

Emmeskay's Automotive C code Simulation Technology



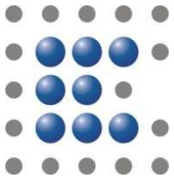
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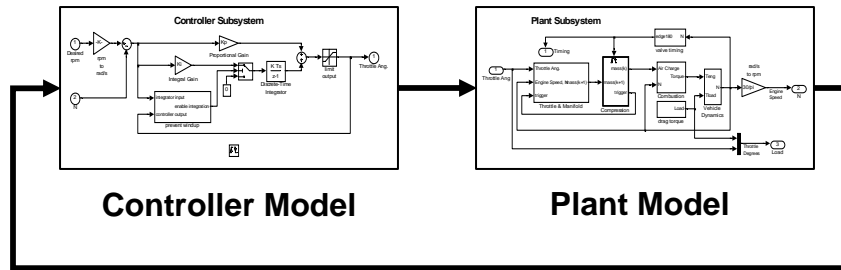
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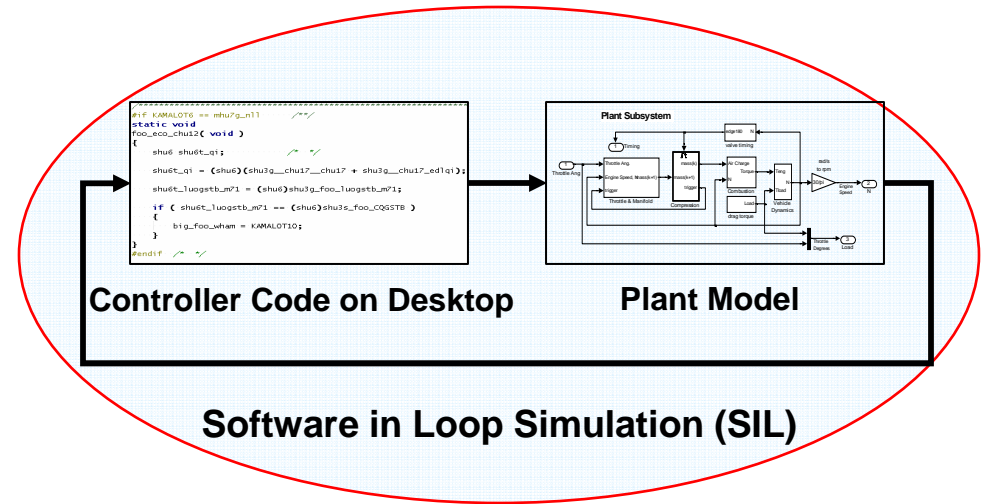
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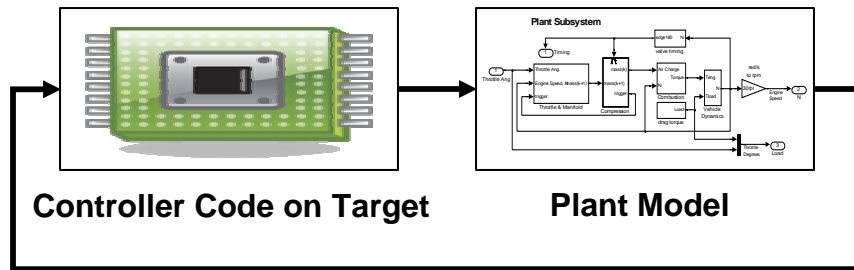
Simulation Techniques



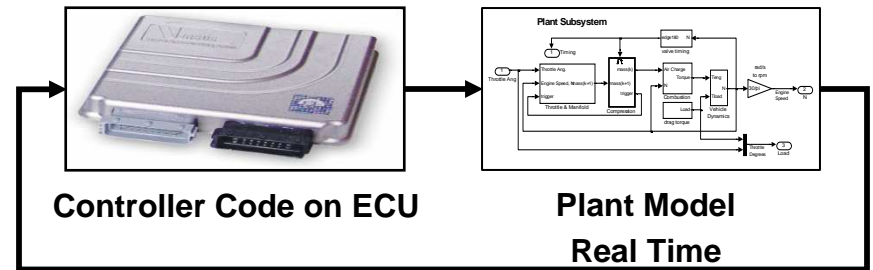
Model in Loop Simulation (MIL)



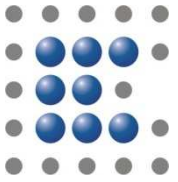
Software in Loop Simulation (SIL)



Processor in Loop Simulation (PIL)

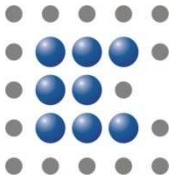


Hardware in Loop Simulation (HIL)

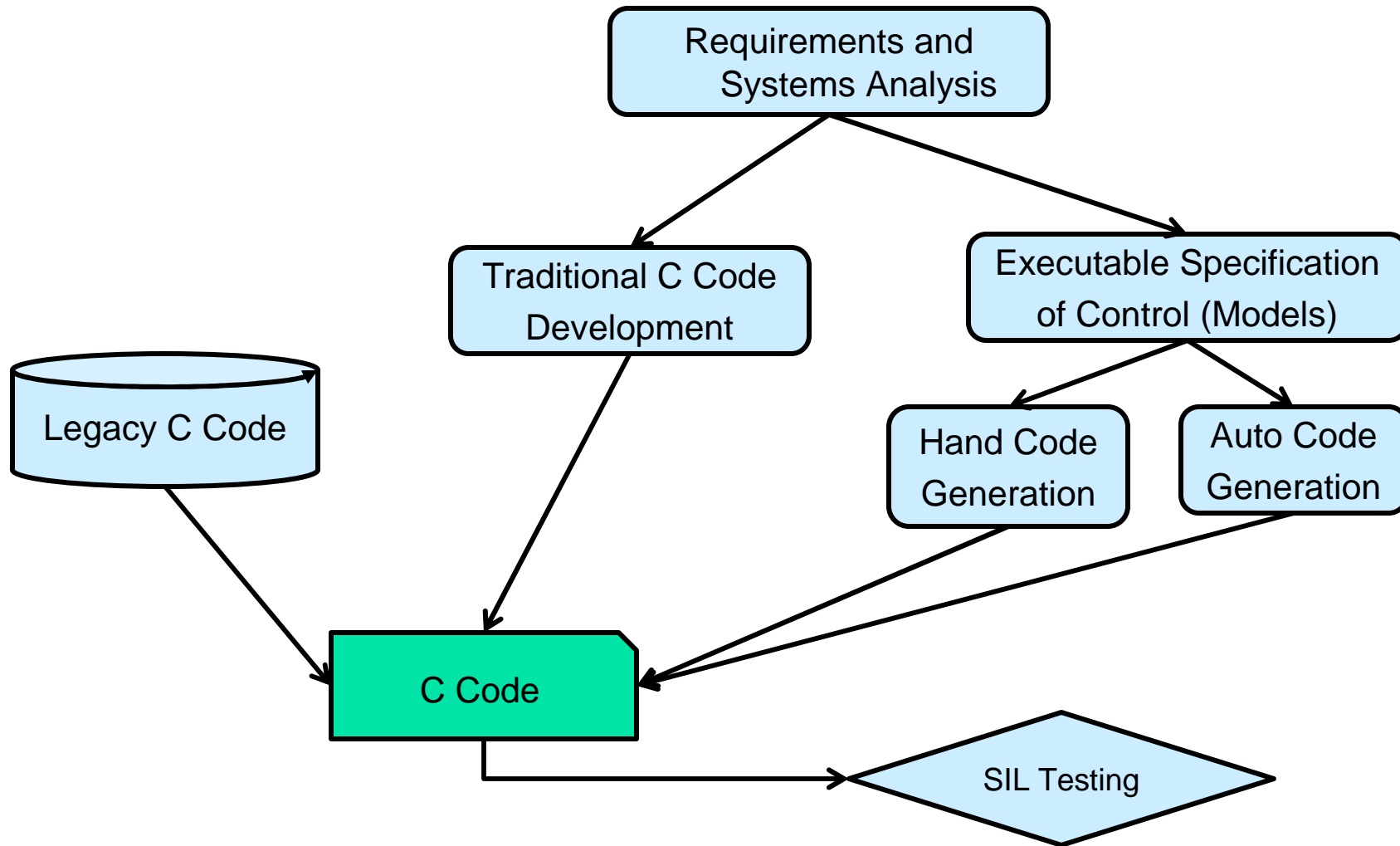


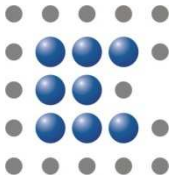
SIL Simulation

- SIL Simulation advantages
 - Non real-time – Allows verification of control software with high fidelity plant models (which may not run in real time for HIL testing)
 - Cost effective – Does not require expensive HIL hardware and associated software
 - Reduced development time - Enables control strategy developers to identify errors early in development cycle (SIL testing can be done before the HIL system hardware is ready)



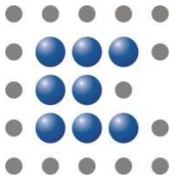
C Code from Multiple Sources





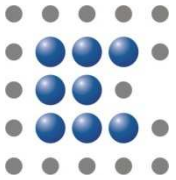
SIL Simulation Tool Environment

- MATLAB®/Simulink® is the most preferred tool for performing SIL simulations
 - Plant Models required for SIL simulation are developed mostly in Simulink®
 - Platform of choice for Model Based Controls Development
- Main Roadblock
 - How to bring the (legacy) C code into Simulink®
 - C2Simulink
 - C2Sfunction

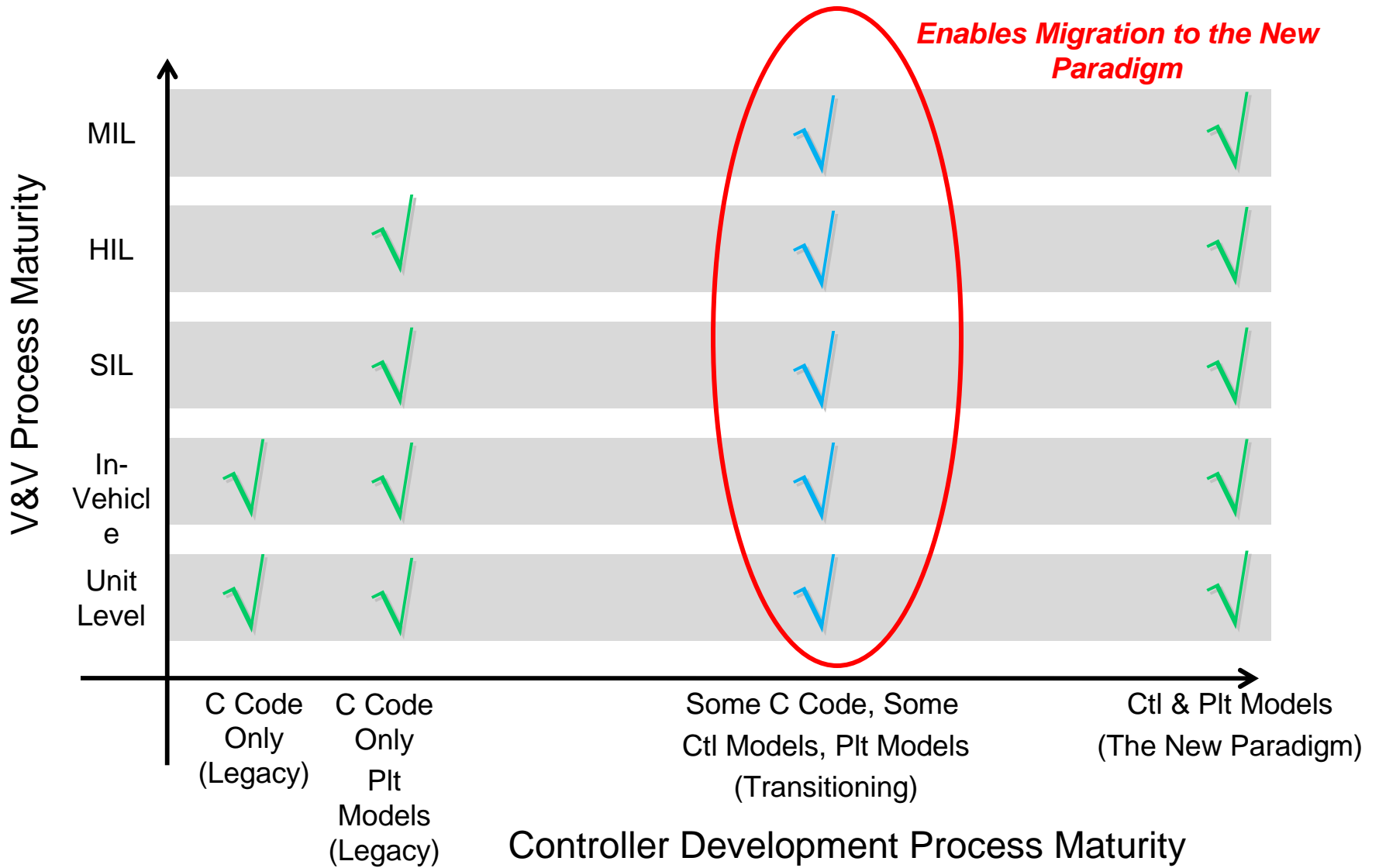


C2Simulink vs. C2Sfunction

- C2Simulink
 - Pros
 - Modeling in the most native format of Simulink®
 - Cons
 - Two schools for conversion
 - Structural Focus – Conversion accuracy, poor leverage of functional architecture
 - Functional Focus – Good functional architecture, difficult to verify conversion accuracy
- C2Sfunction
 - Pros
 - Efficient and accurate conversion
 - Cons
 - Lack of transparency
- We think C2Sfunction offers a very good “bridge” technology for migration to the new model-based development paradigm



Why is the C2Sfunction Technology Important?

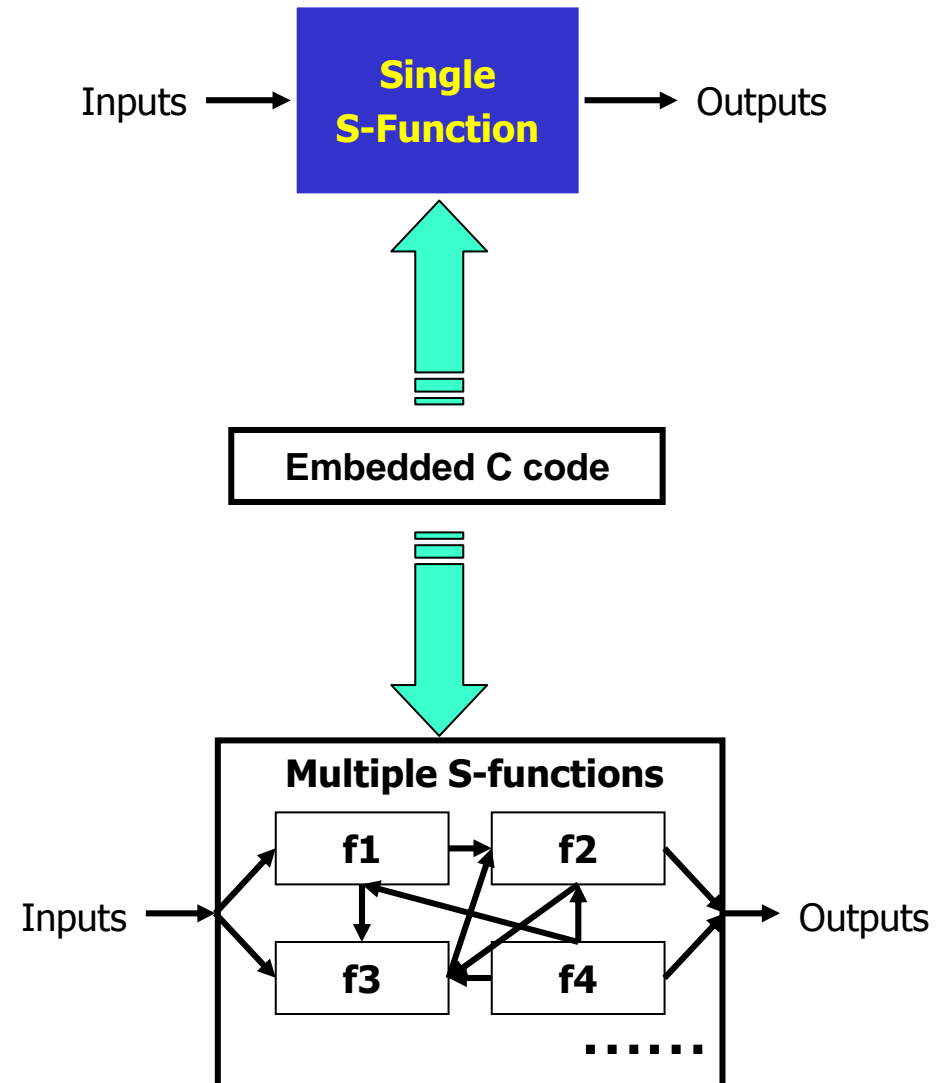


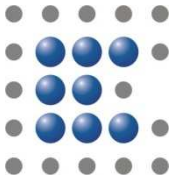


C2Sfunction Approaches

Two Approaches

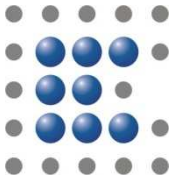
- Single S-function
 - Easy for implementation
 - Easy to distribute to other groups
 - Users cannot see the architecture details in Simulink®
 - Maintenance will be an issue as one needs to regenerate entire S-function whenever there is a minor change in the C code
- Multiple S-functions
 - Enables module (unit) level testing
 - Enables users to see the architecture details
 - Maintenance will be easy as one needs to generate S-function only for the module where there are changes in C code
 - Enables incremental conversion of C to Simulink® models
 - Implementation will be complex



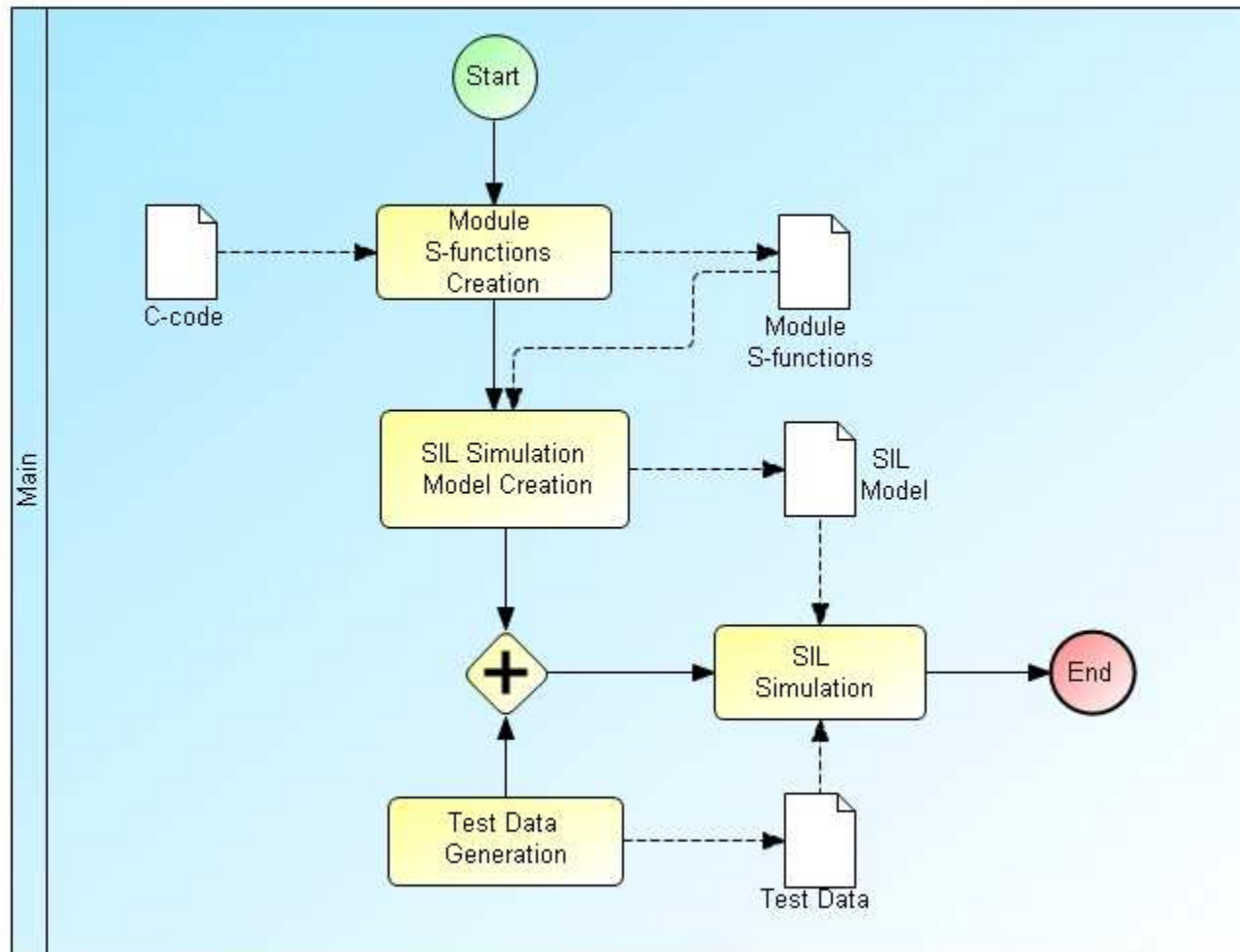


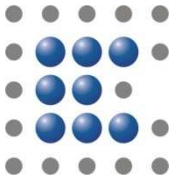
SIL Simulation – Emmeskay's Proposition

- Business Goal: Simulate the automotive C code in Simulink® environment preserving the C code logical unit structure
 - Multiple S-function approach is required
 - Technical challenges involved in multiple S-function approach are
 - How to handle global signals – that are shared across logical units
 - How to handle function calls – that are crossing the logical unit boundaries
- Emmeskay's solution – SILSRAM
(Software In the Loop Shared RAM)

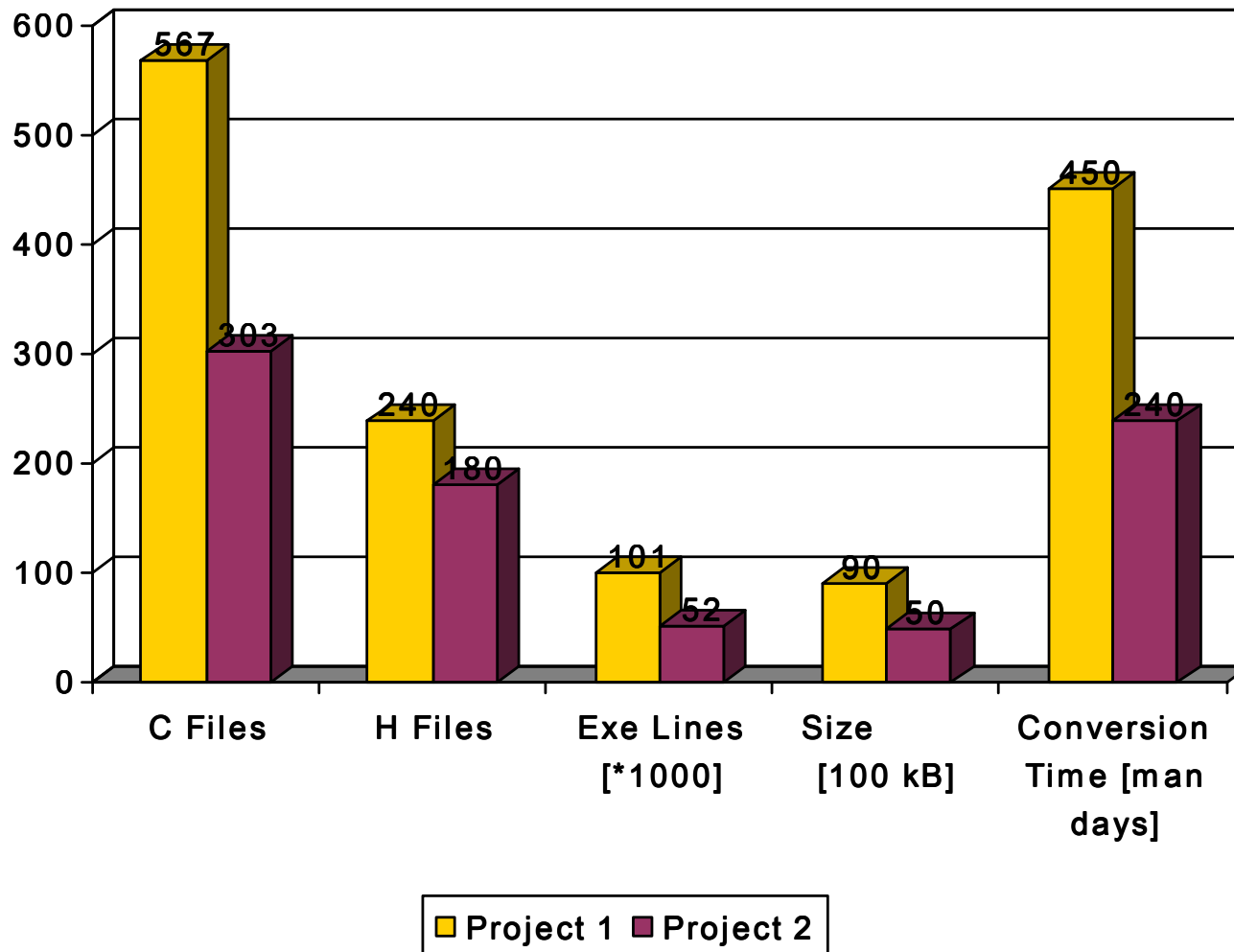


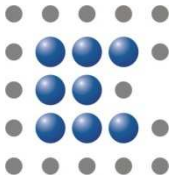
SIL Simulation – Process Diagram





SIL Simulation – Emmeskay's Experience





Typical Process Used for New Customers

Emmeskay's Approach

