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My Plant is Manual, Why do I need S88?

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ABSTRACT

Many manufacturers do not feel confident in designing new facilities incorporating full automation and want to retain manual control of the process. For these users, good modeling of the plant to achieve the required functionality is even more important. Most manual facilities still incorporate a degree of automation for those functions that are difficult to control manually. These functions must be accessible to the operators and easy to use in both normal and emergency situations.

This paper will examine why the use of good structured design, following the principals of S88, will provide major benefits to these users. A structured analysis will identify common modules in the design and may even indicate where reuse of predefined modules is possible. This approach speeds up both the design and validation of the new facility. The user can decide the level of automation that they feel comfortable with and this may vary with the functions provided. E.g. Process operations may be performed by manually selecting equipment modules, but cleaning may be fully automatic to ensure that it is effective.

In all these situations a structured model is the key to understanding the functionality of the plant.

PAPER

Introduction

At the start of a new project, automation is rarely given a lot of consideration. If the project is a highly automated, paperless production facility with minimum operating staff, then there will be a small budget for costing the control system. But, if the plant is small, minimum cost, with little or no automation (with the exception of a couple of small packages), then it is likely that the new facility is to be manual and little or no consideration has been given to automation.

During this stage of the project, the team has serious concerns to look after, such as the process chemistry or equipment size and layout. After all manual operation is the most flexible solution for a multi-product batch plant! Also, as a general comment, Automation Engineers are expensive, want the latest technology, speak a language that no one understands and always overspend their budget!

This paper first looks at what is meant by 'Manual Control' and then looks at how the use of S88 Models and Structures, during the initial design phase, can reduce the overall cost of design and increase the operability of the plant.

Manual Control

When a client declares that the plant is manual, they rarely mean that the plant has no automation. It is not uncommon for the user to declare that they do not know enough about the process to have a fully automatic plant, but there are generally some elements of the process that are suited to higher levels of automation. It is important to be able to recognize these and provide appropriate control schemes for the operators to use.

The key to uncovering the level of automation required is to hold a control and operability review. This will allow you to establish the functions the operator will be expecting to use, where the functions will be performed and the level of automation that is required to support these functions. The output from such a review is the Control and Operability Philosophy for the project. This document forms a key reference document for the duration of the project. If nothing else it provides valuable back up for when you are asked the question 'Why do you (the automation engineer) require so many hours to complete the project when it is a manual plant'.

So what is "Manual Control"?

Very few facilities are designed with zero automation. The automation may not be obvious, or may come from an obscure comment from the user. As an example, a recent project declared that they had 'Zero Automation' but the user wanted to use barcodes to track the product through the process. Following a short study, the need for a material and hygienic status tracking system and a sophisticated control and data recording system was established although the basic operational philosophy is still one of manual control. The project required two automation engineers for three months to define the requirement in detail.

The most common reason for adding automation is to achieve functions that can not be easily realized by an operator, typically this will be temperature control.

Having established that automation exists; the next question is where and what level? Where is quite an important question, as often the levels will very with the function required. Production may require manual operation, but Clean In Place (CIP) may be fully automated. Analysis of projects with manual control indicates that the level of automation in manual control can be broken in to three levels. The lowest level of automation normally implemented, lets define this as level one, consists of independent control loops and on/off valves. This may be satisfactory for simple processes with experienced operating staff, but rapidly leads to problems as the level of complexity rises. This is typical of older facilities where control of the process has evolved rather than being designed.

If the complexity of the process or a lack of experienced operating staff prevents this approach then this can be addressed by linking control loops and on/off devices in to more complex strategies, level two manual control. A typical example of this would be control of a Thermal Control Unit or TCU for reactor temperature control. This consists of a number of control loops and devices that can be controlled as a single entity to achieve accurate control of reactor temperature.

In fact both these levels of manual control can be achieved without the use of a "Control System". Single loop controllers can give independent loop control and TCU's can be bought with their own dedicated controllers. It is the next stage in the development of assisted manual control when it is necessary to provide some form of independently programmable control system.

The final level of automation (level three) that can still be considered Manual operation consists of pre-programmed sequences that can be manually selected to make the operators' job easier. These sequences typically will cover actions such as filling, transfer between vessels and temperature control. This type of sequence is also useful for control of mechanical packages such as filters and centrifuges. Automation above this level is generally no longer considered manual.

Why use S88

Having identified that 'manual control' has not eliminated the need for an automation system, the next question that is raised is 'What benefit does the automation engineer bring to the project', after all if it's just a couple of loops and an interlock anybody can look after that. The answer to this question is not so easy to define. The main benefits come from performing a full analysis of the process systems, identifying the Units, Equipment Modules and Control Modules. This physical model of the plant can then be compared to the Control and Operability Philosophy document to determine where control needs to be applied to achieve the users requirements. The structure of the model should allow the identification of common modules, leading to savings in the design process. At this stage, it is possible to identify inconsistencies in the level of automation, it is not uncommon where the process is manually controlled, for the user to specify fully automatic CIP. This can cause problems when trying to reconcile the operational requirements of a full automatic process with that of a manual process in the same vessel. The CIP process will require control of the valves and drives of the unit, however when operating the process, the operator will require manual control of the same devices. Care must be taken to ensure the essential operating facilities are provided in the correct locations to permit the desired operation of the equipment.

Understanding of these potential conflicts is only possible if all the operating requirements are taken in to account and a good model is built to highlight where possible conflict exist.

So far in the levels of automation that has been described, the use of any of the automation engineers "confusing" jargon has been avoided, but it is not difficult to recognize the S88 elements within the

three levels of manual control described earlier. It can be recognized that level one represents Control Modules, Level two represents Equipment Modules and that level three introduces Phases and Operations. For each of the levels, operational benefits can be identified, that can be gained by use of the S88 structures.

At level one, there are benefits in using a standard approach in the design of the control modules, the operator gets a consistent interface with standard alarm handling. With the correct design of the Control Modules the plant can be upgraded to level two manual control by the addition of equipment modules.

At level two, the implementation of equipment modules gives further operational advantages if equipment state control is included. This allows the operator to select equipment functions directly with out worrying about the detail of which valves and devices to operate, typically this would be applied to Jacket Services or TCU's and Vent Services. Both these areas generally consist of a number of control modules that have to be coordinated to provide a process function. For the operator, operation of the equipment becomes simpler and more consistent. This approach is also ideal for mechanical packages such as filers, dryers and centrifuges. These items generally have a high level of manual involvement that can be best incorporated by defining equipment modules for control of the agitators, jackets, vents and inlet and outlet valves. As with level one, we can also build in an upgrade path to level three. By building in facilities to allow the equipment modules to be remotely driven, this is normally available as a consequence of allowing control from the operator interface; sequence control can be implemented by defining phases to remotely drive the equipment modules through their operational states. The plant has then been upgraded to level three manual control.

At level three, we already have basic sequence control and the requirement has reached a level of complexity where automation engineers will have to become involved, so do we have to defend the benefits of providing this much automation? Generally the answer is YES. By performing the analysis of the process system and building the physical model of the plant we have given ourselves a firm foundation for developing the appropriate level of automation for the functions required. The design can proceed with confidence that all the functions that have been provided can be operated at the desired locations. Further to this, as the users confidence in the process increases and quality improves due to the repeatable nature of the automation provided, we can extend the base level of the procedural model to include unit procedures and procedures.

The question that is generally raised with respect to level three systems, is do we need a batch management system. You can run phases with out the expense of a batch execution system, the coordination facilities that they provide will be handled by the operator, so why buy one. The main reason is data management. You will certainly be using the automation system to collect process critical parameters from the plant. Manual control suggests manual data collection, this leads to unreliable data recording. By using a batch execution system and running each manually selected phase as a batch, the batch execution system will automatically collect the necessary data. This concept can be extended by careful use of the batch id to associate these partial batch records to allow a complete batch record to collated from a manually driven procedure.

Conclusion

The question posed at the start of this paper asked if S88 had any relevance to manually operated processes. This is a question that has to be answered in two parts. The first is 'What do we mean by Manual Control?' the second part is 'How can S88 provide benefits to the project and the user?'

This paper demonstrates that by consideration of the users operational requirements the automation engineer can determine what is meant by Manual Control and by analysis of the process requirements the models defined by S88 can be used to provide efficient design and provide operational benefits to the user.

As a final comment, it is quite normal for the complexity and the level of automation required to increase during the design phase of a project. The role of the Control and Operability Philosophy document becomes critical in this situation to track the change to the original philosophy. This approach was taken on a recent pharmaceutical project where, with the users agreement, the level of automation of the 'Manual Plant' was raised. The original concept was for a low cost Manual system that grew through the addition of CIP and SIP facilities to full recipe control. This Fully Automatic Manual Plant incorporates a dispensary, material tracking system and full batch reporting.

