Increasing effectiveness in industrial F&B production

From challenge to solution

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do it your way

Content

1. Executive summary

The F&B manufacturing industry is under a steadily growing pressure. Once an investment is in place, and as long as there is demand for the products, the production teams are under pressure to produce as much as possible with existing production facilities, whilst keeping costs as low as possible.

Automation is directly connected to this dynamic situation and has the challenge to deliver increasingly agile and open solutions. In this context, industrial software represents the core of the systems dedicated to increasing production effectiveness.

Addressed to all members of the F&B production team, this document contains guidelines for selecting software applications and building solutions towards the fulfillment of the afore-mentioned goals.

The example solution, using zenon software, is universal, flexible and open; and gives high value implementation to a classic approach of measuring Overall Equipment Effectiveness (OEE). For F&B manufacturing these measurements are translated into clear benefits: production effectiveness, reduced production costs, high quality and compliance with regulations.

2. Who should read this document?

This document is designed to be a guide for everyone involved in the implementation of automation-based tools for increasing production effectiveness in F&B manufacturing:

a. **Production & Packaging Managers:**
   Are typically managing a very dynamic production environment and they constantly receive increased targets, for efficiency and effectiveness, for regulatory compliance, for quality, for resource consumption. They will find here how, by using appropriate tools, the way to high performance becomes much easier.

b. **Performance Managers:**
   Focus on continuous improvements in production performance and require a complete overview: processes & resources, management concepts & key indicators, tools and methodology. In this document they will find practical

hints for choosing and implementing a software-based solution to support for these goals.

c. **Automation & Maintenance Engineers:**
Are always a key part of any team involved in the integration or maintenance of an automation system. This document provides them with basic information for writing requirements specifications and for integrating automation systems to support increased productivity.

d. **IT teams:**
Do not usually cover tasks related to the plant floor infrastructure; but they often collaborate with the automation staff, in order to integrate different systems and maintain proper information flows. A better understanding of the challenges and solutions in the production areas will make their work together easier.

e. **Suppliers of production equipment and integration services:**
New machines with new capabilities or just increased performance, systems for one production area or over an entire plant - suppliers have to constantly respond to new challenges. This document represents updated information about new automation technologies and their application.

3. Produce more! Without new investment?

It is a time when new investments in production facilities are not just carefully planned, but are often delayed or cancelled. However, the production volume of most producers of Food & Beverage remains on a growth curve. Their products are wanted, because of their quality, because they follow customer's demands and trends (e.g. "bio" or "light" products) or, simply, because of their excellent marketing. The natural consequence is that manufacturing plants are again and again asked: produce more!

But how does one produce more without investing in new production facilities? The answer involves a focus on efficient & effective utilization of existing equipment, by using appropriate and capable tools.

Overall Equipment Effectiveness (OEE) is a familiar indicator used in many F&B production plants. Increasing the OEE of a production line by just 5%, without relevant capital investment, is significant. The benefits are clear and measurable and a higher turnover with the same investment results in a higher profit! The OEE indicator places focus on improvements through its three components: Availability, Performance and Quality rate.

OEE[%] = Availability[%] x Performance[%] x Quality Rate [%] / 10000

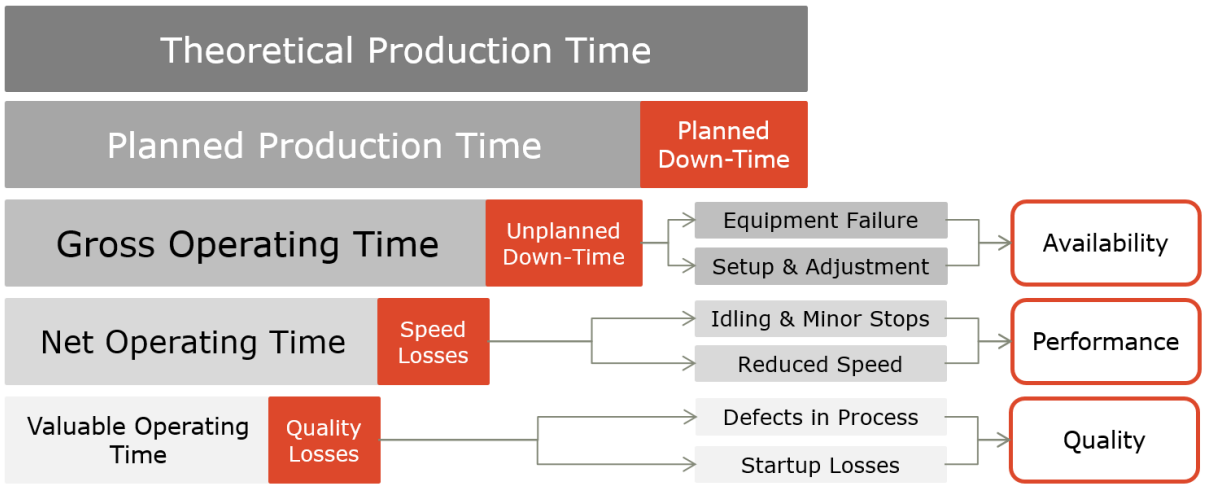

Figure 1: OEE is not just an indicator; it brings focus on potential improvements.

In an OEE-based approach, there is a clear need to collect information from the plant floor, to process it and to present it to the production team. Together with the four factors expressed as a percentage (OEE and its components), a more detailed analysis of the causes reducing the measured effectiveness is required.

On the one hand, this should happen in real-time; the operator will be able to improve or adjust the processes before it becomes too late. On the other hand, data storage and further processes bring extensive advantages through historical analysis. The statistics, in connection to production shifts, batches & articles, will reveal clearly the improvements potential. In this way actions oriented towards effectiveness will always be optimally prioritized.

4. What to expect from a software solution

The software at the core of the production process whether for machine operation, line supervision or operations management, is able to affect all three of the OEE components. Such software is, in fact, the core of the system dedicated to increase the performance of your equipment. We will call it EPS (Equipment Performance System). Industrial users give various names to such system: SCADA (Supervisory Control and Data Acquisition), MIS (Management

Information System), LMS (Line Management System), DAS (Data Acquisition System) etc. The user requirements are more important than terminology.

How does one choose software for constructing an EPS? What is to be expected from it?

As an example, we will consider the zenon SCADA/HMI software, developed by COPA-DATA.

Process connection: reliable, universal to all production equipment and people

Production plants often use a mixture of old and new equipment, devices and measurement instrumentation that are often from different suppliers. These components are usually selected for performance, low maintenance costs or energy consumption reasons. A key condition for the successful implementation of an EPS is the availability of reliable communication with all these “participants” within the production line. In practice, the fully automatic data acquisition is not always supported by existing production equipment. At least partially, the machine operator can observe and bring input for root cause analysis.

SOLUTION: zenon is designed to communicate with a wide range of automation hardware by providing more than 300 communication protocols. The data transfer speed and the management of the connection quality bring reliable and true insight into processes. zenon enables a wide range of client-server technologies and the involvement of the machine operator for manual data introduction, e.g. regarding breakdown causes.

Features: specific, out-of-box, configurable

Owing to requirements like the ones mentioned in chapter 2, developing an automation system can represent a great deal of programming. This is not the case if the software solution represents the right balance between ready-made modules and flexible configuration.

SOLUTION: zenon uses the principle of “parameterizing instead programming”. The HMI/SCADA software offers out-of-the-box modules as components for an application. It is only necessary to configure and interconnect them and thus it delivers results very quickly.

In an EPS, there are standard zenon out-of-the-box functionalities that play a key role: Alarm Management, Chronological Event List, Historian, zenon Logic, Reporting, Extended Trends and so on.

Networking & connectivity: corporate-wide, flexible, open

A key task of an EPS is to share information, raw or processed, online or historical, numeric or graphical, within the company network. In this way, the system provides the right information to the right people, in time.

SOLUTION: zenon has sophisticated networking technologies (Client/Server, Redundancy, Web server, fix or mobile clients etc.) in a way that is simple to implement, using just a few settings in the development environment. The involvement of new members of the production team, allowing them to do their work based on this valuable information, is flexible and cost-effective.

Being designed as an open system, zenon integrates with other software applications, including high level IT systems (e.g. SAP, providing a direct link between plant floor and business levels).

Automation architecture: independent choice of hardware components

Hardware & software – every part of the process automation is subject of different innovation & life cycles. The ideal situation is to be able to choose the optimum mix of new automation products and current ones. Does the EPS software support this?

SOLUTION: zenon is designed not only to communicate with a wide range of PLCs. A zenon Server, the core of the EPS, can be integrated using physical or virtual machines, or even Cloud solutions. The client functionality of zenon can be also freely chosen, from office PCs and notebooks, to tablets or smartphones. Once the calculation logic and the user interfaces are engineered at server level, it provides the freedom to use them wherever they are required.

What does this bring to a packaging manager? He will not only have the benefits of the EPS on his desktop PC. He can also walk around the production area and always have up-to-date OEE information.

Integration & maintenance: easy, time effective

The convenience of system integration determines directly the project costs and the flexibility of later updates. Is this task only the reserve of highly skilled automation specialists?

SOLUTION: zenon does not require programming skills; in this way, the learning curve for the plant engineering team or the automation partner is reduced. As a result, development and maintenance are done in a shorter time and with higher productivity. The development environment of zenon implements concepts dedicated to engineering productivity, such as: object orientation, re-usability or template support.

For large companies or for system integrators, the automatic engineering in zenon assures the standardization and robust roll-out of HMI/SCADA applications across different locations, in order to fulfill both corporate concepts and local peculiarities.

5. How is an Equipment Performance System implemented?

Let´s consider three main steps for the implementation of an EPS.

And let´s suppose that the subject of OEE improvement is a packaging line – such as the one in the following diagram, which shows a filling line for reusable glass bottles.

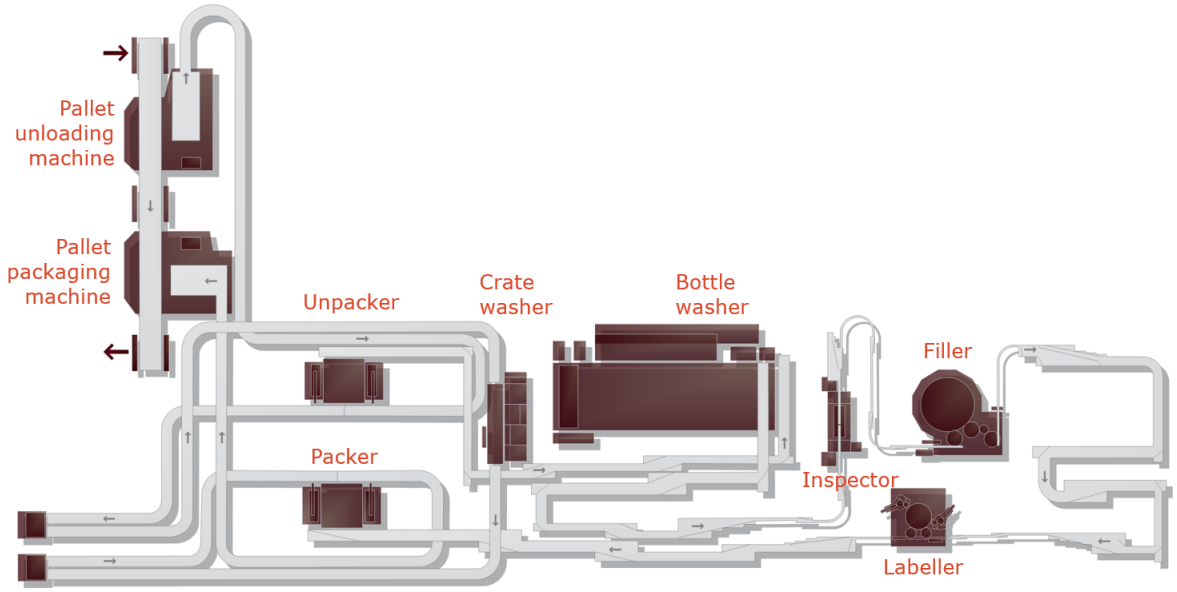

Figure 2: The packaging line, the object for the implementation of an Equipment Performance System

Requirements Specifications

First, it is necessary to describe the requirements, typically in an URS (User Requirements Specification) document. The content should include information like:

- The machines/equipment to be connected to the SCADA system, incl. technical details about the machine automation (PLC, HMI etc.)
- The resulting user requirements from the approach based on OEE or other KPIs (Key Performance Indicators) – see the details in the next chapter
- The methodology for calculations and analysis of OEE or other KPIs, as they can differ from one company to another
- The users of the EPS system and their responsibilities related to production effectiveness
- The requirements for communication with other software systems, including the ERP (Enterprise Resource Planning) system

Solution Design

The main goal of an EPS is to increase the OEE for the packaging line, by improving its three components: Availability, Performance and Quality rate.

The key aspects of the solution design can be structured as follows:

Availability

Items to optimize	Solution with zenon
Changeover Unplanned maintenance Cleaning Breakdowns	▪ Maintenance planned and supervised with zenon Industrial Maintenance Manager, in order to reduce unplanned maintenance ▪ Optimized change over time, from one product to another, by: – Changing machine parameters using Recipe Management in zenon – Transmitting operational information to machine operators by using ERP/SCADA-to-HMI communication ▪ Higher machine HMI availability by integrating zenon redundancy in the SCADA system. ▪ Controlled and documented cleaning procedures for time optimization. ▪ Breakdown management, real time and historic, including automatic or manual data collection, using: zenon´s Alarm Management, Reporting and Extended Trends; the result provides a clear prioritization of corrective actions. ▪ Maximized availability of the EPS system itself by using zenon Redundancy (at SCADA level) and its universality with hardware platforms.

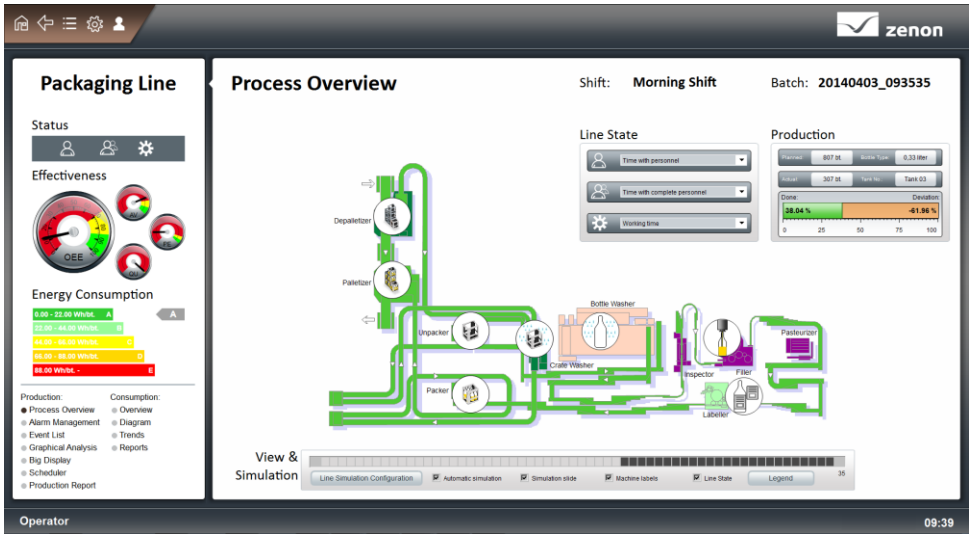

Figure 3: Packaging Line overview in zenon

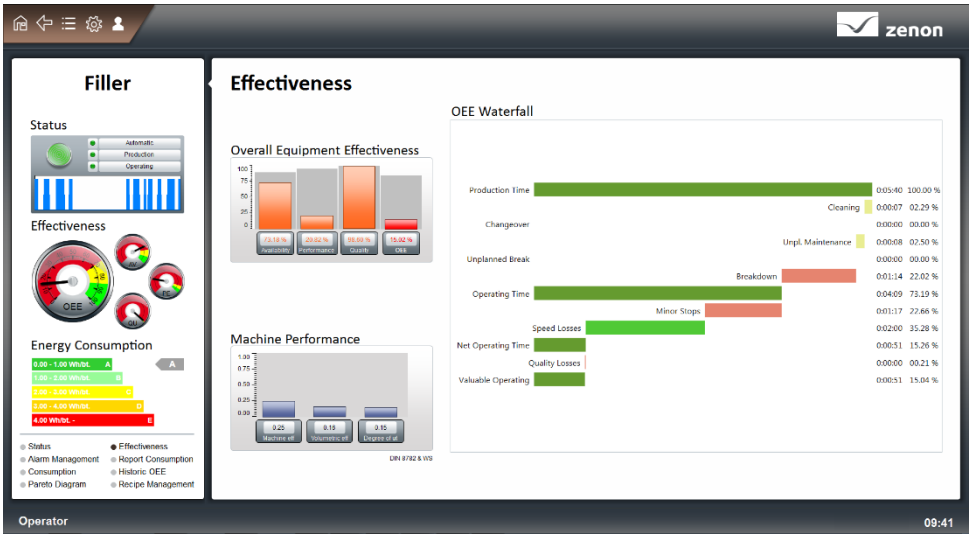

Figure 4: Analysis using an OEE Waterfall Diagram in zenon

Performance

Reduction of	Solution with zenon
Small stoppages Loss of speed	▪ Clear overview and convenient focus in process visualization, both at HMI and SCADA levels ▪ Performance-oriented plant operation based on real-time OEE calculation by using zenon Logic ▪ Small Stoppage management, by automatic data acquisition, real-time filtering and statistics using zenon Analyzer ▪ Reduction of the machine's idling time through synchronised machine operation, based on graphic analysis of machines states evolution in zenon´s Extended Trends ▪ Automatic real-time calculation & historic statistic of the machine"s speed losses ▪ Involvement of other personnel using network, HMI panels, alphanumeric panels, mobile devices etc.

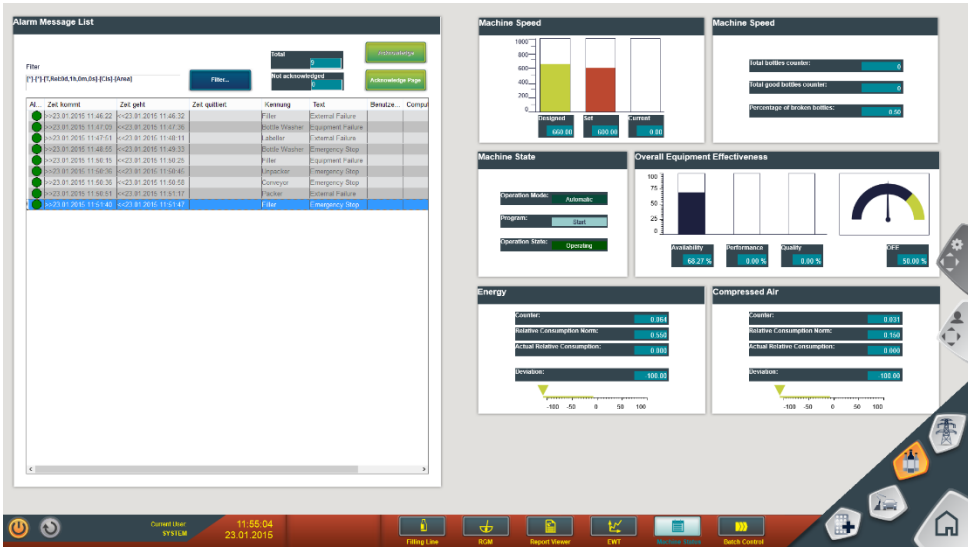

Figure 5: KPI online calculation in zenon

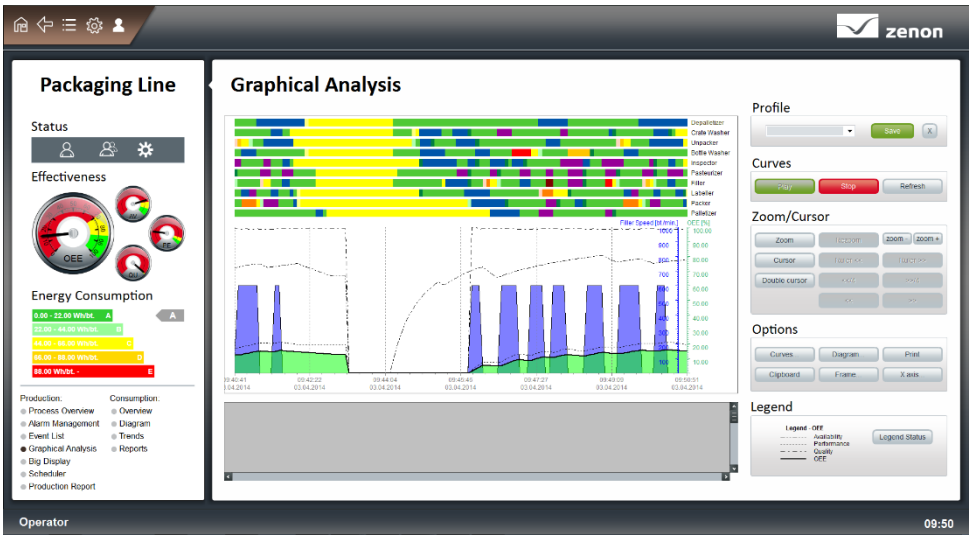

Figure 6: Graphic Analysis in zenon

Quality rate

Items to decrease	Solution with zenon
Start-up rejects Production rejects	▪ Supervising and documenting the violation of the dynamic setpoints with Alarm Management in zenon ▪ Graphic analysis of the process parameter evolution ▪ Real-time calculation and historical analysis of quality indicators, by using zenon Logic and zenon Analyzer

Figure 7: Alarm Statistics in zenon

Figure 8: OEE Reporting in zenon

System Integration

The diagram of below shows a generalized architecture of an EPS. From top to bottom, over a production area, the system communicates with the machines‟ automation (PLCs and HMIs) and human resources. The Ethernet Network is the central communication platform of the

system. The higher level contains the central component – the Server PC – and the others which can be integrated in the system, all at once or step by step, following the user requirements: database server, Client PCs, service PCs and the link to the ERP system.

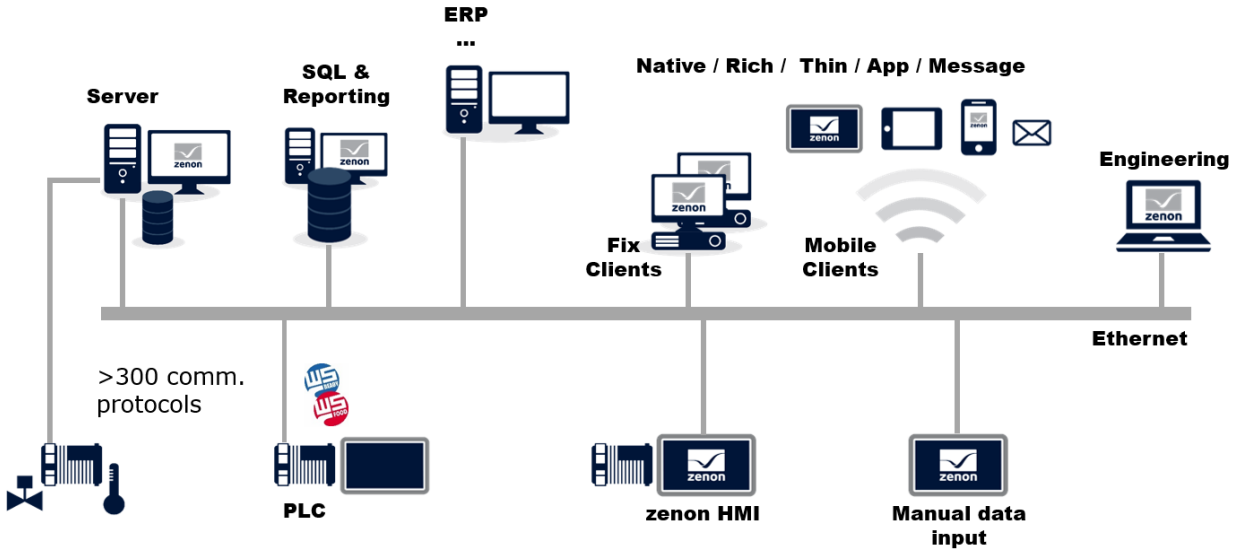

Figure 9: Architecture of an EPS, integrated from production area to ERP level

The zenon software implements a wide range of tasks over this architecture, as mentioned earlier.

Ten key facts of rapid, flexible and open integration are:

- The connection to the various machines is supported by zenon with over 300 communication protocols available (Siemens, Mitsubishi, ABB, B&R, Rockwell Automation, Beckhoff and many others...), including the Weihenstephan Standard Client Driver
- Advanced driver functionalities in zenon, during integration, allow the automated and fast take-over of large lists of PLC variables into the HMI/SCADA application.
- It often happens that the HMI software of the machines is zenon, when it is so integration of the HMI and SCADA applications brings supplementary features, such as redundancy and horizontal transparency.

- The data collected from machines (status information, alarms, events, parameters etc.) is processed in real-time by using zenon Logic (IEC 61131-3 software PLC); the logic is able to run on hardware placed in the network wherever necessary.
- The acquired and processed data is archived by using zenon Historian, in a relational (i.e. SQL, Oracle) database.
- The functionalities implemented on the Server PC, such as process visualization, Alarm Management, Event Logging, Trends, Reports etc. can be made available to the mobile or fixed Clients, natively, over HTML5 or App technologies.
- Communication with operators on the plant floor is assured by using the zenon HMIs, mobile solutions, large flat screens and alphanumeric displays connected to the network. In this way, they are able to input manual information to the system (i.e. identification of breakdown causes) and to receive indicators regarding OEE, planned versus realized production, raw materials to use, special messages from production coordinator etc.; resulting in shared information and awareness.
- If an ERP system is used, e.g. to undertake production planning, zenon brings universal connectivity to plant floor and integrated operational features for the entire combined ERP & SCADA system.
- With zenon, engineering does not require programming skills; this means that integration & maintenance services are available on a broader basis from in-house or outsourced personnel. zenon assures further extensibility via programming as well, due to VSTA and VBA integration.
- Whenever such an EPS system is required to be duplicated, the Automatic Engineering allows a fast roll-out; by programming a Wizard application (.NET, C#, VBA) the application is automatically generated and readily adapted as most of its components are reusable. The engineering time is dramatically reduced to just a few “free-of-programming“ steps, i.e. graphical representation perfectly adapted to every implementation.

6. Conclusion

The wide range of software technologies offered by the zenon Product Family represents a sustainable solution for continuous improvement processes in the Food & Beverage Industry. For production plants the benefits are measurable in increased efficiency and higher competitiveness. The COPA-DATA food and beverage specialists are available to discuss your requirements and can be contacted through www.copadata.com or fnb@copadata.com.