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ELECTRONIC DOCUMENT MANAGEMENT IN BUILDING DESIGN

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Abstract. The problem of managing digital design data including drawings, specifications and other technical data in building design and construction units is a real challenge, especially when there is a need to structure the design information across building design companies. The main difficulty in this information management is the shortage of unified rules (or standards) concerning the ways how the digital design data should be gathered, archived, and preserved in the most efficient way for building design and construction units. The most important issue addressed in this work, is the standardised reference of all design data definitions.

Keywords: computer-aided design, electronic document management, building information technology.

1. Introduction

There is an emerging demand for management of digital design data in building design and construction units. In order to achieve a higher level of efficiency there is necessary to manage complete life cycle of design documentation and design-related data inside CAD applications. Multiple architecture, engineering and construction enterprises such as are seeking for a new efficient ways to allow engineers to collaborate on the same project and efficiently communicate engineering data and changes to the rest of the organization. An assessment model for determining utility of various electronic networking (ENT) services and the optimal configuration of ENT services for D/B projects is presented by Abduh and Skibniewski [1]. An implementation scenario of the utility assessment model and a discussion on issues that should be considered in implementing ENT services in construction are presented. A Multiple Criteria Decision Support Web-Based System (BR-DSS) consisting of a database, database management system, model-base, model-base management system and a user interface was developed in [2]. Important aspects of construction management key factors identification and their relative significance for the construction projects management effectiveness are considered in [3]. The approach of artificial neural network is implemented to study the construction projects management effectiveness model to be built and to determine the key determinants from a host of possible management factors that influence the project effectiveness in terms of budget performance. Project development time is typically long due to a considerable amount of design data that required to be transferred between the members of different project teams. Another possible reason for high project development time and costs is that even typical projects have to be developed from the bases, because there is no centrally and easy accessible information storage. It is based on well-know fact that designers spend 75 % of their time searching for the appropriate data, and only 25 % of the time actually modifying them [4].

As an efficient solution the above-mentioned problems is the application of the electronic document management (EDM) solution, that facilitate the management of documents pertinent to particular enterprises, projects and work groups in computer networks. In addition to the basic file management capabilities, EDM systems contain enhanced features related to the life-cycle, revision history and version management of particular classes of documents [5]. An application model attempting to achieve unification of all the models used by individual participants into one universal model fulfilling the functions of all models combined, along with horizontal and vertical integration in the management of the building construction process is proposed in [6, 7].

A number of commercial tools have been created for document management, project information sharing, online communication, design workflow, construction workflow, time control, and securing information. The case study presented in this work demonstrates how EDM system has become an important element in keeping control of company design activities. Implemented and improved solution provides complete control of the flow of project documentation in both directions: producer – archive – consumer which are archived and stored in one structured way and ready for re-use. They also reduce overall engineering costs by diminishing the project development time and cycles.

2. Environmental model of information flow

A growth of the work intensity in building design companies creates the difficulties of management information flows in the projects. In fact, project management can be accomplished as document life cycle control. The successful application of EDM systems strongly depends on the appropriate structure of the central archive for design information. Preserving information in digital forms is much more difficult than preserving information in forms such as paper. This is not only a problem for traditional archives, but also for many organisations that have never thought of themselves as performing an archival function. The workflow presented for the archive of the construction design documentation is based on ISO Reference Model for an Open Archival Information System (OAIS) for a data repository system [8, 9, 10] (Fig 1). The role provided by each of the entities in OAIS can be described briefly as follows:

Producer is the role played by those persons, which provide the information to be preserved.

Management is the role played by those who set overall OAIS policy as one component.

Consumer is the role played by those persons, that interact with OAIS services to find and get interested preserved information.

Every submission of information by a Producer, and every dissemination of information to a Consumer, occurs as one or more discrete transmissions. Therefore, it is convenient to have three different types of the packages:

Submission Information Package (SIP) is a package that is delivered by the Producer to the OAIS for use in the construction of Archival Information Package.

Archival Information Package (AIP) is a package, consisting of the Content Information and the associated Preservation Description Information.

Dissemination Information Package (DIP) is a package, derived from AIP and received by the Consumer in response to a request to the OAIS.

Having an archive inside the company sometimes becomes an extra load for designer, who is involved in design chain and usually not qualified to maintain it. The design process in the chain (producer-archive-consumer) can be slowed down because of the existence of the archive.

Fig 2 represents Archival Information System where three component parts of the design chain displayed in different coloured rectangles.

Ingest provides the services and functions to accept Submission Information Packages from Producers and prepare the contents for storage and management within the archive.

Archival Storage provides the services and functions for the storage, maintenance and retrieval of Archival Information Packages.

Access provides the services and functions that support consumers in determining the existence, description and availability of information stored in the archive, and allowing consumers to request and receive information data.

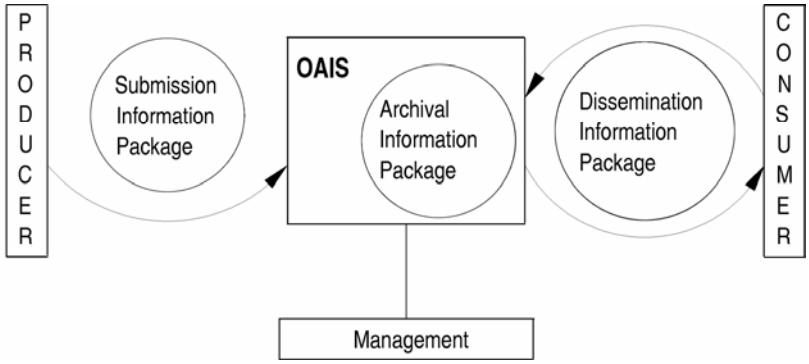

Fig 1. Environmental model of an Open Archival Information System

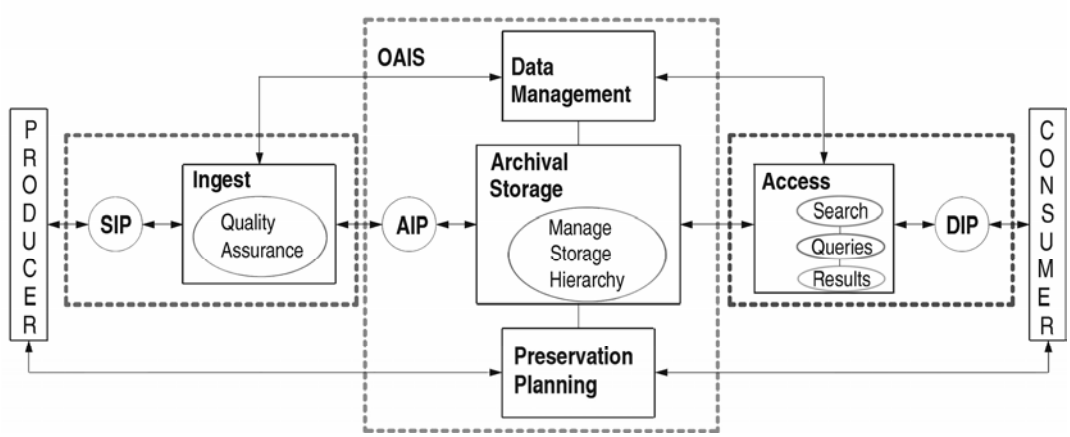

Fig 2. Archival Information System

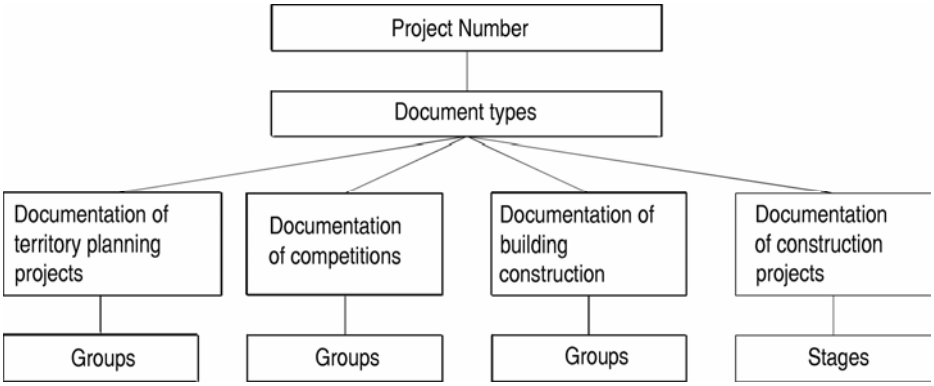

Fig 3. Lithuanian classification of the project documentation

3. Framework for archiving digital design data

Having generic model of the archive was to come to the Framework for Archiving project documentation. The archive is meant to store in a structured way all kinds of project documents. Due the project-centric nature the structure of archive reflects the main parts of the project (Fig 3). This classification is governed by Lithuanian construction regulatory laws [11, 12]. This is the first attempt in Lithuania to provide a unified reference of all document definitions. This standardised reference is the most important issue for development of the efficient IT applications [13].

The direct implementation of the project document classification system leads to overcrowded hierarchical tree of project documentation. In order to overcome these difficulties document file naming schema is established for native CAD documents. The specific CAD document is named beginning with five digital project code showed in Fig 4. This file naming schema is associated with standardised project document classification. File directory organisation together with file naming schema provide an effective framework for archiving digital design data.

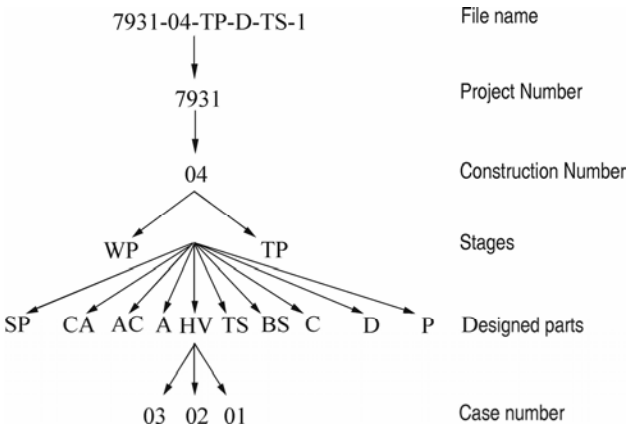

Fig 4. Naming schema of the design documentation

Having classification of the project documenttation, file directory organisation, file naming schema and chosen electronic document management solution "eChange" from Empresa Solution, the structure of the archive and project documentation flow were modelled.

4. Project documentation flow in Archival Information System

For implementing the developed model, the Architecture, Construction and Engineering (AEC) digital design archive was chosen, that is "eChange" EDM software of the company "Empresa Solutions". For more information about basic features of "eChange", the interested reader is referred to [4].

While "eChange" was designed with the CAD sector and engineers as the primary users, the system can be used to store any type of file that can reside on a computer's file system. In our case the largest Lithuanian building design company use "eChange" to manage all their office documents in addition to the CAD drawings they generate. Lithuanian company performs complete residential and industrial building design that includes architecture, construction and engineering. UAB Lithuanian Construction Design Institute (Lietuvos Statybų Projektavimo Institutas), which is engaged in the design of construction units and project management has increasing the number of projects per year, at the same time having designed more and more complex objects, the implementation of efficient EDM system has become essential (Fig 5).

The first steps in creating a successful digital design collection must begin in the designer's office. Each designer (Producer) of the building design company working with "Architectural Desktop" software and using "Project Navigator" is directly connected to general file organisation vault system. Each designer has knowledge about development of the whole project bringing separate CAD documents into project structure adequate catalogues (Fig 5 SIP). If changes are made in one part of the project documentation, the system automatically shows and other designer can follow what's going on.

But before the designers can begin working within a new entered project, the project leader or the administrator of the archive must initiate this process by entering a new project number. By this operation, in the vault of the technical documentation a new tree representing structure of the project documentation is to appear and the SIP of the new project is initialised.

The same tree structure of the project documentation is appeared in the AIP where EDM system "eChange" is.

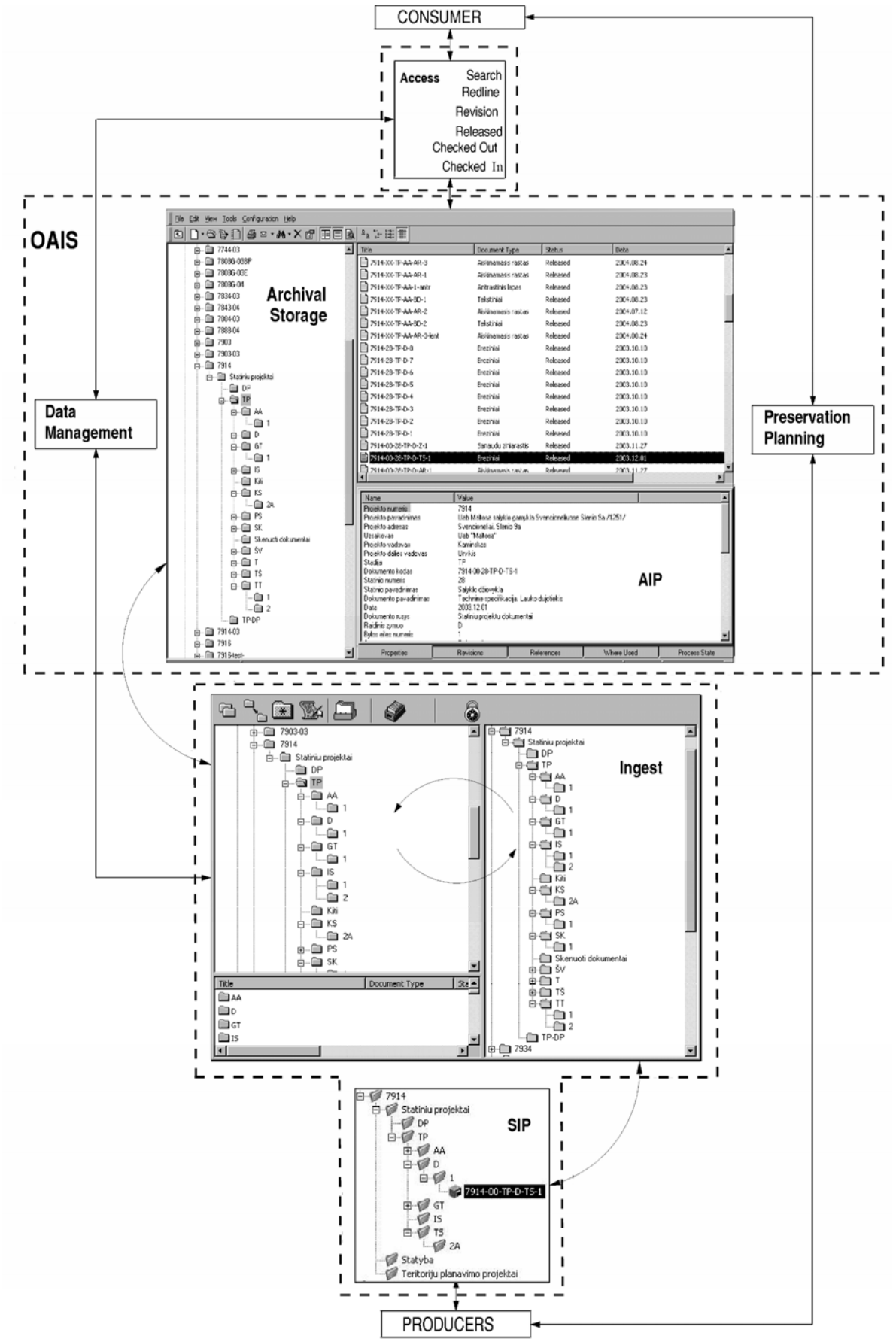

Fig 5. Design chain inside a building design company

The initialisation of the same new project structure in SIP and AIP starts through the Ingest module where conjunctive and transformation tool is (Fig 5). This tool is managed by the project leader or the administrator of the archive.

All design information in one step is transformed by archive administrator from SIP into AIP by using Ingest module. The primary goals for Ingest are to check the design data and to transform the Submission Information Package (SIP) to an Archival Information Package (AIP). The dialogue window of Ingest transformation module is divided into two parts: right part represents SIP, left part represents Electronic Document Management system of "eChange" (AIP).

In AIP all project documentation gains "Released" status and, if all information is correct, documents gain "Archived" status.

After transforming from SIP into AIP all project documentation obtains metadata properties. There is underway of automated attribution of properties and all documentation is placed into project structure adequate catalogues. Hereby all project information being in "eChange" system is accessible for users and groups according to permissions for each document type. The "eChange" system also provides different levels of access rights to documents View/Copy, Check Out/In, Release, Archive, and Delete.

Incorporation of Electronic Document Management system into design chain "producer-archive-consumer" allowed to refuse Dissemination Information Package. "eChange" solutions provides a secure, scalable, and affordable document control, revision history, and workflow across the whole design chain.

5. Conclusions

An attempt has been made to put forward the unified rules (or standards) on how the digital design data should be gathered, archived and preserved. The first digital project documentation archive is developed in Lithuanian AEC industry. The main strategy was to develop the dynamic archive with information flows in the both directions of the design process chain: producer-archive-consumer. The workflow presented for the archive of the construction design documentation is based on ISO Reference Model for an Open Archival Information System (OAIS). The management of digital design data was performed by employing the collaborative design change and document management system eChange of "Empresa Solutions".

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STATINIŲ PROJEKTAVIMO ELEKTRONINĖS DOKUMENTACIJOS VALDYMAS

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Santrauka

Statinių projektavimo ir statybos įmonių didžiausia problema – įvairios techninės dokumentacijos valdymas. Jai valdyti reikalingi sprendimai, kurie leistų šiuos duomenis optimaliai tvarkyti ir panaudoti kitose verslo srityse. Pagrindinis sunkumas valdant techninę dokumentaciją – nebuvimas taisyklių, kaip projektavimo metu gimstančios informacijos srautai turi būti surenkami, tvarkomi, archyvuojami bei publikuojami projektų dalyviams įmonėje ir už jos ribų. Šio darbo tikslas – pateikti keletą taisyklių, kaip parengti statinių projektavimo bei statybos įmonės techninės dokumentacijos valdymo procesų optimizavimo programą.

Reikšminiai žodžiai: automatizuoto projektavimo sistemos, elektroninės dokumentacijos valdymas, informacinės technologijos statyboje.

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