Enterprise Content Management (ECM) System Architecture for Capital Project at Oil and Gas Company

Arief Herdiansah
Informatics Department, Engineering Faculty, Muhammadiyah Tangerang University
Email: arief_herdiansah@umt.ac.id

Abstract – The Enterprise Content Management System (ECM) is an improvement over the Document Management System (DMS) solution. In a DMS solution, corporate documents will be managed at the document level (access rights and document distribution processes) while in an ECM solution, documents can be managed down to the level of content contained in the document. Companies who are engaged in the oil and gas industries, are facing intense business competition and to be able to win the competition, companies must be able to increase their HSE (Health, Safety, and Environmental) supervision. Document content management systems are needed by companies that have capital projects, including oil and gas companies. Before a company builds and implements an ECM solution to manage project capital documents, it is necessary to build a system design architecture so that the built ECM solution can meet user needs in managing documents down to the content level. ECM is one of the enterprise solutions, so an Enterprise Architecture (EA) scale system design is needed with a focus on Digital Enterprise Architecture (DEA). This research produces a reference in the process of making ECM architecture in order to manage project capital documents in oil and gas companies.

Keywords – ECM, DMS, Digital Document, Capital Project, Oil and Gas Company

I. INTRODUCTION

Oil and gas companies have projects that are included in the capital project category which is included in the category of capital projects which are long-term capital-intensive investment projects with a purpose to build upon, add to, or improve a capital asset [1], [2]. Capital projects in the process industries involve the construction of physical plant facilities and materials processing equipment to produce a new product for expected profit or alternatively to maintain or develop operating-level capabilities [3], [4]. Capital projects are defined by their large scale and large cost relative to other investments that involve less planning and resources [5], [6]. As one of capital project, the oil and gas company needs a system to support the business activities of the oil industry, cater multiple phases from detail design, execution, and operations, and also support document management for corporate. Organizations that run capital projects face several critical information problems related to managing information contained in project documents, it likes to lose information lost between project phases so that project completion is delayed and increases Project costs, due to lack of integration between systems and workflow processes that use project document [7], [8]. For this reason, a document management system is needed that is more than just digital archive management but also a solution for managing content contained in company documents [9], [10]. Therefore, it is needed to implement Enterprise Content Management (ECM) solution to meet and accommodate the need for digital document management and document content management owned by the company and perform document control process for both capital projects (feed, EPCI, and operation) with considering costs effectiveness in implementing ECM solutions.

In the process of implementing the ECM solution, it is necessary to design an ECM system architecture so that it can describe the details of the ECM solution design which consists of functional architecture, infrastructure and information architecture, in order to describe the ECM solution design to align with the improvement of digital corporate document management including business process enhancement and could be a reference technical design document for ECM enhancement in a future. The ecm system is a development of a DMS (Document Management System) solution [11], [12]. DMS is a softcopy document management system responsible for the efficient and systematic control of the creation, receipt, maintenance, use and disposition of records, including processes for capturing and maintaining evidence of and information about business activities and transactions in the form of records [13], [14].

This research is different from previous research on ECM, where in this study the researcher specializes in the process of designing an ECM system for managing capital project documents in oil and gas companies.
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II. RESEARCH METHODOLOGY

The type of research used in this research is descriptive quantitative research method by finding and collecting information about the implementation of the ECM system in oil and gas companies. The information is then clearly defined the goals to be achieved, plans the approach, collects data as material for making a planning report on the design of the ECM system capital project. Data collected by conducting a direct discussion process with related parties where the ECM design was developed. In addition, researchers also use input from information obtained from books and previous research [15]–[17].

The two things that were first formulated from the results of data collection were the ECM Business Use Case for capital projects and the Enterprise Architecture Principles.

2.1. ECM Business Use Case

ECM allows companies to have a single platform in managing project capital documents digitally. The benefits of using a single ECM Platform enable you to collaboratively create, manage, deliver, and archive the content that drives business operations. The ECM Platform makes it possible to distribute all of this content across internal and external systems, applications, and End-User communities. The ECM system has document management features that can be applied to business use cases, project document workflows including the use of standard features of a DMS solution as shown in table 1 below:

Table 1. ECM business use case

No	Use Case Name	Remarks
1	**General System Functionality**	
1.1	Login to ECM	DMS & ECM standard feature
1.2	Create New Project/Domain	DMS & ECM standard feature
1.3	Add Members to Project/Domain Group	DMS & ECM standard feature
1.4	Document Number Generation from Creating/Importing Document	DMS & ECM standard feature
2	**As-built/Project Data Management**	Integrated with asset operation application
3	**Document Management**	
3.1	Search Document	DMS & ECM standard feature
3.2	Check Out and Check In Document	DMS & ECM standard feature
3.3	View Revisions of Document	DMS & ECM standard feature
3.4	View Versions of Document	DMS & ECM standard feature
3.5	View Relationships of Document	DMS & ECM standard feature
3.6	View Locations of Document	DMS & ECM standard feature
3.7	Export Document	DMS & ECM standard feature
3.8	Subscribe Document	DMS & ECM standard feature
3.9	Add Relationship	DMS & ECM standard feature
3.10	View Comparison	DMS & ECM standard feature
4	**Transmittal Management**	DMS & ECM standard feature
4.1	Distribution Matrices	DMS & ECM standard feature
4.2	Project Document (External Document Flow)	DMS & ECM standard feature
4.3	Corporate Document (Internal Document Flow)	DMS & ECM standard feature
5	**Integration with design/engineering tools**	
5.1	Integrate Other Engineering Tools with ECM (ECM as a document repository)	Need to create an integration script
6	**Intelligent Document**	
6.1	Search Content of the Document	ECM can search the content of the document
7	**Tag Management**	ECM has relationship function between documents. So, one document can have relationship with another document.
7.1	Add Relationship	DMS & ECM standard feature
7.2	View Relationship	DMS & ECM standard feature

2.2. Enterprise Architecture Principles

Enterprise Architecture (EA) and Digital Enterprise Architecture (DEA) are different information technology architecture designs. EA focuses on structuring the company based on the main framework of IT tools, while DEA focuses on document management and lifecycle so that documents can be easily accessed, modified, and managed at any time following company developments [18]. EA is increasingly being developed to manage information systems for business purposes [19]. EA has now inspired IT architects and technology innovators to design and deliver new operating models, resulting in businesses that are now the center stage [20].

The Architecture Principle of EA consists of several layers, namely: Business Principles, Data Principles, Application Principles and Technology Principles [18], [21]. ECM architecture is closely related to Data Principles (Data is an Asset, Data is Shared, Data is Accessible, Data Trustee, Common Vocabulary and Data Definitions, Data Security) and Technology Principles (Requirements-Based Change, Responsive Change Management, Control Technical Diversity, interoperability) [18].

III. RESULTS AND DISCUSSION

3.1. ECM Architecture for Capital Project

The ECM architecture involves a multi-tiered Client/Server where the software system will serve as a platform for the development of business-specific solutions: enabling users to customize with in order to define specific data objects; create forms and reports; define user workflows with face application programming (API) that enables system automation [22], [23].

ECM does not refer to a single technology, but ECM is a system that combines methods, tools, and strategies in order to support the process of storing and retrieving digital documents, managing content, and sending information throughout the life cycle of a document [24], [25].

ECM system for management capital project document includes these key capabilities:

a) Project information governance through project role-based security
b) Simple engineering document lifecycles,
c) Revision Codes
d) Access control based on discipline and document classification types
e) Easy-to-use configuration options that give documendt dontrollers control over their project content and collaboration between disciplinary engineers
f) Automatic numbering and properties population, inherited from the project work breakdown folder structure hierarchy and document templates
g) Folder templates that can encapsulate project work breakdown folder structure hierarchy configuration rules (permissions, permissible documents, Property Inheritance, etc).

The application of ECM for the management of capital project documents essentials define the solution's key features, which are managed with a common configuration model that provides a consistent and integrated system for engineering information management.

Figure 1 is a high-level view of the current (and planned) ECM Solution capabilities. The ECM Essentials Solution represented is typically the first phase for most Organisations.
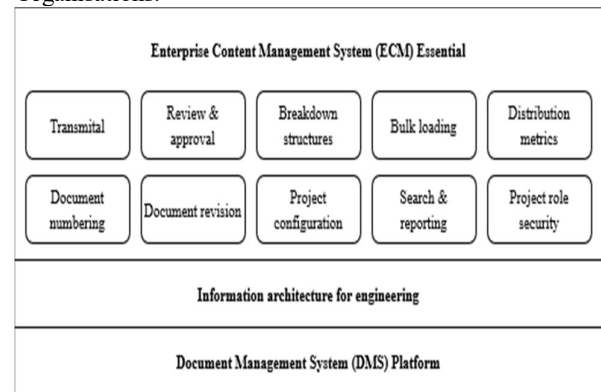

Figure 1. ECM High-Level Solution Architecture

ECM for capital project essentials provide the standard basic feature as shown on the image above. If the customization required, ECM provide the SDK file which can be used by the ECM administrators/developers to start customizing the ECM system. Also for integration part, ECM provide some extensions with the 3rd party application which can be used based on customer's requirement.

3.2. ECM System Architecture for Capital Project at Oil and Gas Company

The first thing to create is the infrastructure architecture as shown in Figure 2. Technically, users can use web service application as a front-end server to serve site requests directly. However, in a production environment, user may want to use some web servers as front-end to route the requests to the web service application. Using a web server to handle the requests gives performance and security benefits. If user using web service application HTTP as a front-end web server, then must consider securing that as well. Web service application HTTP must be publish to HTTPS and use different URL if there is an external user want to access the URL. Web service application HTTP must be publish to HTTPS and use different URL if there is a external user want to access the URL
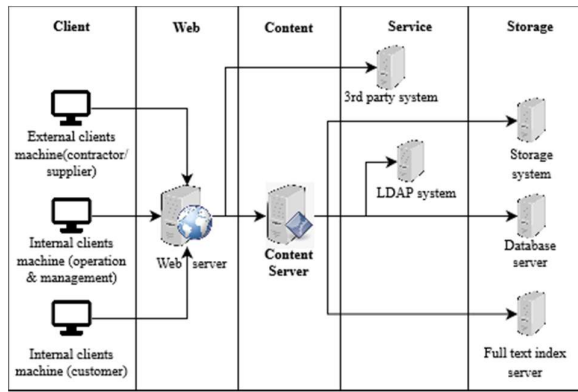
Figure 2. ECM for Capital Project Infrastructure
Architecture

The implementation of ECM in oil and gas companies will involve the functions of the company's Document Management, Project manager, Controller, Engineering Design (FEED), Procurement and Construction (EPC) and EPC Suppliers/Contractors.

The next stage is to create a functional architecture as shown in figure 3 the functional architecture shows that SCM Solution allows an Organization and its contractors to easily interact on digital document management solutions and manage them. The new ECM shall be accessed by Intranet User, Extranet User, and Internet User. For Internet and Extranet User, will be using port to get the access of it.
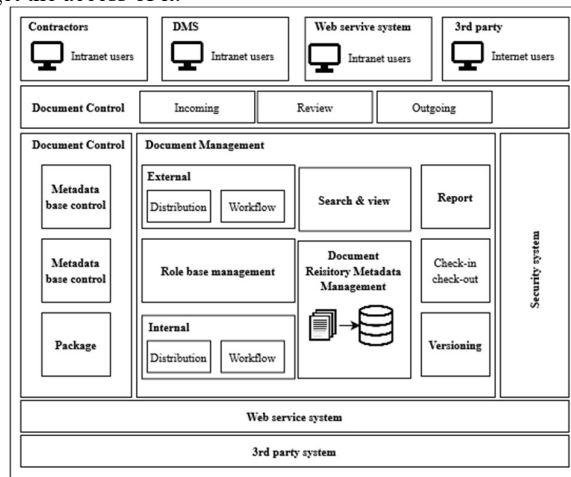

Figure 3.ECM system functional architecture

. Based on the figure above, the two big process of ECM functionality, can be divided into document control and document management.

1) In document control process, the documents can be controlled through validation process against the document loading file when perform bulk loading, updating metadata based on right permission, and transmittal packages by creating Incoming, Internal (Review/Approval), and Outgoing Transmittal Types, with their status being easily tracked and references between Transmittals and Content.
2) In document management process, internal and external project have the transmittal process (distribution and workflow). The document controller will typically manage the process of a transmittal process from start to finish and they are the context throughout the process. For the user who involved in transmittal workflow (user who becomes reviewer and responsible person) can be configured through role base management. Role base management uses content file and metadata from Document Repository.
3) Role base management can also be used to manage the permission, so that user with right permission can search or view document, view the report, check in and check out the document, and also do versioning against the document.
4) The documents or files have metadata that is stored in the repository of ECM.
5) ECM can be integrated with other system (third party application) by utilizing web service interface (example integration with SharePoint (SharePoint Connectors) and PEGA (PEGA Page Connector). EDMS exposes its entire set of services through standard-based web services and java-based API. Customizations and integrations are achieved through these basic set of classes and interfaces.
6) Through the web service systems, third party application can upload, view, and edit the document using the applied URL web services from EDMS

IV. CONCLUSION

Based on the information and descriptions generated from research conducted related to Enterprise Content Management (ECM) system architecture for capital projects at oil and gas companies, it can be concluded:

1) Capital project run by an oil and gas company is a large project that involves a team with a variety of functions and documents produced from these functions and it requires an ECM system that is designed according to the flowflow needs of each user.
2) The design of the ECM system must refer to the business use cases of the users in each function
3) The design of the ECM system must be able to accommodate the involvement of contractors, internal teams, project teams and 3rd parties with strong data access security.
4) The research conducted has not discussed and provided details of the digital document storage capacity needed to support the ECM system capital project in oil and gas companies.

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