BREWING BEER CREATIVELY WITH ZENON

Enjoy the Taste of Ergonomics

The elegantly-shaped glass, the sophisticated concert of subtle tastes and complex aromas, the cool, refreshing euphoria – all of these things define, for many of us, the extraordinary experience of savoring a good beer. Behind this experience is great passion… and technology.

CURRENTLY creativity in beer production is again becoming a popular trend. Alongside well-known favorite brands, it is also delightful to try something new and special. The dynamic trend of *craft beer* has emerged, blending local tradition, special ingredients, unexpected flavors, secret recipes and slow brewing – which has more to do with brew masters' innovation than with industrial mass production.

The capacity of brewing equipment, however, is not decisive in achieving a good or bad result. The one thing that really does make a difference is how automation technology supports the brew master to put his ideas into practice and to refine his creations. Is automation flexible or limiting? Do changes have a reasonable or dramatic budget impact? Does the technology support a quick or slow time to market?

This article highlights for system integrators a way to integrate a brewing process control solution using zenon. The following generic solution is designed to widely fulfill general requirements in the food & beverage industry, while identifying opportunities to accommodate particular brewing-specific or individual requirements.

SYSTEM INTEGRATION IN 4 STEPS

In any given project, the system integrator typically requires the valuable input of a process specialist, such as the brew master, in order to define the user requirement specification (URS).

STEP 1: PROCESS CELL MANAGEMENT

In this instance, the URS refers concretely to a brew house – or, generically, the *process cell* – which is the subject of batch control. For every batch unit, such as the *mash kettle, lauter tun, wort kettle or whirlpool*, the functional capabilities (phases), such as *Transfer In, Add Water, Heating, Mixing,*

Transfer Out etc., must be specified. The mechanical components and the necessary *equipment modules* are described in detail – down to the level of single valves and sensors. These are all essential definitions which enable the next steps.

STEP 2: CHOOSING THE SYSTEM ARCHITECTURE

A typical architecture follows the principles of ISA-88 which separates the implementation of the *basic control* from the *recipe procedural control.* It usually consists of a PLC with all necessary I/Os for connecting actuators and sensors and a PC with display – for example: compact form factors without rotating hard disks and ventilators, which adapt to the specific environmental conditions. Through its universal connectivity, zenon Supervisor can be combined with practically any PLCs, whether in completely new projects or when refurbishing existing breweries.

Fans of completely hardware-independent software who want the ability to turn hardware into a true commodity have an even better option: an integrated solution using zenon Logic (for basic control) and zenon Supervisor (for recipe control and visualization). Choosing this approach means hardware architecture can be even more compact: just an (embedded) industrial PC with display and bus I/Os. Both zenon Logic and zenon Supervisor should run on the PC, in order to combine the advantages of the PLC and the PC/IT world. This way, in the event of a hardware upgrade or replacement, users retain complete freedom over their choice of hardware and the software application can remain unchanged.

STEP 3: PROCESS CELL ENGINEERING

In zenon Logic, the state models for every batch unit and equipment phase are programmed. For instance, Sequential Function Charts can be used, being one of the IEC 61131-3 languages. This includes the creation of all required phase parameters which will be later controlled from the batch recipe, such as *time duration, set temperature, material quantity,* etc. The engineering effort can be dramatically reduced by programming common state models for different and non-simultaneous running phases, so that the required function is preselected as a *control strategy* before execution.

In order to reduce the engineering time, zenon Logic offers a preconfigured state model according to OMAC (the Organization for Machine Automation and Control) guidelines – *see Figure 1.* Using a specially designed interface within zenon Logic Workbench, several states of the model can be activated or deactivated. This makes it possible to create a simpler model while maintaining compatibility with the standard. The integrator has complete freedom over how to write the programs to be executed in every state for process measurements, control and regulation. He can choose from the available IEC 61131-3 languages, and preconfigured libraries and can also create his own libraries – for example, for supporting

company-specific or unusual concepts within brewing process regulation and optimization.

After the equipment phases' implementation, the next step is to engineer the recipe control. This happens in the zenon development environment by configuring the Batch Control module. The batch units considered in Step 1 can now be modelled. The flexibility of the configuration makes the integration with both new and older equipment possible.

The recipe phases cover a wide range of functionalities, from bidirectional parameter communication through PLC variables, through *phase done* and *interlocking logic,* up to complete *exception handling* mechanisms. These specific recipe phases have sophisticated interfaces with the equipment phases. Hence, the two state models at control level (e.g. the OMAC model) and recipe control level (the ISA-88 model) are consistently correlated. Any status change or event occuring on one side will have a clear effect on the other side. This is key for a successful implementation which adheres to the ISA-88 principle of separating equipment capabilities from product manufacturing instructions.

For more efficient engineering, the preconfigured batch control components can be reused at the required level of detail.

STEP 4: APPLICATION ENGINEERING

Batch Control is a completely integrated part of the brewing application, together with all other required functionalities: brewing recipe management, recipe execution and process operation, process visualization (*see Figure 2*), alarm and event management, trend curves, data archiving, brewing reporting, etc. Out-of-the-box and reliable components are available for parameterization in the zenon development environment which deliver the optimum balance between flexibility and fast engineering. The symbol library offers preconfigured typical graphical symbols specific to general process control, and also those specific solely to brewing applications.

zenon reduces the integration time by enabling the definition of user-configured graphical templates and encapsulated symbols and by extended mechanisms to reuse

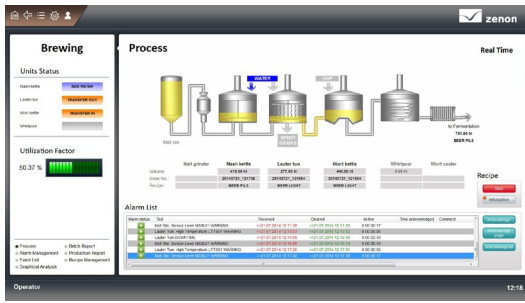*Figure 1:* OMAC-compliant state model definition in zenon Logic.

Figure 2: Brewing visualization at
the operator's required level of detail.

pre-engineered project components. OMAC and ISA-88 standardization, combined with generic design of brewing units make zenon's automatic engineering an ideal solution for rapid application generation. By programming adequate parameters (such as the selection of batch units composing the process cell, required application functionalities, user interface templates, etc.) into their individual zenon wizard, the system integrator assures the necessary level of flexibility.

The integrated zenon Logic and the simulation mode support the careful testing of the entire application before on-site commissioning. Afterwards, the detailed level of system events tracking and reporting enables the validation of every equipment phase and recipe phase – and supports ongoing optimization initiatives.

SOLUTION ATTRIBUTES

The zenon Product Family brings several essential features to the entire brewing control solution.

SUPPORT FOR MANUFACTURING ROLES

In a compact architecture design (for example, for smaller breweries) the system utilizes a single user interface. Even in this situation, different people are involved in the brewing

process. The brew master is the one creating the template recipes for different beer types (so-called *master recipes*). He has all production equipment capabilities at his disposal, because they have already been created by the automation specialist as recipe phases. Not only can the phase parameters be flexibly configured, but also the execution order over time by using a Process Function Chart (PFC) or a matrix representation – *see Figure 3*.

Within the remit of preconfigured user access rights, the operator may undertake different tasks: creating control recipes based on templates, adjusting certain recipe parameters, starting recipes and supervising the process. He is able to monitor the process in real-time and take any corrective action, should any relevant alarms occur. For the best result, the brewing process planned by the brew master has to be followed accurately – *see Figure 4*.

In addition, the process data is archived for every brewing stage. The process documentation is not only essential for traceability; analyses of the process with respect to quality, efficiency or material consumption are typically required by management.

In this way, every involved member of the production team contributes to the high performance of the brewing process.

EXPANDABILITY

Any brewing system using zenon benefits from the technology made available within the whole zenon Product Family. A small project can be easily expanded to larger applications; for example: to encompass more production units with different volumes and more complex control modules.

zenon's connectivity can be used to communicate with other software systems in the plant, for instance with production planning tools. zenon's VSTA and .NET programming interfaces extend the system's openness with one more dimension: huge additional scope for user-programmed functionalities.
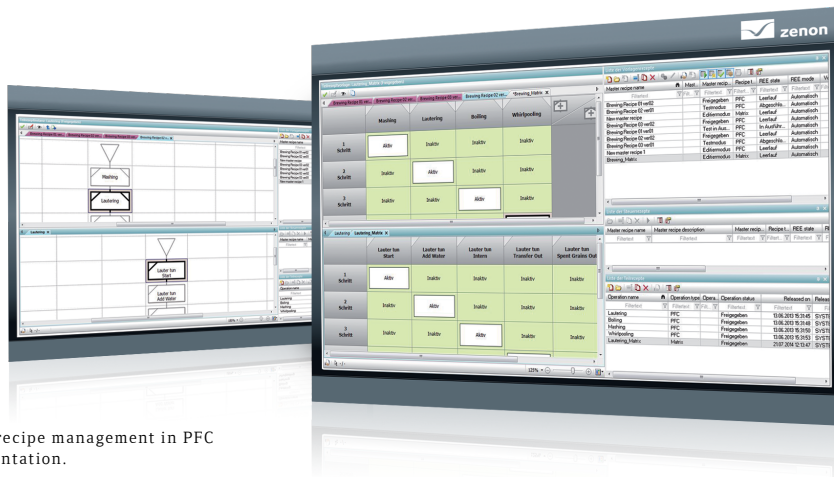

Figure 3: Brewing recipe management in PFC
and matrix representation.

Data archiving in SQL databases, Multi-Touch user interfaces, Dynamic Production Reporting, wider team involvement by leveraging the plant IT network and mobile communication are just a few examples of how such a solution can be extended based on the native functionalities available in zenon. As with any process in the plant, the brewing process has to be integrated with the quality, efficiency and consumption optimization initiatives.

RELIABILITY

A reliable automation solution plays a central role not only in reaching expected results in a timely manner, but also in creating the conditions of maximum reproducibility and in eliminating wastage. The zenon Product Family embeds technologies guaranteeing availability and exactness. The lifecycle-based management of master and control recipes is designed for the complete control of brewing process design and execution.

The configurable and pretested modules grant the entire application a high software reliability. The quality of the communication with hardware is continuously supervised. The sophisticated *exception handling* between the basic and recipe control components assures the consistency of the entire process. The *process image backup and restore* mechanism provides values in case of equipment failure.
The hardware independence of the software enables high equipment availability in case of PC or panel failure. This is because the software can even be temporarily executed on non-industrial PCs. The hardware reliability can then be improved at any time by replacing or updating hardware products – without the need to re-engineer the software.

EFFICIENT ENGINEERING

On their way to support innovation in brewing, automation specialists deserve more ergonomics in system integration – be it a new project or a functional extension. COPA-DATA's commitment to efficient engineering is reflected by the extended features of the zenon development environment. For beginners, basic zenon training can support the learning process and provide understanding in easy engineering.

Parameterization-based integration brings the user more rapidly to project completion and the desired results. Bringing together standardization and flexibility, zenon's automatic engineering provides an opportunity for a drastic reduction in the lead time required for system integration.

zenon also enables the efficient integration of international projects. For instance, the language or the measurement units can be quickly changed without restarting the application.

CONCLUSION

In response to today's appetite for creative brewing, zenon is prepared to make the difference and deliver competitive advantage through flexibility at reasonable cost. Good
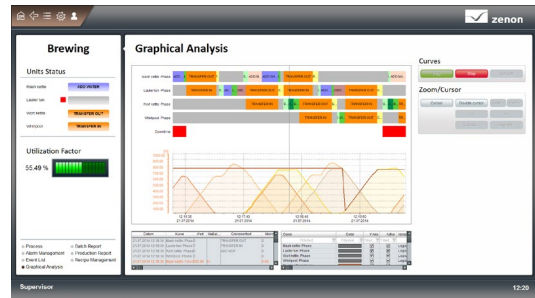

Figure 4: Trend curve analysis of the brewing process.

automation technology can help everyone in food & beverage production and system integration to be more successful, with more satisfaction and less stress. This is what zenon delivers. This is the taste of ergonomics. Cheers!

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http://kaywa.me/B6E1l

Batch Control in Food & Beverage with zenon: watch the video!