White Paper
June 2018

Dynamic Core with Mimic

Introduction

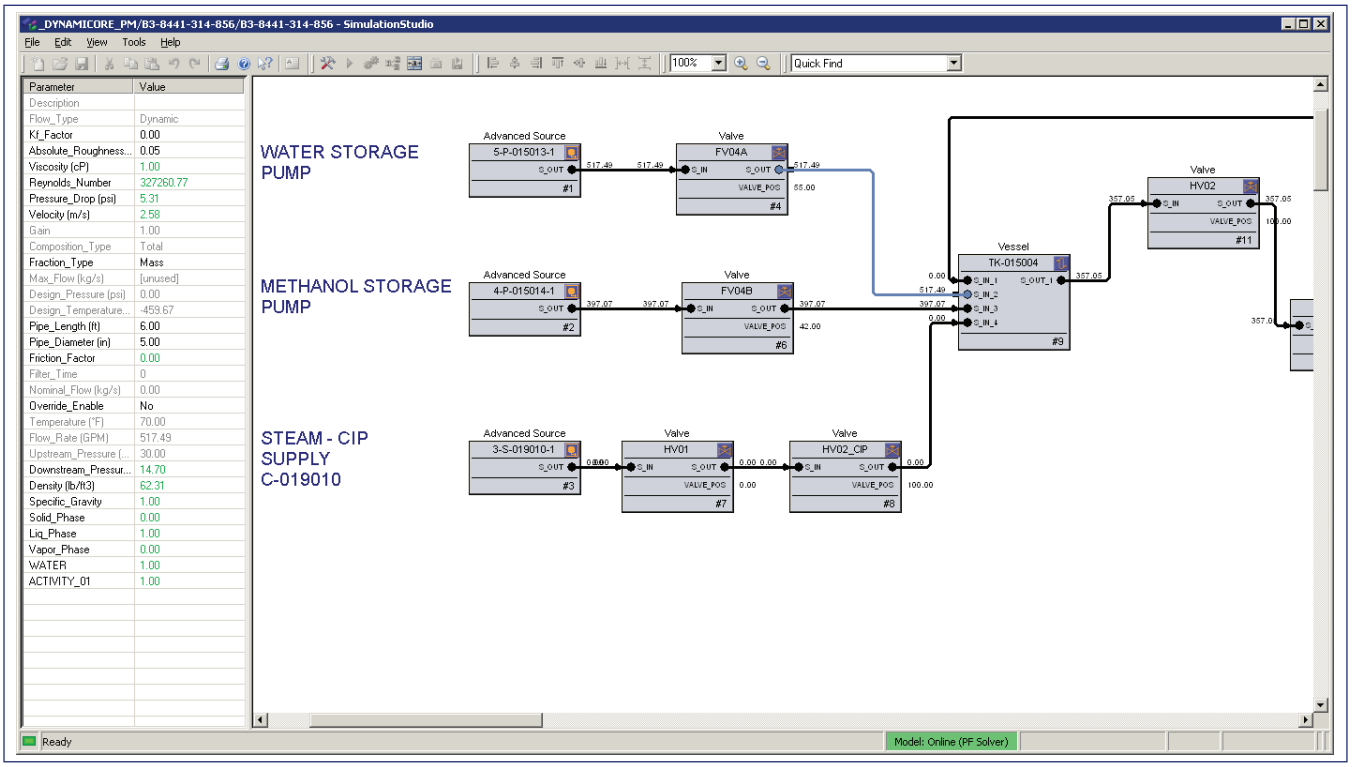
Dynamic Core is a unique approach to delivering dynamic simulations for operator training and control system testing. This method of modeling delivers a medium fidelity dynamic model at a high speed of implementation and delivery.

Dynamic Core Approach

Dynamic Core is a unique approach to delivering dynamic simulations for operator training and control system testing. This method of modeling delivers a medium fidelity dynamic model at a high speed of implementation and delivery.

- Modeling built upon a backbone or core of first principles dynamic process models, using Mimic Advanced Modeling Objects Core License
- Seamless ability to upgrade to high fidelity modeling for the entire process or key unit operations at a future time
- Fast delivery supporting compressed project schedules
- Low demand on end user time during the project
- Minimal data requirements to build the model
- Supports complete use of Mimic Operator Training Manager for training scenarios, session reporting, and instructor screen development
- Mimic Advanced Modeling Objects supports easy to maintain dynamic process models that follow the process flow through the customer supplied P&IDs
- Supports parallel implementation of the simulation with the control system configuration, allowing the model to be used for control system FAT as well as immediate operator training

Dynamic Core has been proven on many projects where the process plant end user needs the benefits of dynamic simulation but does not require the rigor of a high fidelity dynamic model.



Unit operation objects are used to quickly develop accurate models for testing and training.

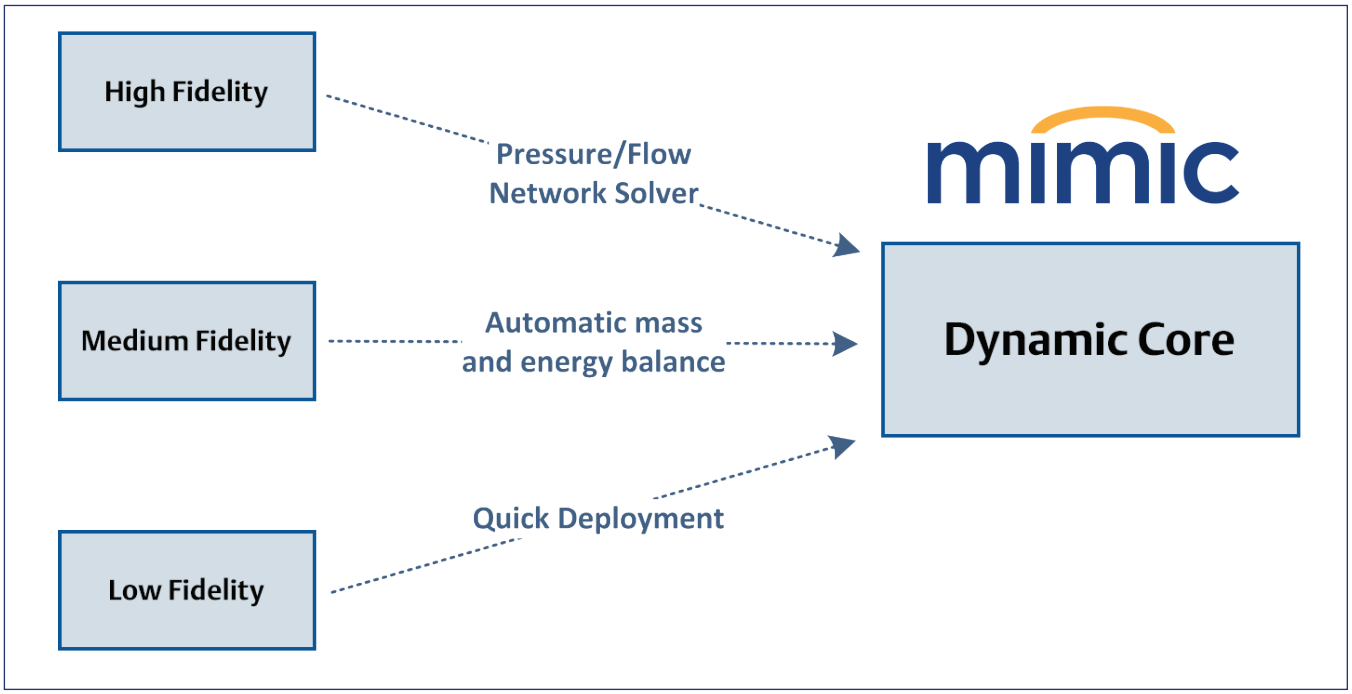
Dynamic Core also avoids many of the issues seen in other attempts in medium fidelity modeling approaches including:

- Reliance on data-driven models, and curve fitting for base modeling capabilities, producing a model that is easily broken when operating conditions change
- Implementation of simulation models in the control system configuration, making the maintenance of the control system simulator difficult
- Development of simulation models in process control configuration tools instead of process modeling tools
- Inconsistent project implementation approaches that require a large amount of end user time, process data and historical data
- No consideration of best practices for control system testing and process control improvement in the solution development

The Dynamic Core approach avoids these mistakes by leveraging simulation technology included in Mimic Advanced Modeling Objects Core and Emerson's high-performance project implementation process.

Dynamic Core Modeling Technology

The Dynamic Core modeling approach uses Mimic's Advanced Modeling Objects Core to create accurate simulation models for system testing and operator training. These modeling objects obey laws of conservation of mass and energy, while including a fully developed and dynamic pressure flow network. Traditional modeling requires the user to build each piece of equipment within the software (vessels, pumps, valves, heat exchangers) that follow these laws leading to a very time consuming and difficult to maintain solution. This approach incorporates benefits from low, medium, and high fidelity models to deliver a simulation system that is highly functional yet cost effective.



The Dynamic Core approach combines the three main levels of modeling fidelity.

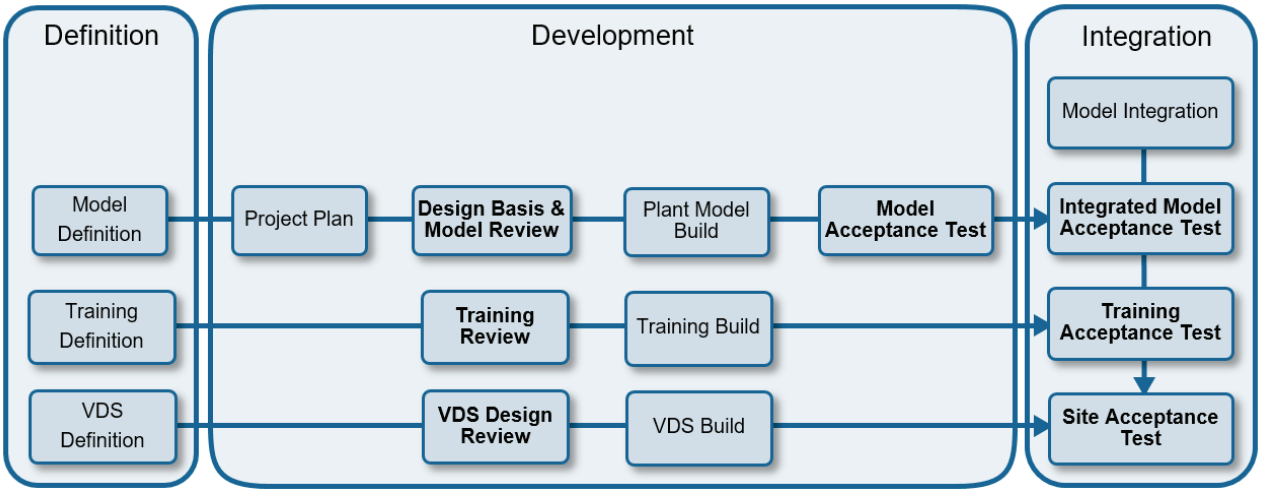
Although a high fidelity simulation can be extremely valuable for in-depth testing and thorough operator training, it is not always suitable for all applications. Capable of providing very accurate process dynamics, high fidelity models come with increased cost, due to the additional engineering effort required. The Dynamic Core modeling approach is built on the foundation blocks of high fidelity models, but only utilizes key features. These include a complete pressure/flow network solver, the capability of using real equipment data, and automatic integration with the Mimic Operator Training Manager.

Automatic mass and, to some extent, energy balances are the foundation of a medium fidelity model. The Dynamic Core approach uses objects that automatically conserve mass and energy without exception. Unlike typical medium fidelity models, Dynamic Core is capable of seamlessly upgrading to high fidelity where required. The backbone of the model is already complete, resulting in a quick and economical transition.

Low fidelity models are useful in that they have low data requirements and light demands on the end user during the project. As they are quick and easy to develop, these models provide a great return on investment. Like low fidelity models, the Dynamic Core approach has low data requirements and light demands on the end user's time. The unit operation based approach to modeling allows for quick and repeatable model development with easier lifecycle sustainability of the simulation.

Dynamic Core Project Execution

To accommodate tight project timelines and maximize the benefits of the dynamic simulator, Emerson develops the simulation in parallel with the control system. The model is developed completely independent of the control system, making it complete and available for control system internal testing and FAT.



Dynamic Core project execution process designed for rapid deployment.

Definition – P&IDs and IO counts will have been collected during the estimation phase, but additional information collected during this stage include control strategy documentation and IO lists with structure of control logic.

Base Model Development – The simulation will consist of three layers of models: landing models, interface models, and process models. Mimic's Bulk Generation Utility will be used to streamline the development of landing and interface models while all process models will be quickly created with Mimic's Advanced Modeling Objects.

Process Model Tuning – This collaborative effort with the integrator and customer will vary depending on end user requirements. All objects will require initial configuration, but any amount of tuning and optimization can be performed to meet specific goals.

Integration – Emerson engineers are present during the initial installation of the model and integration of the control system on the user's equipment. Emerson will lead an on-site acceptance test and train end users on important operational aspects of the system.

Dynamic Core Delivers Business Results

The Dynamic Core modeling approach has been implemented successfully on multiple projects. This multi-purpose dynamic simulation has been proven to be a valuable tool for control system engineering, control system validation, and operator training. Through a particular combination of low, medium, and high fidelity models, this unique approach to dynamic simulation has produced great business results.

A corn wet milling company has exclusively used the Dynamic Core methodology for all simulation requirements, currently running at 6 separate sites. This program is a series of control system upgrades to Emerson's DeltaV distributed control system. While control logic is being developed, simulation models are created in parallel for testing of alarm points, ranges and scales, PID loop control direction, simple and complex interlocks, process sequence control, and HMI configuration. With these items tested at an early stage in the project, factory acceptance tests were completed quickly and successfully. At the end of testing, the same model is ready for operator training without any additional effort. Control logic was tested and operators were trained before any changes were made to the production system.

During a plant-wide upgrade from old controllers to Logix processors, a life science customer needed to ensure new code functioned identically in Rockwell's PlantPAx System. Due to numerous regulations and a limited time frame, a dynamic simulation with high fidelity characteristics was needed, but one that could be completed quickly. In 4 weeks, the entire process including utilities, media preparation, reactions, buffer, filtration, purification, and CIP system was modeled in a high fidelity pressure/flow network with complete mass and energy balances across every unit operation. The model interfaced directly with ControlLogix via EtherNet/IP and provided a method for non-intrusive testing of both logic and IO.

Dynamic Core Delivers Results

Used across multiple control systems for processes ranging from wet corn milling to polymerization, the Dynamic Core modeling approach is a proven technique for delivering life cycle dynamic simulators. Providing unique process and business benefits, it delivers a medium fidelity characteristic model at a very high speed of implementation. Rather than dedicated for testing or training, the simulation will be used for both Capital Project Execution and Operational Excellence Initiatives.

Emerson
North America, Latin America,
Asia Pacific, Europe, Middle East:
+1 636 728 2000
MIMIC@Emerson.com
PSSCHES.Orders@Emerson.com

www.emerson.com/mimic