[To Mary Kay O'Connor Process Safety Center Home Page](#)
[To Program details for Day 1](#)
[To Program details for Day 2](#)

Impact of Data Exchange Standards on Maintainability of Process Units

Dr. John T. Baldwin
Department of Chemical Engineering
Texas A&M University
College Station, Texas 77843-3122

Paper presented at the 1st Annual Symposium of the Mary Kay O'Connor Process Safety Center,
"Beyond Regulatory Compliance, Making Safety Second Nature",
George Bush Presidential Conference Center, College Station, Texas
March 30-31, 1998.

Impact of Data Exchange Standards on Maintainability of Process Units

John T. Baldwin*, *Texas A&M University

Abstract

Over the last decade a number of new standards for data exchange have been initiated in Europe, the U.S., and Japan. Of particular interest to the process industries are the Application Protocols (AP's) under ISO 10303 (STEP, a standard for product data exchange). The AP's under STEP that are focused on the process industries address the exchange of data generated at any time during the life cycle of a process unit on activities that are taking place either at the same time or later in the life cycle. These efforts hold the potential of greatly improving the communication of data generated during design for use during the operation of process units. This paper will summarize significant worldwide activities highlighting their potential impact on maintainability.

Contents

Introduction

The commodity nature of most of the process industries makes it imperative to make the right decisions. The hazards of the materials participating in the processing and the increased documentation requirements further impact the need for good recordkeeping by all concerned. The recognition of these conditions helped give rise to data exchange standards.

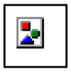
However, we are now suffering what might be called a standards overload. There are standards in the communication industry (ATIS, T1), in the instrumentation area (ISA, IEEE), in the business information area (ANSI, NISO, NCITS), in the scientific area (NIST, DIPPR), and in the mechanical design world (ASME, TEMA). Unfortunately, the following graphic is about the way all these come together in our minds:

This variety of standards organizations present a challenge to those involved in the process industries. While all of these organizations are important to the process industries the image to many engineers are that there are more organizations than can be contended. As a result, many just don't participate.

Sorting it out

Unfortunately, there is not an easy paacea to the dilemma of standards. But logic can obviously be applied. When a standard applies to ones daily work activity, attention should be given to it. When there are functions reporting to an individual for which standards are present, resources need to be given to determine the appropriate interaction and follow-through.

As given in the abstract, this paper focuses on the transmission of information for processing equipment, e.g., towers, pumps, exchangers, piping, valves, etc. Specifically, the emphasis is on the activities within the International Organization for Standards, ISO, within their standard number 10303, sometimes called STEP, a standard for product data exchange.



Introduction to ISO and ISO 10303 (STEP)

Some insight can be gathered of ISO by its name. According to its web site, the name ISO is not an acronym. If it were an acronym, it would be IOS, standing for International Organization for Standards. Instead ISO is taken from the Greek word meaning "equal". Examples of this word are in common chemical engineering usage as isothermal, isobaric, etc. So the ISO has as its leading objective to bring an equal footing via its standards.

For ISO 10303, this means that the exchange of information is to be on an equal footing. As we all know, information (and its associated knowledge) means **power**. Therefore, it is a logical extension that ISO/STEP is intended to give equal power to all by the use of its exchange standards.

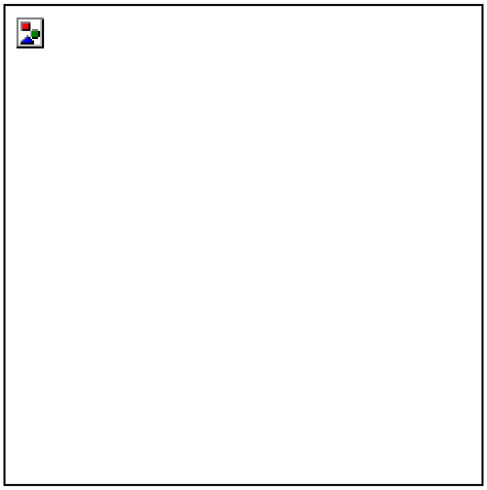
So why do we need STEP? An important underlying reason is that the world is becoming increasingly a closer-knit place. It is typical to have people in various and diverse locations working on a single project. For example recent projects have been as dispersed as being in North America, South America, the UK, and Indonesia all working on a single (and not a particularly large) project. This has given rise to the term "global village" and might be represented by the following graphic describing the effort:

Another important reason for the STEP initiative is the issue of handling computer programs. Without an agreed-upon approach for moving information between the various programs, the user (engineer) becomes the transfer mechanism. This involves reading the output of one program and entering the same information into other programs. This is labor intensive and is error proned.

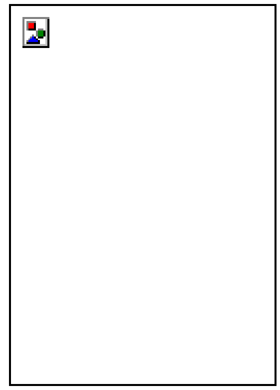
One solution used by many companies is to have customized transfer systems that are managed by the engineer. In at least one company a few years ago, most of the "development" budget was taken with doing just this: constructing various computer systems that would be activated when a data transfer was needed. The systems worked well and greatly reduced the time for individual data transfer situations as well as the tendency to make errors. However, the interface programs were specific for that one company and involved massive maintenance to track changes in the individual vendor-supplied systems. In some situations the larger customers of software suppliers have agreed to supply parts of the interface programs as a part of making the sell. While this appears to reduce the costs to the end user, it is still the same problem; only the one doing the effort is different.

The ultimate solution for all these situation is the same: **<u>An agreed-upon standard format</u>**. Then the information suppliers, whether it be a software supplier or an end user, can provide the information in the standard format and the receiver, whether it be another software system or another end user, can have confidence in the form that the information will be received.

Please note that all this discussion can apply to a design engineer, a vendor of either commodity or engineered equipment, a plant manager, or a maintenance manager.



A verifiable story has been aired at various AIChE meetings in which a company lost weeks of production time of a unit because the specifications of an important valve was lost (including the old valve itself). While the cost of the valve itself was minor, the cost of the lost information became very large.



The process of coming to a ISO standard is specified in the STEP standard itself. It involves defining the requirements, drafting the standard, review, and, finally, acceptance. This is done in indivual definable pieces and the process is rigorous and time consuming. The following graphic from a STEP primer prepared by Hans Tiejgeler shows the steps involved. International involvement takes place after the issuance of the AAM, the ARM, and AIM.

Although this presentation is not intended to be a primer on how to implement STEP standards, a short discussion of the process shown above would be proper.

The process starts with a function analysis (work process model, or, what STEP calls an AAM, an Application Activity Model). This model is normally made in IDEF0 notation and it describes the work process covered by the new Application Protocol. In any AP this AAM is one of the so-called "information annexes" which means that what is in an AAM is not a standard but only reference material. Also, the AAM has what information technologist call "course granularity" meaning that it views the information from a rather high level (say at the 1000 foot level).

Data and domain (of the area of interest) experts then use the AAM to perform a data analysis to prepare the Applicaiton Reference Model (ARM). This is an application model that can be done in either IDEF1X notation or in a notation provided by STEP called EXPRESS-G. The aRM is the closest to the models used for application software and it is normally still understandable by non-IT domain experts (e.g., engineers).

STEP provides a standard view of all data in what is called the Generic Resources. The next step in this process is to use this standard view of all data and map the view of the data in the ARM into this generic view of data to produce the AIM, Applicaiton Interpreted Model. This is also the time that the interfacing of different AP's are reconcilled. In a perfect world there would be absolute boundaries between AP's. This is not practical in many cases, particularly in the process industries, and there are frequently overlaps between the AP's. In some cases this overlap is simply what the inputs and outputs are named, but in more severe cases, there are substantial overlaps. The success of using multiple AP's in a single environment depends on the successful reconcilliation of the overlaps.

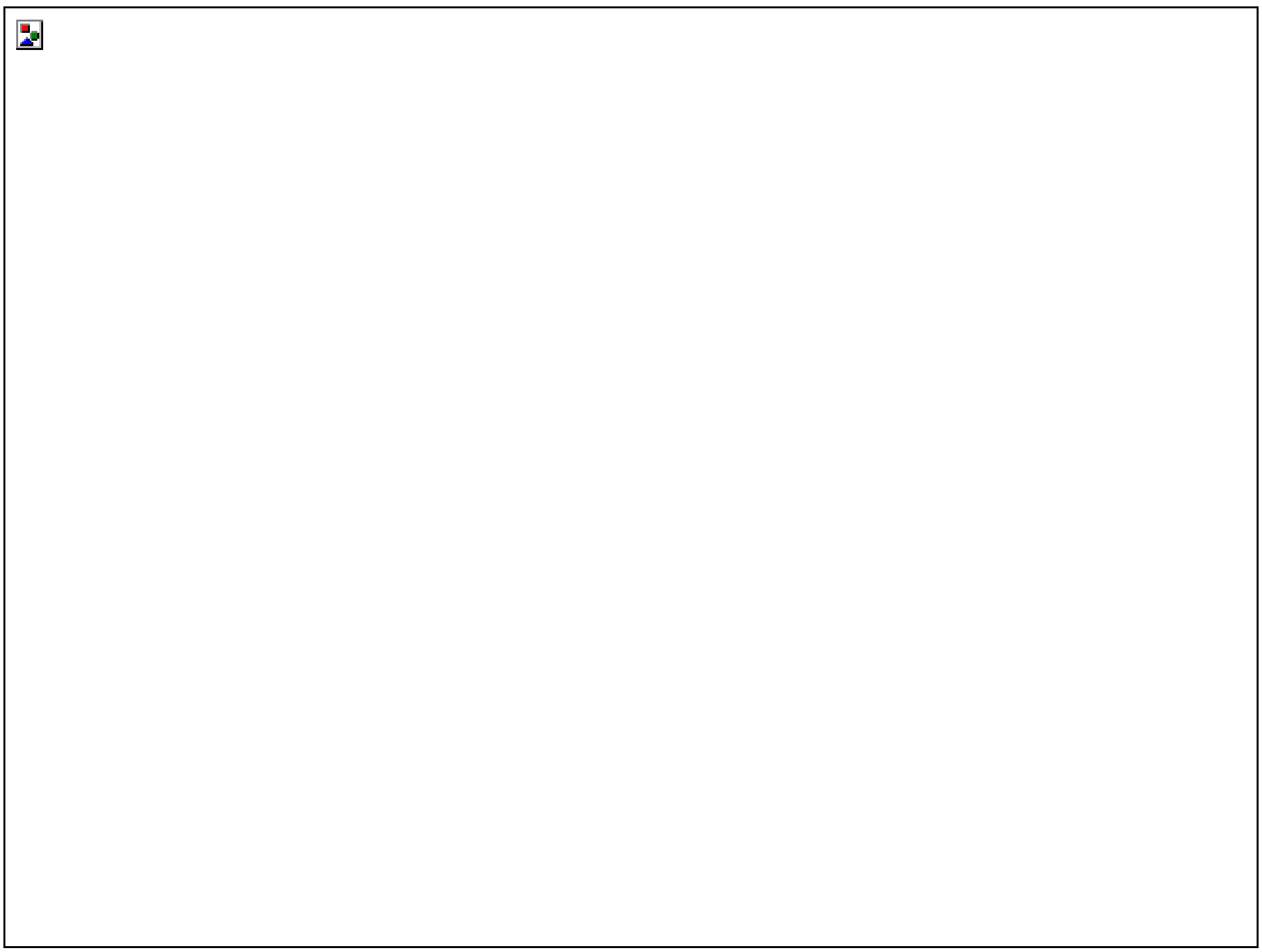
ISO 10303 (STEP) For the Process Industries

Substantial planning has taken place for the application of the STEP approach for the process industries. An overall activity model for the life cycle of processes was prepared early in the process and has been reviewed by interested parties in Europe, in the Americas, and in Asia. A copy of this model (in IDEF0) is shown below:

From this the interested parties initiated projects to prepare Application Protocol (AP) for the various portions of the activities. These AP's were selected based on importance to the industries and on the interest of the participating parties. The current active and planned AP's that are pertinent are:

- AP 212 - Electrotechnical Installations (by a German consortium)
- AP 221 - Plant Systems Design and Hardware Specifications (by a European consortium)
- AP 225 - Building Shapes (by a German consortium)
- AP 227 - 3D Plant Design and Piping Design (by PlantStep of the US)
- AP 230 - Structural Steel (by a UK consortium)
- AP 231 - Conceptual Process Design (by pdXi of the US)
- AP 23x - Operations (planned by a Japanese consortium)

The interaction of these and future AP'x for the process industries are shown in the following graphic:



Those AP's that are either completed or currently underway are colorized whereas the planned ones are not. Of particular interest are the grouping of AP 221/227/231. These

AP's are unique to the process industries and have received substantial attention from various components of these industries in the US, Europe, and Japan. Specifically, the sponsoring organizations of these AP's have agreed to work together outside the needs specified by ISO in order to assure that they are well positioned to support the industry. While different people around the world have different approaches to solve problems, it has been recognized by the 221/227/231 sponsoring organizations that the success of the standards approach depend on global cooperation.

The Plant Operations AP has not yet started but is under current preparation by the Japanese consortium and therefore is partially colorized.

Get information on AP 23x and insert here.

At the time of this writing, the status of the three primary AP's for the process industries are as follows:

- AP 221 has completed the issuance of the first committee draft of the standard and is now addressing the issues and other comments made in order to derive the final version of the standard.
- AP 227 has issued its first committee draft and is now addressing comments as they are received.
- AP 231 is in the final preparation of its first committee draft of the standard and should be issuing this document during the spring of 1998.

So when will all these be real? This question begs for explanation. When is any standard real? Is it when the standard accepted or is it when it is actually being used in day-to-day activities? There will be a substantial body of paper standards within another year. In order for STEP standards to be real, they must be implemented in the software that people use. The day-to-day use of the standards within the software that people use should be practical within three years.

Using the Standards

As stated above, the practical use of the standards will be through the software that people use. In fact, it might well be stated that most people that will be using the standards will not even be aware that the standards are being activated; they will just start noticing that the use of diverse software in concert will become a reality.

Consider two possible scenarios:

- Using a standard to interface calculational programs
- Using a standard to construct and maintain a plant's data warehouse

These scenarios will be discussed now to the extent that how the standards will be activated. For any AP to be used, a computer utility system called an Application

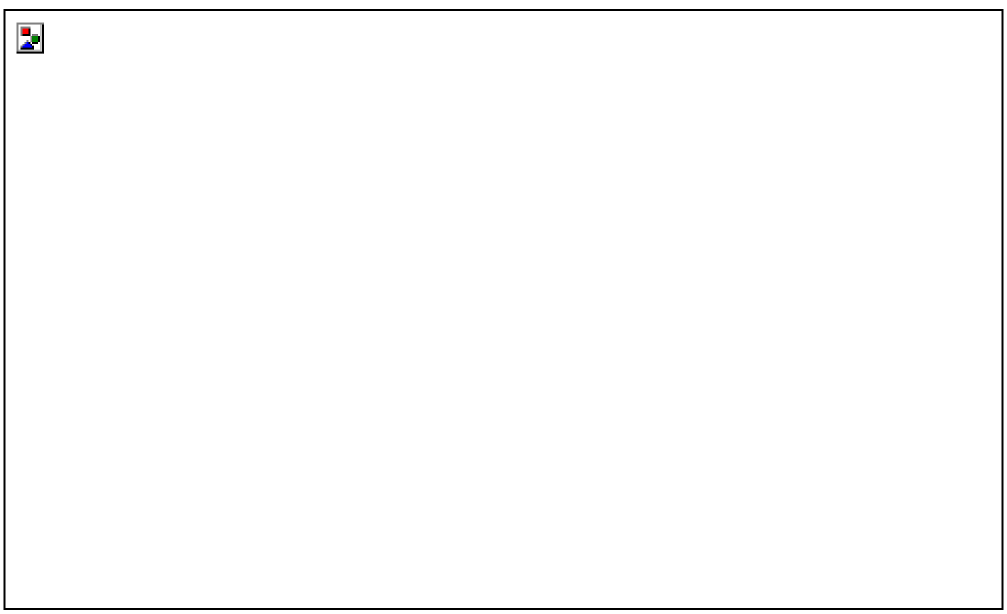
Programming Interface (API) will be needed. Any computer program will necessarily contain some version of the API for each standard that it utilizes.

Example: Using a Standard to Interface Calculational Programs

For this example we will consider three calculational programs that will be in use at the same time:

- A commercial process simulator
- An inhouse physical property calculational system
- A vendor-supplied heat exchanger program

Refer to the diagram below for this example. The user would normally initiate the process in this kind of environment with the process simulation program from a workstation, say a PC. Assuming that the simulator has the capability to activate a "standards-based" physical property system, that system could be activated through the standards interface in which the requests for information is made through an agreed-upon program interface (say via the CAPE-OPEN approach now being developed) and the actual data interchange through the AP 231 API. The data might also be stored to a disk file for tracking and documentation purposes via a standard language, e.g., EXPRESS which is specified by STEP.



The user could also initiate a heat exchanger program which might recover its needed stream and other process information from the process simulation system in a similar manner. In this case, the likely approach would be to recover the information directly from a standard data file on disk instead of direct communcation between API's but both would be possible.

Note what has happened. The user has activated the normal programs needed for assistance for the design activities. The data transfer is made automatically in a quality (and documentable) manner and the user only interacts with the systems as needed for the judgement and other value-added efforts in which human interactions are cost effective. The clerical activities are greatly reduced and possibly eliminated.

Example: Using a standard to construct and maintain a plant's data warehouse

This example will include recovering information from the design of a processing plant to initiate a plant data warehouse and then update it during construction as well as during operation. It will show using multiple STEP standards for the updating of a single data warehouse system which, for the purposes here, will be a commercial data base system.

> **Note: There is a proposed ISO standard for life cycle data warehousing, ISO 15926, which is sponsored by the Petrotechnical Open Software Corporation, POSC, under a project called CAESAR. This project, POSC/CAESAR, is being conducted in Norway by a consortium of companies who are focusing on off-shore platforms.**

As with the first example, the actual data transfer occurs through programs called Application Programming Interfaces or API's. The user may enter the data directly or recover it from other computer programs which might range from a spreadsheet to a full simulation system.

In this example there can be multiple users interacting with multiple systems. But from a computing system, all appear very similar. Each user will likely be working with a program but might be working directly with the data base system for a particular type of data. While it would be possible for the warehousing system to handle the data itself, there is substantial reason for it to treat each type of data according to their AP which would mean that the API for each system would necessarily be used. A primary reason for this approach would be to buffer the warehousing system itself from changes and migrations in each standard. Standards don't change very quickly but they can change enough times during the life of the data warehousing system itself (which would have a life on the same order of magnitude of the plant itself) to make this buffering worthwhile.

Likely, the initiation of this system would occur during design as a product of that effort. In fact this use could well be as important as the procurement and construction since the longterm success of the plant could well depend on the existence of this data warehousing system. Why? Because of competitive pressures to be effective and efficient on a longterm basis.

So what is the impact?

The performance expectations of all components of the process industries continues to increase: we are expected to design, build, and operate safer, cleaner, more efficient plants. The maintainability of a process must start during the conceptualization of the process and continue until it is torn down. ISO 10303 (STEP) as envisioned has a net positive impact on this process. As with all such activities, there are the social and political matters, but the fact is that the ISO/STEP standards are becoming realities and they will have a positive impact on all aspects of processing.

Conclusions

This has been a short introduction to the standards whose preparations are now underway, detailing the approaches being used and their current status. It is clear that substantial effort is being given from many places in the world to deriving appropriate standards. These efforts are being made by various components of the process industry for their own use. While not everyone is involved in the process, enough large players are in the process (for good economic reasons) that the effort is worth noticing and taking action based on those observations.

Those who are building plants should at least be asking the question of those doing the design of current and future of what they are doing to accomodate these standards. The true winner will be the ultimate owner and operator of processing units and they are the ones who should be asking the questions.

To Mary Kay O'Connor Process Safety Center Home Page
To Program details for Day 1
To Program details for Day 2