



## The DeltaV System versus PLC/HMI in a Highly Discrete Application

This document presents and compares the total costs of purchasing and configuring a PLC/HMI system with the costs of the same application with a DeltaV™ digital automation system.



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This whitepaper compares the purchase and project engineering costs of a 98% discrete I/O application in a materials drying, handling, and packaging application using a DeltaV system versus a PLC/Human Machine Interface (HMI) solution.

## Background

The application is the control of a material transfer operation, composed mostly of discrete control modules such as pumps and valves. The process involves storage hoppers, blending, mixing, and dust collectors. The automation controls equipment required transferring materials into and out of the storage hoppers and performing all blending operations. Diverter valve positioning and bin vent dust collector control is included in this automation application. Other automated processes include product code transfer and equipment interlocks from drying through packaging

The devices required for this application included:

- 168 motors and valves
- 5 analog inputs
- 92 discrete alarm inputs

I/O count for this project, totaling 750, is **98% discrete** with the following breakdown:

- 328 discrete inputs
- 175 discrete outputs
- 5 analog inputs

## Project Scope

All of the equipment required to transfer both into and out of the hoppers was previously controlled and sequenced by hardwired relays and timers on a panelboard. This project will replace the panelboard control functionality with either a Emerson Process Management DeltaV digital automation system or an Allen-Bradley PLC-5 and Intellution Human Machine Interface (HMI) engineered solution.

## PLC/HMI Approach

The PLC/HMI system includes one controller with associated I/O modules to operate the system and two user workstations.

The control hardware will consist of one Allen-Bradley PLC-5/80 controller. This system will have three 16-slot I/O carriers with I/O modules. This I/O quantity covers the I/O identified in the I/O list plus 10% spares.

The Intellution HMI Workstations run the Windows NT operating system.. The workstation software will be an HMI development package for one workstation and an HMI runtime package, for the other workstation. The appropriate I/O software drivers and Allen-Bradley interface card are included.

The HMI workstations will communicate to the Allen-Bradley controller via ControlNet communication. ControlNet communication will also be used for the interconnection of the PLC processor with the remote I/O adapters in the second and third chassis. An Ethernet interface is also included with the PLC to allow communication to the Data Historian.



## DeltaV System Approach

The DeltaV system includes two controllers with associated I/O modules to operate the system and two user workstations to provide a user environment for many functions from operating and analyzing the process to interfacing to the plant Data Historian.

The control hardware will consist of two controllers, 350 DST sequence version each. I/O quantity covers the I/O identified in the I/O list plus 10% spares.

The workstation software will be the ProfessionalPlus (engineering and operation), 700 DST version for one workstation and Operator, 700 DST version for the other workstation.

The DeltaV workstation includes an Ethernet interface to allow communication to the Data Historian.

## Additional Engineering for Comparable Functionality

For this application, the user desired the discrete control requirements listed below. Note that the PLC/HMI products and typical configuration services associated with the PLC solution do not include the noted capabilities. These capabilities are DeltaV standard and included in the DeltaV purchase price. Additionally, the capabilities listed are viewable and/or adjustable from the DeltaV Operator Workstation.

Capability	DeltaV	PLC/HMI
Display <b>both</b> time limit <b>and</b> elapsed time for state transition	✓	✗
Dedicated adjustable confirmation timers for passive, active1 and active 2 setpoint changes	✓	✗
Dedicated adjustable timers for trip, delay, restart and crack times	✓	✗
Descriptive English display of dynamic interlock conditions	✓	✗
Capability to bypass active interlocks	✓	✗
Display by-passed interlock condition status	✓	✗
First-out trapping of multiple interlock conditions	✓	✗
Display discrete state of input and output channels	✓	✗
Change module to simulation mode and adjust simulated input	✓	✗

## Comparisons

### Purchase Price

The comparison systems are based on 750 total I/O, with two operator interfaces. The purchase price of the hardware components was 25% lower with the PLC/HMI solution.



## Control Strategy Development

This application took advantage of control strategies that come pre-engineered in the DeltaV system. These control strategies include motor starting/stopping logic, analog alarming, and discrete alarming logic as noted in the foregoing. To duplicate these capabilities in a PLC/HMI solution, the following additional engineering configuration and associated hours would be required:

- Approximately 20 rungs of logic for each motor and valve module with 15 timers (approximately 3,360 rungs of logic and 2,520 timers.)
- The alarms associated with the analog modules will require approximately 7 rungs of logic each, for a total of 35 rungs.
- Discrete alarms will require approximately 3 rungs of logic each, for a total of 276 rungs of logic.

Development Summary:

<b>Timers</b>	<b>2,520</b>
<b>Total rungs of logic required</b>	<b>3,671</b>

Associated Project costs:

<b>Project Phase</b>	<b>Time Required</b>	<b>Engineering cost at \$88/hour</b>
Planning	70 hours	\$6,160
Development	60 hours w/exported code	\$5,280
Testing	80 hours	\$7,040
Documentation	40 hours	\$3,520
<b>Total</b>	<b>250 hours</b>	<b>\$22,000</b>



This additional engineering requires additional memory usage in the PLC. An initial estimate requires the following PLC data table memory:

Motors and valves	7,560 words
Discrete alarms	92 words
Analog alarms	50 words
Total	7,702 words

Further testing would be required to calculate program memory requirements. The hour estimates quoted herein for PLC implementation are conservative.

### PLC/HMI Operator Interface Development

The DeltaV Operator Interface comes with pre-engineered operator faceplates, integrated alarming, and reporting. Like with the PLC logic configuration, the HMI portion of the solution will require the the following additional Operator Interface development hours to meet the desired requirements for discrete logic interface to the same level of capability as the DeltaV system.

Project Phase	Time Required	Engineering cost at \$88/hour
Planning	40 hours	\$3,520
Development	320 hours w/exported code	\$28,160
Testing	40 hours	\$3,520
Documentation	0 hours	\$0
<b>Total HMI</b>	<b>400 hours</b>	<b>\$35,200</b>

A user may not be entirely pleased with the look and feel of the end result in the PLC/HMI solution, custom engineering, and on-going support and maintenance.



## Total Costs

In implementing features similar to those in the DeltaV system, the approach would be to create PLC code for all the logic required and create faceplates in the HMI that can interact with the PLC logic, producing the following base bid project:

Base Bid Project	DeltaV	PLC/HMI
Purchased system materials (excludes enclosures)	\$123,040	\$91,800
System design, development and documentation	\$150,150	\$164,400
PLC and HMI development to add similar capability required for the application as DeltaV control modules	N/A	\$57,200
<b>Total Cost</b>	<b>\$273,190</b>	<b>\$313,400</b>

## Conclusion

For this highly discrete application, the **PLC/HMI solution was almost 15% more expensive** when factoring in the total installed cost of both hardware and project engineering costs.

PLC/HMI solutions have long been thought the best-cost solution for highly discrete processes. With the newer technologies that the DeltaV system incorporates, this conclusion is no longer true. The DeltaV system's object oriented structure, single global database, and integrated communications easily facilitates a library of pre-engineered control strategies, pre-engineered operator faceplates, and pre-engineered alarms. Even for applications in the 100s of I/O, the DeltaV system is more cost effective. With the clonability of the DeltaV object-based structure, the difference becomes even greater as the size of the application grows.

This comparison did not compare the additional costs of commissioning the system, operator training, and on-going support of the system. In customized versus pre-engineered solution, the pre-engineered solution will be lower in most every case.