TRC3000 Automation Project

Management: Systems Development Model

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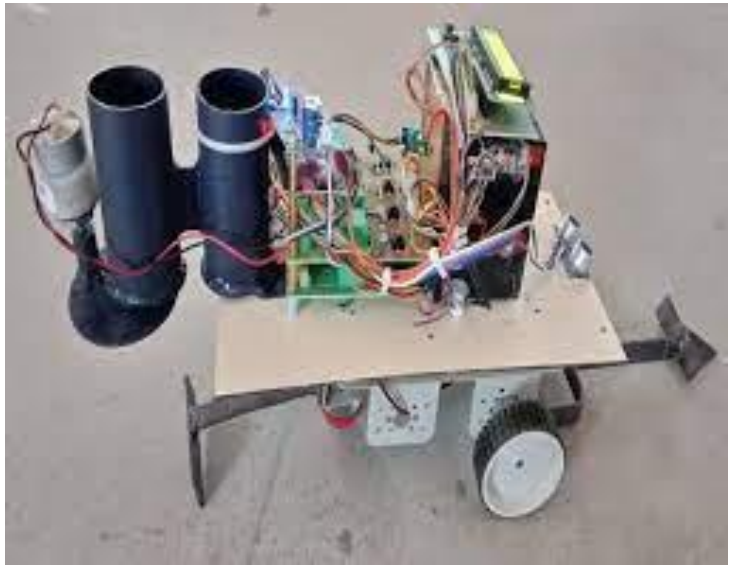
Development Models

- Projects need to be completed within a specific allocated time and cost
- It is helpful to apply a systems development model when approaching projects
- The existence of a model helps the project team to relate the required tasks to the goals of the project
- Possible models to adopt
  - Prototyping
  - Waterfall
  - V
  - Iterative Enhancement
  - Spiral

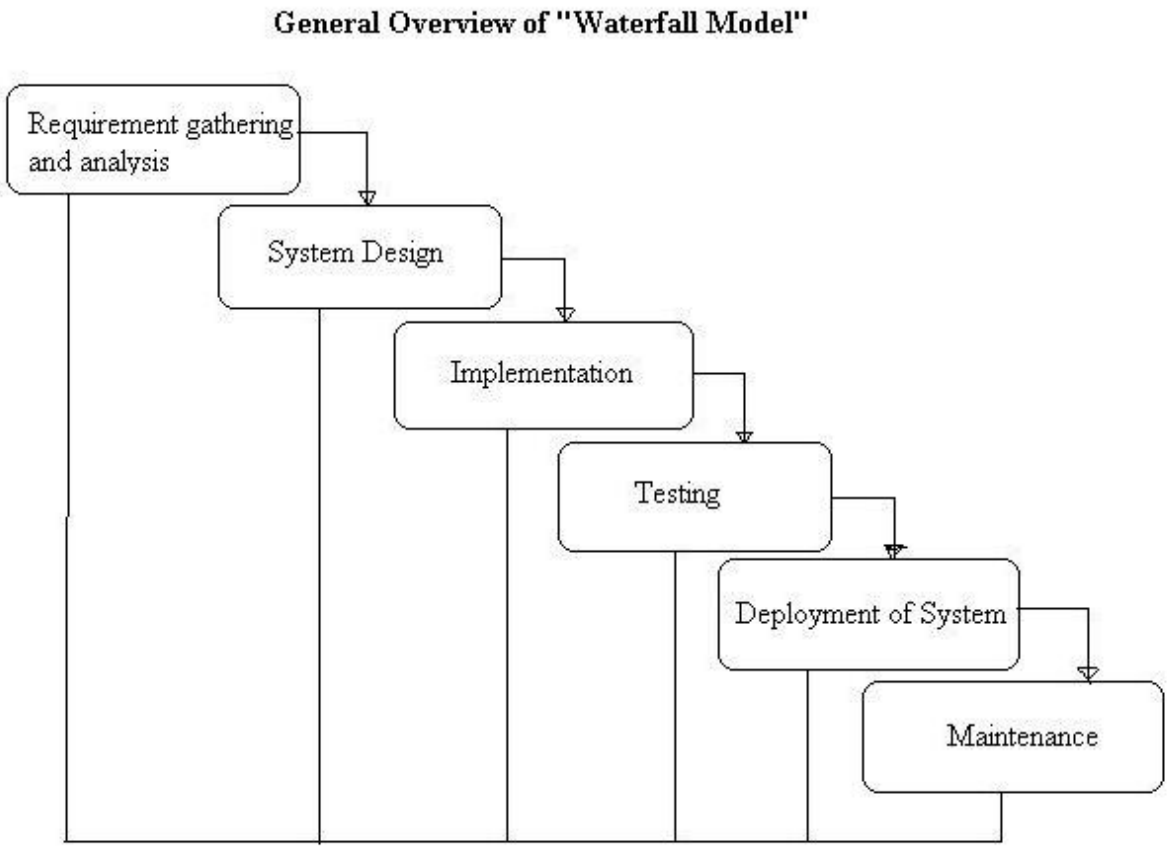
Prototyping Model

- A prototype is a system that does not include all the requirements of the user
- The prototyping model is useful when
  - Identification of all the requirements is difficult
  - The requirements change drastically during development
  - Venturing into a relatively new area
  - It is possible to abandon the project without too much consequences
- Problems in using this model include
  - Possible protracted process of refinement which results in too much time, effort and money
  - Difficulty in management



Waterfall Model

- The main feature in the waterfall model is that the phases do not overlap.
- Some salient points are
  - It is simple and easy to understand and use
  - Works well in projects where requirements are clearly defined and very well understood
  - Used when there are strict standards and requirements that have to be followed
  - Design is assumed to be straightforward and a once-off process

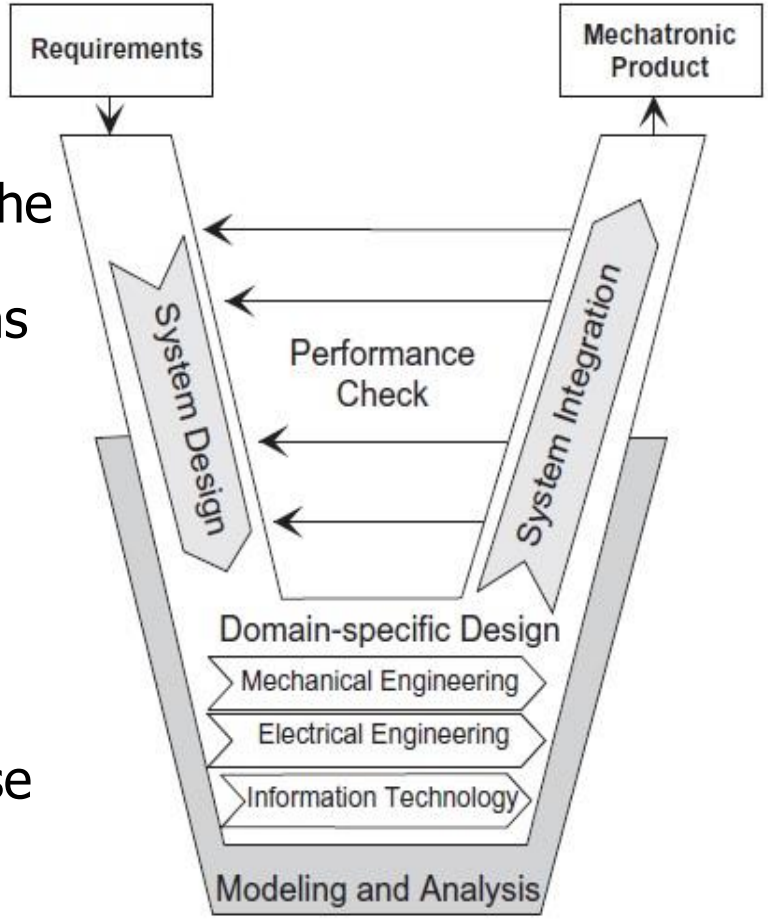


V Model

The V-model involves

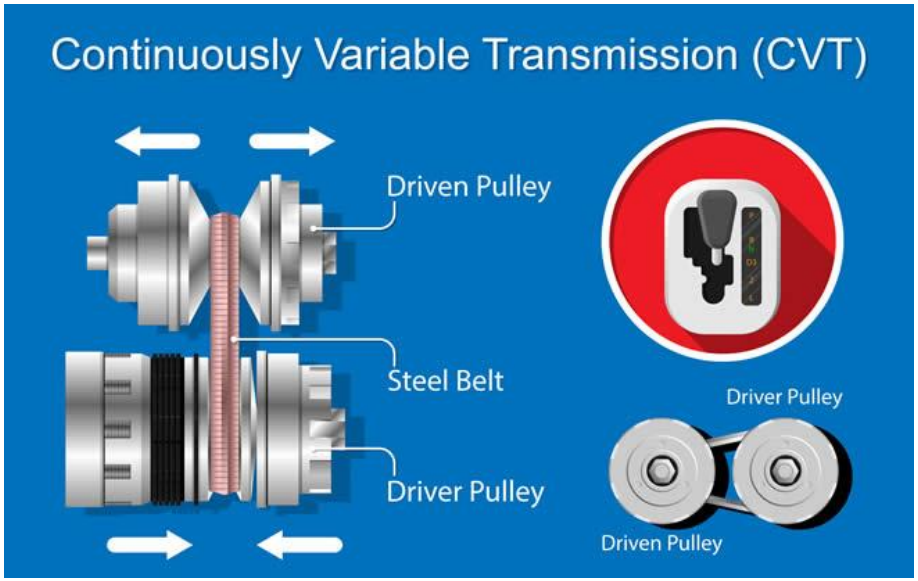
- Analyzing all requirements on the total system
- Define the sub-functions (left branch of the V-model)
- Develop, verify, and test the sub-functions using cooperating development teams
- Integrate the sub-functions step by step (right branch of the V-model)
- Check the performance of the integrated system
- If improvement is needed, repeat the process again

It enhances the waterfall model by extensive use of testing to validate requirements and introduce changes in design if necessary



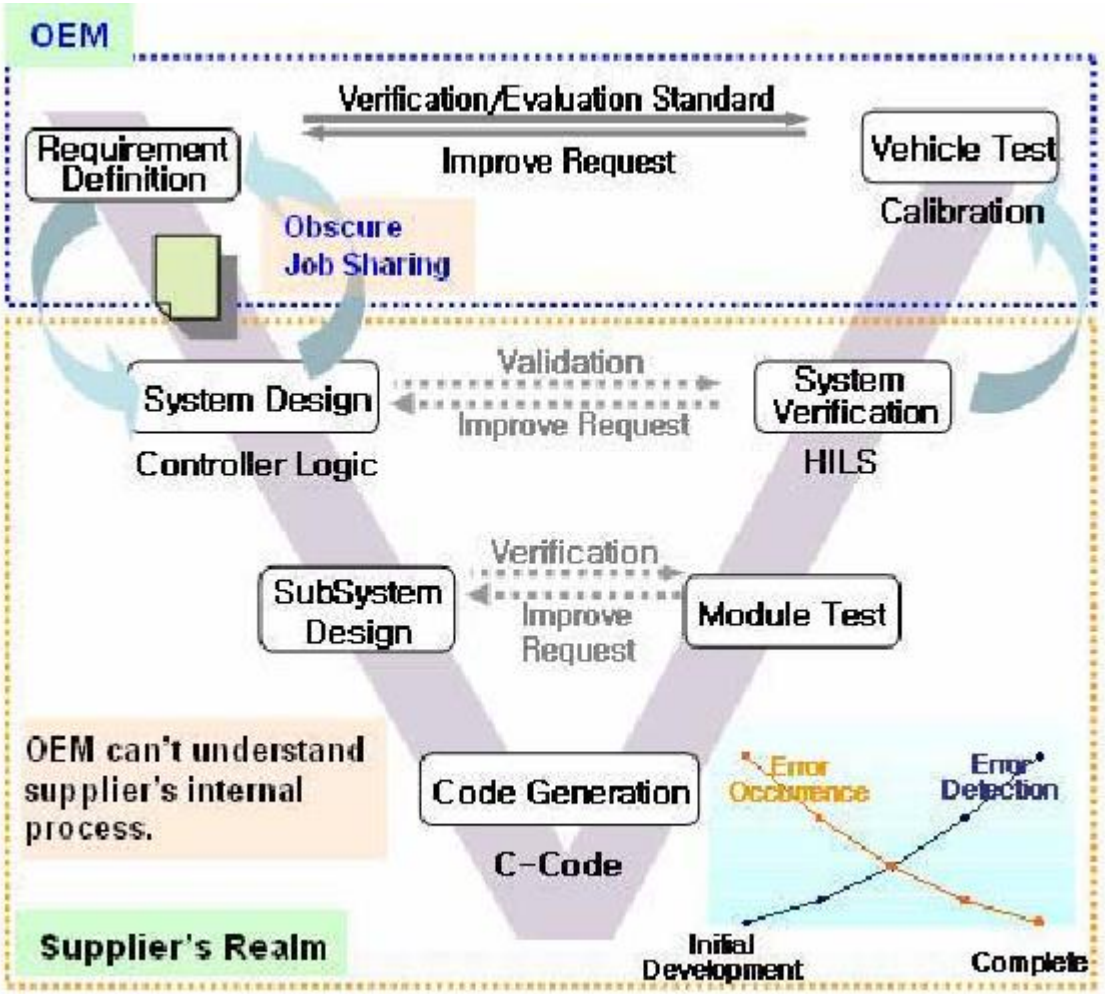
Case study: Continuously Variable Transmission (CVT) Development

- Similar to an automatic in that it doesn't use any input from the driver.
- Doesn't have any gears.
- It has two pulleys, one pulley connects to the engine, and the other connects to the wheels.
- A flexible belt connects the two pulleys
- When one pulley gets larger, the other one gets smaller.
- This provides an infinite number of gear ratios, unlike the automatic, which has a set number of gears.
- Project uses the V-model for characterization



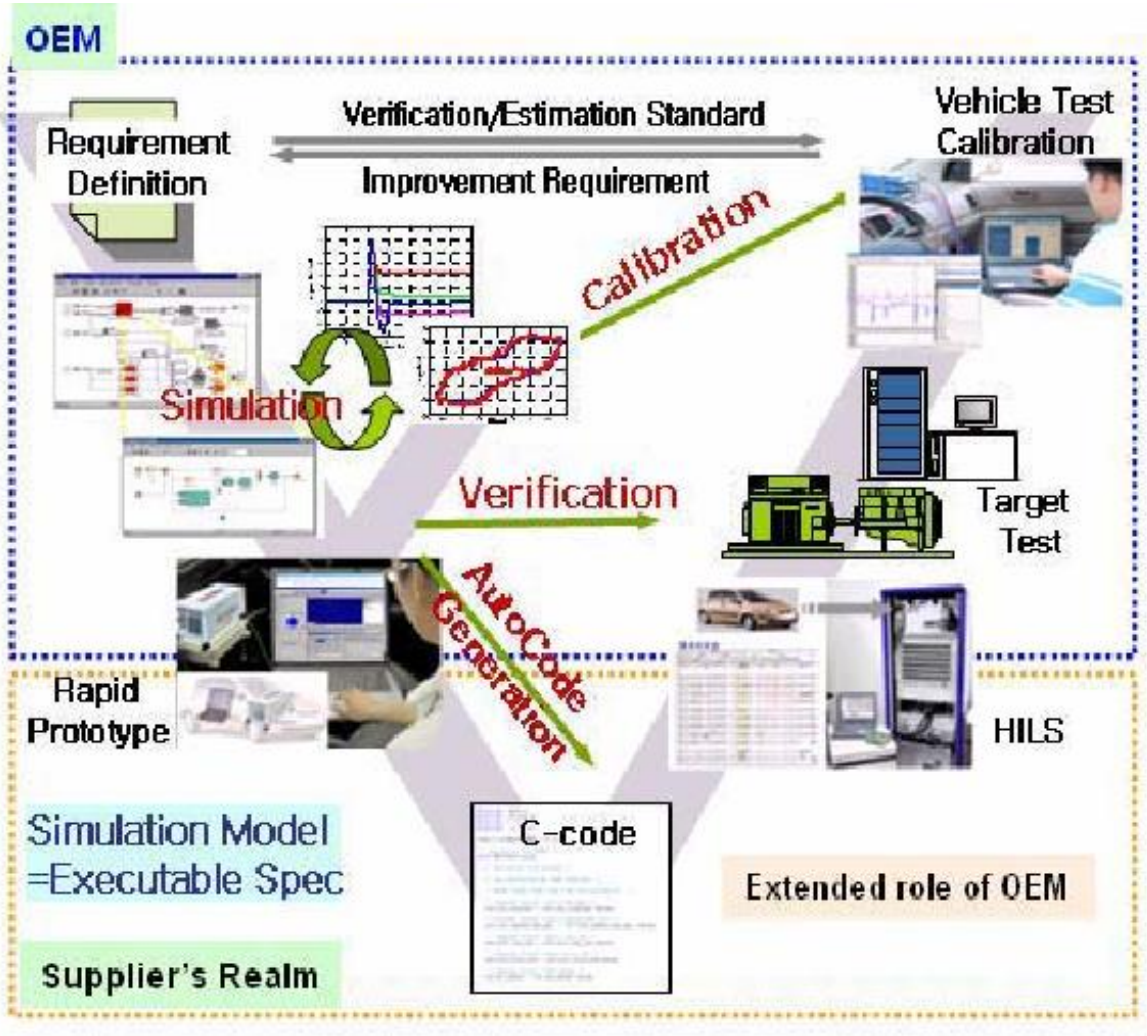
Case study: CVT Development

V-model in document form



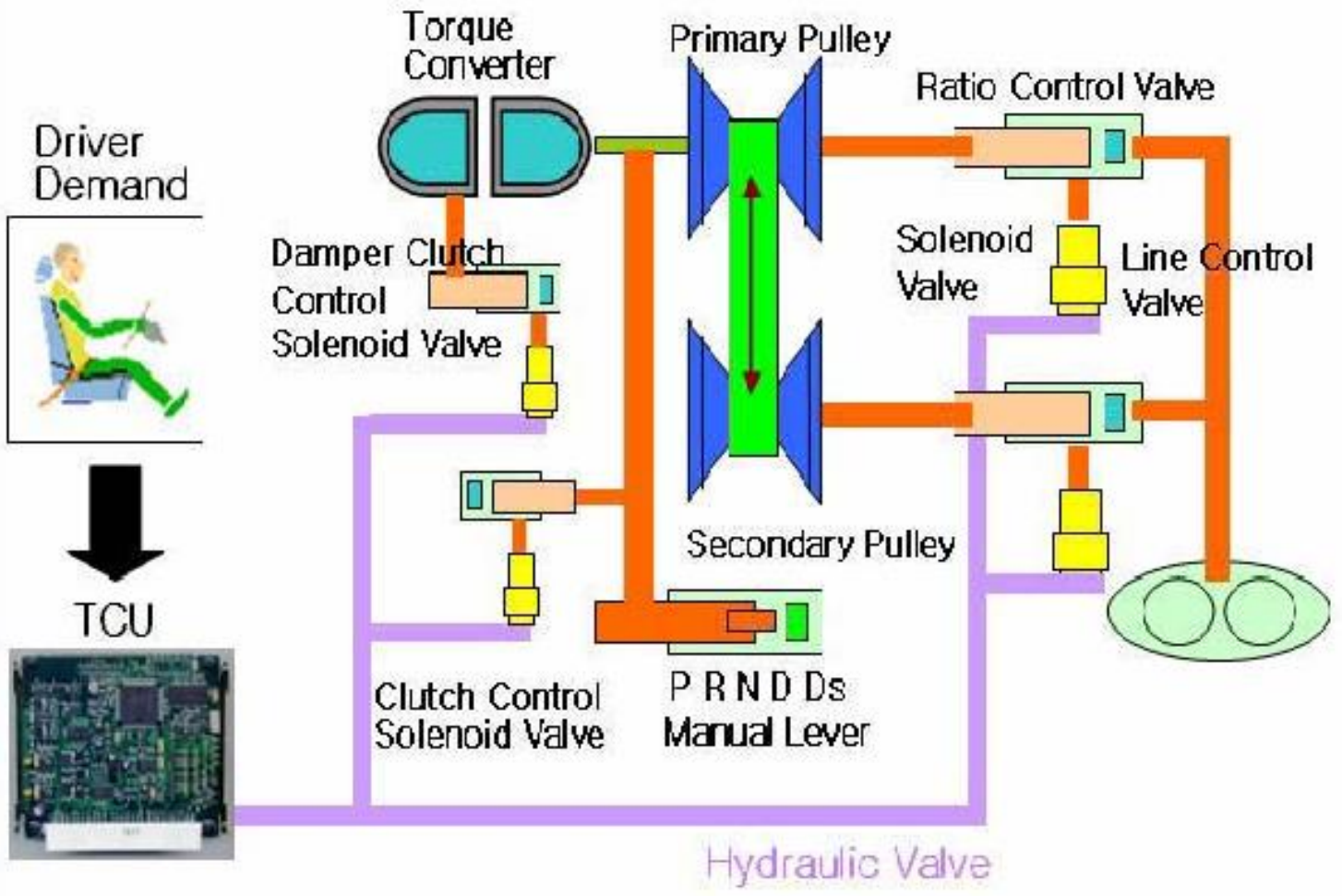
Case study: CVT Development

V-model in pictorial form



Case study: CVT Development

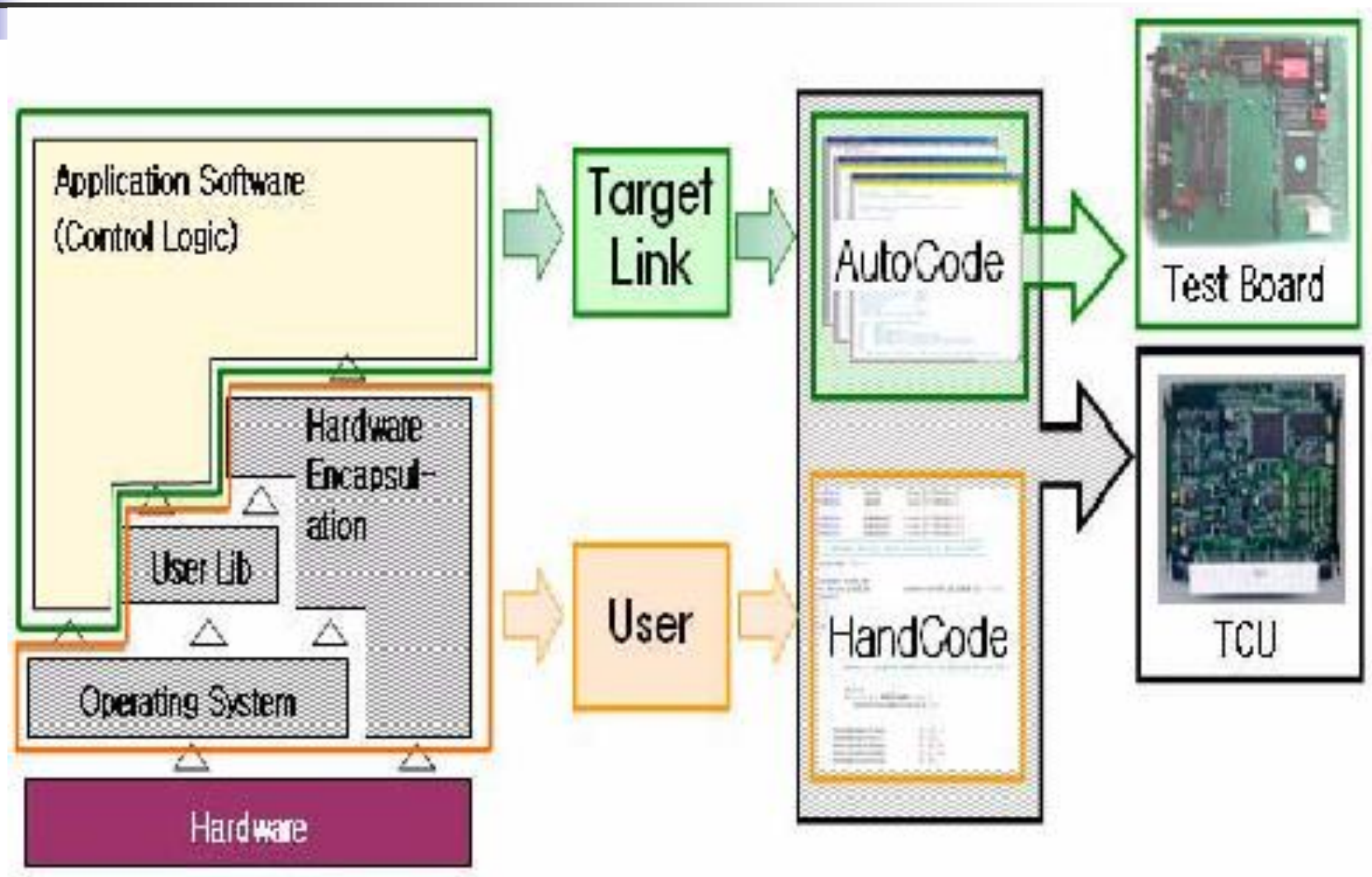
System Schematics



Telematics Control Unit

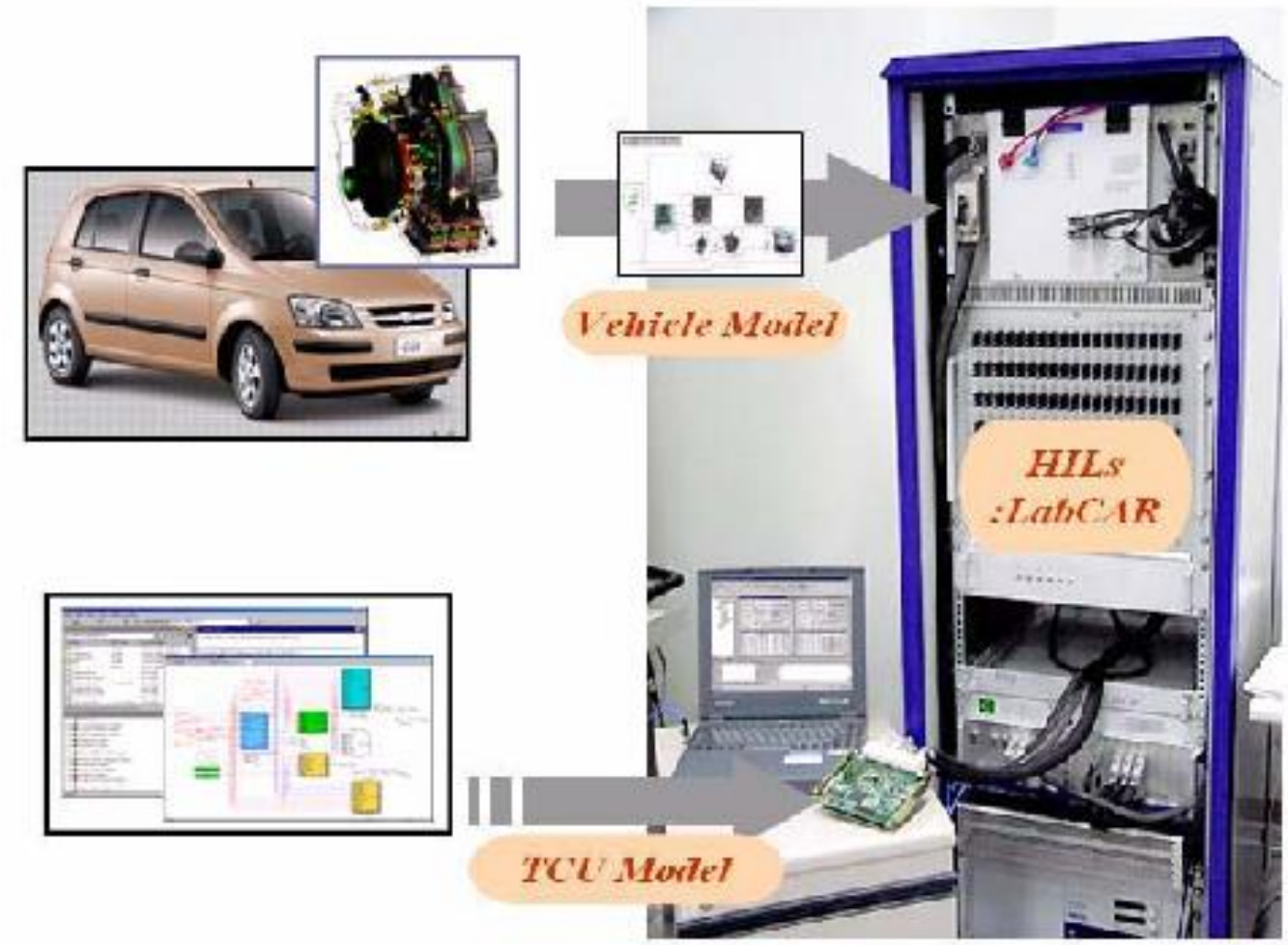
Case study: CVT Development

Test Board & TCU Code Generation



Case study: CVT Development

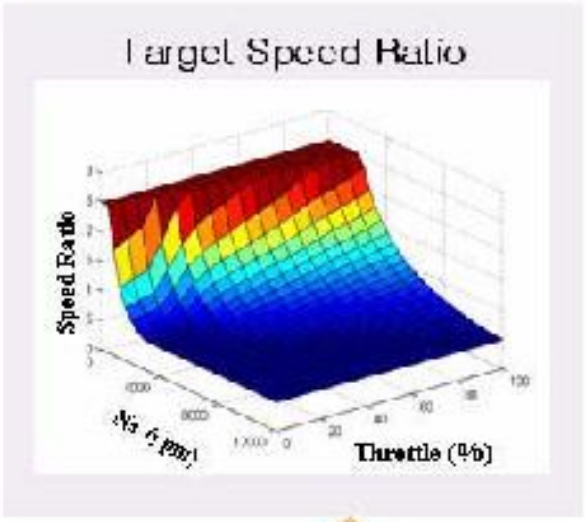
Hardware in the loop (HIL) testing

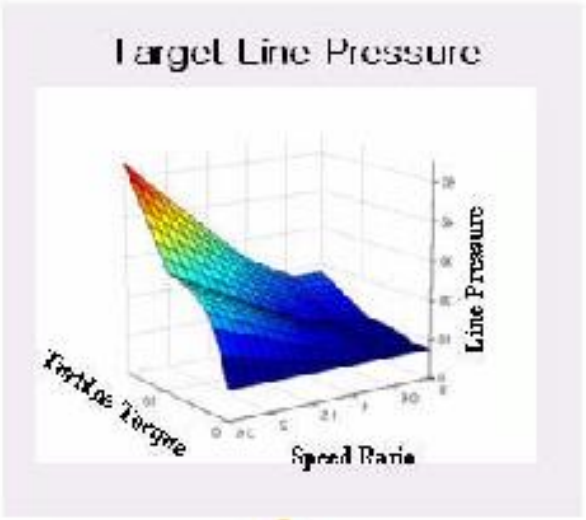


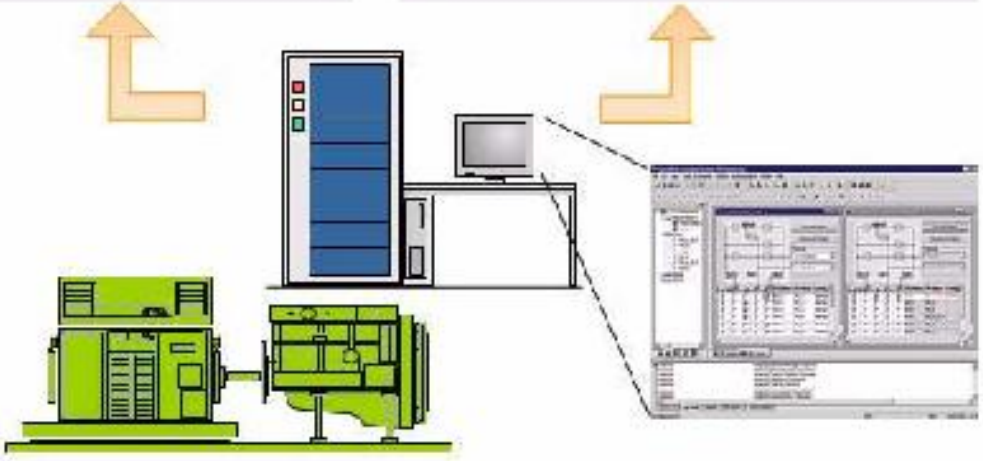
- Integration of real control system hardware, often a controller under test, with a simulation model representing the real environment.
- Reduces reliance on expensive prototype systems.

Case study: CVT Development

Dynanometer testing







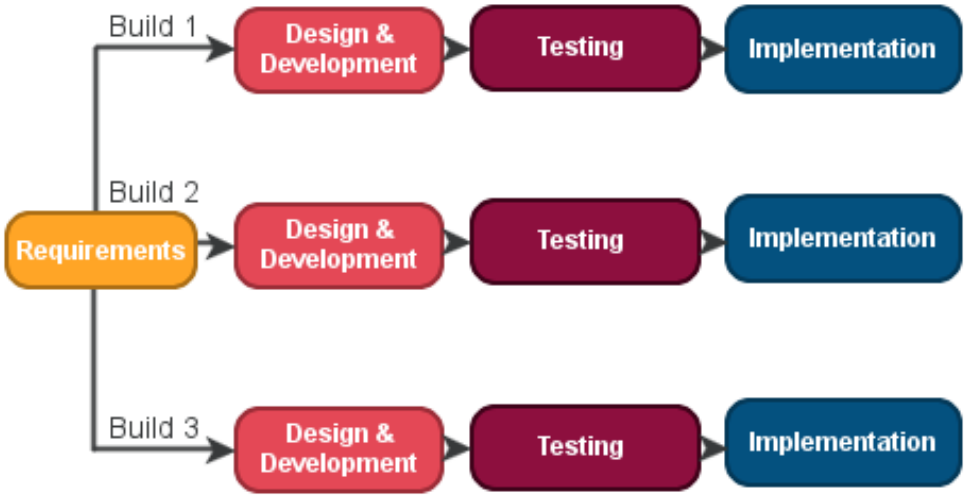
Measures the torque and power of the transmission system

Case study: CVT Development

In-vehicle testing

Iterative Enhancement Model

- The main feature is that the system is developed in increments
- Each increment adds some functionalities to the system
- Some salient points are
  - More parallel development can be implemented
  - Risks are identified and resolved during iteration, making each iteration easier to manage
  - Model runs into difficulty if significant changes to the system is required



Spiral Model

- The model adopts a cyclic conception
- There are 4 quadrant phases, as the process continues, the radius increases and thus also the cumulative cost of the project
- Some salient points are
  - It is suited when budget constraints and risk evaluation are important in the project
  - It allows requirements to be added in as they become known
  - The management tends to be more difficult
  - It is not suited for small or low risk projects