AUTODESK **UNIVERSITY** 2014

Vault Professional and Microsoft SharePoint for Engineering Collaboration

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Code CV5861-P

This class will examine the challenges and the most efficient practices to effectively implement a comprehensive Data Management Solution for capital projects. We will explore the various components of data management and the different roles in these projects. Covering both Vault software and Microsoft SharePoint software, we will reveal how to most effectively utilize both tools. We will touch upon document control, master document register management, transmittals, model management, deliverables, progress tracking, and much more.

1 Learning Objectives

At the end of this class, you will be able to:

- Identify Major Development phases for assets
- Understand and effectively explain the major differences between document control and engineering data management
- Recognize the strengths and weaknesses of Microsoft sharePoint and Vault Professional in large capital projects
- Understand document and data management requirements for the various phases in asset development

1.1 Intended Audience

Project Managers and Document Control managers who are interested to learning more about data management in capital projects.

1.2 About the Speaker

Edwin Elmendorp holds a bachelor's degree in computer science from The Netherlands' Zuyd University, he has over 10 years' experience in implementing SharePoint Software Solutions and Vault Software Solutions in the engineering enterprise. Having closely worked with major operators as well as engineering, procurement, and construction companies (EPCs), he has experience in using both of these technology platforms for engineering data management and document control. Edwin is the president of Cadac Group Americas and lives with his family in Houston, Texas. With an entrepreneurial and pragmatic spirit he has grown the Cadac brand extensively internationally.

2 Introduction

This handout will provide background information to support the successful usage of Autodesk Vault and Microsoft SharePoint for EPC (Engineering Procurement Construction) projects and Asset Operations. We will explore the business requirements and discover how the proposed technologies fit into this business model. As this hand-out explains a number of general concepts, the main focus is towards controlled documents (deliverables) in the context of EPC projects and Owner Operators. Where we refer to "EPC" firms, there are several variations of this model. Some companies execute only "EP" projects, other firms cross the full gamma and perform "EPCM" or "EPCI". For a more comprehensive view on these topics I refer to: THEIAM or EPC

Asset management is a broad spectrum that covers many different aspects; Wikipedia

"*Infrastructure asset management is the combination of management, financial, economic, engineering, and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner. It includes the management of the entire lifecycle—including design, construction, commissioning, operating, maintaining, repairing, modifying, replacing and decommissioning/disposal—of physical and infrastructure assets. Operating and sustainment of assets in a constrained budget environment require a prioritization scheme.*"

The scope of this definition can be applied to almost every physical asset; Chemical Plants, Mines, Bridges, Tunnels and highways, Energy utilities, offshore production platforms, pipelines, and many more.

Depending on the type of industry and geography you are in, many different regulatory requirements will apply for designing, implementing and operating the asset:

- Offshore industry: Lloyd's Register for classification and certification of marine vessels and equipment.
- Infrastructure in the USA; FHWA is one of the governing bodies in the USA for new and updated infrastructure.
- Chemical plants; PSM Process and Safety Management for the management of hazardous materials.

Because of these many differences, data models utilized throughout the various industries will differ greatly. Another factor is that the some of these bodies allow for different interpretations of their regulations. Combined with many years of operational data, constant evolution in regulatory requirements and often acquisitions, there are many different shapes and forms of

how people design, construct and operate their assets. Because of this, there is not a one-size fits all approach for Asset Information Management.

However, at the 40.000 feet level, requirements are very similar and through this handout we will provide insight in how Autodesk and Microsoft technologies can be applied and work coherently to provide an integrated approach to the challenges.

3 The Asset Information Management Business Case

Before we describe how Autodesk Vault and Microsoft can be used in a coherent fashion, let's review the reasons that drive the need for Asset Information Management.

According to research conducted by FIATECH in 2004 (Capital Facilities Information handover Guide, Part1) the cost for not having a system that allows for interoperability of data was estimated at 15.8B USD in the USA. See: http://fire.nist.gov/bfrlpubs/build04/art022.html

From the research above:

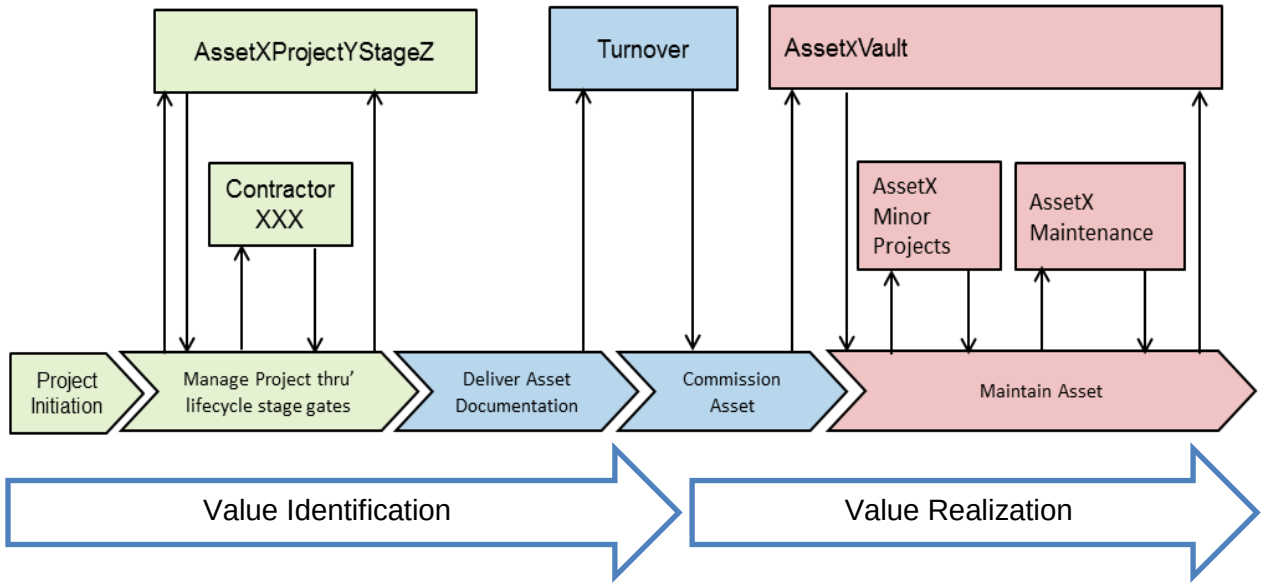
"Based on interviews and survey responses, $15.8 billion in interoperability costs were quantified for the U.S. capital facilities supply chain in 2002. The majority of the estimated costs were borne by owners and operators; the O&M phase has higher costs associated with it than other life-cycle phases as information management and accessibility hurdles hamper efficient facilities operation. Owners and operators bore approximately $10.6 billion, or about two-thirds of the total estimated costs in 2002. Architects and engineers had the lowest interoperability costs at $1.2 billion. General contractors and specialty fabricators and suppliers bore the balance of costs at $1.8 billion and $2.2 billion."

Since 2004 many research papers have been released to improve this situation, but surprisingly enough it remains very difficult to improve this. According to a more recent study in 2012 about interoperability FIATECH describes the following:

"The global capital projects industry, despite years of effort, is not achieving a level of interoperability exchanging models and data or in process systems and tools that captures near the value opportunity to the industry stakeholders. Today's information security and emerging economies combined with the industry's fragmentation and slow adoption of new technologies add to the challenge."

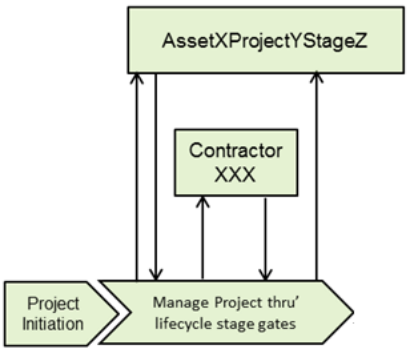
4 The Asset Lifecycle, Major Developments and Capital Projects

To understand the document control and engineering data requirements it's crucial to understand the basics of an asset lifecycle. The following diagram explains the major steps in the asset lifecycle, with the exception of decommissioning or sale. During the decommissioning phase, requirements for an engineering document and data management tool are greatly diminished.



The following chapters will explain in more details the various activities related to each of the major stages.

4.1 Development of the Asset



Development of the asset covers a wide range of activities. Many major asset development projects are managed via the stage gate process. Each stage consists of a set of certain cross-functional and parallel activities which must be successfully completed prior to obtaining management approval to proceed to the next stage of product development.

The entrance to each stage is called: a gate. These gates, which are normally meetings, control the process and serve as:

Quality control, Go / Kill check-points, readiness-checks, Must-Meet and Should-Meet criteria, etc. Upon approval of a stage, funding for the next stage is approved. A sample stage gate process for the energy sector is available at:

http://www1.eere.energy.gov/manufacturing/financial/pdfs/itp_stage_gate_overview.pdf

During any of the stage gates, specialized contractors are hired to perform a portion of the work with many different contractors active on the project at any given moment. As part of an information management strategy a process needs to be in place to support continuous handover to the next stage. A large portion of the information produced in a given stage is only relevant for that stage and not for the next stage.

As part of the feasibility study there might be hundreds of documents that lead to the conclusion for it to be feasible or not. Leading to the next stage, only the outcome (the one report) could be part of the input for the next stage.

4.1.1 Development of the Asset - Research

A first potential activity as part of asset development is the research phase. During this phase the preliminary research steps are taken. Initial technical studies and economic assessments are taken as well as field research and involvement of industry experts. The outcome of this stage is to determine if the brilliant plan is possible.

4.1.2 Development of the Asset - Feasibility

During the feasibility stage, the input from the first stage is used to determine if the plan is actual economical and technical feasible with the defined parameters. Depending on the type of industry the type of activities for this stage will obviously be different. For a mining project, the location of the mine combined with its environmental impact as well as the political landscape would be a huge influence. Assessments against current land reclamation acts would be studied to determine economic feasibility in the long term. For an infrastructure project issues such as right of way, environmental impact and funding are important elements for consideration. We have seen a number of projects where PPP (Public Private Partnership) is the desired funding method, meaning that commercial partners need to be sought to develop and operate the asset.

4.1.3 Development of the Asset - Pre feed

The pre feed stage can be used to review design alternatives against the cost and risk and long term usability of the asset. In Oil & Gas setting specifically the sample could be to; determine corrosion levels based upon the long-term usage requirements. Assessments from early explorations could be used to determine the suitable materials and acceptable level of risk against the chosen materials.

4.1.4 Development of the Asset - Feed

Front-End Engineering Design (FEED), is an engineering design approach used to control project expenses and thoroughly plan a project before a fix bid quote is submitted. It may also be referred to as Pre-project planning (PPP), front-end loading (FEL), feasibility analysis, or early project planning.

FEED is basic engineering which comes after the Conceptual design or Feasibility study. The FEED design focuses the technical requirements as well as rough investment cost for the project. FEED can be divided into separate packages covering different portions of the project. The FEED package is used as the basis for bidding the Execution Phase Contracts (EPC, EPCI, etc) and is used as the design basis.

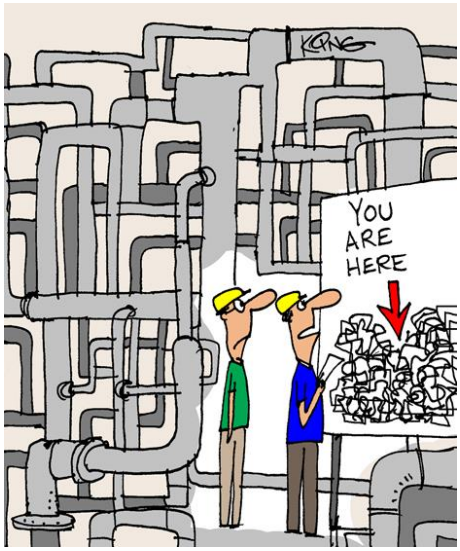
The amount of time invested in Front-End Engineering is higher than a traditional quote, because project specifications are thoroughly extracted and the following typically developed in detail:

- Project Organization Chart
- Project Scope
- Defined civil, mechanical and chemical engineering
- HAZOP, safety and ergonomic studies
- 2D & 3D preliminary models
- Equipment layout and installation plan
- Engineering design package development
- Major equipment list
- PFD's
- etc

The importance of an engineering document and data management solution is important during all stages of development. During the Pre-Feed and or FEED stage, vendor interaction increases as well as the associated deliverables. For this reason the importance of an engineering document and data management solution will be more important than ever.

4.1.5 Development of the Asset - Detailed Design

In the Detailed Design phase the Project Specification developed during FEED shall be further detailed to the level which is needed for procurement, fabrication/construction, testing, commissioning and handover.



Key assurance and design reviews are carried out during the Detailed Design phase, after incorporating any changes to the FEED design basis and actual vendor design data. It is important that the vendors participate in these reviews so that any assumptions made in the design are corroborated by them and all controls and safeguarding issues in vendor packages are addressed.

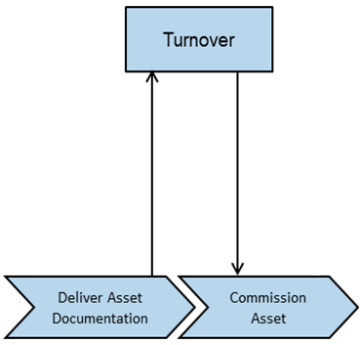
As review packages are electronically exchanged, it's easy to imagine the added value for a collaboration environment where all parties are well informed of status and expectations to keep the project on track and within budget. As the EPC firms are providing these review packages, the ability for the owner to return and review within contract schedule is a key element. It will save costly design changes if they are identified early in the process.

4.1.6 Development of the Asset - Construction

The construction phase will actually deliver the asset as designed in the previous stage. For a large contract we are talking about thousands of workers on a daily basis, many different nationalities, hundreds of companies, countless numbers of construction equipment, millions of parts and components, etc. Projects are executed in some of the most remote places on the planet with very harsh conditions, between extreme heat and severe cold.

Due to constant changing conditions (weather, political, environment, unforeseen, "acts of god") effective collaboration tools are a must to quickly adapt to new situations and provide the correct information in a timely matter.

4.2 Turnover and Commissioning



When a project is completed, is not the same moment as when it's brought to life. During "Turnover and Commissioning" activities will take place to ensure proper functioning of the asset. A commissioning strategy will be developed ranging from activities at the asset to system level and equipment level activities. This stage is not only about the technical aspect of the asset an equal level of effort is related to training, procedure development, safety and risk assessments and handover. These activities need to result in a situation where the owner can operate and maintain the asset for many years.

Major steps in the commissioning process can be defined as:

- Preparation and planning
- Mechanical Completion and Integrity checking
- Pre commissioning ad operational testing
- Start-up & initial Operation
- Performance and Acceptance testing
- Post Commissioning

Although definitions could differ, for the purpose of this context we are assuming that handover is part of the commissioning stage. Any asset delivery project should have two main assets in terms of delivery which are equal in importance, the physical asset and the information asset.

4.2.1 Turnover of the Asset Information

This Information asset exists in 2 forms:

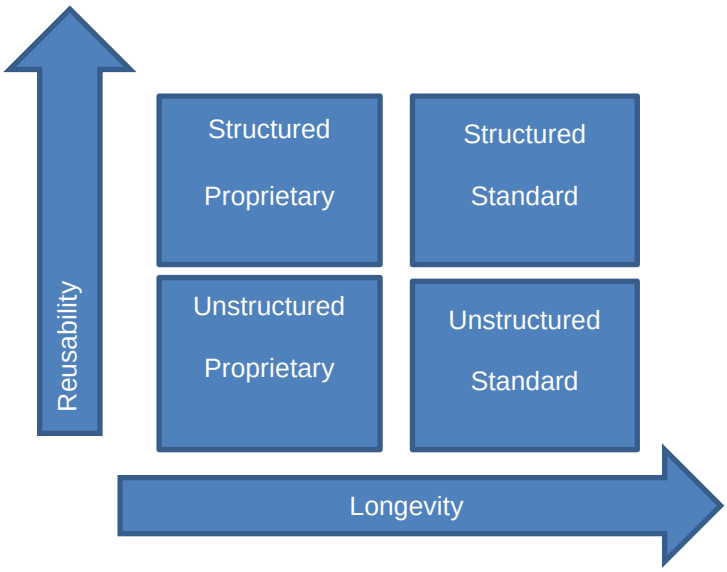
- Documents (printed or electronic): to be read by people e.g. Reports, Specifications & drawings.
- Data: to be manipulated by tools e.g. Spare Parts, Tag Register & Maintenance Routines.

Proper implementation of project and asset IM achieves two main objectives and serves two “masters”:

- The Project Team: Support for the engineering processes that deliver the physical asset (i.e. design, review, approval, and handover between phases)
- Operations (Maintenance, Engineering): Delivery of the information asset itself (i.e. final handover to Operations).

For a handover process to be more efficient and successful, the information management system requires the same level of detail and attention as the delivery of the physical asset. Similar control and delivery mechanism need to be introduced to reduce significant cost when the facility is moved into operations and lower the cost to maintain and operate.

As part of a handover strategy for information management, the company should consider the following diagram.



The diagram on the left explains the relationship between various types of data and its usability in the long term.

Early on in the development of the asset, governance needs to be established that describes what data will be used for what type of purpose.

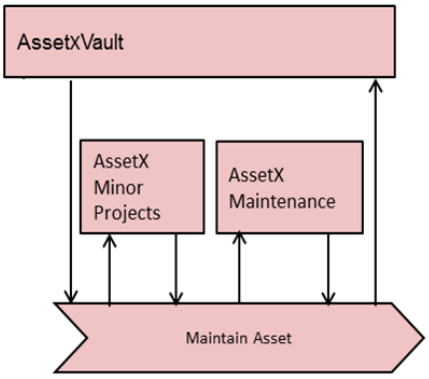
In the top right corner, we can see that structured standard data has the highest potential for reuse and will be usable for the longest amount of time.

For this reason, engineering records are often required to be submitted in PDF form with the native models as supporting documentation.

On the top left side, we can see that Structured Proprietary formats will have a shorter lifespan. Upon handover, many operators request a 2D dwg representation aside with the PDF copy of that record. DWG however is a proprietary format and the practicality of opening an older version many years in the future can be challenging to say at least.

Structured information managed by an information managed system will be easier to maintain over unstructured data (standard and or proprietary). We are all familiar with the case of knowing that the information exists, but simply are unable to locate it in a timely fashion. In the case of a catastrophic event, finding the correct information is extremely crucial for the business.

4.3 Asset Operations & Maintenance



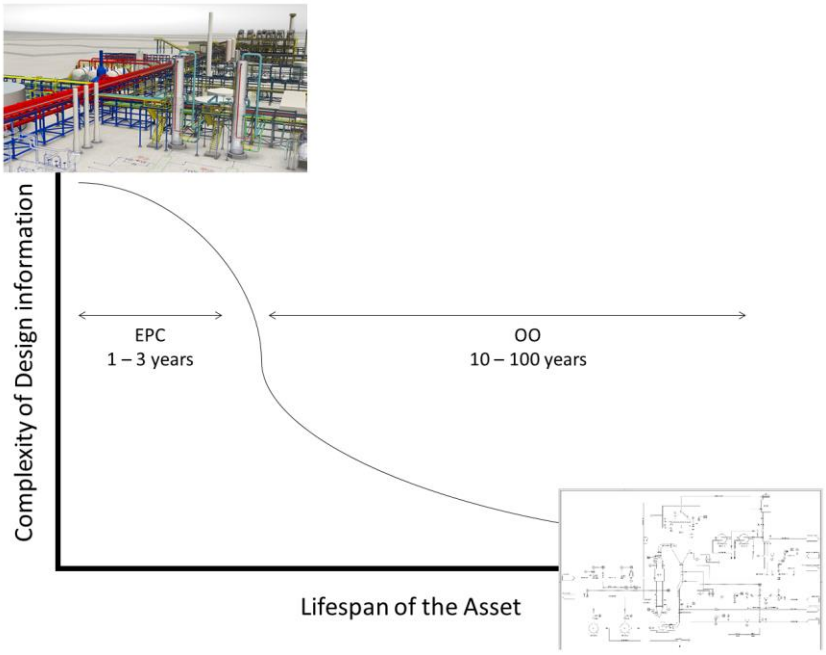
In our diagram the last part describes the operations phase for an asset. Upon successful completion the asset will be alive and in operation for many years (decades) to come.

During the operational phase there are many different types of requirements that drive a coherent and holistic approach to Asset Information Management.

External factors such as regulatory requirements drive this need. Process and Safety Management is a prime example

for chemical plants. More important however is that a sound information management system will support key decisions that will support the asset in reaching its highest economic value. There are many different support systems that will contribute to key decisions;

- Maintenance management
- Materials management
- Procurement management
- SCADA systems
- Project management
- Project controls system
- Document Control
- Document management
- Model management
- Etc



As part of the operations phase a number of challenges are typical for the Owner Operator. Very often, upon completion of the initial delivery, documents (engineering records) are delivered to the owner.

Where the EPC Company could have used many different modeling tools (i.e. Plant 3D), the typical approach for the owner is to work with views of these models.

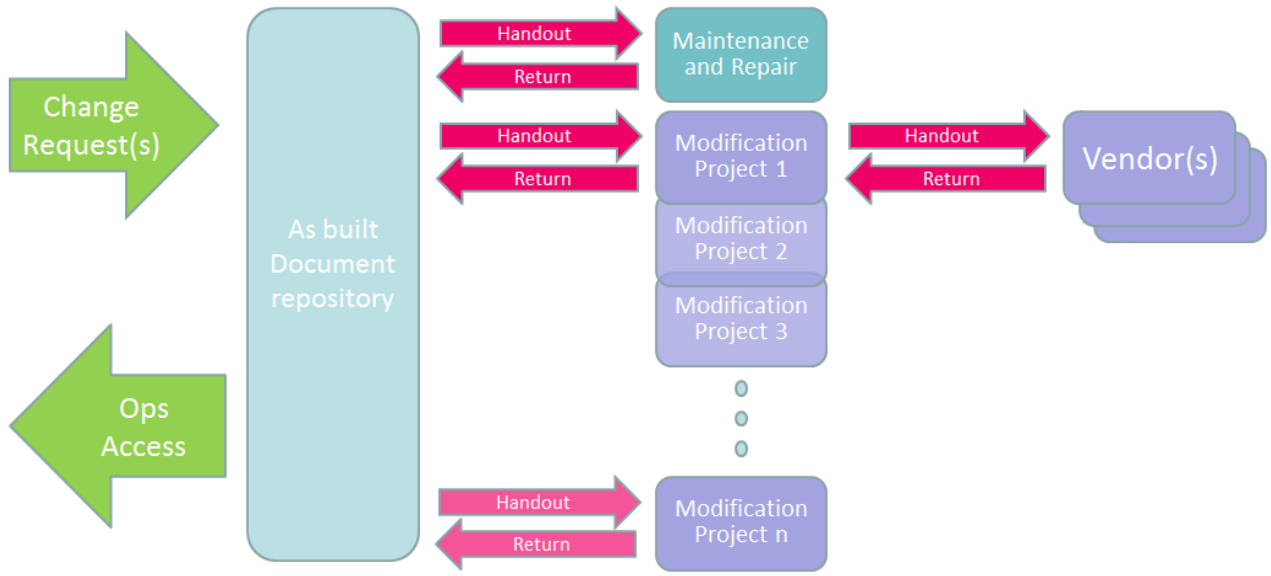
In many cases the owner does not have the staff and systems to maintain the complex models. Aside from the ability of understanding the model, regulatory requirements do not mandate for management of the model, but they are requiring the management of these views (i.e. “As Built” P&ID’s). The diagram above describes this transition of design complexity.

A key driver for this behavior is that EPC contractors will invest resources to produce a better more accurate design in a shorter timeframe – providing them with a competitive advantage.

This is opposite from the interest of the operator. Their responsibility ranges into the decades to properly maintain engineering records.

4.3.1 Operations Process Overview

The following diagram provides a high level overview of the activities during the operations phase in relation to engineering records.



4.3.2 Change requests

There are many different reasons for a change request. The typical industry term to manage a change request is referred to as the MOC (Management Of Change) process. The actual change request can be initiated by various stake holders such as: management, engineering or the operations group. Weather it is to initiate a capital project for extending the life or routine maintenance to exchange broken equipment. A governance model needs to be in place to conform to regulatory requirements and keep an accurate view of the live operational data.

A typical MOC process will describe the full lifecycle of the change.

4.3.3 Ops Access

Operational access refers to the need for the operations team to access the latest operational information. While maintenance and projects are executed, the maintenance team needs to have access to the “latest and greatest” information. The practical approach is that still to date, this information is available in print form in the maintenance area. Many of these hard copied records contain red-lines to indicate changes to the operational asset.

Often this is where challenges arise as the engineering team is not always aware of what is actually in production. A costly but necessary answer to this is field inspections to verify the actual installation. Companies are also creating point clouds from a facility to capture the current status and use this as part of a 3D model.

4.3.4 As Built Document Repository

A widely common approach for managing engineering records is to differentiate between an “As-built / Operations” repository and the actual projects where records are updated.

The “As-built” repository is under strict security where documents can only be updated through a formal change process. Many organizations have specialized roles that are the gate keepers for engineering and operations: “Records manager, Print Room, Doc Control, etc”.

The “As Built” environment is also being used by the operations team to quickly find and retrieve the information they need to operate the plant.

4.3.5 Handout / Return

The hand-out and return refers to the process that the “gatekeeper” will perform to ensure that projects are using the correct information to execute their project. In this context it’s important to understand that there are potentially many different projects concurrently ongoing for the asset.

In many cases this is not an issue, i.e. with a large mine there is only a small change of projects needing access to the same data. However in the case of a refinery or chemical facility where there are many different processes on a relatively small area there is big change of concurrency.

This is also referred to as concurrent engineering. Multiple projects potentially require access to the same base data to execute their project. Some of these projects could be completed in a fairly short amount of time, where others potentially take years to complete.

There are several scenarios that can tackle this issue; the most important element in this is that a process needs to ensure that the “As-built” data is not polluted by overwriting data with faulty information. Secondly for project execution it’s crucial to understand the impact of a potential change. By providing accurate and up to date information about the concurrent use, projects can better anticipate project work and easily save millions.

4.3.6 Maintenance and Repair

Maintenance and repair refers to regular ongoing activities that are fairly short and easy to execute. These activities are still managed through a management of change process. Depending on the type and complexity of the facility, the process for change could be fairly straight forward, however in the case of a complex chemical installation there are potentially many approval steps before the change is implemented.

4.3.7 Modification Projects

Depending on the size, complexity and scope of the project, a project can follow the same steps as during a green field project. For an existing infrastructure situation, the decision to upgrade and modify can be years if not decades in the planning. Even for smaller capital investments (20 M USD), a formal process will be followed to justify the cost associated with the project.

In many cases the operator has a relatively small inside engineering team and will heavily rely on the expertise of an EPC firm to support them. For this reason there is a great need for improved collaboration and the ability to track the ongoing project work.

Some operators will want to keep their vendors “at arm’s length”, others will look for a tight collaboration process.

4.3.8 Vendors

As a vendor interacting with the client, a collaboration system will support the engineering project as well as decision makers. The ability to review progress against multiple initiatives and the ability to transform this into Business Intelligence are vital for an engineering group for any organization.

- How great would it be to monitor the project performance across multiple assets?
- How great would it be to monitor the performance of vendors across multiple projects?

Questions like these attribute to a more efficient organization and provide management the tools they need to drive profitability. With this introduction, we have provided a glimpse of the activities that occur in capital intensive projects and their relationship to the asset lifecycle.

5 Differences Between Document Control and Engineering Data Management

The previous chapters provided background information on the mechanics of how these assets are developed. The following chapters will dive into and provide more details on how document control can augment engineering data management and their respective roles in these projects.

The previous chapter was mostly described from the owner viewpoint; this chapter will focus more on the EPC viewpoint. Many of the owner operators have contracted with EPC firms for their engineering work. The samples described here can partially translate to an owner scenario; a difference will be where engineering records are reviewed as part of the MOC process for an asset.

According to the all-knowing internet, there are many definitions of engineering data management and document control. For the purpose of this hand-out we will follow the following definitions.

- *Document Control; a system and or process to manage the formal recordkeeping of information assets related to the delivery of the project and or physical assets.*

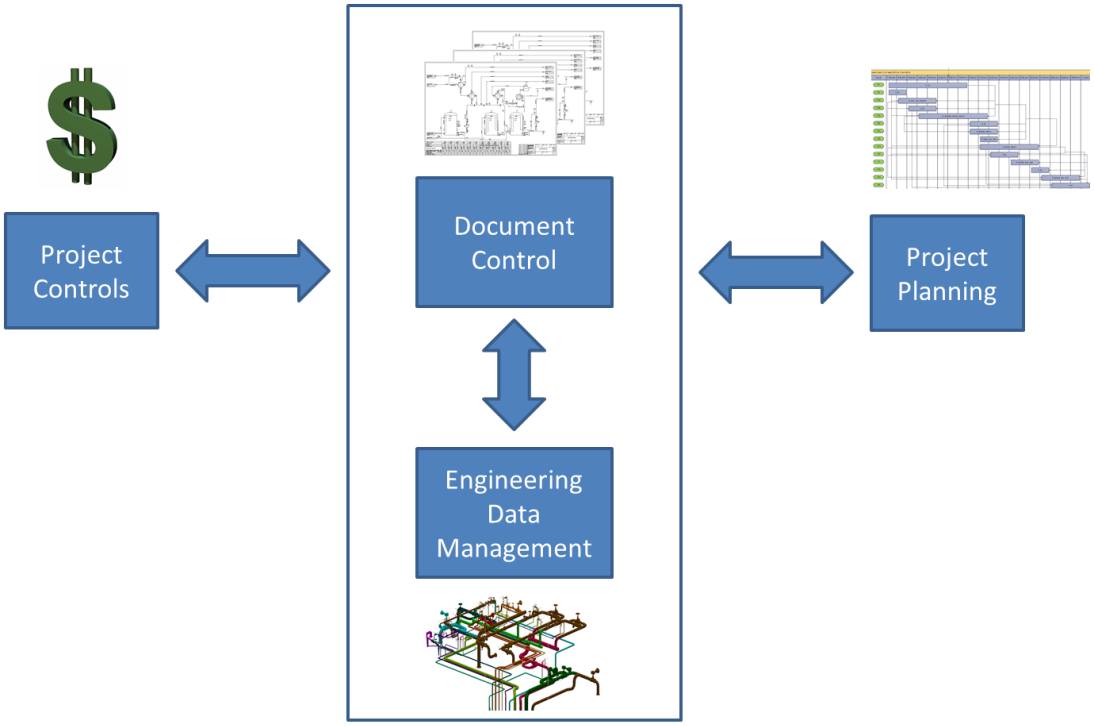
- *Engineering data management: a system and or process to manage complex digital design information used for the generation of project and asset records*

5.1 Basic Elements for an EPC Type Project

To understand the differences between document control and engineering data management it's equally crucial to understand the basic components of an engineering project from a content management perspective. By explaining these basic elements it will disseminate the differences between the two. In this context we are again focused on the engineering records (drawings, transmittals, specifications, MSDS's, HSE docs, Project Execution Plans, DWG's, etc).

5.2 The EPC Project Software Ecosystem

With any engineering project, many software systems are being used to support the project. The diagram below can easily be extended with several other systems that are needed to successfully run a project. For the purpose of this handout we are focused on a few examples to highlight the main differences between document control, engineering data management, project controls and project planning.



Where a project controls system will understand the billing rules and invoicing schedules, a document control system will understand the rules regarding when a deliverable is allowed to jump from revision A to revision B and the revision number that your customer is expecting. Within an engineering firm, often there is a specialized group dedicated to the purpose of project controls. They control the list of deliverables from a financial point of view. Every new deliverable is a potential change in scope and will have a financial impact as design and engineering will need to spend time to produce this deliverable.

Project planning is where resources are scheduled based upon some logical breakdown or sequence of the project In the project there is usually a reasonable relationship between a package of work and a number of resources. For that reason it's not very practical to try to manage the project plan at a deliverable level, because there would simply be too many items to manage.

Document Control is responsible for managing the actual documents associated with the list of deliverables. Through the course of the EPC project a deliverable will start out as some type of model. However at some point in time, when the deliverable needs to be produced, a snapshot of the model is used in PDF format to communicate with project stakeholders. The document control system is the traffic cop on the project for deliverables.

Engineering data management is where the actual models are being produced as part of the project. There are potentially many different systems that form the basis of these models and managing this information is a discipline on its own, equally so, where document control is a discipline on its own.

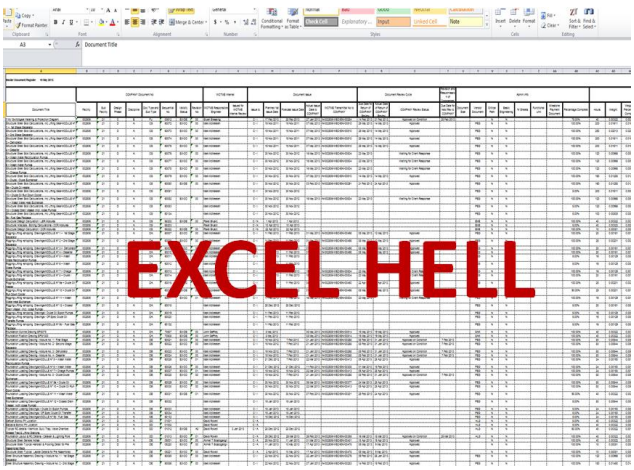
One can easily see how these systems influence each other. A group of piping designers will start working on their model based upon input from the engineering team. An estimated list of deliverables is established through project controls to describe this model for the customer. As this group of designers works on this model, they will log their time on “PUMP STATION A”, so that project controls can relate the effort against the planned budget for that group of deliverables. Equally so, project planning will need to be aware of the estimated and actual effort, to make sure that the level or resources is properly committed.

When the group of designers is ready, they will release 2D views of the model (P&ID’s) for engineering and client review through a document control system. A typical use case could be that a customer wants to receive a 30% review for “PUMP STATION A” on a single transmittal.

5.3 The List of Deliverables – Stepping Away From Excel Hell

In taking a few steps further on the list of deliverables, almost every EPC type project has some form or shape of a list of deliverables. When a project is started, a list of deliverables is negotiated between the owner and the EPC firm. As the project matures, the list of deliverables will mature as well. There is a natural progression of the deliverable set where deliverables are removed; declared obsolete and new deliverables are added. During the project, requirements for the project will change, changes in scope will occur and design alternatives will need to be introduced as the projects will run into practical challenges. In some cases you simply do not know how many documents will be produced (i.e. iso metrics). Maintaining the list of deliverables is therefore a highly dynamic process.

A list of deliverables is important for the project, because many of the contract forms are organized in such a way, where the engineering firm can invoice for work delivered (i.e. delivery of P&ID drawings for “PUMPSTATION A”).



If this is properly organized, it allows the engineering firm to track progress and calculate elements such as “Earned Value”. See: EVM.

When a set of deliverables reaches a certain percentage complete (i.e. 60% - client review) the EPC firm can claim progress on the set distributed. By claiming this progress they are allowed to invoice the customer for the work performed. With smaller projects this is a reasonable task to accomplish, however where projects become bigger, the amount of deliverables will easily run into thousands of documents.

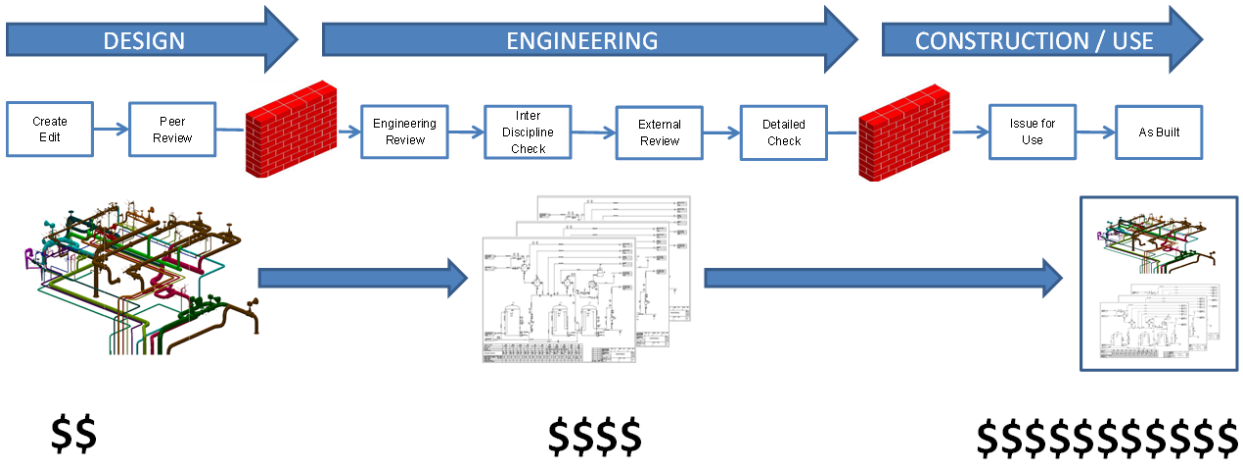
As each deliverable can easily have several revisions, the project team will need to manage tens of thousands of transactions and keep track of who has ownership to perform actions on the deliverable.

A common request for project managers is to quickly identify which party is late in responding to certain information on the project. As time is of the essence in these projects, a typical approach in the contracts is to have contractual timeframes for submission and subsequent return of documents. To prevent the project from stalling, it is also very common that if there is no feedback, the EPC firm and or customer can assume to proceed as noticed.

Managing the list of deliverables should be the responsibility of a document control system. The document control system should keep track of the status of the deliverable and where the document is in the process and the ability to deliver content to the project stakeholders. The document control system should provide a collaborative environment where stakeholders can interact on the document. Issuing the wrong revision or the wrong information on a perceived revision should be an unnecessary evil of the past.

5.4 Engineering Deliverable Lifecycle

For an EPC firm to commit to the list of deliverables and commit to the quality their customers demand they will use several steps from initial creation to actual delivery. Depending on the type of content and the complexity of the project, these lifecycles can change greatly. The following is a sample with a number of steps we have frequently encountered. We can also refer to this as a document deliverable lifecycle.



With the above sample we have purposely displayed barriers between design, engineering and the use of the document. As these are very different groups, the technologies and processes usually differ greatly between these groups.

The individual steps in this lifecycle can be translated to milestones for delivery. Per example, the “External review” step could be a 75% milestone. Upon delivery for external review, the EPC Company would be able to claim this progress and start the billing cycle for this milestone.

5.4.1 Design

The design group will use many complex engineering tools to produce a model of the project. In the sample of a piping model, there are potentially many references files that will make up the model. The design group will have their own business rules on how they want to check the model before the model is released to engineering. In the case of a civil 3D model, they could exercise checks to ensure that the underlying data is of a certain version. While the model is in development, any changes to the model are reasonably easy to accomplish and the cost impact is fairly low.

5.4.2 Engineering

The engineering team will want to review the information as if it would be delivered to the customer. As we can see in the sample, many times the model is then converted to views of the

model that are easy to analyze and distribute. As more team members get involved, any changes that need to be introduced will become more costly to implement. As the deliverable is further developed, the amount of team members will greatly increase. Outside verification by specialty contractors or IDC checks (Inter Discipline Check) are very common during this stage of development. With this increasing number of involved team members, the amount of revision changes should be kept as low as possible to keep the cost for development down.

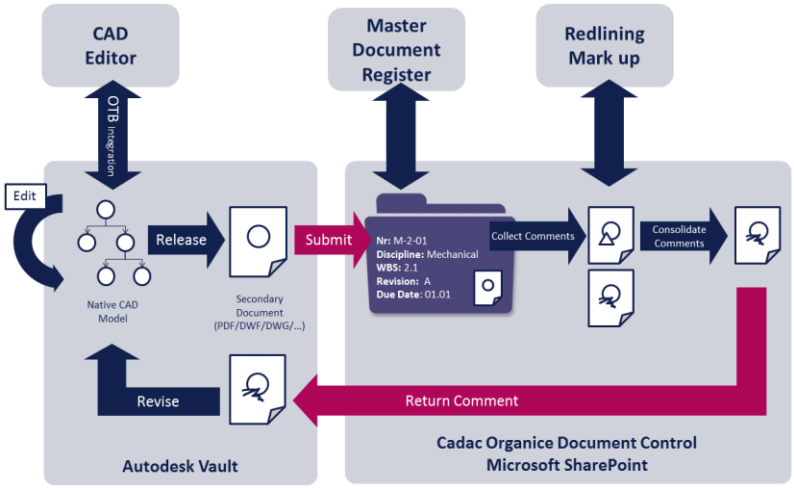
A common challenge during this stage is how does design knows what changes to incorporate based upon reviews conducted by engineering. It's a simple mistake for designers to open the wrong revision of a document and publish respectively the wrong revision for review back to engineering.

5.4.3 Construction / Use

During this stage, the documents have been released for some type of use by the project. There are many types of use, like: acquisition, construction, etc. This step is also were the financial and legal impact are greatest. When deliverables are issued "For Acquisition" the impact of ordering the wrong equipment can cause huge delays on the construction side as well as financial risk for the engineering company.

As the project is being delivered, the actual situation (as built redlines) will need to be communicated back to engineering (design). Upon final delivery a customer could request to receive a "Clean" set of as-built drawings. When the information is handed over, customers also want to be able to include quick changes and modifications on their own. Therefore there is often a request to include 2D DWG versions of these deliverables.

5.5 The best of Both Worlds



As we reviewed the engineering lifecycle, the boundaries of both Autodesk Vault and Microsoft SharePoint are emerging. In a perfect world both systems are fully integrated were Autodesk vault is the tool to manage all your complex models and Microsoft SharePoint facilitates collaboration and recordkeeping of project records.

6 Strengths and weaknesses of Microsoft SharePoint and Autodesk Vault

The final chapter of this handout will review both Autodesk Vault and Microsoft SharePoint as a platform for Capital projects. Both platforms have their strengths and weaknesses and through this final chapter we will explore the most important elements therein.

6.1 Microsoft SharePoint

Microsoft SharePoint is an immensely popular general purpose enterprise content management system.

"According to Microsoft, SharePoint is used by 78% of Fortune 500 companies. Between 2006 and 2011, Microsoft sold over 36.5 million user licenses, Microsoft has two versions of SharePoint available at no cost, but it sells premium editions with additional functionality, and provides a cloud service edition as part of their Office 365 platform. The product is also sold through a cloud model by many third-party vendors."

As the above sounds like a great story, however research by AIIM pointed out, many deployments for SharePoint are stalling. The following conclusions were drawn from this report:

- **Most of the deployments are driven through IT**, with SharePoint being a business application this is a huge obstacle. Through the research it was pointed out that the successful SharePoint implementations are driven by a business effort and only supported by IT.
- **SharePoint out of the Box, is not doing a whole lot,** SharePoint is not an Out of The box **business solution**. By many people it is described as a development platform that will require customization for it to be usable in a given business process. As this is true, this is a contributing factor to the current deployment challenges. With a low perceived market entry point, projects are easily underestimated and don't provide the business value they should in the expected amount of time.
- **SharePoint needs third Party add-ons,** many of the respondents are looking at several options to enhance the SharePoint platform with additional business applications for specific purposes. As there is a large marketplace for SharePoint add-ons, there are however only a few "Critical" business applications.

Despite the slower adoption rate within these organizations, the majority of the respondents will continue to invest in SharePoint, with the most important reason being that SharePoint offers companies a tremendous opportunity to improve how they do business. As companies take on new SharePoint initiatives, they will also need to change how they execute these types of projects.

Because of the large install base of SharePoint there is an abundance of resources to support with any project you have in mind. Furthermore, because of the large install base with many

global enterprise deployments, Microsoft SharePoint is a very stable well defined platform that scales from a few users to tens of thousands of users. A number of business cases are published by Microsoft that describes how SharePoint is being used by large organizations in very challenging environments (TECK Global deployment).

A key capability for the SharePoint platform is its ability for collaboration. By its very nature, Microsoft SharePoint is designed to collaborate on content in a team type setting. Where it needs help is to support the specific business requirements to drive an engineering business process. Cadac Group has been investing in the SharePoint platform for over 10+ years with dozens of successful implementations in an engineering environment.

Where SharePoint really falls short is the ability to understand **native** design files. The main reason for this is that the platform does not support a concept of relationship management. To support the management of complex models, the platform inherently needs to support a relationship model.

From about 10 years of experience in doing this line of work there is a small number of companies that have really succeeded in using SharePoint for native CAD files. Even if through initial conversations the modeling environment seems to be easy, there is usually a level of complexity where Autodesk vault truly has a better approach. As design platforms provide more capability with every release, the underlying technology becomes more complex. With this increase in capability and complexity it also drives the need for an engineering data management solution.

However where Microsoft SharePoint by far outshines the Autodesk Vault application is in all of the other functionality that it brings to the table and therefore as an overall ECM solution provides a more compelling story.

- Business Intelligence Stack
- Reporting capability
- More advanced search capabilities
- Authentication mechanisms
- Office web apps and office integration
- Integration with other LOB applications (Maximo, SAP, JD Edwards, etc)
- Scalability
- Records management
- Project collaboration
- Process Automation
- Third party applications
- Great diversity of deployment models

6.2 Autodesk Vault

With Autodesk vault having its roots in the manufacturing industry, by its very nature it is designed to manage complex models. Autodesk vault offers the best in class integration for the Autodesk product line. It is expanding its integration capabilities to other Autodesk products almost every release. A great advantage of Autodesk Vault is that it offers out of the box an immediate productivity improvement.

For many engineering firms there are many sleepless nights in restoring xref structures, always just before a deadline to a client. Autodesk vault provides a very strong integration with the AutoCAD product line, where the reference integrity is guaranteed. We have done several implementations where the business case for Autodesk Vault was based upon the simple premise of solving the Xref nightmare.

In contrast to the Microsoft Platform there are a number of challenges to manage an EPC project beginning to end.

- Vault does not have the concept of a deliverable. With EPC projects evolving around a managed list of deliverables, this is a major issue.
- Vault does not easily scale to the level as Microsoft SharePoint with a multitier architecture that can be scaled up and down as the situation desires.
- Vault does not have any concepts for records management – legal hold – retention policies etc.
- Vault (OOB) does not have the ability to generate PDF records
- In contrast to a wide array of capabilities on SharePoint the workflow configuration options for Vault are more limited
- Autodesk vault does not support a concurrent engineering scenario for Owner Operators
- Vault is challenged when “Outside Vault” collaboration scenarios are required. The only tight integration available is with buzzsaw. Buzzsaw does offer an interesting collaboration scenario, but lacks functionality to manage the required document control function.
- Vault can only be deployed in “On-Site” scenarios, hosted or hybrid options are not possible currently.

Autodesk vault is geared around providing the best design experience for advanced CAD designers. Where Microsoft SharePoint is targeting a much broader audience geared around collaboration and process optimization. These are two completely different design philosophies for a software development group.

We have also seen companies trying to find the “Holy Grail” in document management to achieve a 100% one-stop shop. With the many different vendors that are available for the design tools and their associated data management systems, it’s almost impossible to suit the needs of everybody. With Autodesk Vault and a SharePoint combined solution a company can achieve the best of both worlds.

6.3 How about the Autodesk integration for Vault and SharePoint

During this last topic we will review the options available by Autodesk Vault to collaborate with outside users.

6.3.1 Vault web client (OTB Vault PRO)

The Out the box web client provides users with the ability to view documents in a browser. This scenario provides the following options:

- Enables (internal) users to search for documents in Vault
- No mark up capability
- No integrated viewer
- No workflow capability
- Only available for Vault professional users

6.3.2 Vault SharePoint Integration (OTB Vault PRO)

The Sharepoint 2010 integration is achieved with Microsoft Business Data Connectivity Services (BDC) by using Autodesk Vault Collaboration or Professional with Microsoft SharePoint 2010. SharePoint users can search, list, link, and download visualization files from Autodesk Vault using the SharePoint interface. It provides the following capabilities.

- Search for documents in Vault from SharePoint
- No security trimming
- No mark up capability
- No integrated viewer
- No workflow capability
- Only available for Vault professional users

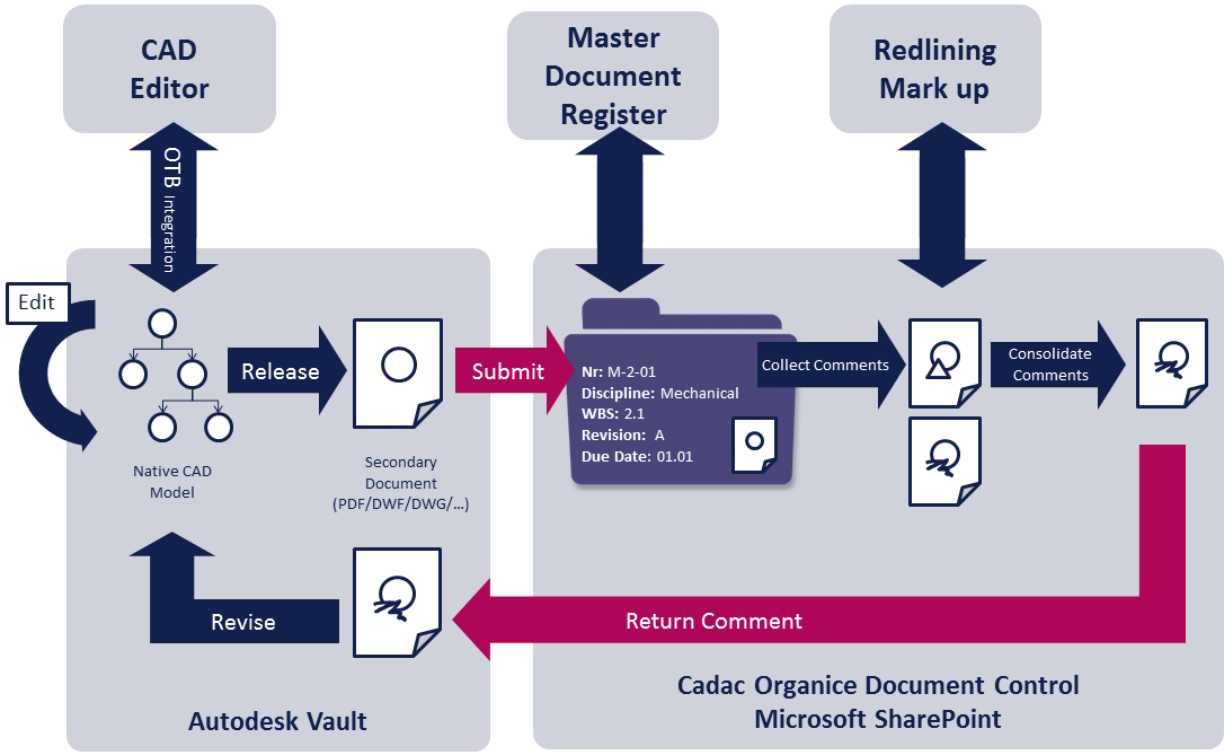
6.3.3 Vault Publish to SharePoint (OTB Vault PRO)

- Manual publish action
- Mono-directional integration (from Vault to SharePoint)
- No integrated mark up capability
- No integrated workflow capability
- Very limited set of publishing formats (Autodesk formats to DWF and ZIP)
- No mapping (library and meta-data) between Vault and SharePoint

6.3.4 Cadac Organice Vault Connector

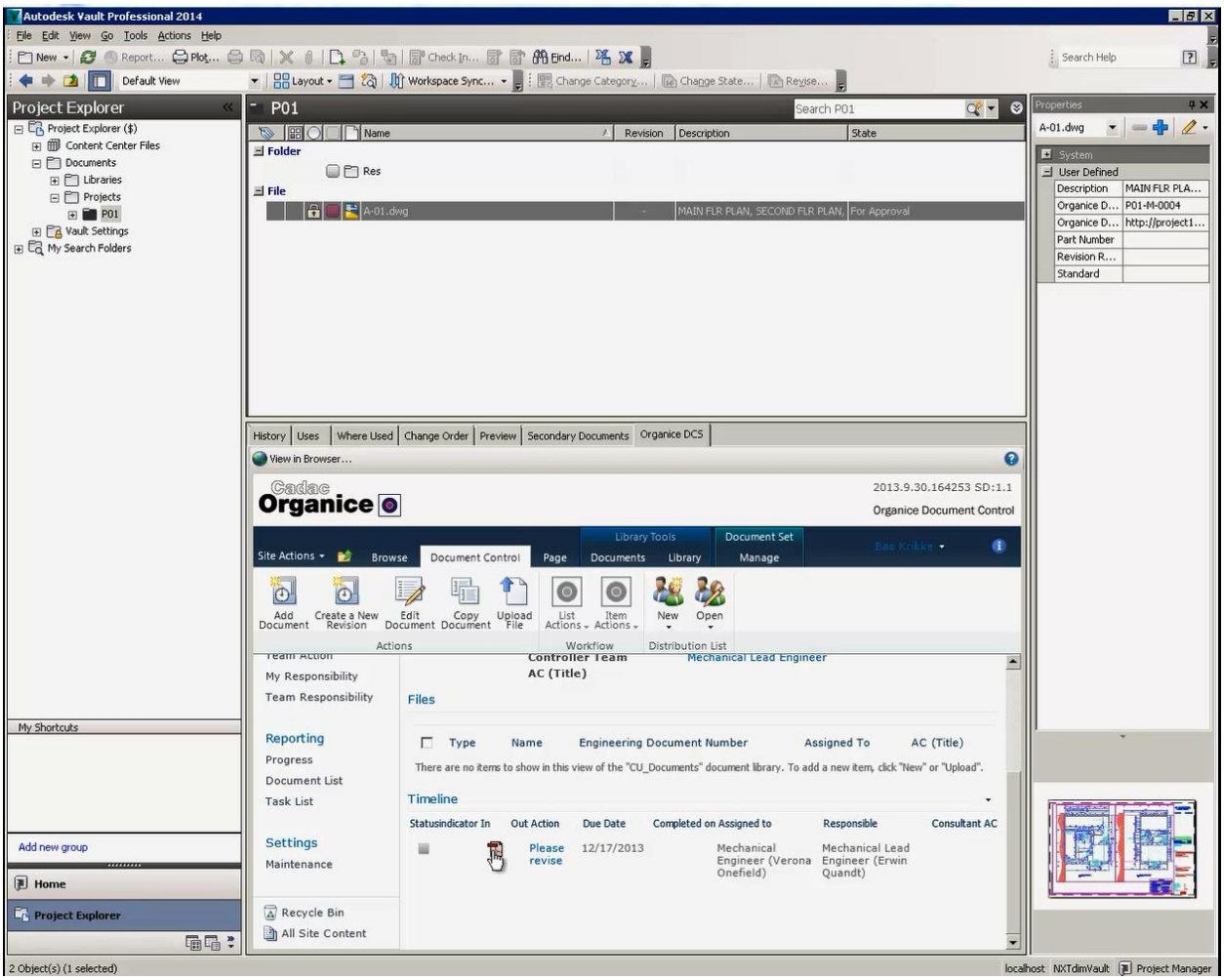
Cadac Group's vault connector provides a full blown bi-directional integration between Autodesk vault and Microsoft SharePoint. The vault connector is part of a document control suite of products specifically designed for EPC type projects and owner operators.

The following diagram shows an overview of this integration.



- On the left hand side of this diagram Autodesk vault manages all the complexity of the native design documents.
- Based upon a release process configured inside Autodesk Vault, the system will produce a non native version of the document that can be used for distribution.
- This document is automatically loaded to a record inside Microsoft SharePoint that controls the lifecycle of the deliverable. All the required properties are mapped between Autodesk Vault and Microsoft SharePoint.
- The Cadac Organice document control system provides the ability to control the lifecycle of the document and manage all the typical review workflows for engineering.
- Upon consolidation of comments, the document will be made available for the designer using Autodesk vault.

Below is a screenshot that displays the integration between Autodesk Vault and Microsoft SharePoint.



7 Bibliography

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