STEP into the Real World

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1. Introduction

In the Process Industries there is a move to develop STEP based data warehouses to support both the integration of design information, and the support of plant operations and maintenance activities. This paper reports on early experience of one of these projects, to develop an On-line Data Dictionary System (ODDS) for the Shearwater project, a North Sea platform development. This project also represents early exploitation of the results of the Esprit Project No 20506, Pilot Implementation of a Process Plant Information Warehouse (PIPPIN) by Shell.

2. Acknowledgement

The author wishes to acknowledge the permission of the Shearwater Project to use material from the project in this paper.

3. Background

In the process industries, owner/operator companies are increasingly aware of the benefits of acquiring process plant design information in electronic form as part of the project deliverables, in order to improve performance of the asset throughout its life. Contractors have been using CAD (Computer Aided Design) and related systems for a number of years, but have been used to support a paper based, rather than data based, delivery of information.

The requirement to deliver design information as data, so it can be used and maintained electronically during the operational part of the plant life-cycle, has placed a challenge on the design contractors to deliver design data in a consistent and integrated electronic form. This is leading design contractors to develop engineering data warehouses able to support the integration and consolidation of data from a number of design systems as a mechanism to ensure consistency and appropriate quality of data prior to handover. Some are looking to gain benefits in the design process from having the integrated data available to support the engineering design and construction activities.

Similarly, owner operators are identifying benefits that access to design data in electronic form provides for decision taking during the life of a plant, and improvements that can be achieved in maintaining design data consistently to reflect plant changes. The results of this are in reduced reaction time and cost to unplanned maintenance requests, and the increased plant availability that results from this. In addition, during major shutdowns, consistency of information can help to reduce construction errors, and hence reduce total shutdown time.

Data warehousing of engineering data requires the use of data models that are able to support the data management requirements that bringing together data from different sources and integrating them demands. The only data models currently available to do this in the process industries are based on the EPISTLE Framework and Core Data Model (http://www.stepcom.ncl.ac.uk/). These models include the ARM (Application Reference Model) of ISO 10303-221 - Plant Functional and Schematic Data, and ISO 15926 Integration of life-cycle data for oil and gas production facilities (ISO 15926 represents the formal standardisation of the POSC/Caesar data model).

The PIPPIN project has played a major role in investigating and eliminating the technical barriers to implementation of engineering data warehouses, and in bringing together interested parties to exploit business opportunities.

4. The Shearwater Project

Shearwater is a £1.5b North Sea oil development project. The Shearwater Alliance is a consortium consisting of Shell Expro, AMEC Process and Energy, and Heerema. The project involves all aspects of the facility from front end engineering through to field operation. This incorporates design, fabrication, hook-up and on-shore commissioning, installation, offshore commissioning and operation.

As part of the development the Shearwater Alliance is seeking to hand over the design information for the plant in electronic form, rather than paper, and in as intelligent a form as is practicable. This process started with the development of the Shearwater On-line Document System (SODS). However, significant amounts of the information is data rather than documents, and this lead to the desire to develop an On-line Data Dictionary System (ODDS) to integrate data from a number of different design systems.

5. Existing Situation

5.1 Business

The alliance approach to project development means that there is both a risk sharing and profit sharing approach to how the project operates. This is designed to encourage behaviour that is to the benefit of the Shearwater development over its whole life, rather than emphasising the traditional confrontational relationship that can exist between contractor and owner/operator. This provided an open relationship, which was essential for the success of a ground breaking information systems project like this one.

5.2 Technical

The design systems being used included major packages for intelligent Piping and Instrumentation Diagrams (P&IDs) and Electrical Diagrams, and a large number (10+) small systems. These systems are developed to deliver design information on paper. Further, the same information can be found in a number of different systems, both simultaneously, and at different stages of the design and construction process.

6. Project Objectives

6.1 Business

The main objectives of the On-line Data Dictionary System are:

- Integration of data from a range of design systems to support:
    - Improvement of design data quality, especially duplication and inconsistency of data, and
    - Delivery of consistent data to construction and commissioning systems,
- Delivery of design data to the operations and maintenance phase in a STEP based form to meet contractual requirements.

6.2 Technical

The technical objectives of Phase 1 of the project were:

1. Develop an Engineering Data Warehouse to provide an integrated and consistent source of data,

2. Acquire data from a limited number of source systems and integrate the data from different sources about the same things,

3. Demonstrate the potential of an Engineering Data Warehouse to deliver benefits in the design and operations phases.

7. Approach

Following a tender process, Quillion's PETS product was chosen as the basis for the development. To undertake the implementation Shell Services International was asked to provide technical direction for the project, and to provide a team to support the configuration of PETS and the implementation of the necessary interfaces. The team was brought together from a number of sources, including EuroSTEP, PDT Solutions, REV-ENG Consulting, and STEPdata.

A feature of this project is that there is no record of similar projects from which a clear pattern of what to do has emerged. Thus a learning approach was deemed to be necessary. This means that it was not assumed we could predict precisely what would happen, and that we might make mistakes and have to change the course of the project to reflect our learning. A prerequisite for success when you are not precisely sure of what you are doing, is a high quality team and the selection of individuals from the companies mentioned above reflected this.

A key part of a project of this nature is managing risk. If you look at the full ambition that the Shearwater Alliance have, and indeed both Shell Expro and AMEC have in terms of what they wish to achieve and develop to improve their business performance through improved management and availability of engineering data, then it is clear that taken as a whole it is a significant undertaking that will affect both business processes and software.

If a project of this scale is undertaken on the grand scale, there is significant risk of project failure. The approach taken by this project was therefore to "Think Big, Act Small". This means that whilst the grand vision is kept firmly in mind, that the whole development is undertaken as a series of phases. Each phase should be small enough to be manageable, yet be significant enough to deliver benefits in its own right. Each phase should also contribute to the overall vision, and act as a foundation for later phases.

With this approach, the risk is limited to a single phase, which, since it is more focused, is easier to manage anyway.

Within a phase of a project with this multi-phase approach there might be work undertaken that belongs to one of a number of threads. Understanding which thread work is in helps to understand the reasons for undertaking it, and for prioritising work. Four threads were identified:

1. **Tactical:** the main thrust of this phase that will produce deliverables that give direct benefits.

2. **Strategic:** activities that do groundwork for later phases, and which ensure the long term success of the development. Benefits will accrue in later phases of the development.

3. **Follow-up:** following the main delivery of the tactical thrust, there may be a number of loose ends that arise from review of the deliverables, or extension of work to other areas. This activity may overlap formal phases.

4. **Exploitation:** activities undertaken based on the tactical deliverables, to ensure benefits are harvested. This may include training and support of users, or providing other support services in the use of the systems developed.

8. Results and Experience

Phase 1 was delivered on-time (three month time frame) and to budget £250,000. Benefits delivery has not started yet, but expectations are that predicted benefits will be delivered. Figure 1 below shows the implementation developed.

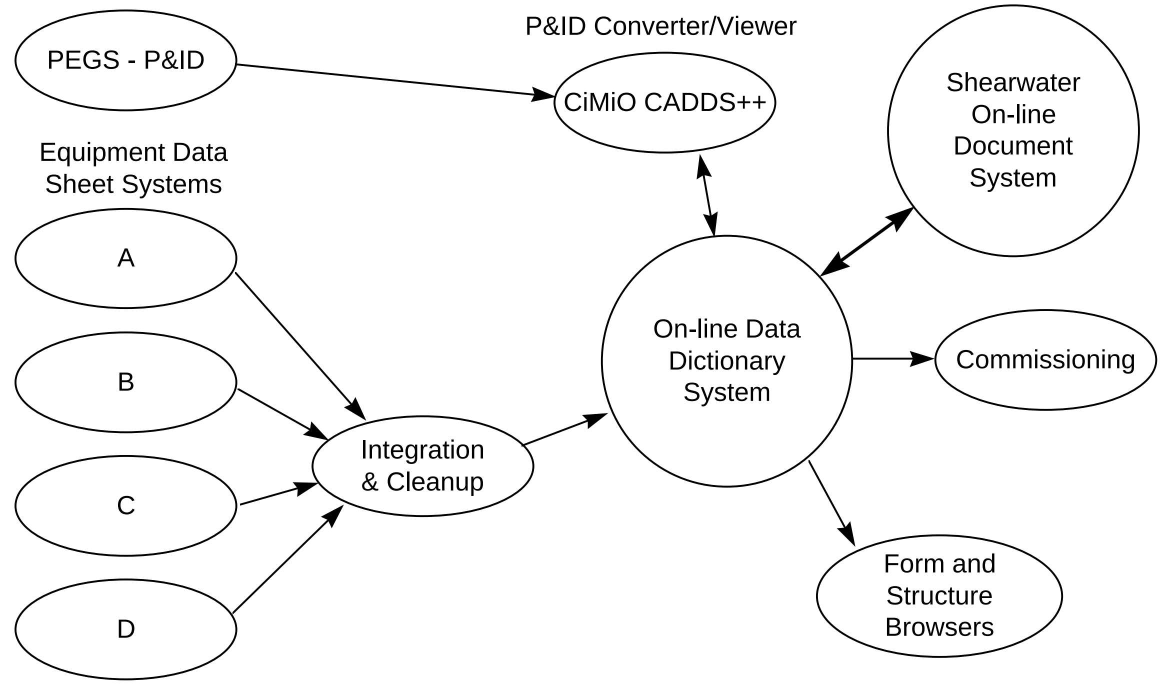

Figure 1: The On-line Data Dictionary System.

thread of Phase 1 of this project are:

- An Engineering Data Warehouse implementing the PIPPIN developed data model, itself based on the ARM (Application Reference Model) of AP221 and the EPISTLE Framework. This was implemented using Quillion's PETS data management product.
- A number of sample browsers to access the data in the data warehouse.
- A class library, based on that used by ETAP (Eastern Trough Area Project).
- Semi-automated interfaces from a number of source systems that map and integrate data from a number of source engineering systems into the data model and class library of the engineering data warehouse. The interfaces are one shot interfaces, so if update of the engineering data is required then a flush and load process is required. The master data resides in the source systems.
- Data loaded from the source systems into the data warehouse.
- Links were provided from ODDS to SODS.
- A sample intelligent P&ID has been loaded and linked into the warehouse so that the potential of integrated drawings and data can be demonstrated. CiMiO's CAD++ browser was linked to PETS to achieve this.

The source systems consisted of CADCentre's PEGS, and a number of specialist AMEC engineering systems, many of which held their data in relatively simple databases. The striking thing that characterised all these systems was that they targeted delivery of design information on paper, to be read by an engineer. In extreme cases this even meant that a text field might be used to hold data like "109KW". There is certainly no ability to deal with changes in design data, or to flag updates. This resulted in the development of interfaces that supported incremental updates being difficult or impossible to develop.

This should not be a surprise. The business requirement has historically been for delivery of design data on paper for handover to the user. However, it is an indication of how much there is to do to move from a paper based to a data based paradigm.

The original expectation was that permanent STEP based interfaces would be developed between each of the source systems and the data warehouse. Building a permanent interface means that a thorough understanding is required of the:

- data model of the source system,
- the usage made of the data model by the application, and
- the usage of the application by users.

To gain this understanding, temporary interfaces were constructed to the source systems in order to examine both the data model and the data stored. This activity proved extremely valuable, and resulted both in a clear understanding of the source data, and resulted in discovery of defects in the source data that could have been costly if they had not been detected.

However, in the light of the shortcomings of the source systems in a data based rather than paper based environment, and given that the cost of interfacing to the systems would usually be more expensive than redeveloping the system directly onto the data warehouse, only temporary interfaces were developed.

9. Conclusions and Next Steps

There are a number of conclusions that can be drawn from this project.

1. The development of the Shearwater On-line Data Dictionary System is one of the first projects in the process industries aimed at delivering benefit from the investment the industry has made in STEP. The project customers are confident that, as a result, their investment in ODDS will show a good return.

2. The technology to support Engineering Data Warehouses based on EPISTLE style models is available, and from evidence of other projects from more than one source. Thus implementing projects of this type may formally be considered to be a leading edge, rather than bleeding edge use of technology.

3. Many engineering systems today are designed to support the paper based paradigm for managing information. From the experience of this project, it is clear that to move to a data based paradigm will require the redevelopment of many of the existing engineering design systems.

4. STEP was vital to the success of this project. However, it was not used directly, but indirectly. No process plant AP has reached International Standard status, so no part of this project could claim STEP compliance. However, data models and Class Libraries developed as part of AP221 were at the heart of the solution provided. It is important to note that business benefits from standardisation work to no have to wait until formal IS status is reached.

A number of actions resulting from Phase 1 and its assessment have been started or are planned at the time of writing.

1. A follow-up thread has started to widen the range of systems that are interfaced to the data warehouse. These should provide all the data that is required for commissioning in electronic form.

2. A Phase II is planned that is aimed at delivering further benefits to the Shearwater development project.

3. A Phase III is planned that will exploit the investment made on the Shearwater development for use by other projects in which AMEC is involved.