

## Leading-edge brewing technology software

**The requirements set out by Carlsberg for migration to a new process control system were clear and deliverable. The brief for the new automation solution at the Danish brewery in Fredericia was quite simple: make the complex production processes more transparent and safer, considerably improve user-friendliness and, naturally, implement it as quickly as possible – with a minimum amount of production downtime.**

There were a number of good reasons why brewmaxx from ProLeiT was eventually chosen: On the one hand, ProLeiT has already been responsible for putting numerous Carlsberg breweries around the world into operation, and with over 25 years of experience to call on it has the necessary skills and expertise to implement projects. On the other hand, brewmaxx is one of the most widely applied process control systems in the brewing industry, including brewery-specific standard functions and modules, as well as an intuitive user interface. The Carlsberg project involved the re-automation of the entire beer produc-

tion process – from malt delivery to the bottling line.

### The Danish challenge

The Carlsberg brewery in Fredericia is one of the largest European breweries with an annual output of roughly 4.3 m hl. More than 40 beer types and no less than 20 mixed products make Fredericia the most important brewery location for Carlsberg in Denmark. It was therefore essential to complete the changeover to the new control system with the least amount of production downtime. This obviously required exceptionally close cooperation between the experts at Carlsberg and ProLeiT. The resulting process descriptions and technical specifications ensured that changeover to and commissioning of brewmaxx were as smooth as possible. The individual process areas were implemented one after the other in record time, and were put into operation as planned with only a few brief interruptions. Carlsberg was obviously thrilled with the way the project was handled:

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“It has in general been a positive experience to work with ProLeiT in this project. The ProLeiT team is highly skilled, they know about brewery automation and processes, and are very keen on getting things solved. (...) All beer supplies to the packaging areas were started as planned, and we had no major unplanned interruptions in deliveries. In the brewhouse we made 46 brews in the second week after shutdown of the old system, which was significantly above the expected at that stage,” says Kim Christensen, Senior Project Manager at Carlsberg.

### Beer tree and CIP matrix

The primary goal of the brewers in Fredericia was to increase the plant's process safety while minimising costs and losses. The entire beer tree which defines which beer types can be brewed in which composition across the various production steps – from wort to bright beer - was thus stored in the process control system. Based on this “beer tree”, the system initially supports the operator in selecting compatible tanks for the chosen product with regard to material compatibility and technological status of the beer. This checking of the underlying rules optimises the process



Aerial photo of the Carlsberg brewery in Fredericia, Denmark

# application profile

safety for tank allocation. After selecting the tanks, in the second step a cleaning matrix is used to check the status of the needed pipes. Depending on the product type which previously occupied the lines, the system automatically decides whether the lines require cleaning for the new product or not. The operator is informed at once about product incompatibilities or an incorrect cleaning status. Operating errors are therefore excluded. Only required cleaning in between transferring various products is selected, thus saving time and cutting cleaning costs.

## Mashing rhythm

The lautering duration of previous brews of the same product type is considered in the brew scheduler in order to optimise allocation in the brewhouse. The expected lautering duration stored at the wort material is adjusted to the actual duration in order to react to the real lautering behaviour. Furthermore, the system automatically optimises malt

outtake for the two brew lines. The main brew line is operated with higher priority to ensure constant utilisation.

## Production planning with order parameters

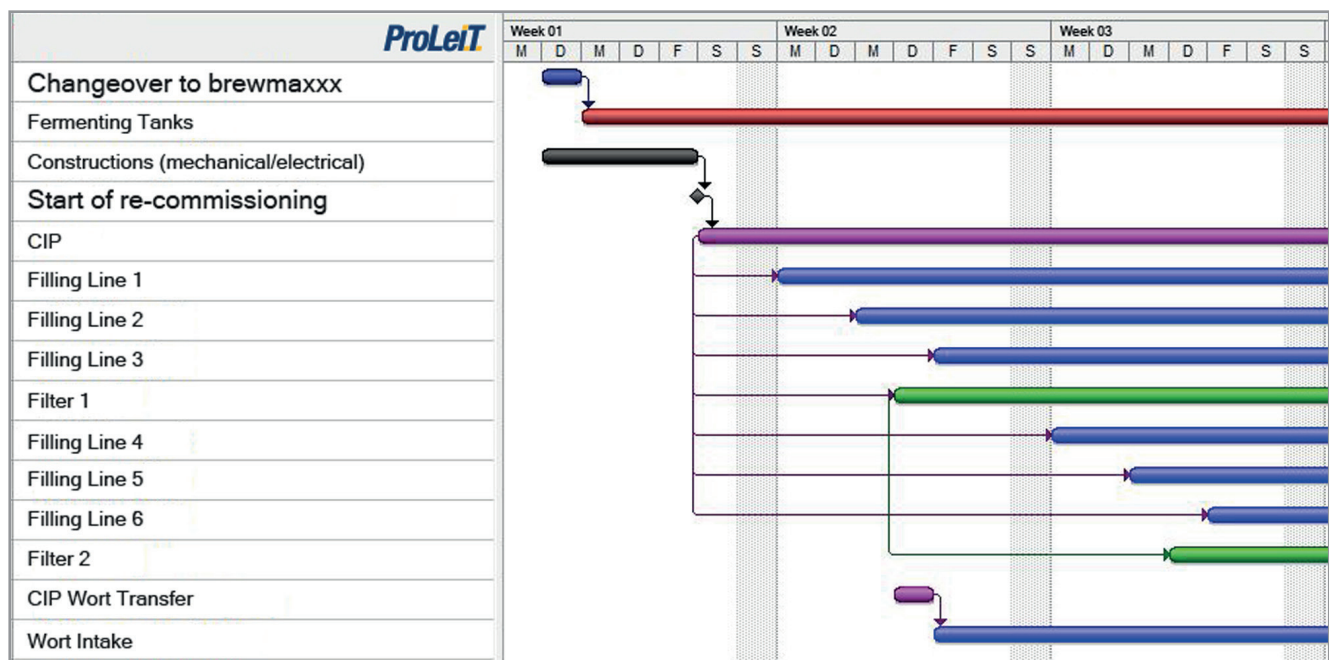
Production specifications take place in the brewhouse and for the filters on the basis of brewmaxx order planning. The filling of the fermenting tanks is basically planned in brew groups at Carlsberg. The operator is able to carry out the necessary settings for the entire group or for individual brews when planning the order: malt silos, fermenting tanks, yeast dosing as well as special features, such as the wort output in the yeast propagation. The master brewer is able to define any target value as an order parameter in the recipe and to enter it in the order list for brew-specific changes.

This is a tried-and-tested method, particularly when adapting dosing quantities for the compensation of variations during production. Blend ratios and tar-

get quantities are additionally specified for each order in the filtration planning. This ensures that Carlsberg can dispatch production specifications from the ERP system (SAP) directly to the order planning.

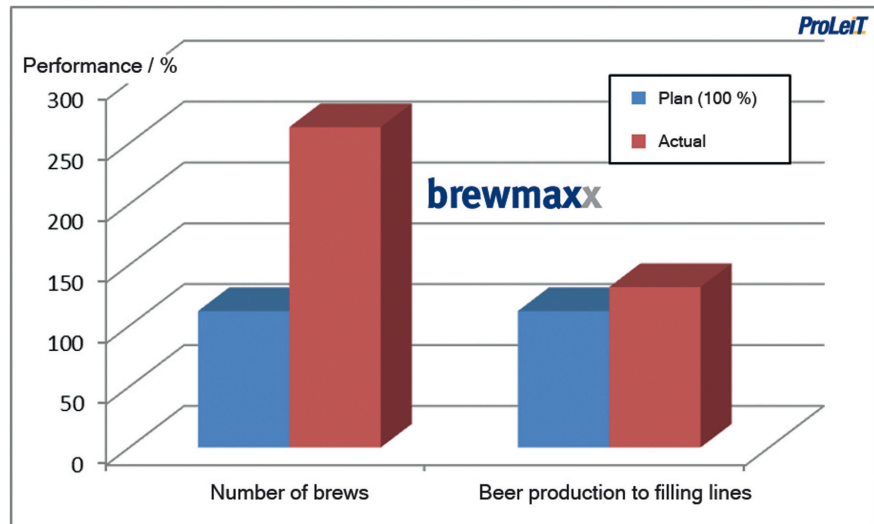
## First project phase: Fermenting cellar, filtering lines and pressure tank cellar

The first project phase involved the re-automation of the whole cellar, consisting of four fermenting cellars with 54 fermenting tanks and two filtering lines with 40 downstream bright beer tanks and several tanker stations. brewmaxx was implemented for this entire cold block in one large step. Amazingly, it took just nine days after restarting the automatic programs until all the areas of the fermenting cellar were up and running again with brewmaxx. Together with the Carlsberg experts it was possible to restart over 300 different programs within a very strict time limit. The tank cooling systems were re-activated after just one



Changeover during the first project phase – fermenting cellar, filtration and bright beer cellar

day. This was followed by a few days of electrical and mechanical engineering work on the plant before all six beer bottling lines were eventually put back into operation at two-day intervals. The first filter commenced production after five days, the second filter followed suit six days later. Finally with the wort intake all areas of the cellar were running fully automatically with brewmaxx again. An impressive achievement by both the Carlsberg and the ProLeiT team, who demonstrated excellent cooperation throughout every project phase. Kim Christensen was also highly satisfied with the way the project had been handled: "Further I think that it is also positive to highlight the expansion of the scope within the actual agreed timeframe (...): During the engineering phase the scope was extended with re-automation of the two Profi Filter lines, so they now are fully controlled by brewmaxx. Further scope changes covered within the agreed timeframe also included beer supply to a new canning line, interfacing to a new Oenoflow filter and integration of a new yeast separation plant."



Level of performance when restarting production with brewmaxx

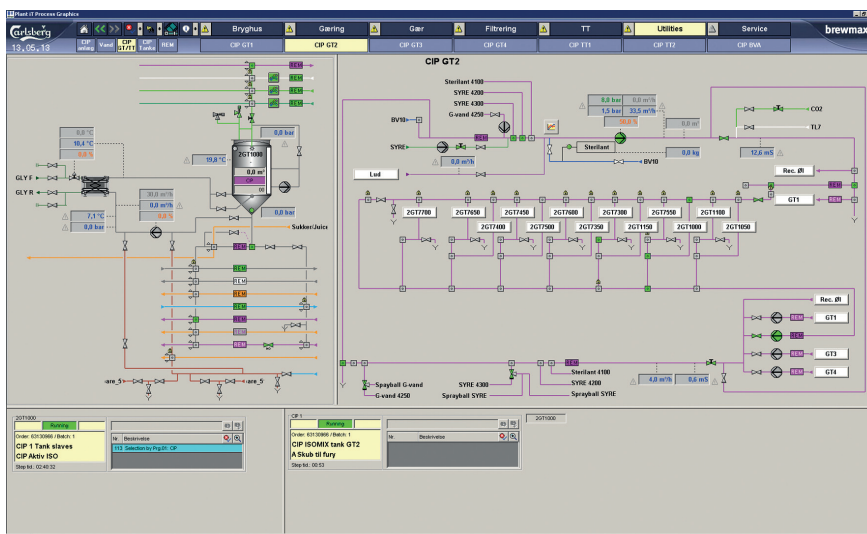
## Second project phase: Silo plant and brewhouse

Wort preparation was adapted to brewmaxx during the second project phase. The brewhouse was actually out of service for just six days. To ensure the company's operating staff had sufficient time to familiarise themselves with brewmaxx, Carlsberg planned 20 brews for the first week after the changeover.

In fact no less than 46 brews were carried out. Thanks to the high level of user-friendliness, Carlsberg's staff became well acquainted with the new automation system brewmaxx in next to no time.

## Integrated materials management for the brewing process

Due to the large variety of products in Fredericia, the effective handling of order and recipe-controlled production processes was one of the main requirements of Carlsberg which the new control system had to meet. brewmaxx material, the materials management module, was used to achieve this objective. Production output and consumption are thus recorded on the basis of a process-compliant warehouse structure with inventory management. Moreover, full traceability is guaranteed from the pressure tank to the malt silo. Using the brewmaxx materials management solution it is also possible to link a single process sequence, including the material parameters of various beer types, to different recipes. This is highly recommendable for technologically less



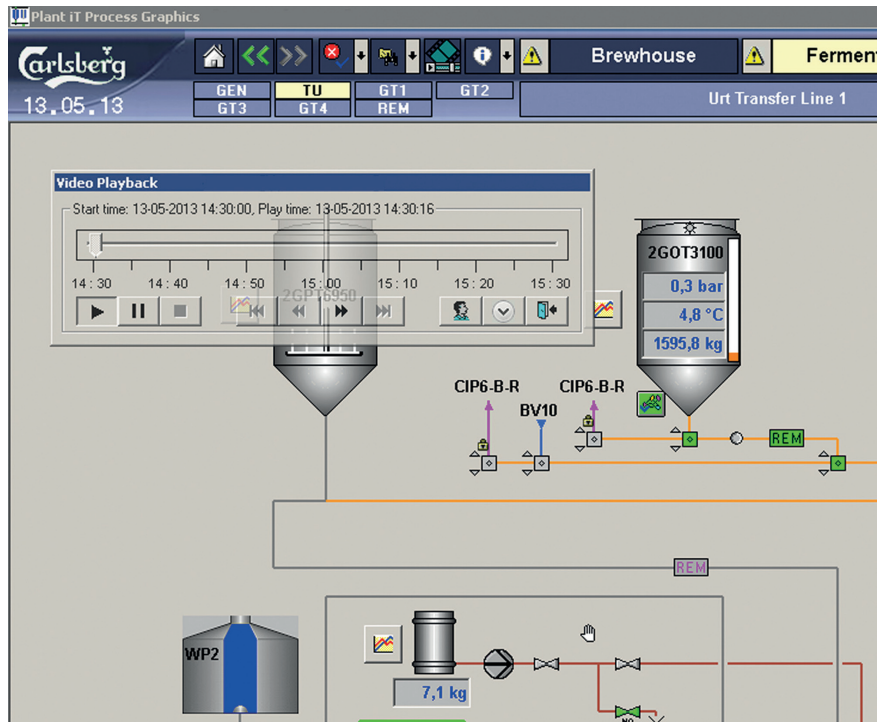
User interface for the CIP overview in Danish



advanced vessels, such as the pressure tanks, which have an identical process sequence for all beer types. Through the provision of material-dependent parameters and clearly structured methods, Carlsberg achieves a high level of flexibility with regard to type specification. Seeing as the process sequence is already defined, only the material parameters need to be specified for new beer types. This option means, that various process areas have access to the same material parameters. And if these parameters require modification, they only have to be corrected once and are subsequently available in the updated form throughout the brewery's entire control system.

## Everything under control

To ensure the people at Carlsberg always remain fully in control of the over 40 beer types and the more than 20 additional products, consisting of roughly 200 materials in total and produced at a plant boasting approximately 6,000 automatic valves, 1,000 manual valves and 1,000 pumps/motors, ProLeiT designed dynamic overview screens specifically for the needs of the production facility in Fredericia. These screens enable immediate intervention in every main process from each of the operating stations. The respective tanks and line sections appear dynamically according to the relevant selections. In other words, operators only see the plant components relevant for the respective process. The resulting user-friendliness of the system enhances staff response time and guarantees simpler, more transparent and safer working processes. To achieve a new level of user-friendliness, Carlsberg also requested that all the control system interfaces be made available in Danish. This adjustment helped to promote the highest levels of staff safety in Fredericia.



*brewmaxx Visu-Recorder – recording and output of the process visualisation*

## All process sequences ensured

Also in Fredericia, Carlsberg uses the brewmaxx Visu-Recorder which documents every operating and process step and subsequently replays it via the standard user interface of the control system. This means it is possible to display who intervened in which process or which route each product has taken through the plant at every operating station. This can provide the basis for effective process optimisation and troubleshooting. Its intuitive and simple handling has led Carlsberg to also use the brewmaxx Visu-Recorder for staff training purposes.

## The future

The latest project in Fredericia is to replace the current reporting system. This involves extending brewmaxx with additional MES functions, such as com-

plete process validation, detailed reports, key performance figures derived from production processes and finally order confirmation to Carlsberg's SAP system. In summary, it can be said that everyone involved in the project agrees that Carlsberg's goal of providing "safe operation with brewery proven automation" has been fully achieved.