

## **Electronic Document Management Systems in Large Construction Projects in Greece**

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### **Abstract**

This paper deals with the electronic document management systems in three big state owned construction management companies in Greece, namely Egnatia Odos S.A. (who is responsible to deliver the 680 Km of the Egnatia highway in Northern Greece), Attiko Metro S.A. (responsible for the construction of the Athens metro) and Ergose S.A. (responsible for the upgrade and renovation of the Greek 1,300 Km railway network). A short presentation of these companies and of their respective document management systems is made. By comparing the systems it is evident that these companies follow different document management philosophies ranging from simple electronic archiving to more sophisticated contract management ones. This discrepancy of attitude is justified by the lack of state guidelines and standards which, in turn, hinders the wider adoption of interoperable document management systems by both state regulated construction management companies and private construction contractors and, in effect, the development of nation-wide specifications related to construction projects. It is argued that such guidelines and specifications should be developed before the Greek construction industry moves to more advanced product modeling document based solutions.

### **Keywords**

Document Management Systems, Construction Management, Greece.

### **1. Introduction and Background**

Producing documents such as drawings, specifications, bills of quantities etc using computers is common practice in the construction industry. Document Management (storage, transfer and retrieval of documents) has proved, however, a much more difficult problem to be dealt with by computers (Bjork, 2001). The impact of inefficient document management on a construction project can be quite severe; out-of-date, missing or contradictory information, delays, cost overruns, mistakes and, last but not least, legal consequences, disputes and claims. These problems are well known both to practitioners and researchers and a number of research efforts (Lownertz, 1988, Bjork, 2002), commercial products (Floberg and Thoennes, 2003; Document Management Avenue, 2003) and in-house developments (Bjork, 1993 & 2001) have taken place.

A search in the construction IT literature reveals that there is another research stream, namely that of product modeling, that has also addressed the problem of project information management. Papers presented (see, for example, the CIB W78 conferences) on product modeling (including STEP and IFC standardization efforts) outnumber the papers on document management by a factor of 2 to 3. Researchers have clearly selected the product modeling approach (Bjork, 2002), however, real-life is different.

Document management (and not product modeling) is one of the top priorities of most construction companies today (Edwards *et al*, 1996, Eloranta *et al*, 2001, Kirilis, 2002). The management of documents via computers, databases and computer networks is usually termed “Electronic Document Management” (EDM) and is one of the fastest growing IT applications in the construction industry (Bjork, 2001).

Another approach to project information management is that of country-wide initiatives such as the “Corenet” initiative in Singapore (<http://www.corenet.gov.sg>). The Corenet (COnstruction and Real Estate Network) project is an e-information system attempting to increase the competitiveness of the construction industry by being a central dynamic repository for building and construction related information (e.g. codes, regulations, standards, product information etc.) that is accessible via the Internet. Corenet can be used for obtaining information (e.g. a specific regulation), for submitting information (e.g. a project bid) and for checking information (e.g. checking that a particular floor plan abides with the building regulations). Corenet is based on a National standard for classifying construction information and is the result of a joint effort between Government agencies spreading across eight Ministries, service providers and professional bodies. Corenet’s budget is approximately € 50 mil per year. Systems such as Corenet offer distinct advantages to the construction industry and facilitate the design, implementation and use of EDM systems for as much as the relieve some of the burden of developing an all-encompassing EDM system by a particular construction organization or pay the penalty of operating a system of limited functionality. More specifically, certain information which should usually be stored in the organization’s EDM system, such as regulations, standards, classifications, design guidelines, methods of measurement etc. can be stored “centrally” on the internet and simply be referenced or replicated as needed.

Of course, document management is not only related to construction; A small market survey in Greece revealed that most document management solutions are used by other industries (e.g. Banking, publishing, education, the Greek Standardization Organization, the National Research Foundation etc (Xerox, 2002)). The situation is quite similar in other countries. Document management for construction, however, has several distinct characteristics most of which pose additional requirements to the EDM system. These characteristics are:

- Construction documents themselves (plan drawings, sections and elevations, bills of quantities, specifications etc), although based on modified regulations and standards, have not changed significantly since the 1970s. In effect, the procedures followed to create these documents, which always aimed at producing hard copies, are “frozen” in the minds of those responsible for their making. This fact hinders the adoption of EDM systems; construction organizations have only recently begun to understand the importance of EDM systems.
- A project organisation is formed anew for each project and involves a number of specialists from different organizations with varying document / information requirements.
- Construction documents are usually produced using computers. Most popular software used for this purpose include MS-Office (Word, Excel, PowerPoint and Access), AutoCAD, Primavera, design programs and other country specific packages (especially legislation, cost estimating and valuations software).
- Construction drawings are usually large in size (e.g. A0 size blueprints) and need to be photocopied a number of times (e.g. 5 or 6 for a design submission).
- Paper printouts of drawings are the most popular format used in practice. Pantouvakis (2003a), after reviewing the situation in Greece, claims that it is impractical at the moment to use electronic drawings on a PC/PDA screen, especially at a construction site.
- An EDM system for construction should include utilities related to the fact that drawings play an important role in the field such as a “viewer” for looking at and redlining drawings without having the original CAD software installed (Bjork, 2002) and a “takeoff viewer” for taking off quantities without having the paper print-out (Miller, 2002).
- The same document may have several versions that need to be transferred in many places (e.g. designer’s office, project manager’s premises, construction site etc.) to be checked, approved or

constructed. The size and IT capability of each of the organizations involved vary, so there is an additional need for interoperable systems.

- Documents can be voluminous (e.g. several hundreds of pages – e.g. a monthly bill for a large construction project including the calculations of the measured quantities).
- Construction documents bear legal responsibilities and need to be duly stamped and signed by representatives of more than one organization (e.g. issuance by an engineer / designer and approval by the project promoter’s representative (design checker and/or project manager).
- Documents are inter-related (e.g. plans are related to designs, specifications and standards). The checking and maintenance of consistency between these different inter-related documents is a major concern for construction organizations.

So EDM for construction is a challenging problem with unique characteristics that deserves further study and research. There were, however, two more reasons that motivated the writing-up of this paper:

- Although the Greek construction sector has doubled in recent years reaching a staggering 25% of the GDP due to the EU-funded projects and the preparations for the 2004 Olympic Games, EDM systems installed in construction are still used by less than 5% of the industry and mainly by the larger organizations (Pantouvakis, 2003a). Arguably, EDM in Greek construction lags behind the respective use in other EU countries; a fact which is directly accountable for inefficient document management and, in turn, for a number of problems (time delays, cost overruns, disputes etc.) associated with the realization of construction projects.
- EU and the Greek Government promote the “Information Society (IS) / e-Government” program in Greece which is in line with “e-Europe 2002” (Greek Ministry of Internal Affairs, 2001). This program stipulates the use of electronic indexing and workflow management systems in the Greek public sector archives since September 2001. Although the program is delayed, the public sector has commenced its implementation (see, for example, Greek Ministry of Development, 2001). Arguably, there is no direct relation between the “IS / e-Government” program and EDM systems for construction other, perhaps, from the adoption of such systems by the Greek Ministry of the Environment & Public Works (which is the supervising authority of construction) and the publication of EDM specifications and guidelines that are immediately exploitable.

## **2. Problem Statement, Method and Rationale**

The problem of EDM for construction, as well as the specific conditions pertaining to the Greek construction industry formed the background upon which the comparative survey of EDM systems described in this paper was performed. The purposes of this comparison were:

- to investigate the use of EDM systems in large Greek construction organizations.
- to study the background, procedures and methods employed in the introduction of these systems.
- to assess the operation of EDM systems and their perceived benefits.

According to Bjork (2002), EDM research can be classified in terms of targets in ten different categories. This paper focuses on the first research target, namely that of system functionality. System functionality refers to the features, facilities and capabilities offered by the implemented systems.

System functionality is usually assessed through questionnaire based surveys. Depending on who answers these questionnaires, surveys are classified to those comparing product features based on answers by the vendors (e.g. the Finnish ProCe project), by independent users (e.g. postgraduate students comparing nine EDM systems at the University of Arkansas, U.S.A., Bjork, 2002) or by both vendors and end-users (e.g. comparison of 48 systems based on vendors responses and collection of the views of five major construction organizations related to their implemented EDM systems, CICA, 1998).

In this paper the survey was based on reviewing and comparing the implemented EDM systems in three big state-owned construction organizations in Greece, namely Egnatia Odos S.A. (who is responsible to

deliver 680 Km of highway in Northern Greece), Attiko Metro S.A. (responsible for the construction of the Athens metro) and Ergose S.A. (responsible for the upgrade and renovation of the Greek 1,300 Km railway network).

It was believed that the above analysis would consolidate the lessons learned from the implementation and operation of EDM systems in the Greek construction organizations for the purpose of formulating a view towards the steps required for the wider application of project information management systems in Greek construction organizations.

As such, during the data collection phase, particular reference was made both to product modeling and to related country-wide initiatives, such as the Corenet mentioned previously, in order to collect views on the subject. It should be mentioned from the outset that both approaches were by and large unknown to the Greek construction industry.

### **3. Survey of EDM Systems in Large Construction Projects in Greece**

#### **3.1 Egnatia Odos S.A.**

Egnatia Odos S.A was created in September 1995. Although it is a wholly state-owned public enterprise, experienced private foreign firms have been incorporated into its operational structure to ensure the management and supervision in accordance with private sector economic criteria. The company's aim is the management of the design and construction, the maintenance, the assets and the exploitation of the Egnatia Motorway, its vertical axes as well as of other projects within or outside the Greek territory. The total budget is approximately € 3,8 bn.

The Egnatia Motorway is designed to the specifications of the Trans-European Road Network (TERN). It is a closed dual carriageway motorway with a central reserve, two traffic lanes plus an emergency lane per direction, for a total paved width of 24.5 meters over its greatest part. It is 680 kilometers long running across Northern Greece from Igoumenitsa in the East to Evros in the West. The project is one of the largest road construction projects in Europe. It is the modern reincarnation of the great Roman highway known as "Via Egnatia". Nine major vertical axes connect the motorway with Albania, FYROM, Bulgaria and Turkey. Furthermore, 6 airports and 5 ports service Egnatia, a road of 1,650 bridges, 350 interchanges, 76 tunnels and 43 river crossings. More information is available at the company's website at <http://www.egnatia.gr>.

##### **3.1.1. Document management system**

From its initial setup Egnatia uses the EDM system "FileMagic" to register all incoming/outgoing correspondence. Today, although the system is rather obsolete and there are plans for its replacement, it is still used. For design submissions the EDM system "Primavera Expedition" is used. This system is used to register all submissions and for the Design department workflow management. All construction related documents are stored at the local Egnatia office and not centrally in the EDM system. The fact is justified by the dispersed nature of the project. Document control is well established in Egnatia, well documented (Egnatia Odos S.A., 2001) and is considered indispensable. Today an ambitious effort is underway, to develop in collaboration with external consultants, a Project Information System (P.I.S.) of enhanced functionality.

#### **3.2 Attiko Metro S.A.**

Attiko Metro S.A. was established in 1991 to supervise the design, construction, organization, administration, operation, exploitation and development of the Metro network in Athens Metropolitan Area, a city of 4 million inhabitants and 1.4 million cars. The Greek State is the sole shareholder of the company at the moment, but up to 49% of the shares can be transferred to private investors.

The contractor of the project is “Olympic Metro”, a consortium of 22 Greek, German and French companies working together to construct the project on a fixed-price turnkey contract. The Metro system consists of two lines at an average depth of 20 meters radiating in four directions from Syntagma Square to Ethniki Amyra - Sepolia and serving 400 thousand passengers daily. This capacity is additional to the 350 thousand passengers carried daily by the existing line connecting Pireas in the south (the port) with Omonia (city center) and Kifissia to the North. The total budget of the project is € 2,1 bn. Construction will produce 2.6 million cubic meters of excavated rock and soil and utilize 700,000 cubic meters of concrete and 60,000 tons of structural and reinforcing steel. Mainly two tunnel boring machines designed in Japan and manufactured in France perform the work. More information about the company and the project is available at the company’s website at <http://www.ametro.gr>.

### **3.2.1. Document management system**

The first EDM system used was an electronic register developed in Clipper. By the end of 1992 the company was using the French EDM system “Sibelius” which, however, was never put to everyday use. A study by Hewlett Packard (1996) indicated the use of the “Documentum” system whose implementation started in 1998. Today the system is used as a meta-data based EDM system (see Lownertz, 1998 for EDM system approaches) without workflow management. Documents of A4 size and up to 5-6 pages are scanned and stored in the system. Drawings and larger documents are also registered by the system. Since 2000 it has been stipulated to deliver electronic versions of the drawings in all design submissions. An in-house developed system “Engineering Documents Workflow” is used for monitoring document flows within the company. By the end of 2003 the workflow capabilities of Documentum will be used. It should be noted that different departments use their own archiving systems and keep their independent incoming / outgoing documents register in Excel.

## **3.3 Ergose S.A.**

Ergose S.A. is the company formed in 1997 to take over the management of the Greek Railways Investment Programme, and in particular to manage the projects co-funded by European Union’s funds. The sole share holder is the Greek Railway Organisation (OSE in Greek) which is a wholly state-owned public enterprise. The total budget is approximately € 5 bn and the project is the largest in monetary terms single construction project in Greece today. It entails the upgrade of the basic railway network backbone (approx. 700 Km) to achieve speeds of 200 Km/hour and the refurbishment of the secondary lines (approx. 600 Km) to assist urban development. Electrification of the basic backbone and telecommunications and signalling for the greatest part of the network is also envisaged. The project is scheduled to be completed by 2008. The project includes 84 railway stations, 340 bridges and 65 tunnels. More information is available in Pantouvakis (2003b) or at the company’s website (<http://www.ergose.gr>)

### **3.3.1. Document management system**

The first EDM system was adopted in 2001 (Pantouvakis, 2001). It is an in-house developed application in Access which can be classified as a meta-data based system coupled with a file-hierarchy one. All departments use the system and they do not have their separate register or filing system. All data from the initial setup of the company has been entered. In the immediate priorities belongs the implementation of a workflow management system, possibly using one of the commercially available systems.

## **4. Conclusions**

EDM systems were introduced in Greek construction companies in isolation from one another and followed somewhat different approaches ranging from electronic registers to design contract management systems. Product modeling was never considered as an alternative. Central websites incorporating standards, regulations etc. were found interesting by those interviewed as they were considered

complementary to their the EDM systems. At the moment EDM systems are in a transition period in all companies contacted, as they are in the process of update. Perhaps this fact may offer the opportunity for centrally planned actions that would assist further the deployment of EDM systems in the Greek construction industry.

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