

Success Story

“Seamless integration of casting simulation solution in SolidWorks is ensured by Enosis QA team”



Pretext

The client turned to Enosis' SQA and testing team to improve the stability of their product as they confronted challenges in incorporating their casting solution in SolidWorks due to a number of unanticipated crashes & performance bottlenecks. As part of their strategic initiative, testing was identified as one of the focus areas to discover the critical bugs in terms of functionality, usability and performance benchmarks.

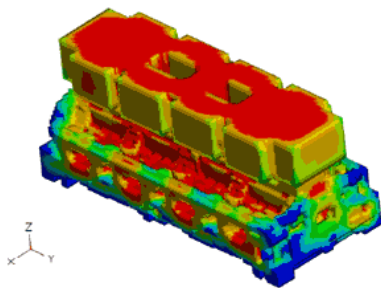


The Client

A world leader and pioneer of developing engineering simulation software used to predict how product designs will operate and how manufacturing processes will behave in real-world environments. They are developing software to solve the most challenging engineering problems allowing engineers to refine and validate designs at a stage where the cost of making changes is minimal. Their simulation solutions are deployed across automotive, aerospace, defense, electronics, marine and shipbuilding industries serving engineers and researchers in corporations that include Airbus Industries, Air Force Research Lab, Bell Helicopter, Boeing, Rolls-Royce, John Deere, Hitachi, LG Electronics, Lockheed Martin, NASA, Toshiba Corporation, US Navy, GE, Hitachi, Toyota, Honda, BMW and Ford.

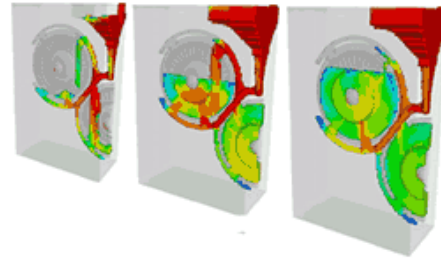
APPLICATION OVERVIEW

The casting process simulation application is a 3-D Finite Element program for predicting the manufacturability of cast parts. Enthalpy conservation equations and the Navier-Stokes equations are solved for the filling and solidification processes, allowing engineers to analyze design parameters from concept to production.



A user-friendly, pre-processor with capability to read meshes from other mesh generation codes, permits the entering of material properties, process conditions and numerical control parameters interactively. The interactive, dynamic postprocessor displays interpreted color graphics of

standard casting variables in contour, vector and x-y graph forms.



Simulation of complete casting process in SolidWorks allows selection of application, casting type and material, creation of STL model from existing geometry, defining metal pouring conditions, 3D grid building and mesh generation

MAJOR CHALLENGES

- The magnitude of testing requirements were high while proper Software Requirement Specifications and formal functional documentations were not available
- Casting process simulation application requires domain knowledge to design and execute an effective software verification and validation strategy. The SQA team had to garner adequate domain knowledge to ensure performance to the desired quality threshold
- Casting Simulation is based on two broad segments: the preprocessing and post processing steps. The preprocessing steps obtain input including environmental specific variables like pressure, temperature, casting material type, molt positioning, fluid flow speed etc which have an impact on the casting process. For post processing based on the input data, the solver simulates the casting process and writes information in delineated format. Therefore to ensure quality we had to understand the workflow and software functionalities of casting simulation in details for being able to identify and insert valid inputs for testing of preprocessing steps and then evaluate the output obtained from post processing

- The preprocessing for casting simulation consists of several steps and executing the steps for different set of input were inevitable for testing all possible input combinations to different steps. For each set of input, post processing results are analyzed which include checks on different frame, user interactions with different controls and expected behavior
- Anticipating application crash scenarios by exploring the various scenarios in the application level to discover thread synchronization problems which can lead to freezing the application and result in destabilizing the application
- Features of the casting simulation can be availed by executing different set of actions in a particular sequence. A number of alternative execution sequences can be leveraged to avail a particular feature. The SQA team had to test each of these different paths exhaustively for all available functionalities
- Analysis and identification of the necessary steps that are to be executed to replicate the problems reported by the test users of the casting application from client’s side
- The nature of the application necessitates black box and white box tests to take place simultaneously

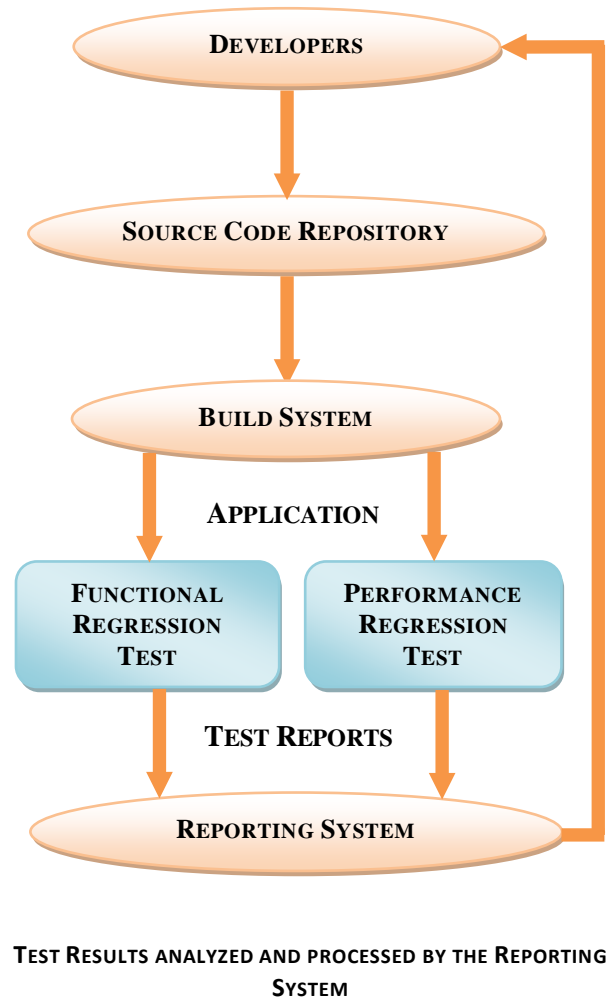
THE SOLUTION

Enosis was chosen as the preferred partner to ensure the quality of deliverables and reduce the timelines to get the desired results. Enosis adopted “Test early, test often” approach, which was an intuitive step forward towards resolving significant shortcomings of the “traditional” approach. Its goal was reducing the uncertainty of application stability during all stages of development by identifying major problems before they get rooted too deep into the fabric of the application. This approach promoted starting testing as early as application prototyping and continuing it through the entire

application lifecycle. This approach is too subjective to be consistently reliable, its success largely depends on the discipline to run tests consistently as well as the knowledge and qualification to evaluate test results correctly and reliably.

Continuous, periodic, daily or nightly build processes are common in forward-looking organizations. For the testing on regular builds, implementation of ‘Continuous development testing process’ becomes a prerequisite.

The figure below shows the workflow that we implemented in terms of source code, tests, and test results in the build-test infrastructure for this project.



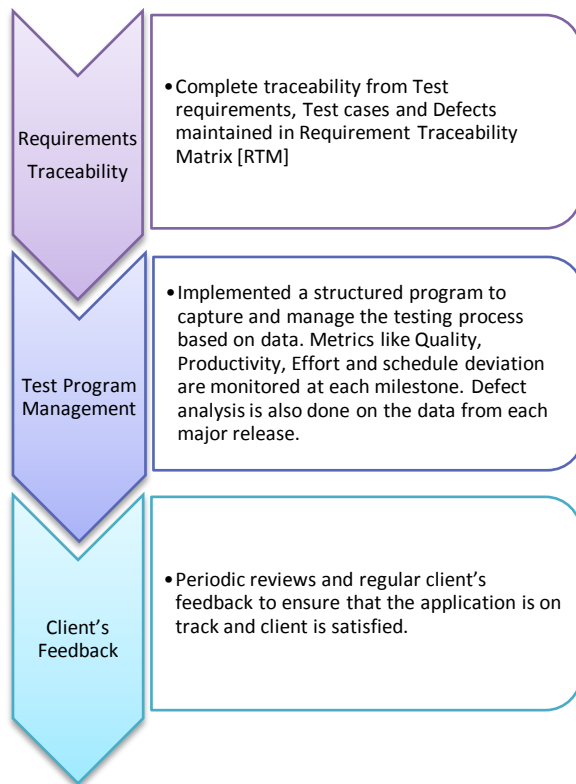
TEST RESULTS ANALYZED AND PROCESSED BY THE REPORTING SYSTEM

ENOSIS TESTING APPROACH

Our verification and validation measures are delineated below:

- Executing more use case scenarios to increase test coverage. Analyzing test reports makes test results and test directions more consistent
- Testing sub-systems and components of the casting application in isolation improved the diagnostic potential of the tests
- Gap analysis of the existing testing frameworks by conducting interviews and analyzing testing artifacts
 - ✓ identifying strengths, gaps and areas of optimization
 - ✓ Benchmarking against industry best practices according to context
 - ✓ Providing a roadmap for implementation, evaluation and refinement

Best Practice Adopted



- Effectively managing multiple platform support. A structured testing approach is followed to manage multiple platforms and transitioning testing activities
- Domain knowledge acquisition with the help of close communication with the subject matter experts, clients and exploring the product with the approach of exploratory testing. A knowledge management process is put in place, with defined templates for knowledge artifacts. Weekly open house sessions to discuss domain related topics for enhancing skills
- Documentation and process improvements were done by creating and updating test documentation and regression test cases to reflect all changes by analyzing the systems
- As time elapsed, the scope of the testing expanded from functional testing to regression testing, extensive performance analysis and code level analysis to address the unexpected crash and application freezing uncertainty issues detected earlier
- Performance analysis was done to measure the response time, throughput and resource usage of the casting application while extensively simulating visual animations of casting processes. Calculations are done on various high profile models to achieve the optimum performance level. One of the main objectives of performance testing was to maintain a low response time, high throughput and low resource usage. Performance indices for different codes and tools are compared across subsequent versions

BENEFITS

- Clients were constantly aware of the application's performance profile. Performance problems get detected soon after they are introduced due to regular and frequent test execution
- Full set of structured test documentation from SQA team including test results, final release

reports, quality estimations & recommendations of enhancements was provided

- Test execution and result analysis made test management very efficient
- Quality of the application has exceeded expected thresholds based on different quality parameters
- Early identification of critical issues in the test cycles
- Timely suggestions regarding different major and minor issues helped the development team in resolving the issues promptly
- Simplified bug Identification and bug reporting process
- Significant decline in the number of functionality failures and usability issues reported by the client

KEY FEATURES:

- GUI and menus to define the process and process parameters embedded in SolidWorks
- Look and feel consistent with existing SolidWorks menus and workflow
- Generation of mesh and solver input files using a command driven, batch version interface
- Solver launching and monitoring
- GUI for post-processing in SolidWorks 3D graphics window
- Software protection in SolidWorks batch interface and solvers

TOOLS & TECHNOLOGIES

VC++, OpenGL, SolidWorks API