

# AI for System Integration

extended abstract

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## Objective

Traditionally, system integration is one of the implicit features of systems engineering. The common way to validate the integration is by testing, conducted at the latest stage of the system development cycle. The implicit goal of traditional validation testing is to detect and identify unexpected situations. The challenge is to identify the sources of operational waste, namely, exceptional activity that hampers the system performance and might result in accidents.

To protect from operational waste, we need to develop affordable methods enabling to constrain operation by the rules, and to detect and alert exceptions. Recently, a model of system integration has been developed. The new model may be used in integration design, a development activity in the emergent sub discipline of integration engineering. This presentation will demonstrate potential contributions of AI processes in integration engineering.

## Methodology

The new discipline of integration engineering is based on a model, driven from case studies drawn from the history of well-known accidents, in transportation, process industry, medical, and homeland security. The root cause of these accidents is confusion in the operation while in exceptional situations.

Key elements of the integration model are models of normal activity, diversion to exceptional situations, exception detection, resilient safe-mode operation, troubleshooting, and recovery.

These models are based on a generic model of controller multi-service integration, in which both the controller and the services employ both human and artificial intelligence. The integration is based on generic rules describing normal operation, including situational coordination and activity control, as well as generic rules for exception management.

The situational coordination is based on scenarios that mediate the controller's tasks with the services situations. Such mediation is critical to solving issues of operational complexity, which is exponential otherwise. AI may contribute to the facilitation and quality of processes such as:

- Configuration control
- Assembly verification
- Accessibility control
- Operation control
- Service control
- Performance control
- Synchronization control
- Emergency control

The control tasks include decision making based on prediction of the effect of optional control commands. AI processes may assist in controller's decision-making and may take over some of the error-prone tasks of the human operators in the services.

## The outcome

The outcome of this study is a methodology for integrating AI into the design of system integration, comprising:

- Scenario definition, key to the controller-multi-service coordination design
- Generic rules for controller-service integration: situations and activity
- List of potential AI tasks in employing generic rules

## Relevance to practice

Operation control is often complex, due to the need to consider details of potential diversion from normal operation. Consequently, many projects cannot afford to implement sustainability demands. The scenario-based generic rules enable facilitation of the operation definition and implementation. AI generic processes may add value to the controller decision-making by providing ongoing preview of the service situations, as well as preview of the services reaction to optional controller input.