

Integrated material requirements and production planning

The challenge

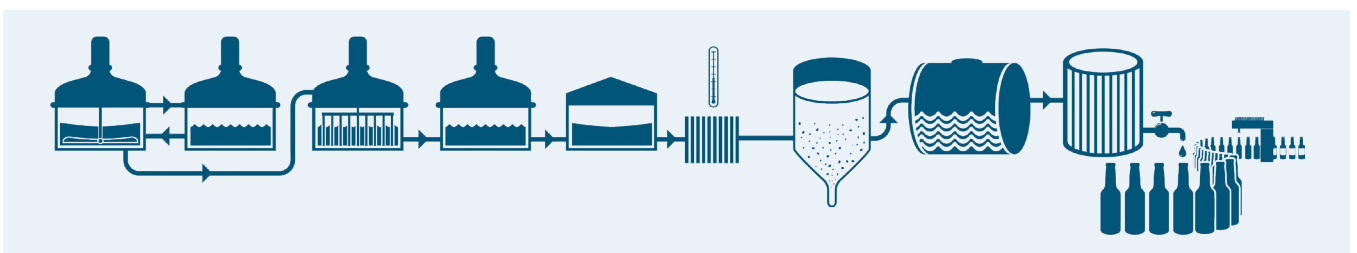
Production planning is defined as the crucial step between acquiring orders and the production of goods. Usually, the set-up of the production planning assumes unlimited quantities of resources available at any time in the process.

Material Requirements Planning (MRP) is the step in the entire process that ensures resource materials are available when production begins. Optimization of both MRP and production planning is usually carried out separately. However, holistic approaches combining both steps have been described in the past, e.g., Advanced Planning and Scheduling (APS).

Most production planning scenarios deal with machines and discrete goods being produced. Optimization in production planning from a more mathematical point of view is in that case solving the so-called Job Shop Scheduling Problem (JSSP).

Production processes involving liquids and gaseous substances processed in reactor columns and tanks pose a more complex optimization problem. E.g., processes finishing on one "machine" regular overlap with subsequent processes on the following "machine". Machines in this context are tanks and reactors but also filters, pumps, flow coolers, and the like.

The efficiency of the processes in beer brewing companies can be increased significantly.



Beer brewing consists of many different processes like mashing, lautering, cooling, fermentation, resting, filtration and packaging.

Together with our partner *operaize GmbH* in Cologne, we have developed a holistic solution for combining MRP and production planning focusing on processes involving liquids and gaseous substances.

Beer brewing use case

A typical use case for such processes is the beer brewing process on an industrial scale. From mashing via lautering, cooling, fermentation, resting, and filtration towards packaging, the process is centered around the modification of water to become the intended beer.

While most parts of the brewing process are usually carried out within a few hours, the fermentation and resting phases involve days to weeks and accordingly occupy some of the production resources for that time.

Hence, the knowledge of a certain type of beer being ready for bottling around a given date allows a more relaxed MRP concerning the availability of bottles, caps, and labels. However, demand forecast is crucial to have the right amount of beer ready when needed. Moreover, the packaging and logistics end of the production line must be prepared, e.g., by stocking up on bottles at the right point in time.

Combining MRP with process scheduling introduces more degrees of freedom to the underlying mathematical problem. Both parts will influence each other and result in a tighter schedule on the MRP side. Hence, a combined solution leads to better just-in-time availability of resources, reduces the shelf space required, and also has a positive impact on the balance sheet of the brewery.

Furthermore, necessary rescheduling resulting from problems along the supply chain are likely to have less impact on the production costs with MRP and production planning combined.

Fraunhofer SCAI and *operaize GmbH* take it a step further by utilizing machine learning techniques for sophisticated demand prediction.

Demand prediction, in this case, allows early stocking of resources that may encounter a shortage due to increased demand or limited availability. A typical case was the availability of standard deposit beer bottles during the first phase of the Covid-19 pandemic in Germany. Due to the effects of the lock-down, customers returned much fewer bottles than usually. In addition, the printing companies were not able to produce enough labels, so breweries had trouble packaging.

Our fast optimizer combines the latest research findings with clever use of machine learning resulting in short calculation times as well as superior optimization results within seconds. These properties enable customers to explore what-if scenarios like analyzing the possible effects of introducing new or even seasonal products.

MRP and Production Planning combined

Of course, Fraunhofer SCAI's MRP and production planning solution is not limited to breweries. Even if you are producing paints or dairy products, every industry building on processes involving liquids, gaseous substances, and bulk goods can directly benefit from the solution we are offering with our partner *operaize GmbH*.

Our planning solution allows customers to

- seamlessly combine MRP and production planning,
- obliterate error-prone spread-sheet planning,
- get real-time results in seconds,
- save costs by robust just-in-time stocking of production resources, and
- react to market changes pro-actively.

And, of course, our planning solution nicely integrates into almost any enterprise resource planning (ERP) system.

Our software provides solutions for MRP and production planning within seconds.

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