

10 Reasons to use Off-Line Controls Testing for Your Next Automation Project

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Overview - What is Off-Line Controls Testing?

Off-line controls testing, or virtual commissioning, is an approach which allows the logical testing of an automated system's controls to be taken off the project's critical path.

Compared with the traditional methods of testing, the benefits of virtual controls testing are both numerous and compelling. This paper identifies ten major advantages to adopting a virtual approach for this phase of your next automation project:

1. Reduces on-site testing time and costs
2. Reduces ongoing warranty costs
3. Removes logic controls testing from the project's critical path
4. Allows controls testing to start earlier in the project cycle
5. Increases control system quality and reduces start up and ramp issues
6. Makes testing safer, and improves working conditions for the controls engineer
7. Improves operator training and minimises disruption to existing production
8. Improves relations between the integrator and the end user
9. Makes overall project duration simpler to forecast and price
10. Reduces the risk associated with the investment, making further investment in automation more likely

Introducing Award-Winning Software from Emulate3D

Emulate3D Controls Testing is an engineering tool designed specifically to provide an efficient test bed for the off-line controls testing of machines or systems. It comprises a 3D environment in which to create the replica of the machine or material handling system being controlled, functionality to create realistic loads within the system, and connectivity to a wide range of types of control systems under test. Emulate3D technology provides a robust and powerful framework which allows users to customise and extend the system, should the need arise.

Emulate3D products are used worldwide in the material handling industry, airport baggage handling, general production and manufacturing, as well as warehousing and distribution centers.

Emulate3D provides training and support at all levels to ensure users get the maximum benefit from the technology.



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The Promise and the Challenge of Automated Systems

Industrial automated systems promise consistent quality, predictable throughput, product traceability, and many other benefits which make them an attractive proposition in a rapidly changing environment. As consumer buying patterns continue to evolve and companies strive to remain competitive, material handling systems within factories, postal facilities, and distribution centers are becoming more automated, but also more complex. The same is true for airport baggage handling systems, where rising passenger numbers and growing security concerns create a demand for constant evolution and improvement.

Every System is a Prototype

Despite the widespread use of standard components in automation systems, specific customer requirements make each one a prototype, in need of thorough testing. Central to every automation project is the control system; frequently hierarchical, always custom designed for each system, and often unavoidably complex. Design decisions determining the cost of ownership, throughput, flexibility, and ease of use of the resulting system are taken early in the project cycle, and these result in a physical and operational definition which includes the controls. An off-line virtual commissioning approach can benefit from this definition and begin testing in parallel with the start of manufacturing processes, in a way that traditional methods cannot.

Dynamic Systems are Complex and Unpredictable

The complexity inherent in many controls is often due to the dynamic nature of the system; as many simultaneous events are often subtly interconnected, it becomes increasingly difficult to create a robust control system without observing and testing the many potential conflicts.

Test Early, Reduce Costs

Without a virtual test environment, controls engineers are obliged to wait for the availability of the real system before they can implement and test the controls. The fact that the testing phase is at the end of the project's critical path, makes it particularly vulnerable to any delays occurring in the steps preceding it. This unavoidable problem is often worsened by the fact that the duration of testing itself is notoriously hard to control or predict, as simultaneously occurring events generate unforeseen situations which need to be taken into account.

The Benefits of Off-Line Controls Testing are Numerous

Taking controls testing off the project's critical path creates a cascade of benefits. At the primary level, not only does the project duration become more easily predictable, but the testing phase can be started earlier than is otherwise possible. This means that the control system can be more thoroughly tested before going on-site, with the remaining testing reduced to a predictable checklist.

Test under Better Conditions



As buying patterns continue to change and the availability of cheap flights grows, the demand for robust automation is ever increasing



Not only does a virtual approach to logic testing take this central part of the project off the critical path, but it also takes it off the client's site, and into a calm, air-conditioned office. Away from the pressures, noises, and sometimes extreme temperatures of a production facility or a warehouse, it is surely easier to concentrate on creating and debugging a robust control system under these conditions.



Testing with Product

On-site testing often requires a team of people to prepare and operate machines and material handling equipment which cannot be connected to existing equipment until the new elements are fully tested. Quantities of product may need to be moved manually to specific areas to create appropriate test conditions. Periods of unproductive yet costly inactivity are unavoidable while modifications are carried out on the controls.



Whether you are working on custom machines or larger systems, off-line controls testing presents significant advantages over traditional methods

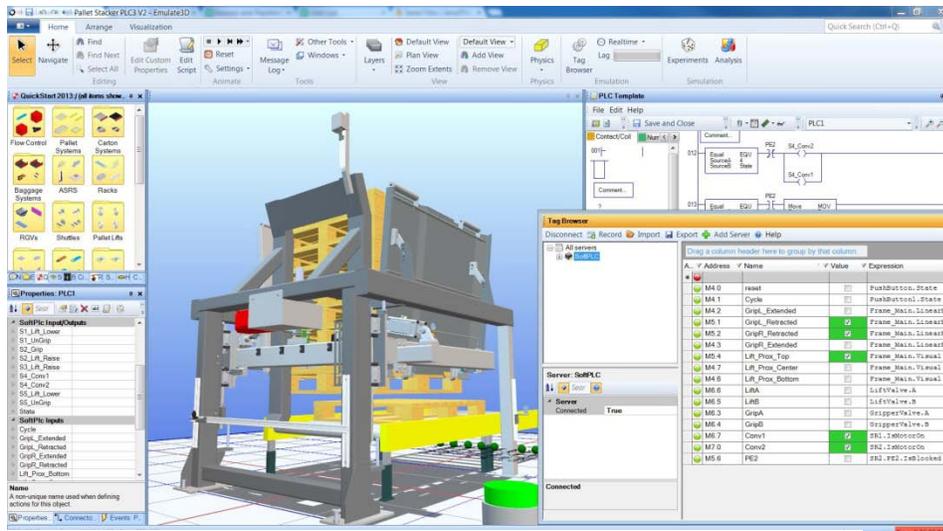
Virtual testing avoids the need for all of this, and starting conditions can be recreated in one click.

Run Virtual Testing Models in Parallel

Carrying out testing in a virtual environment creates further opportunities – multiple instances of the system can be running simultaneously, dividing the time it takes to carry out real time testing by the number of instances running.

Train Operators in a Safe Environment

Operators can be trained in a safe but realistic environment – interacting with the HMI to start, stop, and interact with the real control system whilst observing the response of the whole virtual system; a perspective which is often impossible in the real world. There's no need for safety fencing in the virtual world, and potentially damaging or dangerous situations can be identified and resolved before they can become real problems.



The Emulate3D controls testing environment makes it easy to connect your controls to the model and observe them driving the virtual system

Generate Testing Situations



Creating faults the operator has to deal with is straightforward, and the system offers considerable training opportunities for complex restarts following incidents. Viewing the implications of a bad sequence of operator interactions in a virtual world is without consequence, and may be instructive to the operator as well as the system designer.

How Does Virtual Controls Testing Work?

Virtual controls testing replaces the machine or automation system that the control system is designed for, with an accurate 3D model. As the control system responds to inputs, the virtual system needs to reproduce these inputs faithfully in order to provide a useful sandbox in which to develop and test. In addition to this, the virtual system needs to be quick and easy to set up and run, in order to be cost effective, practical, and appealing.

User-Defined Loads Test the System

Users create various schedules of loads to be introduced into the system under test. The schedules are easily repeatable, so models can be quickly reset and then retested following control system modifications. Loads block and clear photo eyes, and barcode information can be read from them, for example. Just as in the real system, the progression of all loads in the model is determined by the control system as it triggers machine operations, merges and diverts, based on the load identities and the business rules that the control system represents. Users can use counters or more advanced systems to detect whether the controls have functioned correctly over a prolonged period, so testing can often take place automatically, unobserved.

How Can I Implement Emulate3D Controls Testing?

Implementing controls testing is a straightforward procedure – build the model, connect it to your control system, then run the model. If there are changes to be made in the control system logic, you reset the model and run again once the changes have been made. The pattern of load arrivals is completely under the user's control, and is rigorously repeatable.

Start with the Model

Controls testing models are constructed in the same way as real systems – as far as possible from standard pieces of equipment. Emulate3D provides catalogs of commonly used material handling equipment such as conveyors of all types, AGVs, ASRS cranes, racking, and so on. All these elements are user-modifiable, and once they have been changed to more closely resemble the types of equipment you use regularly, they can be saved into proprietary catalogs for re-use.

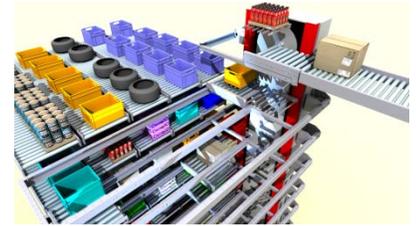


Connect models to a wide range of PLCs from mainstream manufacturers such as Allen-Bradley, Siemens, Mitsubishi, and Rockhoff



Build Rapidly from Standard Catalog Equipment

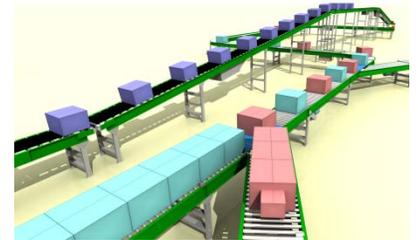
Drag and drop equipment from the catalogs into the edit environment to create the layout – elements may be modified and then locked to avoid accidental changes, if required. Users can also import CAD files from a variety of sources, and these may be used as visuals, loads, or dynamic machines with scripted behaviors which allow them to communicate correctly with the control system.



The Emulate3D product framework provides a rich interface to users and facilitates the creation of powerful catalog elements using .NET languages.

Connect to the Control System

Emulate3D Controls Testing models can connect to a wide variety of mainstream programmable logic controllers (Allen Bradley, Siemens, Mitsubishi, etc), databases, and manufacturing control systems. Although model elements may be manually connected to their corresponding control address, a spreadsheet file is normally used to define the virtual wiring between the virtual equipment and the real PLC.

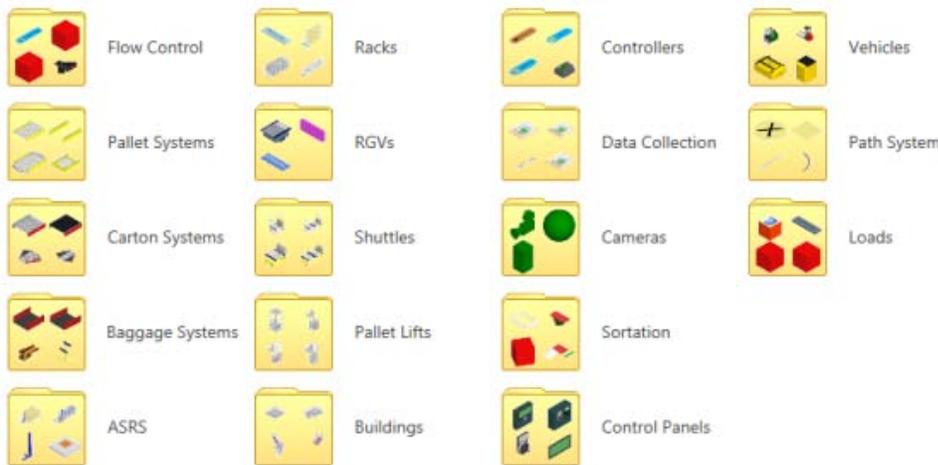


Build models with equipment from the supplied catalogs or import your own CAD and create your company specific catalog elements

Run the Model

Define the points in the model where loads are to be introduced, then create the types of loads to be used, and run the model. Bar code or other information associated with each product (such as RFID tags) can be read from spreadsheets and written to each load on creation, or generated algorithmically within the model.

The model responds to control system outputs in the same way the real system would, by starting and stopping motors, initiating moves, activating stop blades, etc, and the progress of products within the system, as well as feedback from mechanical devices, provides the inputs. This test bed is useful not only prior to implementation, but remains relevant throughout the lifetime of the system, whenever modifications are



proposed.



How Can I Get Started?

Emulate3D holds a monthly on-line Introductory Workshop which is the ideal place to start. Attendees are guided through the product basics and are given access to a full license for three weeks. During that period you will be fully supported and you'll get a better appreciation of how Emulate3D technology can help your company.

World Class Support

Emulate3D users are supported by email and web meetings whenever required, and we can recommend third party consultants should you require professional assistance with your projects. In addition, there are extensive reference materials and tutorials in the Web Store, a resource which is freely accessible to all users following registration.

Further Resources

- Emulate3D has a **YouTube** account named [Demo3DVideos](#), where many examples of models and several "How to" videos can be found.
- The annual **Emulate3D User Group Meeting** is a great source of User Presentations on various subjects, and these are available on request. See the agendas for past User Group Meeting presentations and [contact us](#) to request those that interest you.
- The **Emulate3D Newsletter** is published once a month and contains information about the latest product releases, user models, trade shows where Emulate3D is exhibiting, and a Web Store example. Click [here](#) to subscribe to the Emulate3D Newsletter.
- **The Emulate3D** website at <http://www.demo3d.com> has information about the different ranges of products, as well as the dates of the next on-line Introductory Workshop, an essential first step into the use of Emulate3D products. You can register [here](#).

Partnerships

Emulate3D is in partnership with many supporting companies in order to provide the most complete solutions for all users.



Getting started with Emulate3D is easy – just register for an on-line Introductory Workshop on the website

