

**EXPLORING KNOWLEDGE MANAGEMENT
IN THE PRACTICE OF ARCHITECTURE:
A PILOT STUDY IN THE TURKISH CAPITAL**
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The Architecture-Engineering-Construction industry has recently been altering the ways of managing its resources. Knowledge is considered to be among the most precious of these resources. Knowledge is a critical factor in choosing the right projects, preparing the winning bids and successfully realizing the projects. It is also a critical factor for organizations because of the fact that - due to its nature that it exists as tacit or explicit, or in between - it is hard to record and reuse.

This paper provides a pilot study in order to investigate the knowledge management issue in the practice of architecture. The study has been carried out in the Çankaya district of Ankara. Face-to-face interviews have been carried out with the head architects of 15 architectural offices. The subject domain is assumed to be experiencing the problems such as managing knowledge at a strategic level. This is due to the facts that the amount and importance of tacit knowledge is significant and communication of this knowledge to other parties is the responsibility of the architectural partners.

The survey found out that management of architectural knowledge is considered to be beneficial for the overall productivity of architectural offices. However, challenges such as lack of standard procedures and low profit margins in the AEC industry render knowledge management to be less effective on overall profit and innovation in design.

INTRODUCTION

Today, knowledge is considered as the most important asset for the business organizations. The phenomenon is attracting both academia and industry and there is a significant amount of research effort devoted to the management of knowledge. Knowledge is the center of attention due to the fact that business environment is changing significantly with the emergence of the knowledge era as a fundamental part of the global

economy (Egbu and Robinson 2005, 31). Although its value has long been neglected in organizations, knowledge is now regarded as a key factor for long-term corporate sustainability. Managing knowledge is imperative in converting it as an asset for organizational use to facilitate continuous improvement (Robinson et al., 2005). In this respect, organizations must seek for ways to understand the nature of knowledge they possess and develop methods to utilize it at maximum performance.

There are many definitions of knowledge in the literature. According to Udejaja et al. (2008), knowledge is a body of information accompanied with understanding and reasoning. Davenport et al. (1998) define knowledge as a high-form of information combined with experience, context, interpretation and reflection that can be applied for decision making in actions. Many researchers agree on the fact that only human interpretation can provide data and information with such meaning. Bhatt (2001) states that it is only through meaning, that information finds life and becomes knowledge.

In general, knowledge is proposed to be in two different forms according to characteristics it possesses: Tacit knowledge and explicit knowledge. Nonaka and Takeuchi (1995, 59) state that tacit knowledge is personal, context-specific, and hence is hard to document and share. Tacit knowledge can be shared and utilized through semi-structured communication means such as face-to-face contact, communities of practices, or lessons learned (Carrillo and Chinowsky, 2006). On the other hand, Polanyi cited in Kivrak et al. (2008) claims that explicit knowledge can directly be recorded in words and numbers, easily shared in manuals, and is easy to distribute. Koskinen et al. (2003) state that explicit knowledge is gained mainly through education and involves factual statements about material properties, tool characteristics etc.

Nonaka and Takeuchi (1995, 61) assume that human knowledge is created and expanded through social interaction between tacit and explicit knowledge. The authors claim that this social conversion process enhances both forms of knowledge in terms of quality and quantity. Both tacit and explicit knowledge is important for organizations; however, since Polanyi (1967) presented the first theory concerning tacit knowledge, numerous studies have demonstrated the importance of tacit knowledge. Also, Sternberg et al. (2000) hold that much of the knowledge needed to succeed in real-life events is tacit and experience-based.

One of the largest industries among which knowledge has seen a great deal of attention is the architecture, engineering and construction (AEC) industry. As of today, Sheehan et al. (2005, 50) state that AEC industry demands results faster than ever and individuals are exposed to significant pressure due to the need for rapid communication through advanced tools. Also, the AEC industry is large and very competitive and displays low profit limitations. This competitive environment makes managing of knowledge to appear particularly attractive. In this respect, systematic management of knowledge can enable organizations to improve their overall productivity and gain competitive advantage by decreasing project durations, improving quality of products, increasing employee contribution and developing solid organizational knowledge repositories. On the other hand, Kamara et al. (2002b) argue that should organizations fail to utilize project knowledge into knowledge assets, AEC organizations, especially temporary establishments, may have to re-invent the wheel, waste time and come up with weakened project performance.

Woo et al. (2004) show that much knowledge in the AEC industry is experience-based and tacit and hard to manage due to the orientation toward unique projects. The major reasons behind the need for knowledge-based strategies to be applied in the AEC industry are considered to be (i) the work culture that depends on social communication, (ii) limited data exchange standards caused by the fragmented nature of industry and (iii) the subjectivity of data structures.

Developing and implementing a strategy for knowledge management in the AEC sector is considered challenging due to several reasons such as the uniqueness of construction projects, their temporary nature, and the complex interrelated activities required in achieving the objectives. There have been many research efforts in order to explore the knowledge management issue within the AEC industry. These research efforts can be grouped in different areas: Some authors, for example, explored the use and spread of knowledge management issue within the AEC industry. For example, Kamara et al. (2002a) reviewed current initiatives for the management of knowledge within the AEC sector. Robinson et al. (2005) investigated how large UK construction organisations manage their knowledge assets. The authors adopted a case study methodology and interviewed four large UK construction organisations. Carrillo and Chinowski (2006) investigated how major United States engineering design and construction firms are implementing knowledge management initiatives in order to identify best practice.

Some authors, on the other hand, explored selecting / defining knowledge management strategy in construction organizations. For example, Kamara et al. (2002b) described a framework for selecting a knowledge management strategy that is appropriate to the organisational and cultural context of an organisation. Al-Ghassani et al. (2002) proposed a tool for developing knowledge management strategies. Carrillo et al. (2003) presented a framework for the assessment of the likely impact of KM and discussed findings from an evaluation workshop held to critique the framework. Wu et al. (2004) introduced an IT approach to satisfy the needs in managing knowledge in construction projects. The paper also suggested that significant realisation of IT benefits can only be achieved by knowledge based systems, which are underpinned by a consistent design and construction knowledge framework. Carrillo et al. (2006) proposed a framework for linking knowledge management to business performance.

Finally, the latest research efforts explored the next generation knowledge management systems that can be used within the construction industry. For example, Anumba (2009) provided the need for next-generation knowledge management (KM) systems in the construction sector and outlined the key features that such systems should have. Christiansson (2003) and Lai et al. (2003) investigated an ontology-based knowledge management system. Evolving concepts, such as semantic web and ontology have been investigated in order to improve the knowledge management initiatives in the construction industry. Rezgui (2006) also explored a set of knowledge management services articulated around ontology and Web services model.

The above examples of research efforts present a snapshot of the extent of knowledge management research applied within the AEC industry. Starting from the 2000s much progress has been achieved in this area. However, almost all of these research projects are from the perspective of engineering and construction companies. Nevertheless, the discipline and

the practicing organizations of architecture are different from than those of the construction industry in terms of its size and conduct of business. Therefore, the issue of how architectural practices manage the sources and processes of their knowledge assets is still unknown.

In the AEC industry, architectural organizations are responsible from providing enormous amount of information in the collaborative project environment. Much of the construction works depends upon the work produced in the design stages. Architectural organizations organize the flow of knowledge and communication between clients and contractors, engineers and governmental bodies, office and construction site in order to provide construction site with valid and refined information. Architecture is a knowledge intensive business in that sense and therefore, managing architectural knowledge within the whole project life cycle is crucial. Due to the unique nature of architectural process, there is a need to explore the characteristics of knowledge and current strategies utilized in architectural organizations in order to develop better approaches.

Based on this short introduction, this research aims to identify the knowledge sources and methods of sharing, storing and deploying knowledge in the practice of architecture. Identifying the barriers and benefits of managing knowledge assets in the architectural practices is another important aim that was looked after.

ARCHITECTURAL DESIGN PROCESS AND KNOWLEDGE

Architectural process is heavily dependent on information about what is expected and how it can be accomplished. According to Kalay (2006), architectural design is an information-centric activity where current conditions of a being is analyzed and plans for new and better conditions of being are devised. Zisko-Aksamija (2008, 216) defines architectural design as a process, based on tacit knowledge, gained through education and experience. The author notes that architects and engineers also use explicit knowledge for the design, such as materials databases, building codes and specifications, manufacturer's catalogs, etc. In this context, the transmission between tacit and explicit knowledge in architectural design is inevitable and essential.

The nature of architectural design is a subjective matter that is contingent on many factors such as the type of project, the project site, the client and the architect. Many researchers agree that architectural process is the search for the best fitted solution for the given design problem which satisfies the client's needs, environmental expectations, and architectural standards. Zisko-Aksamija (2008, 223) claims that there is not a single formula to transform the performance requirements into an organizational assembly of building elements. One of the reasons for that is given by Lawson (2006) who suggests that problems and solutions in architectural design overlap each other in an unpredictable way. It is suggested that design process is an iterative activity and achieved solutions may generate new design problems until adequate requirements are satisfied. This cyclical practice is presented as the Marcus - Maver map of the design process by Lawson (2006, 37) in **Figure 1**.

Collecting data and information about the existing condition of a subject matter is imperative to define the constraints and possible solutions for a design problem. In order to access to the solution, several set of information sources need to be brought together and processed by the architect.

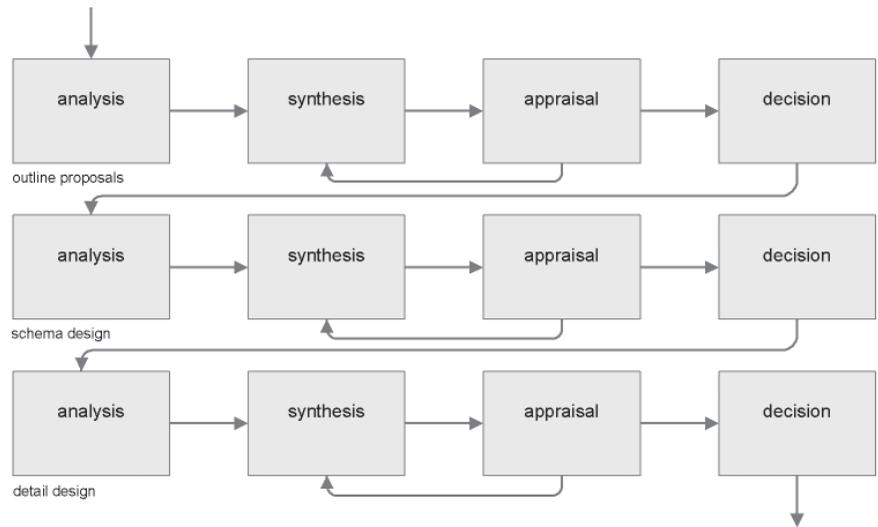


Figure 1. The Marcus - Maver map of the design process (Lawson, 2006, 37).

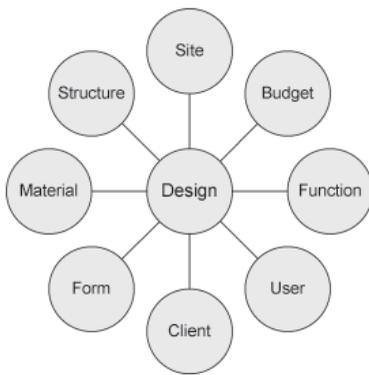


Figure 2. Factors affecting architectural design process (adopted from Zisko-Aksamija 2008, 224).

According to Zisko-Aksamija (2008, 223), the initial stage of architectural design is the collection of information such as a set of spatial, functional, economical requirements, and site conditions. Zunde and Bougdah (2006, 89) consider recording all the related material about project constraints in an organized and accessible way as a key activity in architectural design, as the reflection of this data leads to determination of critical internal factors on the design such as constraints on budget and time, codes and regulations and client requests. In this manner, architectural design can be defined as the interpretation of collected input into design solutions in the best possible way. Kalay (2005, 13) describes this process as a relationship between two paradigms: problem solving, where the designer analyzes problems and generates solutions, and puzzle making, where design is seen as discovery of parts are meant to be synthesized into a meaningful whole. Factors affecting the architectural design process are depicted in Figure 2.

In the literature, there are several methods of increasing, if not guaranteeing, the possibility of achieving a better design solution. These methods in general are meant to enable the designer to clearly see the external and internal constraints of a problem. In Duerk’s study (1993, 12), several frameworks for organizing design data are cited. First divides design issues into four categories: form, function, economy, and time. Second categorizes design issues as such: human factors, physical factors, and external factors. Third focuses on building up check lists for facts to be find out about the existing context and utilized the following categories: similar projects, client, financial, codes, planning by related organizations, function, site, climate-growth, and change. Duerk (1993, 12) proposes the use of design issues as the categories for organizing design information with facts, values, goals, performance requirements, and concepts.

The subjectivity of project information and the amount of tacit knowledge in the architectural process are challenges against the strategies for managing knowledge. Also, the seamless transfer of necessary knowledge to other parties requires a great deal of diligent organization. Duerk (1993, 8) claims that the process of managing knowledge in design process is vital for making the right kind of information available at the right time and stage of the process, and for giving the best possible decisions in the building design. It is apparent that architectural organizations can

benefit from systematic approaches towards knowledge considering the competitive environment, tight project schedules and the overall subjectivity which requires flexible organizations with quick decision making ability.

RESEARCH MATERIAL AND METHOD

This section presents the research material and the methodology used in collecting and analyzing the data. In order to have a clear explanation of the concepts, first, the population of the research study and the sampling method are explained briefly, and then, the framework which is developed for this study is given in details.

According to a recent research conducted by *The Architects' Council of Europe (ACE)* (ACE, 2008), there are 32300 registered architects and 6497 practicing offices in Turkey. The majority (78, 42%) of these offices include less than 5 people and the majority of the architects are aged under 40 (61%). With these figures, Turkey has the 4th largest number of practicing architects within the whole Europe.

In order to explore how architectural practices manage their knowledge resources, a questionnaire was prepared and published at the web site of the Chamber of Architects of Turkey. In spite of additional informative telephone conversations by the Secretary Member of the Ankara Branch, only 12 offices returned this questionnaire. In the second attempt, 16 extra responses were received from the three cities. Considering the number of practices in the three big cities (İstanbul, İzmir and Ankara) of Turkey (1669, 1127, 937 respectively), the response rate (0.75%) is considered very low. Therefore, the structured questionnaire approach was abandoned and the study was decided to be implemented in a more defined population.

Even though, conducting the survey in three main cities of Turkey would have provided more generalized findings, the conditions above had led the study to a local population. As a result of this, Çankaya District of Ankara was chosen as the community from which the selection of offices was to be made due to the high number of its architectural offices. Among the sample space of 211 architectural offices that were located in Çankaya District, 15 architectural offices were randomly selected which constitutes approximately 8% of the sample space.

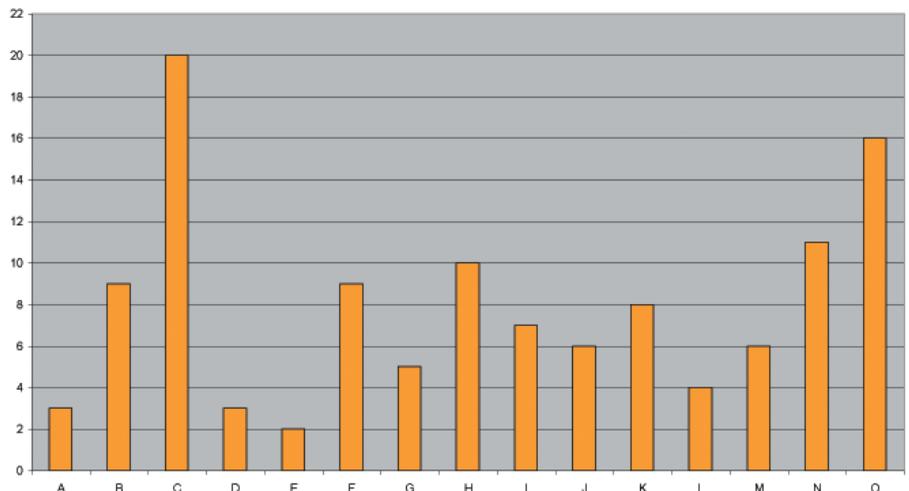


Figure 3. Number of personnel working in the selected organizations.

The architectural offices were selected from a list which was provided by the Chamber of Architects, Ankara Branch. The offices were arranged according to the registration number on the list and they were assigned numbers from 1 to 211. Then, every 15th office on the list was chosen and a selection of 15 offices was achieved.

Majority of the selected organizations had less than 10 staff. To illustrate, 5 of the offices include between 1-5 full-time working staff and 7 of the offices included between 5-10 full-time working staff (**Figure 3**). Depending on the literature survey, these offices were categorized according to their number of staff they have, as small (1 to 5), medium (6 to 10) and large (more than 10). Each office in each categorization is also given a number which is given along with the categorization initial (e.g. S₁, M₁, L₁).

The selected offices conduct business in different areas of architectural practice (**Figure 4**). All participant organizations have finished residential projects. 12 of them have also worked in commercial and public projects. Only 4 of organizations practice in sport facility projects and restoration.

Face-to-face interviews were carried out with the selected architectural offices in order to retrieve sufficient data on systematic and personal methods applied in the organizations. The main objectives of this survey were defined as:

1. To examine the knowledge resources of architectural organizations,
2. To observe the methods of managing architectural knowledge,
3. To evaluate the barriers and benefits of the knowledge management strategies.

The questionnaire consists of two major parts. The first part is including questions about participant information, company background and organizational setting. The second part is focusing on the management of knowledge and subdivided into categories as follows:

Knowledge sources

Knowledge sharing, storing and deployment mechanisms,

Barriers and benefits of knowledge-based strategies.

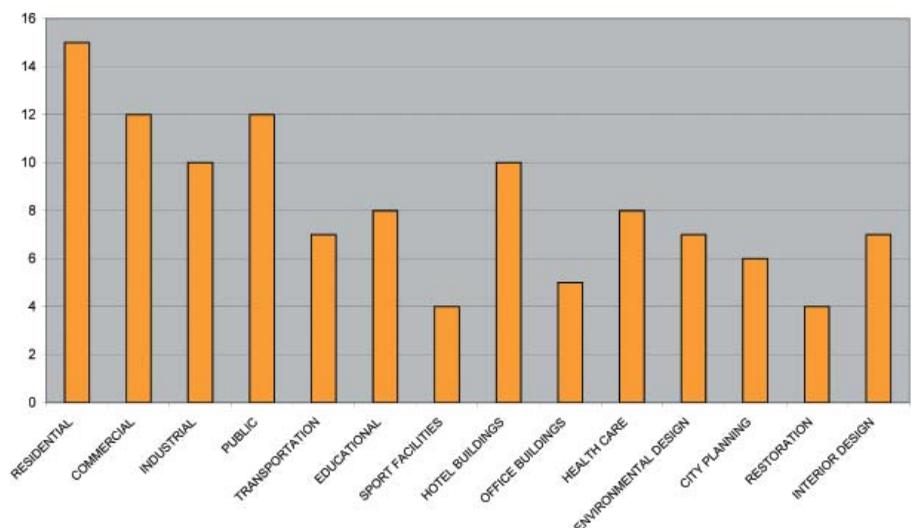


Figure 4. Scope of design project types by survey participants.

The questionnaire was designed according to a framework which is adopted and altered from the study of Dikmen et al. (2005). The original framework investigates the impact of organizational learning competency on the performance of construction companies. Main components of the proposed framework for this research consist of i) knowledge sources, ii) knowledge mechanisms and iii) organizational settings as shown in **Figure 5**. Knowledge sources are divided as internal and external learning sources. Knowledge mechanisms are tools that are used for the acquisition, storing, sharing and deployment of knowledge. Organizational setting consists of factors such as structure, culture and strategies that are developed within. Organizational knowledge is crucial for productivity and innovation in the architectural design process. It is assumed that, employees in an organization build up individual knowledge repositories prior to an organizational knowledge can be achieved. Knowledge mechanisms allow these single repositories to contribute into a more effective organizational knowledge. In the framework, it was assumed that mechanisms perform well when:

- the sources are utilized frequently and effectively,
- necessary mechanisms are used effectively to build the organizational knowledge,
- an appropriate organizational setting exists to support learning.

The questions in the second part aim to record both qualitative and quantitative data on the related subjects. For a better organization of the responds, the interviewees are asked to reply in 1-5 Likert-scale implying 'never' to 'very often' for use frequency of knowledge sources, 'very low' to 'very high' for availability of stored knowledge and importance of knowledge mechanisms and effectiveness of barriers and benefits.

In the framework, the vast phenomenon of architectural knowledge is attempted to be categorized in a systematic way which can allow the types of knowledge to be identified as tacit or explicit. The architectural knowledge is broken into three headings such as: (i) design knowledge, (ii) application knowledge and (iii) strategic knowledge.

The **design knowledge** is defined as the knowledge and ability, which are gained through education and practical experience that is necessary for conducting architectural design and generating project ideas and related products that are created during this process. In this type of knowledge, design constraints, design ideas, schemas, project estimates, drawings etc. are included.

The **application knowledge** is consisting of general building knowledge that is necessary for realizing the design ideas into real life products. In this type of knowledge, unit costs, productivity, equipment and applied methods are included.

The **strategic knowledge** is the sum of all knowledge that enables organizations to conduct their business which is necessary not only for architectural offices but all types of business. In this type of knowledge, information about employees, clients, contractors, competitors and country-market are included.

The types of knowledge determined in the framework are questioned while investigating about knowledge sources and mechanisms. In the arrangement of knowledge acquisition, knowledge sharing, storing of

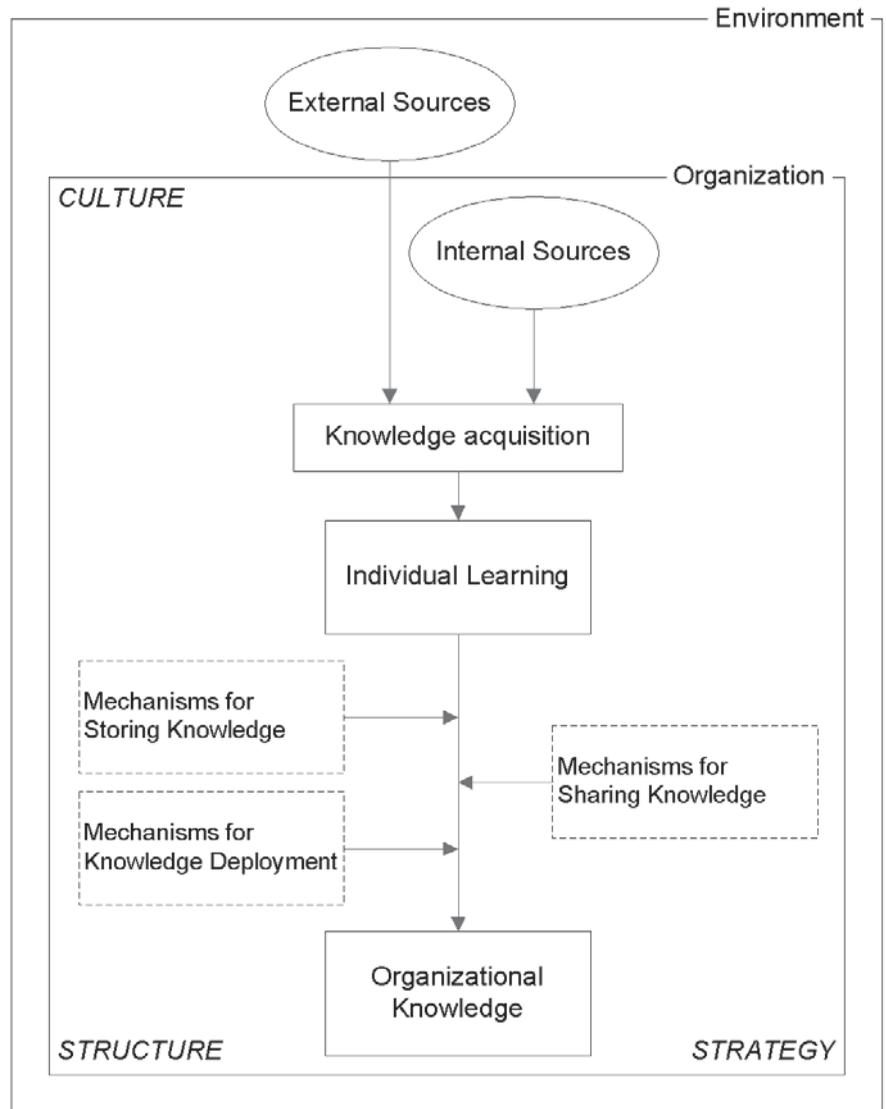


Figure 5. Organizational knowledge management framework (adopted from Dikmen et al., 2005, 170).

knowledge and deployment of knowledge, it is aimed to analyze the flow of each knowledge type given as design knowledge, application knowledge, and strategic knowledge in the architectural offices. Assuming the nature of knowledge in the given types range from tacit to explicit in the given order, it is also aimed to observe the effect of nature of knowledge in the management of knowledge.

SURVEY RESULTS

The survey results are examined in three main parts. Part I examines the learning process in the practice of architecture. Part II investigates the knowledge sharing storage and deployment mechanisms. Lastly, Part III identifies barriers and benefits of managing architectural knowledge.

Part I: Knowledge Sources

In the first part, the individual learning sources, learning from other parties and organizational learning mechanisms have been examined. Individual learning and learning from other parties are dependent on external

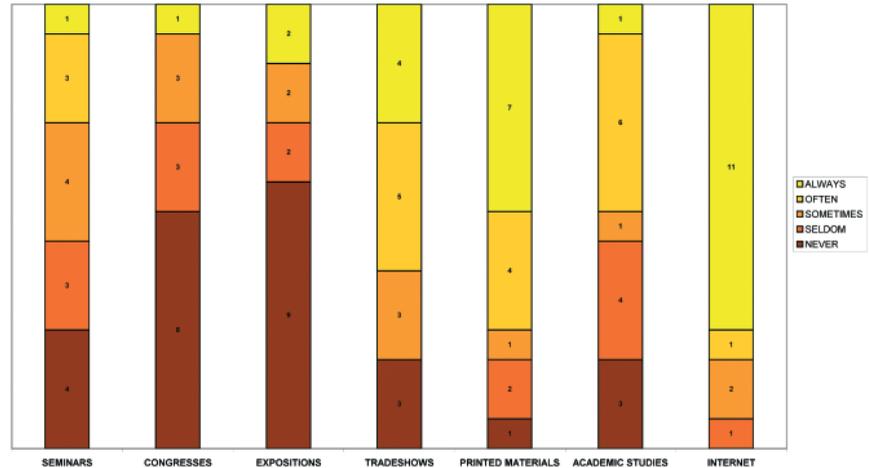


Figure 6. Individual learning sources.

sources or groups. Sources identified for individual learning are seminars, congresses, expositions, tradeshow, printed materials, academics studies and Internet. Groups identified for learning from other parties are clients, partners, competitors, universities, consultants, governmental and non-governmental bodies and foreign organizations. Organizational learning includes activities such as benchmarking and project evaluations where information is derived from internal sources.

I-A. Individual Learning Sources

The survey results (**Figure 6**) indicate that Internet is considered as the most frequently used individual learning source. 12 out of 15 organizations agree or strongly agree that the use of Internet is important in collecting information on projects, communicating with producers and firms, accessing material knowledge and receiving information on project applications. Internet is considered as the most practical resource for organizations to access information. For example, organizations S_1 and S_5 define Internet as a source of “more information in less time and space”.

In spite of its advantages, organizations need to identify how they can benefit the most from the sources on Internet. It is clear that the amount of time to locate information and the space needed for storage of this information are important issues. On the other hand, Organization M_4 claims that the comfort of Internet drives individuals through making narrow research on issues and be satisfied with those available on Internet. Similar to this opinion, Organization L_2 suggests that with the amount of information and orientation, it is not hard to get distracted and end up with less useful information for your cause.

Organizations agree on the fact that the emergence of the Internet has hindered the usage of the printed material. When the interviewees are asked to compare the printed material with online sources, Organizations S_2 , M_4 and M_5 suggest that there is a tendency of not trusting the validity of information on the Internet, so that printed materials prove to be a more dependable source in that sense. 11 out of 15 organizations agree or strongly agree that printed materials are the main sources of knowledge. Organization M_2 mentions that while general information is abundant throughout the Internet and websites, it is hard to spot information on specialized issues such as materials and applications. Besides, architects habitually utilize some of the standard books and catalogues at any phase

of the design process, so it is evident that printed materials are valued. It is also observed that, organizations which prefer printed materials as the main sources of knowledge tend to use Internet as a means of rapid communication. Organization L₃ gives a brief of this situation by stating that “in general, we utilize Internet for receiving bidding information and procedures, find general detailing and applications in websites of other firms, and research publications for specialized issues in architectural projects”.

Other than printed or online sources, tradeshow are observed to be preferred by 9 out of 15 organizations as useful information sources in order to “have the feeling” of advances in the AEC industry and “see with their own eyes” how the applications are made. 3 organizations emphasize the importance of experiencing the matter in real life and agree that this experience is more valuable in some ways than those of other sources.

By 4 organizations, project competition expositions are considered as perfect occasions to interact and share knowledge with colleagues and specialists. As defined by Organization M₄, “architects are a group of professionals who can gather and discuss in a critical manner in ease”. The organizations agree that they get the chance to compare themselves with other architects, receive comments and critiques on many dimensions of projects and improve themselves at all directions. One of the interviewees with a part-time academic position emphasize on the benefits of student jury seminars by claiming that “one way of keeping yourselves updated is evaluating 80 projects a semester”. The interaction with young candidates of architecture is considered as an important means of receiving fresh information.

I-B. Learning from Other Parties

Architectural organizations are regulated by professional and governmental bodies, dependent on construction industry and provide service for clients in public or private sector (Emmitt, 2007, 173). The survey results (Figure 7) are implying these facts as the top three parties that organizations are in frequent communication are clients, partners and governmental bodies.

Clients and partners are considered as essential information sources throughout the whole project processes. 14 out of 15 organizations confirm that they communicate with clients frequently and 11 out

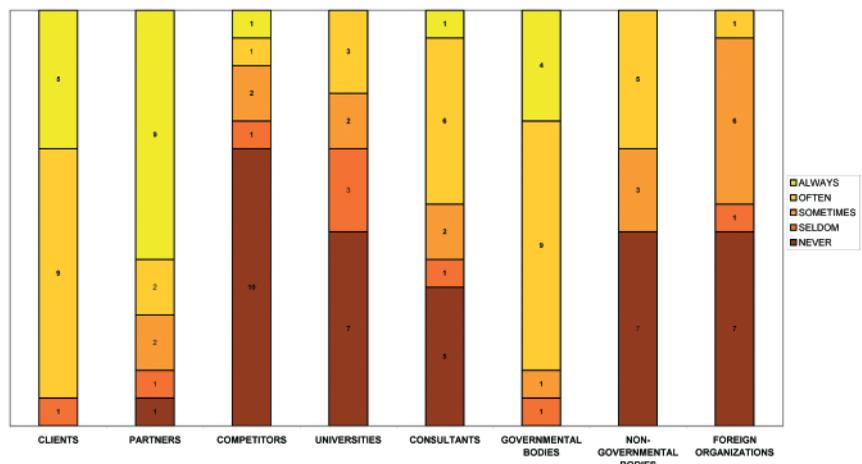


Figure 7. Learning from other parties.

of 15 organizations suggest partners as a regularly utilized source. Organization S₁ and S₄ clearly inform that they “record every bit of information received from clients as it is not predictable when you may need them”. Organization S₃ and M₅ add that it is also important to lead the clients rather than merely sharing ideas. Organization M₅ proposes that architects should be able to evaluate clients and be capable of giving future development plans, just like an image maker. Organization S₄ points out that this communication is limited by the knowledge collection of the clients, which is also referred as the effect of shared knowledge in communication. Consequently, the client affects the amount and quality of the information.

Organization M₁ defines governmental bodies as “the greatest client due to the amount of project works, material information, application experience and rights”. Depending on the client profile, the frequency of communication varies among organizations but all organizations make use of government repositories for receiving regulatory information. 13 out of 15 organizations agree or strongly agree that they frequently communicate with governmental bodies for several reasons such as receiving bidding information, updating regulations, etc.

The collaborative working environment in architectural projects is mentioned by most of the organizations. The necessity of cooperating with other groups in architectural projects such as partners and consultants is emphasized. 11 out of 15 organizations consider project partners as one of the most communicated group within the project environment. 7 out of 15 organizations refer to consultants frequently for dealing with specialized issues. Organization L₂ expresses the vitality of working with specialists by repeating a local phrase which suggests working with experts regardless of cost. The architects of organizations M₂, M₆, L₂ and L₃ agree that they are not meant to provide every bit of information and application for building projects and leverage the importance of consultants.

While communication with other parties proves to be important for organizations, interaction between architectural offices seems to be problematic and rely on personal relationships due to several factors. Only two organizations claim that they are sharing knowledge with competitors frequently. Organization S₅ and M₅ emphasize the importance of sharing best practices with their competitors for the sake of architectural industry, especially in restoration, by saying that “there is no better way of learning than experiencing problems on site and no single architect can experience them all”. The intentions are noble and reasonable but Organization M₄ and M₆ refer to the lack of legal regulations on the transmission of intellectual property rights, trademarks, and copyright issues. Even though, the lack of collective studies and sources is considered to be a major problem by most organizations, Organization M₄ admit that they rejected to contribute to a database project on application details lead by the Chamber of Architects due to similar reasons.

I-C. Organizational Learning Mechanisms

Most of the organizations claim that they improve their knowledge repositories mainly through the evaluation of projects during or after the design process. According to the results (**Figure 8**), 11 out of 15 organizations prefer after-action reviews for evaluation during projects and 10 out of 15 organizations utilize post-project appraisals as a method of collecting information on their projects. The common reason given by

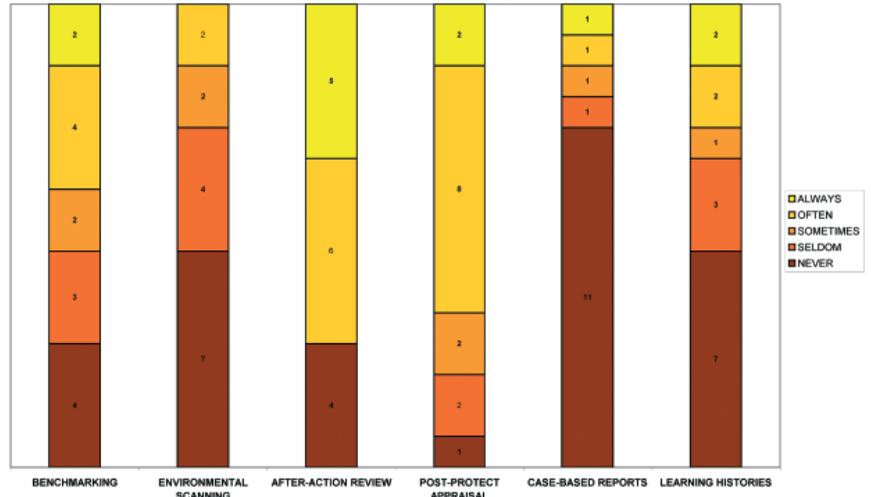


Figure 8. Organizational learning mechanisms.

interviewees neglecting during and/or post project appraisals is the lack of time. Either, the offices claim that they barely have time to finish and submit their projects during the design phase, or they immediately focus on the next project and delay general project evaluations.

Eleven out of 15 organizations state that they collect and create knowledge mostly during the project design with after-action reviews by continuously evaluating right after problems and revising for better solutions. Organization M_4 and L_2 suggest that the evaluation during project design focuses on the partial solutions and implementation in the projects and claim that this is an almost reflexive method used in project designing. Due to the nature of this ad-hoc method, Organization L_2 implies that the information collected is at best contributing to the experience of architects but cannot be recorded. Organization S_3 , S_5 , M_5 , L_2 and L_3 champion the benefits of project consultancy during the construction phase. Sharing more time on the project by also shouldering the consultancy service, they admit that they receive valuable experience and application information which can be recorded in a more formal manner but also they become capable of providing better solutions for the real-life product.

Post-project appraisals are frequently utilized by 10 out of 15 organizations in order to collect information in an organized manner and share time for archiving their projects for re-use in the future. Organization M_4 and L_2 claims that general findings that are easier to document can be achieved by this method. It is observed that organizations have developed different methods for this activity. While some methods can be considered as organized, other methods are very personal and unique in their own. Organization L_1 states that they build two-men teams from architectural, static and mechanical personnel in order to update their archives after projects. Organization L_2 has a more personal approach for post-project appraisal and prefers spending time in the finished projects and interacts with users to share their feelings in person.

In the survey, it is observed that organizations tend to rely on their archive of projects and drawings but do not spend adequate time to prepare evaluation documentation on their projects. Only 2 out of 15 organizations agree or strongly agree that case-based project articles (collection of similar cases) are frequently used and only 4 out of 15 organizations generate learning histories for their projects on a regular basis. Due to the nature

of restoration works, Organization S₅ and M₅ state that they record and document application information and information about material in several forms, written and in photo albums. Though, Organization S₅ admits that “procedures in the projects done have remained in our minds. We couldn’t transfer this experience to some sort of media, no further than daily conversations and chats. I feel a need of writing down this experience of mine; it is not easy to earn practical knowledge”.

Seven out of 15 organizations admit that internal benchmarking is futile due to several reasons such as economical problems, lack of time, high churn-rate of staff, unpredictable market conditions and project volume. But it is observed that, architectural offices are in close relation with each other and naturally performing competitive benchmarking in order to improve themselves. Organization M₄ claims that they compare themselves with other offices in “not an ambitious, but in a critical yet appreciating manner”.

Part II: Knowledge Sharing, Storing and Deployment Mechanisms

In the second part, knowledge sharing, storing and deployment mechanisms have been examined. While observing in the methods of knowledge sharing, the media preferred to share knowledge is also examined. The use of information technologies are also questioned in the storage and deployment of architectural knowledge.

II-A. Knowledge Sharing Mechanisms

According to the survey, organizations share their knowledge mainly through social communication within their office and utilize some basic electronic communication tools (e.g. instant messaging, e-mail) frequently within and out of their organization. While, all organizations claim they prefer both methods for sharing knowledge, 14 out of 15 organizations strongly agree that social communication is the most frequently used method. All of organizations agree or strongly agree that electronic communication tools are utilized the most (Figure 9).

As mentioned previously, the amount of tacit knowledge in architectural design process renders the social communication as the main method of transferring information and also an enabler of other sharing methods to perform efficiently. Though, it should also be noted that the scale of

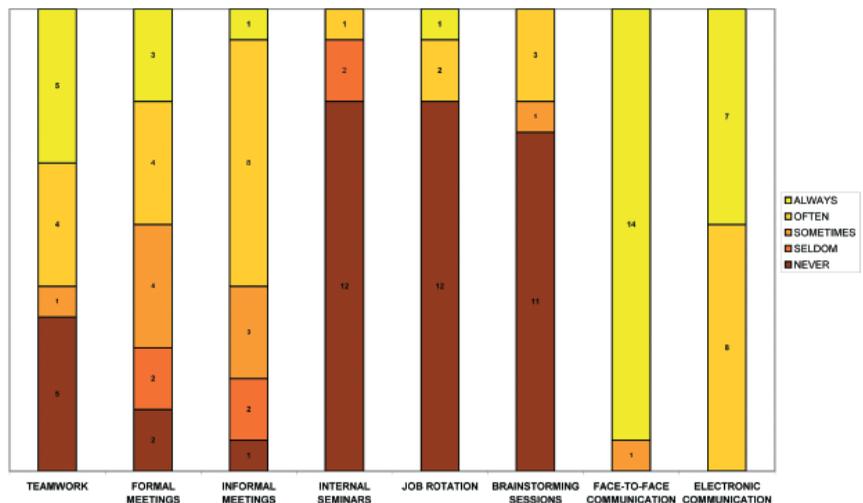


Figure 9. Knowledge sharing mechanisms.

the participant organizations are very small, so the need for organizing the transfer of knowledge within the offices is not as crucial as large organizations.

Social communication is also vital for the training of employees within the organizations. Organization M₆ applies training sessions in which office standards and architectural drawing standards are given to employees. Organizations M₅ and L₂ utilize a mentor-apprentice relationship to train their employees up to a satisfying level. Other than specific applications, all organizations mention the importance of training through project design in time and leverage the value of social communication within office.

All participant organizations are observed to make use of electronic communication tools very frequently in some ways. Due to the fact that AEC projects are realized by collaboration of multi-disciplinary teams, the most common way of usage among the participant organizations is the rapid information transfer between partners and engineers.

II-B. Knowledge Accumulation and Dissemination Mechanisms

The results of the survey (Figure 10) indicate that organizations are utilizing printed and electronic media as the main mediums of storing their knowledge. Besides the printed material in their library, organizations tend to keep important documents such as notifications, mails, intermediate and final products on paper. Other than these, all organizations except Organization S₅ agree on that their digital archive has become larger than the paper archive. It is seen that projects generated in CAD programs are all archived in digital media and printed versions are also stored for administrative purposes.

The accumulation of knowledge in digital format has been facilitated by CD-DVDs, external hard disks and mobile disks. Several organizations claim that they maintain the continuity of their files by updating their mobile disks daily. None of the organizations have an archive specialist or a similar position, consequently in most organizations; it is the responsibility of group leaders and technical personnel to maintain the security and validity of files. In both paper and electronic documentation, ad-hoc methods that are heavily specific to each organization are preferred for locating the stored knowledge. Basic catalogue and categorization systems are the most common approaches for organizing archives.

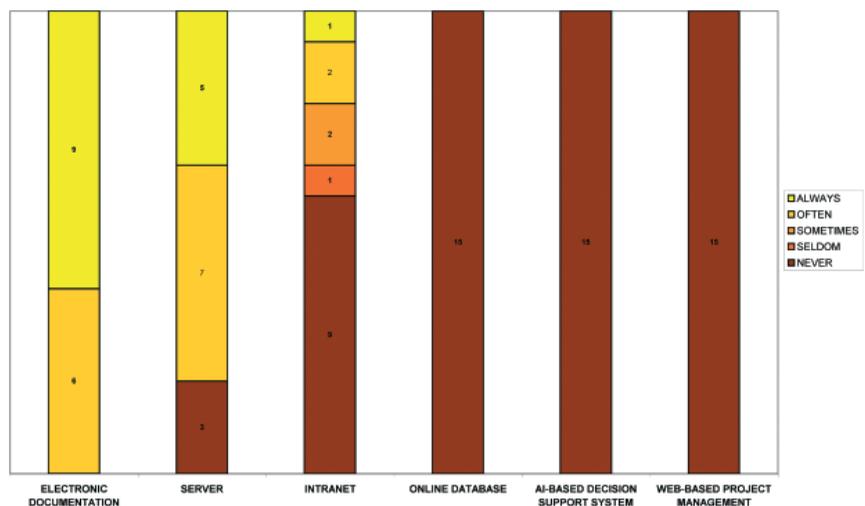


Figure 10. Knowledge ‘accumulation and dissemination’ mechanisms.

All of the organizations agree or strongly agree that they prefer electronic documentation as a means of storing and deployment of knowledge. However, few organizations have a structured system for organizing their archives. Only 6 organizations claim that they have a catalogue of displaying the locations of files. Most of the organizations depend on their tacit knowledge for retrieving necessary information. In general, technical personnel is comfortable with finding information that they have been responsible from, but it is one or two individuals who knows what is where. Although, categorization of files according to project type, name and date are observed, it is apparent that more thorough and practical systems are required for the organizations to fully utilize their knowledge repositories.

Twelve out of 15 organizations utilize servers in their offices to share and reuse their information. Due to their very small scale, three organizations do not consider it necessary. Servers are utilized for rapid sharing of information within office and accessing distributed knowledge with ease. While, most organization prefer evaluating project drawings on paper, Organization L₂ utilize their server as a simultaneous control method in design process. The head architect checks the drawing files located on server while technical employee continues on working on the same file. This is claimed to be a practical method which saves time. It should be noted that most organizations consider computer-based evaluations of projects as a disadvantageous method since excessive amount of details are stored in CAD drawings. It is not easy to grasp all these details from the computer screen. As a result of this, most organizations prefer paper-based project evaluations.

According to the survey, advanced knowledge deployment methods such as online databases, AI-based decision support systems and web-based project management systems are not utilized by any organization. Intranet, which is considered as a major enabler in knowledge management, is preferred by only 3 organizations as a frequently used method. Organization M₄ utilizes a common mailing space for each project to communicate with employees and engineers. Organization L₃ provides an area of digital space in their computers accessible via Internet. Organization S₄ makes arrangements and planning in their web space.

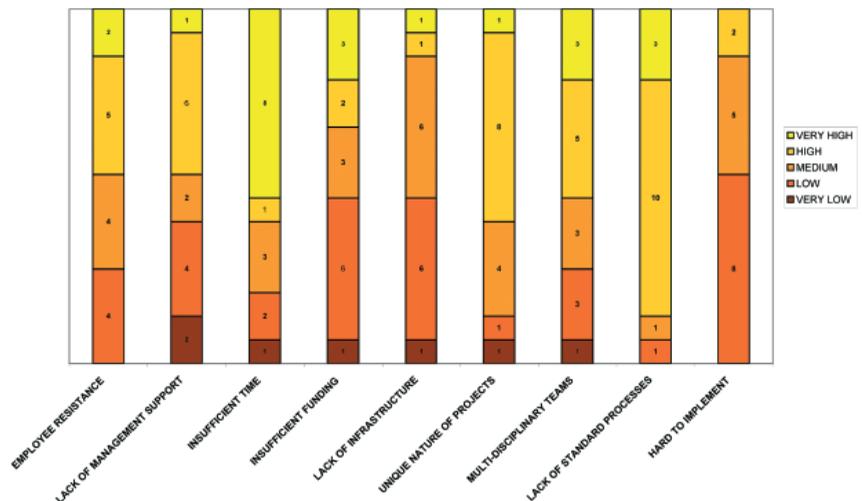


Figure 11. Barriers of managing architectural knowledge.

Part III: Barriers and Benefits of Managing Architectural Knowledge

Barriers and benefits of managing architectural knowledge have been examined in the third part of the survey. The organizations were provided with common knowledge management barriers and benefits and their opinions were analyzed.

III-A. Barriers of Managing Architectural Knowledge

The results of the survey (**Figure 11**) indicate that 13 out of 15 organizations consider lack of standard processes as the main barrier against managing architectural knowledge. Insufficient time and unique nature of architectural projects are regarded as strong barriers by 9 out of 15 organizations. The lack of management support and employee resistance is mentioned as effective barriers by 7 organizations. None of the organizations neglect the effect of employee resistance. This implies that organizations are willing to alter the way they manage knowledge, but also are aware that this is only possible with the support of their employees. Furthermore, it is observed that 14 out of 15 organizations consider lack of time as an equally or more effective problem when compared to the funding of knowledge management implementations. The effect of insufficient time is also apparent in the fact that there is not enough documentation of collected knowledge.

Thirteen out of 15 organizations strongly agree that the lack of standard procedures, information formats and clearly defined norms in architectural applications as the main barriers of managing architectural knowledge. Organization M_1 claims that there is no methodology of managing knowledge in the architectural industry and Organizations S_2 , M_1 , M_2 , M_5 and L_2 add that the scarcity of collective knowledge resources affects the accessibility of desired knowledge negatively. Organization S_3 and M_2 also mentions the burden of accessing the vast number of resources in several formats to gain due knowledge. Organization S_3 , M_6 and L_1 complains about the rapid changes in the resources and content of information, which renders collecting and archiving knowledge very hard and exhausting due to the need for continuous checking and updating. Also, working with the multi-disciplinary teams is regarded as an effective barrier by 8 out of 15 organizations. According to these organizations, collaborative working environment with several parties enhance the problem of lack of standards even more crucial. Organization M_4 states that "organizing and coordinating parties from different disciplines is already a huge, time wasting responsibility on the architect, and when there are no standards for activities, the problem grows even more". Despite the fact that organizations solely attempt to standardize their activities, these attempts would remain very specific to each organization. Organization L_2 compares the availability of regulation books and standard catalogues in Turkey with those in foreign countries and states that the gaps in regulations and undefined building applications are the origins of lack of standards. Organization M_5 points out the absence of building institutions which can provide an across-the-board definition for design activities and information.

The low-profit margin, when compared to the effort spent in the architectural industry, is considered as the major problem in not providing due time and funding for managing activities. Only one organization neglects the lack of time and funding as barriers against knowledge management activities. 4 out of 15 organizations (S_4 , M_4 , M_6 and L_2) strongly emphasize on the low ratio of profit to project amount in Turkey.

Organization S4 claims that architects produce the largest amount of information in construction project life cycle, bearing most of the responsibility and in charge of the coordination. The interviewee states that the lack of appreciation of drawings and services given by architects in the industry causes the unfair distribution of profits among the AEC groups. Organizations M₃ and L₂ agree at this point and adds that the absence of professional union structures in architectural industry. The interviewees suggest that the low profit and payments also causes short-term job relations, increase the turn-over rate and hinders the investments made on knowledge management. According to the survey results, it is apparent that time and funding are major problems within offices, but when results for both barriers are compared, only 5 out of 15 organizations consider insufficient funding as a significant factor. This implies organizations are willing to invest in knowledge management for the sake of possible benefits.

Organizations agree on the fact that application of knowledge management systems is easier than the implementation phase. While, only 2 out of 15 organizations consider the application of knowledge management systems as a major problem, organizations emphasize on the need for professional support on implementation phase. Organizations M₂, M₆, L₂ and L₃ suggest that archive specialists and IT managers are required for a better arrangement of organizational knowledge at the beginning.

III-B. Benefits of Managing Architectural Knowledge

The results of the survey (Figure 12) indicate that all the organizations identify the benefits of knowledge management systems. Fourteen out of 15 organizations believe that the main benefit of managing architectural knowledge is the increased productivity within the office. Twelve out of 15 organizations mention the enhanced employee satisfaction as a major benefit. Eleven out of 15 organizations consider the decrease of re-work as a significant benefit. It is observed that organizations leverage the support of knowledge management as an improvement on the office activities and internal issues. On the other hand, the participants show hesitation on the possible increase on profit and emerge of innovation in design solutions where 6 organizations agree with former and 5 organizations agree with the latter. Also, due to the fact that client satisfaction is regarded as a major

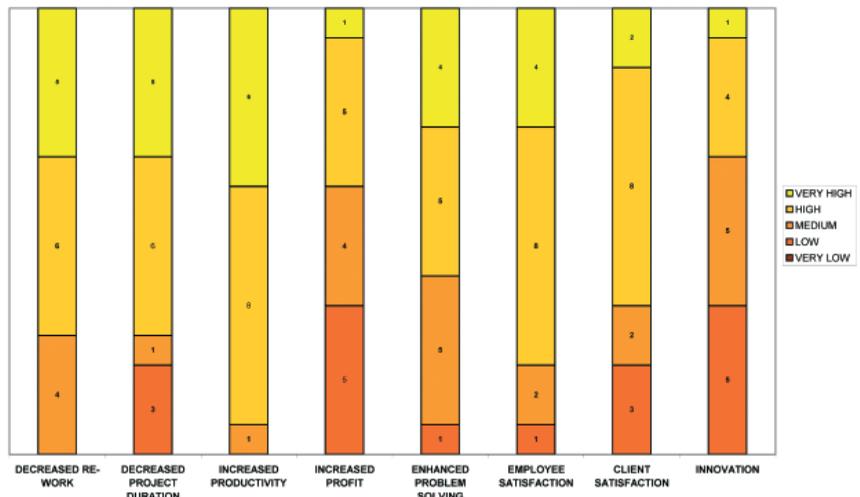


Figure 12. Benefits of managing architectural knowledge.

benefit by a lesser portion of organizations, by 10 of the organizations seem not to be expecting much appreciation from outside but are eager to see developments within their offices.

This situation can be related to several factors. Firstly, there is a common opinion among the organizations on the underestimation of the design works in the construction industry. The general depreciation of governmental institutions regarding the knowledge assets does not allow organizations to increase their profits even if they enhance their productivity. Organization S₄, M₄, M₆ and L₂ criticize the perspective of government and clients toward design works and point out that there are no regulations on competitive advantages they may gain from increasing their performances, volume of works or establishing a long-term company. Secondly, the interviewees also agree that in the profit-oriented construction industry, the clients are merely interested in the architectural quality and at any cost, they are going to reject appreciating their works as default.

In the survey, there is not a consensus on whether knowledge management can bring innovation to design or not. While, 5 organizations agree or strongly agree that innovation in design can be expected as a benefit, 5 organizations claim otherwise. One of the reasons for this opinion is that the technological advances, such as CAD tools, have only brought quickness to production up to now. This has enabled the production of project documents faster than ever and decreased the project durations but it has also shortened the deadlines given by the public or private clients. As a result, the amount of time required for designing has decreased without much gain. Organizations S₅ and M₅ suggest that this condition has brought standardized design solution with less quality.

Statistical Tests Regarding the Survey

According to the survey results, three hypotheses were presented in this study. In order to evaluate the validity of these hypotheses, paired sample t-tests were applied (Neter et al., 1992, 404-5). Three main hypotheses proposed for further evaluation were as follows:

Hypothesis I

Null Hypothesis: There is no significant difference between the effects of barriers and benefits of knowledge management on organizations.

Alternative Hypothesis: The benefits of knowledge management are considered to be more effective than barriers.

(H₀: $\mu_1 = \mu_2$, H_A: $\mu_1 > \mu_2$ where μ_1 = benefits, μ_2 = barriers)

Hypothesis II

Null Hypothesis: There is no significant difference between the effects of external barriers and internal barriers of knowledge management on organizations.

Alternative Hypothesis: The external barriers of knowledge management are considered to be more effective than internal barriers.

(H₀: $\mu_1 = \mu_2$, H_A: $\mu_1 > \mu_2$ where μ_1 =external barriers, μ_2 =internal barriers)

Hypothesis III

Null Hypothesis: There is no significant difference between the effects of internal benefits and external benefits of knowledge management on organizations.

Alternative Hypothesis: The internal benefits of knowledge management are considered to be more effective than external benefits.

($H_0: \mu_1 = \mu_2$, $H_A: \mu_1 > \mu_2$ where μ_1 =internal benefits, μ_2 =external benefits)

Hypothesis I: Comparison of barriers and benefits of knowledge management on organizations.

Knowledge management is a recent phenomenon and most of the implementations are at an experimental and immature stage. For an organization to facilitate a systematic approach, the will and support of top management is extremely important for the further development of knowledge management activities. According to the survey, it was seen that the effect of barriers against knowledge management was not regarded as significant as the possible benefits by the executives of the organizations. According to two sample dependent Student's t-test, t-stat for the sample data was calculated to be ± 2.552 ($\pm t_{0.05(14)} = \pm 1.761$). The null hypothesis which implied that the effect of benefits of knowledge management is equal to that of barriers was rejected at the 5% level of significance. Also, the significance value (p-value) was less than 0.05 ($p = 0.023$). The \bar{D} value ($\bar{D} = -0.474$) enabled us to determine that the effect of benefits was greater than that of barriers. The test results implied that the benefits of knowledge management had significant effect on architectural organizations. Taking into the account of the fact that architects were already shouldering the responsibility of organizing different parties in projects and dealing with a large amount of information, it can be claimed that they were experienced in dealing with given barriers.

Hypothesis II: Comparison of external barriers (e.g. insufficient time, lack of standard processes, multi-disciplinary working environment and unique nature of projects) and internal barriers (e.g. employee resistance, insufficient funding, hard implementation of knowledge management and lack of top management support and infrastructure) of knowledge management on organizations.

It was observed that organizations were emphasizing more on barriers related with AEC industry, but they considered barriers originating from their office less effective. In order to analyze this condition, a hypothesis was proposed which claimed external barriers such as insufficient time, lack of standard processes, multi-disciplinary working environment and unique nature of projects were considered as more effective than internal barriers such as employee resistance, insufficient funding, hard implementation of knowledge management and lack of top management support and infrastructure. According to two sample dependent Student's t-test, t-stat for the sample data was calculated to be ± 3.248 ($\pm t_{0.05(14)} = \pm 1.761$). The null hypothesis which implied that the effect of external barriers of knowledge management is equal to that of internal barriers was rejected at the 5% level of significance. Also, the significance value (p-value) was less than 0.05 ($p = 0.006$). The \bar{D} value ($\bar{D} = -0.763$) enabled us to determine that the effect of external barriers was greater than that of internal barriers. The test results implied that external barriers had significant effect against the knowledge management.

Hypothesis III: Comparison of internal benefits (e.g. productivity, decreased re-work, enhanced problem solving, and employee satisfaction) and external benefits (e.g. client satisfaction, decreased project durations, increased profit, and innovation in design) of knowledge management on organizations.

When benefits of knowledge management was analyzed according to categorization such as being internal and external, internal benefits such as productivity, decreased re-work, enhanced problem solving, and employee satisfaction were considered as more effective than external benefits such as client satisfaction, decreased project durations, increased profit, and innovation in design. According to two sample dependent Student's t-test, t-stat for the sample data was calculated to be ± 4.153 ($\pm t_{0.05(14)} = \pm 1.761$). The null hypothesis which implied the effect of internal benefits of knowledge management is equal to that of external benefits was rejected at the 5% level of significance. Also, the significance value (p-value) was less than 0.05 ($p = 0.001$). The \bar{D} value ($\bar{D} = 0.633$) enabled us to determine that the effect of internal benefits was greater than that of external benefits. The test results implied that internal benefits had significant effect on architectural organizations.

DISCUSSION

This survey provided a general overview of knowledge management in Turkish architectural practices. The findings are discussed based on the following three sections mentioned in the survey: i) knowledge sources, ii) Knowledge sharing, storing and deployment mechanisms, and iii) Barriers and benefits of knowledge management.

Knowledge Sources

Architectural organizations value collecting knowledge and updating their knowledge repositories from different sources. Internet and publications, in this respect, are observed as the main external sources that architectural organizations focus. Also, governmental bodies, partners and clients are the external groups which organizations communicate frequently to share information. On the other hand, it is seen that the activity of searching and validating of knowledge are exhausting. Due to the advances in communication, the amount of knowledge and number of sources are tremendously increasing. The lack of standards in architectural processes causes the sources to be in different formats and conflicting with each other time to time. The scarcity of collective sources, either accessible online or in printed material, is the main obstacle in this aspect. Governmental and non-governmental institutions must put due effort in generating sources which can ease the process of collecting knowledge.

Beside the external sources, architectural organizations generate significant amount of knowledge in projects. They retrieve this knowledge mainly through process-based project learning (after-action reviews and post-project appraisals). On the other hand, documentation-based project learning (cased-based articles and learning histories) are not frequently utilized due to lack of time. Process-based project learning methods generate tacit knowledge for architects, but in order to have explicit sources which can easily be shared, organizations should focus on preparing evaluation documentation for their projects.

1. Knowledge Sharing, Storing and Deployment Mechanisms

Due to the collaborative working environment of architectural projects within and out of office, social communication and electronic communication are main communication methods for sharing knowledge. Architectural design process includes considerable amount of tacit knowledge, which means that sharing tacit knowledge such as social communication, teamwork and meetings are commonly utilized. Even

though, training is a crucial aspect of knowledge management strategies, architectural organizations prefer ad-hoc methods for improving their employees while working in projects. Methods such as utilizing preset standards and leading new employees through useful job rotations could be utilized more frequently for a good start-up in sharing knowledge.

Even though, storing of knowledge is suggested as very important, advanced tools for storing and deployment of knowledge are not implemented by organizations. Electronic documentation depending on specific categorization to each organization is preferred along with servers for supporting the deployment of knowledge. Intranet, which is introduced as an essential enabler of knowledge management strategies, is used by a small ratio of organizations. For better deployment of stored knowledge, architectural organizations may seek for appropriate tools such as data miners, project management software. Also, collecting and archiving architectural knowledge may be embedded into daily activities of all employees with the monitoring of appointed specialists (e.g. archivist or IT specialists).

2. Barriers and Benefits of Managing Architectural Knowledge

Throughout the survey, it was observed that the participant organizations emphasize the importance of managing architectural knowledge and claim that improvements can be made within their offices. In the previous sections, it is mentioned that organizations consider possible benefits of knowledge managements more effective than barriers against this activity. Moreover, it is seen that organizations expect internal benefits within their offices but neglect external benefits that are related with end-products and rewards. On the other hand, organizations put emphasis on barriers that are related with the AEC industry more than the barriers related with their organizational wheels. In the following section, barriers and benefits are discussed as internal and external factors.

2a. External and Internal Factors

According to survey results, organizations believe that knowledge management provides advantages in managing architectural practices more efficiently. However, it is observed that the expected value from this activity is linked more strongly to internal benefits such as productivity, decreased re-work, enhanced problem solving, and employee satisfaction. External benefits such as client satisfaction, decreased project durations, increased profit, and innovation in design, on the other hand, are less important.

When we observe the reasons behind this difference between the value derived from internal versus external benefits, it is seen that internal barriers (such as employee resistance, insufficient funding and hard implementation of knowledge management, lack of top management support and lack of infrastructure) are claimed to be easier to tackle by most organizations. On the contrary, the external barriers related to architectural industry (such as insufficient time, lack of standard processes, multi-disciplinary working environment and unique nature of projects) are considered as the main factors that are hindering possible benefits of knowledge management. The survey results imply that organizations are significantly affected by these external factors and thus they may not reflect their organizational values and performance to architectural design and overall profit as expected.

Further analysis of this issue reveals a common shared problem of architectural practices in Turkey. The participant organizations refer to the lack of large-scaled architectural organizations with *established institutional settings* in the AEC industry.

2b. Institutionalization

Organization A defines the problem very clearly: "Knowledge is limited by the continuity of the architect himself. Unfortunately, there may not be much difference between organizational knowledge and personal knowledge in our industry." 7 out of 15 organizations agree that the lack of large scale architectural firms and the related lack of institutionalization have profound effects against a knowledge-based architecture environment. Organizations link the origins of this problem to the current characteristics of the AEC industry in Turkey.

Currently, most of the organizations in architectural practice are very small scaled (1-5 architects) and more than half of them are individual proprietorships (Emmitt, 2007, 172). This suggests a strong link between company and head architect. The head architect determines the quality / quantity of the knowledge repository and also the life span of the company. For healthy management of knowledge, there should be a distinct organizational knowledge repository and adequate time for knowledge-based strategies to generate results. According to Tolbert and Zucker (1996, 180-1), institutional organizations are defined as a development of shared definitions of empirically generated behaviors by types of actors. The authors state that these behaviors are generalized in such away that they become independent of the specific individuals who carry out the action. These organizations can also maintain the continuity of corporate identity. Institutionalization may hence provide adequate resources for architectural organizations to overcome some of the obstacles originated from AEC industry.

Through the survey, it is suggested that the most important aspect of knowledge management is to transmit organizational knowledge beyond individuals and generations. On the other hand, the greatest barrier against knowledge management is the discontinuity of architectural offices. This occurs when executive architects may not continue working or when the architectural office cannot maintain doing business due to economical reasons. Architectural offices tend to shrink when they face an economical situation due to lack of capital and unpredictable work volume. For a healthier business environment, the architectural organizations should embody large scale legal entities that are strong in economy and workforce with a long life-span. In the past, many qualified Turkish architectural offices have been dismissed due to the retirement of head architects. When compared to foreign countries, several architectural offices have managed to survive in similar situations by building up an institutional language, commitment to organization and unique knowledge repository. These features are also considered as the requirements to generate an architectural style that is specific and identifiable.

Architectural organizations may benefit from an institutional setting in the design process. Recording all activities in a process with defining better job and activity descriptions, organizations have a greater control on all aspects including the design process. Removing excessive subjectivity on how activities should progress may render architectural design process less dependant on single individuals. With a better control on design activities, it could be easier to capture and manage the architectural knowledge.

Also, one of the main advantages of an institutional organization is the capability of performing all activities even in the absence of executives. In such environment, the responsibilities of company can be spread among employees. By doing so, organizations may provide flexibility and increase the work volume and also establish a more satisfying working environment for their employees. Through institutionalization, business environments can be achieved where employees remain within organizations and promote and finally keep the organizations working. Possessing such an organizational culture is the key factor for performing knowledge management mechanisms.

2c. Barriers against Institutional Architectural Organizations

There are various reasons of why architectural offices cannot become institutional organizations. The most important factor is the economical condition of the AEC industry. It has been suggested that the ratio of payments is 1/10 when compared to foreign countries. Consequently, the profits of architectural organizations are not allowing them to invest due amounts required for expanding. The depreciation of architectural products, perspective of investors and the absence of a professional union against these factors cause the low-profit margin. Also, unsatisfied employees, due to low payments, tend to keep their business relations short-termed and prefer to establish new organizations.

In the survey, it was introduced that Turkish architectural industry is rather traditionalistic and not very constructive for changing this characteristic of its own. It is also given that there is not enough legal incentive for architectural organization to expand or unite. Features such as being long-termed, finishing large amount of projects could be rewarded more by the governmental institutions. Should there be more encouragement from industry and government, the participant foresees that architectural organizations prefer to establish larger entities. On the other hand, while there are roadmaps on institutionalization for several other industries, there is not one for architectural industry. It is been put forward that studies on such documents must be prepared by professional bodies and universities. In general, participant organizations agree on the fact that these phenomena are rather new to Turkish architectural industry and it may take time for such developments to flourish.

It is also put forward that there should be some improvements in the architectural education. One of the problems in this aspect is the lack of orientation for architecture students. It is suggested that there should be encouragement for specialization in the educational area so that new architects would be comfortable in the collaborative working environment. Architectural practice is not limited with design area, there are many other aspects. For institutional organizations where employees have distinct and clearly defined jobs, it can be useful for new architects to be aware of the different possibilities and be eager to work in collaborative environments.

CONCLUSIONS

Managing knowledge is a critical activity for architectural organizations. This study presented a pilot study that explored the knowledge management practices of architectural organizations in the capital of Turkey. With this aim, semi-structured interviews were carried out with 15 architectural offices in the Çankaya District of Ankara. The interviews were based on a questionnaire which includes issues of learning capabilities,

knowledge storing, sharing and deployment mechanisms and barriers and benefits of managing knowledge. Having already implementing knowledge management activities at a high level but in an ad-hoc system, the participant organizations have presented an eager approach towards knowledge-based strategies. On the other hand, organizations cannot invest adequate time, funding and workforce for knowledge management activities due to economical and industrial problems. The main findings of this study can be summarized as follows:

1. The benefits of managing architectural knowledge are identified as important by all of the participant organizations. The main benefits are seen as the increased productivity, decreased re-work and enhanced employee satisfaction. While, organizations champion knowledge management for improving such internal factors, the expectation towards end-results such as increased profit and innovation in design are seen to be neglected.
2. Lack of standard processes, insufficient time, and the unique nature of architectural projects are considered to be the main barriers against managing architectural knowledge. While organizations are observed to be managing barriers such as employee resistance, lack of management support and infrastructure, they are significantly affected by external factors.
3. The vulnerability of architectural organizations towards external barriers related with AEC industry requires a greater solution which is also suggested by the participants. Architectural offices can cope with economical and industrial problems successfully if they establish strong and large-scaled institutional organizations. The lack of institutional organizations with long-life span is regarded as the main deficient of the Turkish architectural practice.
4. One of the key areas where the knowledge management applications can benefit from is the educational platform. Within the last couple of decades, new IT and CAD tools have already brought novel design methods in the architectural practice and education. At this point, additional knowledge of CAD standards (where design representation is standardized by a set of rules) may constitute a fundamental solution to the lack of standard processes in representation in the design activity.

Alternative methods such as building information models (BIM), where all relevant information about a building is stored in a single 3-D model, can also be utilized in the educational institutions. Besides, exploring the new possibilities of this method, students may understand the ins and outs of the multi-disciplinary working environment of the architectural design. Experiencing the collaborative working environment in the educational area, architecture students may easily adapt themselves into knowledge management systems where roles and activities are clearly defined.

As mentioned earlier, companies may also use off-the-shelf (OTS) software applications to facilitate a systematic storage and management of knowledge during design process. According to survey it was seen that organizations valued storage and acquisition of architectural knowledge. These software applications may provide basic but advantageous abilities for architectural organizations. Data-miners, data management software may be utilized without having much investment. Such methods can be suggested for organizations as initial steps in improving the management of architectural knowledge.

Organizations may apply knowledge-based strategies in order to utilize most out of their knowledge assets and they may be successful with a diligent effort. However, it is clear that as long as these organizations cannot survive through time, there will not be a cumulative benefit of managing knowledge to organizations themselves and to the architectural industry. Unless, organizations manage to transmit their knowledge repositories to somewhere else, valuable knowledge collected by them is lost forever. It is important that organizations continuously collect valuable information, validate and archive them as architectural knowledge and apply the best out of their knowledge repositories in projects through a long life-span. The end results actually forms the overall knowledge repository of Turkish architecture, which all the architectural organizations can share and benefit from.

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MİMARLIK MESLEK PRATİĞİNDE BİLGİ YÖNETİMİNİN İNCELENMESİ: TÜRKİYE BAŞKENTİNDEN BİR PİLOT ÇALIŞMA

Günümüzde mimarlık, mühendislik ve inşaat sektörleri kaynaklarının nasıl yönetildiği konusunu gözden geçirmektedirler. Bu kaynaklardan en önemlileri arasında bilgi yer almaktadır. Bilgi, doğru proje seçmekte, kazanan ihaleleri hazırlamakta ve projeleri hayata geçirmekte vazgeçilmez bir öğedir. Bilgi, aynı zamanda, doğası bakımıyla insanların zihinlerinde, ya da belgelenmiş olarak, ya da bu iki durumun arasında bulunabildiğinden, kayıt edilmesi ve yeniden kullanılması zor bir öğedir. Bu makale, bilgi yönetimi kavramını mimari meslek pratiğinde incelemeye yönelik bir pilot çalışma sunmaktadır. Ankara'nın Çankaya semtinde bulunan 15 mimarlık bürosuyla karşılıklı görüşmeler düzenlenmiştir. Seçilen araştırma grubunun bilgi yönetimi konusunda stratejik düzeyde sorunlar yaşadığı varsayılmıştır. Bunun nedenleri olarak, bilginin taşıdığı kayda değer önem ve bu bilginin çoğunlukla insan zihninde bulunması ve ayrıca bu bilginin diğer iş ortaklarına aktarımının mimari ofislerin sorumluluğunda olması gösterilebilir.

Bu çalışma, mimari bilginin yönetiminin mimarlık ofislerinin genel üretkenliğini artırdığını saptamıştır. Ancak, düşük kar oranlarını ve sektörde standart süreçlerin bulunmaması gibi nedenler yüzünden bilgi yönetiminin mimari ofislerin genel kar düzeyleri ve mimari tasarıma olan katkılarının az olduğu görülmüştür.

APPENDIX

The data regarding the t-tests are presented in the following tables.

Organization	Mean Barriers	Mean Benefits	Mean difference	\bar{D}	Standard deviation	t-stat	p-value
A	2.778	4.125	-1.347	-0.474	0.719	-2.552	0.023
B	3.333	3.625	-0.292				
C	2.889	3.875	-0.986				
D	3.111	3.375	-0.264				
E	2.889	3.750	-0.861				
F	2.556	3.750	-1.194				
G	3.000	4.250	-1.250				
H	3.222	3.375	-0.153				
I	3.333	3.625	-0.292				
J	3.444	3.375	0.069				
K	3.667	3.625	0.042				
L	3.556	2.625	0.931				
M	3.778	3.375	0.403				
N	4.111	4.375	-0.264				
O	3.222	4.875	-1.653				

Table 1. Paired sample t-test for Hypothesis I.

Organization	Internal barriers	External barriers	Mean difference	\bar{D}	Standard deviation	t-stat	p-value
A	3.200	2.250	0.950	-0.763	0.910	-3.248	0.006
B	3.400	3.250	0.150				
C	2.200	3.750	-1.550				
D	3.200	3.000	0.200				
E	2.000	4.000	-2.000				
F	2.400	2.750	-0.350				
G	2.600	3.500	-0.900				
H	3.400	3.000	0.400				
I	2.800	4.000	-1.200				
J	2.600	4.500	-1.900				
K	3.400	4.000	-0.600				
L	3.000	4.250	-1.250				
M	3.600	4.000	-0.400				
N	3.600	4.750	-1.150				
O	2.400	4.250	-1.850				

Table 2. Paired sample t-test for Hypothesis II.

Organization	Internal benefits	External benefits	Mean difference	\bar{D}	Standard deviation	t-stat	p-value
A	4.250	4.000	0.250	0.633	0.611	4.153	0.001
B	4.000	3.250	0.750				
C	4.000	3.750	0.250				
D	3.250	3.500	-0.250				
E	4.500	3.000	1.500				
F	4.000	3.500	0.500				
G	4.250	4.250	0.000				
H	3.750	3.000	0.750				
I	3.500	3.750	-0.250				
J	3.750	3.000	0.750				
K	4.250	3.000	1.250				
L	3.250	2.000	1.250				
M	4.250	2.500	1.750				
N	4.750	4.000	0.750				
O	5.000	4.750	0.250				

Table 3. Paired sample t-test for Hypothesis III.

