



Following the Lines - BBBBB (Bonus)

Design Patterns for Flexible Manufacturing by Dennis Brandl

Reviewed by Nick Sands

It has been over 10 years since ISA published the S88.01 standard Batch Control Part 1: Models and Terminology. Many companies, users and vendors, have implemented systems based on the S88 model, or as Dennis Brandl calls it, the S88 design pattern. In *Design Patterns for Flexible Manufacturing*, Brandl illustrates the power of the S88 pattern and extends it beyond batch to continuous or non-stop manufacturing. Brandl, the founder of BR&L Consulting, is the current chairman of the SP88 committee, now working on the maintenance update of S88.01, a very active member of SP95, and the chairman of the IEC/ISO joint working group on Enterprise and Control System Integration. Brandl has a MS in Computer Science from California State University, a MS in Measurement and Control from Carnegie Mellon and over 30 years of varied application experience such as working on the last Soyuz mission, the space shuttle program, Siemens, Texas Instruments, Shell Research, and consulting for many other companies. He also has a regular column in Control Engineering.

The first chapters introduce the terminology of batch, discrete, and continuous processes and the symbology used in class diagrams, state diagrams, and sequence diagrams. Here Brandl gives some of the typical benefits achieved by application of the S88 standard and design pattern. The fundamental rule of this pattern is to separate the recipe from the equipment. This is done by layering control, with basic control interacting with the equipment and executing the commands of procedural control which is organized by coordination control.

The chapters on master and control recipes and the S88 pattern are the core of the book. Brandl breaks down the recipe structure and how the types of control connect to each other and to the equipment. Included are the states and modes of recipes, phases, and control modules. The rules for Procedural Function Charts (PFCs) and Sequential Function Charts (SFCs) are given, along with how to use these tools to write recipes and phases respectively. Brandl also addresses the tricky question of how much information to put in the recipe vs how much to build into the phases. The section of the book really addresses batch control or the S88 pattern and sets the stage for the final chapters.

The final chapters extend the S88 design pattern to non-traditional applications. The first case is manual operation of a batch process. The same principles should be used as for an automated batch process, though the systems are manual. This means the procedures should be written in a similar format to recipes with steps and actions. The extension to non-stop and continuous processes requires again separating the recipe from the equipment and also modifying the S88 rule that a unit contains only one batch at a time. The transition of products, start-up and shutdown operations are included in the NS88 pattern. The final chapter covers the common cases of splitting or blending batches of material.

Brandl's patterns provide the clearest explanation of the S88 models and how to apply them. Experts have already discovered these patterns, which Brandl shares with the rest of us. *Design Patterns for Flexible Manufacturing* is a bonus (BBBBB) and a must read for anyone that designs or configures control application, batch or continuous. It is the current evolution of automation design. Find it at ISA.ORG for \$89 (member price).