

## ESP-net meeting

# Introducing product line architecture in product development

**Date** 24-09-08  
**Talk** 3:00PM at 4A14  
**Workshop** 4:30PM at 4A22

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# Introducing product line architecture in product development

## Abstract

In prior research, designing product line architecture has been widely focused on technically embedded systems, in which requirements are constrained by hardware specifications and can be elicited beforehand. In contrast, in *socially embedded systems*, design decisions have to support intensive tailored and interactive uses.

This talk presents an empirical study of transition steps from a single product development to *a product line development* of socially embedded systems.

Key aspects like observing business context, use context, software engineering organisation, software engineering practice, technical infrastructure, and technical selection are addressed.

In order to reach a product line approach, *software architecture awareness* should be introduced in the development organisation's work practices. This study also shows an impact on the organisation, when introducing a product line approach.

## Outlines

- Introduction
  - Software product line
  - Software architecture awareness
  - Socially embedded systems
- Empirical study
  - Introducing product line architecture thinking at DHI

## Software product line

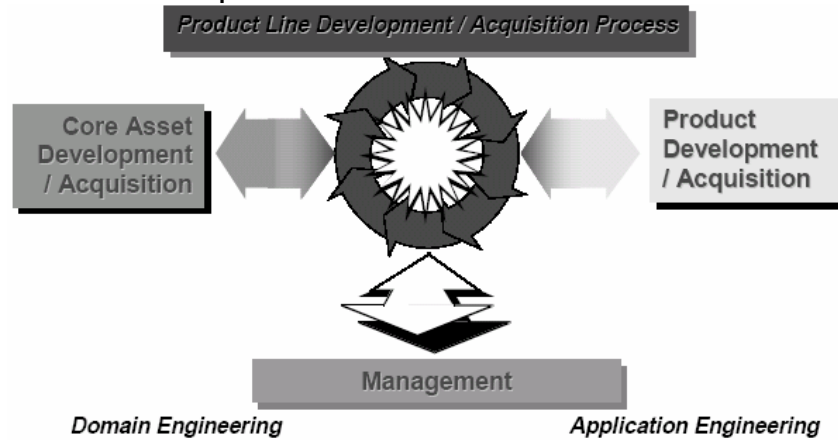
@SEI

- Definition:
  - A software product line (SPL) is a set of software-intensive systems that *share a common, managed set of features* satisfying the specific needs of a particular market segment or mission and that are developed from *a common set of core assets* in a prescribed way.
- How about software reuse? Why are product lines different?

## Software product line

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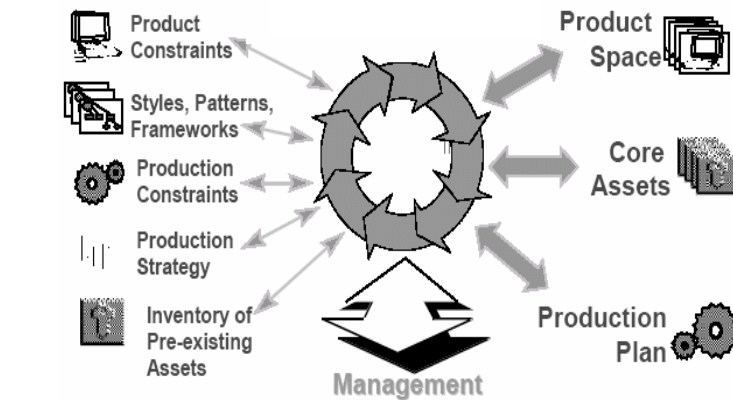
- Essential product line activities



## Software product line

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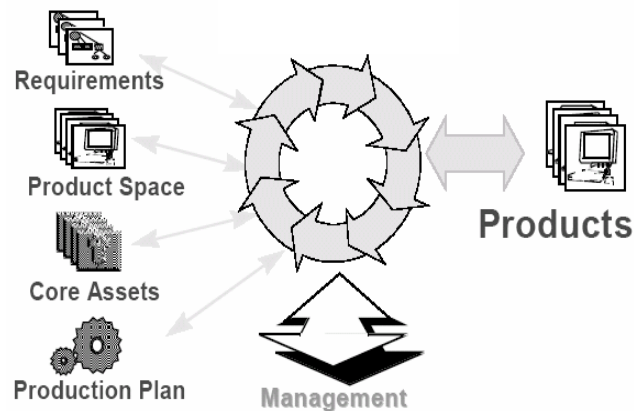
- Essential product line activities
  - Core Asset Development /Acquisition



## Software product line

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- Essential product line activities
  - Product Developments /Acquisition



## Software product line

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- Essential product line activities
  - Management
    - To provide resources, coordinate, and supervise.
    - Organisation management, organisation structure, and organisational risk management.
    - Building and communicating a business case.
    - Customer and supplier interface management.
    - Technology forecasting.
    - To create adoption plan.
    - Operations and executions.
    - To act or find and empower "a product line champion".

## Software architecture awareness

- Software architecture
  - The structure or structures of the system, which comprise software components, the externally visible properties of these components, and the relationships among them [Bass98].
- Awareness
  - an ability to be conscious of, feel or perceive.
- Software architecture as a tool for communication.

## Software architecture awareness

- Phases of awareness
  - Analysis and design
  - Development and test
  - Production and operation
- Raising architecture awareness
  1. Understand
  2. Explain
  3. Discuss
  4. Plan

## Socially embedded systems

- Definition
  - Systems aiming at promoting conditions for use of the systems oriented to environment and practices of end-users that often design decisions have to support intensive tailored and interactive uses.
- S-, P-, E-Programs [Lehman80].
- Use-oriented development [Floyd89].
  - STEPS
- Examples
  - An ERP system
  - An e-gov application
  - A virtual office software
  - A decision support systems



## Introducing product line architecture thinking at DHI

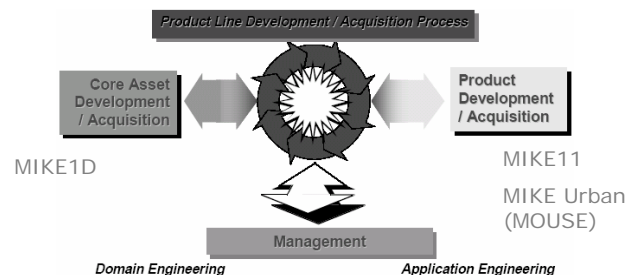
- DHI case description
- Product line architecture
- Key aspects
- Examples: MIKE11 re-engineering, Merging MIKE11 and MOUSE, MIKE1D project

## Introducing product line architecture thinking at DHI

- DHI case description
  - Independent research and consultancy in the fields of water, environment and health.
  - Release 15 water modelling software products in the areas of marine, urban, and water resources.
  - Provide training and consulting services.
  - More than 750 employees, based in more than 25 countries worldwide.

## Introducing product line architecture thinking at DHI

- Product line architecture
  - A single specification capturing the overall architectures of a series of closely related products [Muccini & van der Hoek03].

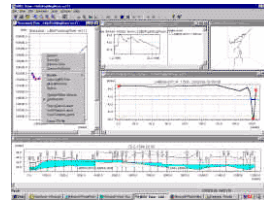


## Introducing product line architecture thinking at DHI

- Key aspects
  - Business context
  - Use context
  - Software engineering organisation
  - Software engineering practice
  - Technical infrastructure
  - Technical selection

## Introducing product line architecture thinking at DHI

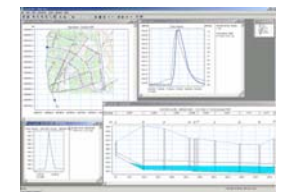
- Re-engineering MIKE11
  - **MIKE11** is a simulation software product for *river* modelling in **one dimension**.
  - **Application areas:** flood analysis and alleviation design, real-time flood forecasting, dam break analysis, etc.



- Business context
- Use context
- SE organisation
- SE practice
- Technical infrastructure
- Technical selection

## Introducing product line architecture thinking at DHI

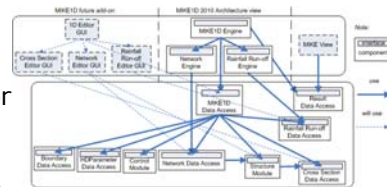
- Merging MIKE11 and MOUSE
  - **MOUSE** is, the short name of **MODEL** for **Urban SEwers**, a software that models collection system for *urban* wastewater and stormwater.
  - **MOUSE** is the first micro-computer based software product in DHI, launched in 1985.
  - **Application areas:** urban drainage systems modelling, real-time flood forecasting, hydrology etc.



- Business context
- SE organisation
- SE practice
- Technical infrastructure
- Technical selection
- Use context

## Introducing product line architecture thinking at DHI

- MIKE1D project
  - **MIKE 1D** is a professional engineering software tool for simulating flow and water level, water quality and sediment transport in *rivers*, irrigation canals, reservoirs, *urban* drainage, sewer systems and other inland water bodies.
  - **Application areas:** MIKE11, MIKE Urban (MOUSE)

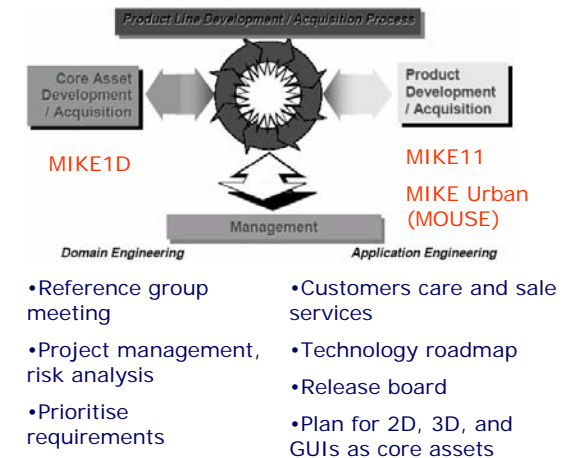


- Use context
- Business context
- SE organisation
- SE practice
- Technical infrastructure
- Technical selection

## Introducing product line architecture thinking at DHI

- Product line activities at DHI

- Maintain the existing core functionalities
- Underlying components: EUM, TSO, OpenMI
- License library, license system
- Top down approach
- Reuse optimised equations
- Cleaning up, re-structure, create new modules/components



- Reference group meeting
- Project management, risk analysis
- Prioritise requirements

- Customers care and sale services
- Technology roadmap
- Release board
- Plan for 2D, 3D, and GUIs as core assets

## First conclusions and Further steps

- Organisation matters in developing product line architecture.
- Management is a crucial key to a successful software product line.
- Architecture awareness is a tool for product line architecture.
- Socially embedded systems require social interaction among groups of users in evolving the systems.
- Introducing PLA thinking at DHI looks promising.
- Business context, use context, SE organisation, SE practice, technical infrastructure, and technical selection are factors in the evolution of software.

## Q&A

Thank you.

## References

- DHI. URL: <http://www.dhigroup.com/>
- Floyd, C., Reisin, F.-M., and Schmidt, G. *STEPS to software Development with Users*, Proc. 2nd ESEC (1989).
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