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## Think & Do Featured Applications

### Tray Filling with Vision Inspection

Federal Cartridge in Minneapolis, Minnesota makes ammunition. There are a lot of packaging applications in the manufacture of ammunition. One of the more interesting ones is the handling and filling of center-fire primer cups. The primer is that small cup-like device on one end of a center fire cartridge which ignites the gunpowder inside and sends the projectile toward its target.

#### The Process

Since there are a lot of these primer cups to be made they like to make them fast, in batches, and with a high degree of quality (law enforcement officials lives can be threatened if their ammunition misfires). Federal gets the desired quality employing vision systems for inspection. They use vision systems for inspection and do all the mechanical machine design/controls integration in-house (since this is where all the process knowledge resides).

This particular machine orientates cups into a tray. A vision system inspects the tray for bad cups, motors index the tray to reject bad cups and replaces them with good cups before sending the tray off to the next operation.

### Open Systems and PC Control

Federal has taken the 'open-system' approach in their automation. This application uses a desktop PC to control the process. Machine logic was designed using Think & Do flowchart logic running on Windows NT. The advantage of a flowchart-based programming language is that the Principal Mechanical Engineer at Federal can understand flowcharts. He knows how the machine/process works, and he can therefore best write/debug the control logic.

Using a PC for the controller (instead of a traditional PLC) gives them an open platform on which to integrate the machine logic, Visual Basic HMI, vision system, fieldbus network and plant networking. The PC gives the Principal Electrical Engineer access to many other standard off-the-shelf programming tools such as Visual Basic.

Visual Basic is used to create a very specialized and intuitive HMI for the operator. This lets them give lots of graphical and easily understood diagnostics to the operator to help resolve problems, keep the machine running longer and produce more parts. Visual Basic is also used as an intermediate communication task between the flowchart logic task and the serial data coming from the vision system. Typically this problem is solved on a PLC with a Basic module and is a headache due to the difficulties of communicating between an intelligent module and the PLC's main processor. The VB HMI is readily integrated with the machine logic via standard Microsoft communication methods.

Machine design was complimented by distributed I/O using the ProfiBus fieldbus network. The ProfiBus network connects to the PC through an ISA bus interface card. This particular application uses ProfiBus DP (Decentralized Periphery) which is a master-slave bus using shielded twisted pair cable. The I/O devices are a combination of machine mountable pneumatic valves (Festo valve packs with quick-connect proximity switches) and panel mountable terminal blocks (Wago I/O System with ProfiBus coupler).

How did this I/O system aid in machine assembly and commissioning? The predominant benefit was in elimination of any on-site work by a systems integrator. The panel was built outside but the only on-site wiring that had to be done was main power connections, motors, and the ESTOP switch. All the assembly could be handled by in-house electricians and mechanics.

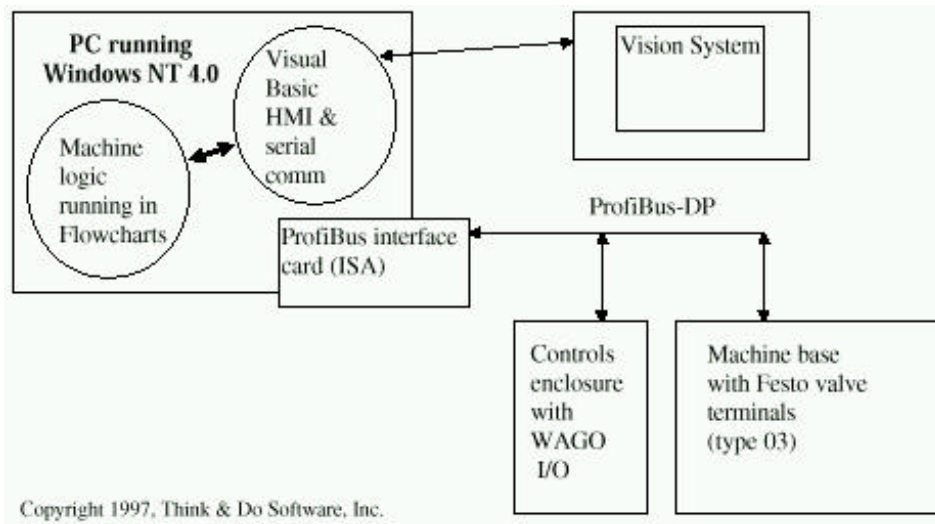
## How Did They Do?

The goals which Federal originally envisioned for this project (and have so far achieved) are:

- Let the machine designer program the logic (get controls guys out of the loop).
- More efficient machine assembly with in-house people (wiring).
- Use of standard tools for logic design and system integration (VB and Flowcharts).
- Improved diagnostics and more informative messages to the operator.

Some of the goals they believe they'll be able to take achieve in the future as they expand the capabilities of the overall process automation (which this module is a part of) are:

- Scalability of PC-based logic and it's ProfiBus I/O network to control other modules down the assembly process.
- Interface to standard plant-wide Token-Ring network and get useful machine statistics to the company Information System for analysis and improvement of the process (down-time, good/bad part counts, what broke and why, etc.)



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