Virtual
Milk in Virtual
Cartons

Simulation environment for
testing process control software

Intelligent process control software has an important job to do to continuously optimize downtimes, but developing and testing it is time-consuming and expensive. This issue is successfully addressed by the Tetra Pak Simulation Environment (TSE), an efficiency-boosting software and hardware system for the virtual commissioning of beverage filling machines.

Challenges for the Food Service Industry

In times of shifting markets, the food service industry is facing new challenges. Increasing cost pressure and intense competition are forcing companies to optimize their processes and shorten the time to market. This was one of the factors that prompted Tetra Pak to develop the Tetra Pak Simulation Environment (TSE) for the virtual testing of beverage filling machines. As a leading provider of processing and packaging systems for beverage products, Tetra Pak gained an international reputation with its milk cartons.

Broad Potential for Simulation

Tetra Pak has two primary objectives in developing the TSE. One is to support the development of process control software for filling machines. The TSE does this by simulating and optimizing new concepts before they even reach prototype status, and by enabling developers to test and optimize their own code.

The other is to run hardware-in-the-loop (HIL) simulations of the programmable logic controller (PLC), including the process control software, on the TSE. The trend toward HIL testing has recently gained momentum, especially in the German and Italian packaging industries, because virtual machine commissioning enables them to automate tests and run regression tests. The latter ensure that the software will function reliably under real-world conditions.

How the Simulation Environment Helps

The environment gives users decisive advantages. Firstly, by simulating a PLC's work environment, it greatly reduces the expense and time needed to construct real prototype machines. There is also no risk of damage to any hardware, which can occur if real

A Tetra Pak beverage filling machine: By the time the first prototype is ready, its process control has already passed a whole series of virtual tests.
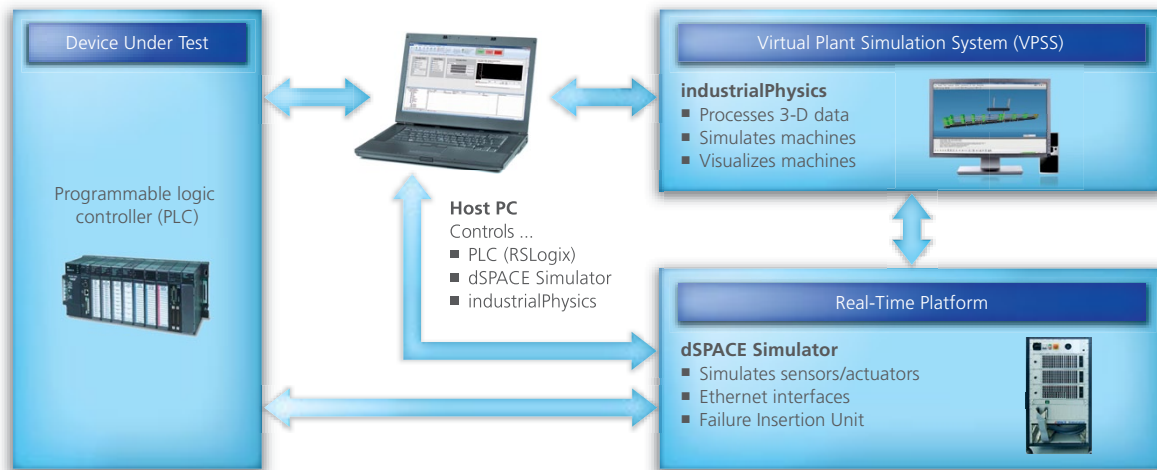
Structure of the simulation environment: Simulation tools from dSPACE and the industrialPhysics software are the heart of the Tetra Pak Simulation Environment (TSE).

machines are used to test a function such as an emergency stop. And finally, simulation reduces the amount spent on liquid products and packaging materials.

With individually selectable add-ons, there is a wide range of different machine variants, and they all need thorough testing before mandatory or optional software updates can be supplied to the customer. Here too, HIL simulations help identify problems at an early stage. Furthermore, HIL-based software tests are just as important when customers want to integrate new components into existing machines.

Tetra Pak Seeks All-Round Talent
In the hunt for the optimum project partner, Tetra Pak evaluated the port-folio of services provided by various suppliers of HIL processes and automation solutions, and also those of machine manufacturers. It was very quickly clear that the ambitious vision could not be achieved with out-of-the-box solutions, rather it would have to be built step by step. Not least because of this, Tetra Pak placed particular importance on receiving sound engineering support over and beyond the usual standard products.

Solution Competence from dSPACE
Tetra Pak chose dSPACE because of their well-recognized know-how on HIL and modeling. The company's versatile product portfolio covers almost the entire HIL tool chain that the project requires – with ControlDesk® Next Generation, Real-Time Interface for Multiprocessor Systems, the AutomationDesk test automation software, and so on. Powerful and scalable hardware for multiprocessor structures is also available. Moreover, dSPACE has comprehensive experience in multiple sectors, acquired over many years in the automotive, aerospace, robotics and e-drive industries. dSPACE's location not far from Tetra Pak was also important for the project, as it makes close cooperation in the development process much easier.

Structure of the Simulation Environment
To produce the realistic simulation scenarios that Tetra Pak is aiming for, the TSE uses a dSPACE HIL simulator with two processor boards, analog

> "dSPACE's comprehensive know-how and product portfolio are the ideal foundation for building a simulation environment for Tetra Pak beverage filling machines."
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> *Mauro Gargiulo, Tetra Pak*
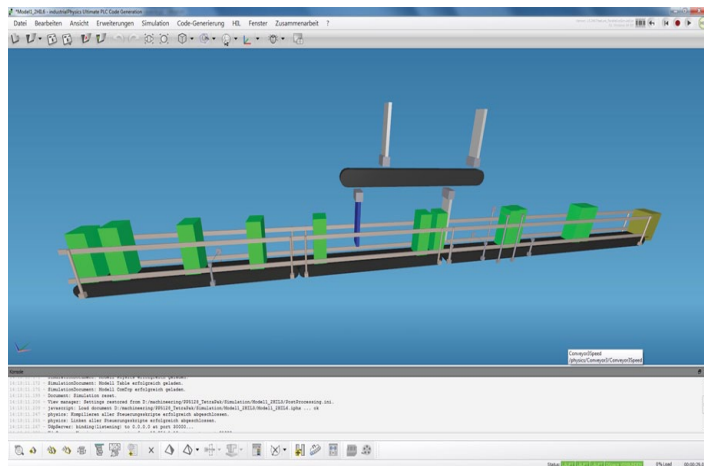
Physical computations made by the industrialPhysics simulation tool produce a virtual image of the machine.

Summary

The Tetra Pak Simulation Environment effectively supports the development of control software for beverage filling machines long before the first prototype is constructed. The dSPACE HIL simulator is the heart of the system. It enables developers to test a PLC reliably under real-world conditions and helps to permanently boost machine efficiency.

and digital I/O boards, and a Failure Insertion Unit. Other components in the simulation environment are the host PC, the 3-D virtual plant simulation system (VPSS), and what is called the control environment, which contains the programmable process control to be validated and also the human-machine interface (HMI).

Visualization and Simulation
For testing purposes, dSPACE simulation tools and industrialPhysics (a tool from machineering GmbH & Co. KG) stand in for the real machine. Tasks such as 3-D computation and visualization of the virtual machine, package flow, and conveyor belts are performed by industrialPhysics, while the dSPACE tools are responsible for simulating the thermodynamics, fluid mechanics, and so on. Where strict real time and small simulation step sizes are required (for example, to simulate filling processes or perform motion control tasks), the dSPACE tools are indispensable. ∎

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