i.e., social networking and community engagement). This social embeddedness results in social construction reality by customers/clients about the perceived benefits of using the product or receiving the service. The unit level of analysis in this perspective is the network of customers/clients. This perspective also focuses on (1) what the customer/client does

with the products/services provided to him or her and (2) how customer/client uses the product/service in his/her daily activities to achieve desired goal.

Value outcomes are about how a customer/client evaluates and determines the value of a product/service. Gummerus (2013) proposes four types of value outcomes: (1) value as means-ends, (2) value as benefits and sacrifices, (3) value as experience outcomes and (4) value as phenomenological. *Value as means and ends approach* focuses on the characteristics of products or services and their consequences. It proposes that customers/clients use a three level evaluation process: attributes-performances-goals. First level involves the evaluation of the *attributes* of products or services. Second level involves the evaluation of the *performances* of products or services. Final level involves the evaluation of the *fitness* of the products or services to the *goals and purposes*. *Value as benefits and sacrifices* approach suggest that value outcome determination is a cognitive judgment process in which customers/clients evaluate and compare the benefits (outputs) and sacrifices (inputs) of using a product or receiving a service. *Value as experience outcomes* approach argues that customers'/clients' interactive and relative experiences jointly influence their judgments about a product/ service and in turn shape and determine the evaluation process and outcomes of that product and service. *Value as phenomenological approach* focuses on the experiences of customers'/ clients' relationship with space, time and personal history. It analyses experience through three different viewpoints: (1) single actor vs. multiple actors, (2) resource integration/interaction vs. determination by experience and (3) network vs. social embeddedness. Gummerus (2013) concludes that (1) that multiple perspectives on value outcome determination are present, (2) these multiple perspectives can be symmetrical (i.e., presence of consensus on value outcomes among stakeholders) or asymmetrical (presence of conflicting views on value outcomes among stakeholders), (3) value creation process can be driven by single unit (creation) or multiple units (co-creation), (4) value creation process can involve the alignment of actions and goals (presence of consensus on actions and goals) or misalignment of actions and goals (conflicting views on actions and goals) and (5) customer's/client's experience is missing in both value outcome determination and value creation process.

Holbrook (1999) points out that value is *interactive* (i.e., entails an interaction between subject- customer or client, and object –the product or service), *relativistic* (is comparative, personal and situational-specific to context), *preferential* (embodies a preference judgment) and *experiential* (resides in the consumption experiences and

derived from products, brands and possessions). He proposes a three dimensional model for analyzing value outcome determination: (1) extrinsic value vs. intrinsic value, (2) self-oriented value vs. other-oriented value and (3) active value vs. reactive (passive) value. The first dimension of Holbrook's model focuses on distinctions between two forms of appreciations: *extrinsic value* - appreciation for using a product or receiving service as a mean to achieve a goal (e.g., task completion) and *intrinsic value* - appreciation for using a product or receiving service as its own sake (e.g., play and fun). The second dimension of Holbrook's model differentiates two forms orientations for judging the value outcomes: value is *self-oriented* when it is solely driven by someone's own sake (i.e., self-interest) and value is other-oriented when it is sought for the sake of someone or something else. The third dimension of Holbrook's (1999) model focuses on distinction between two forms of actions: active value derives from a physical and mental manipulation of an offering by a customer or client whereas reactive (passive) value derives from a customer's or client's comprehension of, appreciation of and response to an offering or consumption experience (i.e., non-manipulative and solely being a part of the experience). The combination of three dimensions of value outcome determination produces eight different value types which coexist with varying degrees in any type of product use or service experience. The term "other(s)" in Holbrook's (1999) model ranges from the micro level (family, friends, colleagues) to a meso-level (community, country, world) to the macro level (mother nature) (Holbrook, 1999).

Grönroos (2011) focuses on value in use dimension and criticizes previous value creation models proposed in literature on a number grounds: (1) the customer/client is always value creator, (2) the firm is a facilitator of value to its customers/clients, (3) and it can deliver value to its customer/client if and only if it engages direct interaction with its customers/clients and (4) this engagement makes a firm become a value co-creator.

### **2.3 Value Proposition/Creation Process**

How a social actor can propose or create value to his/her customers/clients and in turn capture social and/or economic gains has been a central question in literature for quite long time. This central question has been primarily addressed by complementary perspectives: (1) *resource-based view* (e.g., Wernerfelt 1984) and (2) *activity-based*

*view*. (Porter 1985; Stabell and Fjeldstad (1998). First one focuses on resources possessed or controlled by a social actor and conceptualizes a social actor as a bundle of resources. It proposes that resources which meet the criteria of being (1) valuable, (2) rare and (3) costly to imitate are the primary drivers for proposing/creating value to customers/clients and in turn capturing social and economic gains. The second one focuses on activities performed by a social actor and conceptualizes value position or creation process as a set of complementary activities. The unit of analysis in activity based view is discrete activities performed by a social actor to propose/create value to its customers/clients. Activity based view intends to identify (1) the structural properties of activities, (2) structural properties of process as required to perform activities and (3) structural properties of relationships among activities. Yet, identifying these structural properties is a challenging task. Different value configuration models have been proposed in the literature to address this challenging task. The proposed value configuration models decompose activities into two groups: (1) primary activities and (2) support activities. The primary activities of each of proposed value configurations are different from each other but support activities are the same for all proposed value configurations even though their relative importance and implementation may differ. Primary activities are the critical activities that have direct impact on value proposition and creation process. Support activities include activities that have direct impact on the performance primary activities but have indirect impact on the offerings (i.e., service or product) of the social actor. Porter's (1985) *value chain* configuration model is one of the earliest value configuration models (Figure 1). Primary activities in value chain configuration model include: (1) inbound logistics – (i.e., receiving, storing and disseminating inputs) (2) operations (i.e., transforming inputs into outputs), (3) outbound logistics (i.e., collecting, storing and distributing outputs), (4) marketing sales and (5) service. These primary activities enable a social actor to physically transform inputs into outputs (i.e., products). The core feature of this transformation process is managing the sequential interdependence of activities. Support activities in Porter's (1985) value chain configuration model include: (1) infrastructure (i.e., performing managerial tasks) (2) human resource management (hiring, training and developing of personnel), (3) technology development (improving process and outputs) and (4) procurement (purchasing of inputs). Examples of this value configuration model include social actors operating in manufacturing industries.

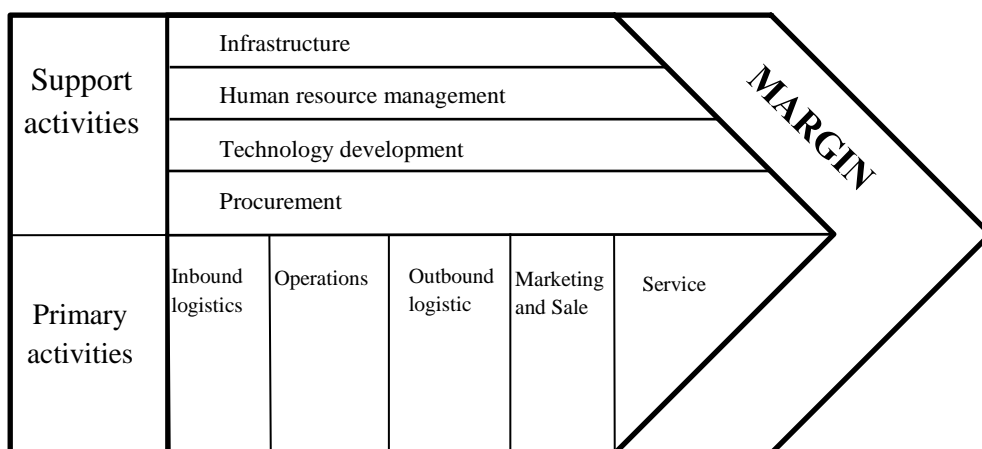


Figure 1. Value Chain Diagram  
(Source: Porter, 1985)

Stabell and Fjeldstad (1998) extended Porter's value chain configuration model by borrowing Thompson's (1967) technology classification model. Thompson's (1967) technology classification model proposes that the core technologies used by social actors can be classified under three types: (1) long linked (sequential interdependency of activities), (2) intensive (reciprocal interdependency of activities) and (3) mediating (pooled interdependency of activities). Each technology involves different sets of activities and relies on different types of interdependence. Stabell and Fjeldstad (1998) argue that Porter's (1985) value chain configuration model is valid only for social actors whose core technologies are characterized as long-linked but alternative value configurations for social actors whose core technologies are characterized as intensive or mediating technologies are missing in the literature. They add two more alternative value configurations to Porter's earliest value chain configuration model: *value shop* and *value network* configuration models.

*Value shop* configuration model is proposed for analyzing the value creation or proposition process of social actors whose core technologies are classified as intensive technology. The term intensive technology involves performing a set of complex, cyclical and reciprocally interdependent activities to solve the unique problems of customers or clients. Therefore the core logic in creating or proposing value in this configuration is *problem-solving process*. The primary activities in value shop

configuration include: (1) problem finding (i.e., analyzing, recording, reviewing and formulating the problem to be solved), (2) problem solving (i.e., generating and evaluating solutions to the problem), (3) choice (i.e., assessing alternative solutions and deciding about the most suitable solution), (4) execution (i.e., communicating and implementing the selected solution), (5) control and evaluation (i.e., evaluating and measuring the selected solution with respect to the initial goals and constraints of the problem). The support activities in this model are the same as those of value chain configuration model. Examples of this value configuration model include social actors who are operating professional service industries such as architectural, engineering construction, medicine and law.

Infrastructure
Human resource management
Technology development
Procurement

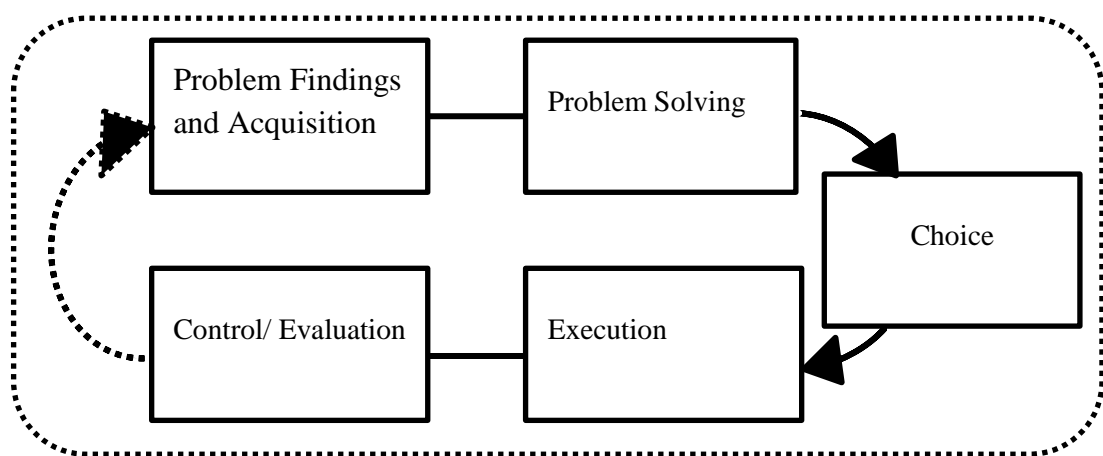


Figure 2. The Value Shop Diagram  
(Source: Stabell and Fjeldstad, 1998)

*Value network* configuration model is proposed for analyzing the value creation or proposition process of social actors whose core technologies are classified as mediating technology. The core value creation logic is to provide an exchange platform or environment to social actors who are distributed in time and space (i.e., independent) but prefer to get connected (i.e., become interdependent) with other social actors. The primary activities in value network configuration model includes: (1) network

promotion and contract management (i.e., inviting potential actors to join network and administering contract terms and conditions), (2) service provisioning (i.e., procedures for establishing, maintaining and terminating connections between social actors) and (3) infrastructure operation (i.e., running, maintaining and improving a physical, information and communication technology infrastructure. Examples of this value configuration model include social actors operating in telecom industries, transportation, banking and insurance industries.

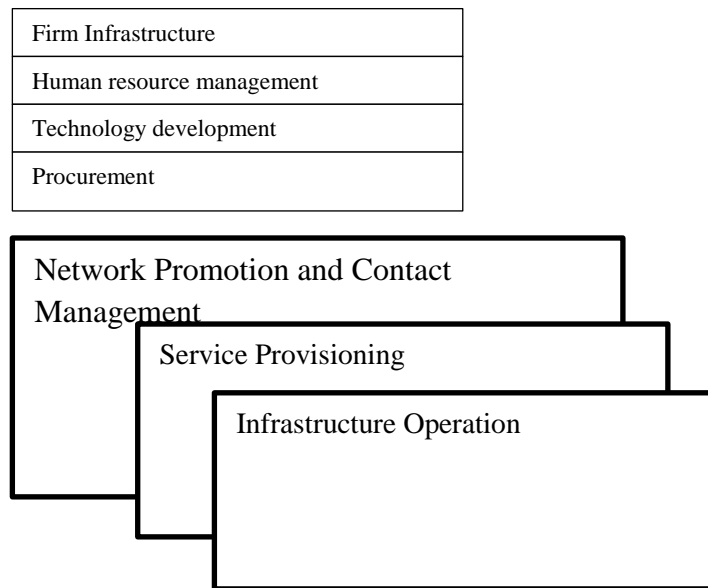


Figure 3. The Value Network Diagram  
(Source: Stabell and Fjeldstad, 1998)

## 2.4 The Concept of Value in the Built Environment

Some scholars (e.g., Emmitt and Prins, 2005; Macmillan, 2006) have been involved in finding answers to the questions of “value for whom?” and “what is value?” for quite long time. Yet finding answers to these questions is not an easy task. Emmitt and Prins (2005) address these challenging questions by decomposing the value of interest into two groups: (1) internal value (i.e., the values of the members of project organization - designers, contractors and suppliers) and (2) external value (i.e., the values of other stakeholders). (e.g.,). They warn that this classification is just a starting point for understanding the complexity of the question of “value for whom?” because the term client is a broad concept and covers a wide range of stakeholders which have different values and interests. They emphasize that the values of stakeholders are



subjective and dynamic - evolve through their interactions with the object (i.e., project) and subjects (i.e., other stakeholders). Emmitt et al. (2005) further decompose external value into: *process values* and *product values*. *Process values* in the built environment derive from the experiences of client with the members of project organization (e.g., architects, engineers, planners and project managers) through design and construction process. It includes soft value such as work ethics, communication and conflict solving and hard values such as completing the project within its defined scope, quality level, budget and on-time and complying with governmental regulations. On the other hand, product values in the built environment derive from firmness, commodity, delight, impact on internal and external environment and constructability. External value represents the values of clients (e.g., owners and occupants).

Macmillan's (2006) research findings based on three workshops reveal that the concept of value in context of the built environment can be explored from two dimensions: (1) the *stakeholders of value outcomes* and (2) *variety of value outcomes*. Macmillan (2006) identifies five types of stakeholders among whom value is exchanged: (1) *financial actors* – financiers, banks, developers and government, (2) *design and construction professionals* - architects, engineers, designers and contractors, (3) *occupant organization* - managers, general workforce, facility managers, security staff and cleaners (4) *community actors* - local authority, local community, regional and national community and (5) *visitors to building* - the general public, hospital patients, hotel guests, retail customers and students. Macmillan (2006) also points out that each stakeholder in these value exchanges has different or even conflicting criteria and/or priority set for evaluating the value outcomes of a building project. The primary concerns of financial actors are return on capital, long-term value, ease of selling and renting whereas design and construction professionals have a tendency to evaluate value outcomes of a building with respect to its profitability, awards and prestige and repeat business. Occupant organizations commonly focus on the value outcomes such as working environment, productivity, corporate image and identity, operating and maintenance costs. Community actors are primarily concerned with the value outcomes such as regeneration and inward investment, pollution, local health, employment, pride, identity, accessibility, quality of life and vandalism. Improving and enhancing the performance of visitors to building is another commonly used value outcome evaluation criterion in the built environment. Macmillan (2006) identifies that the built environment presents five different types of value to its stakeholders: (1) exchange

value – book value, rental, return on capital, (2) use value – satisfaction and comfort, (3) image value – brand awareness and prestige, (4) social value - sense of community, civic pride, low crime and vandalism rate and friendly neighborhood, (5) environmental value – environmental impact, life cycle assessment LCA and costing (LCC) and cultural value – mass media coverage and public and expert opinion and criticism. Salvatierra-Garrido et al.'s (2010) brief review suggests the concept of value is constructed in the literature as (1) an objective concept – is based on measurable attributes of objects, (2) a subjective concept – is a result of individual perceptions and preferences, (3) a relative concept – is based on the comparative judgments of individuals, (4) a context dependent concept – varies from one context to another and (5) a dynamic concept – varies across time. Best and De Valence (2002) propose that the concept of value in the context of the built environment can be studied under three categories: (1) exchange value – market price of a building, (2) use value – maintenance and operating costs of a building to an organization occupying it and (3) esteem value – perceptions regarding the desirability and attractiveness of a building. Jensen (2005) starts exploring the concept of value by pointing the difference between “value” and “values”. The term “value” represents the worth of a product or service whereas the term “values” refers to guiding principles for a belief or behavior (Jensen, 2005). Building on this distinction he identifies that two categories of values and four categories of value in the literature: (1) religious values – are based belief system, (2) behavioral values – are based on morals and ethics, (3) economic value – derives from market exchanges, (4) use value – based on the utility of a product or service, (5) cultural value – based on interpretation of symbols and (6) perceptual value - deriving from individual's subjective experiences.

There is strong consensus in the literature that value can be created by meeting the clients' expectations and needs (Leinonen and Huovila, 2000). Ballard and Howell (1998) argue that value in the built environment can be generated by negotiation between clients' means and needs and resolving conflicting demands. Kelly and Duerk (2002) propose that the client's value system includes seven elements: (1) time, (2) capital cost – initial cost, (3) operating cost – maintenance and repairs, (4) environment – local and global impact, sustainability and embodied energy, (5) exchange and resale , (6) aesthetic and esteem and (7) fitness for purpose.

Volker and Prins (2006) observe that the term “value” in the context of built environment is commonly equated to design “*quality*”. Prasad (2004a, 2004b) propose

that the design quality of a building project is a function of its tangible (i.e., technical, physical and objective) and intangible (i.e., judgmental, perceptual and subjective) characteristics. Gann et al. (2003) propose Design Quality Indicator (DQI) to evaluate the quality of architectural design projects. The DQI builds on an explicit assumption that evaluating an architectural design quality is a challenging task but can provide some benefits to its diverse stakeholders. The DQI model is has three main criteria: (1) *functionality* – use, access and space, (2) *impact* - character and innovation, forms and materials, internal environment, urban and social integration, and (3) *build quality* – performance, engineering systems and construction. Each main criterion has different number of sub-criteria. Devine-Wright et al. (2003) conceptualize value as a subjective judgment of a social actor about a product or process which is framed by the social actor's values. They propose a value framework which aims to explain the complex relationship between the values and value in the context of built environment. The proposed model adopts a hierarchical framework in which the societal, industrial, professional and organizational values influence the project values; and the project values in turn influence design value. This interaction process leads to the emergence of three interfaces in the design process: (1) *project values* – negotiated and shared guiding principles, (2) *objectives* - specific goals reflecting project values and (3) *qualities* – required product or process characteristics for achieving objectives.

#### Proposing/Creating Value in the Built Environment

Several models (e.g., Dorst, 2011; Emmitt and Prins, 2005; Kelly and Male, 2003) have been proposed in the literature for studying the question of how the social actors of the built environment propose/create value for their stakeholders. Male (2002) conceptualize the value proposition/creation process in the built environment as a “value chain” (Figure 4). The proposed model follows the logic of project life cycle. Kelly and Male (2003) point that each stage in project lifecycle has significant potential to contribute to propose/create value to the stakeholders of built environment. Yet the proposed model falls short in presenting a detailed explanation on how to propose/create value in each stage of the project lifecycle.

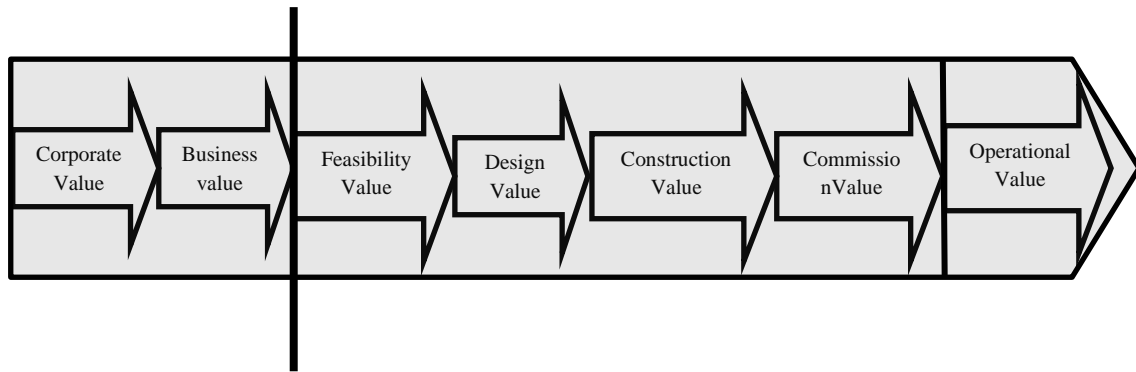


Figure 4. Individual Project Value Chain  
(Source: Standing 2001)

Emmitt et al. (2005) propose a value thinking model for building process based on 7Cs: (1) customer needs, (2) contact, (3) concept, (4) contract, (5) construction, (6) control and (7) consume (Figure 5). The first three Cs represent the processes for creating/proposing *value in design* whereas the last four Cs include processes for creating/proposing *value in delivery*. Emmitt et al. (2005) view value as an outcome of the collaborative efforts of parties involved in design and construction process. This collaborative process starts with identifying the needs and requirements of clients and developing consensus on process values, and continues with reflecting the identified needs, requirements and values into conceptual design alternatives and completes with selecting the design alternative based on process values.

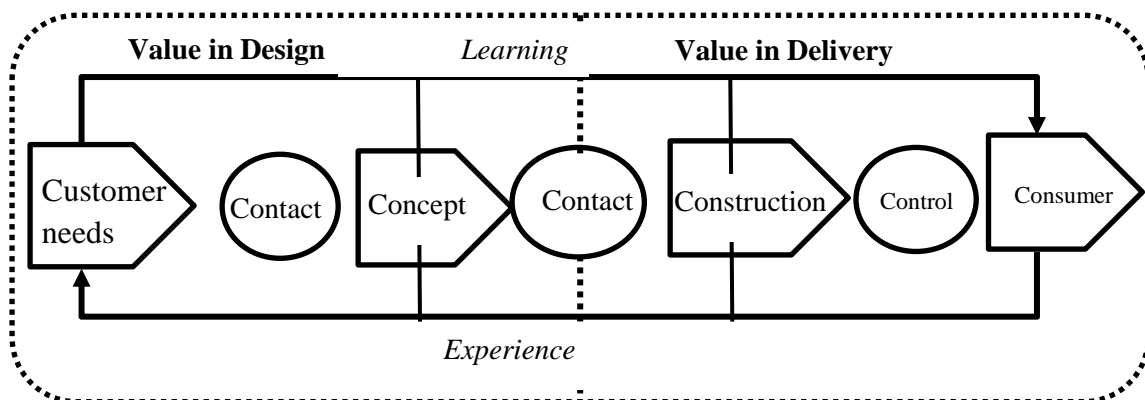


Figure 5. A Value-based Building Process  
(Source: Emmitt et al., 2005)

In a most recent research study, Dorst (2011) presents a model which focuses on creating/proposing value in the design stage of project life cycle (Table 1). She

proposes that creating/proposing value in design is an “*open problem solving*” process which requires solving two unknowns: “*What to create/propose?*” and “*How to create/propose?*”. Dorst (2011) argues that value can be proposed/created by “framing” the design problem (See Chapter IV for a detailed discussion on the concept of “framing” in design process).

The emergent perspective from the above reviewed research studies is that (1) the proposed models for creating/proposing value in the built environment literature appears to be quite opaque, (2) the “*value configuration*” of social actors in the AEC industry, like any other project based industries, is “*value shops*”, (3) the primary activities of value shop configuration are problem acquisition, solution, choice and implementation, and (4) the key ability underlying these primary activities is acquiring, assimilating, transforming and exploiting external information and knowledge. The following chapter presents a brief review of one of the most influential concepts developed to explore a social actor’s ability to acquiring, assimilating, transforming and exploiting external information and knowledge: absorptive capacity.

Table 1. Creating and Proposing Value in Design  
 (Source: Dorst, 2011)

<b>Reasoning</b>	<b>Equation</b>				
<b>Patterns</b>					
Basic problem solving	<b>WHAT</b> (thing)	+	<b>HOW</b> (working principle)	leads to	<b>VALUE</b> (aspired)
Deduction	<b>WHAT</b>	+	<b>HOW</b>	leads to	???
Induction	<b>WHAT</b>	+	???	leads to	<b>RESULT</b>
“Closed” Problem Solving	???	+	<b>HOW</b>	leads to	<b>VALUE</b>
“Open” Problem Solving	??? (thing)	+	??? (working principle)	leads to	<b>VALUE</b> (aspired)
Design Reasoning	<b>WHAT</b>	+	<b>HOW</b> ————— FRAME	leads to	<b>VALUE</b>

## CHAPTER 3

### THE CONCEPT OF ABSORPTIVE CAPACITY

#### 3.1 Introduction

This chapter presents the concept of absorptive capacity and traces its roots, evolution and discusses the primary absorptive capacity models proposed in the literature.

#### 3.2 The Concept of Absorptive Capacity

The concept of absorptive capacity has its roots in economics, in particular economic growth and development studies. The early work of Adler's (1965) points out that there is a blurred picture on what is meant by the term absorptive capacity. Adler (1965), addressing this issue, argues that absorptive capacity refers to "the amount of capital, or the amount of foreign capital, or the amount of foreign aid in terms of financial capital or technological assistance that a developing country can use effectively and/or efficiently." In the subsequent decades, the term absorptive capacity has been predominantly conceptualized as an ability of a nation/country to access and import new technology developed in another country/nation, in other words international technology transfer (e.g., Kedia and Bhagat, 1988). It is the seminal paper by Cohen and Levinthal (1989) that broadened and enriched this economic concept by using industrial organization economics (IOE) concepts. This seminal paper has led to the development of several absorptive capacity models. A succinct review of literature on absorptive capacity reveals that the most influential absorptive capacity models include: Cohen and Levinthal (1990), Kim (1998), Lane and Lubatkin (1998), Van den Bosch et al. (1999), Lane et al. (2001), Zahra and George (2002), (Lane et al., 2002), Jansen et al. (2005) and Todorova and Durisin (2007). Table 2 presents a brief summary of the most cited absorptive capacity models.

Table 2. The Most Cited Absorptive Capacity Models

Authors	Main Dimensions of ACAP	Antecedents	Outcomes	Times Cited *
Cohen and Levinthal (1990)	Recognize, assimilate and use	Research and development, prior knowledge and regimes of appropriability	Innovation performance	7058
Lane and Lubatkin (1998)	Recognize, assimilate and use	Knowledge and social context similarities	Inter-organizational learning	1198
Zahra and George (2002)	Potential (acquire, and assimilate) and realized (transform and exploit)	Knowledge source and complementarity, activation triggers, social integration mechanisms and regimes of appropriability	Strategic flexibility and innovation performance	1608
Lane et al. (2001)	Understand, assimilate and apply	Trust, cultural compatibility, knowledge base similarity, organizational flexibility and adaptability, specialization, formal goals and managerial involvement	Inter-organizational learning	484
Todorova and Durisin (2007)	Recognize, acquire, assimilate, transform and exploit	Knowledge source, prior knowledge, power relations, activation triggers, social integration mechanisms and regimes of appropriability	Flexibility, innovation and performance	242
Lane et al. (2006)	Recognize, acquire, assimilate and apply	Environmental conditions, characteristics of external and internal knowledge, characteristics of learning relationships, strategies, mental characteristics of social actors and organizational structures and processes	Commercial and knowledge outputs	391
Kim (1998)	Prepare, acquire, assimilate and apply	Internal and external crisis, prior knowledge base and intensity of efforts	Learning and innovation	267

\* ISI Web of Knowledge (2015)



### 3.3 Absorptive Capacity Models

Cohen and Levinthal (1989) define absorptive capacity “as the ability of a social actor to identify, assimilate and exploit knowledge from its external environment”. It is clear from this definition that the concept of absorptive capacity involves three processes: (1) identifying external knowledge, (2) assimilating it and (3) finally exploiting it (Figure 6). In their seminal paper the concept of absorptive capacity is explicitly presented as “learning process”. Cohen and Levinthal (1990) elaborated and extended their early conceptualization of absorptive capacity and redefine the absorptive capacity as the ability of a social actor to (1) recognize, (2) assimilate and (3) use new external knowledge. This new reconceptualization builds on theories developed for studying “cognitive learning” (e.g., Vygotsky, 2012) and “problem solving” processes at individual level. Therefore, the building block of this reconceptualization is “individuals” and also the analogy between “individual level learning and problem solving” and “organizational level learning and problem solving”.

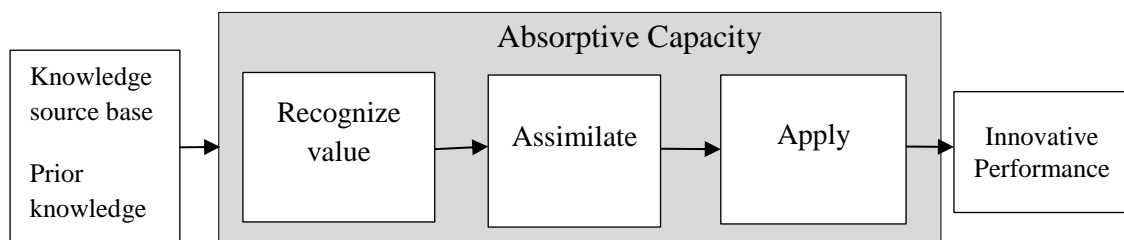


Figure 6. A Model of Absorptive Capacity  
(Source: Cohen and Levinthal, 1990)

Cohen and Levinthal (1990) explicitly acknowledge that: (1) an organization’s absorptive capacity depends on its members’ individual absorptive capacities, (2) prior knowledge plays important role on the development of absorptive capacity, (3) the development of absorptive capacity tends to be cumulative and path dependent, (4) absorptive capacity leads to learning and in turn learning leads to a new absorptive capacity (i.e., single loop learning) and (5) an organization’s absorptive capacity is significantly influenced by its knowledge sharing activities and/or mechanisms. The above reviewed seminal papers of Cohen and Levinthal (1989, 1990) have been subject to numerous elaborations, refinements and modifications.

Kim (1998) builds on Cohen and Levinthal's (1990) absorptive capacity model. She proposes that absorptive capacity requires learning capability and develops a social actor's problem solving skills. Kim (1998) defines learning capability as "capacity to assimilate knowledge" whereas problem solving as "capacity to create new knowledge". She also proposes that a social actor's absorptive capacity depends on its prior knowledge base and intensity of efforts but develops through internally and/or externally evoked crises. Internally and/or externally evoked crises lead a social actor to intensify its efforts to solve problems caused by the crises which in turn elevate its absorptive capacity.

Lane and Lubatkin (1998) use inter-organizational learning theories to shift the unit of analysis in absorptive capacity research from "organization level" to "inter-organizational level". The primary focus of their research is exploring an organization's ability to identify, assimilate and utilize its strategic alliance partner's knowledge. Lane and Lubatkin (1998) propose that the relationship between strategic alliance partners can be conceptualized as "student organization" and "teacher organization" and the ability of a student organization to learn from teacher organization depends on (1) similarity of their knowledge bases and (2) similarity of their knowledge processing systems. Lane and Lubatkin (1998) point out that absorptive capacity is a relative concept because the ability of an organization to identify, assimilate and utilize its strategic alliance partner's knowledge is jointly determined by their relative characteristics (Figure 7).

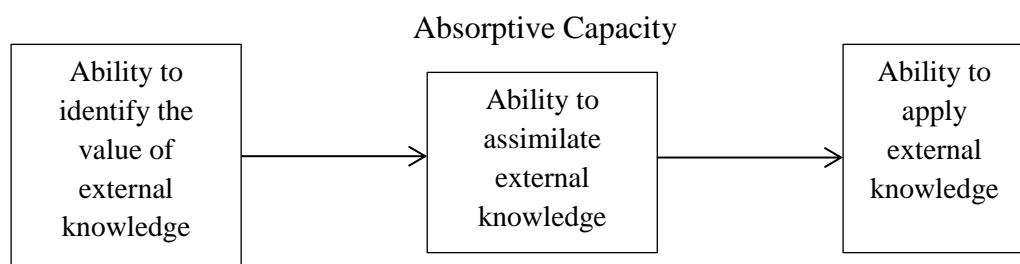


Figure 7. A Model for Absorptive Capacity  
(Source: Lane and Lubatkin, 1998)

Van den Bosch et al. (1999) propose two frameworks for studying the concept of absorptive capacity at firm level. The first one elaborates the impact of knowledge processing systems proposed by Lane and Lubatkin (1998) on absorptive capacity. It

proposes that organizational determinants of absorptive capacity include (1) level of prior knowledge and (2) organizational knowledge processing systems such as organizational forms (i.e., functional, divisional or matrix form) and combinative capabilities (i.e., systems capabilities, coordination capabilities, and socialization capabilities). The second one is a co-evolutionary framework which proposes that absorptive capacity is a joint outcome of managerial actions and developments in the knowledge environment.

Lane et al. (2001) refined Lane and Lubatkin's (1998) relative absorptive capacity concept at inter-organizational level by incorporating a set of factors such as (1) cultural similarity between social actors, (2) trust between organizations, (3) prior knowledge exchange experiences, (4) knowledge base similarity, (5) learning structures and processes and (6) business strategy (Figure 8). Lane et al.'s (2001) model proposes that the identification and assimilation of external knowledge have positive impact on learning whereas application of knowledge has positive impact on organizational performance. Furthermore it points out that the identification and assimilation dimensions of absorptive capacity are relative (i.e., depend on the characteristics of partners) and the application dimension is absolute (i.e., depends on each partner's capabilities developed internally) (Lane et al., 2002).

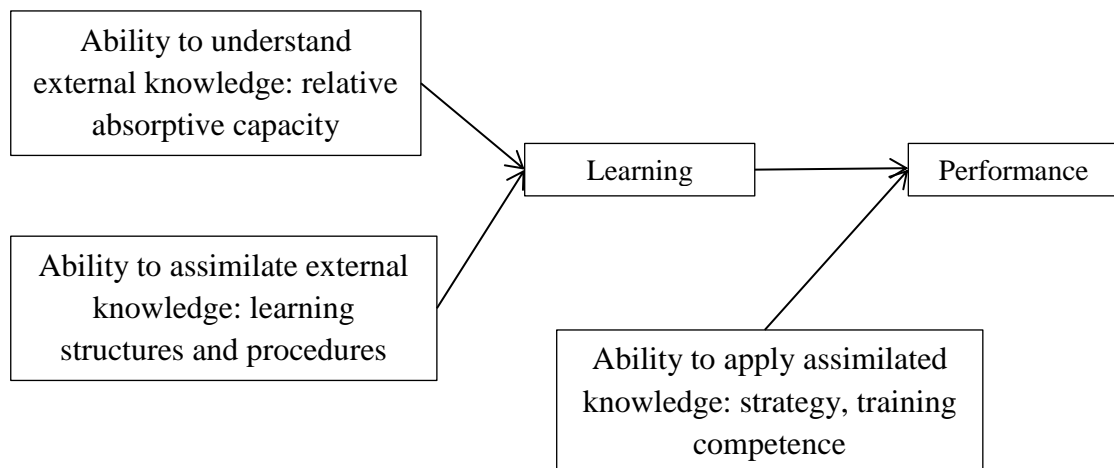


Figure 8. A Model for Absorptive Capacity  
(Source: Lane et. al., 2001)

Zahra and George (2002) propose a radical modification to the Cohen and Levinthal's (1990) absorptive capacity model (Figure 9). The primary contribution of their model to literature include (1) conceptualizing absorptive capacity as a dynamic capability, (2) highlighting the role and importance of different components of

absorptive capacity and (3) identifying conditions under which the components of absorptive capacity create value. Zahra and George (2002) define absorptive capacity as a dynamic capability that involves knowledge creation and utilization processes that enhances an organization's ability to gain and sustain competitive advantage. Zahra and George (2002) decompose absorptive capacity into four distinct but complementary dimensions: (1) acquisition, (2) assimilation, (3) transformation and (4) exploitation (Figure 9). Acquisition is the ability of a social actor to identify and acquire relevant external knowledge. Assimilation is ability of a social actor to develop routines and processes to analyze, process, interpret and understand relevant external knowledge. Transformation is the ability of a social actor to develop routines to combine previous knowledge with newly assimilated knowledge. Exploitation is the ability of a social actor to utilize the transformed knowledge to create value for its stakeholders. Zahra and George's (2002) model also makes a clear distinction between a social actor's potential absorptive capacity (PACAP) and its realized absorptive capacity (RACAP). Potential absorptive capacity (PACAP) involves first two dimensions of absorptive capacity, namely acquisition and assimilation whereas realized absorptive capacity (RACAP) involves transformation and exploitation dimensions. Potential absorptive capacity of a social actor reflects its receptiveness to identifying, recognizing, acquiring and assimilating external knowledge. On the other hand realized absorptive capacity of a social actor reflects its capacity to transform and exploit the acquired and assimilated knowledge. Zahra and George (2002) emphasize the presence of a sequential relationship between potential absorptive capacity and realized absorptive capacity: (1) a social actor cannot transform and exploit external knowledge without acquiring or assimilating it, (2) similarly a social actor can acquire and assimilate external knowledge but cannot create value without transforming and exploiting it. Zahra and George (2002) propose an efficiency factor to analyze this sequential relationship between potential absorptive capacity and realized absorptive capacity. The proposed efficiency factor is defined as the ratio of potential absorptive capacity to realized absorptive capacity. Zahra and George (2002) elaborate the Cohen and Levinthal's (1990) model by adding three contingency factors (Figure 9): (1) *activation triggers*, (2) *social integration mechanisms* and (3) *regimes of appropriability*. *Activation triggers* are programmed or un-programmed events that encourage or force a social actor to respond to specific internally or externally constructed stimuli. *Social integration mechanisms* include a wide range of informal or formal practices that facilitate sharing

and disseminating knowledge. Zahra and George (2002) argue that social integration mechanisms are primary moderating factors that enable a social actor to increase its absorptive capacity efficiency by reducing the gap between potential absorptive capacity and realized absorptive capacity. The term *regimes of appropriability* refers to the ability of social actor to protect the value it creates from new knowledge.

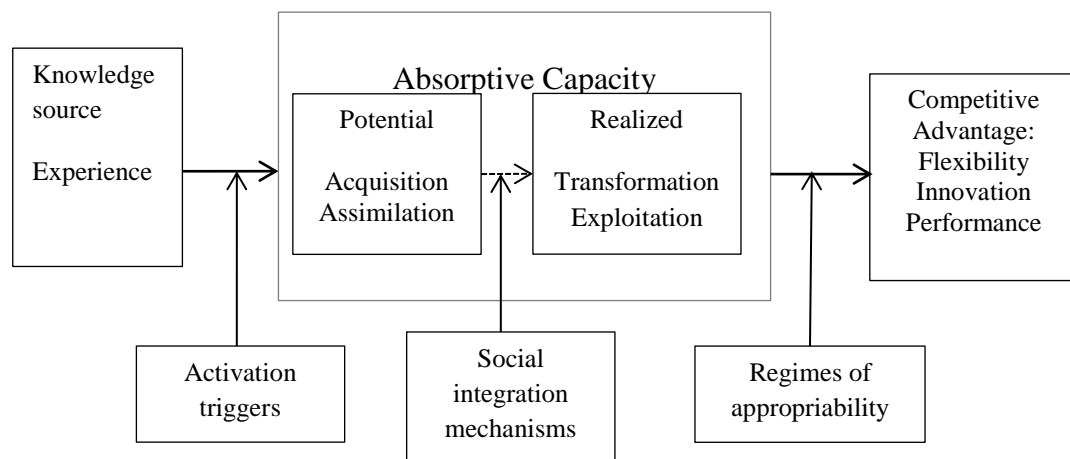


Figure 9. A Model for Absorptive Capacity  
(Source: Zahra and George, 2002)

Jansen et al. (2005) explore the impact of organizational mechanisms on each dimension of absorptive capacity (i.e., potential absorptive capacity and realized absorptive capacity) proposed by Zahra and George (2002). The research findings of Jansen et al. (2005) study suggest that organization mechanisms associated with coordination capabilities (e.g., cross functional interfaces, participation in decision making and job rotation) are positively related with potential absorptive capacity whereas organization mechanisms associated with socialization capabilities are positively related realized absorptive capacity.

Todorova and Durisin (2007) criticize Zahra and George's (2002) absorptive capacity on number of grounds: (1) knowledge transformation is not a step after knowledge assimilation but a parallel process, (2) social integration mechanisms do not solely influence the knowledge transformation dimension of absorptive capacity but also the other dimensions of absorptive capacity, (3) this influence of social integration mechanisms on absorptive capacity can be positive as well as negative and (4) feedback links which make a process to be qualified as a dynamic capability are missing in their

model. In the light of these criticisms, Todorova and Durisin (2007) substantially change Zahra and George's (2002) model and propose a new absorptive capacity model (Figure 10).

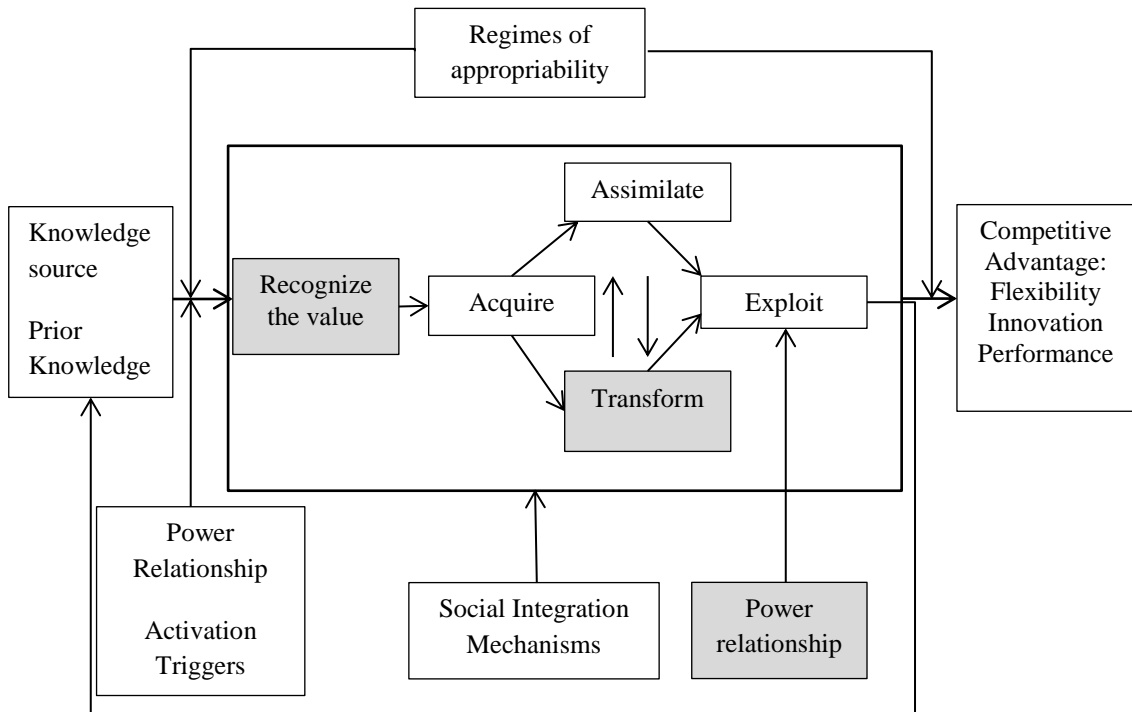


Figure 10. A Refined Model of Absorptive Capacity  
(Source: Todorova and Durisin, 2007)

The proposed absorptive capacity model reintroduces Cohen and Levinthal (1990) recognizing the value of external information dimension and adds a new contingency factor named (2) “*power relationships*” and (3) “*feedback links*” to Zahra and George’s (2002) model. The newly introduced contingency factor “*power relations*” refers the use of power and/or other resources by an internal or external social actor to obtain his or her preferred outcomes (Pfeffer, 1981).

### 3.4 Absorptive Capacity in Project Environments

Previous sections present a brief review of the concept of absorptive capacity, its antecedents and outcomes at different levels (i.e., unit of analysis): intra-organizational – working unit, organizational and inter-organizational – (e.g., strategic alliances and networks). The emergent picture from this brief overview is that the concept of

absorptive capacity is a multi-level construct. The use of this multi-level construct (i.e., absorptive capacity) has been extended to explore how project organizations acquire, assimilate, transform and exploit new external knowledge and how organizations create value to their stakeholders from new external knowledge. Biedenbach and Müller (2012) explored the outcomes of absorptive capacity: the impact of absorptive capacity on short- and long-term project success in the context of pharmaceutical and biotechnological R&D projects. They concluded that absorptive capacity is positively related to all measures of project success. Popaitoon and Siengthai (2014) focused on the outcomes (i.e., project performance) and moderators (i.e., human resource practices) of absorptive capacity in the context of project organizations operating in the Thai automotive industry. They concluded that potential absorptive capacity has positive impact on short-term project performance, realized absorptive capacity has positive impact on long-term project performance and human resource practices moderate the relationship between absorptive capacity and long-term project performance. Cuellar and Gallivan (2006) studied the applicability of the concept of absorptive capacity to pre-project (i.e., ex-ante) risk assessment process. They proposed a risk evaluation framework for predicting the system implementation outcomes (e.g., failure or success in software projects). The proposed framework uses the antecedents of absorptive capacity as evaluation criteria (e.g., prior knowledge, combinative capabilities, motivation and expectations, organizational form, and cultural match, communication channels). Cuellar and Gallivan (2006) concluded that the higher levels of absorptive capacity significantly can reduce the risk of implementation failures and in turn can increase the chances of successful project implementation. Leal-Rodríguez et al. (2014) explored the impact of potential (i.e., acquisition and assimilation), social integration mechanisms (i.e., information sharing, joint sense making and knowledge integration) and realized absorptive capacity (i.e., transformation and exploitation) on innovation outcomes in project teams. They report that potential absorptive capacity and social integration mechanisms jointly and positively influence the realized absorptive capacity of project teams and the realized absorptive capacity of project teams in turn has positive impact on innovation outcomes. Zhu et al. (2014) used the concept of absorptive capacity to explore the performance of project organizations. Yet the definition of absorptive capacity adopted in Zhu et al.'s (2014) study is not from the main stream of absorptive capacity literature. Zhu et al. (2014) use the definition proposed in resilience analysis studies such as Vugrin et al. (2011); Francis and Bekera

(2014). Zhu et al. (2014) define absorptive capacity as “*the ability of a project organization to resist uncertainty-induced perturbations or seize opportunities without changing its initial stable governance structure and execution processes*”. The research findings of Zhu et al. (2014) study reveal that the ability of project organizations to respond uncertainty partly depends on their absorptive capacities. Huber (2003) defines a project team’s absorptive capacity as “an ability of a team to recognize the value of new external information, assimilate it and apply it”. Lee et al. (2012) argue that a project team’s absorptive capacity is determined by the individual team members’ readiness to absorb new external new knowledge. Grace (2013) also used the main stream definition of absorptive capacity to define the concept of team absorptive capacity. She proposes that absorptive capacity is the ability of a team to recognize the value of new external knowledge, assimilate it and apply it to outputs. Tiwana and Mclean (2005) define a project team’s absorptive capacity as the ability of the members of a team to interrelate with the expertise of their peer team members. They explored the influence of project team’s absorptive capacity on project team’s creativity. Tiwana and Mclean (2005) concluded that the project team’s absorptive capacity has indirect influence - rather than direct influence - on project team’s creativity. Zhu et al. (2014) propose a theoretical framework for exploring factors influencing cross-project knowledge transfer. The proposed framework was empirically tested in the context of a project oriented industry. The results point out that the absorptive capacity of recipient project team is one of the key factors that influence effective cross –project knowledge transfer. Bakker et al. (2011) adopted a set-theoretic approach to study the factors influence knowledge transfer in the context of twelve projects. The results of set-theoretic analysis reveal that the absorptive capacity of project owner is one of the most critical factors influencing the success of knowledge transfer in project environments.

Some built environment researchers have been involved in applying the concept of absorptive capacity to explore how construction project organizations can create/propose value to their stakeholders. Table 3 presents a summary of research studies on absorptive capacity in the context of AEC industry. The earliest research using the concept of absorptive capacity in the leading journals of built environment literature is of Gann’s (2001) study. Gann (2001) used the concept of absorptive capacity to explore ability of construction organizations to absorb knowledge produced by academic institutions. He concludes that only a few construction organizations operating in the UK have the capabilities to absorb and capture the benefits of academic



research studies. Manley (2006) argues that the innovation competency of construction clients can be explored by using the concept of absorptive capacity – the ability of construction clients to absorb innovations offered by construction organizations. She explored the absorptive capacity of Australian repeat public construction clients by administering a questionnaire survey. Manley (2006) concluded that Australian repeat public construction clients are innovation competent and have strong capability to drive innovation in the industry. Gluch et al. (2009) propose a model called “the green absorptive capacity model” to explore moderators and antecedents of green innovation in the context of the built environment. The proposed model predominantly builds on Zahra and George’s (2002) absorptive capacity model. It proposes (1) a sequential relationship (i.e., linear) between the dimension of absorptive capacity (acquisition → assimilation → transformation → assimilation). Gluch et al. (2009) argue that external knowledge sources (i.e., environmentally driven inter-organizational relationship and contractual agreements), experience (i.e., environmental scanning, marketing and benchmarking) and activation triggers (i.e., stakeholder pressure) are the antecedent of acquisition dimension of absorptive capacity. They view acquisition dimension as “*knowledge gate*”, assimilation dimension as a “*meaning-creating process*” and transformation and exploitation dimensions as “*motivators*” for green innovations. Gluch et al. (2009) adopted used a questionnaire survey method to empirically explore the antecedents and outcomes of absorptive capacity in the context of AEC industry. They conclude that the four dimensions of absorptive capacity jointly influence the ability of construction organizations to capture the benefits of green innovations and improve their activities and operations, (2) social integration mechanisms (i.e., operationalized as perceived hindrance) have negative impact on exploiting new external knowledge, (3) transformation and exploitation have positive impact on creating/proposing value (i.e., operationalized as business advantage and green innovation) to the stakeholders of built environment and (4) regimes of appropriability (i.e., institutional dynamics and social mechanisms) have direct impact on creating/proposing value to the stakeholders of the built environment. Bosch-Sijtsema and Postma (2006) point out that studying the concept of absorptive capacity in a project-based industry, namely AEC industry, is different from those presented in the main stream absorptive capacity literature. Bosch-Sijtsema and Postma (2006) propose that the level of prior knowledge and the level of common knowledge stock might not be sufficient to study absorptive capacity in a project based industry and other factors

such as openness, responsibility and trust should be also considered studying the concept absorptive capacity in the context of project environments. The propositions set forth by Bosch-Sijtsema and Postma (2006) were explored by using comparative case study analysis of four cases of construction projects. The research findings of four case studies reveal that the levels of prior knowledge and common knowledge positively influence absorptive capacity whereas time and financial restrains negatively influence absorptive capacity (i.e., ability to create/propose value from new external knowledge) (Bosch-Sijtsema and Postma, 2006). Unsal and Taylor (2011) explored the factors that influence the absorptive capacity of project networks by using a series of simulation experiments. The results of the agent based modeling simulation experiments reveal that the relational stability has a number of overarching implications on the absorptive capacity of project networks. Firstly, the absorptive capacity of project network increases as the relational stability increases. Secondly, the influence of relational stability on the absorptive capacity of project networks varies depending on the type of innovation. Unsal and Taylor (2011) used Henderson and Clark's (1990) framework to classify innovations in the AEC industry. Henderson and Clark's (1990) framework classify innovation based on two dimensions: (1) change core design concepts and (2) change in relationship between core concepts and components. The proposed framework is composed of four quadrants: (1) *incremental innovation*, (2) *radical innovation*, (3) *architectural innovation* and (4) *modular innovation*. *Incremental innovations* are the innovation in which core design concepts and relationship between them are refined and improved. *Radical innovations* are the innovation in which a new set of core design concepts and relationship between them are established. *Architectural innovations* (e.g., introduction of a new delivery system in the AEC industry) are the innovations in which underlying core concepts remain same but relationships between them change (Henderson and Clark, 1990). *Modular innovations* (e.g., a new certification system) are the innovations in which underlying core design concepts change but the relationships between them remain unchanged) (Henderson and Clark, 1990). Unsal and Taylor's (2011) propose that the absorptive capacity of project networks for architectural innovations is higher than for modular innovations under the conditions of high relational stability whereas the absorptive capacity of project networks for architectural innovations is lower than for modular innovations under the conditions of low relational stability.

It is clear from the above presented review (Table 3) that the concept of absorptive capacity is still remains relatively unexplored in built environment literature.

Table 3. A Summary of Research Studies on Absorptive Capacity in the context of AEC industry

Author(s)	Minor Citation	Used in Hypothesis, Proposition or Model	Dimensions of ACAP Discussed
Green and May (2005)	✓		None
Davis and Love (2011)	✓		None
Manley (2008)	✓		None
Squicciarini and Asikainen (2011)	✓		None
Kraatz and Hampson (2013)		✓	Acquisition, Assimilation, Transformation and Exploitation
Reichstein et al. (2005)	✓		None
Connaughton et al. (2015)	✓		None
Styhre et al. (2004)	✓		None
Carrillo et al. (2006)	✓		None
Kulatunga et al. (2009)	✓		None
Javernick-Will (2009)	✓		None
Lloyd-walker et al. (2014)	✓		None
Rose and Manley (2014)	✓		None
Peansupap and Walker (2006)	✓		None
Bröchner et al. (2004)	✓		None
Manley (2006)	✓		None
Ganesan and Kelsey (2006)	✓		None
Gann (2001)		✓	None
Gluch et al. (2009)		✓	Acquisition, Assimilation, Transformation and Exploitation
Unsal and Taylor (2011)		✓	Acquisition, Assimilation, Transformation and Exploitation

### 3.5 Absorptive Capacity: Retrospective Analysis

The preceding section presents the most influential absorptive capacity models – the core models of absorptive capacity. The core models of absorptive capacity received an overwhelming interest from academic researchers. This overwhelming interest has generated a rich but fragmented literature on the concept of absorptive capacity. The concept of absorptive capacity and its antecedents and outcomes have been the subject of numerous theoretical (theory building) and empirical (theory testing) research studies. Appendix A presents a succinct review of this literature on the concept of absorptive capacity. A close inspection of research studies presented in Appendix A reveals that (1) different definitions of absorptive capacity exist in the literature and (2) the concept of absorptive capacity is a multilevel (i.e., individual, organizational/firm, industry) and multidimensional concept. The concept of absorptive capacity has been the subject of numerous and various review studies such as “*Absorptive Capacity and the Implementation of Knowledge-Intensive Best Practices*” by Daghfous (2004), “*The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the Construct*” by Lane et al. (2006), “*Absorptive capacity: Antecedents, models and outcomes*” by Van den Bosch et al. (2006), “*Absorbing the concept of absorptive capacity: How to realize its potential in the organizational field*” by Volberda et al. (2010) and “*Capturing absorptive capacity: A critical review and future prospects*” by Ducheck (2013).

Daghfous (2004) points out that the antecedents of absorptive capacity can be classified under two major groups: (1) internal and external factors. Internal antecedent of absorptive capacity include prior knowledge bases, individual absorptive capacity, level of education and academic degree, diversity of backgrounds, presence of gatekeepers, investment in R&D and organizational structure, level of organizational bureaucracy, organizational culture, empowerment of employees, size, organization inertia, human resource management practices. External factors include industry dynamism, position in the knowledge networks.

Table 4. Determinants of Absorptive Capacity  
(Source: Daghfous, 2004).

Determinants		Relation
Internal Factors	Prior knowledge base	Positive
	Level of education and academic degree	Positive
	Investment in R&D	Positive
	Organizational structures	N/A
	Size	N/A
	Organizational bureaucracy	Negative
	Organizational inertia	Negative
	Social mechanisms\Internal communication	Positive
	Social climate	Positive
	Individual absorptive capacity	Positive
	Cognitive proximity	N/A
External Factors	External knowledge environment	Positive
	Position in knowledge network (interaction)	Positive
	Boundary spanning and gatekeepers	Positive
	Knowledge types	N/A

Lane et al. (2006) conducted a comprehensive analysis of absorptive capacity research and proposed a process model of absorptive capacity. The proposed model includes four main groups of factors: (1) *internal drivers of absorptive capacity*, (2) *external drivers of absorptive capacity*, (3) *absorptive capacity* and (4) *outcomes of absorptive capacity*. Internal drivers of absorptive capacity include the characteristics of organizational members' mental models, the characteristics of firm's structures and processes and firm strategies. External drivers of absorptive capacity include environmental conditions that create incentives for developing absorptive capacity, the characteristics of internal and external knowledge and the characteristics of learning relationships with other social actors. In the proposed model, the absorptive capacity construct is conceptualized as a three sequential learning processes: (1) recognizing and understanding new external knowledge through exploratory learning, (2) assimilating valuable external knowledge through transformative learning and (3) applying assimilated external knowledge through exploitative learning. Firm performance which is proposed to be driven by knowledge outputs (i.e., general, scientific, technical and organizational) and commercial outputs (i.e., products, services and intellectual property) is conceptualized as the outcomes of absorptive capacity.

Van den Bosch et al. (2006) focus on the evolution of the concept of absorptive capacity and identify the level of progress on theoretical and empirical issues such as definition and measurement, dimensions, antecedents at different levels,( i.e., intra-

organizational, organizational level and inter-organizational level) and organizational outcomes. Intra-organizational level determinants of absorptive capacity include a unit's research and development intensity, prior related knowledge, knowledge flow configuration, the similarity of social actors (Van den Bosch et al., 2006). Organizational level determinants include prior related knowledge, internal mechanisms, combinative capabilities, external sources, knowledge complementary (Van den Bosch et al., 2006). Inter-organizational level determinants include similarity of compensation policies, practices and structures, familiarity with problems (Van den Bosch et al., 2006). Van den Bosch et al.'s (2006) study points that absorptive capacity is also moderator of various inter-organizational, organizational and intra-organizational outcomes such as innovative performance, new product development, coevolution, strategic renewal, knowledge flows with the organization, competitive advantage, new wealth creation, financial performance and knowledge transfer. Volberda et al. (2010) trace the evolution of the concept of absorptive capacity and its links with other research streams. They argue that various research streams such as learning, innovation, managerial cognition, knowledge based view of the firm, dynamic capabilities and co-evolutionary theories have significant influence on the evolution of the concept of absorptive capacity. Volberda et al. (2010) that the antecedents of absorptive capacity include (1) managerial factors (e.g., combinative capabilities, management cognition, dominant logic, individual knowledge development and sharing) (2) intra-organizational factors (organizational form, incentive structures, informal networks and internal communication), (3) inter-organizational factors (e.g., knowledge creation and sharing, alliance management systems, dyad and network knowledge development and transfer and relatedness of organizations) (4) prior related knowledge (e.g., depth of knowledge, breadth of knowledge, retrieval of knowledge and short-term/long-term knowledge) (5) environmental factors (e.g., competitiveness, dynamism appropriability regime and knowledge characteristics). They also report that the outcomes of absorptive capacity include competitive advantage, innovation, exploitation/exploration, firm performance.

Duchek (2013) emphasizes the multidisciplinary aspect of the concept of absorptive capacity by arguing that the concept of absorptive capacity is positioned between the research streams of organizational learning, knowledge management, and dynamic capabilities. Duchek's (2013) review provides important insight into the questions of *“what has been measured in previous empirical research studies on*

*absorptive capacity and how it has been measured*". Duchek (2013) argues that the common factors measured in previous research studies on absorptive capacity include (1) the dimensions of absorptive capacity, (2) the antecedents (i.e., determinants) and (3) outcomes of absorptive capacity. Duchek's (2013) review points out that both quantitative and qualitative approaches have been used to study the concept of absorptive capacity. Quantitative methods used for the operationalization of the concept of absorptive capacity include input oriented indicators (e.g., R&D expenditure, R&D efforts, R&D human capital), output-oriented indicators (R&D patents and publications), one-dimensional perceptive measures (i.e., absorptive capacity is measured as a single component - whole) and multi-dimensional perceptive measures (i.e., multiple items for each dimension of absorptive capacity). Qualitative methods used in absorptive capacity include single case studies and multiple case studies.

The brief overview presented in the preceding paragraphs reveals that the concept of absorptive capacity is a multidisciplinary, multidimensional and multilevel concept. The "multi" nature of the concept of absorptive capacity has led some scholars to conclude that it is an umbrella concept. This umbrella concept has been one of the most influential research issues in the literature in the last decade. Studying an "umbrella concept", such as "absorptive capacity", has always been a challenging task because an "umbrella concept" does not have a common definition and a common unit of analysis.

The main impetus behind the development of the concept of absorptive capacity is to address one of the fundamental questions of social sciences: how social actors can create/propose value for their stakeholders. This fundamental question has been originally framed and predominantly addressed from the perspective of social actors which have *value chain* configuration. Yet it has been pointed out in the previous chapter that social actors have different value configurations and each value configuration has different primary activities. Therefore, the application of the concept of absorptive capacity to a different value configuration requires exploring in detail the primary activities in value configuration that is under consideration. The following chapter presents a brief overview of the primary activities of architectural design teams.

## CHAPTER 4

# ABSORPTIVE CAPACITY IN ARCHITECTURAL DESIGN TEAMS: A CONCEPTUAL MODEL

### 4.1 Introduction

The concept of knowledge has been an important subject for humans since antiquity. The last decades witnessed a surge in interest in academic research studies on knowledge, in particular, its importance on proposing/creating value for stakeholders. This chapter presents a conceptual model for proposing/creating value to the stakeholders of the built environment. The proposed conceptual model builds on concepts of *value*, (e.g., Gummerus 2013; Emmitt and Prins, 2005; Emmitt et al., 2005), *value shop configuration* (e.g., Porter, 1985; Stabell and Fjeldstad, 1998) and *absorptive capacity* models (e.g., Cohen and Levinthal, 1990; Zahra and George, 2002; Todorova and Durisin, 2007) presented in the previous chapters.

### 4.2 A Conceptual Model of Absorptive Capacity in Architectural Design Teams

The fundamental issue in Architectural Engineering and Construction (AEC) industry, like any other industry, is creating/proposing value to its stakeholders. Therefore creating/proposing value to stakeholders has been an important question in the literatures of several disciplines. Each industry has unique characteristics and hosts different threats and opportunities and in turn has key success factors for creating/proposing value which differ from other industries. This fundamental issue in the context of the AEC industry can be addressed at different units of analysis such as (1) individual level, (2) project level, (3) firm level and (4) industry level. AEC industry is a project-based industry. The primary unit for creating/proposing value to the stakeholders of a project-based industry is *projects*.

Construction projects can be analyzed by breaking down into phases or also termed stages. Each stage or step can be further decomposed into sub-stages. The life



cycle of a project in AEC industry is commonly conceptualized into four stages: (1) briefing, (2) design, (3) planning and (4) construction (Figure 11). Each stage requires the contribution and collaboration of professionals from different disciplines and also involves different knowledge processing activities such as acquisition, assimilation, transformation and exploitation. It is widely acknowledged that value can be proposed/created in the design process as well as in the construction process (Dorst, 2011; Emmitt et al., 2005; Kelly and Male, 2003) but the potential for creating and proposing value in design process is significantly higher in the earlier stages of the project life cycle (Figure 11). Therefore the primary focus of this research is on the absorptive capacity of social actors (i.e., architectural design teams - architects, structural/civil engineers, mechanical engineers, and electrical engineers) who carry out design process.

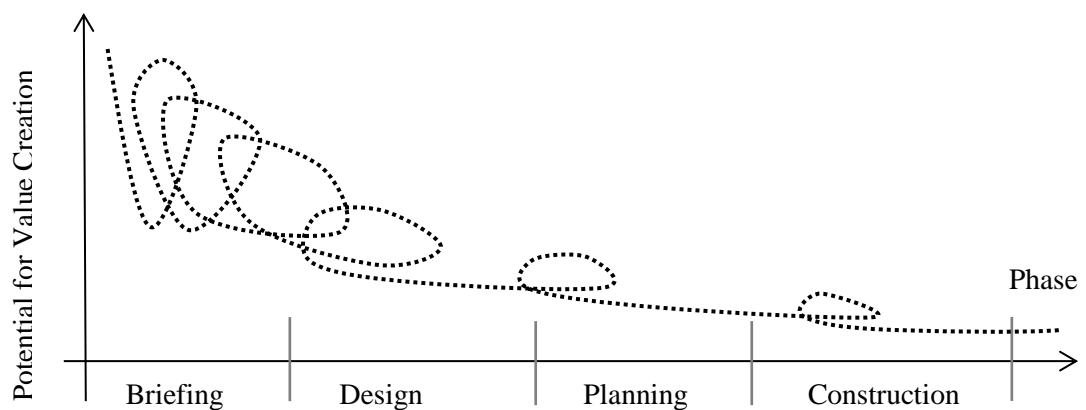


Figure 11. Potential for Value Creation in Different Phases of Construction Projects  
(Adapted from Overgaard, 2004)

The proposed model conceptualizes architectural design process as a complex social, cognitive and collaborative activity (Figure 12). The following section presents a succinct discussion of this conceptualization based on absorptive capacity models (e.g., Cohen and Levinthal, 1990; Zahra and George, 2002; Todorova and Durisin, 2007) and knowledge search strategies (i.e., (Cohen and Levinthal, 1990; Katila and Ahuja, 2002; Laursen and Salter, 2004; Todorova and Durisin, 2007; Zahra and George, 2002).

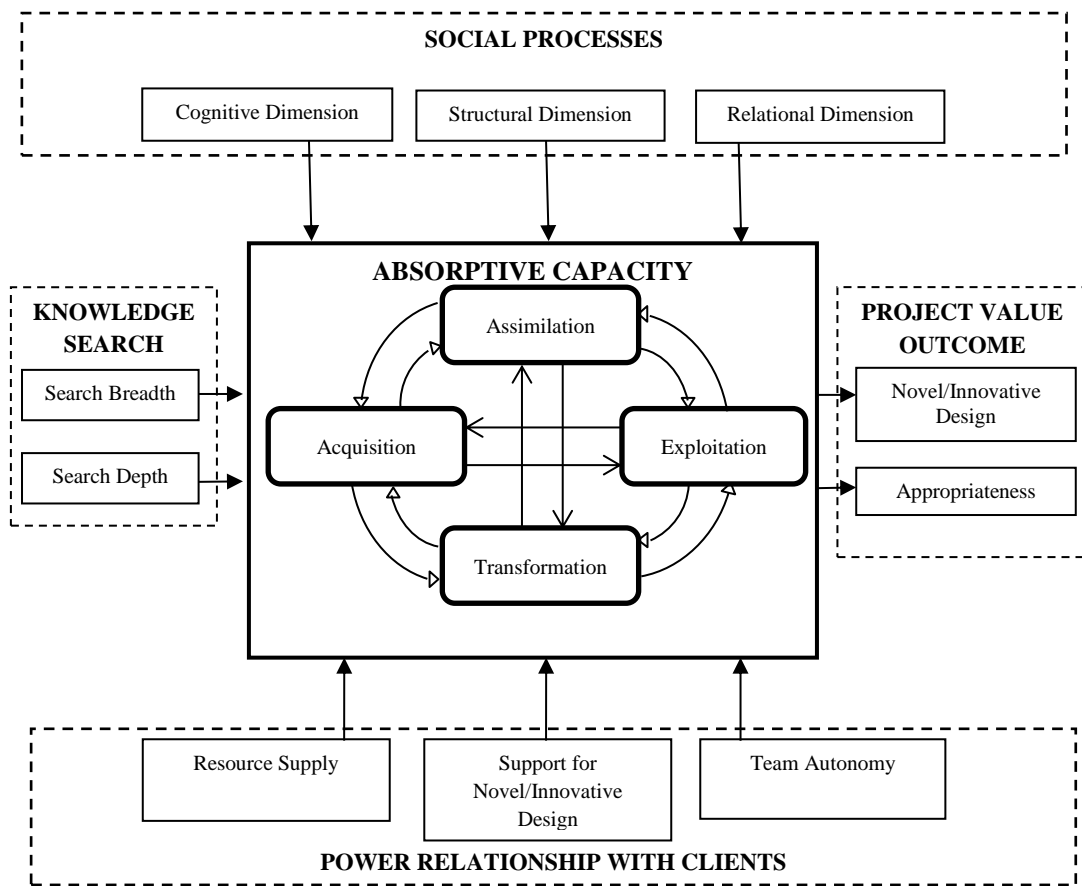


Figure 12. A Conceptual Model of Absorptive Capacity in Architectural Design Teams

#### 4.2.1 Absorptive Capacity in Architectural Design Teams

Architectural design process is one of the oldest activities of human beings. It has been an important research issue in the literature. Therefore it is no surprise that it has been addressed from different disciplines which has different sources of inspiration and epistemological and ontological assumptions. Architectural design process, like other types of problem solving processes, is based on information and knowledge. Architectural design projects are carried out by collaboration of professionals from different disciplines. A succinct review of literature on architectural design projects reveals that previous research studies have predominantly focused on design ideation or how architects think or design? Yet AEC industry has been witnessing unprecedented technological developments in the last decade which significantly changed the design

and construction practices. Technological advances coupled with the sophistication of clients' requirements and needs, increasing globalization and competition require close collaboration of architectural design team members. Therefore the focus of research on creating/proposing in the design process should shift from individual level to project team level. The following section presents a brief overview of research studies on architectural design process and highlights the paramount importance of external information and knowledge in creating/proposing value in architectural design process.

Architectural design process research has been not only strongly influenced from “general design process research” and “creative problem solving research domains but also led some significant conceptual developments in the “*general design process*” and “*creative problem solving*” research domains.

Architectural design is a special kind of *problem-solving* process with unique goals and constraints (Kalay, 2004). Rittel and Webber (1973) argue that design process is a *wicked problem-solving* activity. Simon (1973) explicitly acknowledges that architectural design process is an *ill-structured problem-solving* activity. Lawrence (1981) considers architectural design process a special kind of *problem solving* activity which is dominated by a conflict between logical analysis and creative thinking. Chan (1990) argues that architectural design is one kind of *problem-solving* which primarily involves a series of actions that must be performed in order to solve a design problem. Lawson (1997) points out that architectural design process is simultaneous learning about the *design problem* and *alternative design solutions*. Hölscher et al. (2005) conceptualize architectural design process as an ill-defined *problem-solving* activity. More recently Winch (2010) reemphasizes that architectural design process is a wicked problem solving activity. It is clear that there is consensus in the literature that the primary process underlying the creating/proposing value in architectural design projects is *problem-solving activity*.

The concept of problem solving activity has been commonly explored with respect to problem types. Different classification schemes such as *tame vs. wicked problems* (Rittel and Webber, 1973) and *well-defined vs. ill-defined problems* (Simon, 1973). The primary properties of *tame problems* include: (1) tame problems are relatively easy to define, (2) tame problems can be treated by separating or isolating from other problems and the problem environment, (3) tame problems can be solved with readily available information, (4) there is a consensus among stakeholders present on the best method to solve them, (5) tame problems can be solved by following

precedents and (6) stakeholders of the problem observe, respect and defer the solution proposed by the problem solver, (7) proposed solutions can be either correct or false, (8) have clear ending point, (9) proposed solutions can be tested until the correct solution is achieved and (10) problem can be defined as variance between desired state and goal state, constraints are clearly defined (Rittel and Webber, 1973).

Rittel and Webber (1973) suggest that a wicked problem (1) has no definitive formulation, (2) has no definite boundaries or stopping rules, (3) has no right or wrong solution but has good or bad solution, (4) has no clear or structured template to reach solution, (5) has more than one possible explanation for the proposed solution, (6) has no definitive testing procedure, (7) has “one shot” solution process, (8) is a symptom of another problem, (9) is a unique problem and finally (10) actor(s) involved has no right to be wrong.

Simon (1973) posits that it is impossible to define what an *ill-defined* problem is and proposes a list presenting the properties of *ill-defined problems* to guide researchers to identify ill-defined problems. The term *ill-defined* problem refers to a class social system problem which (1) is ill-formulated, (2) has confusing and contradictory information and knowledge structure, (3) involves stakeholders which have conflicting interests and (4) has high interdependency and interconnectivity with the other problems of whole systems (Simon, 1973).

The following paragraphs present a brief overview of the evolution of the conceptualization of design process as a special kind of *problem-solving activity*. There have been many attempts to map primary activities underlying the design process. Early research studies conceptualize design process as a linear process. Linear models of design process dominated literature in 1960s and 1970s. The linear model of design process (1) starts by conducting a comprehensive analysis of design problem to have a close insight and clear idea about the constraints and requirements (e.g., regulatory, technological, functional, economic, social) of the design problem, (2) continues by matching/mapping the definition of the design problem to the candidate design solutions, and finally concludes by evaluating the proposed design solution in order to ensure that constraints and requirements of the design problem are met. Winch (2010) argues that this linear conceptualization does not provide a complete representation of the design practice and points out that conducting a comprehensive analysis of design problem results with “paralysis by analysis” due to excess load on cognitive processes. More recent research studies conceptualize it as a *concurrent* and *cyclic problem-*

*solving process*. Three decades ago Lawrence (1981) pointed to the existing tension between proponents of describing design process as logical analysis (i.e., rational problem solving activity) and proponents of describing architecture design as a creative thought. This tension still exists in the literature.

It has been a challenging task for researchers to classify the models proposed for studying design process, particularly architectural design process (Stempfle and Badke-Schaub (2002)). Architectural design process has been classified under a number of different labels such as (1) *black box models* (i.e., based on intuition and inspiration processes) and *glass box models* (i.e., based on rational decision making), (2) *descriptive models*, *prescriptive models* and *interpretive models*, (3) *romantic models* and *stage based models*, (4) *cognitive models* and *reflective models*, and (5) *positivist epistemology based models* and *interpretive (i.e., phenomenology) epistemology based models*, (6) *rational problem solving models* and *reflection in action models* (Dorst and Dijkhuis, 1995), (7) *romantic models* and *non-romantic models* (Howard et al., 2008) and (8) *rational models*, *situated models* and *inspirational models* (Fällman, 2003). Stempfle and Badke-Schaub (2002) propose an alternative schema for classifying previously proposed design process models under three main headings: (1) *normative models*, (2) *empirical models* and (3) *design as an art models*.

More recently Johansson-Sköldberg et al. (2013) review design process models and identify five different research streams in literature: (1) *design as the creation of artefacts*, (2) *design as a reflexive practice*, (3) *design as a problem-solving activity*, (4) *design as a way of reasoning/making sense of things* and (5) *design as creation of meaning*.

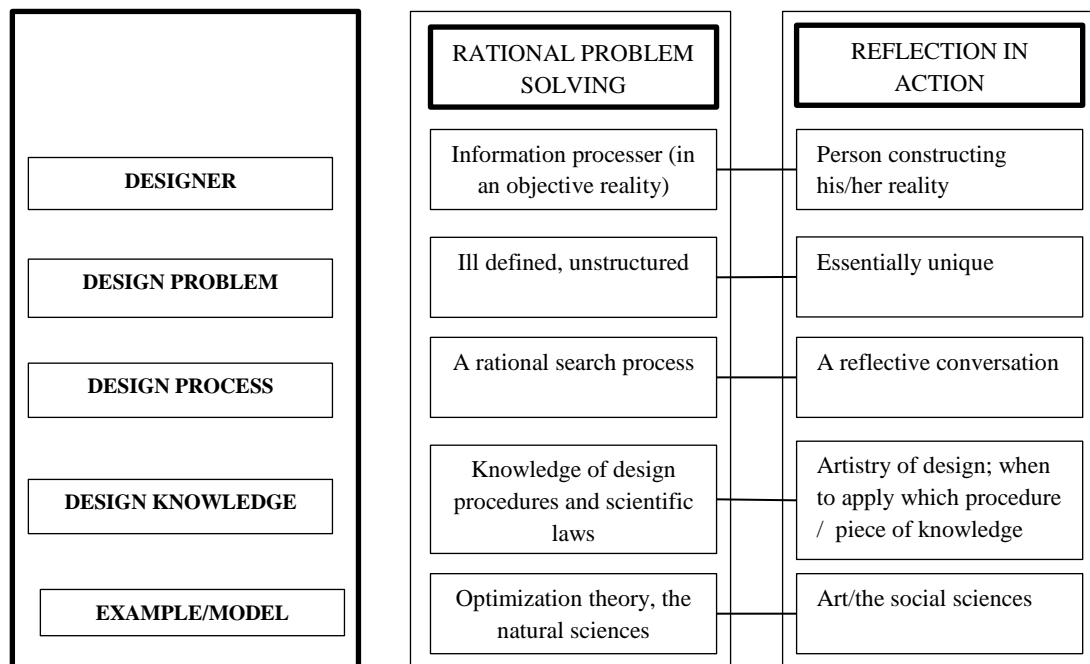


Table 5. Rational Problem Solving and Reflection in Action  
(Source: Dorst and Dijkhuis, 1995)

The observed differences in these categorizations (i.e., classification schemes) can be explained by their epistemological assumptions. Each design process model has its own weaknesses such as (1) normative models provide prescriptions for what designer should do without considering his/her needs, (2) empirical models lack a valid conceptual foundation and follow a rigorous research method, (3) design as- an art models suffer from over-romanticizing design process, places paramount importance on intuition, (4) early stage based models assumes *linear relationships* between the stages of design process and (5) more recent stage-based models assume *concurrent* and *cyclic relationship between the stages of design process*.

Wallas (1926) points out that creative design process includes five steps: (1) preparation – collecting information, (2) incubation –unconscious processing (3) intimation – sense of development, (4) illumination – conscious processing and (5) verification – elaborating and applying.

Alexander (1964) points out that the subjective approach to architectural design problems should be replaced by a systematic approach. He points out that architectural design problems are too complex and requires processing a large amount of information

which is beyond the limits of the cognitive capacity of a designer. Under these conditions a designer heavily relies on his/her intuition and judgment and limited information to develop architectural design solutions. This subjective approach is vague and inadequate because such approach leads to an emergence of a gap between designer's solution (i.e., design project) and user'/ client's needs. He proposes that design problems can be systematically solved and the gap can be reduced by following a two stage process: (1) *analysis* and (2) *synthesis*. Analysis stage involves identifying architectural program requirements and decomposing these requirements into a set of hierarchically structured sub-requirements (i.e., a hierarchical tree of sub-requirements) - the formulation of a set of hierarchically structured sub-design problems. Synthesis stage involves the exploration and generation of solutions to each sub-design problem, combining and harmonizing the solutions of each sub-design problem and if required the reconciliation of conflicting solutions. Alexander (1964) emphasizes that the use of a highly mechanical process (i.e., synthesis follows analysis) is needed in order to remove the subjectivity involved in design process. Archer (1965) argues that a vital process is missing in design process, communication, and proposes a design process model which includes six sub-processes: (1) programming, (2) data collection, (3) analysis, (4) synthesis, (5) development and (6) communication.

Archer (1968) suggests that architectural design process involves four major activities: (1) assimilation, (2) communication, (3) general study and (4) development. Assimilation process involves acquiring information and developing design brief. General study process involves the comprehensive analysis of design problem, the generation of design solutions and the identification of the most promising design solution. Development process involves the refinement of developed and selected design solution. Communication process involves the act of sharing design information and solution with project stakeholders such as client, owner, design team members, regulatory agencies and general public.

Reekie (1972) suggests that design process includes five sequential processes: (1) briefing, (2) analysis, (3) synthesis, (4) implementation and (5) communication.

Cross's (2000) design process model includes four steps: (1) exploration, (2) generalization, (3) evaluation and (4) communication.

Simon (1973) acknowledges that architectural design process is an ill-structured problem solving activity which is driven by a rational search of the problem space. This rational problem solving process assumes that the goals, requirements and constraints

cannot be clearly defined (at the outset of the design problem). Simon (1973) argues that the solution space of ill-structured problems is too large and not impossible but quite difficult to define. Therefore the process of solving ill-structured problem requires decomposing the design problem under consideration into a set of well-defined sub-problems by employing decomposition methods (i.e., search strategies: breadth-first, depth-first). Simon (1973) proposes that architectural design problems, like any other problem types, can be solved by a rational problem solving approach.

Darke (1979) proposes a model to explain how an architect can cope with paralysis by analysis and reduce his/her cognitive load. The conjectural model includes three sub-processes: (1) primary generator, (2) conjecture and (3) analysis. The primary generator refers to a concept or an object that generates or triggers an initial design solution - a set of initiating concepts. The primary generator is not the product of a complete analysis or rational justification of the design problem but may be based on a hunch from previous experience, an analysis of similar previous design solutions or initial thoughts about the design problems. Darke (1979) points out that a primary generator in fact is a designer imposed constraint that narrows down the solution space and in turn reduces the complexity of design problem and the cognitive load of designer. The process of conjecture refers to conceptualization of the tentative design solution of design problem with developing a series of "if statements". Analysis process involves a number of iterative cycles to modify and improve the candidate design solution with answering the proposed "if then statements" while ensuring that constraints and requirements of the design problem are met. Darke (1979) has no intention to propose a model that explains or describes the entire architectural design process. She suggests that designers may not opt in to follow strictly rationalized design process marked by analysis-synthesis-evaluation and may differ on how they approach to solve design problems.

Lawrence (1981) argues that architectural design is a kind of problem solving process. This process includes three main processes: (1) analysis, (2) synthesis and (3) evaluation/verification. These three main processes can further be decomposed into sub-processes under different labels such as program and problem, insight and hypothesis, proving and improving (Lawrence, 1981).

Schön (1983) conceptualizes the architectural design process as a *reflective conversation* with design problem. This reflective conversation is an ongoing learning process involving two primary cognitive processes: (1) *constructing frames* and (2)



*performing moves*. Construction of a frame is selecting a viewpoint to address the design problem in a certain way for a particular period. A frame reduces the cognitive load of designer by narrowing down the solution space. A designer's preferences, goals, values and previous experiences influence the framing of a design problem. A move is an act of (1) searching for the possible solutions to the design problem under consideration, exploring and making discoveries and (2) evaluating the performed move. The reflective conversation can be considered as a cyclical experiment which presents opportunities for (1) exploring and discovering new insights to the design problem, (2) performing moves towards possible design solution and improving the design solution, (4) evaluating the performed move and the arrived design solution and (5) constructing new frames and performing new moves. The constructing frames and performing moves enable a designer to learn from the design problem under consideration.

Archea (1987) proposes that architectural design process is not a problem solving activity but in fact it is a *puzzle making* activity which involves searching and discovering how the conflicting parts (i.e., concepts, architectural elements and requirements) of a design problem can be reconciled and harmonized into a new, meaningful, internally consistent and unique whole. He points out that the puzzle making activity is primarily driven by modifying and adapting precedents, symbols and metaphors because of limited information about the design problem outset of the design process.

Ullman (1992) proposes that design process includes three sub-process: (1) conceptual design, (2) embodiment design and (3) detail design.

Rosenman and Gero (1993) propose four main activities for analyzing creative design process: (1) combination, (2) mutation, (3) analogy and (4) first principles. Combination activity involves using the information from previous design solutions and in some cases design is viewed as exploring the situation, discovering the solution and presenting the new and unique one through synthesized process and sometimes viewed in attempting to create the solution.

Tajika (1994) proposed that the process of problem solving involves four *cognitive phases*: (1) *translation*, (2) *integration*, (3) *planning* and (4) *execution*.

Goel (1995) proposes that design processes involves two main phases: (1) design problem structuring and (2) design problem solution. He subsequently decomposes design problem solution phases into three sub-phases: (1) preliminary

design, (2) refinement and (3) detailing. Goel (1995) also points that three sub-phases of design problem solution phase differ on a number of characteristics such as considerations for various aspects of design (i.e., people, purpose, resource, behavior, function and structure) change in each sub-phase, the primary source of information/knowledge, increasing commitment to the developing design solution, the level of detailing and type of transformations (i.e. *vertical transformation* – moving from currently developed design solution to slightly different design solution and *horizontal transformation* – elaborating the currently developed design solution).

Maher et al. (1996) view architectural design process as a co-evolutionary process which involves exploration of two spaces: (1) problem space and (2) solution space. The term exploration in Maher et al.'s (1996) model refers to the iterative interaction and also evolution of problem space dimension (PS) with solution space (SS) dimension over time (t) (i.e., during architectural design development process). Problem space dimension (PS,  $t=0$ ) includes initial design goals, requirements and constraints whereas solution space dimension (SS,  $t=0$ ) includes initial architectural design solution. During the exploration process the initial problem space dimension (PS,  $t=0$ ) evolves to a new problem space dimension (PS,  $t=1$ ) and from this new problem space dimension (PS,  $t=1$ ) to another new process problem space dimension (PS,  $t=1+n$ ) and continues to evolve. Similarly initial solution space dimension (SS,  $t=0$ ) evolves to a new solution space dimension (SS,  $t=1$ ) and from this new solution space dimension (SS,  $t=1$ ) to another new solution space dimension (SS,  $t=1+n$ ) and continues to evolve. These two parallel evolutionary processes do not operate in isolation with each other. On contrast initial problem space dimension influence solution space dimension (PS,  $t=0$ ) and in return solution space dimension (SS,  $t=0$ ) influences subsequent problem space dimension by prompting and imposing new requirements, goals and constraints which are defined at initial problem space dimension.

Buchanan (1996) points out that a numerous variations of sequential design process model have been proposed in the literature but a close inspection reveals that the proposed design process models have two common sub-processes: (1) *problem definition* and (2) *problem solution*. *Problem definition* is an analytic process in which the inputs and constraints of the design problem are determined and also the criteria set for evaluating the quality of the design solution are specified. *Problem solution* is a synthetic process in which different requirements and expectations are combined and balanced against each other to generate the final solution.

Lawson (1997) describes the design process as “a negotiation between the problem and solution through the three activities of (1) *analysis*, (2) *synthesis* and (3) *evaluation*”.

Cross (2000) proposes a model for analyzing design process which involves (1) *exploration*, (2) *generation*, (3) *evaluation* and (4) *communication*.

Stempfle and Badke-Schaub (2002) suggest that design process is a complex problem solving activity which involves operating on problem spaces. A problem space is composed of two sub-spaces: (1) goal space and (2) solution space. A goal space includes the requirements and constraints of a design problem (e.g., design program and client’s brief) whereas a solution space includes a range of possible design solutions for the design problem. The primary goal in any type of problem solving activity is to establish an optimum overlap between these two sub-spaces: finding a solution which satisfies and meets all of the requirements and constraints. Stempfle and Badke-Schaub (2002) argue that a set of cognitive operator is required to achieve this ultimate goal. A *cognitive operator* is any type of process that changes state of knowledge (Chan, 1990). Stempfle and Badke-Schaub (2002) propose four cognitive operators which underlie any type of design problem activity: (1) *generation*, (2) *exploration*, (3) *comparison* and (4) *selection*. First two cognitive operators (i.e., generation and exploration) aim to widen the problem space whereas last two cognitive operators (i.e., comparison and selection) aim to narrow the problem space.

Mayer (2003) points out that the problem solving process involves four cognitive phases: (1) *translating*, (2) *integrating*, (3) *planning* and (4) *execution*.

Kalay (2004) proposes that design process can be explained by a cyclical dialogue between “*problem solving*” and “*puzzle making*” processes.

Akin and Moustapha (2004) argue that architectural design process involves converting an “ill-structured problem” into a “well-structured problem” or “well-structured component tasks” by restructuring the problem – transforming problem parameters by modifying relations and/or redefining specifications. Akin and Moustapha (2004) report that *breadth-first* and *depth-first* strategies are used to for structuring/restructuring architectural design problems. *Breadth-first* strategy involves developing multiple design solutions (i.e., alternative design solutions) and then identifying and selecting the one that meets the requirements and constraints. *Depth-first* strategy involves selecting a single design solution and then conducting a comprehensive and detailed analysis of it.

The above presented review of architectural design models reveals that (1) architectural design process is an information and knowledge based activity (Yu, 1989), (2) architectural design process includes three primary activities (i.e., analysis, synthesis and evaluation (van der Voordt and Wegen, 2005), (3) different cognitive operators/processes underlie the primary activities of architectural process (e.g., Stempfle and Badke-Schaub, 2002), (4) decomposition strategies are used to reduce the cognitive load in architectural design process (Akin and Moustapha, 2004) and (5) cognitive activities underlying architectural design process have been predominantly conceptualized and explored at individual level (i.e., micro level) (Figure 13) Larson and Christensen (1993) propose that teams or groups can be conceptualized as “*problem solving units*”. They also propose that team or group level cognitive activities/operators can be conceptualized as parallel to those that take place at the individual-level: (1) acquisition, (2) transmission, (3) manipulation and (4) use of information and knowledge to produce a group or team level (meso-level) output. Hinsz et al. (1997) adopt a similar approach and conceptualize teams or groups as “information processors” and propose that a group-level (i.e., meso-level) information processing model which include eight cognitive activities/operators: (1) information, (2) processing objective, (3) attention, (4) encoding, (5) storage (6) retrieval, (7) response and (8) feedback. The group or team level cognitive activities can be also explored by the concept of absorptive capacity.

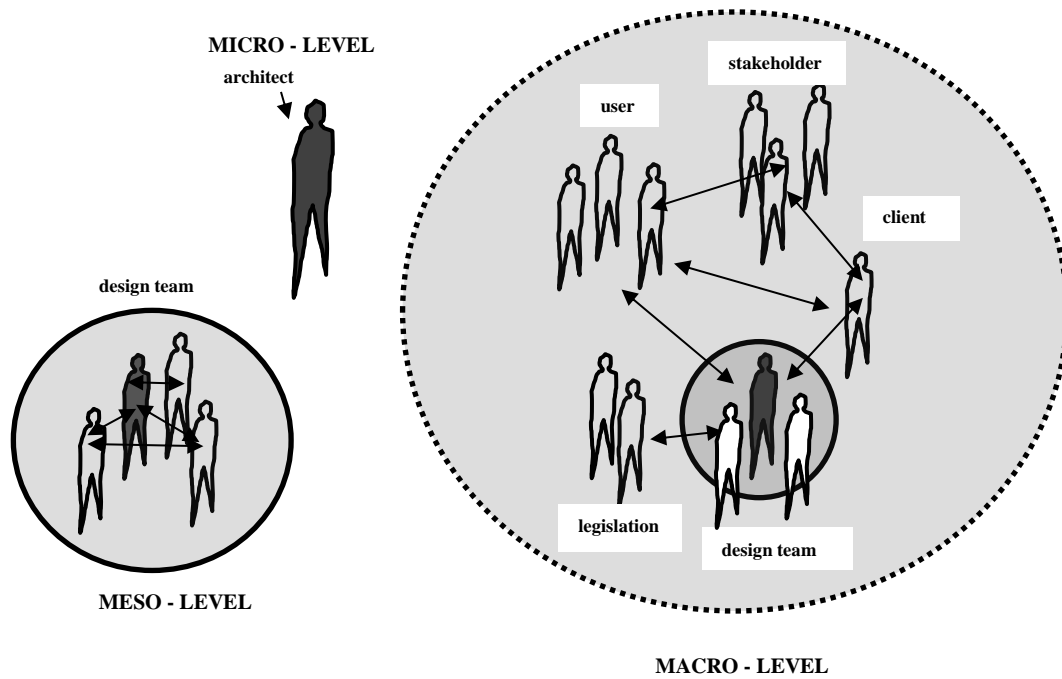


Figure 13. The Three Hierarchical Levels of Architectural Design Process  
(Source: Moum, 2006)

The concept of absorptive capacity builds on four cognitive operators/processes: (1) acquisition, (2) assimilation, (3) transformation and (4) exploitation. The absorptive capacity of architectural design team significantly influences its ability to create/propose value to the stakeholders of built environment. Each architectural design project requires acquisition, assimilation, transformation and exploitation of new external information/knowledge such as the (1) needs, expectations, requirements and resources of clients, (2) physical and spatial constraints, (4) legal, (5) social, (6) political, (7) technological, (8) economic and (9) cultural issues. The following research proposition can be developed:

*Research proposition 1: Absorptive capacity of architectural design teams is significantly and positively related to project value-outcomes.*

### **4.3 Search Strategy and Absorptive Capacity**

Architectural design teams can be conceptualized as *ill-defined problem solvers*. This conceptualization points out that architectural design teams can create or propose value to their stakeholders by solving ill-defined design problems. The primary prerequisite for any type of ill-defined design problem is search activity (Grimpe and Sofka, 2009) or also termed decomposition strategy (Akin and Moustapha, 2004), - searching solutions to problems such as for developing new ideas for products, services and processes, structuring/restructuring design problems, decomposing a large and complex design problem into small and simple design problems or searching solutions for existing design problems.

#### **4.3.1 Search Depth and Scope**

March (1991) suggests that the search activity of social actors (i.e., individuals, teams, firms) can be viewed in terms of a bipolar continuum *exploitation* and *exploration*. Exploitation activity describes the use or reuse of prior or existing knowledge in the problem solving process whereas exploration activity describes the exploration and the use of new knowledge in the problem solving process. Katila and Ahuja (2002) challenge this view by pointing out that the distinction between exploitative and explorative search activities is useful but incomplete because social actors vary in their search efforts and viewing search activities along a single dimension (i.e., bipolar continuum) implies a trade-off between exploitation and exploration. They propose that the search activity of social actors varies along not one but two dimensions: (1) search depth and (2) search scope. The first dimension, *search depth*, can be defined as “the degree to which search revisits a social actor’s prior knowledge” (Katila and Ahuja, 2002). In other words, it describes how deeply a social actor uses its existing knowledge. The second dimension, *search scope*, can be defined “as the degree of new knowledge that is explored” (Katila and Ahuja, 2002). In other words, it describes how widely a social actor explores new knowledge. Each dimension of search activity has positive and negative impacts on problem solving process and in turn on value proposition/creation process. Search depth enables a social actor to use the

same knowledge elements repeatedly which in turn reduces the possibility of errors and false starts, improves the efficiency of search process, increases the reliability of search process, enables a social actor to decompose the problem into sub-problems effectively, facilitates the identification of valuable concepts and provides a deeper understanding of the concepts used in the problem solving process. Yet the excessive search depth has a number of negative impacts on problem solving process. The repeated use of same knowledge elements can limit the possible improvements in the problem solving process – approaching the limits of trajectory. It can also introduce rigidity to the problem solving process. Search scope enables a social actor to enrich its existing knowledge pool by adding distinctive new knowledge elements and present possibilities and opportunities to discover a new useful combination of acquired distinctive new knowledge elements. The excessive search scope also has a number of negative impact on problem solving process such as increasing cost of integration (i.e., difficulty in communicating, understanding and interpreting) of new knowledge to social actor's existing knowledge base and reducing a social actor's ability to respond to new information correctly (i.e., reliability in problem solving). Katila and Ahuja (2002) report a curvilinear relationship between knowledge search activities (i.e., scope and depth) and value creation process. Katila and Ahuja (2002) conclude that search depth and scope are mutually beneficial knowledge search activities and the interaction of these two search activities positively influences a social actor's absorptive capacity.

### 4.3.1.1 External Search Breadth and Depth

Laursen and Salter (2006) extended Katila and Ahuja's (2002) work on knowledge search processes by shifting the focus from internal knowledge sources to external knowledge sources. This shift points to the important role of external knowledge sources in social actors' search activities. Laursen and Salter (2006) suggest that external information and knowledge sources for creating value to customers/ clients include: (1) *market* (e.g., suppliers of equipment, materials, components, or software, clients or customers, competitors, consultants, commercial laboratories/R&D enterprises) (2) *institutional* (e.g., universities or other higher education institutes, government research organizations, business links, government offices and private research institutes) (3) *other* (e.g., professional conferences, meetings, trade associations, technical/trade press, computer databases, fairs, exhibitions) and (4) *specialized* (e.g., technical standards, health and safety standards and regulations, environmental standards and regulations). Laursen and Salter (2006) propose that a social actor's search activities with external knowledge sources can be conceptualized as having two distinct dimensions: *external search breadth* and *external search depth*. External search breadth can be defined as the diversity of external sources or search channels that a social actor uses in its problem solving activities. External search depth can be defined as the degree to which a social actor draws and relies intensively on different external sources or search channels in its problem solving activities. Laursen and Salter (2006) report the presence of curvilinear relationships (i.e., inverted -U-pattern) between external search breadth and value creation process – performance in value creation process initially increases with external search breadth, reaches a peak point and decreases thereafter due to over-search. They also report the presence of similar inverted -U- pattern between external search depth and value creation process - external search depth activity initially increases performance, reaches a peak point and decreases thereafter. Laursen and Salter's (2004) findings are in line Katila and Ahuja's (2002) findings even though the authors followed different research approaches.

Leiponen and Helfat (2010) conceptualize external search activity along two dimensions: the objectives and knowledge sources of social actors. The objectives of external search activity include product objectives (e.g., introducing new products or services, improving existing products or services, expanding product or service portfolio, entering new markets) and process objectives (e.g., reducing labor, material



and energy costs, increasing flexibility of production, conforming governmental regulations and standards requirements and mitigating environmental damage) (Leiponen and Helfat, 2010). External knowledge sources include business group, competitors, customers, consulting firms, suppliers of equipment, materials, components, or software, universities, public or private non-profit, research institutes, patents, conferences, scientific/trade publications, online databases, internet, trade fairs and exhibitions (Leiponen and Helfat, 2010). Leiponen and Helfat's (2010) research findings provide empirical support that the proposition that the breadth of search objectives and external knowledge sources is positively associated to value creation/proposition process.

Heisig et al. (2010) reported that designers' information and knowledge needs can be analyzed under four major categories: (1) *design description* (e.g., design information, detailed design, design, definition, sufficient detail, full description), (2) *design documentation* (e.g., original design documents, design definition reports, design records, design reports, change records, system design, documents, design notes, standards, design inputs, design outputs, system changes documentation, design documentation information) (3) *design solutions* (e.g., typical, technical, original, alternative, sustainable and different) and (4) design process (e.g., task performed, design activity, how the design is made up from 'core' building blocks, detailed description of what was done and how verified). In the light of the preceding arguments, the following research proposition can be developed:

*Research Proposition 2: Knowledge search strategies are positively related to the absorptive capacity of architectural design teams.*

#### 4.4 Social Integration Mechanisms and Absorptive Capacity

There is a rich literature on absorptive capacity proposing that social integration mechanisms influence a social actor's absorptive capacity. The term social integration mechanism is an umbrella concept that covers a wide range of social processes. This umbrella concept has its roots in different research streams such as "strength of a tie" (Granovetter, 1973), "*social embeddedness*" (Granovetter, 1985, 1992; Uzzi, 1997), and "*social capital*" (Adler and Kwon, 2002; Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998) which build on different assumptions, offer different conceptualizations, suggest diverse terminology and use different rules of evidence but jointly propose that problem solving activities do not take place in a vacuum but in a social context. The social context in which social actors operate has been conceptualized along several dimensions.

One of the most influential conceptualizations of social context is that of "strength of a tie" argument. The strength of a tie argument proposed by Granovetter (1973) emphasizes the paramount role of social relations plays in acquiring, transferring and sharing new information and knowledge between social actors. Granovetter (1973) defines "the strength of a tie as (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie". There are two competing arguments on the influence of tie strength on the acquiring transferring, absorptive capacity of a social actor: strong tie and weak tie arguments. The proponents of strong tie argue that strong ties between/among social actors enable them to cooperatively, efficiently and effectively exchange information and knowledge. On the contrary, the proponents of weak tie argue that weak ties between/among social actors enable to them access new information and knowledge. Some scholars have argued that an actor's weak ties can bridge separate networks, offering access to unique resources (Granovetter, 1973). However, there is evidence that weak ties may be inadequate for transferring more complex knowledge (Reagans and McEvily, 2003).

Granovetter (1985) points out an ignored fact in an economic action by arguing that "most behavior is closely *embedded* in networks of interpersonal relations". The term social embeddedness refers to "how social actors are structurally embedded in

ongoing network of social relations among social actors”. Granovetter (1985) suggests that the use of *embeddedness analysis* can reveal important insights on how ongoing network of social relations influence and shape not only economic actions but also the social context in which economic actions take place.

The concept of “social embeddedness” is further elaborated and extended in Granovetter’s (1992) subsequent work. Granovetter (1992) distinguishes two forms of social embeddedness: (1) *structural embeddedness* and (2) *relational embeddedness*. *Structural embeddedness* refers to the patterns of (e.g., social interactions, density of interactions) connections between and among social network actors whereas *relational embeddedness* refers to the characteristics (e.g., expectations, norms, trust and trustworthiness) of connections between and among social actors.

Nahapiet and Ghoshal (1998) propose a three-dimensional framework analyzing social context in which social actors operate. This framework mainly builds on Granovetter’s (1992) demarcation of structural and relational embeddedness and also incorporates the cognitive dimension in social processes. Nahapiet and Ghoshal’s (1998) model for analyzing social processes includes (1) *structural dimension* (pattern of social interaction, network configuration, strength of tie, closeness and frequency), (2) *relational dimension* (e.g., trust and trustworthiness) and (3) *cognitive dimension* (e., shared goals, codes, practices, language and discourse).

The *structural dimension* refers to the general pattern of linkages between social actors (Nahapiet and Ghoshal, 1998). The pattern of linkages between social actors has been explored from various aspects such as focusing on the frequency and content of social interactions, network ties, network configuration and network stability. Yet the social interaction stands out in this respect and has been the predominant research construct of structural dimension in project environments. Social interaction provides opportunities to project team members to get to know each other, to share important information, to get access to others’ resources, to acquire new information and to combine and transform acquired information and knowledge (Bartsch et al., 2013; Chen et al., 2011; Gu et al., 2013; Mäkelä et al., 2012).

The *relational dimension* refers to the relational outcome of social interactions such as trust and trustworthiness (Tsai and Ghoshal, 1998). Trust is a property of relationship and based on social judgments of a social actor about other social actors’ ability/competence, integrity and benevolence (Mayer et al., 1995). Competence refers to a social actor’s (i.e., trustor’s) perception that the other social actor (i.e., trustee) has

the required skills, abilities and characteristics to perform a predefined or pre-agreed task. Benevolence refers to the perceptions of a social actor (i.e., trustor) regarding concern of the other social actor (i.e., trustee) for the wellbeing of the trustor - perception of a positive orientation of the trustee toward the trustor (Mayer et al., 1995). This positive orientation includes three major properties: (1) perception that trustee will act honestly and openly to the trustor, (2) perception that trustee will refrain from opportunistic actions and (3) perception that trustee will proactively care for the welfare and interest of trustor. Integrity refers to a social actor's (i.e., trustor's) perception that the other social actor (i.e., trustee) conforms to a set of principles and norms that the trustor considers acceptable (Mayer et al., 1995). Trust is the primary requisite for almost any type of interdependent process or task. The presence of mutual trust between social actors facilitates the information and knowledge sharing, assimilation, transformation and exploitation.

*Cognitive dimension* refers to shared representations, experiences, interpretations, understanding and systems of meanings which facilitate a common understanding of collective goals and guide social actors to act properly in a social setting (Tsai and Ghoshal, 1998). The major manifestations of cognitive dimension include (1) common goals, (2) common language, narratives and frameworks for interpretation, (3) common working practices/culture and codes of conduct (Nahapiet and Ghoshal, 1998). *Common goals* refer to the degree of shared commitment of social actors to achieve a predefined goal that requires their collaborative efforts (Du Chatenier et al., 2009). *Common language, narratives and frameworks for interpretation* refers to extent that social actors share the same understanding and interpretation of work-related discourse (Du Chatenier et al., 2009; Mäkelä et al., 2012). *Common working practices/culture and codes of conduct* refers to a pattern of basic assumptions to develop solutions (Du Chatenier et al., 2009; Mäkelä et al., 2012). to design problems and how to perform design activities such as “how to decompose design problem”, “how to acquire, assimilate, transform and exploit external information and knowledge”, and “how to offer value (i.e., how to solve design problem) to stakeholders”. Previous research studies have provided strong support for the argument that social integration mechanisms have positive impact on the absorptive capacity of social actors (i.e., project teams).

*Research proposition 3. Social integration mechanisms are positively related to the absorptive capacity of architectural design teams.*

## 4.5 Power Relationships and Absorptive Capacity

The concept of power relationships has received overwhelming interest in the literature. Emerson (1962) defines *power* as “the ability of an actor to influence another to act in the manner that they would not have otherwise”. (Pfeffer, 1981) defines *power relationships* as “those relationships that involve the use of power and other resources by social actor (i.e., individual, group or organization) to obtain his or her preferred outcomes”. Maloni and Benton (2000) propose that in an industrial setting the term *power* can be defined as the ability of one social actor (*the source – S*) such as client, customer or buyer to influence the intentions and actions of another social actor (*the target - T*) such as seller, producer or provider. Brown et al. (1996) argue that a *source S* achieves power over *target T* through its possession and control of valuable and rare resources and “embeds them within the influence strategies it uses to signal and communicate its demands to *target T*”. The perception of *Target T* about the *source S*’s use of power is jointly socially constructed by *source S*’s rare and valuable resources and its influence strategies Brown et al. (1996). In other words power enables *source S* to influence or control *target T* in a manner that *source S* desires and demands. Different classification schemas have proposed for studying the sources of power in relationships. French and Raven’s (1959) classification schema stands out in this respect. French and Raven (1959) decompose the sources of power into two major groups: (1) mediated power (i.e., reward, coercive and legal legitimate) and (2) non-mediated power (i.e., expert, referent and traditional legitimate). The demarcation between mediated and non-mediated power lies in “whether the source *S* controls or does not control the reinforcements (e.g., rewards or punishments) which guide the target *T*’s behaviors” (Tedeschi, 1972). *Mediated power* can be further decomposed into (1) *reward power*, (2) *coercive power* and (3) *legal legitimate power*. *Reward power* refers to the ability of *source S* to provide tangible and intangible rewards to target *T* in return for compliance to *source S*’s expectations, requests, desires and requirements. *Coercive power* refers to the ability of *source S* to impose tangible and intangible sanctions and administer tangible and intangible punishments to *target T* for *target T*’s failure to comply with *source S*’s expectations, requests, desires and requirements. *Legal legitimate power* refers to the extent that *target T* believes that

she/he should comply with the expectations and demands of *source S* and derives from contracts, rules and regulations. *Non-mediated power* can be further decomposed into (1) *expert power*, (2) *referent power* and (3) *traditional legitimate power*. *Expert power* refers to the perception of *target T* that *source S* possesses valuable information, knowledge or expertise that is worth to follow. *Referent power* refers to the desire of *target T* to identify with or be like source S. *Traditional legitimate power* refers to the extent that target T feels that she/he should comply with the wishes of *source S* and derives from social norms, values and beliefs.

There is overwhelming evidence in the built environment literature that clients are the most *powerful* and *active social actors* of the AEC industry. The term “*clients’ power*” in architectural design projects refers to the relative influence clients have vis-à-vis project team members. *The power of clients in the construction industry* derives from their possession or control of valuable and rare resources. Architectural design projects are commonly considered *post demand activities* – an architectural design project is initiated based on the request of a client. Therefore, the clients of the AEC industry, as compared to the customers of manufacturing industries, have higher mediated power (i.e., reward based power and coercive power) to influence the design and construction process. Some built environment researchers (e.g., Kulatunga et al., 2011; Nam and Tatum, 1997) prefer to use the term *champion*, but not power, for describing the central and active role played by the clients of the AEC industry in promoting and insisting novel/innovative design solutions. Nam and Tatum (1989) define the term *champion* as “*a social actors who leads the innovation process*”. Identifying the primary characteristic of champions, also termed championing behavior, has been an important research theme in the literature. Markham (2000) defines championing role “*as one in which a social actor strongly advocates innovative ideas and generates positive support for it or work on its behalf*”. Dulaimi et al. (2005) define *championing behavior* as “*observable actions directed towards seeking, stimulating, supporting, carrying, and promoting innovation in the project*”. Kulatunga et al. (2011) point out that the main characteristics of the clients that influence innovation in the AEC industry include: (1) acting as a team player, (2) promoting respect for people, (3) knowledge and information dissemination, (4) support for innovation, (5) active involvement and commitment. Walter et al. (2011) argue that that championing behaviors are (1) pursuing innovative ideas, (2) network building, (3) persisting under adversity, and (4) taking responsibility for the idea. Scott and Bruce

(1994) do not use the term “champion” but emphasize that any type of innovative behavior is influenced by two major factors: (1) support for innovation and (2) resource supply.

Brandon and Lu (2008) propose *the six ‘I’s of clients’ framework* for describing the attitudes of clients to novel and innovative design and construction process (Figure 14). The proposed framework ranges on a spectrum of impeding to insisting. At the one end of the spectrum, *impeding*, a client does not appreciate and support innovative/novel design solutions and therefore encourages design team member to stick and follow to the conventional or conservative design solutions. At the other end of spectrum, *insisting*, client insists and supports innovative novel design and in turn encourages design team member to search, experiment and develop innovative/novel design solutions. Insisting attitude can lead architectural design teams to search for new external knowledge and information whereas impeding attitude can lead architectural design team members to rely on their existing knowledge and information base.

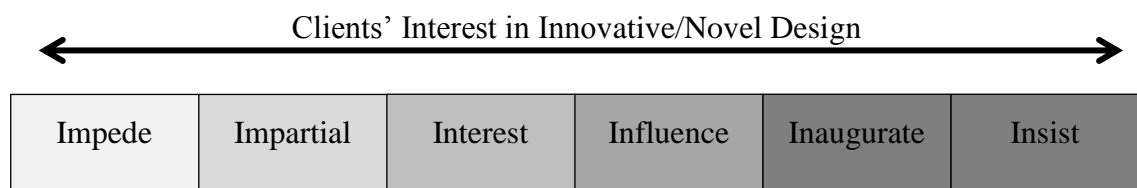


Figure 14. The spectrum of a Client’s Attitude to Driving Innovation  
(Source: Brandon and Lu, 2008)

The attitude of a client towards the design process and its outcomes (design solutions) derives from their *mediated power* which can have overarching implications on primary design activities - acquisition, assimilation, transformation and exploitation of new external knowledge and information. The *six ‘I’s of clients’ framework* points out that the mediated power can have a supportive or impeding impact on design and construction processes (Figure 14). Previous research studies suggest that the *supportive mediating power* (i.e., tangible or intangible rewards) of social actors (i.e., clients) manifests itself by three influence strategies: (1) *supporting innovative/novel design solutions*, (2) *providing the required resources* and (3) *granting autonomy to the project team members* (e.g., Amabile et al., 1996; Scott and Bruce, 1994). Each

influence strategy carries important information about the client's expectations regarding to the design project (i.e., design activities, project outcomes) to the architectural design team. Architectural design team uses this information to formulate "expectancies" (how to act?) and "instrumentalities" (valued outcomes). *Supporting innovative/novel design solutions* refers to the degree that project team members view the client as open to innovative/novel design solutions, encouraging risk taking behaviors and supportive of innovative/novel design ideas and solutions. Supplying required resources facilitate the acquisition, assimilation, transformation and exploitation of new external knowledge. *Project team autonomy* refers to the degree of independence and discretion granted to the team by the client in making decisions about design objectives, design problem, design process and design solution. There is overwhelming evidence that supportive power relationship has positive impact on the absorptive capacity of project teams (e.g., Amabile et al., 1996; Ivory, 2004; Kulatunga et al., 2011; Scott and Bruce, 1994). In the light of the preceding discussion the following research proposition can be developed.

*Research proposition 4. Supportive power relationships are positively related to the absorptive capacity of architectural design teams.*



## CHAPTER 5

### RESEARCH METHODOLOGY

#### 5.1 Introduction

This chapter briefly delineates the levels of theory, measurement and analysis. It presents the rationale behind the selection of data collection method and key informant, the sampling procedure used for data collection, the organization of the research instrument used for data collection and items used for measuring research constructs.

#### 5.2 Levels of Theory, Measurement and Analysis

The research presented builds on multilevel and multidimensional concepts to explore the absorptive capacity of architectural design teams. Using multilevel and multidimensional concepts in any research study necessitates addressing three major research design issues: level of theory, level of measurement and level of analysis (Mathieu and Chen, 2011; Rousseau, 1985). The *level of theory*, *level of measurement* and *level of analysis* must be simultaneously aligned to ensure that obtained results are not biased and/or misleading. Discrepancies between level of theory, level of measurement and level of analysis may lead to misspecifications, fallacies and misinformation and in turn wrong inferences and conclusions.

*Level of theory* refers to focal unit or target (e.g., individuals, groups/teams, organizations, industry) that a researcher intends to explore and make inferences – “*it is the level to which generalizations are made*” (Rousseau, 1985). *Level of measurement* refers to the actual source of data - “*to the unit which the data are directly attached*” (Rousseau, 1985). *Level of analysis* refers “*to the unit to which the data are assigned for statistical analysis*” (Rousseau, 1985). The following paragraphs briefly explain how level issues are addressed in this research.

The research presented herein explores the concept of absorptive capacity and its moderating factors in context of the architectural design teams. Therefore, for the level of theory, the focal unit is “*the architectural design teams*”.

The *level of measurement* in the research presented herein is also *architectural design teams*. Yet delineating the level of measurement in architectural design teams is a challenging task. It necessitates addressing the unique features of architectural design teams. Some built environment researchers (e.g., Cherns and Bryant, 1984; Lizarralde et al., 2011) point out that terms “*team*” and “*group*” in the context of the AEC industry are loosely used in the built environment practice and literature and a “*team*” or “*group*” that carries out a design and/or construction project is not really a “*team*” or “*group*”; instead, it is a *temporary multi-organization* (TMO). It is *temporary* because it lasts only for the duration of a single project, at the end of which the members separate (or may not all work together on subsequent projects) and it is a *multi-organization* because it is composed of professionals from different disciplines (Cherns and Bryant, 1984). The *temporal* and *multi-organizational* features of architectural design teams can easily lead to misalignment between level of measurement and level of theory. The research presented herein aligned the measurement of research constructs (i.e., level of measurement) to the intended level of theory by (1) *adopting an event oriented technique* and (2) *justifying key informant approaches*. The temporal, one-off, feature is addressed by using event oriented technique. The event oriented technique involves instructing to individuals participating in a research study to recall “the most recent or important job-related project, task, or problem you have worked on” and to answer the directed question based on this recollection. Event oriented technique presents two major advantages: (1) it is much easier for individuals participated in research study to recall accurately what they did on most recently completed project than remember what they do in general and it avoids potential selection bias (i.e., choosing the most successful project). Event oriented technique has been commonly used in previous research studies (e.g., Dewhirst, 1971; Johnson et al., 1995; Smith et al., 1996). The survey instrument used in this study instructs the respondent to “please answer the questions from the point of view of the most recently completed project that you worked”. The multi-organization feature of architectural design teams was addressed by using key informant approach. Campbell (1955) proposes two criteria for qualifying a social actor a key informant in any research study: (1) a social actor should occupy roles/position or perform tasks that make him/her the most knowledgeable about the

research issues being explored and (2) social actor should be able and willing to participate in the study. Value creation/proposition process in the AEC industry is primarily driven by system integrators. A *system integrator* is defined as a social actor who has (1) the skills to integrate interdependent components into a coherent whole, (2) detailed knowledge of client requirements and (3) knowledge of the rules and regulations governing the industry (Winch, 1998). Winch (1998) identifies two “*system integrators*” in the AEC industry which play central roles value creation process: architects in “design process” and general contractors in “construction process”. Therefore, architects were chosen as key informant as they were best positioned to provide the relevant project team information.

The level of analysis in this research is “the architectural design team”. The relationships between the dependent (DV) variable and independent variables (IV) were statistically tested at architectural design team level.

### **5.3 Sample**

The sample of the research presented herein is composed of 400 architects operating in Turkey. It is constructed by referring to different information sources such as internet, social media and the Chamber of Turkish Architects.

### **5.4 Data Collection**

The research presented herein is based on an online survey. The online survey method was administered to the architects listed in the constructed sample by sending an email that kindly requests their participation and provides a hyperlink to them to take the survey. The number of architects who participated in the survey was 121.

### **5.5 Research Instrument**

The research instrument used to collect data was composed of five parts. The first part includes 7 open-ended questions which solicit information about the

*characteristic of design project and design team.* The second part has 24 questions for measuring the four dimensions of *absorptive capacity* (i.e., *project team knowledge acquisition, knowledge assimilation, knowledge transformation and knowledge exploitation*). The third part includes 21 questions for measuring the three dimensions of *social process* (i.e., *structural dimension, relational dimension and cognitive dimension*). The fourth part includes 56 questions measuring the two dimensions of knowledge search process (i.e., *search breadth and depth*). The fifth part has 8 questions measuring the three dimensions of *supportive power relationships with clients* (i.e., *support for innovation, resource supply and project team autonomy*). The final includes 6 questions measuring the two dimensions of *project value outcomes* (i.e., *project novelty and appropriateness*).

## **5.6 Characteristics of Design Project and Project Team**

The characteristics of design project were measured by (1) the project size (in square meters), (2) project type, (3) project duration (months) and (5) estimated cost (in Turkish Liras - ₺) whereas the characteristics of design team were measured by (1) *team size* (number of specialist/experts involved in the project) and (2) *prior collaboration of team members* (number project team member(s) that have collaborated prior to joining this project). Appendix B presents the items used to measure research variables in Turkish.

## **5.7 Measurement of Research Constructs**

Multi-items scales from previous research studies which have proven to be reliable were used to operationalize the research variables. Yet new multi-item scales were developed in the light of conceptual foundations of the research presented herein when none were available. Most of these previous research studies have been conducted in a completely different social setting (e.g., industry context and unit of analysis). Therefore, the measures used in this research were adapted to the context of architectural design process (i.e., value shop) in order to ensure the simultaneous alignment of level of theory, level of measurement and level of analysis (i.e., architectural design project and the project team that designed it).

Absorptive capacity of architectural design team was measured by new multi-item scales developed for this study. New multi-items were developed by following an approach similar to the ones adopted by previous research studies (e.g., Schleimer and Pedersen, 2013; Flatten et al.- 2011). Acquisition dimension was measured by 5 items: “*For the most recent project that we have completed, we (our project team) ...*” (1) collected site data such as zoning status and land conditions related to the project, rigorously, (2) conducted comprehensive research for new technologies that could be used, (3) continuously sought to identify client's needs and requirements, (4) followed a comprehensive process of gathering information to accurately determine client's needs and requirements for the project and (5) were insistent on correctly interpreting environmental constraints (i.e., social, site conditions, zoning status, etc.) for the project. Assimilation dimension was measured by 5 items: “*For the most recent project that we have completed, we (our project team) ...*” (1) compared the client's expectations and needs with our experience gained from earlier projects, (2) investigated the adaptability of new developments in technology to the design project, (3) comprehensively evaluated the potential of the site in terms of opportunities for innovation in design, (4) identified client's needs and requirements comprehensively and (5) had difficulties in prioritizing client's needs and requirements. Transformation dimension was measured by 5 items: “*For the most recent project that we have completed, we (our project team)....*” (1) utilized the site data we collected (such as zoning status and land conditions), after refining (correcting, improving) them, (2) successfully resolved the contradictions among our design decisions on various aspects of the project (form, function, comfort conditions, aesthetics, cost, technical systems, etc.), (3) had difficulty mitigating the constraints/limitations imposed on the architectural design by technical systems (structural, mechanical and electrical), (4) revised the technical requirements to match the client's aesthetic expectations and (5) transformed various environmental constraints into design opportunities by using them to our advantage. Exploitation dimension was measured by 9 items: “*For the most recent project that we have completed, we (our project team) ...*” (1) continuously discussed how we can apply current technological know-how in the design process, (2) adapted and utilized the information gathered on the project's physical, social and environmental conditions, for design development, (3) found it difficult to meet the client's expectations and needs, under the environmental conditions of the project, (4) constantly considered how to better meet client's expectations and needs in the

architectural design, (5) discussed, with the client, their aesthetic expectations, applied their proposed ideas and improved our design, (6) clarified, as a project team, how we will make use of the information we obtained on physical, social, and environmental conditions, (7) were able to immediately recognize the negative or restrictive characteristics of environmental data that could be turned into design opportunities, (8) reapplied many of the design decisions which were appreciated/praised in our past designs, in the current project as well and (9) had difficulties in communicating our design proposal and preferences to the client. The items used to measure absorptive capacity dimensions were assessed on a seven point Likert scale (1=strongly disagree, 7=strongly agree).

*Project team cognitive dimension* was measured by using a modified version of the scales developed by Nahapiet and Ghoshal (1998) and Mäkelä et al. (2012). It was also operationalized by three sub-research constructs: (1) goal proximity among project team members, and (2) discourse proximity among project team members and (3) practice proximity among project team members. Project team cognitive dimension was measured as an average of nine items: (1) regarding the objectives of the project, the opinions of the individuals in our design team were similar, (2) major contradictions or inconsistencies between the goals of the project and goals of the individuals in the design team did not occur, (3) significant differences of opinion arose among design team members in priority ranking of the qualities expected from the project, (4) significant contradictions between the approach of the design team and the approaches of some of the individual design team members occurred, (5) approaches and methods adopted during the design process were accepted by all individuals in our design team, (6) the design team members' comments and views on the project, the design process and approach showed similarity, (7) some team members found the language (jargons) that was used during project meetings to be too complex, (8) design examples presented during project meetings were generally comprehensible for all members of the design team and (9) in general, during project meetings, design team members were clearly understood by the rest of the team. The items used to measure project team cognitive dimension were assessed on a seven point Likert scale (1=strongly disagree, 7=strongly agree).

*Project team structural dimension* was measured by using the scale proposed by Nahapiet and Ghoshal (1998). It was also operationalized by two sub-research constructs: (1) the frequency of social interactions between architectural design team

members and (2) the closeness of social interactions between architectural design team members. The frequency of social interactions was measured by two questions: (1) how frequently did project team members (including yourself) interact with (either via telephone, email or face-to-face) each other for issues related to the project and (2) how frequently did project team members (including yourself) interact with (either via telephone, email or face-to-face) each other for social support (i.e., issues not related to the project). The items used to measure the frequency of social interactions were assessed on a seven point Likert scale (1=not at all, 7=very frequently). The closeness of social interactions was measured by asking respondents: how close do you think are the working relationships (professional ties) among the members (architects, engineers, planners, etc.) of the project team? A seven point Likert scale (1=very distant, 7=very close) was used to measure the closeness of social interactions.

*Project team relational dimension* was measured by using the scales proposed by Chattopadhyay (1999); Mayer and Davis (1999); Mayer et al. (1995); Tang (2015). It was operationalized by using three sub-research constructs: (1) competence based trust, (2) benevolence based trust and (3) integrity based trust. *Competence based trust* was measured by three items: (1) given the track records of the project team members, we see no reason to doubt each other's competence and preparation for a job, (2) members of the project team believe that everyone on the project team approaches their work with professionalism and dedication and (3) members of the project team are concerned with monitoring each other's work [reverse coded]. *Benevolence based trust* was measured by three items: (1) in this project team we talked comfortably and freely with each other about difficulties we were having and know that other would want to listen, (2) members of the project team would feel a sense of loss we could no longer work together and (3) members of the project team had a sharing relationship with each other, we freely and shared our ideas, feelings, and hopes. *Integrity based trust* was measured by three items: (1) it was believed that there was mutual trust among project team members (2) it was believed that the individual interests of project team members come after the common interest of project team and (3) it was believed that a project team member would not take the advantage of other project team members even if the opportunity arises. The items used measure relational dimension were assessed on a seven point Likert scale (1=strongly disagree, 7=strongly agree).

*Knowledge search breadth and depth* were operationalized by using a procedure similar to that proposed by Laursen and Salter (2006). The respondents were presented

a list of 14 sources for information and also knowledge and four major categories of knowledge and information needs and requested to indicate, on a four point Likert scale (0= not important at all, 1= low important, 2= moderately important, 3=very important), the degree of importance the knowledge or information source holds for each category of their knowledge and information needs. The 14 information and knowledge sources are: (1) project owners/clients, (2) contractors and subcontractors, (3) suppliers and vendors, (4) consulting firms, (5) public agencies, (6) universities and research centers, (7) professional associations, (8) trade fairs and exhibitions, (9) seminars and conferences, (10) internet, (11) social media, (12) books journal and trade magazines, (13) technical excursions and (14) specialist/experts. The four major categories of knowledge and information needs include: (1) design concepts (2) design solutions, (3) design process and (4) design documentations.

*Knowledge search breadth* was operationalized by a combination of 14 knowledge and information sources and 4 major categories of knowledge and information needs. It was measured by counting the number of “1= low important” “2=moderately important” and “3= very important” responses. This simple research construct assigns 0 if given knowledge and information source is “not important” for the project team.

*Knowledge search depth* was measured by counting the number of “3= very important” responses. This simple research construct assigns 1 if given knowledge and information source is “very important” for the project team.

*Power relationships with clients* were measured by using the scales proposed by Scott and Bruce (1994) and Haas (2010). It was operationalized by using three sub-research constructs: (1) support for innovative/novel design, (2) resource supply and (3) project team autonomy. Support for innovative/novel design was measured by two items: “In the most recently completed project, the project owner / sponsor ....” (1) had embraced the adoption of innovative design approaches for the design project and (2) insisted on following known and tested design approaches for the design project. Resource supply was measured by two items: “In the most recently completed project ....” (1) the project owner / sponsor provided the necessary resources and support for applying innovative design approaches and (2) The priorities of the project owner / sponsor prevented the implementation and development of innovative design solutions. Project team autonomy was measured by four items: “In the most recently completed project ....” (1) the project owner / sponsor gave full authority to the design team for



determining the primary objectives for the project, (2) the project owner / sponsor allowed the design team to freely select the design approach to be followed, (3) the design team held the authority to select technological systems and their specifications for implementation in the design project and (4) the project owner / sponsor gave full authority to the design team for determining the project budget, cost, duration and work schedule. The items used measure power relationships with clients were assessed on a seven point Likert scale (1=strongly disagree, 7=strongly agree).

*Project value outcome* was operationalized by following a similar approach proposed by Lepak et al. (2007). Lepak et al. (2007) propose two dimensions for evaluating the project value outcome: the appropriateness and the novelty of the architectural design project. The appropriateness of developed architectural design project was measured by using four items: “As the project team, we ...” (1) developed design solutions which substantially meet the client's/sponsor's needs and requirements, (2) completed the architectural design project on schedule, (3) we completed the architectural design project within budget and (4) were able to arrive at a design solution following advanced approaches that improve on architectural qualities. The novelty was assessed by using two items: “As the project team, we ...” (1) applied innovative ideas successfully and (2) were able to arrive at a solution following innovative/creative approaches. A seven point Likert scale (1= not at all, 7=completely) was used to measure the project value outcomes.

## CHAPTER 6

### RESEARCH FINDINGS AND DISCUSSION

#### 6.1 Introduction

The following chapter presents the statistical analysis of the research data and the interpretation of the research findings. The statistical analysis of the research data is presented in three main sections: (1) descriptive statistics (i.e., mean and standard deviation) and reliability of research variables (2) the statistical tests of the research hypotheses concerning the moderator factors (i.e., project and team characteristics, social processes, power relationships and knowledge search mechanisms) on absorptive capacity dimensions (acquisition, assimilation, transformation and exploitation) and testing the research hypothesis concerning the absorptive capacity dimensions and project value outcomes (novelty and appropriateness).

#### 6.2 Descriptive Statistics and Reliability

Table 6 presents the mean and standard deviations of the characteristics of design projects (i.e., project type, size, duration, estimated cost and cost per area) and the characteristics of design teams that performed the design projects (i.e., team size and team prior collaboration). The types of design projects completed by the surveyed design teams include housing buildings (57.85%), office buildings (14.88%), public buildings (10.74%), office buildings (6.61%), sports and recreation centers (4.96) and others (4.96%) (Figure 15). The mean size of design projects is 18.898 square meters (m<sup>2</sup>) (Table 5). The mean project cost is 54,186,467.016 Turkish Liras (₺) with and the cost per square meter of the projects is 2,949 m<sup>2</sup>/Turkish Lira (₺). The mean project duration is 9.5 months.

The reliability of multi-item scales used to measure research variables (i.e., research constructs) was evaluated by the Cronbach alpha method ( $\alpha$ ). The Cronbach alpha values (where appropriate) of the research variables are presented in Table 7. The Cronbach alpha values of the research variables range from a high of 0.939 to a low of

0.713, indicating that the multi-item scales (i.e., research constructs) used to measure research variables meet the minimum threshold value of 0.70 ( $\alpha \geq 0.70$ ). Table 8 and Figures 16 – 19 present the importance value of fourteen knowledge sources for architectural design teams with respect to four knowledge /information categories (i.e., design documentation, design solution, design concepts and design process). Figures 20 – 33 present the frequency distribution of importance scores with respect to each knowledge/information category.

The presence of common method variance (CMV) was explored by conducting Harman's one-factor test as recommend by Podsakoff and Organ (1986). The results of Harman's one-factor test (i.e., the first factor accounted only for 9.4%) provide satisfactory evidence of the absence of CMV in this study.

### 6.3 Statistical Methods and Analysis

Twenty-two multiple regression models (*Models 1 – 22*) were used to explore the test the research propositions: two for project value outcomes (*Model 21 - 22*) and twenty for the four dimensions of absorptive capacity (*Models 1 - 20*). The explanatory power of regression models (*Models 1-22*) is measured by the adjusted coefficient of determination (adjusted  $R^2$ ) and ranges from a minimum of 6% to maximum of 46% with a mean of 20% and a standard deviation of 11% (Table 15).

*Models 1-4* use the four absorptive capacity dimensions (i.e., acquisition, assimilation, transformation and exploitation, respectively) as the dependent variable and project characteristics as the independent variables (i.e., *project type, size, cost, and cost per square meter*). For operationalizing the project type, a dummy variable representing project type was constructed with a value of 1 for housing projects and 0 for other types of building projects. Natural logarithmic transformations were applied to three independent research variables (i.e., project size, cost and cost per square meter) variables in order to adjust and reduce their skewness. *Model 1* is statistically significant at  $p < 0.01$  and explains 8% of the dependent variable's (i.e., knowledge acquisition) variance (Adjusted  $R^2=0.08$  and F-Value = 3.694). It is clear from Table 9 that project duration is the only independent research variable in Model 1 that is statistically significant and positively ( $\beta_{1\_project\ duration} = 0.336, p < 0.001$ ) related to knowledge acquisition. The regression coefficients of other independent variables (i.e.,

project type, size, cost and cost per square meter) are not significant in explaining the variance in knowledge acquisition. *Model 2* is statistically significant at  $p < 0.001$  and explains 12% of the dependent variable's (i.e., knowledge assimilation) variance (Adjusted  $R^2=0.12$  and F-Value = 4.899). In *Model 2*, project duration is statistically significant and positively ( $\beta_{2\_project\ duration} = 0.214$ ,  $p < 0.05$ ) related to knowledge assimilation whereas project size is statistically significant and negatively ( $\beta_{project\ size} = 0.181$ ,  $p < 0.05$ ) related to knowledge assimilation (Table 9). *Model 3* is statistically significant at  $p < 0.01$  and explains 9% of the dependent variable's (i.e., knowledge transformation) variance (Adjusted  $R^2=0.09$  and F-Value = 3.799). Project type is statistically significant and negatively ( $\beta_{3\_project\ type} = - 0.141$ ,  $p < 0.05$ ) related to knowledge transformation (Table 9). This finding reveals that project teams involved in designing projects such as office buildings, public buildings, office buildings and sports and creation centers experience more difficulties in transforming external design knowledge than project teams involved in designing housing projects. *Model 4* is statistically significant at  $p < 0.05$  and explains only 6% of the dependent variable's (i.e., knowledge exploitation) variance (Adjusted  $R^2=0.059$  and F-Value = 2.884). In *Model 4*, project duration is statistically significant and positively ( $\beta_{4\_project\ duration} = 0.278$ ,  $p < 0.01$ ) related to knowledge exploitation (Table 9). *Models 1 – 4* provide partial support to the theoretical argument that the project characteristics have significant impact on four absorptive capacity dimensions. Only project duration has a significant positive impact on three out of four dimensions of absorptive capacity.

Table 10 presents the results of regression analysis (*Models 5 – 8*) using the absorptive capacity (i.e., acquisition, assimilation, transformation and exploitation) as the dependent variable and the three dimensions of power relationship with client as independent variables (i.e., *support for innovative/novel design*, *resource supply* and *team autonomy*). *Model 5* is statistically significant at  $p < 0.01$  and explains 26% of the dependent variable's (i.e., knowledge acquisition) variance (Adjusted  $R^2=0.258$  and F-Value = 14.872) (Table 10). In *Model 5*, two independent variables, support for innovation and team autonomy, are statistically significant and positively ( $\beta_{5\_support\ for\ inn} = 0.191$ ,  $p < 0.05$  and  $\beta_{5\_team\ autonomy} = 0.399$ ,  $p < 0.001$ ) related to knowledge acquisition. *Model 6* is statistically significant at  $p < 0.01$  and explains 16% of the dependent variable's (i.e., knowledge assimilation) variance (Adjusted  $R^2=0.163$  and F-Value = 8.818) (Table 10). In *Model 6*, out of four independent variables only one independent variable, team autonomy, is statistically significant and positively ( $\beta_{6\_team\ autonomy} =$

0.352,  $p < 0.001$ ) related to the knowledge assimilation. *Model 7* is statistically significant at  $p < 0.01$  and explains 27% of the dependent variable's (i.e., knowledge transformation) variance (Adjusted  $R^2 = 0.275$  and F-Value = 16.137). In *Model 7*, only one independent variable, team autonomy, is statistically significant and positively ( $\beta_{7\_team\ autonomy} = 0.487$ ,  $p < 0.001$ ) related to knowledge transformation (Table 10). *Model 8* is statistically significant at  $p < 0.01$  and explains 27% of the dependent variable's (i.e., knowledge exploitation) variance (Adjusted  $R^2 = 0.334$  and F-Value = 21.086) (Table 10). In *Model 8*, team autonomy and resource supply are statistically significant and positively ( $\beta_{8\_team\ autonomy} = 0.487$ ,  $p < 0.001$ ) related to knowledge exploitation (Table 10). *Models 5 – 8* provide partial support to the research proposition that the three dimensions of supportive power relationships have significant impact on the four dimensions of absorptive capacity. Table 10 points out that project team autonomy has significant positive impact on all four dimensions of absorptive capacity whereas resource supply has significant effect on assimilation and exploitation, but not on the other two dimensions of absorptive capacity (i.e., acquisition and transformation). Furthermore, the results of *Models 5 – 8* jointly point out that support for innovative/novel design has no significant effect on any dimension of absorptive capacity.

*Models 9- 12* use the absorptive capacity dimensions (i.e., acquisition, assimilation, transformation and exploitation, respectively) as dependent variables and four dimensions of social processes as independent variables (i.e., cognitive dimension, relational dimension, social interaction and social closeness) (Table 11). *Model 9* is statistically significant at  $p < 0.001$  and the four dimensions of social processes explain 29% of the variance in knowledge acquisition (Adjusted  $R^2 = 0.291$  and F-Value = 13.311). In *Model 9*, only the cognitive dimension ( $\beta_{9\_cognitive\ dimension} = 0.179$ ,  $p < 0.05$ ), relational dimension ( $\beta_{9\_relational\ dimension} = 0.322$ ,  $p < 0.001$ ) and social interaction ( $\beta_{9\_social\ interaction} = 0.172$ ,  $p < 0.01$ ) are statistically significant and positively related to the knowledge acquisition whereas the regression coefficient of social closeness is not statistically significant (Table 11). *Model 10* is statistically significant at  $p < 0.001$  and explains 19% of the dependent variable's (i.e., knowledge assimilation) variance (Adjusted  $R^2 = 0.192$  and F-Value = 8.151). The regression coefficient of relational dimension ( $\beta_{10\_relational\ dimension} = 0.342$ ,  $p < 0.001$ ) is statistically significant and positively related to knowledge assimilation (Table 11). *Model 11* is statistically significant at  $p < 0.001$  and explains 33% of the dependent variable's (i.e., knowledge

transformation) variance (Adjusted  $R^2=0.331$  and F-Value = 15.823). The regression coefficients of cognitive dimension ( $\beta_{11\_cognitive\ dimension} = 0.229$ ,  $p<0.05$ ), relational dimension ( $\beta_{11\_relational\ dimension} = 0.231$ ,  $p<0.05$ ) and social interaction ( $\beta_{11\_social\ interaction} = 0.242$ ,  $p<0.001$ ) are statistically significant and positively related knowledge transformation (Table 11). Yet the regression coefficient of social closeness is not statistically significant. *Model 12* is statistically significant at  $p <0.001$  and explains 46% of the dependent variable's (i.e., knowledge exploitation) variance (Adjusted  $R^2=0.460$  and F-Value = 26.584). The regression coefficients of relational dimension ( $\beta_{10\_relational\ dimension} = 0.238$ ,  $p<0.05$ ) and social closeness ( $\beta_{10\_social\ closeness} = 0.280$ ,  $p<0.001$ ) are statistically significant and positively related knowledge exploitation (Table 11). *Models 9 – 12* provide partial support for the research proposition that the social processes have significant positive impact on the four dimensions of absorptive capacity. Relational dimension has positive significant impact on all dimensions of absorptive capacity whereas social closeness has positive effect on only one of dimensions of absorptive capacity: exploitation.

*Models 13 – 16* use the absorptive capacity dimensions (i.e., acquisition, assimilation, transformation and exploitation, respectively) as dependent variables and knowledge search breadth and search depth as independent variables (Table 12). The explanatory power of the regression models (i.e., *Models 13-16*), measured by adjusted  $R^2$ , range from 7% to 13%. *Model 13* is statistically significant at  $p <0.001$  and explains 11% of the dependent variable's (i.e., knowledge acquisition) variance (Adjusted  $R^2=0.110$  and F-Value = 8.525) and the regression coefficients of both independent research variables (i.e., search breadth and depth) are statistically significant and positively ( $\beta_{13\_search\ breadth} = 0.289$ ,  $p<0.001$  and  $\beta_{13\_search\ depth} = 0.188$ ,  $p<0.01$ ) related to knowledge acquisition (Table 12). *Model 14* is statistically significant at  $p <0.001$  and explains 7% of the dependent variable's (i.e., knowledge assimilation) variance (Adjusted  $R^2=0.074$  and F-Value = 5.806) and the regression coefficients of both independent research variables (i.e., search breadth and depth) are statistically significant and positively ( $\beta_{14\_search\ breadth} = 0.223$ ,  $p<0.01$  and  $\beta_{14\_search\ depth} = 0.185$ ,  $p<0.05$ ) related to knowledge assimilation. *Model 15* is statistically significant at  $p <0.001$  and explains 14% of the dependent variable's (i.e., knowledge transformation) variance (Adjusted  $R^2=0.143$  and F-Value = 9.827) and the regression coefficients of both independent research variables (i.e., search breadth and depth) are statistically significant and positively ( $\beta_{15\_search\ breadth} = 0.290$ ,  $p<0.001$  and  $\beta_{15\_search\ depth} = 0.224$ ,

$p < 0.05$ ) related to knowledge transformation. *Model 16* is statistically significant at  $p < 0.001$  and explains 10% of the dependent variable's (i.e., knowledge exploitation) variance (Adjusted  $R^2 = 0.105$  and F-Value = 8.015) and the regression coefficients of both independent research variables (i.e., search breadth and depth) are statistically significant and positively ( $\beta_{15\_search\ breadth} = 0.275$ ,  $p < 0.01$  and  $\beta_{15\_search\ depth} = 0.215$ ,  $p < 0.05$ ) related to knowledge exploitation. *Models 13 – 16* provide strong support to the research proposition that the project characteristics have significant impact on four absorptive capacity dimensions. In *Models 13-16*, search breadth is more strongly related to knowledge acquisition, assimilation, transformation and exploitation than is search depth (Table 12).

*Models 17 – 20* explore the impact of the interaction effect of knowledge search breadth and depth on four dimensions of absorptive capacity. A statistically significant change in the explanatory power ( $\Delta R^2$ ) of models implies significant the interaction effect of of knowledge search breadth and depth (Table 13). *Models 17- 20* use the absorptive capacity dimensions (i.e., acquisition, assimilation, transformation and exploitation, respectively) as dependent variables and knowledge search breadth, search depth and the interaction of search breadth and depth as independent variables. The explanatory power (Adjusted  $R^2$ ) of the regression models (i.e., *Models 17-20*) ranges from a minimum of 11% to a maximum of 13%. The addition of interaction term (i.e., search breadth X search depth) to *Models 13-16* does not improve the explanatory power (i.e., Adjusted  $R^2$ ) of the *Models 17-20* – change in explanatory power ( $\Delta R^2$ ) is not statistically significant. The signs of regressions coefficients in *Models 17 – 20* are in the predicted direction. Yet only the regression coefficients of interaction terms in *Models 19 and 20* are statistically significant and positively related to knowledge transformation and exploitation, respectively (Table 13). *Models 17 – 20* do not support the research proposition that the interaction of search breadth and depth significantly related to the four dimension of absorptive capacity.

*Model 21* uses innovative design as the dependent variable and knowledge acquisition, assimilation, exploitation and transformation as independent variables. *Model 22* is statistically significant at  $p < 0.001$  and explains 25% of the dependent variable's (i.e., innovative design) variance (Adjusted  $R^2 = 0.250$  and F-Value = 11.014) (Table 14). The regression coefficients of knowledge acquisition, transformation and exploitation ( $\beta_{21\_acquisition} = 0.308^{***}$ ,  $p < 0.001$  and  $\beta_{21\_exploitation} = 0.224$ ,  $p < 0.05$ ) are statistically significant and positively related to innovative design. *Model 22* uses

appropriateness (fitness to the purposes and predefined goals) as the dependent variable and knowledge acquisition, assimilation, exploitation and transformation as the independent variables. *Model 22* is statistically significant at  $p < 0.001$  and explains 40% of the dependent variable's (i.e., innovative design) variance (Adjusted  $R^2 = 0.395$  and F-Value = 20.618) (Table 14). Three independent variables, knowledge acquisition, transformation, and exploitation ( $\beta_{22\_acquisition} = 0.255^{**}$ ,  $\beta_{22\_transformation} = 0.170^{**}$ ,  $p < 0.001$ , and  $\beta_{22\_exploitation} = 0.394$ ,  $p < 0.001$ ) are statistically significant and positively related to appropriateness. *Models 21 – 22* provide strong support to the research proposition that absorptive capacity dimensions have significant positive impact on project value outcomes.

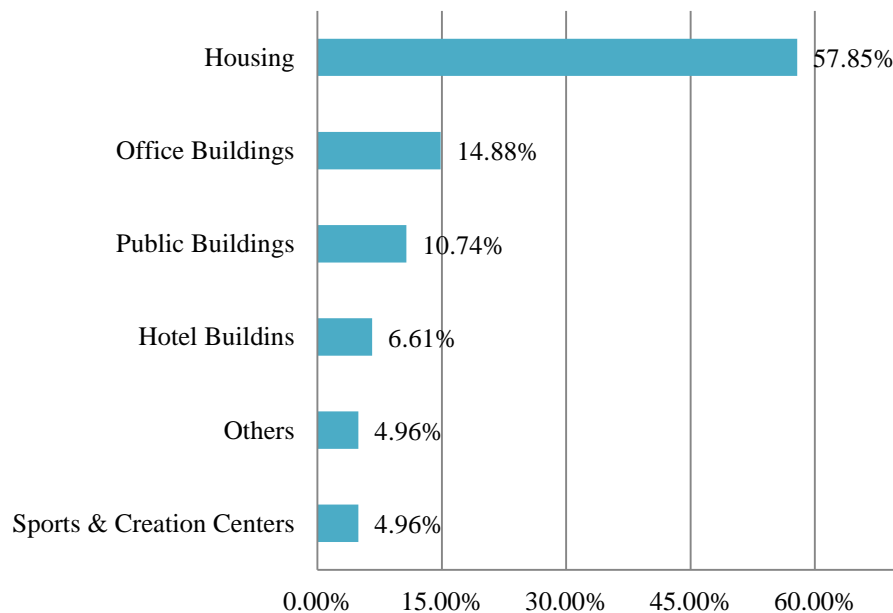


Figure 15. Types of Architectural Design Projects (N=121)



Table 6. Project and Architectural and Team Characteristics (N = 121)

	Mean	Standard Deviation
Project Characteristics		
Project Size (m <sup>2</sup> )	18,898.537	5,3281.936
Project Duration (months)	9.533	9.480
Project Estimated Cost (₪ )	54,186,467.016	260,051,375.074
Project Size/Cost (m2/ ₪ )	2949.978	3,260.536
Project Type (Dummy Variable; 1 for housing project, 0 for other projects)	0.578	0.496
Ln(Project Size)	8.178	1.805
Ln (Size/Cost)	7.579	0.860
Ln (Project Estimated Cost)	15.757	1.9413
Design Team Characteristics		
Team Size	7.405	4.099
Team Prior Collaboration	4.272	3.547

Table 7 Means, Standard Deviations and Reliability for Research Variables (N = 121)

Research Variable	Mean	Standard Deviation	Cronbach Alpha
Absorptive Capacity			
Acquisition	5.479	0.902	0.739
Assimilation	5.297	0.921	0.710
Transformation	5.309	0.912	0.727
Exploitation	4.899	0.828	0.742
Power Relationship			
Support for Innovation	4.351	1.106	0.732
Resource Supply	4.277	1.228	0.745
Team Autonomy	4.457	1.338	0.854
Social Processes			
Cognitive Dimension	4.881	0.873	0.793
Relational Dimension	5.372	1.133	0.917
Structural Dimension			
Social Interaction	3.826	0.787	0.713
Social Closeness	4.545	1.437	NA
Knowledge Search			
Search Breadth	45.099	9.696	0.939
Search Depth	12.124	9.779	0.924
Project Value Outcomes			
Novelty/Innovative	5.045	1.409	0.901
Appropriateness	5.279	1.101	0.754

Table 8 Importance of Information/Knowledge Sources for Each Information/Knowledge Category (N=121)

Information/Knowledge Source	Information Knowledge Category			
	Design Concepts	Design Documents	Design Solutions	Design Process
Universities & Research Centers	0.88	0.98	1.10	1.11
Consulting Firms	1.18	1.35	1.26	1.30
Professional Associations	1.21	1.55	1.50	1.45
Public Agencies	1.32	2.18	1.26	1.37
Contractor & Subcontractors	1.36	1.56	1.43	1.40
Clients	1.47	1.60	1.62	1.59
Social Media	1.48	1.27	1.56	1.39
Specialists	1.53	1.85	1.80	1.66
Suppliers	1.54	1.85	1.81	1.65
Seminars & Conferences	1.55	1.54	1.54	1.68
Trade Fairs & Exhibitions	1.64	1.59	1.74	1.48
Technical Excursions	1.72	1.50	1.56	1.54
Books Magazines & Journals	1.98	2.01	1.60	1.54
Internet	2.13	1.88	2.07	1.84

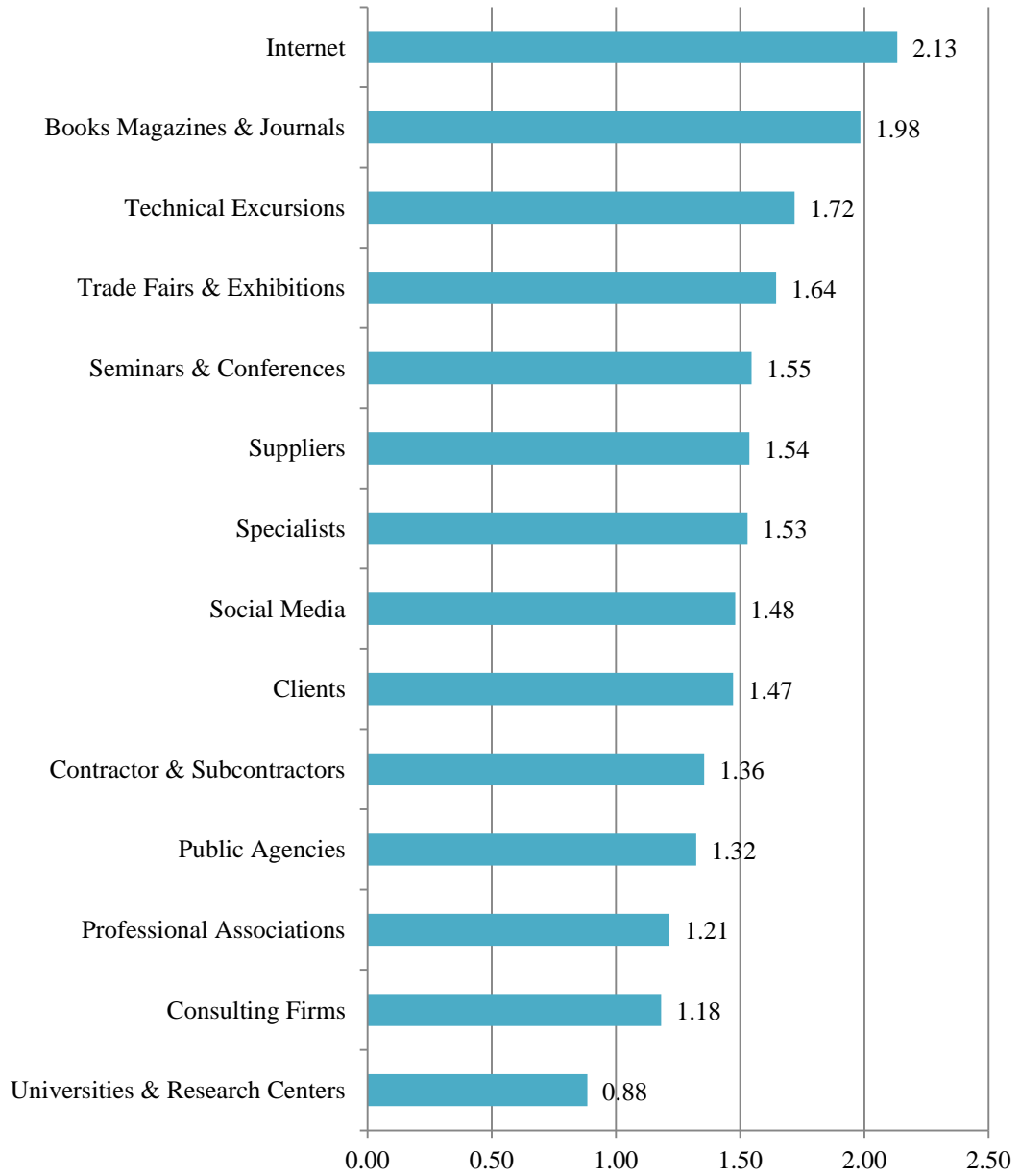


Figure 16. Importance of Information and Knowledge Sources for Design Concepts

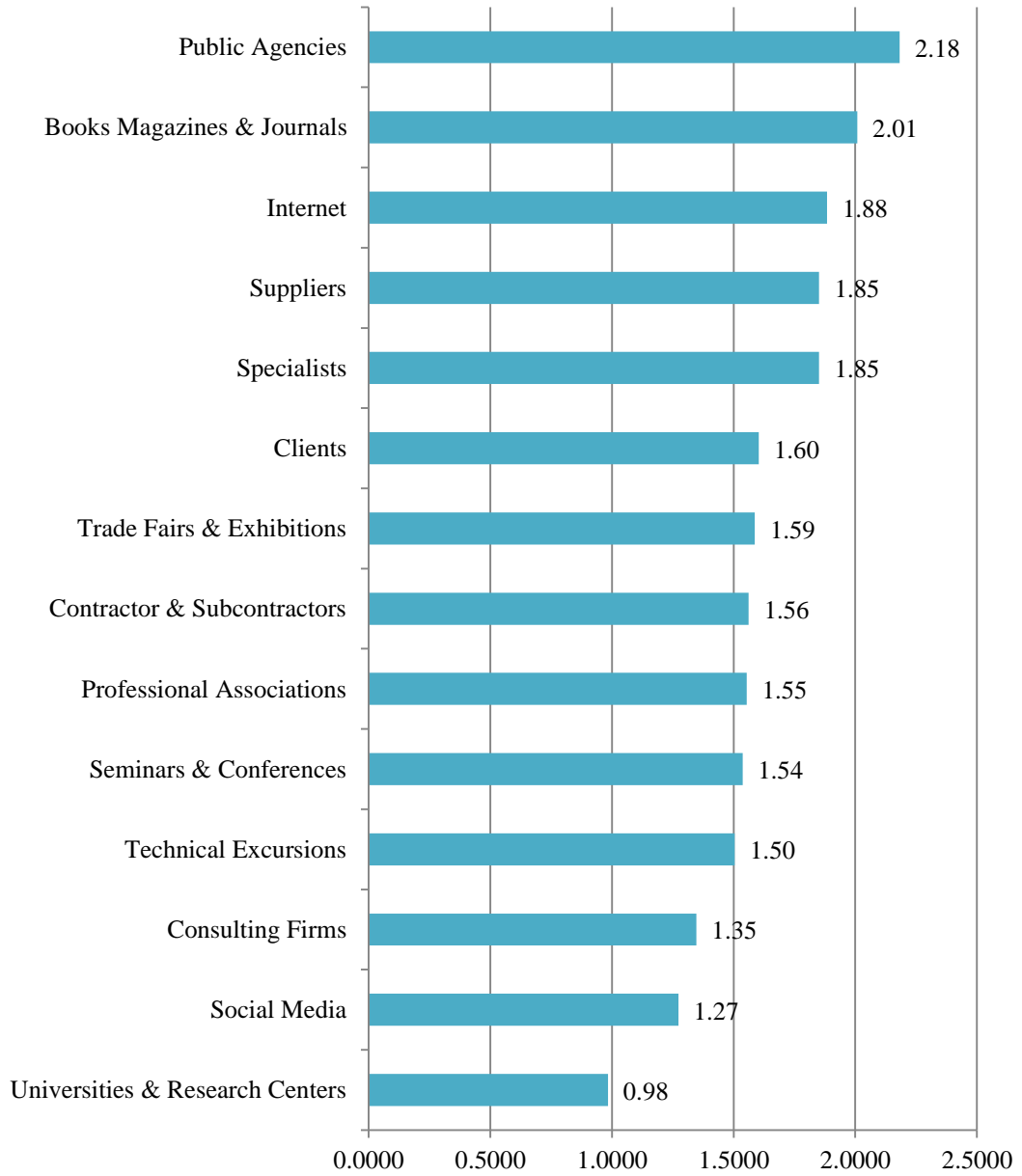


Figure 17. Importance of Information and Knowledge Sources for Design Documents

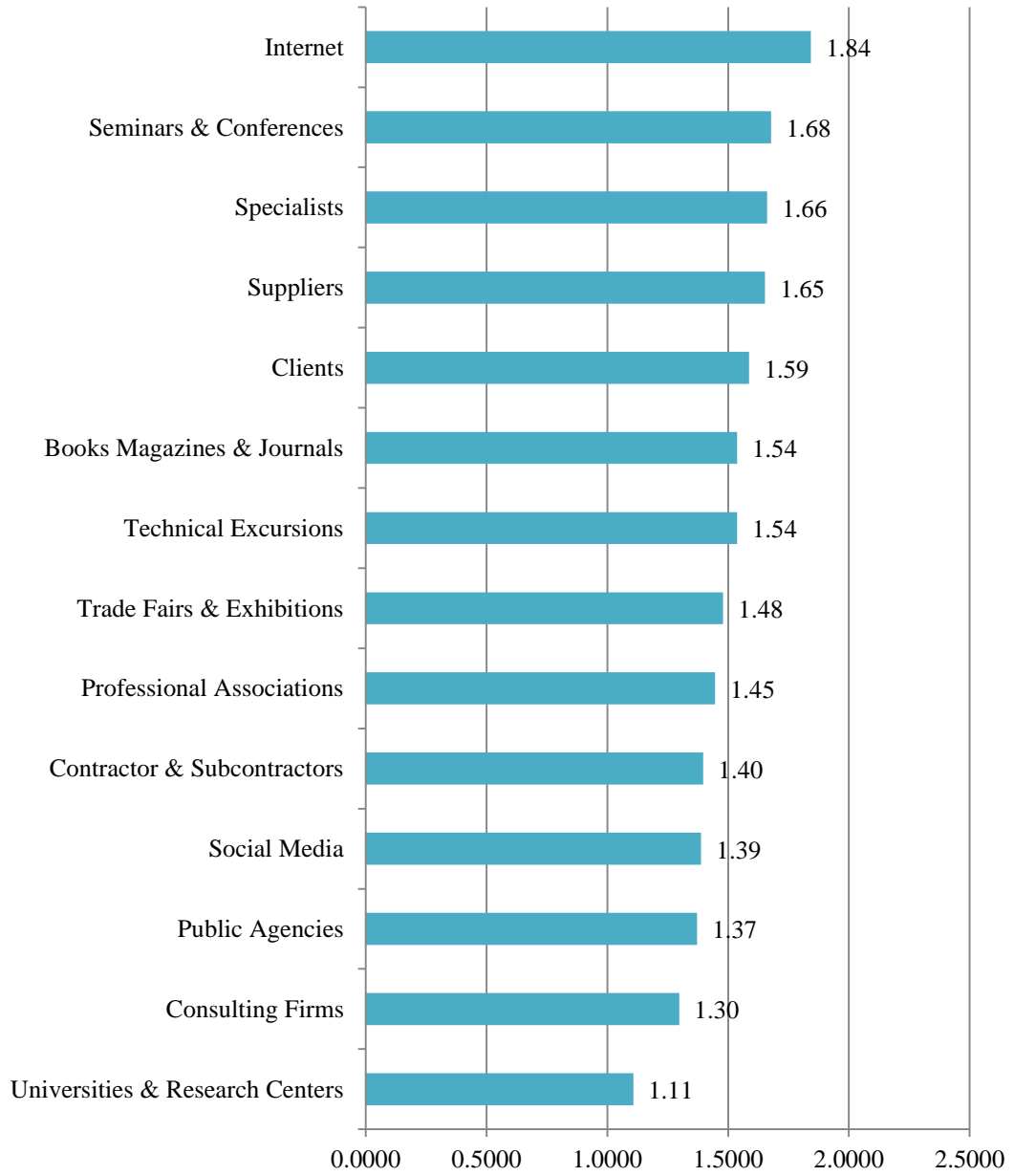


Figure 18. Importance of Information and Knowledge Sources for Design Process

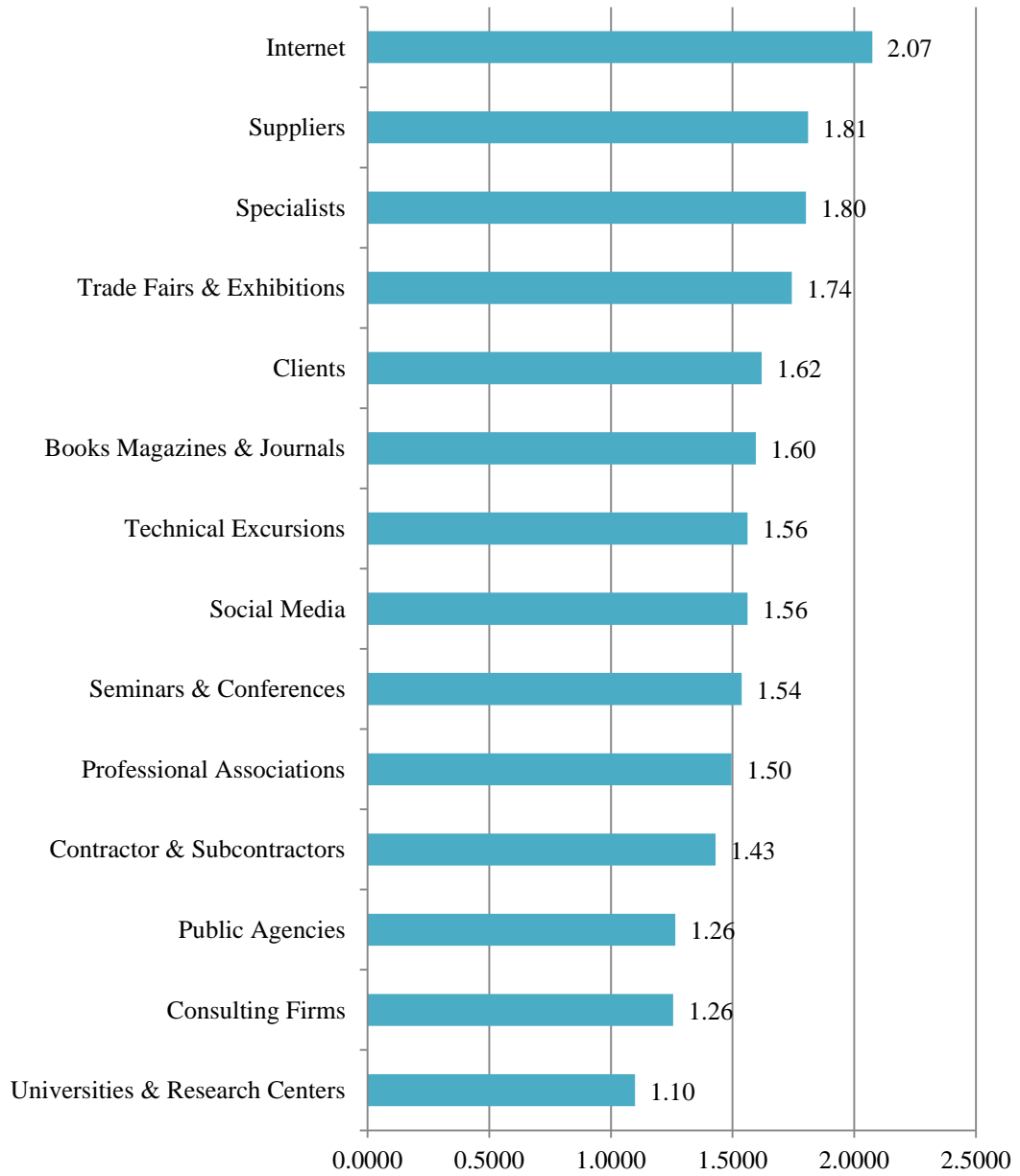


Figure 19. Importance of Information and Knowledge Sources for Design Solutions

Table 9. Results of Regression Analysis for Absorptive Capacity – Project Characteristics

Research Variable	Model - 1	Model - 2	Model - 3	Model - 4
	Acquisition	Assimilation	Transformation	Exploitation
Project Type (Dummy)	0.076	-0.078	-0.141*	0.012
Project Duration	0.336***	0.214*	0.168	0.278**
Ln (Project Size)	-0.004	-0.181*	0.147	-0.204
Ln (Project Cost)	-	-	-	-
Ln (Cost/Size)	-0.054	-0.078	-0.041	-0.116
Model Summary				
R <sup>2</sup>	0.111	0.152	0.120	0.093
Adjusted R <sup>2</sup>	0.080**	0.120***	0.090**	0.059*
F-Value	3.694	4.899	3.799	2.884

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

Table 10. Results of Regression Analysis for Absorptive Capacity–Power Relationships

Research Variable	Model - 5	Model - 6	Model - 7	Model - 8
	Acquisition	Assimilation	Transformation	Exploitation
Support for Innovation	0.191*	-0.111	0.005	-0.006
Resource Supply	0.031	0.204*	0.105	0.219*
Team Autonomy	0.399***	0.352***	0.487***	0.471***
Model Summary				
R <sup>2</sup>	0.276	0.184	0.293	0.351
Adjusted R <sup>2</sup>	0.258***	0.163***	0.275***	0.334***
F-Value	14.872	8.818	16.137	21.086

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

Table 11. Results of Regression Analysis for Absorptive Capacity – Social Process

Research Variable	Model - 9	Model - 10	Model - 11	Model - 12
	Acquisition	Assimilation	Transformation	Exploitation
Cognitive Dimension	0.179*	0.034	0.229**	0.131
Relational Dimension	0.322***	0.342***	0.231**	0.390***
Structural Dimension				
Social Interaction	0.182**	0.140	0.242***	0.107
Closeness	0.065	0.083	0.145	0.280***
<b>Model Summary</b>				
R <sup>2</sup>	0.315	0.219	0.353	0.478
Adjusted R <sup>2</sup>	0.291***	0.192***	0.331***	0.460***
F-Value	13.311	8.151	15.823	26.584

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

Table 12. Results of Regression Analysis for Absorptive Capacity – Search Breadth and Depth

Research Variable	Model - 13	Model - 14	Model - 15	Model - 16
	Acquisition	Assimilation	Transformation	Exploitation
Search Breadth	0.289***	0.223**	0.290***	0.257**
Search Depth	0.188**	0.185*	0.224**	0.215*
<b>Model Summary</b>				
R <sup>2</sup>	0.126	0.090	0.143	0.120
Adjusted R <sup>2</sup>	0.110***	0.074**	0.128***	0.105***
F-Value	8.525	5.806	9.827	8.015

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001



Table 13. Results of Regression Analysis for Absorptive Capacity – Search Breadth and Depth and Interaction of Search Breadth and Depth

Research Variables	Model - 17	Model - 18	Model - 19	Model - 20
	Acquisition	Assimilation	Transformation	Exploitation
Search Breadth	0.192	0.172*	0.060	0.044
Search Depth	0.142	0.161	0.114	0.113
Search Breadth x Search Depth	0.138	0.073	0.398**	0.305**
<b>Model Summary</b>				
R <sup>2</sup>	0.133	0.092	0.183	0.154
Adjusted R <sup>2</sup>	0.111***	0.068*	0.162***	0.132***
F-Value	5.999	3.931	8.711	7.093

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

Table 14. Results of Regression Analysis for Project Value Outcomes

Research Variable	Model - 21	Model - 22
	Novelty	Appropriateness
Acquisition	0.188*	0.255**
Assimilation	0.007	0.058
Transformation	0.308**	0.170*
Exploitation	0.162*	0.394***
<b>Model Summary</b>		
R <sup>2</sup>	0.275	0.416
Adjusted R <sup>2</sup>	0.250***	0.395***
F-Value	11.014	20.618

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

Table 15. Summary of Models 1- 22

		<b>Absorptive Capacity</b>				<b>Project Value Outcomes</b>	
		Acquisition	Assimilation	Transformation	Exploitation	Innovative Design	Appropriateness
Project Characteristics	Model 1	0.080**					
	Model 2		0.120***				
	Model 3			0.090**			
	Model 4				0.059*		
Power Relationships	Model 5	0.258***					
	Model 6		0.163***				
	Model 7			0.275***			
	Model 8				0.334***		
Social Processes	Model 9	0.291***					
	Model 10		0.192***				
	Model 11			0.331***			
	Model 12				0.460***		
Knowledge Search Processes	Model 13	0.110***					
	Model 14		0.074**				
	Model 15			0.128***			
	Model 16				0.105***		
	Model 17	0.111***					
	Model 18		0.068*				
	Model 19			0.162***			
Model 20				0.132***			
Absorptive Capacity Dimensions	Model 21					0.250***	
	Model 22						0.395***
	Mean	0.17	0.12	0.20	0.22		
	Std	0.09	0.04	0.10	0.16		
	Min	0.08	0.07	0.09	0.06		
	Max	0.29	0.19	0.33	0.46		

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

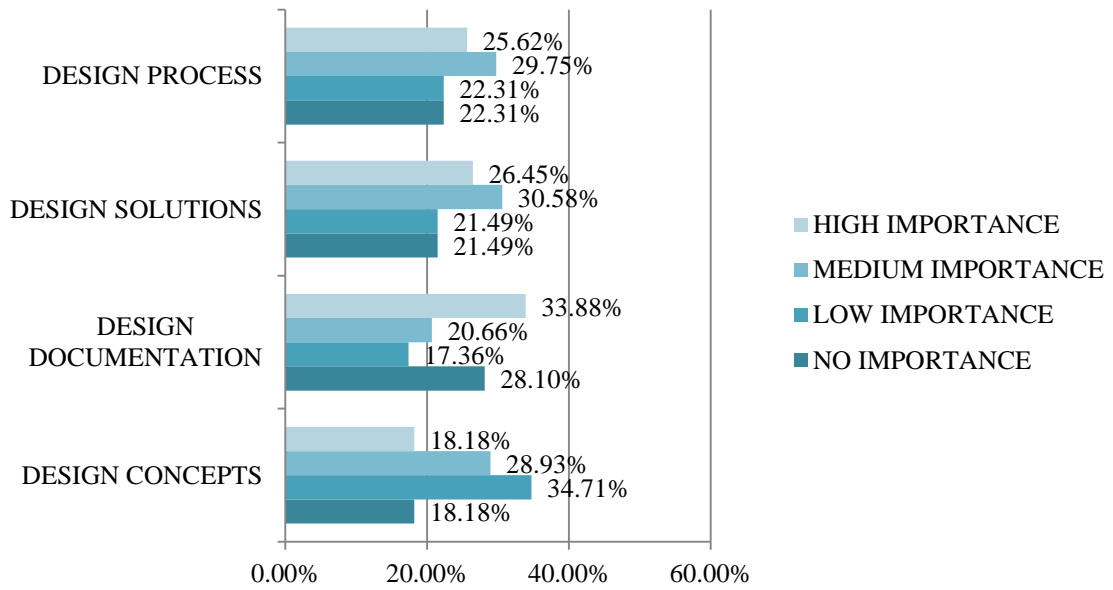


Figure 20. Importance of Clients/Sponsors as a Knowledge/Information Source for Each Knowledge/Information Category

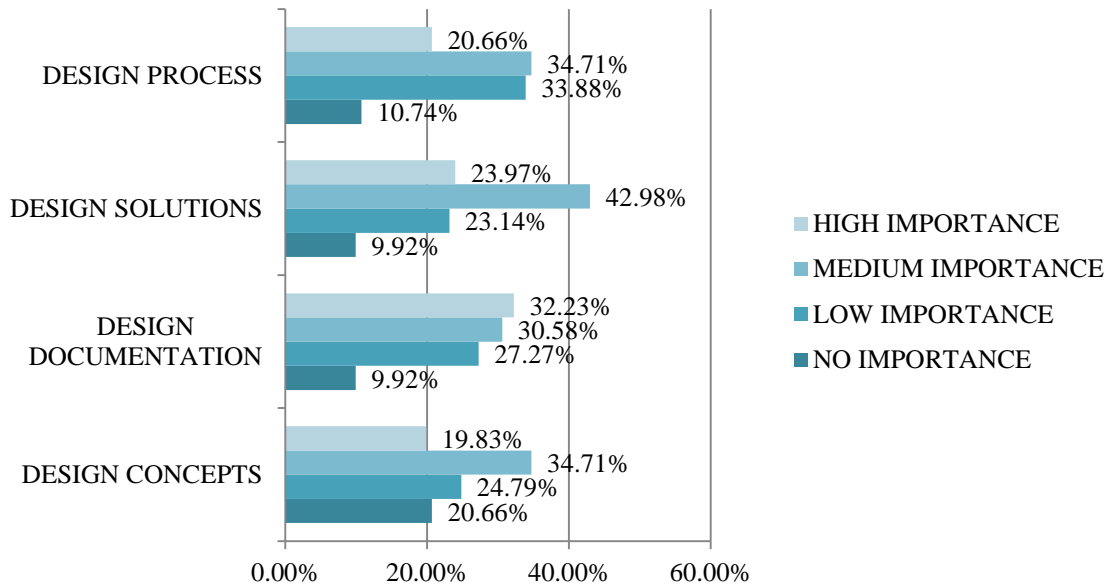


Figure 21. Importance of Suppliers as a Knowledge/Information Source for Each Knowledge/Information Category

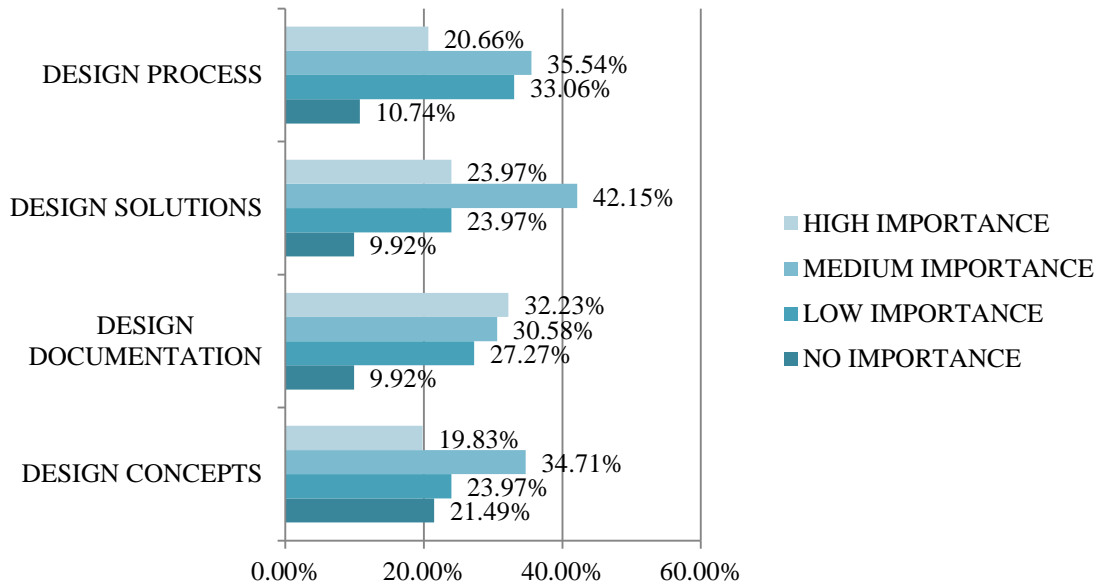


Figure 22. Importance of Specialists as a Knowledge/Information Source for Each Knowledge/Information Category

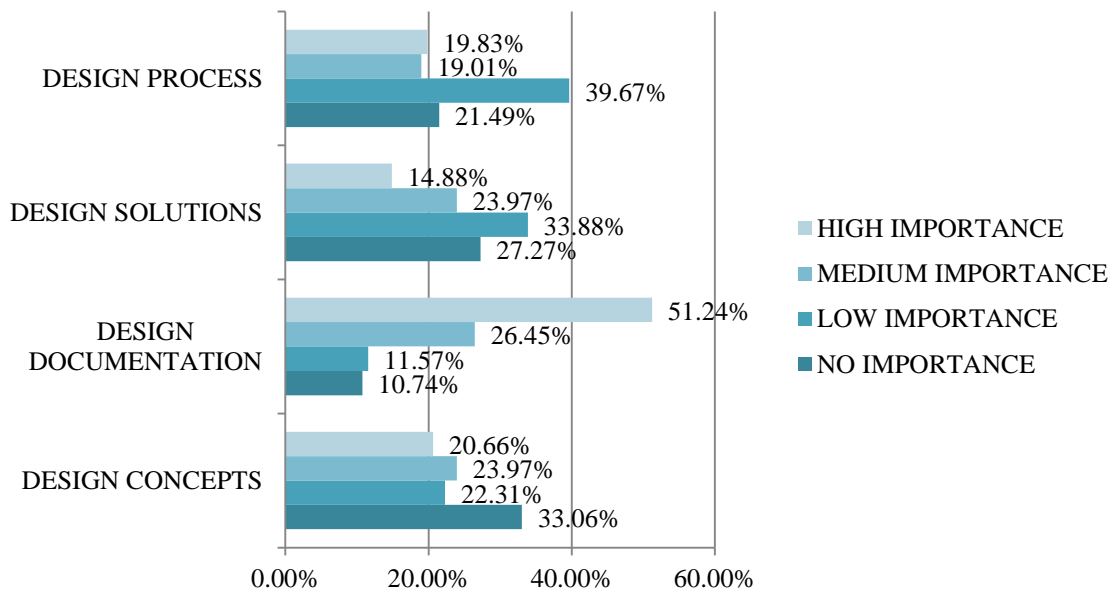


Figure 23. Importance of Public Agencies as a Knowledge/Information Source for Each Knowledge/Information Category

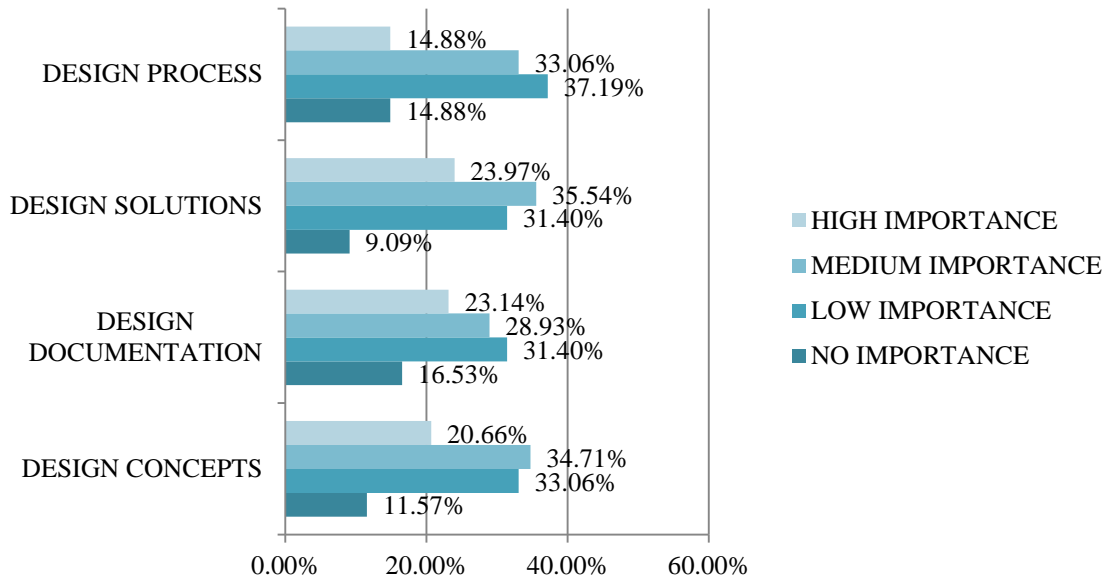


Figure 24. Importance of Trade Fairs/Exhibitions as a Knowledge/Information Source for Each Knowledge/Information Category

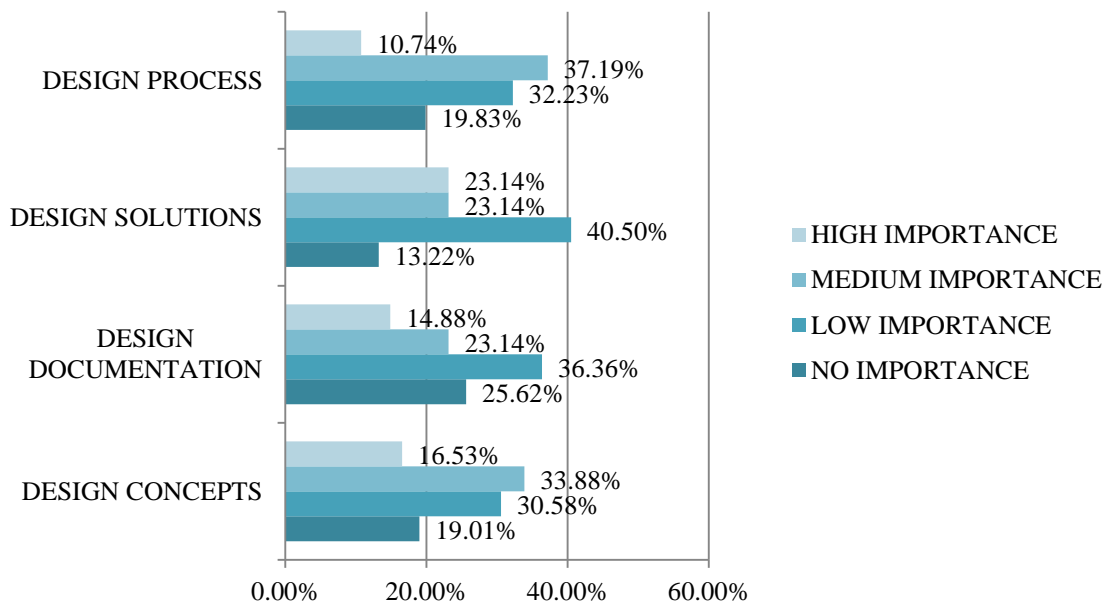


Figure 25. Importance of Social Media as a Knowledge/Information Source for Each Knowledge/Information Category

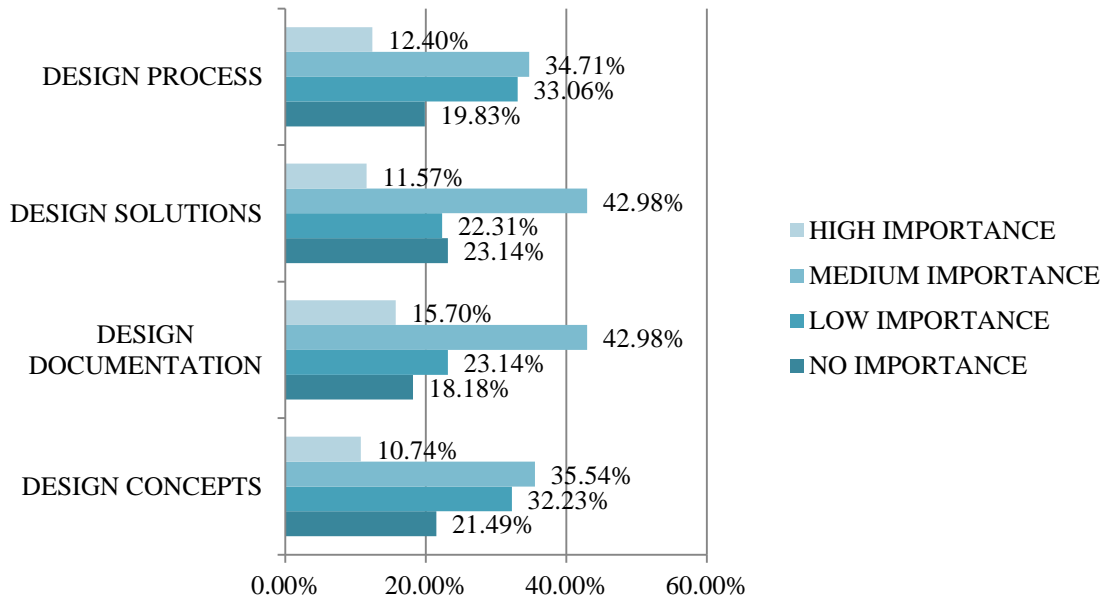


Figure 26. Importance of Contractors & Subcontractors as a Knowledge/Information Source for Each Knowledge/Information Category

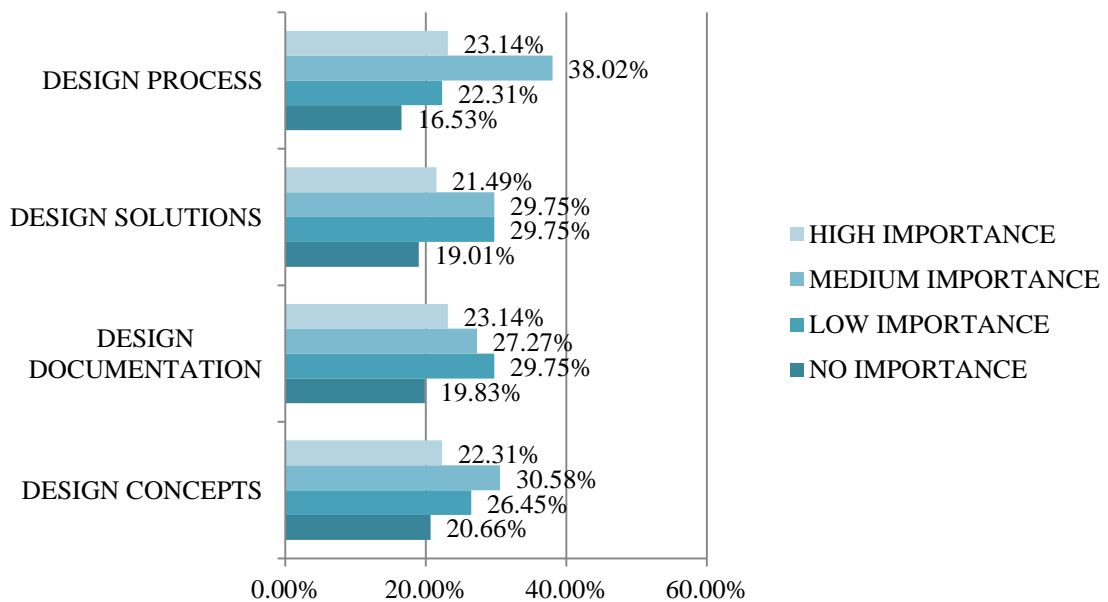


Figure 27. Importance of Conferences & Seminars as a Knowledge/Information Source for Each Knowledge/Information Category

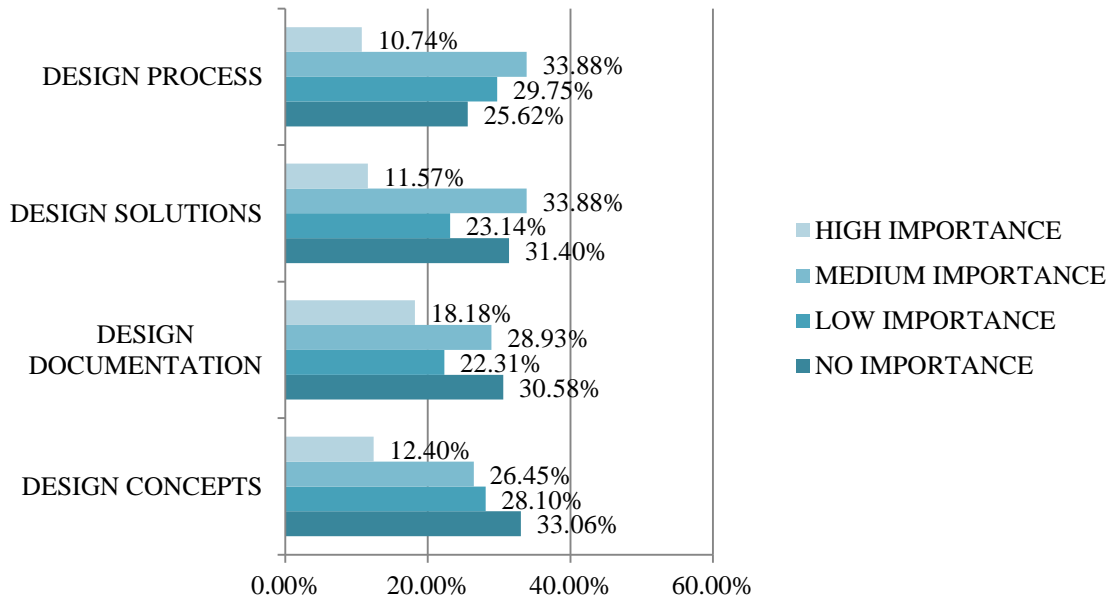


Figure 28. Importance of Consulting Firms as a Knowledge/Information Source for Each Knowledge/Information Category

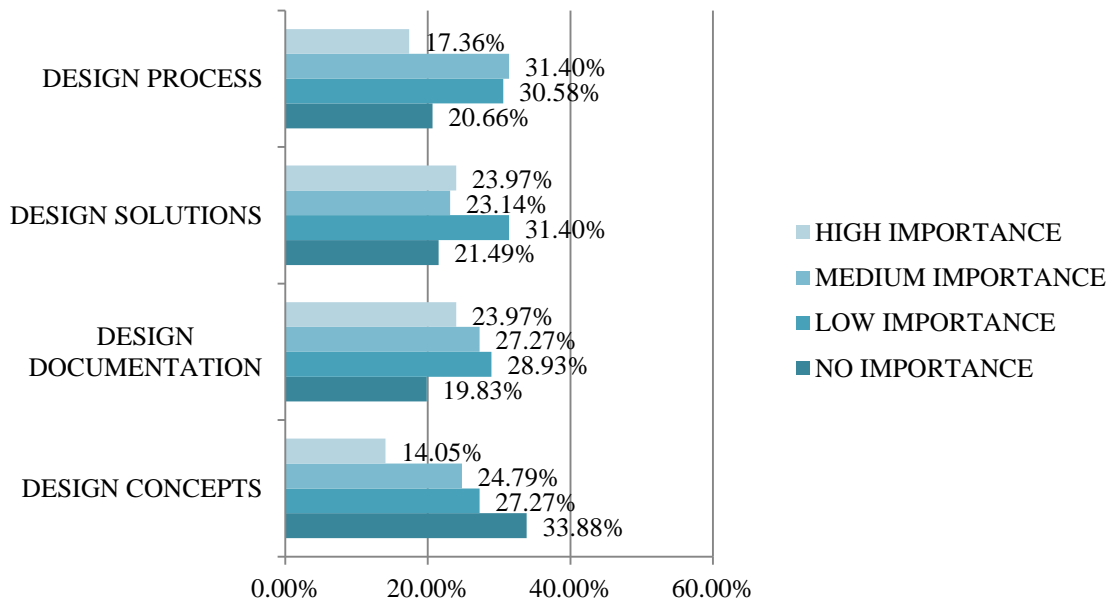


Figure 29. Importance of Professional Associations as a Knowledge/Information Source for Each Knowledge/Information Category

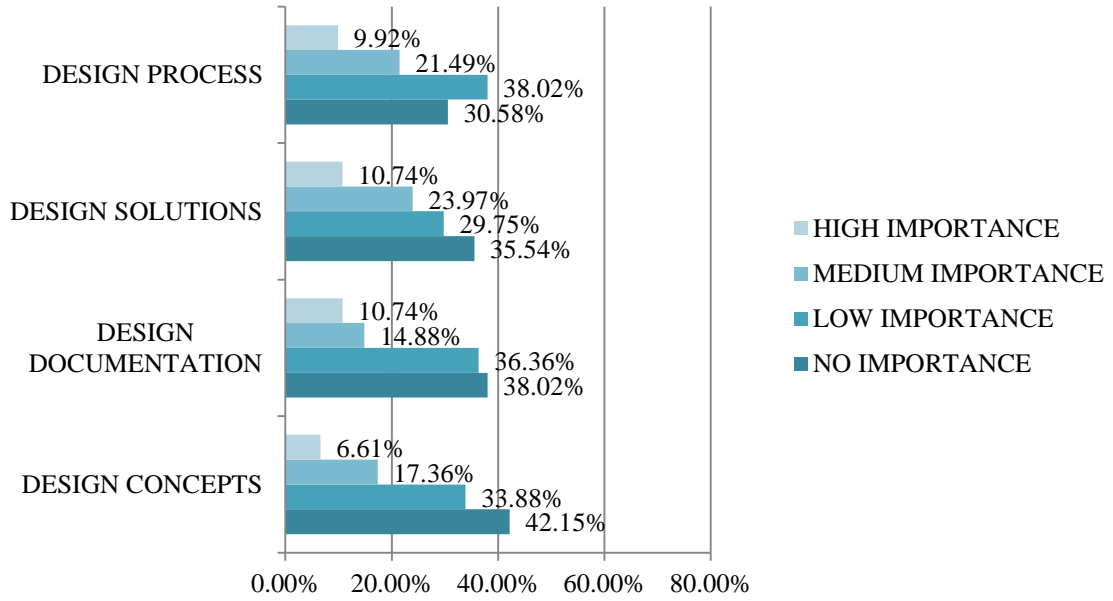


Figure 30. Importance of Research Center/Institutes as a Knowledge/Information Source for Each Knowledge/Information Category

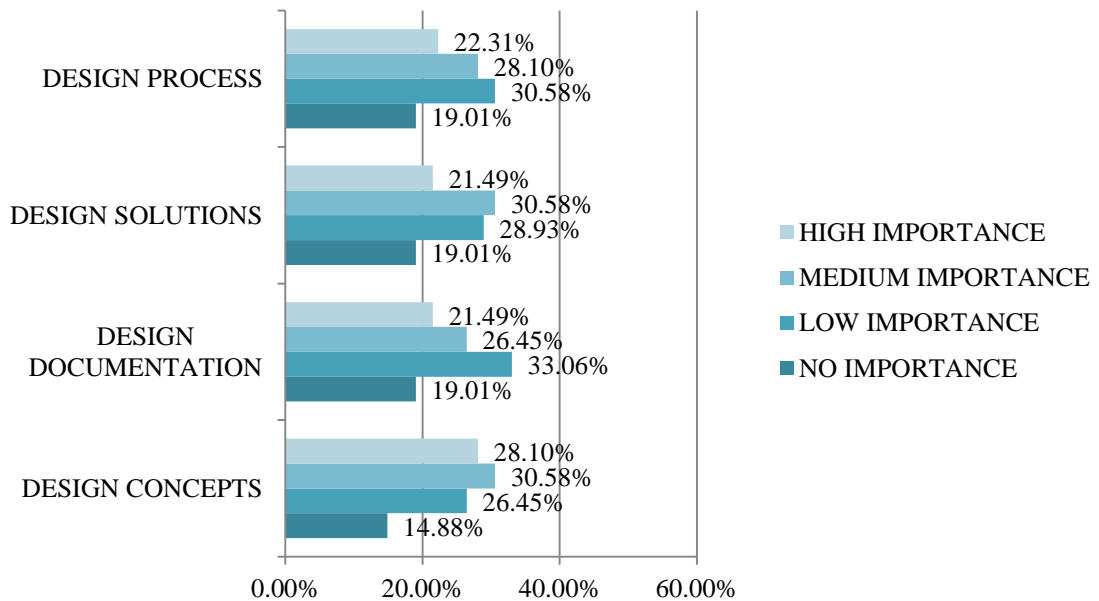


Figure 31. Importance of Technical Excursions as a Knowledge/Information Source for Each Knowledge/Information Category



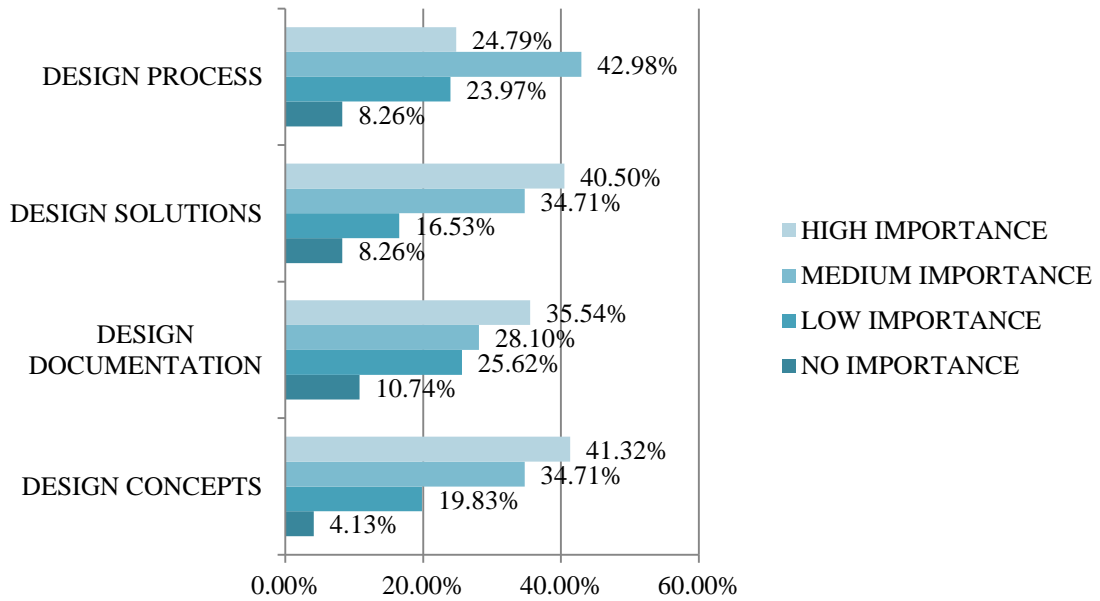


Figure 32. Importance of Internet as a Knowledge/Information Source for Each Knowledge/Information Category

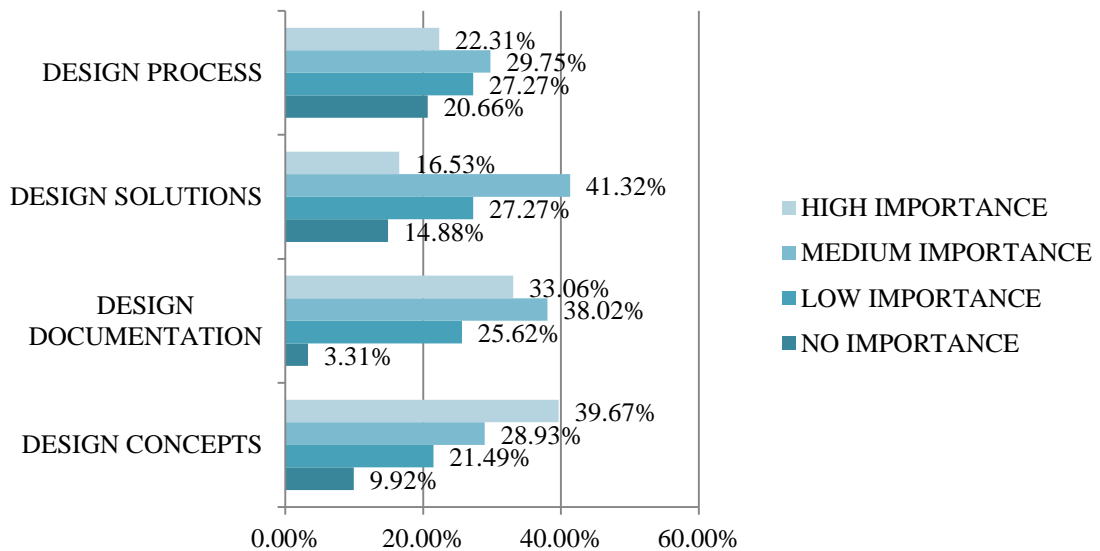


Figure 33 Importance of Books/Magazines/ Journals as a Knowledge/Information Source for Each Knowledge/Information Category

## CHAPTER 7

### CONCLUSIONS

Delivering value to the stakeholders of the AEC industry has been at the central stage of built environment literature for quite long time. The research addresses this topical issue by using the concept of absorptive capacity. It explores the absorptive capacity of architectural design teams and its moderators and value outcomes. The conceptual framework and derived results have significant implications for the built environment literature, in particular architectural design studies, design management, architectural management and construction management literature. The current literature on delivering value to the stakeholders of the built environment explicitly points out that architecture design process is knowledge intensive and collaborative activity. Yet the influences of knowledge search mechanisms (i.e., search breadth and depth), social integrative mechanisms (i.e., relational, cognitive and structural dimensions), and supportive power relationships (i.e., support for innovative design, resource supply and team autonomy) on acquisition, assimilation, transformation and exploitation of new external knowledge remain relatively unexplored. Furthermore, the influences of absorptive dimensions on project value outcomes also remain unaddressed in the literature. The conceptual framework proposed in this thesis and the research findings contribute to research on absorptive capacity, architectural design process and construction project management literature in several ways and have some practical implications.

Firstly, the research findings point out that project characteristics (i.e., project duration and type) drive a design team's absorptive capacity in several ways. It appears that project duration enhances a design team's acquisition, assimilation and exploitation ability. Project teams which perform design activities in short project durations are not able to acquire, assimilate and exploit new external knowledge.

Secondly, the research findings suggest that power relationships and team autonomy significantly influence a design team's ability to acquire, assimilate, transform and exploit new external knowledge. Yet support for innovation and resource supply provide somewhat surprising results. Support for innovation strengthens a design team's ability to acquire new external knowledge but has no effect on its ability

assimilate, transform and exploit new external knowledge. Resource supply influences a design team's ability to acquire new external knowledge.

Thirdly, the research findings reveal that social integration mechanisms, in particular relational dimension, have overarching influence on a design team's absorptive capacity. Relational dimension (i.e., trust in design team) significantly enhances a design team's ability to acquire, assimilate, transform and exploit new external knowledge. Cognitive and structural dimensions provided somewhat mixed results. Cognitive dimension and social interaction have significant and positive influence on knowledge acquisition and transformation whereas social closeness has significant and positive influence on knowledge exploitation.

Fourthly, the research findings point out that knowledge search mechanisms significantly enhance a design team's ability to acquire, assimilate, transform and exploit new external knowledge. Interaction of knowledge search breadth and depth strengthens a design team's ability to transform and exploit new external knowledge.

Fifthly, research findings suggest that a design team's absorptive capacity dimensions have separate effects on project value outcomes (i.e., design novelty and appropriateness). A design team's ability to transform new external knowledge has strong and positive impact on the novelty of design project whereas a design team's ability to acquire and exploit new external knowledge has positive and strong impact on the appropriateness of design project.

Sixthly, research findings jointly point out that design teams follow different paths in developing their absorptive capacity and delivering value to their stakeholders.

The research presented herein has some limitations. The data used in this research were self-reported assessment of architects with respect to the most recent design project they had completed. Therefore the issues of *recalling* and *single-informant* biases and inaccurate reporting of behaviors cannot be ruled out.

The research propositions were test by using linear models. Using non-linear model, in particular quadratic models, to test the research propositions can provide important contribution to the built environment literature.

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## **APPENDIX A**

### **A SUMMARY OF RESEARCH STUDIES ON ABSORPTIVE CAPACITY**

Source	Definition/Concept	Level	Method	Dimensions/Antecedents	Focus/Contribution
<b>Adler (1965)</b>	Absorptive capacity is “an ability to absorb external information in an economy”.	International	Theory Building	Rate of return on capital	Macroeconomic perspective
<b>Baranson (1970)</b>	Absorptive capacity is “one of the important factor for recipient firm that offsets transfer capability of donor firms”.	International	Theory Building	-	Influence of organizational on technology transfer
<b>Driscoll and Wallender (1981)</b>	Technology absorptive capacity.	International	Theory Building	-	International economic progress with technology absorption
<b>Kedia and Bhagat (1988)</b>	Absorptive capacity is “receptivity to technological change”.	International	Theory Building	-	Cultural constraints on technology transfer
<b>Cohen and Levinthal (1989)</b>	Absorptive capacity is “an ability to identify, assimilate and exploit knowledge from the environment”	Organizational	Theory Building	R&D Investment	Influence of organizational factors on firm performance
<b>Cohen and Levinthal (1990)</b>	Absorptive capacity is “an ability of a firm to recognize the value of new external information, assimilate it and apply it to commercial ends”.	Organizational	Theory Building and Testing	Prior related knowledge Individual absorptive capacity, Domain-specific Path-dependent knowledge	Socio-cognitive rationale for the existence of absorptive capacity – a single loop learning process
<b>Kim (1995)</b>	Absorptive <i>capability</i> “enables to assimilate, use, adapt, and change existing technologies which enables to create new technology and products. Also in includes acquire, adapt and internalize managerial know-how”.	Organizational (International)	Theory Building	Prior knowledge (in house training)  Intensity of efforts (experience with R&D and production).	Boundary spanning cycle
<b>Cohen and Levinthal (1994)</b>	Absorptive capacity is “ability to exploit outside knowledge is comprised of the set of closely related abilities to evaluate the technological and commercial potential of knowledge in a particular domain, assimilate it and apply it to commercial ends”.	Organizational	Theory Building	Direct assimilation and exploitation of technological advances	Past behavior, uncertainty and competitiveness

<b>Boynton et al. (1994)</b>	Absorptive capacity is “an organization’s ability to effectively use information technology”	Organizational	Theory Testing	Managerial IT knowledge, IT management process, and IT management climate	Information technology
<b>Levinson and Asahi (1995)</b>	Absorptive capacity is “the ability of an organization to pick up new ideas and to adapt them ... is the foundation of technical learning within an organization”.	Inter-organizational	Theory Building	-	Power concept and its influence on knowledge transfer process
<b>Mowery et al. (1996)</b>	Absorptive capacity is “a necessary condition for a firm's successful exploitation of technological capabilities or knowledge outside its boundaries is development within the firm of the ability to absorb such capabilities”.	Intra-organizational	Theory Testing	patent investment pre-alliance levels of technological overlap among the partners.	Inter-firm knowledge transfer
<b>Szulanski (1996)</b>	Absorptive capacity is a “function of the recipient’s knowledge endowment prior to the transfer”.	Intra-organizational	Theory Testing	Preexisting stock of knowledge	Lack of absorptive capacity as a major barrier to internal knowledge transfer
<b>Keller (1996)</b>	-	International	Model development	-	Economic absorptive capacity at international scale
<b>Kim (1997a)</b>	Technological learning is “a function of firm’s absorptive capacity which has two important elements: prior knowledge base and an intensity of effort”.	Organizational (International)	Theory Building	Prior knowledge and intensity of efforts	Technological capability
<b>Kim (1997b)</b>	Absorptive capacity is “an ability to make effective use of technological knowledge to assimilate, use, adapt and change existing technologies”	National	Theory Building	Production capability, investment capability, and innovation capability	Technological capability
<b>Dyer and Singh (1998)</b>	Absorptive capacity is “an ability to exploit outside source of	Intra-organizational	Theory Building	Partner specific absorptive capacity developed from a	Influence of regular knowledge sharing pattern accelerates knowledge sharing



	knowledge is a largely a function of prior related knowledge”.				particular alliance partner	
<b>Koza and Lewin (1998)</b>	Absorptive capacity is “an ability of a firm to utilize outside knowledge”	Organizational	Theory building		Form and structure of an alliance	Exploitation alliance vs. exploration alliance
<b>Lane and Lubatkin (1998)</b>	Absorptive capacity is “the ability of a firm to learn from another firm is jointly determined by the relative characteristics of the student firm and the teacher firm”.	Inter-organizational	Theory Building and Testing		Knowledge base, organizational structure, and dominant logic	Relative absorptive capacity
<b>Cockburn and Henderson (1998)</b>	Absorptive capacity is “doing basic science”.	Industry	Theory Testing		Publication counts	Knowledge transfer from public sector to private. Collaboration and co-authorship across public sector
<b>Van den Bosch et al. (1999)</b>	Absorptive capacity is “evaluating, assimilating, integrating and utilizing knowledge”.	Organizational	Theory Testing		Prior knowledge, organization form, knowledge processing and combinative capabilities	Co-evolutionary framework
<b>Shenkar and Li (1999)</b>	Absorptive capacity is “an ability to monitor process, integrate and deploy new flows of knowledge and to link this knowledge to its existing knowledge base”.	Organizational	Theory Testing		Local partners’ knowledge base and ability to link new knowledge to existing base	Knowledge flows in international cooperative ventures
<b>Mangematin and Nesta (1999)</b>			Theory Testing			Knowledge flows, relationship between fundamental or applied nature of knowledge, tacit or codified form of knowledge
<b>Crossan et al. (1999)</b>	-	Organizational	Theory building		-	Flows and stocks of learning 4I model
<b>Matusik (2000)</b>	Absorptive capacity is “an ability to recognize, assimilate, process and distribute valuable external knowledge”.	Organizational	Theory Testing		Existing stock of public knowledge, the porosity of firm boundaries, individual absorptive capabilities and routines and structures	Flexible firm boundaries and firm knowledge

<b>Gupta and Govindarajan (2000)</b>	-	Organizational	Theory Testing	Prior knowledge and unit homophily	Unit homophily as a determinant for absorptive capacity
<b>Autio et al. (2000)</b>	Organizational learning is “the process of assimilating new knowledge into the organization’s knowledge base”.	Organizational	Theory Testing		Organizational learning and assimilation form of absorptive capacity interchangeably
<b>Becker and Peters (2000)</b>	Absorptive capacity represents “the analytical link between the external stock of technological opportunities and in-house capabilities in developing and improved products”.	Industry	Theory Testing	-	Absorptive capacity as an intermediate factor between technological opportunities and in-house capability of firm
<b>Tu et al. (2000)</b>	Absorptive capacity is “the ability to identify, communicate and assimilate relevant external knowledge and internal knowledge and technology”.	Organizational	Theory Testing	Prior relevant knowledge Communication network Communication climate Knowledge scanning	Knowledge scanning mechanisms
<b>Tsai (2001)</b>	Absorptive capacity is “the ability to replicate new information”.	Intra-organizational	Theory Building and Testing	network position external access internal capacity	Social network properties
<b>Lane et al. (2001)</b>	Absorptive capacity is “ability to understand new knowledge, ability to assimilate and last ability to apply the assimilated knowledge”.	International	Theory Building and Testing	Relative absorptive capacity and Trust Learning structures and process Firm strategy and training competence	International joint venture learning and performance
<b>Stock et al. (2001)</b>		Industry	Theory Testing		Inverted –U- relationship between new product development performance and absorptive capacity
<b>Jones and Craven (2001)</b>	Absorptive capacity is “an organizational ability to assimilate new knowledge and skills”.	Organizational	Theory Testing	Introduction of new organizational routines	Importance of absorptive capacity for learning at organizational level and influence of boundary spanning activity

<b>George et al. (2001)</b>	Absorptive capacity is “an organizational capability to value and exploit external knowledge”.	Organizational	Theory Testing	ability to <i>evaluate</i> and <i>assimilate</i> knowledge and second, the ability to <i>apply</i> that knowledge	Influence of alliance portfolio characteristics on absorptive capacity
<b>Deeds (2001)</b>	Absorptive capacity is “a function of the level of a firm’s prior related knowledge”.	Organizational	Theory Testing		
<b>Gann (2001)</b>	Absorptive capacity is “the ability of firms to recognize the value of new external information represents a key ingredient for innovation”.				Construction sector in UK
<b>Zahra and George (2002)</b>	Absorptive capacity is “a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability”.	Organizational	Theory Building	Acquisition, assimilation, transformation and exploitation	Dynamic capability view of absorptive capacity
<b>Lane et al. (2002)</b>	Absorptive capacity is “a strategically valuable capability”.	Organizational	Theory Building	Identification assimilation application	Knowledge characteristics, knowledge transfer, organizational learning, innovation, corporate scope and the properties of alliances
<b>Lin et al. (2002)</b>	<i>Technology absorptive capacity</i>	Industry	Theory Testing	Organizational culture, diffusion channels, interaction mechanisms and R&D resources	Specifies <i>technology</i> absorptive capacity
<b>Liao et al. (2003)</b>	Potential absorptive capacity is “a set of interrelated organizational capabilities of acquiring disseminating and assimilating external information and knowledge”.	Organizational	Theory Testing	External knowledge acquisition and internal knowledge dissemination	Potential absorptive capacity and environmental turbulence
<b>Minbaeva et al. (2003)</b>	Absorptive capacity is “related to	Organizational	Theory	Employees’ ability and	Influence of ability and motivation on

	both employees' ability and motivation".		Testing	employees' motivation	knowledge absorption
<b>Reagans and McEvily (2003)</b>	Absorptive capacity is "an ability that people transfer knowledge".	Organizational	Theory Testing	-	Investigating explanations for knowledge transfer based on absorptive capacity
<b>Eriksson and Chetty (2003)</b>	Absorptive capacity is a "firm's ability to turn experience into useful knowledge in an ongoing business".	Organizational	Theory Testing	Diversity of experience and depth of experience	Influence of network dyadic relationships
<b>Lenox and King (2004)</b>	Absorptive capacity is "a dynamic capability to absorb and implement new practice".	Industry	Theory Testing	Providing information to potential adopters	Managerial knowledge repository
<b>Daghfous (2004)</b>	Absorptive capacity enables "the firm to effectively acquire and utilize external as well as internal knowledge, which, in turn, affects the firm's ability to innovate and adapt to its changing environment and be competitive".	Organizational	Theory Building	Internal and external Factors	Internal and external determinants of absorptive capacity
<b>Caloghirou et al. (2004)</b>	Absorptive capacity is "the capability of a firm to absorb knowledge and information from external sources".	Industry	Theory Testing		Acquisition channels
<b>Styhre et al. (2004)</b>	-	Project	Theory Testing	Learning capability	Influence of informal social mechanisms on learning capabilities of construction organizations
<b>Matusik and Heeley (2005)</b>	Absorptive capacity is an "ability of the firm to use knowledge from outside its boundaries".	Industry	Theory Testing	Porosity of firm boundaries, collective dimension and individual dimension	Drives for effective use of external knowledge
<b>Jansen et al. (2005)</b>	-	Organizational	Theory Building and Testing	<i>Coordination capabilities:</i> cross-functional interfaces, participation in decision making, job rotation; <i>System capabilities:</i> formalization and routinization ;	Why some organizations are able to identify and assimilate new external knowledge but they are not able to transform and exploit it?

				<i>Social capabilities:</i> connectedness and socialization tactics)	
<b>Harrington and Guimaraes (2005)</b>	-	Industry	Theory Testing	Collective knowledge and communication channels	Corporate culture
<b>Kim and Inkpen (2005)</b>	Absolute absorptive capacity is “a firm-specific technological strength and alliance experience, whereas relative absorptive capacity of a dyad refers to the technology overlap and prior alliance experience of a pair of alliance partners”.	Industry	Theory testing	Learning related characteristics: receptivity, intent, transparency	Perspective from alliance learning
<b>Nieto and Quevedo (2005)</b>	Absorptive capacity is “an ability to identify, assimilate and apply for commercial purposes know-how generated outside itself”.	Organizational	Theory Building and Testing	Communication with the outside environment, level of know-how and experience in the organization, diversity and overlaps in the knowledge structure and strategic positioning.	Influence of knowledge opportunity and spillovers on innovative effort
<b>Lane et al. (2006)</b>	Absorptive capacity is “a firm’s ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, and (3) using the assimilated knowledge to create new knowledge and commercial outputs through exploitative	Organizational	Theory building	Exploratory learning, transformative learning and exploitative learning	A comprehensive review of the concept of absorptive capacity and a new absorptive capacity model

	learning”.					
<b>Tu et al. (2006)</b>	-	Industry	Theory Testing	Prior relevant knowledge, communication network, communication climate and knowledge scanning	Measuring the concept of absorptive in the context of time-based manufacturing practices	
<b>Jones (2006)</b>	-	Organizational	Theory Building		Influence of key social actors (i.e., gatekeepers, boundary spanners and change agents) and internal mechanisms on absorbing new knowledge	
<b>Waalkens (2006)</b>	Absorptive capacity is “a special kind or a form of organizational learning”.				Absorptive capacity of small and medium sized AEC firms	
<b>Todorova and Durisin (2007)</b>	-	Organizational	Theory Building	Identification, acquisition, assimilation, transformation and exploitation	A new absorptive capacity model	
<b>Minbaeva et al. (2007)</b>	-	Individual	Theory Testing	Knowledge transfer process, individual ability and motivation	Influence of boundary spanners on the absorption of external knowledge	
<b>Arbussà and Coenders (2007)</b>	Absorptive capacity is “an ability to scan the external environment for new technology and the ability to integrate new external knowledge into its innovation process”.	Organizational	Theory Testing		Innovation activities of firms and appropriation instruments.	
<b>Park et al. (2007)</b>	Absorptive capacity is “the ability of an organizational member to value, assimilate, and apply new knowledge”.	Organizational	Theory Building and Testing	Understanding Assimilating Applying	Adoption of Enterprise Resource Planning (ERP) systems	
<b>Calero-Medina and Noyons (2008)</b>	-	-	Theory Testing	-	Diffusion of absorptive capacity concept	
<b>Fosfuri and Tribó</b>	Potential absorptive capacity is a	Organizational	Theory	R&D cooperation	P	Potential absorptive capacity and its relation

<b>(2008)</b>	“bridge or the gate between what is outside and what is inside the organization” and realized absorptive capacity is “the ability to exploit this external knowledge once it has been brought within the boundaries of the organization”.		Testing	External linkages Experience	A C	with innovation
<b>Easterby-Smith et al. (2008)</b>	-	Organizational	Theory Testing	-		Influence of power and firm <i>boundaries on</i> absorptive capacity
<b>Sun and Anderson (2008)</b>	Absorptive capacity should be considered “a specific type of organizational learning which concerns an organization’s relationship with external knowledge”.	Organizational	Theory Building	Intuition vs. acquisition, interpretation vs assimilation, integration vs. transformation and institutionalization vs. exploitation		Comparison of the concept of absorptive capacity and organizational learning models
<b>Wu and Wang (2008)</b>	Personal absorptive capacity of knowledge is “basic foundation for knowledge creation and transfer”.	Individual	Theory Building	SECI (socialization, externalization, combination, Internalization) and absorptive capacity dimensions (acquisition, assimilation, transformation and exploitation)		Individual absorptive capacity and learning models
<b>Sun and Anderson (2008)</b>	Absorptive capacity is “the collective abilities of a firm which is a concrete example of organizational learning that concerns a firm’s interaction with new external knowledge”.	Organizational	Theory Building			A framework for conceptualizing absorptive capacity as a specific meta-learning capability with regard to external information
<b>Bergh and Lim (2008)</b>	Absorptive capacity is “an ability to exploit information”.	Organizational	Theory Building and Testing	Repetition, explicit knowledge routines		Conceptualizing absorptive capacity as an organizational problem solving process

<b>Vega-Jurado et al. (2008)</b>	The scientific absorptive capacity refers to “the firm’s ability to absorb scientific/ technological knowledge from universities, technology institutes, and public and private research centers; the industrial absorptive capacity refers to ability to assimilate and exploit knowledge from actors in the industry chain”.	Organizational	Theory Testing	Internal factors: organizational knowledge, formalization, and social integration mechanisms	Industrial and scientific absorptive capacity
<b>Deng et al. (2008)</b>	Absorptive capacity is “an ability to acquire new knowledge, synthesize it and apply it to emerging task requirements of an individual”.	Organizational	Theory Testing		Knowledge bases and reasoning mechanisms
<b>Lim (2009)</b>	Absorptive capacity is “an influential, theoretical and multifaceted construct which is formed by type and maturity of technology absorbed”.	Organizational	Theory Testing	Disciplinary Domain specific Encoded	Three different form of absorptive capacity (i.e., disciplinary, domain specific and encoded)
<b>Chen et al. (2009)</b>	Absorptive capacity is “the ability to enable companies to effectively acquire and utilize external knowledge as well as internal knowledge which affects the company’s ability to innovate and to adopt to its changing environment”.	Organizational	Theory Testing	Organizational capability	Absorptive capacity concept as a being of internal determinant for companies in contrast to external determinant
<b>Lev et al. (2009)</b>	Absorptive capacity is “a central concept to explain how organizations learn from their environment”.	Organizational	Theory Testing	Potential ACAP stocks and realized ACAP stocks	Knowledge stocks and flows
<b>Chen et al. (2009)</b>	Absorptive capacity is “the ability to enable companies to effectively acquire and utilize external knowledge as well as internal	Organizational	Theory Testing	Applying new knowledge; understanding, analyzing and interpreting information; and	External knowledge processing



	knowledge which affects the company's ability to innovate and to adopt to its changing environment"			combining existing knowledge	
<b>Fabrizio (2009)</b>		Organizational	Theory Testing		Efficient knowledge search for innovation
<b>Jane Zhao and Anand (2009)</b>	Collective absorptive capacity refers "the structural and cultural attributes of the receiving organization as a whole that are conducive to acquiring and assimilating new knowledge".	Organizational	Theory Building and Testing	Knowledge, teaching and absorptive capacity	Individual absorptive capacity vs. collective absorptive constructs
<b>Lichtenthaler (2009)</b>	Absorptive capacity is "a firm's ability to utilize external knowledge through the sequential processes of exploratory, transformative, and exploitative learning".	Organizational	Theory Building and Testing	Exploratory (recognize, assimilate), transformative (maintain, reactive), exploitative (transmute, apply)	Environmental turbulence
<b>Cadiz et al. (2009)</b>	Absorptive capacity is "the ability to transform new knowledge into usable knowledge through the process of assessment (identification and filtering of valuable information, assimilation (conversion of new knowledge into usable knowledge), and application (using the knowledge)".	Organizational	Theory Building and Testing	Assessment, assimilation and application	Organizational knowledge transfer
<b>Rothaermel and Alexandre (2009)</b>	Cohen and Levinthal's (1994) definition of absorptive capacity is criticized	Organizational	Theory Building and Testing	R&D expenditures	U shaped moderating effect on firm ambidexterity and internal and external firm boundaries
<b>Gluch et al. (2009)</b>	Absorptive capacity is "a concept that links knowledge generated outside the company to knowledge generated within the	Industry	Theory Testing	Acquisition: knowledge Assimilation: knowledge + routines, Transformation: change of routines,	Construction industry in Sweden

	company”.			Exploitation: application new routines	
<b>de Jong and Freel (2010)</b>	-	Organizational	Theory Testing	Absorptive capacity and geographical distance are connected variables	Absorptive capacity reduces the need for geographical proximity in collaboration
<b>Spithoven et al. (2010)</b>	-	Organizational	Theory Testing	-	Open innovation activities of traditional industries
<b>Mu et al. (2010)</b>	Absorptive capacity is “identifying and recognizing the value of external knowledge and information, absorbing and assimilating knowledge and information, and putting them into application”.	Individual	Theory Testing	Quantity of information, network structure, knowledge transfer channels, knowledge transfer rules, behavioral change of knowledge receiver and sender	Absorptive and disseminative capabilities are required to efficient knowledge transfer
<b>Massini (2010)</b>	-	Individual	Theory Testing	internal meta routines based on sharing and combining knowledge external meta routines include conceptualization based on routines for identifying external knowledge for learning from external environment	Coevolving and mutually reinforcing relation between absorptive capacity and learning
<b>Unsal and Taylor (2011)</b>	Absorptive capacity of project network refers to “the maximum rate of innovation introduction at which the project network is able to recognize positive performance gains”.	Project	Theory Testing	Learning in construction project organizations	Simulation model of project networks for productivity paradox
<b>Camisón and Forés (2011)</b>	-	Organizational	Theory Testing	Internal knowledge creation capacity intra district shared competences	Internal knowledge creation and external knowledge absorption
<b>Cantner and Joel (2011)</b>	Institutionalized knowledge management refers to	Organizational	Theory Testing	internal, educational, communicative and	Effects of network position

	organizational absorptive capacity			external knowledge management	
<b>Delmas et al. (2011)</b>	-	Organizational	Theory Testing	-	Proactive environmental strategies can create competitive advantage
<b>Zonooz et al. (2011)</b>	Absorptive capacity is “ the capability to understand and use new (external) knowledge”.	Organizational	Theory Building and Testing	A firm’s relations to its external environment (porosity of the firm boundaries in a social climate), the collectively constructed knowledge structures routines and norms etc. (discrete and abstract aspects of operations and involves structure or architecture of collective memory), and individual absorptive capacities of firm members.	Absorptive and combinative capability forms are the core catalysts of knowledge transfer.
<b>Brettel et al. (2011)</b>					U shape non-linear relations between explorative, transformative and exploitive learning forms
<b>Rejeb and Quelin (2011)</b>	Absorptive capacity is “a dynamic capability to knowledge creation and Absorptive capacity refers to utilization that enhances a firm’s ability to gain and sustain a competitive advantage”.	Individual level	Theory Testing	network size, network density, indirect ties, and strength of ties and range of ties	Interactions between individuals through a social lens and as well as learning theory
<b>Pedrosa and Jasmand (2011)</b>	Individual absorptive capacity refers to the “behavior of individuals by which they identify new knowledge assimilate it, apply it, and disseminate it to other individuals”.	Individual	Theory Testing	Identification Assimilation Application Dissemination	Individual learning process and individual absorptive capacity
<b>Datta (2011)</b>	Absorptive capacity is “information processing in	Organizational	Theory Building	Potential and realized absorptive	Ambidexterity based on centrality and diversity

	organization level”.			capacity	
<b>Yongping et al. (2011)</b>	Absorptive capacity refers to “a series of organizational routines the enterprise identification, digestion and application of knowledge”.	Organizational	Theory Building and Testing		Impact of network structure and knowledge stock
<b>Gebauer et al. (2012)</b>	-	Organizational	Theory Testing	Explorative learning process, assimilative learning processes, transformative learning processes and exploitative learning processes	Influence of combinative capabilities (i.e., systematization, coordination and socialization)
<b>Revilla et al. (2013)</b>	Absorptive capacity is “(1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, (3) using assimilated knowledge to create new knowledge and commercial outputs through exploitative learning”.	Organizational	Theory Testing	Exploratory learning, transformative learning and exploitative learning	Supplier-buyer relationships.
<b>Hu and Schlagwein (2013)</b>	Absorptive capacity is “the ability of the firm to create and deploy the knowledge necessary to build other organizational capabilities”.	Organizational	Theory Testing	Exploratory learning, transformative learning and exploitative learning	Influence of social media use

## APPENDIX B

### ON-LINE QUESTIONNAIRE SURVEY IN TURKISH



Cinsiyetiniz

- Kadın  
 Erkek

En son gerçekleştirdiğiniz Projenin Büyüklüğü:

m<sup>2</sup>

En son gerçekleştirdiğiniz Projenin Türü:

En son gerçekleştirdiğiniz Projenin Yaklaşık Bütçesi:

TL

En son gerçekleştirdiğiniz Projenin Süresi:

Ay

Proje ekibinde görev alan uzman sayısı: (mimar, tasarımcı, mühendis, planıcı vb.):

Bu uzmanlardan kaç tanesi ile önceki projelerde birlikte görev aldınız:

Continue »

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## BÖLÜM I

En son üstlendiğimiz projeyi gerçekleştirirken edindiğiniz izlenimlerinize dayanarak mimarlık pratiği deneyimlerinize yönelik cümleleri fikirleriniz doğrultusunda 1 den 7'e numaralandırınız.

Vereceğiniz yanıt ölçütleri; '1' hiç katılmıyorum, '7' ise kesinlikle katılıyorum 2, 3, 4, 5 ve 6 değerleri ise aralarda kalan değerlendirme ölçütünüzü belirtir.

**Proje ile ilgili arazi koşulları, imar durumu gibi çevresel verileri titizlikle topladık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Üstlendiğimiz mimari tasarım projesinde kullanılabilecek yeni teknolojilere ilişkin kapsamlı bir bilgi arayışına girdik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Üstlendiğimiz mimari tasarım projesinde müşterinin gereksinimleri ve ihtiyaçlarını sürekli olarak belirlemeye çabaladık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ve mal sahibinin ihtiyaçlarını ve gereksinimlerini doğru belirlemek için kapsamlı bir bilgi toplama süreci izledik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Projeyle ilişkin çevresel (sosyal, arazi koşulları, imar durumu gibi) kısıtların doğru yorumlanması konusunda ısrarcı bir yaklaşım izledik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Müşteri beklentilerini ve ihtiyaçlarını daha önce gerçekleştirdiğimiz projelerden edindiğimiz deneyimler ile karşılaştırdık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Teknolojideki yeni gelişmelerin projeye uyarlanabilirliğini irdeledik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje arazisinin yenilikçi tasarım fırsatları oluşturma konusunda potansiyeli olup olmadığını kapsamlı bir şekilde değerlendirdik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ve mal sahibinin ihtiyaçlarını ve gereksinimlerini kapsamlı bir biçimde belirledik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibinin/sponsorunun ihtiyaçları ve gereksinimleri arasında önem sıralaması yaparken oldukça zorlandık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Projeyle ilgili arazi koşulları imar durumu gibi edindiğimiz fiziksel ve çevresel verileri rafine ederek (düzelterek, geliştirerek) kullandık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Projeyle ilişkin almış olduğumuz tasarım kararları (form, işlev, konfor, koşullar, estetik, maliyet ve teknik sistemler) arasında oluşan çelişkileri/uyumsuzlukları başarı ile uzlaştırdık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Projenin mühendislik sistemlerinin (taşıyıcı, mekanik ve elektrik); mimari tasarım çözümlerine olan olumsuz/sınırlayıcı etkilerini gidermekte zorlandık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Müşterinin estetik beklenti ve kaygılarını proje teknik ihtiyaçlarına göre uyarladık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum



**Projenin çevresel kısıtlarını proje lehine uyarlayarak farklı tasarım fırsatlarına dönüştürdük**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Güncel teknolojik bilgiyi tasarım sürecinde nasıl uygulayabileceğimizi sürekli tartıştık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Projenin fiziksel, sosyal ve çevresel koşullarından elde edilen bilgileri, tasarımı geliştirmek için yeniden uyarlayarak kullandık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibinin/sponsorunun beklenti ve ihtiyaçlarını projenin çevresel koşullarına uyarlamakta zorlandık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Müşterinin beklenti ve ihtiyaçlarını mimari projeye daha iyi nasıl uygulayacağımızı sürekli göz önünde bulundurduk**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Üstlenilen proje hakkında, müşteri ile estetik beklentilerini tartışarak önerilen fikirleri uyguladık, tasarımımızı geliştirdik

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Projenin fiziksel, sosyal ve çevresel koşullarından elde ettiğimiz bilgileri, üstlenilen mimari projeye nasıl uyarlayacağımızı proje ekibi olarak netleştirdik

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Çevresel verilerin olumsuz veya kısıtlayıcı özelliklerinden hangilerinin tasarımda fırsata dönüştürülmeye uygun olduğunu hemen farkedebildik

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Geçmiş projelerde uyguladığımız beğenilen/takdir görmüş tasarım kararlarının çoğunu son üstlenilen projede de kullandık

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Tasarım projesine ilişkin geliřtirdiđimiz önerilerimizi ve tasarım tercihlerimizi proje sahibine/sponsora açıklamakta iletiřim zorlukları yařadık

- 1 - Hiç Katılmıyorum
- 2 - Çođuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çođuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

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## BÖLÜM II

En son üstlendiđiniz Projeyi gerçekleřtirirken;

Proje ekibimizdeki bireylerin proje hedeflerine yönelik görüřleri birbirleri ile paraleldi

- 1 - Hiç Katılmıyorum
- 2 - Çođuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çođuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Proje ekibimizdeki üyelerin bireysel hedefleri ile projenin hedefleri arasında önemli geliřkiler yada tutarsızlıklar oluşmadı

- 1 - Hiç Katılmıyorum
- 2 - Çođuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çođuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Projenin karřılması beklenen niteliklerin öncelik sıralamasında ekip üyelerinin arasında önemli görüř farklılıkları ortaya çıktı

- 1 - Hiç Katılmıyorum
- 2 - Çođuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çođuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibinin izlediği tasarım yaklaşımı ile proje ekibindeki bazı üyelerin bireysel tasarım yaklaşımları arasında önemli çelişkiler oluştu**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje süresince izlenen yaklaşımlar ve kullanılan yöntemler proje ekibimizdeki bireyler tarafından ortak kabul gördü ve benimsendi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibimizdeki bireylerin projeye ilişkin yorumları, sürece dair görüşleri ve çözüm yaklaşımları benzerlik gösterdi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Üstlenilen mimari proje için yapılan toplantılar esnasında kullanılan dil (konuşulan kavramlar) bazı ekip üyelerince karmaşık bulundu**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Üstlenilen mimari proje için yapılan toplantılar esnasında verilen tasarım örnekleri, genellikle proje ekibinin tüm üyeleri için anlaşılır düzeydi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Üstlenilen mimari proje için yapılan toplantılar esnasında ekip üyelerince yapılan açıklamalar genellikle diğer ekip üyeleri tarafından da net olarak anlaşıldı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibi/sponsoru projenin tasarımında yenilikçi tasarım yaklaşımlarının uygulanmasını benimsedi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibi/sponsoru projede denenmiş ve bilinen tasarım yaklaşımlarının izlenmesi konusunda ısrarcı davrandı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibi/sponsoru yenilikçi tasarım yaklaşımlarının denenmesi için gerekli kaynak ve destek sağladı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibinin/sponsorunun proje öncelikleri, yenilikçi tasarım çözümlerinin geliştirilip uygulanmasını engelledi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibi/sponsoru, projenin öncelikli hedeflerinin belirlenmesi konusunda tasarım ekibini tam yetkiyle görevlendirdi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibi/sponsoru projede izlenecek tasarım yaklaşımının seçimi konusunda tasarım ekibini özgür bıraktı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Projede uygulanacak olan teknolojik sistemlerin, özelliklerinin belirlenip seçilmesinde tasarım ekibi yetkiliydi**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje sahibi/sponsoru projenin bütçesi, maliyeti, iş süresinin /iş programının belirlenmesi konularında proje ekibini tam yetkili kıldı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak en yenilikçi fikirleri başarılı bir şekilde uyguladık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak üstlendiğimiz mimari projeyi daha yenilikçi/yaratıcı yaklaşımlarla çözmeyi başardık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak üstlendiğimiz mimari projede müşterinin ihtiyaçlarını tamamen karşılayacak çözümler geliştirdik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak üstlendiğimiz mimari projeyi hedeflenen sürede tamamladık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak üstlendiğimiz mimari projeyi öngörülen maliyette gerçekleştirdik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak projenin mimari değerini arttıran nitelikli yaklaşımlarla projeyi çözmeyi başardık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibimizdeki bireylerin mesleki referansları (iş deneyimleri) göz önüne alındığında mesleki yetkinliklerine ilişkin şüphe yada tereddüt duymadık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak bizler, diğer ekip üyelerine meslektaş olarak saygı duyulması ve güvenilmesi gerektiğine inandık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum



**Proje ekibi olarak, kaygı duyulan diğer ekip üyelerinin üstlendikleri görevleri nasıl gerçekleştirdiklerini yakından izledik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak yaşadığımız zorlukları ve sorunları rahatça ve serbestçe aramızda konuşabildik**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibi olarak birlikte çalışamayacağımız duygusuna hiç kapılmadık**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibimizdeki bireyler arasında karşılıklı olarak paylaşımcı bir ilişki vardı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

**Proje ekibimizdeki bireyler arasında karşılıklı bir güven vardı**

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Proje ekip üyeleri arasında bireysel çıkarların ekibin ortak çıkarlarından sonra geldiği düşüncesi hakimdi


- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

Proje ekibimizdeki bireylerden herhangi birinin, kişisel çıkarına yarayan bir fırsat ortaya çıksa bile bundan faydalanmayacağına inandık

- 1 - Hiç Katılmıyorum
- 2 - Çoğuna Katılmıyorum
- 3 - Katılmıyorum
- 4 - Kararsızım
- 5 - Katılıyorum
- 6 - Çoğuna Katılıyorum
- 7 - Kesinlikle Katılıyorum

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 60% completed



## BÖLÜM III

Proje ekibinizde yer alan bireyler arasında, yürütülen projeye ilişkin konularda (yüz yüze, elektronik ortamda veya telefonda) hangi sıklıkla iletişimin gerçekleştiğini düşünüyorsunuz?

- 1-Çok nadir
- 2-Nadiren
- 3-Ara sıra
- 4-Sıkça
- 5-Çok sık

Proje ekibinizde yer alan bireylerin proje konusu dışında birbirleriyle hangi yoğunlukta sosyal etkileşim içinde olduklarını düşünüyorsunuz?

- 1-Hiçbir zaman
- 2-Nadiren
- 3-Ara sıra
- 4-Sıkça
- 5-Çok sık

Proje ekibinizdeki bireyler (mimar, mühendis, planıcı, vs.) arasında ne kadar yakın bir iş ilişkisinin olduğunu düşünüyorsunuz?

- 1-Çok yakın
- 2-Genellikle yakın
- 3-Yakın
- 4-Orta
- 5-Genellikle mesafeli
- 6-Mesafeli
- 7-Çok mesafeli

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80% completed



## BÖLÜM IV

En son üstlendiğiniz projeyi tasarlarken, yararlandığınız kaynakları odaklandığınız konulara göre ne ölçüde katkı sağladığınızı 0'dan 3'e numaralandırınız. Vereceğiniz yanıt ölçütleri; '0' hiç önemli değil, '3' çok önemli' yi belirtir (0:hiç önemli değil, 1:biraz önemli, 2:önemli, 3:çok önemli)

### Konseptler Esin kaynakları

projeye sağladığı katkı, kaynaklara göre:

	0-Hiç önemli değil	1-Biraz önemli	2-Önemli	3-Çok önemli
Proje sahibinden veya sponsordan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tedarikçi firmalardan (yapı malzemesi, yazılım vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Farklı proje ekiplerinde görev alan uzmanlardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kamu kurum ve kuruluşlarından(belediye, vs) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknoloji transfer ofislerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuar sergi vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sosyal Medyadan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnternette edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnşaat firmalarından (Müteahhit, taşeron, vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Danışman, Müşavir firmalardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meslek odalarından edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Universite ve diğer araştırma enstitülerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesleki konferans, seminer vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknik arazi gezilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kitap, teknik, mesleki ve magazin dergilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Yapı ölçüleri, yapı detayları, imar çevre yangın yönetmelikleri teknik şartnameler yapı standartları

projeye sağladığı katkı, kaynaklara göre;

	0-Hiç önemli değil	1-Biraz önemli	2-Önemli	3-Çok önemli
Proje sahibinden veya sponsordan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tedarikçi firmalardan (yapı malzemesi, yazılım vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Farklı proje ekiplerinde görev alan uzmanlardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kamu kurum ve kuruluşlarından(belediye, vs) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknoloji transfer ofislerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuar sergi vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sosyal Medyadan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnternette edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnşaat firmalarından (Müteahhit, taşerondan, vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Danışman, Müşavir firmalardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meslek odalarından edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Üniversite ve diğer araştırma enstitülerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesleki konferans, seminer vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknik arazi gezilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kitap, teknik, mesleki ve magazin dergilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Mimari çözümler mimari örnekler, farklı alternatif tasarım yaklaşımları**

projeye sağladığı katkı, kaynaklara göre;

	0-Hiç önemli değil	1-Biraz önemli	2-Önemli	3-Çok önemli
Proje sahibinden veya sponsordan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tedarikçi firmalardan (yapı malzemesi, yazılım vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Farklı proje ekiplerinde görev alan uzmanlardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kamu kurum ve kuruluşlarından(belediye, vs) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknoloji transfer ofislerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuar sergi vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sosyal Medyadan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnternette edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnşaat firmalarından (Müteahhit, taşeron, vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Danışman, Müşavir firmalardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meslek odalarından edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Üniversite ve diğer araştırma enstitülerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesleki konferans, seminer vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknik arazi gezilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kitap, teknik, mesleki ve magazin dergilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Tasarım süreci, Tasarım sürecine ilişkin eylemler

projeye sağladığı katkı, kaynaklara göre;

	0-Hiç önemli değil	1-Biraz önemli	2-Önemli	3-Çok önemli
Proje sahibinden veya sponsordan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tedarikçi firmalardan (yapı malzemesi, yazılım vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Farklı proje ekiplerinde görev alan uzmanlardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kamu kurum ve kuruluşlarından(belediye, vs) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknoloji transfer ofislerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuar sergi vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sosyal Medyadan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnternette edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
İnşaat firmalarından (Müteahhit, taşerondan, vs.) edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Danışman, Müşavir firmalardan edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Meslek odalarından edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Üniversite ve diğer araştırma enstitülerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesleki konferans, seminer vb. etkinliklerden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teknik arazi gezilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kitap, teknik, mesleki ve magazin dergilerinden edinilen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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# VITA

**Date of Birth:** February 5, 1984

**Place of Birth:** Antalya

## EDUCATION:

### **Ph.D. in Architecture**

Izmir Institute of Technology, Department of Architecture, 2015

### **Master of Science in Architecture**

Izmir Institute of Technology, Department of Architecture, 2009

### **Bachelor of Science in Architecture**

Balıkesir University, Department of Architecture, 2007

### **Associate Degree in Justice**

Anadolu University, 2014

## PUBLICATIONS:

- Ülkeryıldız, E., (2014). Recomposing Mondrian's paintings by using computer programs: The Impact of knowledge and flexibility. International Conference on UIAE, April 3–4 2014, Famagusta, Northern Cyprus.
- Ülkeryıldız, E., Kale, S. (2014). Proje odaklı organizasyonlarda bilgi emilimi: Mimari tasarım stüdyosu. III. Proje ve Yapım Yönetimi Kongresi, Akdeniz Üniversitesi, Antalya, Bildiriler Kitabı, 202-212.
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## EXPERIENCE:

Research Assistant, Izmir Institute of Technology, Department of Architecture  
(December 2008 – August 2015).

## FIELDS OF INTEREST:

Learning theories, basic design, studio culture, organizational politics, power and authority in project organizations, absorptive capacity, space and cinema.