



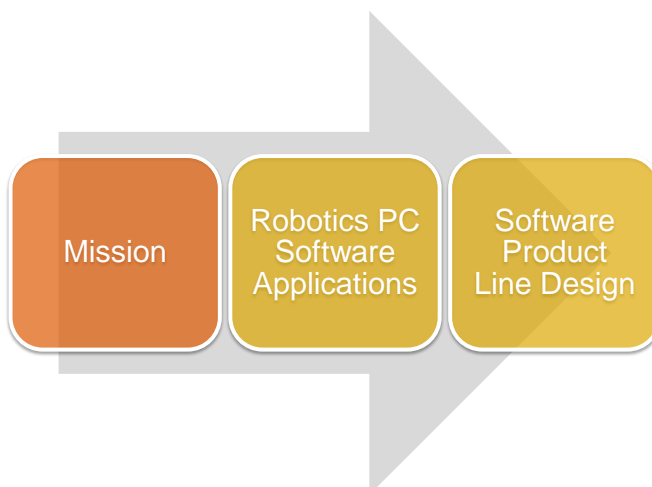
Roland Weiss, Jens Doppelhamer, Heiko Koziolk: Industrial Software Systems, ABB Corporate Research Germany

## Bottom-Up Software Product Line Design A Case Study Emphasizing the Need for Stakeholder Commitment

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for a better world™ **ABB**

## Bottom-Up Software Product Line Design Outline



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**ABB** is not a software company, but...



## ABB Robotics Application Domains ... more than 10 different domains



Spot Welding



Arc Welding



Painting/Coating



Cutting



Press Tending



Finishing



Material Handling



Machine Tending

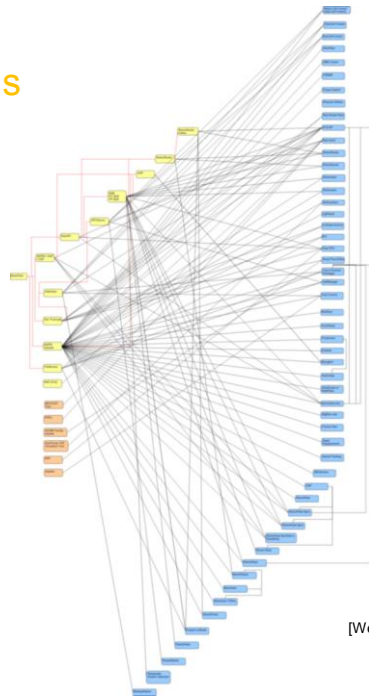
## ABB Robotics Software ... more than 100 applications



VxWorks



**1 - 2500 KLOC  
per Application**

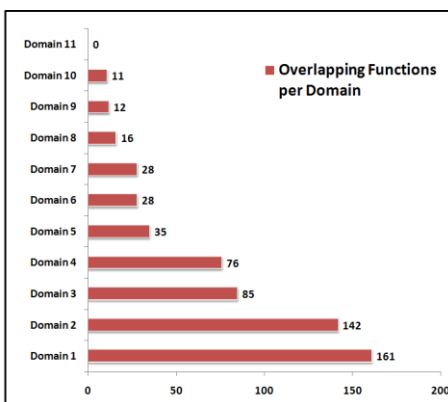
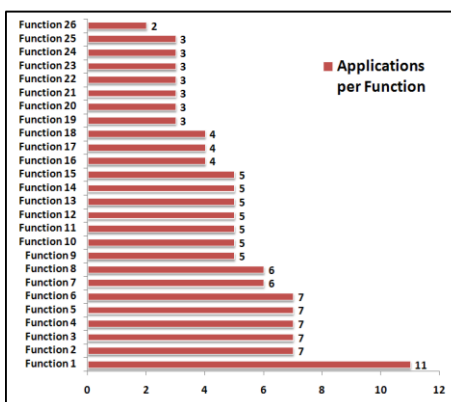


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## ABB Robotics Software Functional Overlap



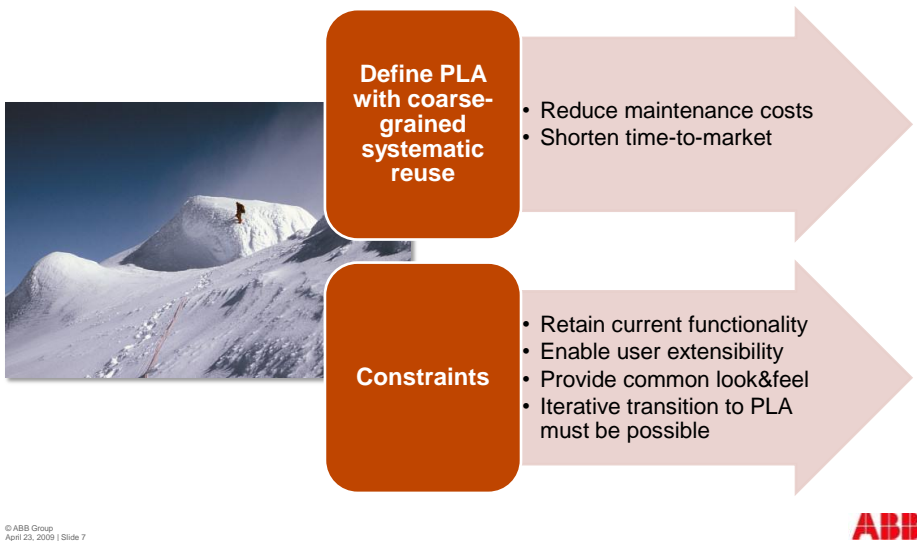
### Example functions

- Operation monitoring
- Alarm & event handling
- Production scheduling

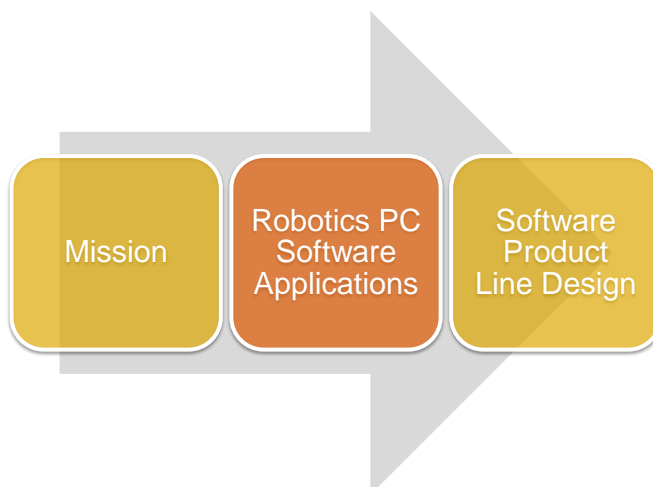
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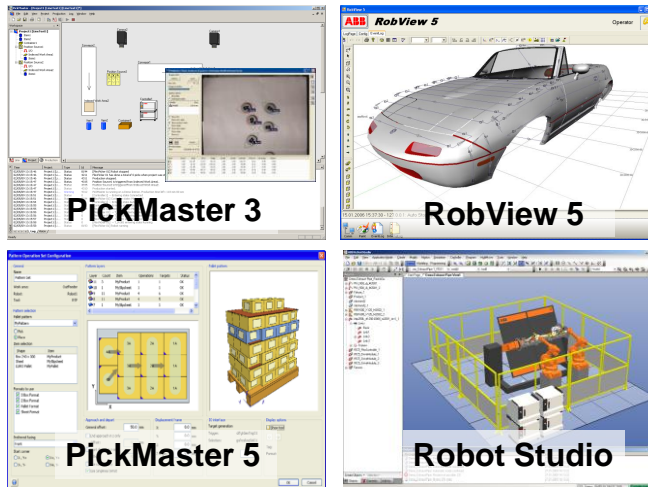
## The Mission



## Software Product Line Engineering for ABB Robotics Outline



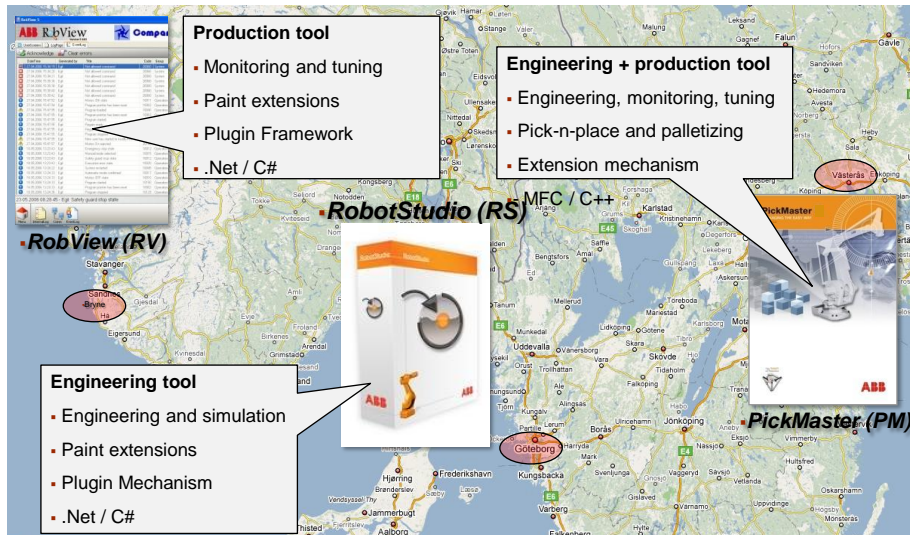
## ABB Robotics PC Applications Product Line Scope



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## ABB Robotics PC Applications Distributed Teams



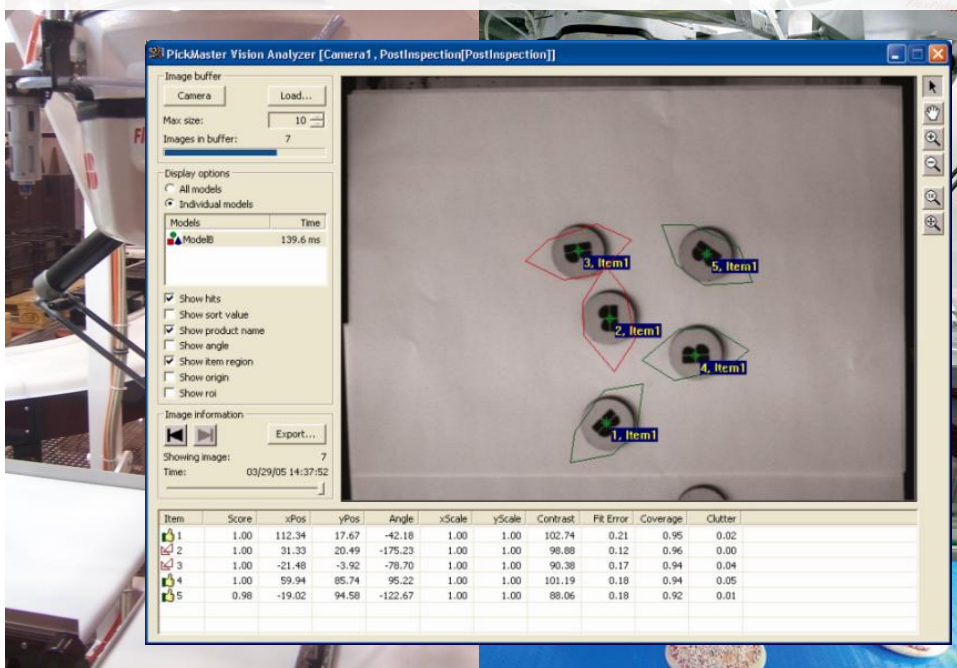
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## Painting: RobView 5

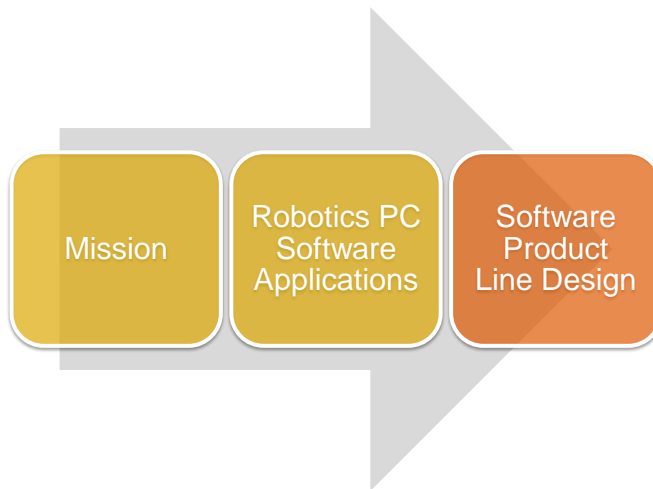


## Pick&Place: PickMaster 3



# Software Product Line Engineering for ABB Robotics

## Outline



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## Design PLA

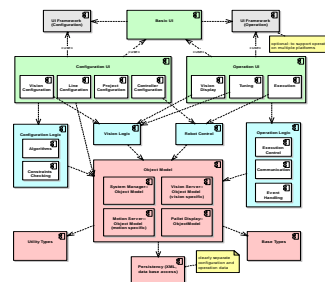
### Starting point

## Architecture documentation

- Available for 2 products
- Sketches available for 1 product
- Not available for 1 product

## To fill gaps...

- Stakeholder interviews were executed
- Manual and automated code inspection was performed



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## Design PLA Approach

### Elicit requirements

- Key architectural drivers
  - Composability: reuse and quality
  - Maintainability: less costs in distributed locations
  - Performance: production part 24/7



### Domain engineering

- Find coarse components for composition
- Harmonize different domains



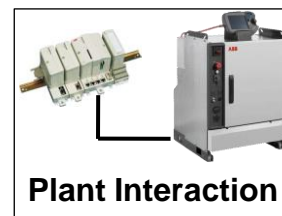
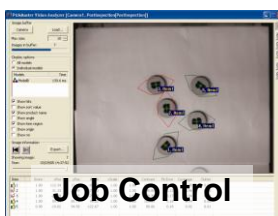
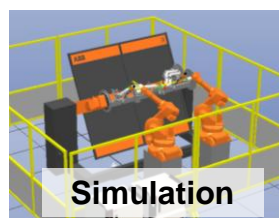
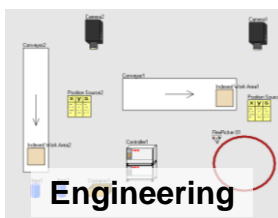
### Attribute driven design

- Mapping of functionality to components satisfying key drivers
- 2-3 iterations done, based on complexity and priority
- Tight coordination with chief architects of single products

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## Domain Engineering Common Functionalities

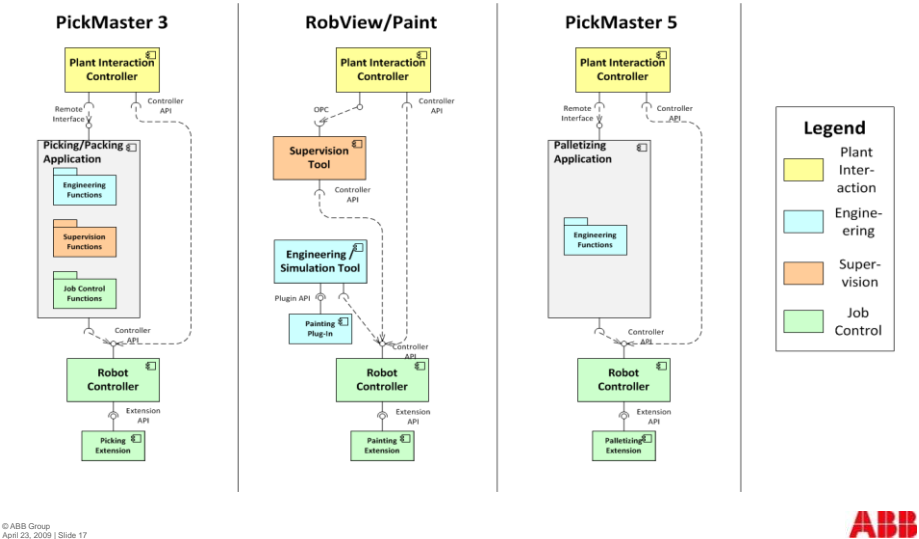


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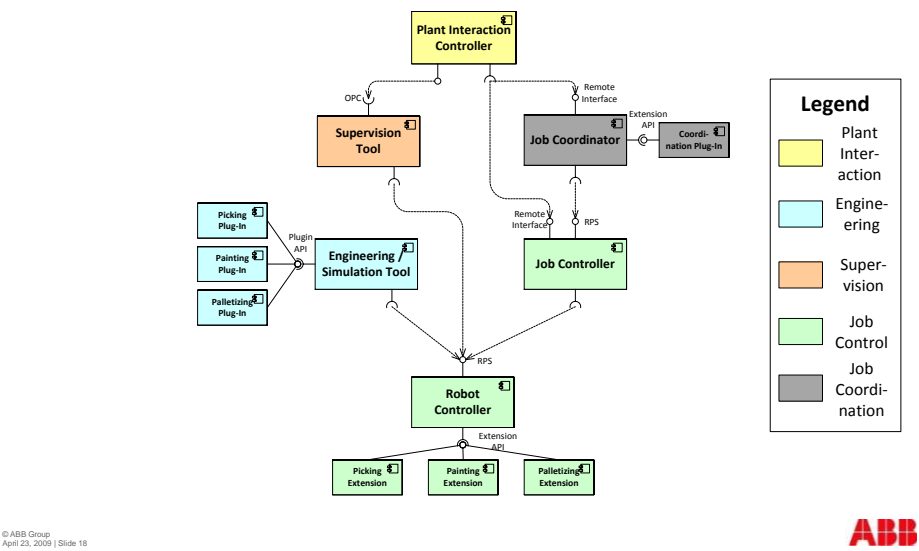
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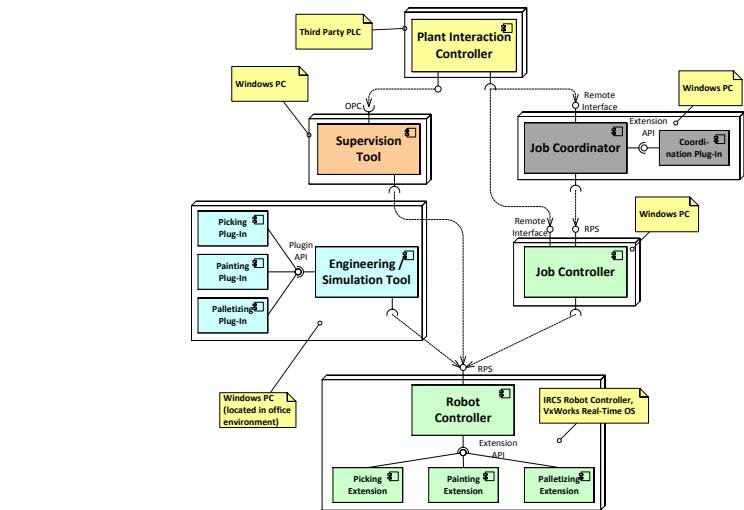
# Mapping Functionalities to Existing Applications Old, High-Level Software Architectures



# New Product-Line Design Component & Connector View



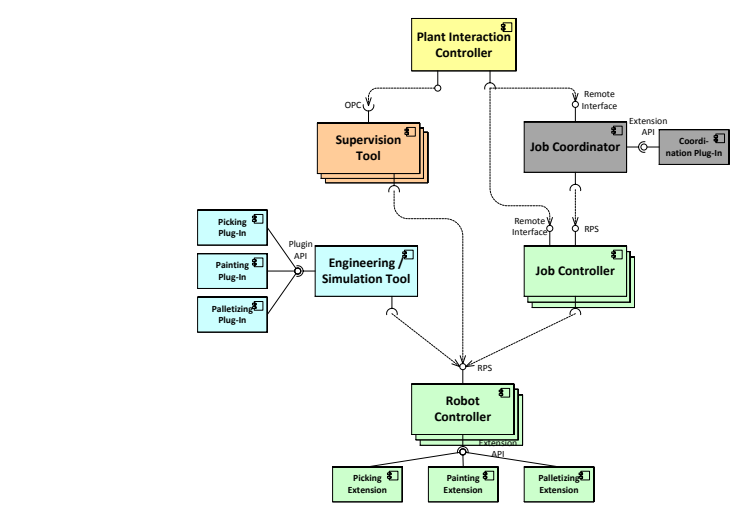
# Product-Line Design Deployment View



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# Product-Line Design Multiplicity View



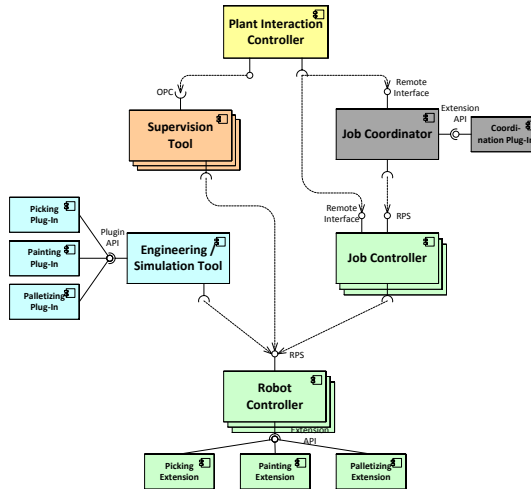
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## Product-Line Design Quality Attributes



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## Observations & Lessons Learned



- A **survey** of existing products and user customizations is essential
- Using iterative **Attribute-Driven Design (ADD)** was beneficial to confirm and establish the PLA
- **Unifying some concepts** within the different products gave all parties a better understanding of the application domain
- The **emotional bindings** towards their established products, was an obstacle to get their commitment → facilitate dialog
- With **multiple stakeholders**, the architecture proposal needed more argumentation and an iterative approach. A **champion** advocating the benefits of a PLA can speed-up the design process and adoption.
- It is mandatory to have **commitment** for the target PLA from stakeholders to start planning migration activities and detailed design: avoid obsolete work.

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## Next Steps

- **Execute iterative transformation of independent products into PLA**
- First iteration planned to start summer 2009



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