

WHITEPAPER

Engineering Documentation - Business Opportunity or Technical Challenge

A discussion paper for organisations responsible for the operations and maintenance of oil & gas, pharmaceutical, mining, energy, utilities, infrastructure assets and large or complex factories or facilities.

Mark Goodwin

McLaren Software

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Introduction

Companies that operate and maintain large physical assets like oil refineries, power stations, water distribution infrastructure, factories and airports, face a number of challenges and opportunities relating to the management and control of engineering documents.

In this paper, we will discuss good working practices for assuring the integrity of asset documentation. What this means is that, in addition to making asset documentation readily available, you must also guarantee they are accurate, relevant and compliant.



More for Less / “Sweat the Asset”

If you are the owner/operator of any large physical asset you will be under pressure to “get more for less” (extract more value from the assets next year while reducing operational and capital expenditure). The value of your assets may well be measured in billions of dollars and without doubt output and costs measured in hundreds of thousands of dollars.

Asset Information Integrity

Assets are renovated, reconfigured, extended and eventually decommissioned to meet changing business demands or external regulatory requirements. It is vitally important that documentation is controlled so that it complies with industry regulations and is reliable and accurate for safety and efficiency. Documentation must be available for operational and inspection purposes for the life of the asset. Effective operation is impossible without accurate up-to-date health and safety documents, policies, procedures, and as-built (or “best so far”) engineering documents and drawings.

Aging Workforce

As the baby boomer workforces age (especially true in the Utilities sector) and retire, the knowledge and work practices built up over many working lifetimes is in danger

of being lost. All the more reason to ensure the right documentation and control processes are available to the ‘new crew’ that may lack the experience or working knowledge to ‘just know’ which information is safe to use.

Information Incidences

Using the wrong document can result in minor to catastrophic incidents causing lost production, fines, suspensions, serious injuries or deaths, and all of which can adversely impact families, brand image, investor confidence and share price.

eDiscovery

‘Information incidents’ often trigger an eDiscovery process by a regulator. If you are subject to an eDiscovery the engineering documentation (records) identified as relevant by investigators must be placed on legal hold. Evidence is then extracted and analysed using digital forensic procedures for use in court. Aside from the eventual settlement, this process can be a significant cost to your business.

Regulators and investigators are not just looking to prove the validity of documentation but also that the processes that govern the creation, approval and use of that documentation meet the regulations concerned.

Maintenance Turnaround

Downtime, for example, for a maintenance turnaround, can be very expensive not only due to the direct cost but due to the lost revenue.

Wrench Time

There have been lots of studies over the years on how to optimize “wrench time”. Wrench time is a measure of operations and maintenance staff at work, using tools to do work. It doesn’t include other necessary activities like time to: get parts, get tools, get instructions & information, travel to/from the job location, train for the job or take breaks. The argument goes if the percentage of ‘wrench time’ can be increased then a smaller workforce can do the work of a larger workforce. Typical wrench time is 25-35% if this could be raised to 50% then a 30 person team could do the work of 60 people .

Capital Projects

A capital project is a new construction, expansion, renovation, or replacement project for an existing facility or facilities. Costs can include the land, engineering design, project management, and contract equipment services needed to complete the project. The project could be a ‘green field’ project with no constraints imposed by prior work or brown field where there is a requirement to remodel or demolish existing structures.

All capital projects generate many project records (plans, contracts, correspondence etc.) and engineering records (drawings, technical documents etc.). Throughout the project and most especially during the commissioning and start-up processes engineering records need to be handed over in a controlled way to operations to provide a basis for the documentation required to operate and maintain the asset.

Concurrent Engineering

There are added complications when there are multiple projects in progress on an operational asset or perhaps part of an asset is operational in a multi-phase project. As large scale projects can last for several years, it is vitally important to support multiple concurrent projects which all require access to modify the same technical documentation and drawings. While the projects are on-going and following completion it is essential that the right documentation is issued at the right time and that changes made to the same documentation at different times by different parties are reconciled in time to support operation.

Operations & Maintenance or Engineering View

Depending on the part of the organisation you hail from you may well have a different view of document control.

future, what will be purchased, what will be constructed. To aid project expedition the logical organisation for the documentation is to reflect the work breakdown structure of sub-projects and phases and contracts and purchase orders.

The right document for Operations & Maintenance in many cases is not the latest revision. Let's consider an example where a drawing has just been modified and approved for issue in a bid package for a contract to make a major modification (approval scope is 'For Procurement' not 'As-Built').

To support these two organisations it is important to manage the processes for the transfer of documents and specifically ownership of revisions.

Field Changes

When working in the facility, documentation errors that were missed during commission, start-up and as-built inspections are spotted. On-going operation, maintenance and reconfiguration continually change assets and procedures. The associated drawings and documents need to be revised to keep them accurate and synchronized. These changes are likely to be captured on a locally issued set of documents and drawings as annotations. The

The Right Document ? But for who?

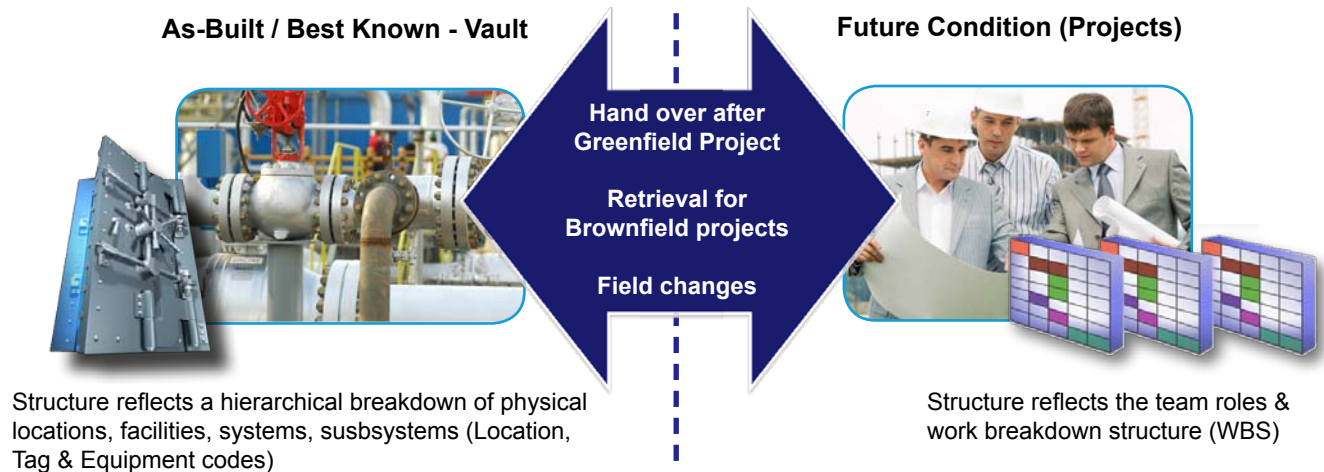


Figure 1 Operations & Maintenance or Engineering View of Document Control

In Operations & Maintenance As-Built is king, you want to use the documentation that most accurately reflects the current condition of the site. You definitely don't want to be using the latest document that is being used for procurement or construction to carry out maintenance. Also, because projects are transient and overlapping – the only logical way to organise the documentation is to reflect a logical asset breakdown structure of locations and equipment/assets.

Engineering projects on the other hand are all about the

person who marked up their own set of documentation is not the only person who will rely on the information. To reduce the risk of an information incident it is very important that field changes are captured and the master set of documentation updated.

Issuing and Superseding

A set of asset documentation is extremely useful and our natural instinct is often to keep a copy for ourselves for convenience. These 'convenience copies' may also accumulate additional annotations. Capital projects and

operation and maintenance work all cause documents to change – new revisions need to be issued. The issuing process needs to take account of superseding not only electronic copies but the physical convenience copies too.

A practical approach where physical copies are required is to have numbered copies with nominated owners who are responsible for physically destroying superseded revisions. All other uncontrolled copies should be clearly watermarked or stamped as such.

Volume Changes Everything

The sheer volume of documentation that needs to be managed to maintain and operate a production asset is vast. A single asset can have hundreds of thousands of individual pieces of documentation which may have

many critical dependencies, making it extremely complex to manage. Asset documentation can come from internal and external sources, and any changes made to the documentation must be recorded and communicated in a controlled manner.

Managing as-built documentation is a growing challenge, primarily for the reasons just stated, but also because it is common for several new and on-going capital projects to be executed concurrently to refurbish and extend facilities. The result of this is simultaneous modification of the same engineering documents by different capital projects and maintenance teams working in parallel. Not only are the existing documents being modified, but they are modified and extended in different ways. When they are brought together, they don't always fit neatly to provide a consistent view of the facility without any gaps.

The Opportunity

The corollary of all this must be that anything that can be done to accelerate the commissioning, reduce the length of the maintenance turnaround, manage transfer between operations and engineering, reduce the risk of information incidents, stem the knowledge drain, comply with and facilitate an eDiscovery, optimise wrench time, manage change and deal with the volume could significantly increase the cost control and efficiency of a plant or asset.



down procedure for generator' and you come back with a page with a list of documents with a 98% confidence indicator that it is the first in the list, 97% the second 96% the third and so on.

What is rarely measured is the amount of time an engineer would spend validating a document found as a result of a search with colleagues to determine if it is indeed the correct version. The more time spent evaluating the lower the confidence the engineer has in the document.

Managing Risk

Think about it, would you like to be in this position? There is only one correct shut down procedure for this generator and it should already have been included in the work order along with the accurate up-to-date health and safety documents, policies, and as-built (or "best so far") engineering documents and drawings documents.

Quality

Wrench time can be optimized by removing the need for the maintenance engineer to spend a lot of time searching for the documentation they need. The safety and quality of the work is increased by also managing the process to assure the integrity of the documentation.

Confidence

Whilst work studies into wrench time can be useful and reducing 'time spent looking for information' will certainly help to optimize 'wrench time' it is not the full story. What is the effect of confidence in information – confidence that comes from knowing that it has been through a quality controlled process? Could consistently providing accurate information improve the quality of the work and/or reduce the time jobs take?

Return on Investment (ROI)

Document management vendors have consistently used the % of time (usually 40%) an individual spends looking information as a contributory measurement to a ROI calculation (offering solutions with full text searches as the key feature). Let's consider the following example, imagine you are a maintenance engineer and your job today is to shut down a very big and dangerous piece of plant and, unsurprisingly, you would like to use the approved procedure. You do your search and enter 'shut

Document Vault

One approach is to simply create a vault or designated file share to publish As-Built documents like records of invoices. However, unlike invoices, engineering records need to be constantly revised to remain relevant. Often then processes which govern the changes are over-

looked and the confidence the business places in the vault diminishes.

Ease of Access

So we have a controlled vault with the right documentation so how do the people and systems that rely on them access them?

The Solution

McLaren's Enterprise Engineer for Assets is designed for companies who own and or operate large or complex physical assets. Complementing plant maintenance applications like Oracle JD Edwards EnterpriseOne, SAP Plant Maintenance (PM) and IBM Tivoli Maximo Asset Management, McLaren Enterprise Engineer provides a document management and control solution to support maintenance, repair and operational (MRO) activities. It has also been designed to enable documentation related to the management of change (MOC) including turnarounds, field changes, brown field as well as multi-phase green field capital projects.

Unfortunately, lifecycles for assets are not as simple, straightforward or consistent. The reality is that operational assets are in constant flux:

- Systems are upgraded and/or reconfigured.
- Equipment gets swapped out of service to be refurbished and returned to different locations

Maintaining the accuracy of the documentation is critical to maintaining the integrity of the asset. **McLaren Enterprise Engineer** provides the business processes that assure that documentation changes are made in a quality controlled manner.

Asset Lifecycle Management

Modern plants go through several distinct phases during their lifecycle. McLaren Enterprise Engineer is a business application that manages documentation accumulated throughout the asset's lifecycle.

The evolution of assets from the initial design, through collaboration with EPC contractors and vendors, construction, handover/turnover & commissioning, through operations, routine maintenance, expansions and refurbishments, and finally decommissioning is dependent on the creation, transfer and revision of hundreds of thousands or millions of documents.

Enterprise Engineer for Assets is designed to address the management of asset documentation through all lifecycle phases; making extensive use of Enterprise Engineer package technology to simplify the handling of large batches of documentation. Capital projects equally generate large volumes of documents, drawings and associated metadata that need to be made available to internal business processes, and ultimately Operations and Maintenance teams. Owner/Operators need secure auditable methods of sending and receiving information to and from engineering projects, suppliers and equipment vendors. At the end of a project, ownership of the documentation is formally transferred to a secure area (known as an Asset Information Vault).

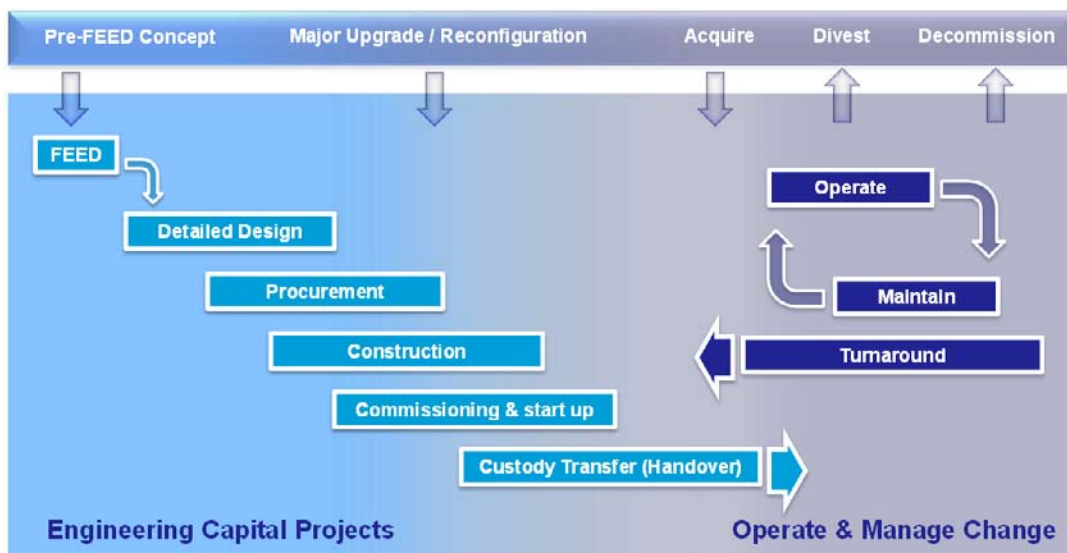


Figure 2 Asset Lifecycle

Enterprise Engineer manages handover (turnover) from both internal and external parties and the management of change of asset documents. Effectively managing this information exchange is key to ensuring assets remain efficient, safe and compliant.

Below is a summary of key processes/functionality supported by Enterprise Engineer:

- Handover of information created during design & build phases
- In-built review processes allow comment documents and mark-ups to be collated and consolidated internally, and then sent back to external parties for further revision
- Default review, consolidation and submission dates ensure contracts are met
- Secure access for external parties to marked-up documents and comments
- Access to historical information e.g. used by engineering projects as reference material. Operations & Maintenance history is used during plant upgrades to evaluate the performance of existing equipment
- Management of vendor and supplier handover drawings, diagrams, maintenance manuals etc. associated with purchase orders. Validation tools ensure vendor and supplier document metadata meets business rules
- Access to validated as-built documents for Operations & Maintenance through an easy to use document access portal
- In-built management of change processes to manage asset document revisions
- Reconciliation process enabling incorporation of differences between handed over documentation and company standards, existing vault versions (master drawings), and other versions of the same documentation being used on other projects.
- Concurrent engineering processes enabling engineers to work in parallel
- Distribution Matrix automatically ensuring the right person receives the right document

Asset Information Vault

Enterprise Engineer for Assets provides a secure Asset Information Vault which is more than just a repository for storing asset related content. It also provides the business process verification steps and security needed to control the creation and on-going change management of asset documentation.



An asset information vault is divided into two principal areas:

- The masters area.
- The released area.

The **masters area** contains the source documents and drawings in their native format and has controlled access through built in security. The **released area** contains copies of the approved documents that have been rendered into a read-only format, PDF for example, and made available for business consumer use. The logical organizational structure for the vault is based on the Asset Breakdown Structure (= functional location breakdown structure and asset/equipment breakdown structure) a logical hierarchy of the physical sites, facilities, buildings, systems, subsystems and actual equipment.

As many large scale projects can last for several years, it is vitally important to support multiple concurrent projects which all require access and modification to the same asset documentation (or concurrent engineering).



Enterprise Engineer for Assets provides the necessary processes to control the change management of asset documentation by automating these key processes:

- Retrieval (Sign-out) of asset documentation from the vault to a project team
- Handing over new and modified documentation from the project back to the vault's
- Reconciling the documentation with vault copies, copies on other projects, and checking for adherence to quality standards
- Formal release of the new asset documentation into the vault
- Reconciliation
- Reduce plant shutdown time, maintain operating licenses and improve production

Operations and Maintenance engineers need access to:

- o Currently effective documents and drawings

- o Latest approved and released as-built drawings or “best so far”
- o Currently sanctioned revisions of procedures and policies

Enterprise Engineer for Assets supports:-

- o Handover from engineering projects
- o Concurrent engineering - Synchronization of documents between multiple maintenance projects
- o Integration to EAM systems
- o Controlled / secure access to approved as built documents and drawings
- Synchronizes master with released documents and drawings

Asset Breakdown Structure

The Asset Breakdown Structure (ABS) can be assigned to a project revision either within the project or during Reconciliation (as the project team may not know what it should be). Vault documents can be associated with multiple facilities or systems therefore it is necessary to be able to apply more than one ABS location code to each document. Documents with multiple asset codes applied to them will be linked to multiple ABS location code folders when they are transferred to the Masters Area and published to the Released Area within the vault.

Industry regulatory bodies require evidence of a formal change management processes. Documents need to be controlled and the Change, Retrieval, Handover and Reconciliation processes must also be captured.



Plant and Equipment Tag Numbers

Organizations assign tag numbers to equipment to define their location and ensure that they can be easily located. Many documents can relate to many pieces of equipment therefore to manage their assets; organizations need to be able to assign multiple equipment tag numbers to documents stored in the vault.

The tag numbers associated with particular documents

can be updated during the project revision or Reconciliation process. In Enterprise Engineer for Assets, a list of tag numbers will be available to users through the document properties dialog. Documentation can be located by searching on tag numbers or by running a report of all tag numbers associated with particular documents.

Equipment Files

Not all documents are associated with the system or functional location, rather they are associated with a specific piece of equipment in that location this can include certificates, drawings, manuals and maintenance histories.

Management of Change

Industry regulatory bodies require a formal change management processes to be both followed and audit-able. Documents need to be controlled and the change, retrieval, handover and reconciliation business processes must also be captured. **Enterprise Engineer for Assets** assists Change Management by supporting good working practices for managing information related to an asset, and how changes are handed back over to the asset when completed.

Capital investment projects are set up to create new assets and to make major changes to existing assets, with smaller changes to assets typically made by minor works or maintenance projects. The **Enterprise Engineer for Assets** primary process, consisting of three main activities: retrieval, handover (turnover) and reconciliation, supports these long term capital investment projects and consists. These large scale projects can often run for years with different projects requiring access to the same documentation at the same time. Thus the primary process facilitates the modification of the same content on multiple concurrent projects – known as concurrent engineering.

Documents can be assigned a critically level (‘Non-Critical’, ‘Critical Business’, ‘Critical Safety’, ‘Critical Quality’) which drives different rules for the number and level of the parties involved in review/acceptance/approval processes. So for example, if the rating of at least one document in a package that is ‘Critical Safety’ then it may need to be approved by two qualified engineers but it does not need approval by the quality representative.

Quick Turnaround

Operations and maintenance organizations implement minor works projects that require small scale engineering and design, project management, procurement management and site management. These maintenance projects may only have duration of a few days.

Enterprise Engineer for Assets supports the ability to use simplified processes that deliver the elements of the processes carried out on major capital projects that are appropriate for these smaller scale/short duration projects.

This process may be used in the following situations:

- An urgent change needs to be made to a Vault Document
- A minor update needs to be made to a Vault Document in response to a maintenance request
- A minor update needs to be made to a Vault Document in response to a field change

Improved Tracking

Enterprise Engineer for Assets maintains a thorough documented history of all documentation showing when processes were started, authorized, verified and completed - by whom and for what purpose. For example, the audit record created when a document was released as the effective active record and the audit record created when the document is superseded or made obsolete clearly denoted the operating or safety envelop for the document which may be very important for eDiscovery.

The comprehensive audit trail allows the modification of documentation to be traced back through its lifecycle. Reporting is provided to show evidence of compliance, documentation status, process exceptions and workload forecasting. To help provide a clear overview the same information can be available via graphical dashboards showing the status of both documentation and document control processes.

As an owner-operator, it is imperative that the integrity of asset documentation throughout the lifecycle of a plant or facility is not only maintained but readily proven to be so.

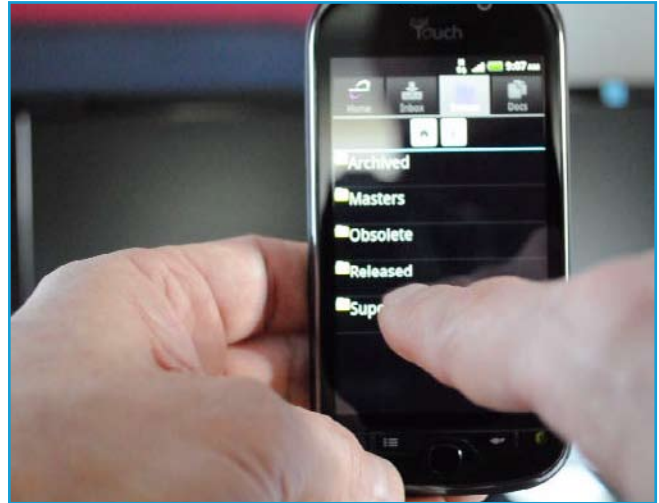
Reduced Costs

Cost containment is primarily linked to the reduction of elapsed time (down time) to perform maintenance and other asset related tasks. Most owner/operators manage thousands of documents a week and to process them individually is very time-consuming.

McLaren's Enterprise Engineer for Assets allows users to process packages of documents instead of one document at a time to be managed, thus accelerating the project and reducing costs without compromising quality.

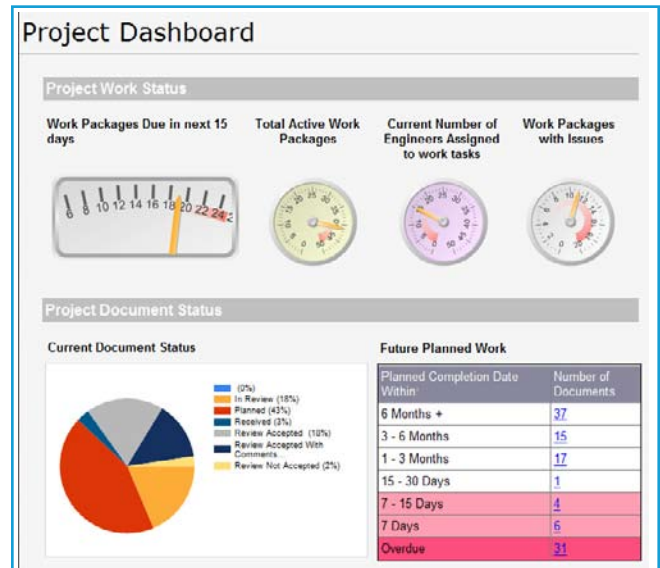
Ease of Access

In addition to the full McLaren Work Manager Smart Client, users can access documents controlled by Enterprise Engineer for Assets through a simple web portal, mobile device such as a smart phone or offline repository. The true value of all these methods of access is that this extends the range of trusted information.



Business Intelligence

Now that you are in control of the process that drives confidence into your asset documentation. The next opportunity is to use a business intelligence portal to enable you to debug bottlenecks and optimise the process.



Conclusion

As an owner/operator, you must maintain and share relevant documents throughout the life of an asset. If you don't manage your asset documentation, you can have some serious problems on your hands; including project delays, increased down time, regulatory and health and safety issues.

All of this affects your bottom line. It is a high risk situation, considering that the value of these assets can be measured in billions of dollars, and each asset has a daily cost and revenue stream in the hundreds of thousands if not millions of dollars. A single asset may accumulate hundreds of thousands, perhaps millions, of documents with complex multiple relationships, so how can you guarantee that you are working with the correct, most updated, and relevant documentation?

Enterprise Engineer for Assets will help you to assure the integrity of your asset documentation providing your business with:

- Support to minimise the impact of your aging workforce
- Access to the right documentation at the right time
- Reduced risk of non-compliance

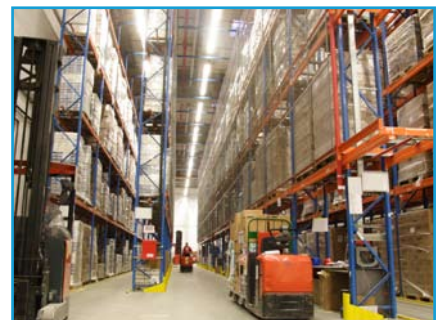
- Minimized rework and project delays
- Bridging the gap between engineering and maintenance operations
- Control of your asset documentation
- Optimize Wrench Time
- Ability to deal with high volume

Metcalfe's Law states:

"The community value of a network grows as the square of the number of its users increase".

The same must be true of a system that supports asset lifecycle management. Ultimately, it is about all distributed organisations and individuals working together to deliver greater benefits than can be delivered by any individual or isolated team.

The right interface for the right user/role – No one size fits all - people should use the tool best suited to the job at hand and not be interrupted by the complexities of document management and control. But that is a discussion for another paper.



About Mark Goodwin



Qualified as a Chartered Instrumentation & Control Engineer with over 20 years' experience of both major capital engineering projects and asset operations. Prior to joining McLaren Software Mark worked as an Engineer at Thames Water and at Black & Veatch. At B&V he designed and implemented an engineering project execution system supporting over 1000 projects in 50 offices in North America. At McLaren Software Mark, as the Principal Architect, is responsible for transforming customer requirements and technology advances into pragmatic business applications.

About McLaren Software

Part of IDOX plc McLaren Software has over a decade of Engineering Document Management and Control expertise.

Our Customers

Our customers are typically Owner Operators and EPCs operating in highly regulated industries where access to validated engineering documents and drawings is essential for the efficient, safe and compliant operation of a plant or facility.

Our Solutions

Our reputation is built on our successful implementations and the quality of our products. Each member of our solutions team is an expert in their field and highly skilled in solving engineering document management challenges.

Our solutions support each stage of the asset lifecycle from FEED, capital projects, handover to operations & maintenance.

Best Industry Processes

Best practice industry processes ensure the management

of change is applied consistently across all engineering activities from a single plant or facility to multiple operations.

Enterprise Engineer

Enterprise Engineer™ is in use in over 100 implementations throughout the world supporting in excess of 85,000 users. McLaren Software applications are accredited by leading ECM and Collaboration technology vendors including Autodesk, EMC, IBM, and Microsoft.

Our Partners

To protect and maximize customer investments, McLaren partners with leading technology companies to ensure all McLaren products and solutions continue to work with the latest releases of supporting platforms and applications.

Office Locations

Headquartered in Glasgow, UK with North America Operations in Houston, Texas, USA and a growing number of reseller and service partners in all major geographies.

www.mclarensoftware.com

McLaren Software Inc.
10375 Richmond Avenue
Suite 825
Houston, Texas 77042
USA
Tel: +1 713 357 4710
Fax: +1 713 357 4711

McLaren Software Ltd
95 Bothwell Street
Glasgow, G2 7HX
UK
Tel: +44 (0)141 227 7600
Fax: +44 (0)141 227 7601

Idox London, UK
Second Floor (South), Chancery
Exchange, 10 Furnival Street,
London EC4A 1AB
Tel: +44 (0)207 332 6000
Fax: +44 (0)870 333 7131