Webinar with Inprocess: DCS Testing and Operator Training Applications of Aspen HYSYS® Dynamics

Webinar Q&A

This document summarizes the responses to questions posed before and during the webinar. Additional questions should be directed to AspenTech Support.

Q: Will the webinar be available on the AspenTech support website after this session?
A: Yes, the webinar will be available to view on aspentech.com by clicking on Events, going to On-Demand Webinars, and looking under Engineering/Process Simulation.

Q: * Is there any advantage of using Aspen HYSYS Dynamics over Aspen Plus® Dynamics for OTS applications, both Emulated and Direct Connect?
A: AspenTech has the leading Dynamic Simulators in the world (Aspen HYSYS Dynamics, Aspen Plus Dynamics, and Aspen Custom Modeler). Aspen HYSYS Dynamics is typically used by customers in the energy industry and Aspen Plus Dynamics and Aspen Custom Modeler are typically used by customers in the chemicals industry. An OTS solution can be built around these simulators using the Aspen OTS Framework, which is an OPC server implementation to the simulators or by using other technologies from 3rd parties.

Aspen OTS Framework is a Simulator Executive that is an OPC server implementation to the simulator. It has two major functions. First, the OTS Framework provides a configuration mode used to set up all of the required data links between the dynamic model or models and the other components of the OTS application, such as the controller emulations and the operator and instructor interfaces. Second, the OTS Framework acts as the traffic cop during the actual execution of the OTS application, coordinating and synchronizing the integration of the dynamic models, and managing the exchange of stream data and commands between the various OTS components. Please see Figure 1 for a diagram with Simulation Executive Framework.

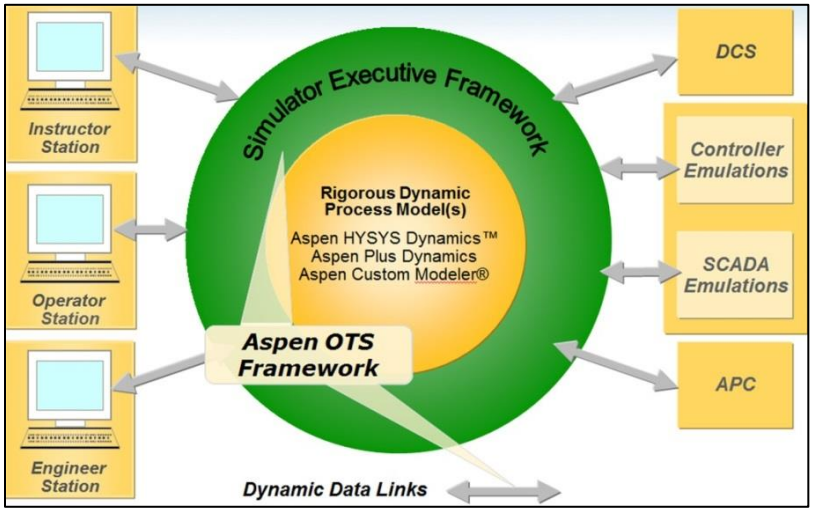


Figure 1: Aspen Simulation Executive Framework Diagram

Q: What is the role of Aspen OTS Framework in the OTS development process?
A: Please refer to a question above marked with "*" for more information about Aspen OTS Framework.

Q: Does the same capability exist for Aspen Plus Dynamics, in addition to Aspen HYSYS Dynamics?
A: Please refer to a question above marked with "*" for more information about the Aspen OTS Framework. Inprocess' OTS use Aspen HYSYS Dynamics, which can cover most of the process industry processes for Operator Training. They are open to analyze the requirements to use their Instructor Station Software with Aspen Plus Dynamics for OTS applications.

Q: What is the status of Aspen Dynamics for DCS testing and operator training applications?
A: Please refer to the question above.

Q: Have you used the Aspen OTS framework in the Inprocess model or have you developed STH on top of the Aspen HYSYS Dynamics model?
A: Inprocess has developed their own software (Inprocess Instructor Station, IIS) to interface directly to Aspen HYSYS Dynamics, but also have a graphic package to develop Emulated OTSs and Instructor Station functionalities. They have also developed additional communication features to handle multiple data sources synchronously in different protocols needed to create more complex OTS architectures.

Please refer to the question above marked with "*" for more information about Aspen OTS Framework.

Q: Do you have any additional information on using the Aspen OTS Framework?
A: Inprocess has used the OTS Framework in some projects in the past, but they rely on their own set of software tools to generate a flexible (in terms of multiple data sources and protocols) and high-performance connecting architecture, which can support the visualization of the Emulated OTS screens at the same time.

Q: What HMI do you use? Is there any HMI software from AspenTech?
A: We use either the DCS emulation software and/or our own Inprocess Instructor Station as the HMI.

Q: Which DCS/IPF systems can be interfaced by the OTS Framework?
A: The OTS Framework is an OPC Server on top of Aspen HYSYS, not an "out of the box" solution to interface to different DCS in the market. Inprocess doesn't use the OTS Framework in their current OTS applications, because every DCS emulator is different.

Q: Can solids be modeled in Aspen HYSYS Dynamics (not only the thermo of solids modeling, but also the particle size distributions)? Are solid handling modules working in Aspen HYSYS Dynamics?
A: Aspen Plus Solids is in general a steady-state simulator. As a result of this, all the blocks by themselves are steady-state models. However, there are ways to mimic dynamic behavior within Aspen Plus by the use of the "clock method". You can find an example for a batch fluidized bed dryer, as well as a corresponding step-by-step guide in the knowledge base or via aspenONE® exchange.

If this approach does not fit your needs you can always use Aspen Custom Modeler (ACM) to model the transient behavior of a process.

Q: Can you expand on the model validation since the results of the FAT/testing can only be as good as the model that represents the real plant?
A: Before integrating the Aspen HYSYS Dynamic model with the DCS emulator, Inprocess has two model validation checkpoints meetings with the client.

1. The first is the model review at steady conditions (Steady-State Review) where all process streams are compared with the Design H&MB of the plant to be built (or process plant data if it is an existing plant). Then, once the SS Review report is accepted, Inprocess develops the control narrative and training scenarios inside the Aspen HYSYS model and performs internal testing.

2. The second is the Model Acceptance Test (MAT) where a battery test for every scenario is conducted and the right dynamic responses of the model are validated based on experience from a licensor, EPC, or operating company.

Once the OTS is delivered and the plant starts up, Inprocess offers to conduct an OTS update to adjust potential discrepancies between the model and the plant. Inprocess can provide more information about these testing protocols if need be.

Q: Can you share how in your approach you are integrating package units with their own PLC that usually have a digital communication with the DCS?
A: Most of the OTS projects contain “External Packages” which self-contains the process and the associated PLC controller for a particular unit or large equipment. This control code is not in the DCS. One typical example is compressor packages which normally contain their own controllers and logic.

For the process modeling, Inprocess includes the units in the Aspen HYSYS model and for the emulation of the controllers they offer three options:

1. Emulate the code inside Aspen HYSYS with standard object palette blocks

2. Emulate the code with a custom dynamic extension inside Aspen HYSYS

3. Use an external emulator of the package which is sometimes available

The communication with the DCS is normally performed through OPC standards, but Inprocess can also emulate digital standard protocols (Mod bus, FF Bus, etc.) which are handled by their own Instructor Station software.

Q: Is it viable to connect an OTS with software for management of real-time data like the PI System, Aspen InfoPlus.21, in order to use real data of the process to run real-time scenarios?
A: Normally, an OTS is in the training room, not connected to real plant operations. The OTS has a predefined set of training scenarios which compile the most interesting phenomena and casuistics of the plant for the operator training purposes.

With that said, expanded functionalities of the OTS can be studied. One example is to use a copy of the OTS linked to real plant data, so the dynamic model is tracking (or is trying to track) the real plant conditions, so that the operators can execute exercises and what-if analysis from an OTS which is at the current plant conditions.

The conceptual idea is good, but there are many practical limitations for realizing it. Inprocess has done cases with small individual dynamic models and the results were satisfactory, as you can see by going here.

But it could be more challenging for large OTS systems. The barriers are, in general, a lack of real-time information for the following:

- Compositions of boundary feed streams
- Manual valves (bypasses, auxiliary lines, etc.)
- Error introduced by instrumentation, in particular flow meters and response to changes in the availability of the measurements
- Unmeasured disturbances (rain, wind in burners, sun, leak, catalyst poison, etc)

In any case, an application like that would have much more usage than purely OTS. If the dynamic model is following the plant reasonably well, it can also be used for fault-diagnostics, virtual sensors, look-ahead predictions, etc.

If the client wants this, it is just a question of investing in many online analyzers for all feed streams and reactors outlets, replacing many orifice plate flow meters by mass flow meters, installing positioners for all manual valves, and a good amount of engineering hours for implementation and testing.

Q: Is possible to connect the Aspen HYSYS Dynamics model to the PLC to run control loops with the PLC program, such as with a Rockwell Control Logix?
A: Yes, Aspen HYSYS Dynamics can be connected to PLCs (PLC emulators or real hardware PLCs) with the right communication software. Inprocess uses their own Instructor Station software which is able to handle different sources of data and commands from multiple sources and protocols (OPC, Field Buses, etc). For the Rockwell Control Logix, they have used the RSLogix™Emulate5000 software emulator.

Q: How much does it cost for the deployment of an OTS? What is the difference between the two kinds of OTSs and what factors determine the cost?
A: The cost of an OTS is highly dependent on how large the scope of the model is. If a Process Flow Diagram and a number of I/O is provided, Inprocess can provide an estimate.

Depending on the cost of the DCS emulation software and the hard and soft for the DCS console, the Direct Connect solution can be more expensive, but this is not always the case. Sometimes developing emulated consoles can be more expensive than acquiring the required DCS hard and soft for the Direct Connect solution. Inprocess can expand more on this if additional information is provided about the plant and the DCS.

You can contact JoseMaria Ferrer, the presenter from Inprocess Technology & Consulting Group:

Phone: +34 933 308 205
Cell: +34 607 570 685
josemaria.ferrer@inprocessgroup.com

Q: Are there any issues with the speed of the DCS links, fast controls, and logics?
A: Most of the common DCS systems run at the cycle of 1 second and there are no problems for the communications software that Inprocess uses implicit in their Instructor Station. Certain PLCs or modules of DCS have a higher cycle frequency than 1 per second and we accommodate those higher frequencies in our software. In those cases, it may be necessary to split the models into sections, so that specific areas can be executed at a different frequency (e.g. with a smaller time step for very fast transients) without penalizing the overall model. Sections of the model would still be connected and synchronized by means of our IIS. Speed of the DCS link is not usually a limitation, since typically the OTS does not rely on the actual DCS, but on a dedicated emulation of it.

Q: In the presentation, Inprocess stated that (on average) three unplanned shutdowns can be avoided. Is that number calculated based on real data or assumptions?
A: This is based on the OTS survey cited at the webinar, which you can find by going here: https://oda.hio.no/jspui/handle/10642/1544 .

Q: The FOD 3D facility looks like a very attractive feature. Is it possible to have in DCS to get better results in operation and to avoid miscommunication between DCS and Field?
A: Yes, but the FOD 3D is thought to give a more realistic representation of the plant to the field operator. The control room operators use DCS displays in 2D, since they don´t need to physically work in the field.

The OTS reproduces the Field Operator in the FOD 3D and the Panel Operator in the DCS 2D, which replicates reality. This kind of system can be used in conjunction with the communication radio system while having the Field Operator (or operators) in another room with the FOD 3D or Oculus Rift glasses. This enables realistic simulation of special scenarios which need field and panel coordination.

Q: Is there any limitation for the number of signals/tags in this system?
A: There is no limitation in terms of the Aspen HYSYS software or Instructor Station software. The DCS emulators have different pricing options depending on the number of modules to emulate. The performance of the whole system depends on the OTS hardware architecture used, but for units of 3,000 I/Os, we have not found any limitations.

It must also be taken into account that not all I/O points are handled, only those included in the model scope. It is also important to mention that large refineries or chemical complexes are not simulated in a single model. They are simulated by units (for example in a refinery: Hydrocraker, Reformer, etc.) or simulated by large chemical plants that are divided by the same areas that the control room panelist are divided.

If there are performance issues with large models, they can be divided into several pieces and run on independent CPUs. It is rare that the model requires more than four pieces for the same unit.

Q: What is the added value (apart from Pre-Tunning) of using this system in a FAT?
A: Inprocess has discovered this from their customers when conducting the OTS FAT and OTS SAT. The customers were using the OTS to test all the programmed functionalities in DCS that couldn´t be tested during the DCS FAT. The DCS providers and operating companies are glad to see the debugging reports that Inprocess generated every time a new release of the DCS database is produced.

By using an OTS in a DCS FAT, the project will be able to anticipate both process and control issues that otherwise will arise in the commissioning and start-up. Slides 13, 16, and 17 of the webinar provide more information about this topic.

Q: What are the benefits of having an OTS vendor opposed to a DCS vendor?
A: The OTS vendor has simulated the plant and the controllers in the Aspen HYSYS model. They know the process, how it should be controlled, and what operating scenarios will need to be handled. In addition, other engineering dynamic studies might have been conducted for the same model.

By having an independent OTS vendor, they can effectively verify the functionality of the DCS system and verify if the programmed code is going to work as expected by looking at how the plant should behave and determine if there are process issues or if there are control issues. These issues are immediately reported independently of the nature of the modifications to be taken by the EPC or the DCS vendor or equipment manufacturer. Also, by having an independent OTS supplier, you don´t need to bind the choice of your OTS process simulation software to your preferred DCS system. You are able to choose the best process simulation software for your OTS, or the software used by your own process

department.

Q: Is the control logic directly downloaded into the Emulated OTS or is there manipulation required?
A: The DCS Database is almost never directly downloaded into the Direct Connect OTS. It requires certain steps in order to be usable in the OTS (I/O removal, checking mapping, external packages handling, etc.). Some of these steps can be automated by scripts and other tools, but it is obviously a delicate and different thing for every DCS in the market.

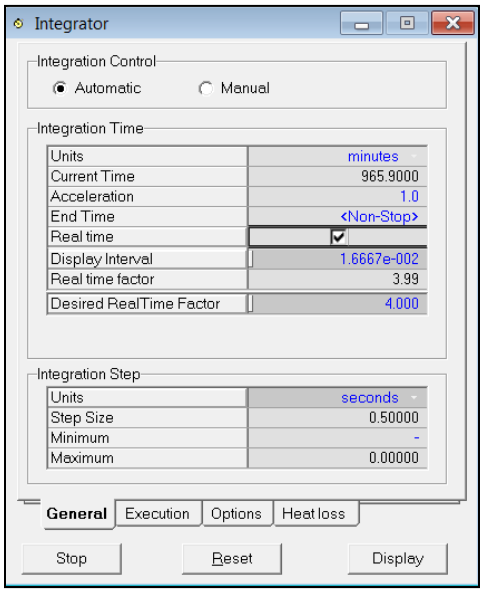
Q: I assume that to keep the real-time factor of the simulation, you increase the simulation step time. What is the range of the step size you usually use?
A: Aspen HYSYS Dynamics offers two ways to speed up the simulation in the integrator page:

1. The “Acceleration” factor, which simply acts as a multiplier of the real step size used in the solver. If you use this, you have to be sure that the simulations run well with these multiples of the step size.

2. The “Desired Real-Time” factor, which uses an internal “controller” that tries to run the simulation to the specified speed. Depending on the CPU performance, the model will not run to the specified speed. In this case, you need to reconsider your CPU, or split the model into two CPUs.

It could result paradoxical, but despite that, most OTS RFQ request to run at multiple factors. Most of the training sessions are conducted at real-time factor=1, since this is what the operator will experiment in the plant. If the operator wants to move the plant quickly to another status they load the corresponding snapshots.

Inprocess’ opinion is that not too much attention should be put on running the model at a multiple of real-time, since this could go in detriment of the OTS (require too many model pieces, very expensive CPUs, larger step sizes, etc.)



For the OTS, Inprocess normally uses a step size in the range of 0.1 to 0.5, but specific scenarios may require a different (typically lower) time step. You should also keep in mind to correctly specify the execution rates on the “Execution” page of the integrator.

Q: How is an Emulated model different from a rigorous Aspen HYSYS Dynamic model? How rigorous or simplified is an Aspen HYSYS Dynamic model that should be to be used in the a/m applications?
A: Both Stimulated OTS and Emulated OTS use the same rigorous Aspen HYSYS Dynamic model of the PROCESS. The only difference between Stimulated vs. Emulated is that in the Emulated case, the control loops are also inside the Aspen HYSYS Dynamic model. In the Stimulated OTS, the control loops are calculated in an external DCS emulator.

Aspen HYSYS Dynamics includes unit operation models with different levels of fidelity from simple conceptual models to very detailed rigorous models. Therefore, Aspen HYSYS Dynamics offers several ways to dynamically simulate the equipment of the PROCESS. For example, you can model a pump in a simplified way by giving a constant duty and efficiency, but you can also build a more complex simulation by using the pump performance curves, NPSH curves, pump inertia, electric motor torque, etc. This all depends on the OTS objectives and scenarios to be trained.