

# System of Systems Architecting and Integration; Visualizing Dynamic Behavior and Qualities

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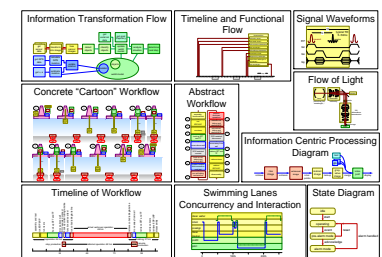
## Abstract

A major responsibility of architecting and integration is ensuring that desired dynamic behavior and desired qualities emerge from the interaction of components within the systems, between systems, and between the users and environment of the systems. A challenge is that organizational attention tends to be on the parts structure, which is determining organization, logistics, manufacturing, and servicing. At the same time, many developers lack the competence to capture dynamic behavior and the way qualities emerge.

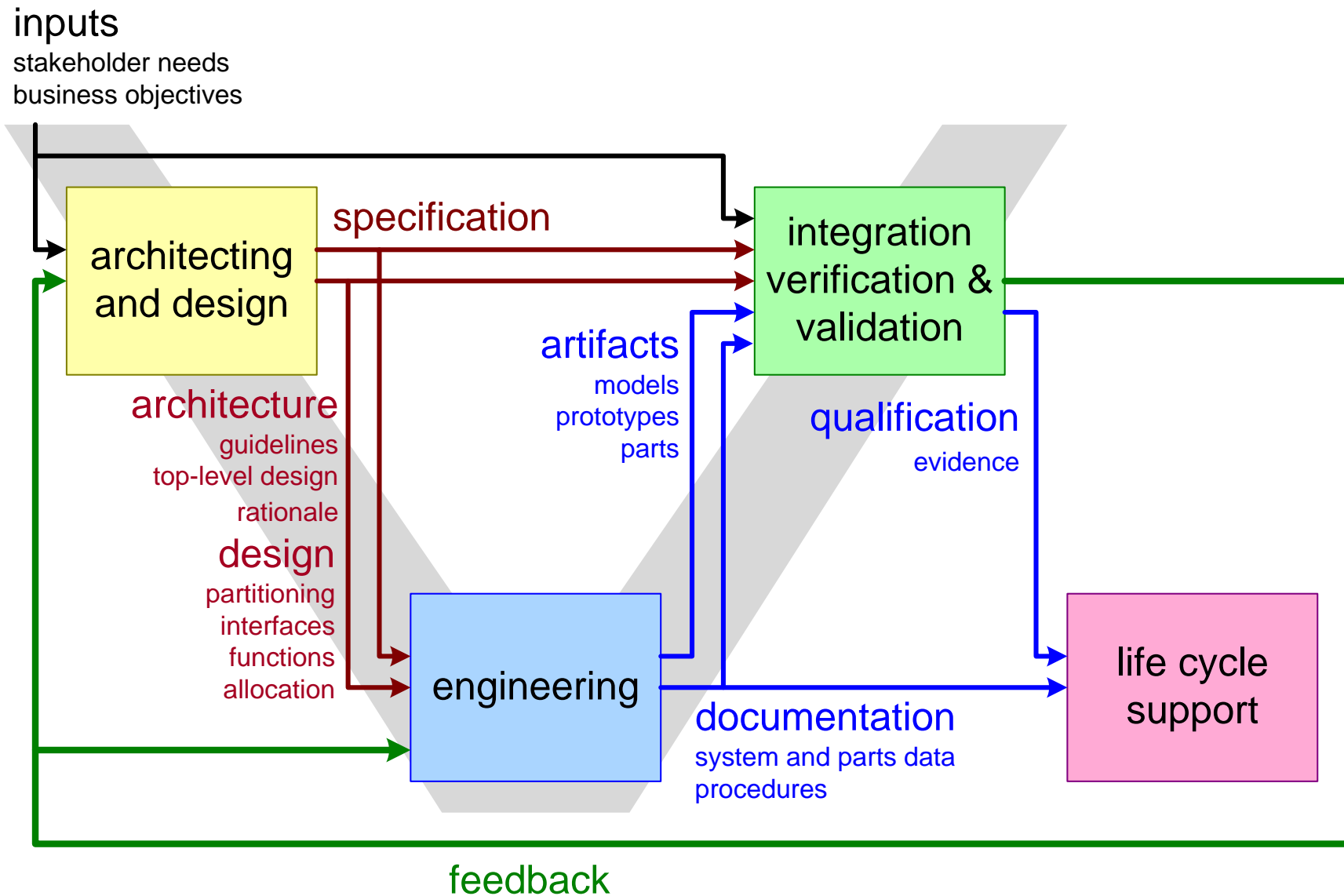
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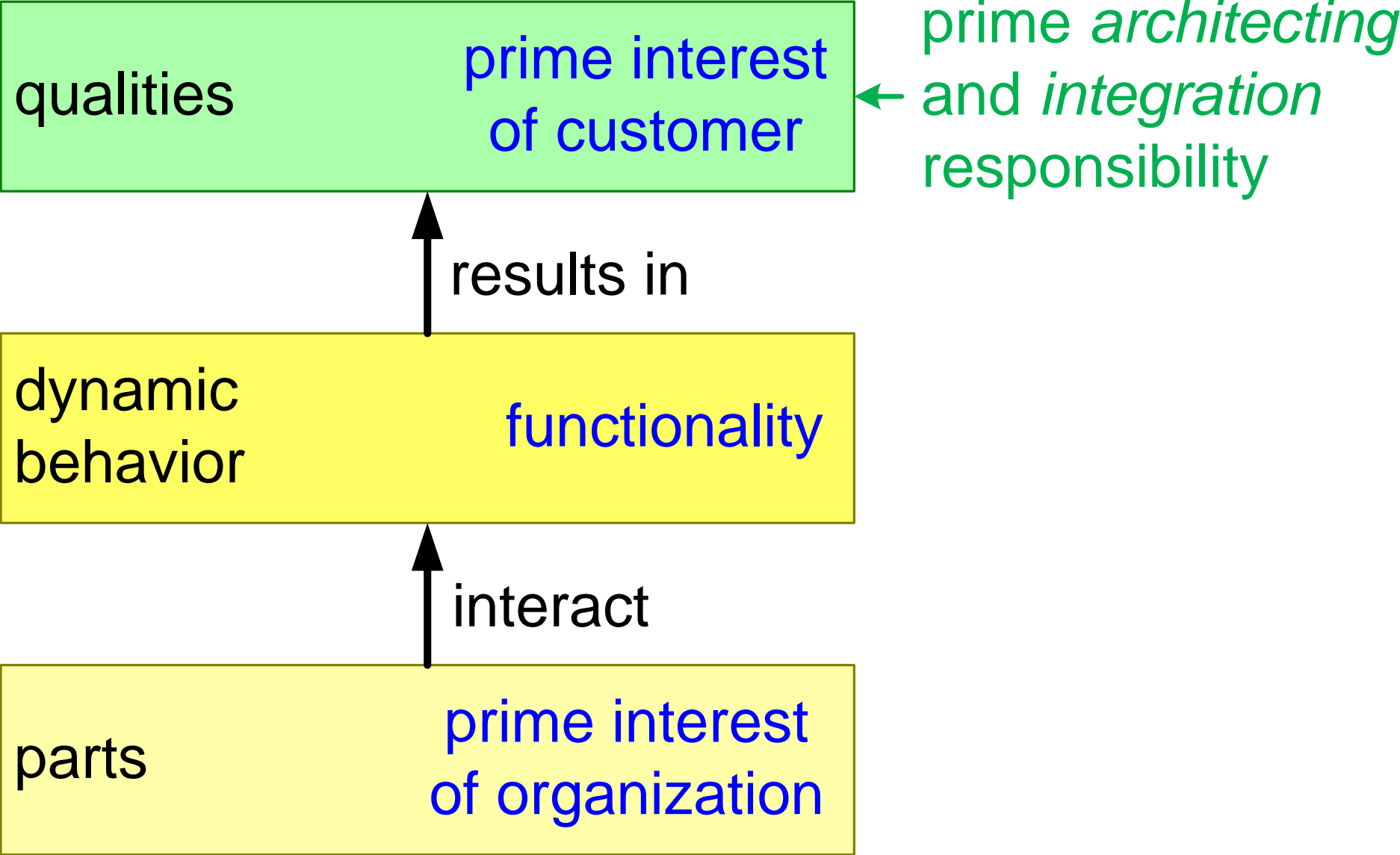
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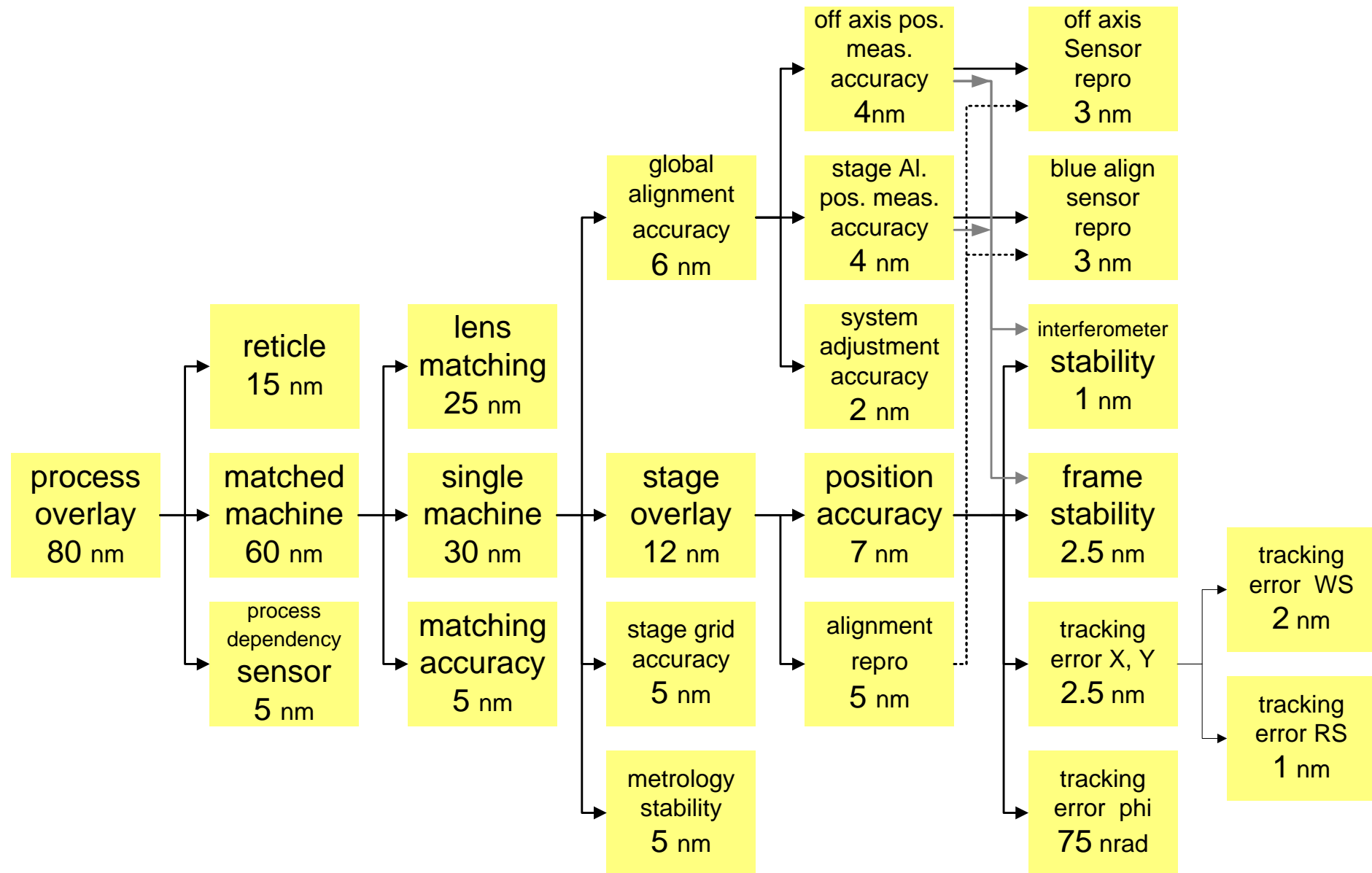
# Simplified Systems Engineering V-model



# From parts to qualities

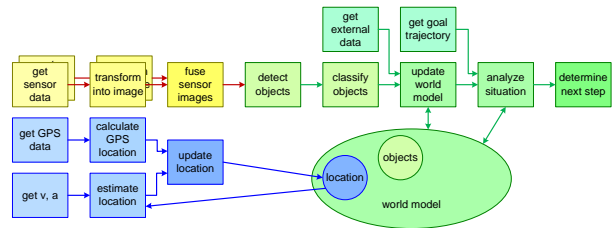


# Example of a technical budget, overlay (positioning accuracy)

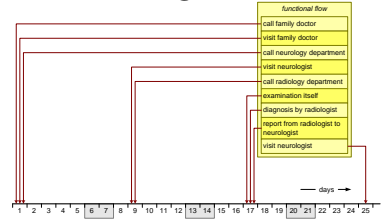


# Overview of Visualizations of Dynamic Behavior

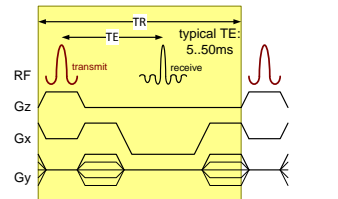
## Information Transformation Flow



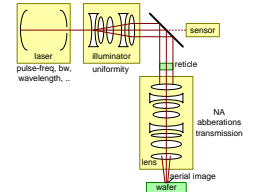
## Timeline and Functional Flow



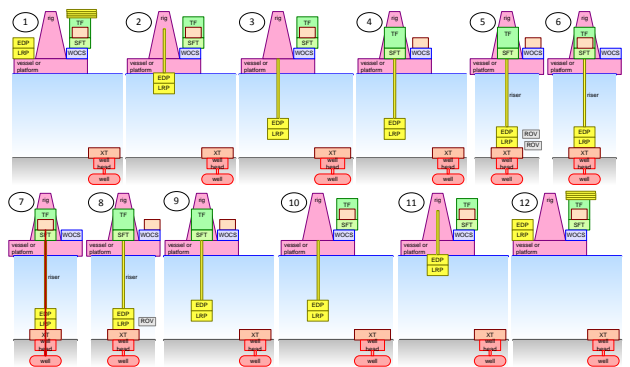
## Signal Waveforms



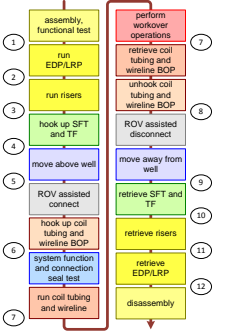
## Flow of Light



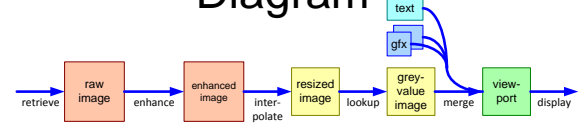
## Concrete "Cartoon" Workflow



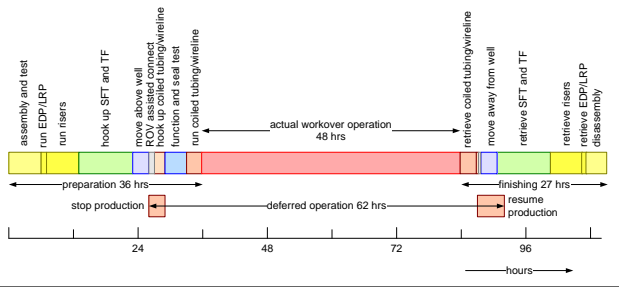
## Abstract Workflow



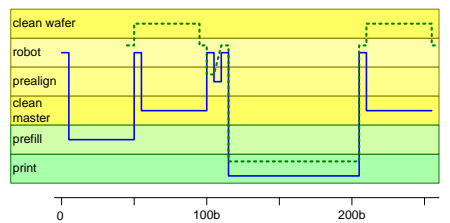
## Information Centric Processing Diagram



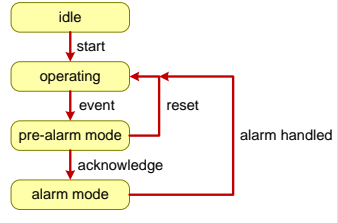
## Timeline of Workflow



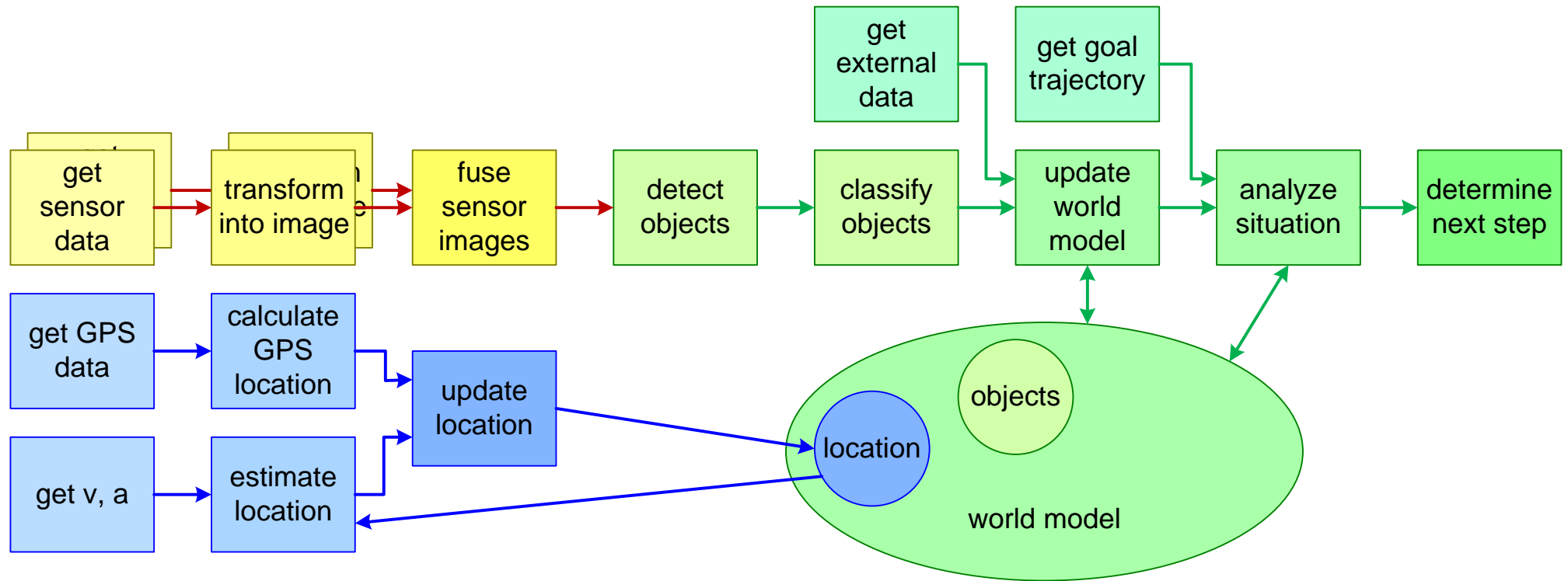
## Swimming Lanes Concurrency and Interaction



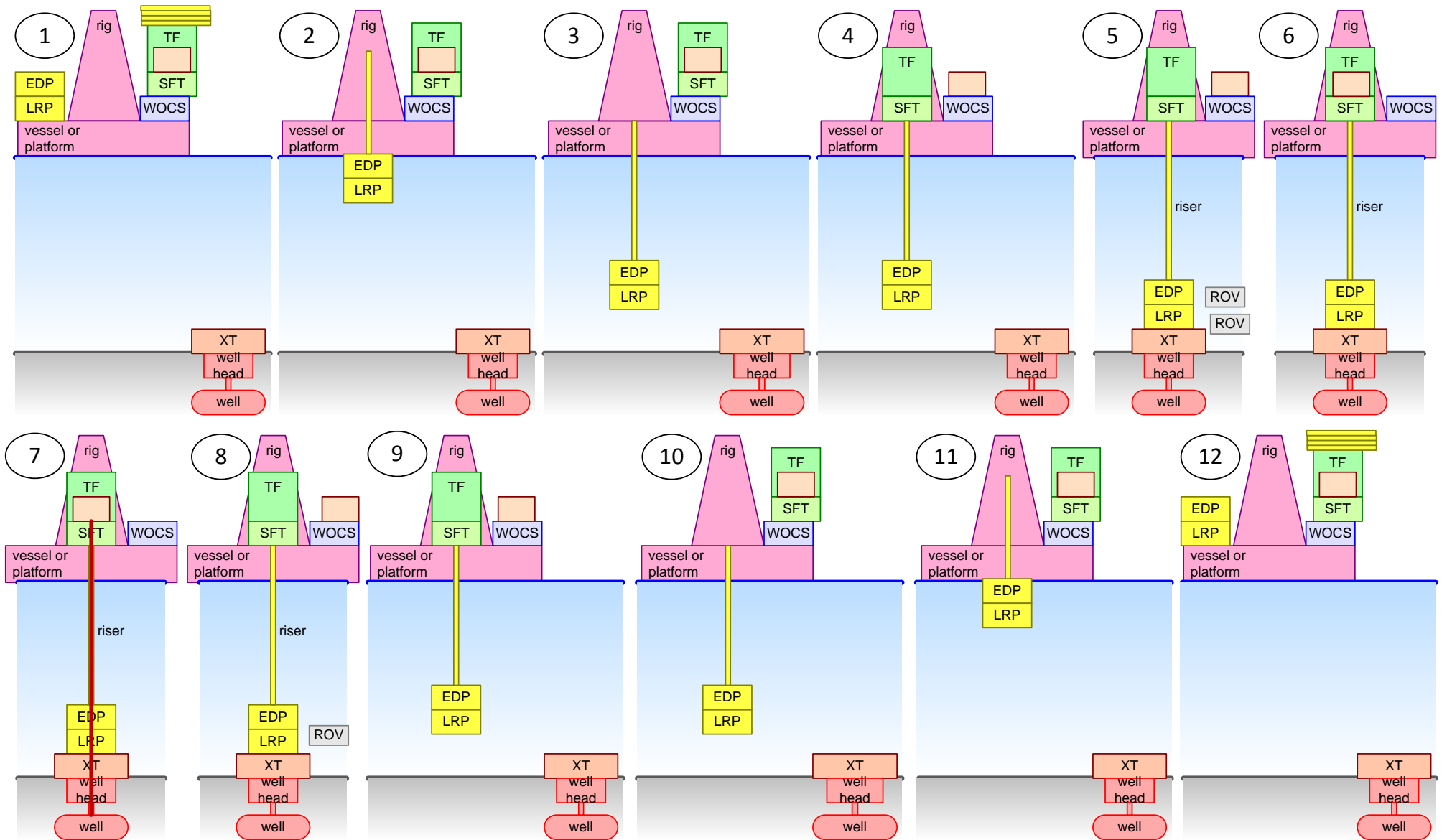
## State Diagram



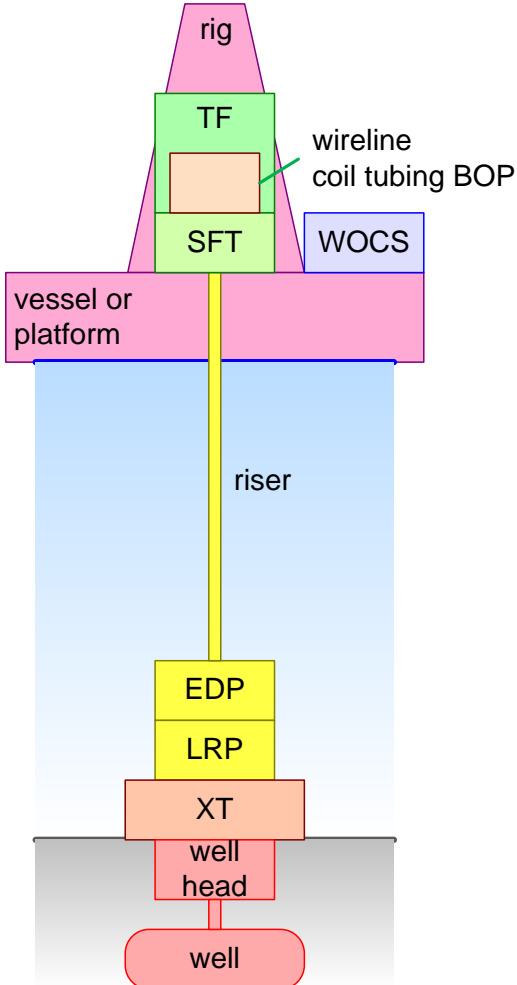
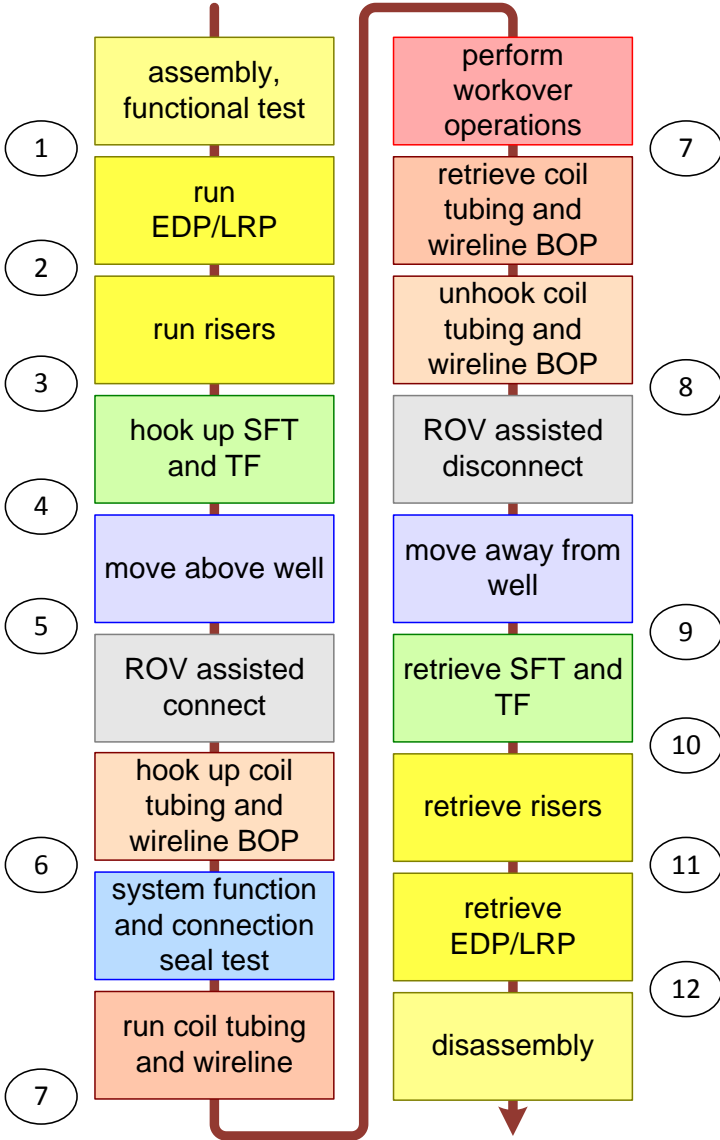
# Example Functional Model of Information Flow



# "Cartoon" Workflow

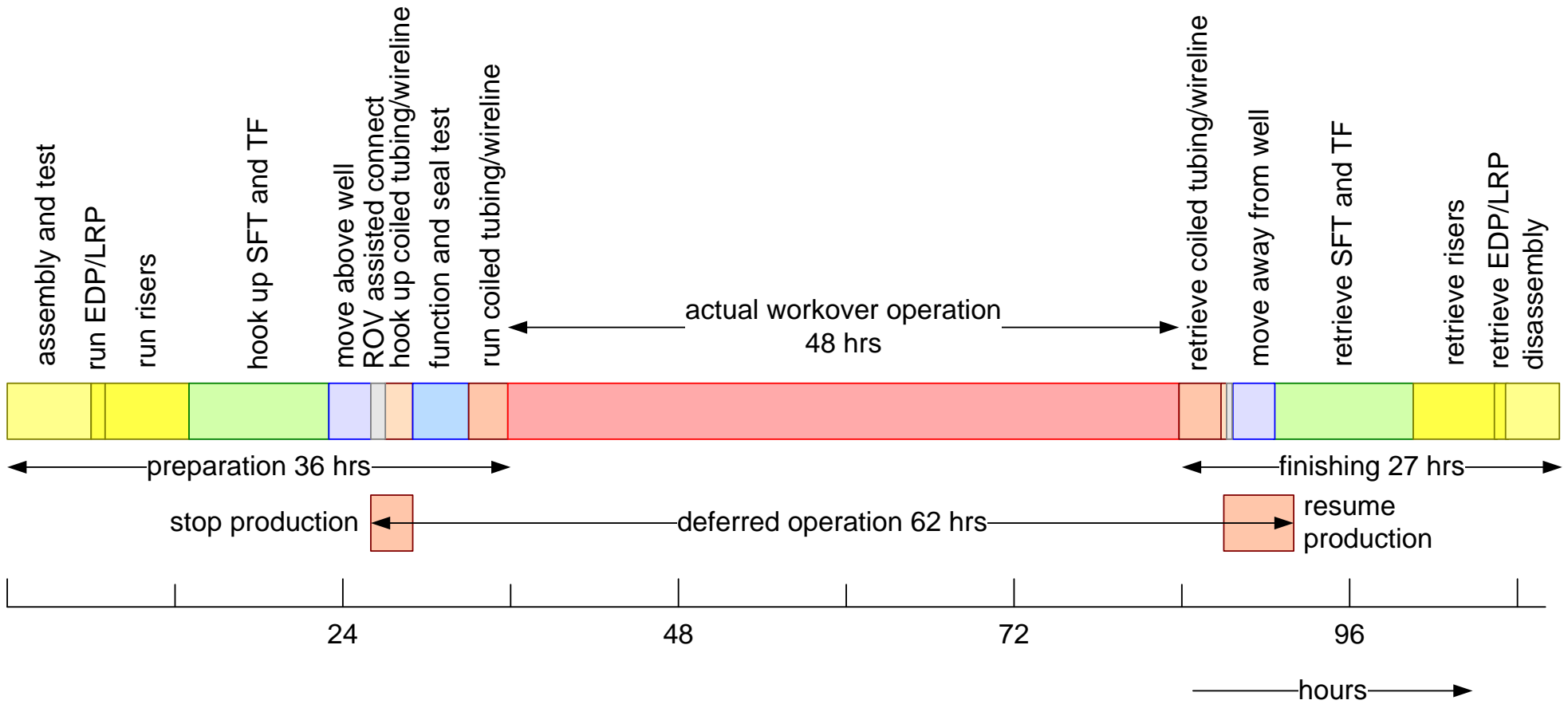


# Workflow as Functional Model

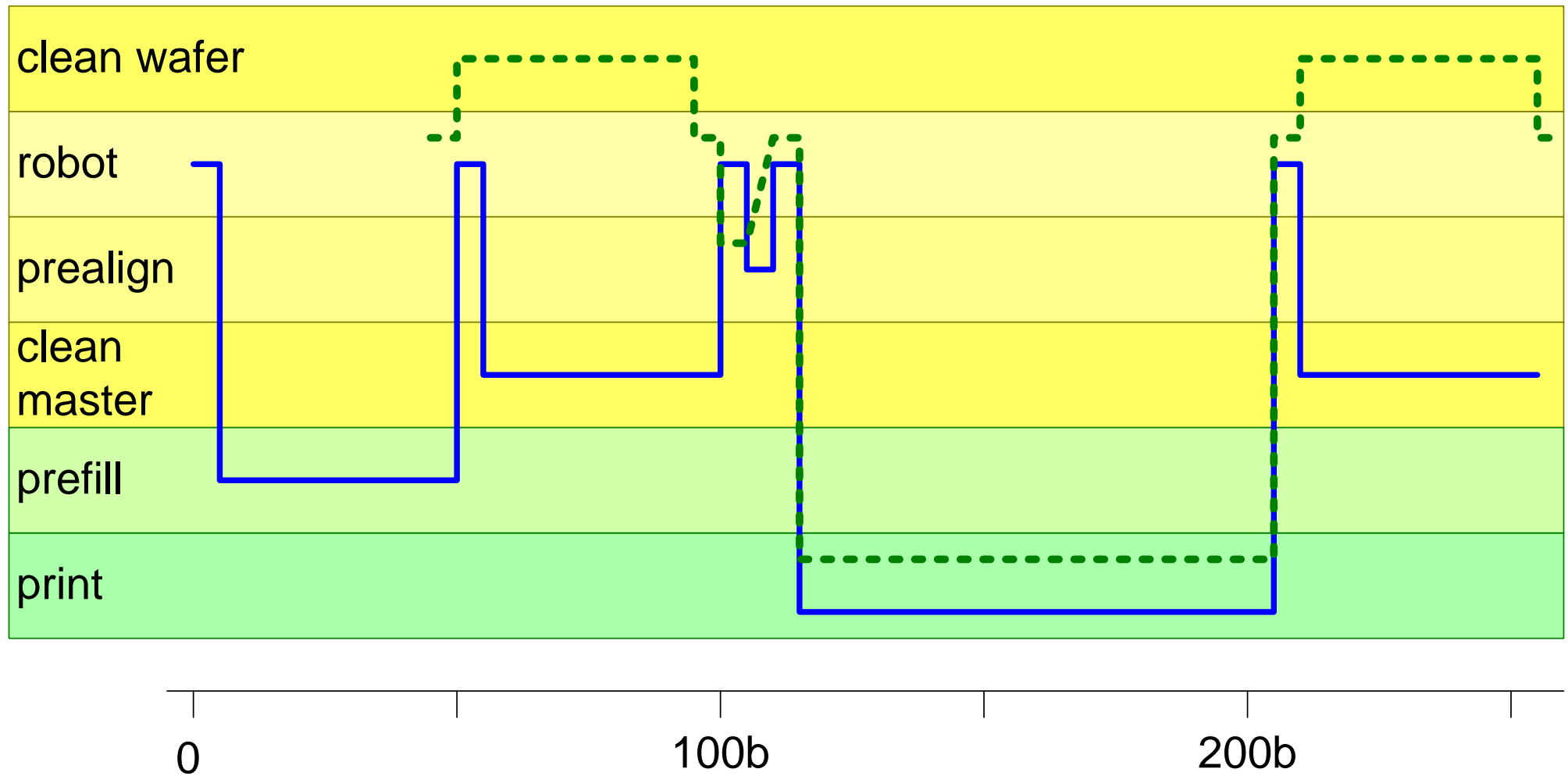


# Workflow as Timeline

*assumptions:*  
 running and retrieving risers: 50m/hr  
 running and retrieving coiled tubing/wireline: 100m/hr  
 depth: 300m



# Swimming Lane Example

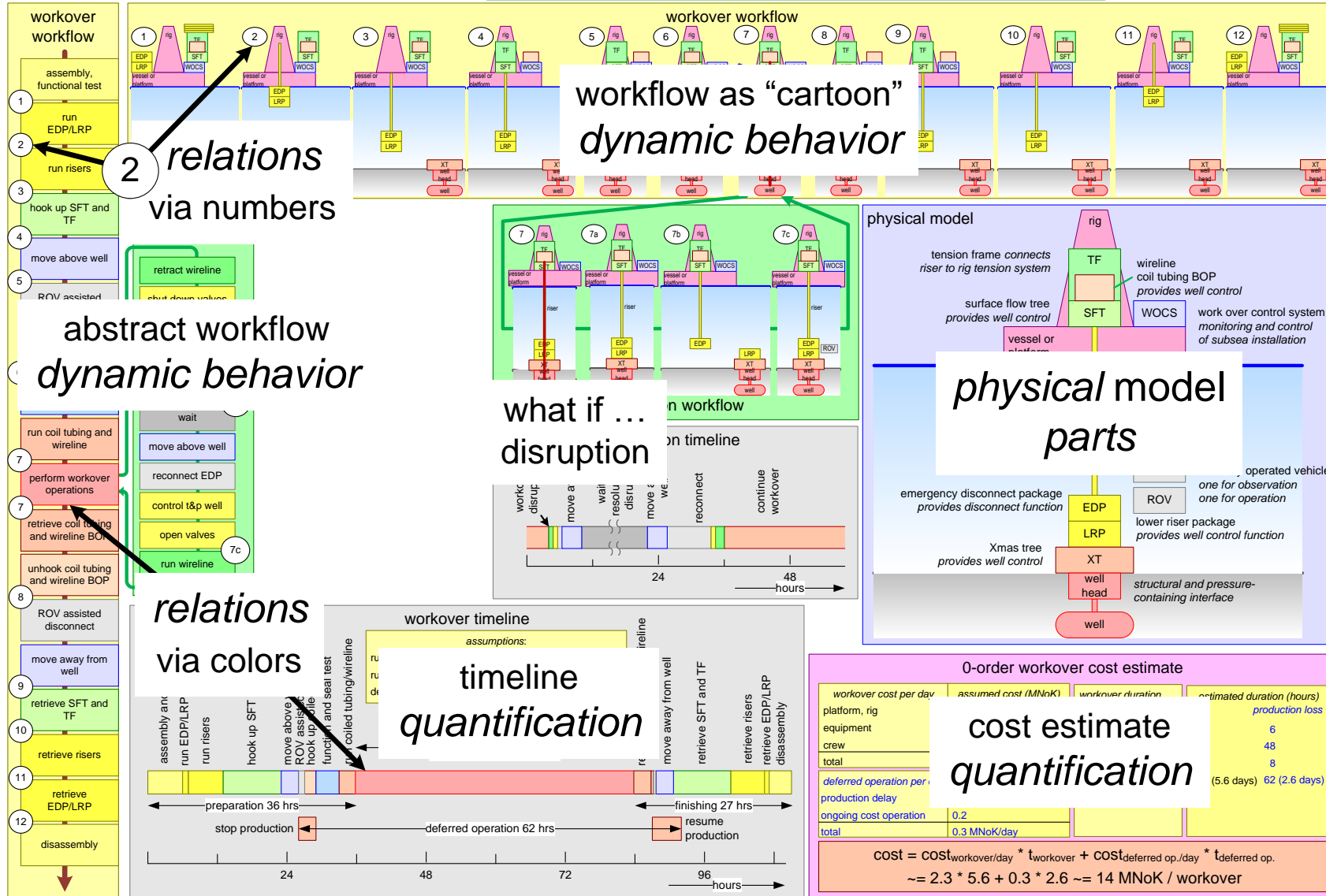


# Combining physical, dynamic behavior, and qualities

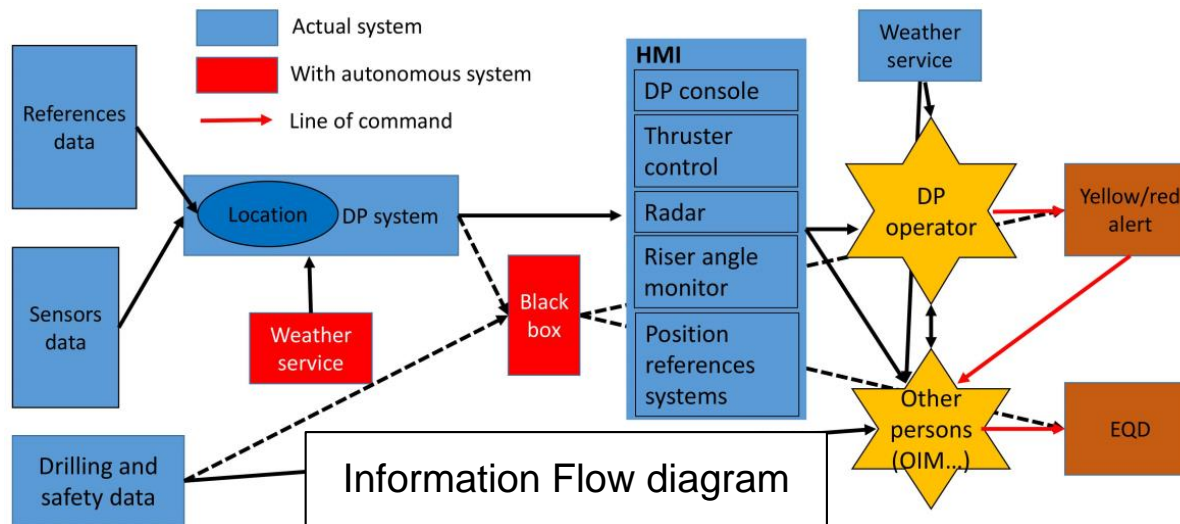
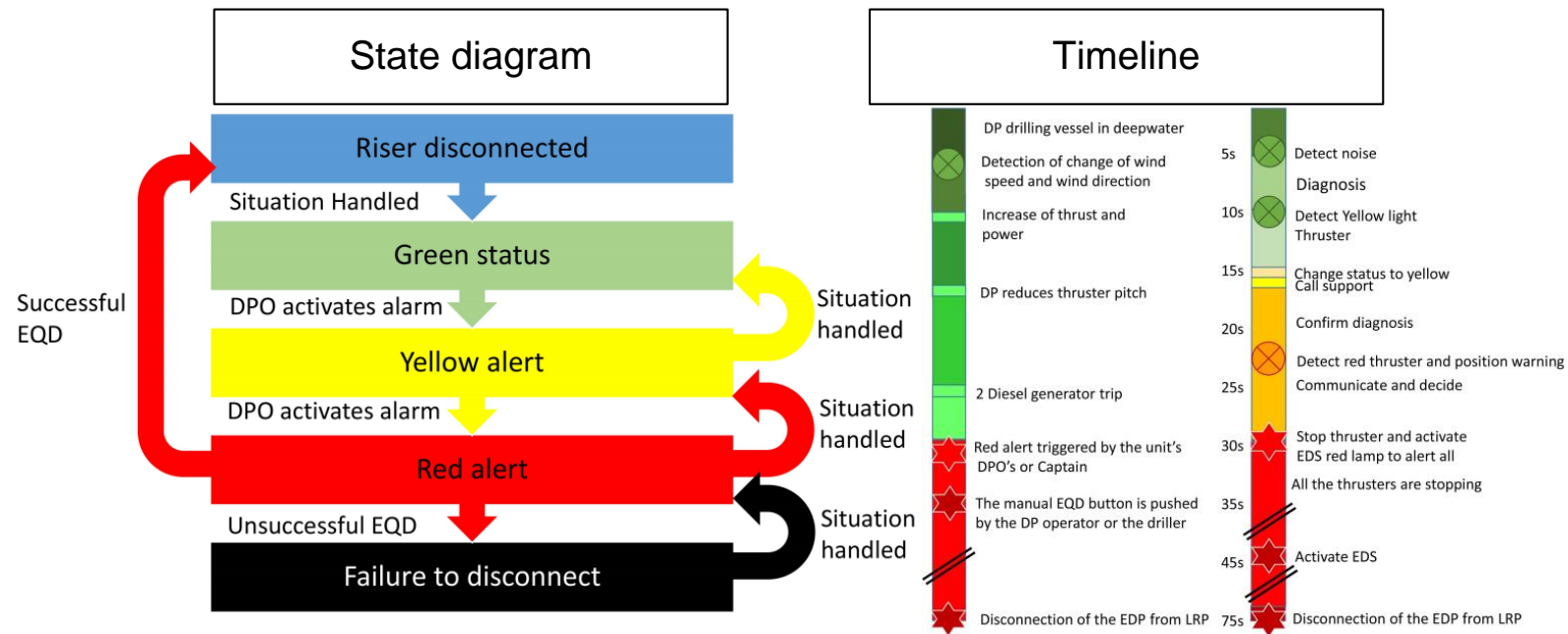
Workover operation; architecture overview

This A3 based on the work of SEMA participants: Martin Moberg<sup>1</sup>, Tormod Strand<sup>2</sup>, Vazgen Karlsen<sup>3</sup>, and Damien Wee<sup>4</sup>, and the master project paper by Dag Jostein Klever<sup>5</sup>.<sup>6</sup> Aker Solutions, FMC Technologies

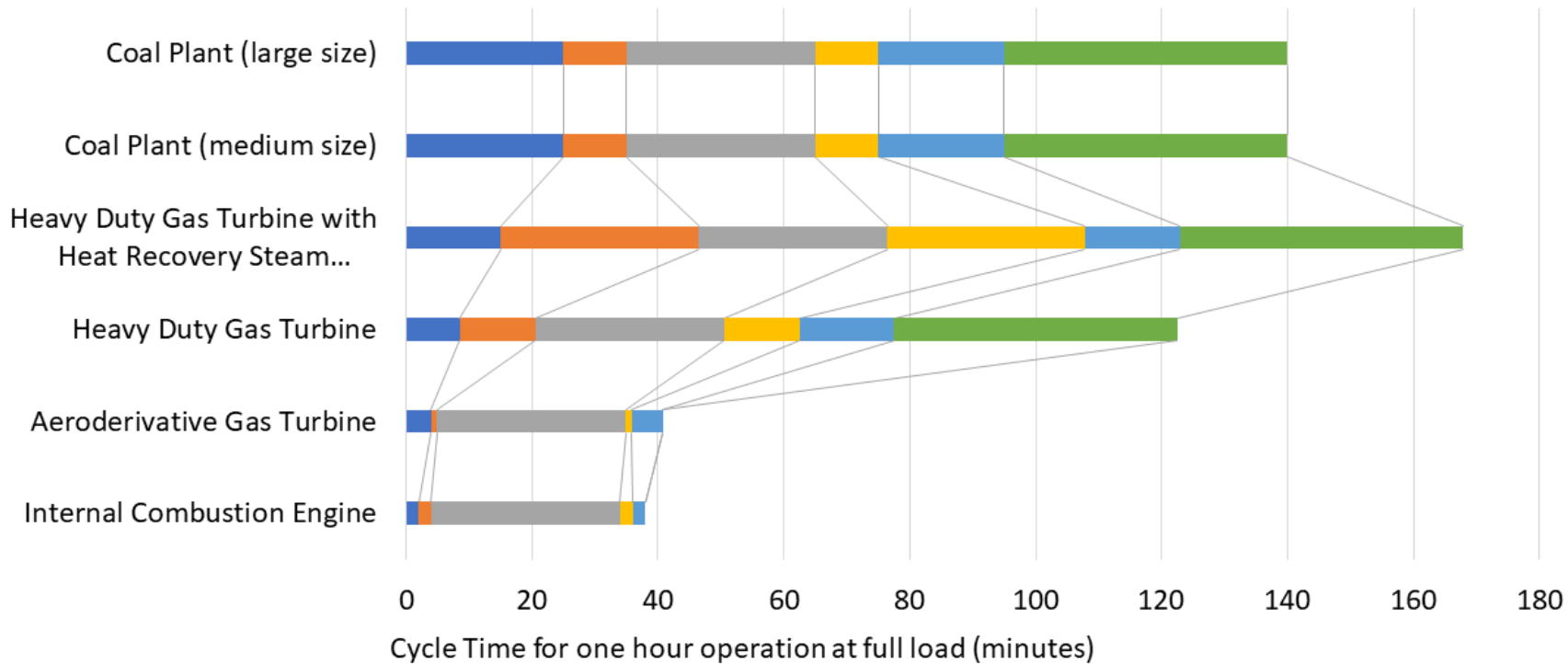
version 2.2 Gerrit Muller



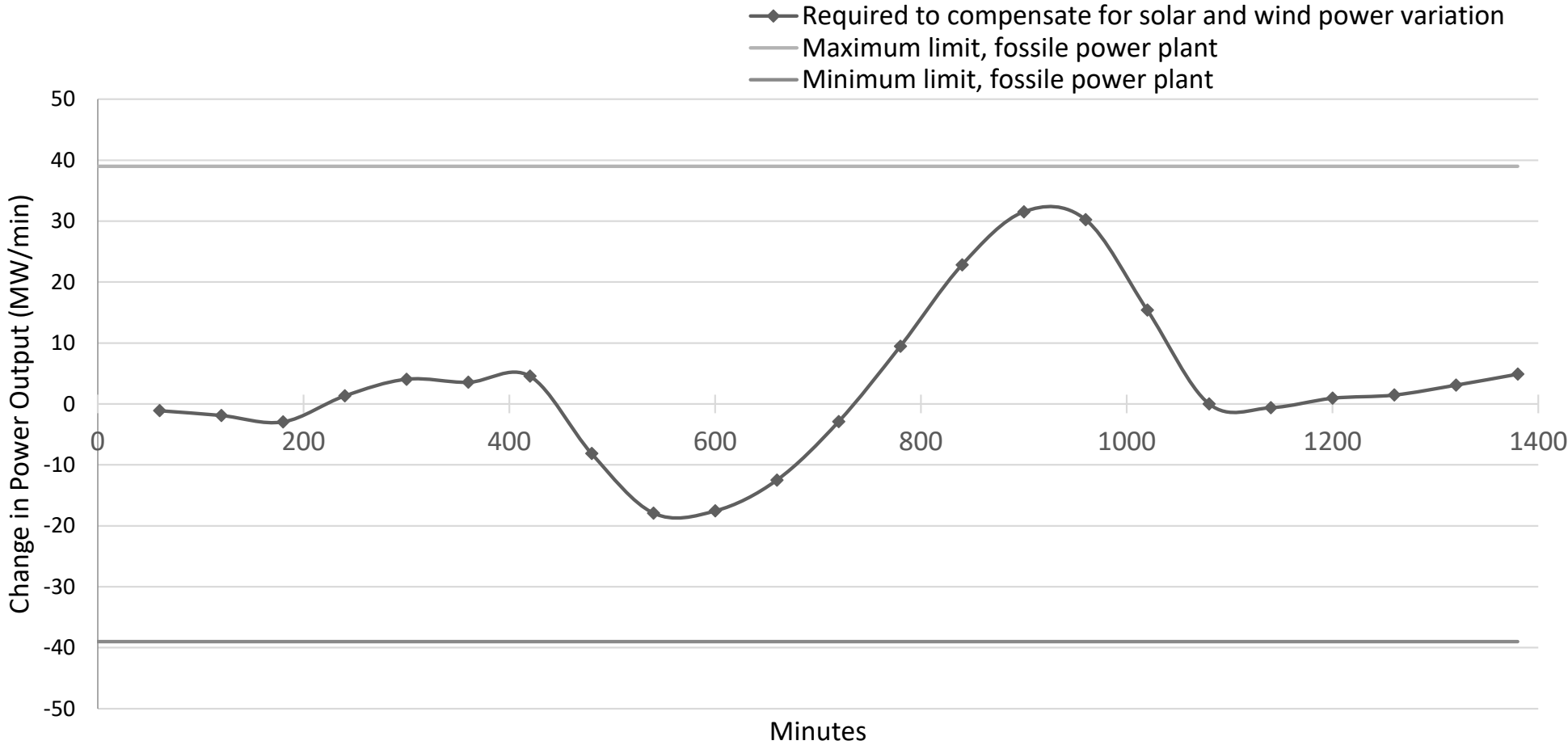
# Emergency Disconnect System



# Example Cycle Time Power Generators



# Example Timeline Power Demand



Our case studies identified **common challenges** associated with **integrating independent systems**:

- **Understand** the impact on the **workflow** (how to handle) and the **impact on time and cost** with workflow disruptions.
- Compare impact on **installation sequence** and means for various concepts.
- Evaluate obstacles in **information flow** in emergency systems that **interact with human beings**.
- **Understand technical constraints** in existing technologies when interfacing new technologies.