

## Abstract

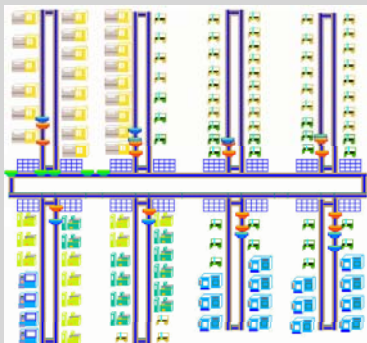
Can we develop a unified framework for modeling control in discrete event logistic systems? If so, the framework should result in the following advantages:

- Better sharing of the control system description among different stakeholder.
- Reusable, modularized, and understandable representation of the control model.

Control Model



System status ↑ Commands ↓



Plant model

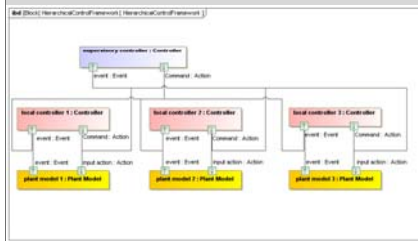
## Solution Approach

The approach involves the following steps:

1. Assume control is distributed and hierarchical—to limit the size and complexity of individual control models—and model the hierarchy using SysML IBD.
2. Model the internal structure of a generic control module using SysML IBD.
3. Specify the control logic within each control module using SysML activity diagrams constructed from predefined reusable control libraries.

### 1. Hierarchical Control

Hierarchical control enables decomposing complex tasks into simpler subtasks.

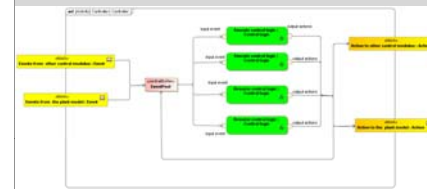


SysML Internal Block Diagrams are used to represent the hierarchical control structure.

1. A supervisory controller provides coordination between local controllers.
2. Local controllers monitor and direct a local plant model and report to their supervisory controller.

### 2. Controller Design

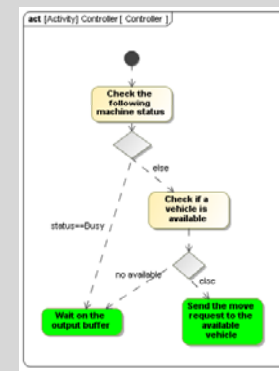
Depending on the received event type, a controller determines the corresponding control logic to be executed and sends commands to other controllers or plant models.



SysML Internal Block Diagrams are used to represent the internal structure of the controller.

### 3. Control Logic

SysML activity diagrams are used to describe control logic, where certain actions are the atomic behavior units selected from control libraries.



## Control Library

Control logic is composed from atomic behavior units. Three libraries are used for constructing control logic: query library, compute library, and command library.



Query library

Query the current status, control parameters from DB, MES



Compute library

The rule of the logic, optimization, DES, queueing.



Command library

Move, request, reserve commands

SysML Packages diagrams are used to represent the containment relationship of the libraries and their atomic behavior units.

## Potential Benefits

- Faster, cheaper control system design
- More effective communication with system stakeholders
- More effective translation to system simulation
- More effective specification for control system implementation.

## For Further Information

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