Implementation of the Lists of Characteristics of NAMUR Recommendation NE 100

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KEYWORDS

Characteristic, property, list of characteristics, electronic data exchange, specification sheet, device specification, planning process.

ABSTRACT

The report describes initial experiences gathered in a pilot project initiated by Bayer Technology Services, Leverkusen, Germany, with the aim of demonstrating the feasibility of comprehensive electronic exchange of product data between manufacturers and users of process control devices, based on the work of the Project Group "Lists of Characteristics" (PROLIST). The project focused on the process control planning process which is being optimized by using CAE systems and with the help of lists of characteristics. The working results of PROLIST are published in the NAMUR Recommendation NE 100. Version 2.0 of NE 100, which was released at the beginning of 2005, contains lists of characteristics for 62 device types. Some of these lists of characteristics were applied in practice during the course of the described pilot project.

INTRODUCTION

Rationalization always involves improvement of workflows to make them more efficient. Electronic data exchange harbors great rationalization potential, if it can be used to exchange data on products, devices and systems, and especially if the entry of data in the various IT systems can be restricted to one-time input at the beginning of the life cycle of a device. This expressly includes data exchange with other companies.

Any method that is capable of recording all existing information once only during the planning and ordering process and making it available for all further processing gives everyone an opportunity to concentrate on the essentials. A precondition for this is to standardize both the descriptions of the objects and the exchange of information for all parties involved, e.g. supplier and customer.

The commercial and technical tools used today already provide all necessary functions for this purpose. What is missing, however, is the unambiguous assignment of the terms and the formats used. The existing classification systems cover only part of process control requirements.

The NE 100 Recommendation is intended to remedy this situation. It provides a method which will allow customers and suppliers to compile device specifications and to transfer the associated transaction data.

In a presentation at the ISA EXPO 2004 [1], some elements of NE 100 were already described and explained. This report refers in part to the stated presentation and in some cases repeats certain aspects in order to make the present report more understandable.

A SCENARIO FOR UTILIZATION OF LISTS OF CHARACTERISTICS

The terms “user” or “customer” and “manufacturer” or “supplier” of process control equipment mentioned at the outset will first be defined more closely.

A customer is any person involved in the planning, installation and commissioning of processing or production equipment incorporating electrical devices or measuring and control instruments. This person may be employed in a processing or manufacturing company or in a subcontractor company. Maintenance staff who look after processing or manufacturing systems in their company and procure replacement parts for these systems can also be termed customers. In this sense, planners and maintenance staff are also users of electrical devices and measuring and control instruments.

Manufacturers are considered to be the companies and their staff who manufacture and sell electrical and instrumentation and control devices and systems. Suppliers dealing only with the distribution of these devices will be included in the term “manufacturers” for the purposes of this paper.

Electrical devices and measuring and control instruments can be collectively referred to as process control systems (PCS) or process control technology (PCT).

Up to now, customers have used a wide variety of different terms to describe the requirements on process control equipment (PCT devices) in their inquiries to manufacturers. The manufacturers, on the other hand, describe the devices using the terms contained in their own documentation in various systems (paper, databases, CD, e-catalogs, etc.). This entails enormous effort, both on the customer and the manufacturer side, for each transaction.

How can this situation be remedied? What tools are required? This will be explained using the following scenario as an example.

The technical inquiry and technical offer processes, including engineering on the customer side and device selection on the manufacturer side will now be examined. These processes can be accelerated and made more efficient, i.e. optimized, by using modern data exchange techniques and by specifying communication structures for data exchange between customers and manufacturers.

The scenario begins on the customer side (see fig. 1). Today, many customers already use modern CAE systems consisting of several modules: a module for process engineering, including the P&I diagrams, one for the piping systems, and one for the process control equipment. The process

control module can import the required data from the processing engineering or the manufacturing engineering module. This relieves the process control equipment planner of many manual input tasks.

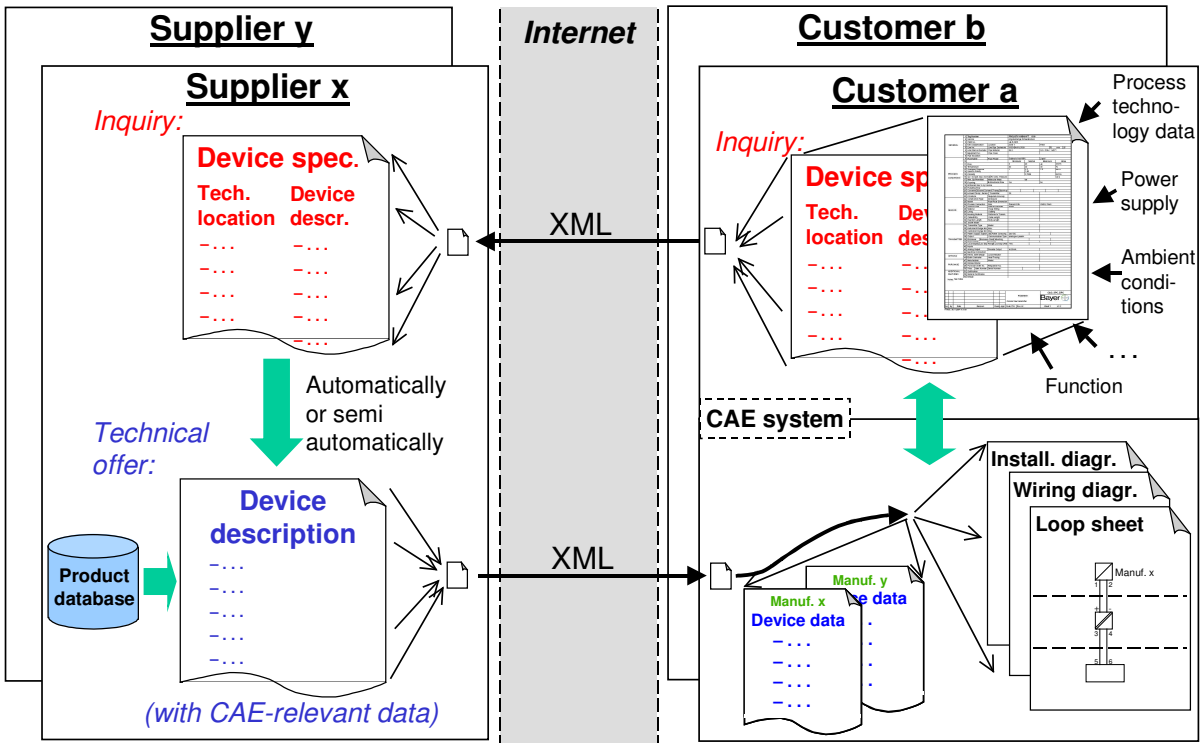

FIG. 1 – DATA EXCHANGE BETWEEN CUSTOMER AND MANUFACTURER USING DEVICE SPECIFICATION AND DEVICE DESCRIPTION

The planner collects further data required for the planning of each process control loop, that is, data concerning the existing or planned power supply, the environmental conditions, and the function to be fulfilled by the entire process control loop and the individual devices and systems which will be used in this loop. The data imported from other modules, as well as the data collected from other sources and entered by hand, can be visualized on the monitor of his computer using e.g. spec sheets which are installed in his system. The ISA TR20 Spec Sheets may be a good choice for this. Parallel to this, the computer combines all the collected data in an electronic document, i.e. a device specification. This document is divided into two sections:

– the requirements list of characteristics, which contains the environmental data and data required for selecting the planned device (“Location” in fig. 1), and
– the device list of characteristics, which contains the desired device characteristics (“Device Characteristics” in fig. 1).

The electronic document can now be sent as a technical inquiry to one or more potential manufacturers via the internet using an XML schema developed specifically for this purpose. The manufacturer can use this data to prepare an offer.

If one now imagines that each manufacturer receives inquiries in one and the same format from each and every customer – i.e. in the form of an electronically transmitted device specification – it becomes evident that this will open up enormous optimization potential for the manufacturer. It

allows him to prepare electronic offers automatically or semi-automatically, mirroring the requirements stated in the received device specification. Once CAE-related data has been automatically added from his product database, the manufacturer can send this technical offer to the customer via the internet using the mentioned XML schema. The electronic offer has been named "device description". The customer is then able to receive offers from every supplier to whom he has sent an inquiry. He can then compare the offers and choose one for his plant. Now, he can immediately input the chosen device description directly into his own CAE system. Once he has done so, the customer is in a position to create all the documents necessary for the installation or maintenance of the plant using the data of the inquired device: process control (PCT) loop sheets, wiring diagrams, installation diagrams, etc.

This scenario naturally applies to all conceivable CAE systems. It should be noted that both the generation of the inquiry and the processing of the device data received from the manufacturer can be handled by one and the same CAE system on the customer side. In striving for optimization, the aim is to ensure that a CAE system will be able to handle both tasks.

STRUCTURAL DATA AND TRANSACTION DATA

As shown in the scenario described above and in fig. 1, a device specification is used to prepare an inquiry for a device or system. This device specification actually consists of two lists of characteristics:

- a requirements list of characteristics (RLOC), and
- a device list of characteristics (DLOC).

An RLOC serves not just to describe a device but to specify the most important requirements on the device/system, i.e. data characterizing the ambient conditions at the location where the device will ultimately be installed, and data required to select the device. The DLOC always describes only the device or system itself. As a part of a device specification, the DLOC normally contains some customer wishes about the new device, e.g. the desired measuring range or the desired output signal.

The purpose of the device specification is to

- describe the functional requirements on a PCT device,
- enable a device manufacturer to offer a suitable PCT device on the basis of these requirements.

A device description, which is sent from the supplier to the customer, on the other hand, consists only of one LOC, i.e. the device list of characteristics (DLOC). In this case, the values assigned to the characteristics are concrete product data, i.e. the data of the device that will be supplied or installed in the plant.

The purpose of the device descriptions is

- to document the data of a PCT device in a structured manner, and
- to provide the device data for planning using CAE tools or for storage in an ERP system.

There are only two structural elements used in the above description LOCs: an RLOC and a DLOC. The Project Group "Lists of Characteristics" (PROLIST), which is a part of the NAMUR

organization [1] is in charge of designing the structure and specifying the details of the LOCs. The structural data are prepared by PROLIST, entered in a database (the PROLIST database) and published in the NAMUR Recommendation NE 100. It should be noted here that the LOCs of PROLIST conform to the two most relevant international standards for characteristics and lists of characteristics: IEC 61360 [2] and ISO 13584 [3].

This is why PROLIST is endeavoring to channel the content of the NE 100 into an international standardization process in order to make the content available to everyone through (an) IEC standard(s).

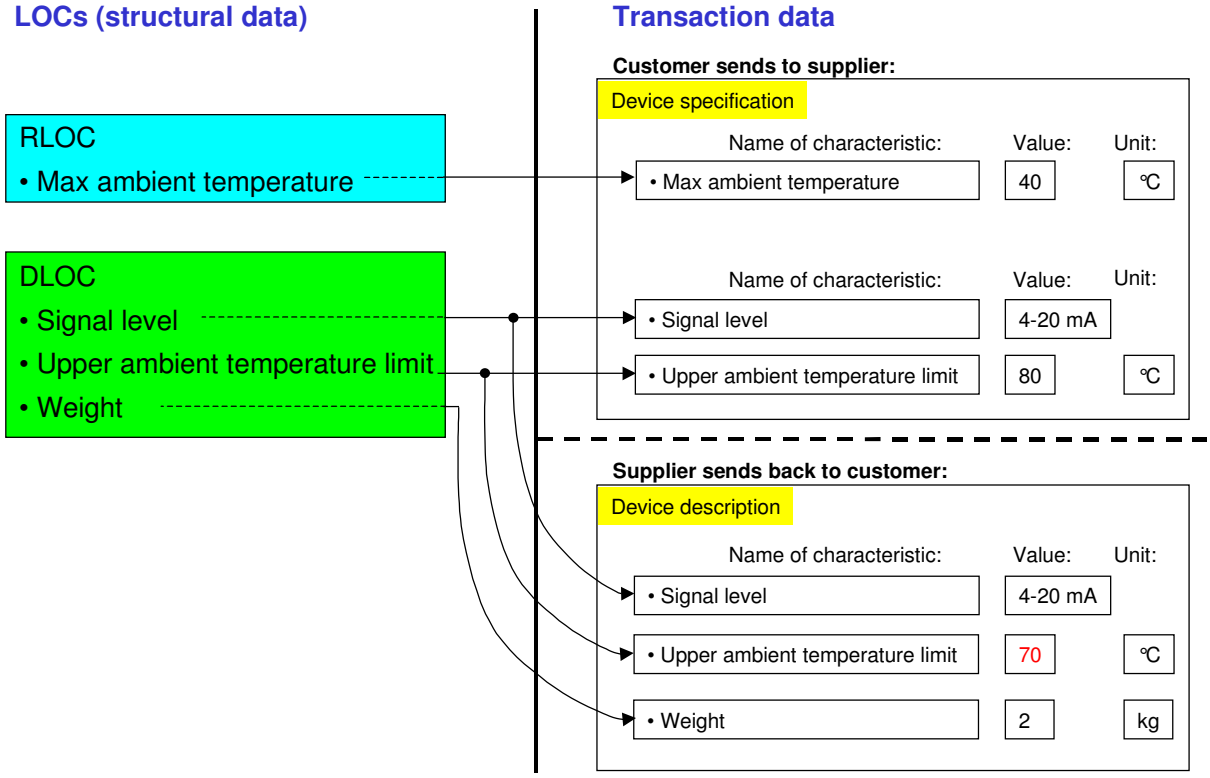

FIG. 2 - GENERATION OF TRANSACTION DATA USING LOCs

The structural data is determined for each device type: an RLOC and a DLOC. A decision is made as to which characteristics are to be included in which order and with which attributes in the RLOC or the DLOC. The attributes of a characteristic include not only a unique ID but also a definition describing the property or physical variable represented by the characteristic, as well as a format and various other aspects. The format specifies how, when the characteristic is used to describe a concrete device, the value of the characteristic is to be expressed as a real number, a string or a logical statement (yes/no).

When data relating to concrete devices or concrete requirements are exchanged between customers and suppliers, this is referred to as transaction data. A distinction must therefore be made between structural data and transaction data. Figure 2 gives an example showing how structural data can be used to generate transaction data.

In the example, when preparing an RLOC, a customer considers the maximum ambient temperature at which the device in question will be working. The customer knows from his experience of the

process that the maximum ambient temperature will be 40°C. He enters this data as the value of the characteristic “Maximum ambient temperature”. Regarding the new device itself, the customer in our example has two wishes:

- He would like the signal level to be expressed as a 4-20 mA current signal, and
- He would like the device to be designed for an upper ambient temperature limit*) of 80°C.

These are the values he enters for the characteristics “Signal level” and “Maximum ambient temperature”.

A *device specification* is generated as a result of this data input process. Once the device specification has been completed, the customer sends it to one or more suppliers in the form of an XML transmission file. The XML transmission file is automatically generated by his CAE system in response to the data he has entered via an XML schema which was created in 2004 by PROLIST in collaboration with SAP.

The XML transmission file can then be automatically sent by the CAE system via the Internet to the suppliers that the customer has selected as recipients. The suppliers can read the XML transmission file into their own systems and prepare a (technical) offer using the data thus transferred. To prepare the offer, the supplier uses only the DLOC which, however, must be completed as fully as possible. In other words, the supplier can only transfer the data of the quoted device into the structure of the DLOC which has been already stored in his own internal databases and which he wishes to transmit to the customer. This is how the *device description* is generated, which also falls under the category of transaction data.

The device description is converted by the specified XML schema into an XML transmission file in the supplier’s system and automatically sent to the customer via the internet. The customer can import the device description directly into his CAE system, for example, which can interpret the XML transmission file. In our example, the customer receives the following information (figure 2):

- The desired signal level of 4-20 mA is confirmed.
- The supplier cannot comply with the desired upper ambient temperature limit of 80°C for the device quoted. He can only offer a device with a certified level of 70°C, and he states this in the device description.
- From the many data that it is possible to use to describe a device, we have included the weight in our example, which the supplier has stated to be 2 kg.

By using XML transmission files based on the same XML schema, the customer can compare offers sent to him by several suppliers and choose the most appropriate one when ordering the device. Since each characteristic is labeled with a unique ID, the values of the characteristics in the offers can easily be evaluated by computer.

Concerning the transaction data, 3 lists of characteristics in all have to be handled:

- an RLOC to be completed by the customer only,
- a DLOC stating the customer’s wishes which, in practice, will contain only a few entries (inquiry view), and
- a DLOC which the supplier utilizes to describe as fully as possible the device that he is proposing to the customer (this DLOC also contains CAE-relevant characteristics to cover the import of the device master data into the CAE system).

The files which transfer the transaction data from one party to the other contain only the ID and the value entered for each characteristic by the customer or the supplier. In our example these are: 40°C, 4-20 mA, 80°C, 4-20 mA, 70°C, and 2 kg.

THE PILOT PROJECT

The standardization of characteristics and lists of characteristics is an essential prerequisite, but testing the exchange of data on the basis of these standards in practice is equally important. In order to demonstrate the practicability of this data exchange, Bayer Technology Services, Leverkusen, Germany, conducted a pilot project with the aim of realizing an electronic engineering workflow with the help of equipment manufacturers who already support the work done by PROLIST. In addition to the equipment manufacturers, Intergraph (a CAE systems manufacturer) also collaborated on the project.

Participating in the pilot project were:

- Bayer Technology Services

referred to below as the "customer", and

- ATB,
- Endress+Hauser,
- Pepperl+Fuchs,
- Siemens

referred to below as the "supplier(s)", and

- Intergraph.

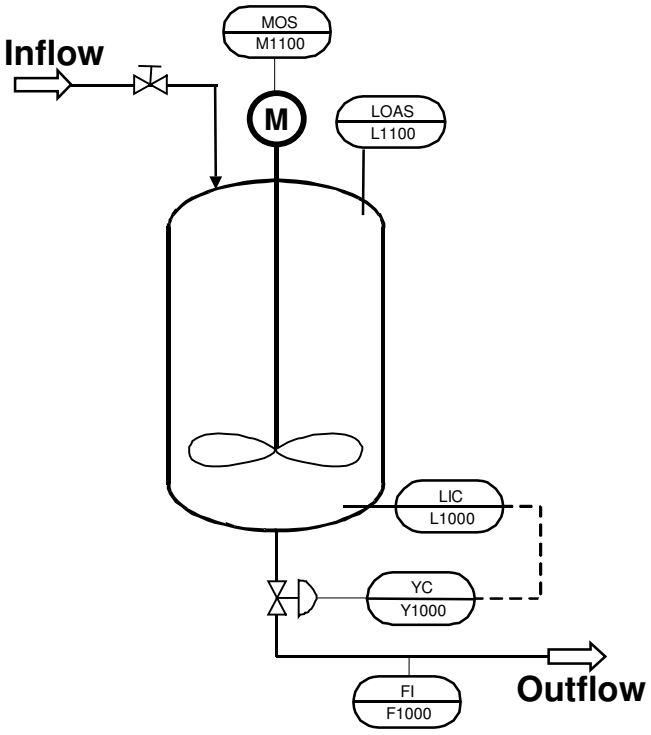

FIG. 3 - THE P&I DIAGRAM REALIZED IN THE PILOT PROJECT

The role of Intergraph, a member of PROLIST, in this project was to demonstrate the automatic data exchange using the CAE planning tool SmartPlant Instrumentation (formerly INtools).

The pilot project considered a process unit, as illustrated in figure 3. This unit contains 5 PCT loops.

The user (customer) utilized the Spec Sheets that had been developed by Bayer for INtools for input of his requirements into the CAE system, SmartPlant Instrumentation. These Spec Sheets have a certain similarity to the S20 Spec Sheets of ISA.

A separate Spec Sheet was used for each device type, i.e. for:
- LV asynchronous motor,
- vibration level switch,
- differential pressure transmitter
- positioner
- coriolis flowmeter,
- remote I/O card input, and
- remote I/O card output.

For each device type, the requirements were transferred converted by the CAE system to a device specification in the form of an XML transmission file. The workflow set up on the customer side is shown in figure 4. The adapter is used to assign the fields (characteristics) in the database of the CAE system, i.e. the input fields of the Spec Sheets, to the corresponding fields in the XML transmission files.

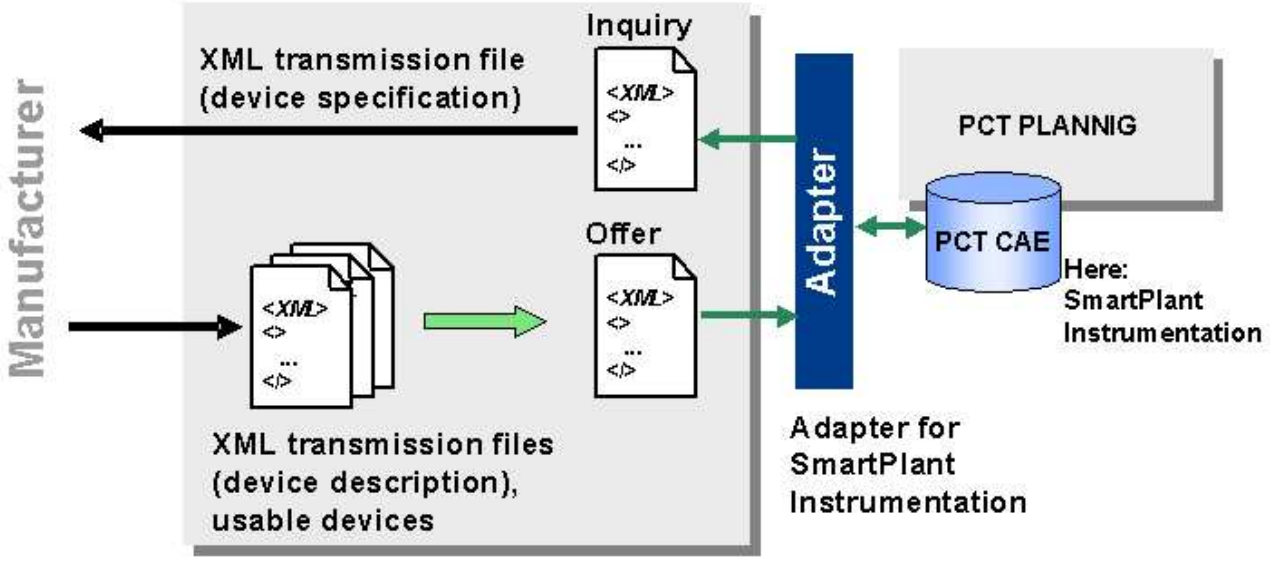

FIG. 4 - WORKFLOW ON THE CUSTOMER SIDE

XML files are not intended to be either generated or read by human beings. XML was designed as a machine-readable format and can only be utilized by computers. For this reason, PROLIST has provided a set of tools on a dedicated PROLIST server to enable users, and especially small and

medium sized enterprises to exchange data by means of XML transmission files, thus making it easier for them to implement this kind of business process optimization.

The tools, which have been collected into an application package, include

- a viewer for visualization of XML files as a table with a block structure,
- an editor for writing XML files,
- a tool for comparing XML files.

The purpose of the application package is to make tools rapidly available in order to provide "proof of work" and to be able to demonstrate that the data exchange will work in practice. In the pilot project described, these tools were used by both the customer and the supplier.

Suppliers were thus able to read the XML transmission files sent by the customer, and selected and sized the corresponding devices using the data provided (the transmitted characteristics). This resulted in the compilation of offers containing the device data in the form of device descriptions which were then converted into XML transmission files using the application package. The XML files were sent to the customer via the internet. The workflow on the supplier side is illustrated in figure 5. The adapter in this case represents the mapping process between the product data base of the supplier and the XML schema in the device description.

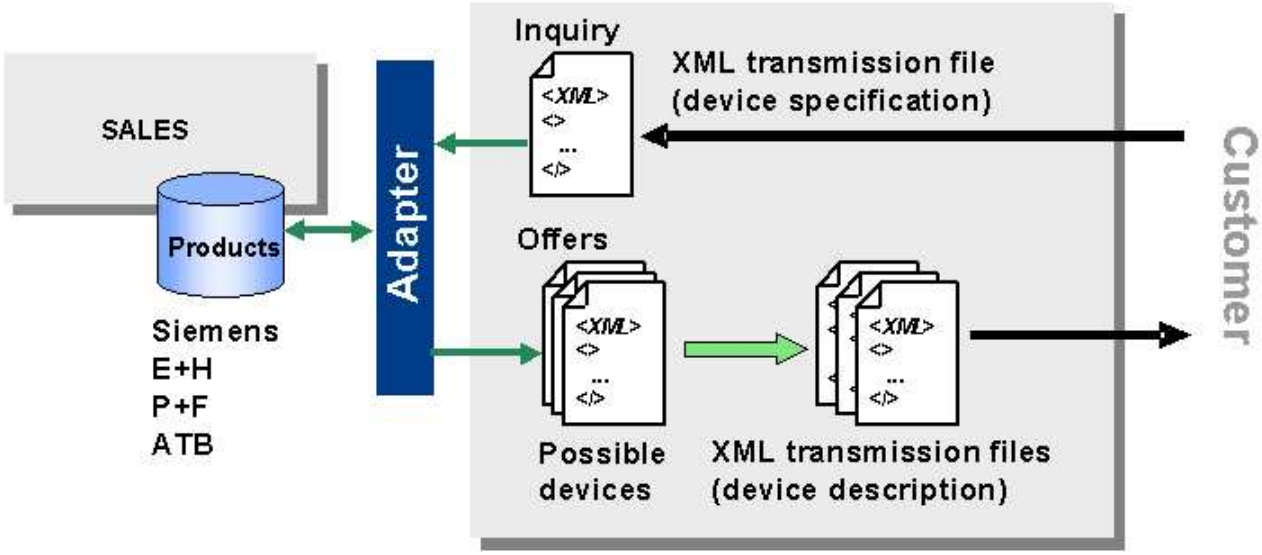

FIG. 5 - WORKFLOW ON THE SUPPLIER SIDE

The customer was then able to import the data of the devices offered to his CAE system via the XML transmission files. Directly after importing the data, the customer was able to generate the process control documentation for the process unit shown in figure 3. Figure 6 shows two of the documents to be prepared for this documentation.

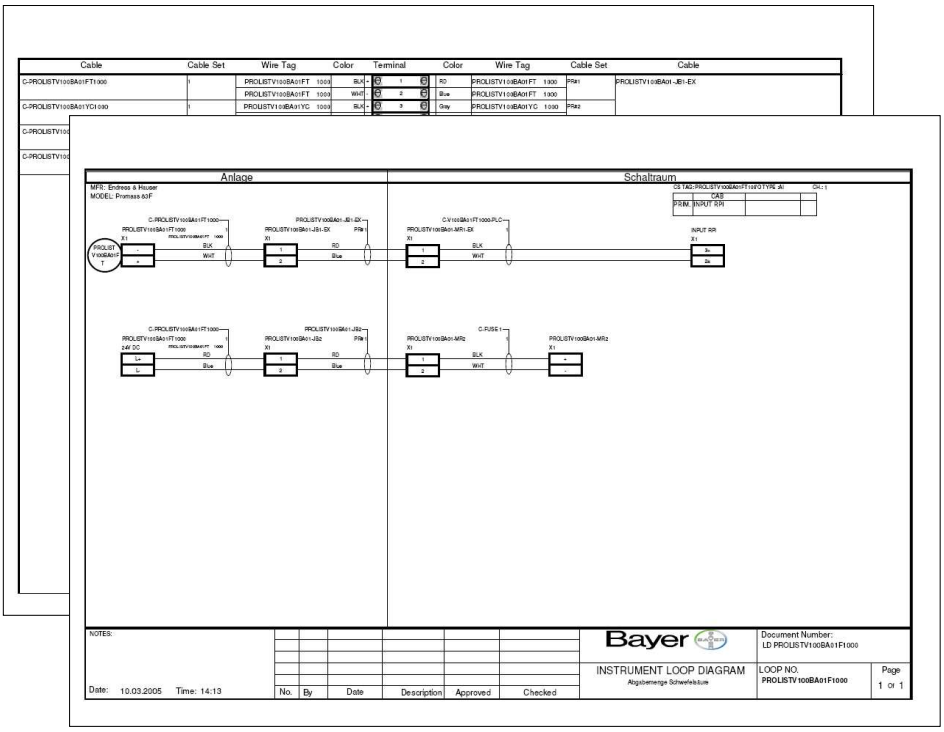

FIG. 6 - LOOP DIAGRAM AND CIRCUITRY LIST OF A DISTRIBUTION BOX

EXPERIENCE GATHERED DURING THE PILOT PROJECT

A complete electronic workflow was set up, thus demonstrating its practicability on the basis of the PROLIST lists of characteristics. The establishment of such an engineering workflow across different systems and system worlds will always encounter certain difficulties at first implementation. This is quite simply a fact of life. Also, during the course of the project, Intergraph switched to SmartPlant Instrumentation Version 7.

The experience gained can be summarized as follows:

- The support of IT specialists is indispensable for the realization of the adapters (interfaces between the XML files and the respective in-house systems).
- The performance of the application package used requires some improvement.
- Automatic adapters for data transmission into and out of the in-house systems must either be improved or have yet to be developed. This includes catalog systems and systems for offer generation on the supplier side, CAE, procurement and maintenance systems on the user side.

On the supplier side, work is progressing at full speed on the adapters for the in-house catalog systems. The interface from and to SmartPlant Instrumentation proved problematical. This was due to the different granularities in the CAE system and the XML files. This problem will occur in one form or another in every system that was not established from the first on the basis of XML file structures.

SUMMARY AND OUTLOOK

The report used examples to illustrate the advantages to be gained from using standardized characteristics and lists of characteristics in planning and maintenance processes employing state of the art CAE systems. The difference between structural and transaction data was pointed out. PROLIST generates structural data in the form of lists of characteristics for different types of process control devices and publishes these through the NE 100.

One of the first pilot projects that was initiated by Bayer Technology Services and which used the lists of characteristics published in the NE 100 was described, as well as the results obtained. Other PROLIST members have completed pilot projects to test the practicability of the NE 100 lists of characteristics or are currently conducting such projects. In addition to the companies listed in the report, further PROLIST members (BASF, Innotec, Krohne and Wacker-Chemie) either participated in the stated project or are involved in other ongoing projects. The current list of PROLIST members can be found on the Internet at www. prolist.org.

The next step will be to disseminate the idea of standardized product data exchange and to push the international standardization process. Success will only have been achieved when the electronic workflow has become established in the field. Essential preliminary work has been completed:

- The provision of standardized characteristics and lists of characteristics through PROLIST, including the data model and its implementation in the PROLIST database,
- The international standardization process has been initiated through a work proposal to IEC and is being supported by PROLIST and its members,
- Leading providers of business process solutions, such as SAP and Intergraph, are currently implementing the technology,
- The electronic workflow has undergone prototype testing (proof of work).

Once the approach has become generally accepted, the following step will be to implement and utilize the standardized characteristics and lists of characteristics in commercial business processes. This will achieve universal usability of the data and reduce the duplication of data in companies' systems still further. PROLIST is currently preparing to take up this challenge. Standardized characteristics reduce the complexity of business processes.

REFERENCES

[1] - Löffelmann, G., and P. Zgorzelski. "Lists of Characteristics for Optimization of the Processes in Automation and Process Control." Proceedings of ISA EXPO 2004 held 5-7 October 2004, in Houston, Texas. Paper #TP04ISA308.
[2] - IEC (ed.), IEC 61360 "Standard data element types with associated classification scheme for electric components"
[3] - ISO (ed.), ISO 13584 "Industrial automation systems and integration – Parts library"

NOMENCLATURE

NAMUR
International user association of process control technology in chemical and pharmaceutical

industries. Its member companies come from the chemical, pharmaceutical and petrochemical industries in the German speaking region. Contractor companies working for the named industries are also eligible for membership. Two thirds of the members are based in Germany. The rest are located in Spain, Austria, Hungary, Switzerland, Belgium and the Netherlands. Manufacturers of process control technology, hardware and software are not eligible as members.

NAMUR Recommendations (NE) and Worksheets (NA)
These are experience reports and working documents prepared by NAMUR for its members among process control users. Their use is optional.

Process Control Technology (PCT) or Process Control System (PCS)
An expression used by the NAMUR members which covers electrical equipment, instrumentation and control equipment, and process control technology.

Characteristic (or Property)
A defined parameter suitable for the description and differentiation of objects. A characteristic describes one detail of a given object.

List of characteristics (LOC)
Describes by means of characteristics the features of one equipment type. An LOC is also used for compiling the requirements a planned device should fulfill.

ABBREVIATIONS

CAE	Computer Aided Engineering
DLOC	Device List of Characteristics
ERP	Enterprise Resource Planning
IEC	International Electrotechnical Commission
ISO	International Standards Organisation
IT	Information Technology
LOC	Lists of Characteristics
NAMUR	Interessengemeinschaft Prozessleittechnik der chemischen und pharmazeutischen Industrie
NE	NAMUR Recommendation
PCS	Process Control System
PCT	Process Control Technology
RLOC	Requirements List of Characteristics
XML	eXtensible Markup Language