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Use of Electronic Document Management Systems in Turkish Construction Industry – Analysis of Contractors and Software Developers Perspectives

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Abstract: ***Inadequacies in internal and external document circulation and storage cause various problems for construction contractors in Turkey. While literature studies state that Electronic Document Management Systems (EDMS) solve many problems regarding document management related problems and especially provide saving opportunities in stationery costs and in end-users document processing speed, the EDMS implementation in Turkish Construction Industry has clearly not been widely spread yet. Thus the aim this study has been to determine the factors affecting the acceptance of these systems in the industry. In this context, a questionnaire survey was implemented to 150 contractors and structured interviews were conducted with 9 EDMS software providers. Survey results show that EDMS usage is low in the industry mainly due to top management lack of knowledge about the systems and its benefits as an investment. Interview results unexpectedly show that software providers are reluctant to change this situation in order to increase the demand in the industry.***

Keywords: Document Management, Electronic Document, Construction Industry

1. Introduction

Construction works generally involve stages of; feasibility, design and preliminary works, tendering and bidding, execution and delivery of the structure and post responsibilities that require different parties to come together and share information that is unique for each project. A huge number of documentation is required in each of these stages even for a simple construction work.

Moreover, having faultless documents in respect to content, circulating them in a systematical way, archiving them in a reachable place and destroying them after they complete their tasks are important factors in order to avoid conflict between parties.

"Document Management" is the discipline dealing with the systematization process of a document from creation to destruction. Electronic Document Management System (EDMS) enable document management processes to be handled in digital media. In addition to its contributions to having faultless document contents, it also reduces process time and stationery costs during the circulation of a document. The use of electronic signature and EDMS applications are becoming widespread notably in universities and public institutions. Public Procurement Authority, which is responsible for the execution of bidding processes for public construction works in Turkey, has considerably increased the number of electronically issued documents. Furthermore EDM Systems which are document-based or model-based have been proposed to construction industry in the world since 1990's [1]. However, the implementation has not been spread to the contracting companies yet. Literature findings show that while EDMS use is gradually increasing by construction contractors in developed countries, it is not the case for the developing world [2] - [5].

Backblom et al. (2003) studied the usage of EDM systems in the Finnish construction industry. Data were obtained by interview with 100 construction projects personnel. The results showed that EDMS adoption is directly proportional to company size. Large projects are more adopted than small projects. The results have also showed that main barrier to implementation of EDMS is psychological resistance of key players [2].

Hjelt and Björk (2007) reported a case study of a large construction project in which Electronic document management (EDM) was used. In this study, attitudes towards EDM from the perspective of individual end users were investigated. As a result, most important barrier on adoption of EDMS is training of end-users. It is emphasized that the system is very useful, but it is necessary that the training should be given to end-users [6].

Samuelson and Björk (2014) studied the usage of Information Technologies such as EDM, EDI and BIM in Swedish construction industry. They conducted IT barometer survey in 2000, 2007 and 2011. Results show that EDM usage in construction companies is increasing year by year [3].

Ahmad et al. (2017) studied the adoption of EDMS in small construction companies in Jordan. A questionnaire survey has been conducted to investigate respondents' evaluation of existing processes of DMS, and motivations, challenges and importance of applying successful DMS in small construction contracting companies. Results show that the barriers on implementation of EDMS are need a major investment of time, effort and money. Another barrier is that employees may be unwilling to learn the new methods and procedures of applying a new system [7].

The aim of this study is to determine the current situation about the implementation of EDMS by contractors in Turkey and the factors hindering the implementation. In order to achieve this, a questionnaire survey has been carried out with the contractors and structured interviews have been carried

out with software companies. Within the scope of the results, recommendations are given which would provide an insight for the future studies related with EDMS implementation not only in Turkey but also in developing countries with similar cultural and industrial relationships.

2. Electronic Document Management Systems

2.1 Definition

EDMS is defined by Turkish Standard Institution 13298 as "selecting the evidential documents related to activities of the institution out of every document that the institution prepares while conducting its daily routines and managing them from the production to final destruction by protecting their format and characteristics [8]." With a more clear expression, it can be defined as keeping every document created in the organization under control from production to destruction process. The main focus here is to create and systematically protect the documents that will completely meet the information need of the organization.

2.2 Process of EDMS

Each document used in the organization has a life cycle. This life cycle involves the processes starting by the creation of the document and ending by the destruction of it [9]. EDMS processes of the documents in their life cycle with regards to different sources can be summarized as it is seen in Figure 1. [9] - [11].

Main process of EMDS can be classified as creation and approval of the documents, filing and storage of the documents, access to the documents, archiving the documents and destruction of the documents (Figure 1). While processes of creation, approval and access are operated depending on the user permissions the system is perpetually kept under control and the system can be developed furthermore depending on user requirements.

2.3 Benefits of EDMS Implementation

Many studies have been conducted on the benefits of implementing EDMS in an organization. Those are summarized below [10] - [16]:

- Faster completion of the tasks.
- Increase in the product/service quality.
- Decrease in the amount of expenditures.
- Increase in the security level of the documents.
- Faster and easier access to the required information and documentation.
- Decrease in the amount of information loss.
- Easier adaptation to legal obligations.
- Faster and easier amendment of documents.

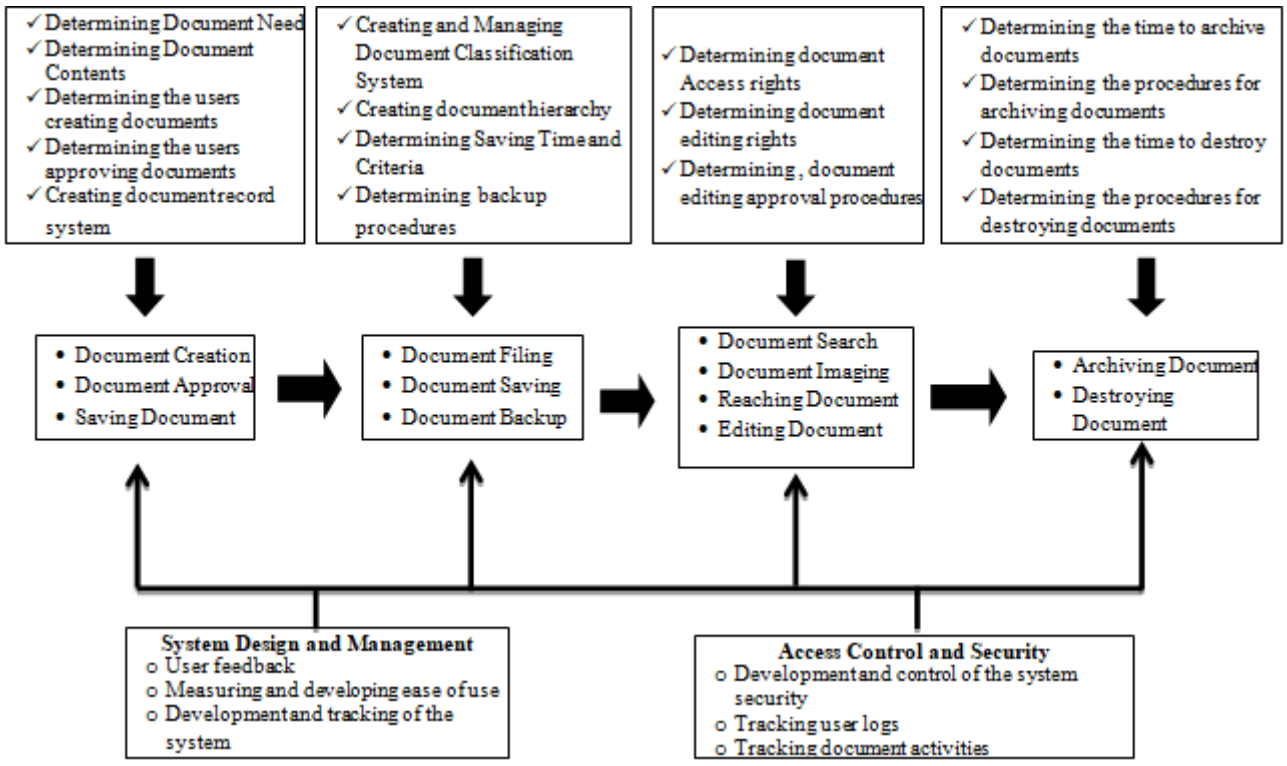

Figure 1: EDMS Processes

3. Methodology

A questionnaire survey was conducted in order to collect data related with EDMS implementations within Turkish construction industry. 150 contractors have participated to the survey. Additionally, structured interviews have been carried out with 9 out 11 software providers with TS/ISO 13298 certificate in order to collect data/information related with the supply side of EDMS. Data was collected from providers by interview because there are a small number of software providers which have maintenance and training services. Therefore it is not possible for survey data to obtain meaningful results.

Questionnaire includes 17 questions which are grouped under 2 main sections. The first section consists questions related with the demographics such as the contractors' business line, number of employees, turnover and annual stationery costs. Second section includes questions related with top management awareness about the system and the factors affecting and hindering EDMS use. Likert Scale was used in the second question group. The format of five-level Likert scale is;
1: Strongly Disagree
2: Disagree
3: Neither agree nor disagree
4: Agree
5: Strongly agree

Collected data was analyzed by SPSS 20 software. In addition to descriptive statistics "Kruskal-Wallis" hypothesis test was also applied in order to analyze the collected data.

4. Results and Discussion

4.1 Business Line and Size of The Respondent Companies

When the business lines of the companies participating in the questionnaire are examined (given in the Table 1.), it is seen that most of the respondents with 78%, are in the field of building construction. This is in good agreement with the distribution of the contractors in Turkey as building construction (residential + non-residential) consists 80% and infrastructural construction consist 20% of the total construction investments in Turkey [17].

Table 1: Business line of the contractors

Business Line	Frequency (%)
Building Projects	78
Infrastructure Projects	24
Building and Infrastructure Projects	2

Table 2 categorizes the respondents depending on their number of employees. Results show that the questionnaire was distributed homogenously when the size of the companies are considered.

Table 2: Number of employees of the contractors

Number of Employees	Frequency (%)
0-10	23.30
11-50	30.70
51-250	22.70
>250	23.30

4.2 Documentation Habits and EDMS Awareness of The Contractors

The contractors were initially asked to identify the documents they used and, how they created and achieved these documents. The results are given in Table 3. Even though the documents listed in Table 3 are essential in any construction project, results show that some are not fully utilized by the contractors. Meanwhile use of electronic media for creating and archiving the documents is more common than manual documentation showing that contractors have an electronic infrastructure that can support the use of EDMS. Internet usage is also widespread by the contractors especially for internal (94.2%) and external (84.2%) information/document sharing.

A survey undertaken by Aydınlı (2013) showed that 48% of Turkish contractors were aware of document management systems. Current research results show that the awareness of the contractors increased to 63% within 3 years' time. This is mainly due to the widespread use of EDMS within public sector by the enforcement of The Electronic Signature Law no 5070 (2004) and TS/ISO 13298 Electronic Document Management Standard (2007) [18]. Meanwhile results in Table 4. show that EDMS are still very rarely (16.6%) used by Turkish construction contractors and that is quite different than the usage rates (50%) in Europe [4].

4.3 Factors Affecting EDMS Usage

4.3.1 Company Size

In their studies, Salami (2014), Acar et al. (2005) highlight that despite the widespread use of the internet use nowadays, the use of internet network in document management changes depending on the size of the companies where the larger the companies are the more they use EDMS. [19][20]. Related results of the current study are given in Table 5.

"Kruskal-Wallis" hypothesis test was performed on 150 contractor in order to define the relation between the size of companies and their internet and EDMS use. Related hypotheses ($p<0.05$) are given below:

Hypothesis 1: H01: There is no difference between different sized contractors in terms of internet usage rates on the construction sites.

Hypothesis 2: H02: There is no difference between different sized contractors in terms of EDMS usage rates on the construction sites.

Both H_0 hypotheses were rejected for the data given in Table 6. with significance values 0.000 and 0,003 for Hypotehsis 1 and 2 respectively.

Table 3: Creating and Archiving Methods of Documents

Document Name	Using the document		Creating/archiving the document manually		Creating/archiving the document electronically	
	Number of Companies	%	Number of Companies	%	Number of Companies	%
Technical Specifications	141	94	3	2.1	138	97.9
Payment Certificate	135	90	10	7.4	125	92.6
Working Schedule	135	90	13	9.6	122	90.4
Detailed Drawings	134	89.3	0	0	134	100

Final Statement	134	89.3	7	5.2	127	94.8
OHS Control Forms	132	88	26	19.6	106	80.4
Meeting Reports	131	87.3	15	11.4	116	88.6
Reports and Documents related to Handling of the Materials	129	86	39	30.2	90	69.8
Instructive and informative documents	125	83.3	28	22.4	97	77.6
Production Control Forms	123	82	22	17.8	101	82.2
Site Log Book	122	81.3	31	25.4	91	74.6
Site Layout Plans	121	80.7	5	4.1	116	95.9

Table 4: Respondent Companies' Awareness of EDMS

	Yes (%)	No (%)
Have you heard the concept of "Document Management" before?	63.3	36.7
Have you heard the concept of "Electronic Document" before?	73.3	26.7
Is "EDMS" used in your company?	16.6	83.4

Additional results (shown in Table 6. and Table 7.) showed that internet and EDMS usage increases as the size of the companies get larger.

4.3.2 Type of The Employer

As it is stated above, public sector investments on EDMS have increased due to the relevant legislation. However, there is no evidence about its influence on construction contractors. Thus, the following hypothesis was tested in order to test the effect of type (private or public) of employers on EDMS investments of contractors.

H0: There is no difference between public and private sector contractors in terms of their EDMS investments.

The sig. value has been found to be 0,173 ($p<0.05$) Thus, H0 is accepted showing that type (public or private) of the employer is not a factor that affects the use of EDMS by contractors. The reason for this is that the relevant legislation only requires the use of EDMS for internal documentation and communication within public institutions and it is not compulsory for the institutions to include the contractors within the system.

4.3.3 Top Management Resistance and Structure of the Company

As stated in previous sections, Bäckblom et al. (2003) and Björk et al. (2003) showed that adaptation ability of both top management and the company structure to EDMS usage is the most important factor affecting the usage of EDMS by the companies. The factors specified by these researchers were thus listed in the questionnaire in order to determine if Turkish contractor have similar approaches against EDMS implementation by their companies.

Top ranked responses are summarized in Table 8. When the results are analyzed, it is seen that the most common barriers to EDMS use in Turkish construction industry are related with the unawareness of top management about the system and its benefits. Working with different and short period employed teams in construction projects is the third important barrier against the implementation of EDMS by construction companies. While these findings are in agreement with the findings of Björk et al. (2003), they are far away from the findings of Bäckblom et al. (2003) in which using the system before and not being satisfied is determined to be the most important reason for the companies not to use the system.

It is clearly seen that companies' managers think that information technology investments are risky and unnecessary. Its' most important reasons are lack of system experience and insufficient information about system. Contractors have recently begun to experience EDMS because such technologies have spread in developing countries such as Turkey in recent years. Therefore top management of the contractors has no enough experience and they have no idea about benefits of such systems.

Table 5: Internet Network and EDMS Usage Rates on the Construction Sites By The Size Of The Companies

Company Size	Number of Respondents	Internet Network	EDMS
<10	35 (35/150*100 = 23.3%)	19 (19/35 *100= 54.2%)	3 (3/35*100 = 8.5%)
11-50	46 (30.7%)	34 (73.9%)	5 (10.8%)
51-250	34 (22.7%)	30 (88.2%)	4 (13.3%)
>250	35 (23.3%)	34 (97.1%)	13 (37%)
Total	150 (100%)	117 (78.0%)	25 (16.6%)

It is thought that a number of cultural reasons underlie the resistance to such systems. These are "avoiding change" and "avoiding cost". Most contractors dislike the change and they don't want to change their form of doing business. They are highly dependent on traditional business cultures. Additionally, contractors are focusing on business extremely cost-oriented. They see all expenditures that do not directly affect the project as unnecessary. Results show that contractors do not have an innovative perspective.

Table 6: Kruskal-Wallis Test Statistics

	Internet	EDMS
Chi-Square	21.325	13.826
df	3	3
Asymp. Sig.	0.000	0.003

Table 7: Kruskal-Wallis Rankings

	Size	N	Mean Rank
Internet	< 10	35	57.71
	11-50	46	72.43
	51-250	34	83.18
	> 250	35	89.86
EDMS	< 10	35	69.43
	11-50	46	71.15
	51-250	34	71.82
	> 250	35	90.86

Table 8: Barriers to EDMS Usage

	Mean	Mode
We do not have enough information about the system	3.406	5
Top management have not been convinced about the benefits of the system	3.098	4
It would be very difficult for short period employed teams that are commonly employed at different stages of construction process to adapt to the system.	3.082	4
Document sharing by e-mail is adequate for us	3.008	4
The system is expensive to purchase	2.885	3
We do not have enough budget to set up the system	2.666	3
We used it before and not satisfied	2.562	3

4.4 Benefits of EDMS Implementation for The Companies

Findings related with the barriers against EDMS implementation show that company managers are not aware of the system and its benefits. In parallel, another important barrier against the spread of EDMS implementation within the sector is the difficulty to express the implementation's cost/benefit trade-off. This in turn makes the marketing of the system harder [12][15]. Thus, expressing the benefits of the system is important in terms of further utilization of the system in the industry. Within this scope, contractors using EDMS were requested to scale the benefits of using EDMS (Table 9.). The results show that the most important two benefits for the companies are reduction in stationery costs and savings in operation durations. Meanwhile it is possible to classify the benefits as tangible reduction in stationary costs and process duration) and intangible (systematical use of documents and consequential productivity increase in knowledge usage) [13][15].

One of the important benefits of EDMS implementation is reduction in stationery costs (Table 10.). Results in Table 10. show that annual stationery costs of the companies increase as the number of employees increases.

4.5 Software Suppliers

In order to determine the state and approach of EDMS software suppliers and their supply -demand relationships with construction companies, 9 software suppliers from the total of 11 software suppliers having TS/ISO 13298 certificate were interviewed face to face. Information obtained from these interviews are presented below.

Table 9: Benefits of EDMS Implementations

	Mean	Mode
Reduces stationary costs	3.770	4
Saves time	3.729	4
Increases the efficiency of information	3.666	3
Increases the efficiency of administrative works	3.468	3
Provides competitive advantage	3.446	3
Increases the efficiency of technical works	3.437	3
Provides us to become the leading company in technology	3.191	3
Provides easy adaptation to ISO 9001 standardization	3.187	3

4.5.1 Software and Service Features

When software suppliers were asked about the software and service features that they could provide to construction companies the following information were determined.

1) 3 of the software companies stated that they could develop special software on demand. Remaining 6 companies could only provide standard software which was stated to be adaptive to any production and documentation type.
2) Prices of EDMS software were stated to be approximately around 100.000 to 250.000 TL (around 25.000 to 60.000 Euro). When the questionnaire data was analyzed, it was determined that the annual turnover of the respondent companies were between 5.000.000 TL and 500.000.000 TL. In this case, the investment cost for the software is equivalent to around 0.02% and 5% of the annual turnovers (Table 11.). For 45.33% of the contractors, whose annual stationary costs are more than 10.000 TL, the cost equals to their 10-years annual stationary costs at most (Table 10.). It is clear that implementation of EDMS would provide advantage to the contractors in terms of cost-benefit aspect.
3) 8 out of 9 software suppliers stated that they provided after sale support such as maintenance and technical support and 5 of them additionally provided training and consultancy services. It is understood that the problem of "adaptation of the teams to the system" which is one of the reasons for not implementing EDMS for the respondent companies can be solved by the software suppliers during the system setup and implementation depending on the company demand.

Table 10: Annual Stationery Costs by Company Size

Company Size (Number of Employees)	Annual Stationery Costs				
	< 5.000 TL	5.000-9.999 TL	10.000-49.999 TL	>50.000 TL	Total
< 10	24	7	4	-	35
11-50	19	12	11	4	46
51-250	5	12	16	1	34
>250	1	2	15	17	35
Total	49	33	46	22	150

Table 11: Respondent Companies' Annual Turnovers vs Company Sizes

Company Size	Turnover (Million TL)									
	< 1	1 - 5	5 - 10	10 - 20	20 - 50	50-100	100-500	500-1.000	>1.000	Total
< 10	17	8	4	2	1	-	-	-	-	32
11-50	7	16	5	10	1	2	3	1	-	45
51-250	-	5	2	10	2	3	7	2	1	32
>250	-	-	-	-	4	3	11	4	10	32
Total	24	29	11	22	8	8	21	7	11	141

4.5.2 Perceptions of Software Suppliers about Construction Industry

Perception of the software suppliers about construction industry are summarized below:

a) Construction is a marginal sector in terms of current demand and market share.
b) Top management of contracting companies ;
   - Are not mentally ready for EDMS implementation,
   - Do not follow the developments in information technology,
   - Are not aware of the benefits of EDMS implementation.
   - Find software prices expensive.

Software suppliers highlighted that these factors negatively affected the EDMS implementation in the sector and requires much more effort to create a demand.

5. Conclusion and Recommendations

5.1 Conclusion

In this study, the EDMS software implementation in Turkish construction industry and the factors hindering its common use have been investigated. Related information/data are collected through a questionnaire survey with contracting company managers and face to face interviews with the relevant EDMS software suppliers. The results generated in consideration of the research data can be summarized as the following:

- Contracting companies still do not have the discipline of basing their work on documents.
- Although EDMS implementation is a 'must' for public clients due to the related legislation, it is generally limited within the public organization itself and very few contractors (mainly large sized companies) utilize the system.
- Benefits of EDMS implementation are not only reductions in stationery costs together with time savings in document creation and circulation process, but also increase in competitive advantage of the companies.
- Contractors are not aware of the system and its benefits. The software prices are perceived to be too high as the cost/benefit relationship is not considered realistically.
- Because of the limited demand, EDMS software suppliers are not interested in construction industry, and not making enough effort for cooperation with contractors about developing sector-specific software.

5.2 Recommendations

The attitudes and efforts stated below can contribute to the dissemination of EDMS implementations in construction industry:

- Sector shareholders can be informed by the related trade associations about the conflicts originating from the lack of documents and document losses in construction industry, and benefits of EDMS implementations to solve these problems.
- "Document Management" subject can be added to "Project Management" lessons in engineering and architecture undergraduate programs, and "Information Technologies in Construction Industry" subject can be added in optional courses lists.
- To increase the benefits of EDMS for contracting companies, software providers can be informed in detail about document and information flow special to construction works in the process of software development. Close cooperation is required between contractors and software suppliers.
- When it is considered that public sector is the leading client of construction industry, it is clear that demand from public sector on EDMS implementation is an important determinant for promoting the system within the industry.

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