

How MSI has successfully designed Custom Control Systems.

By Ed Thompson

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Introduction:

It is easy to claim success in any area of engineering. However, MSI makes this claim for Custom Control Systems designs based on three important criteria. First, the success rate for project over the last 30 years has been 100%. Second, the startup time for systems has been a fraction of typical startup times. Third, control systems have consistently shown long term stability.

While the three areas of criteria above are subjective, these evaluations have been the result of decades of successful project. In addition to project statistics, MSI feels that there are a number of reasons why there has been such high success.

Two important practices that MSI has incorporated has been the generation of Machine I/O diagrams and the development of "Structured PLC Programming" (SPLCP). Also, investments have been made in a Solidworks 3D library of control panel components to help automate the design process. Each of these three areas will be discussed.

Machine I/O diagrams:

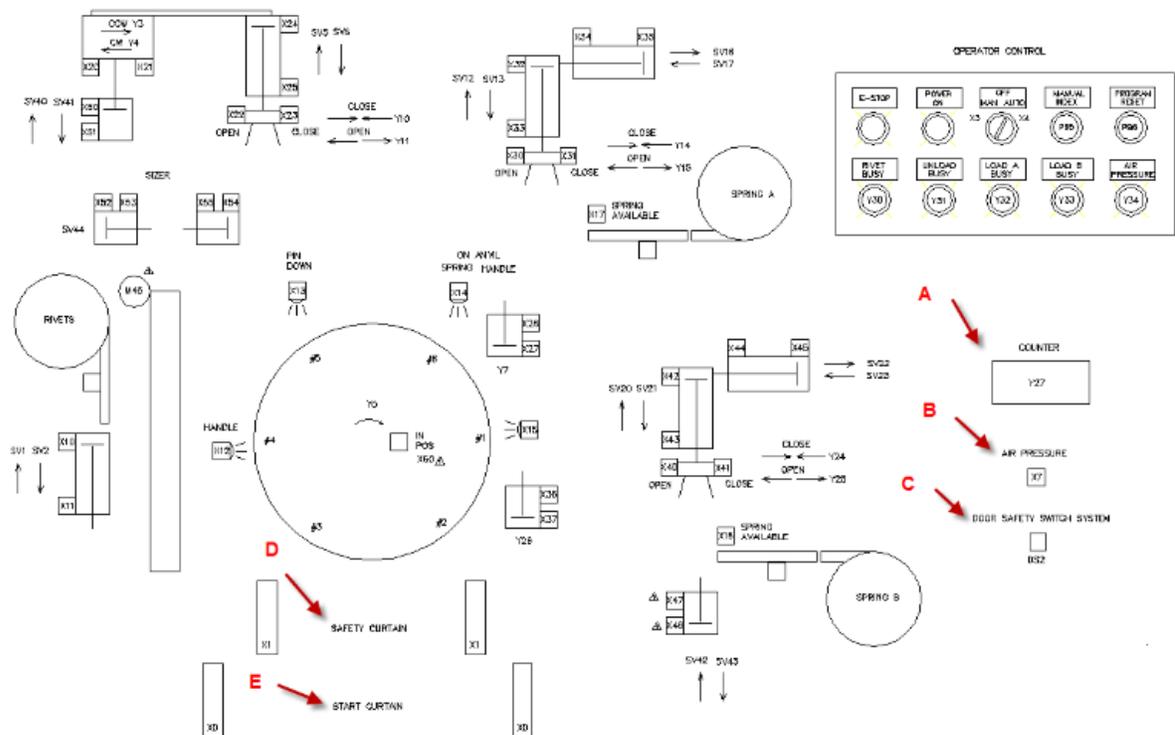
Machine I/O Diagrams are relatively easily to develop but they are extremely valuable for a number of reasons:

1. To begin with, generating Machine I/O diagrams provides a tremendous opportunity to identify and define all of the necessary "functions" and components of control systems. This process requires a fair amount of interaction between the engineer and the Client. To complete properly, a reasonable amount of communications is needed at the beginning of the design project. The result is a much higher confidence that all of the features are included and that they will ultimately be implemented. When completed and all parties approve the design requirements, there is very little room for misunderstanding of what will be delivered or how the control system will ultimately operate.
2. These diagrams clearly illustrate the relationships between various field devices and their related sensors. As each of the field devices and their related field sensors are defined, it becomes clear how they will work internally. By considering how individual functions operate, it becomes easy to understand how various functions interact with other functions, and ultimately the entire system.
3. Machine I/O diagrams present a number of opportunities to help systematically address a number of design tasks.
 - a. One of the first tasks is to identify which field devices will be controlled by which PLC I/O. When completed, the number of I/O will be clearly defined. When this is completed so early in the design process, there are improvements in the documentation.

- b. Power requirements for all field devices can be totaled, which helps define the total power required and the internal power distribution components needed.
- c. The Machine I/O diagram is extremely helpful in designing the wiring schematics.
- d. With the wiring schematics and the Machine I/O diagram, all components, both field and internal to the control cabinet can be easily identified. Thus the design of control cabinets is more efficient.
- e. The Machine I/O diagram provides a tremendous aid for developing the PLC logic. By systematically working through the diagram, the operation of each of the functions can be visualized. MSI has used these diagrams to help develop all Structured PLC Programming objects (to be discussed).
- f. The Machine I/O diagram, in conjunction with the Structured PLC Programming objects allows for every aspect of the system to be easily visualized early in the design process, resulting in much easier and predictable startups.

Machine I/O diagrams also provide a number of other advantages, not the least of which has been easier troubleshooting.

A presentation of how to develop Machine I/O diagrams can be found in an online PHD course through Suncam. The material can be seen at: <https://www.suncam.com/courses/100249-01.html> The material can be viewed under the <Preview Course> button for free.



Example of Machine I/O diagram used in Suncam course.

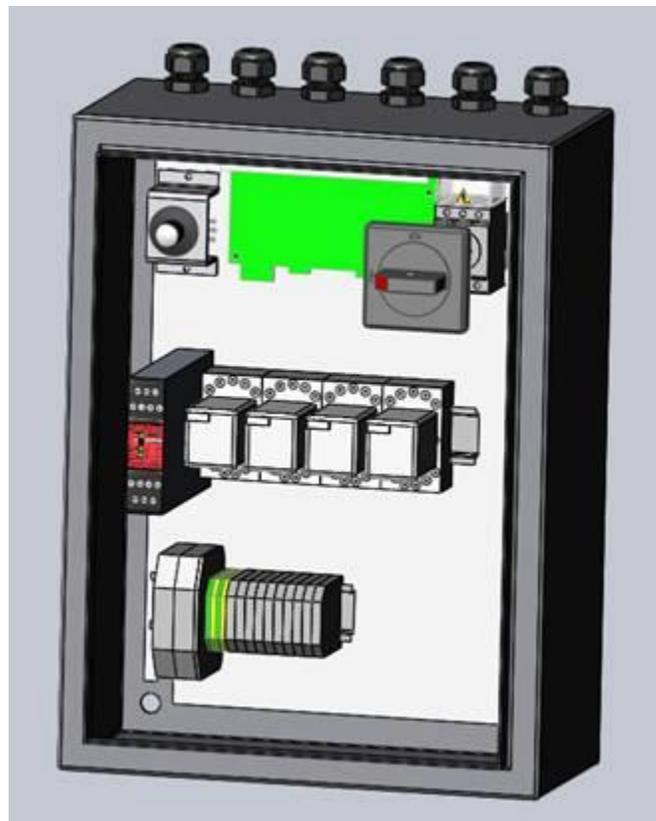
“Structured PLC Programming” (SPLCP):

MSI developed a proprietary method of designing PLC software and has been using it with 100% success for about 30 years. MSI has named this method, “structured PLC programming” (SPLCP). Because the method is proprietary all that can be said is that fundamentally there are some general “objects” that all control systems are comprised of. When these objects are developed in conjunction with the Machine I/O diagram, there is a high confidence of how the system will function, enhancing startups and troubleshooting.

SPLCP objects are generic and can be “compiled” into any PLC syntax. This allows for effective control logic to be developed, even when using a new PLC platforms.

Solidworks 3D Control Component Library:

MSI has made a considerable investment in developing a Solidworks 3D electrical components library. Using these library components, control panels are easier to design and illustrate. The general approach is to drag and drop components from the library into the control panel assembly. Many components will automatically snap into position. Most components are multi-configuration files which presents a selection dialogue box when the component is placed. An example of this may be a relay. The physical size and shape of relays and many electrical components may be the same while specific part numbers will designate coil voltages, contact materials and configurations etc. This drag and drop and selection approach streamlines the design process. A sample is shown below:



Not only are internal components of size and spacing of control panels much more clear, but through custom properties, Bill of Material (BOM) descriptions are automatically populated. When components are placed, edited in the 3D design, the BOM descriptions are automatically populated, minimizing design time and increasing the accuracy.

Summary:

MSI has successfully designed custom control systems through the implementation of three critical design practices. First, Machine I/O diagrams have been developed, improving the definitions of projects and the communication with clients, as well as providing a number of other advantages. Second, developing and employing the use of Structured PLC program (SPLCP) objects, startup and troubleshooting has been greatly improved. Third, developing and using Solidworks 3D library components improves the design process, as well as automating some design activities.

Please contact Manufacturing Systems Inc. if we can help with your existing or new control system challenges.

Manufacturing Systems Inc.

Ed Thompson, PE

(503) 590-1950

www.MSIOregon.com