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Human-Machine-Interaction

German
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IFS Innovative
Factory Systems

SmartMote – A run-time adaptive universal control device for ambient intelligent production environments

W3C MBUI WG Presentation
9. February 2012 @ DFKI, Kaiserslautern

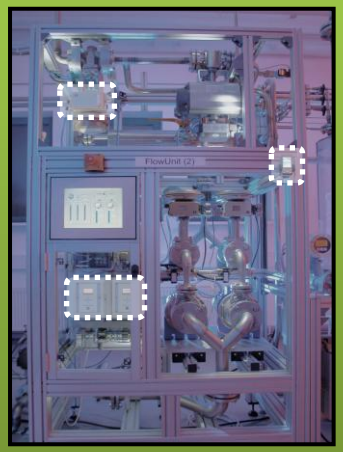
Dipl.-Inf. Marc Seißler
Dr.-Ing. Gerrit Meixner
Dipl.-Inf. Kai Breiner

Agenda

- Mobile Human Computer Interaction in Industrial Environments
- Benefits of Context-Sensitive Systems
- Development Methodology
  - Related Work
  - Shortcomings & Requirements
  - Concept description & Meta-Model Architecture
  - Abstract Modeling Phase
    - The Useware Markup Language (useML)
    - The Useware Dialog Modeling (useDM) Language

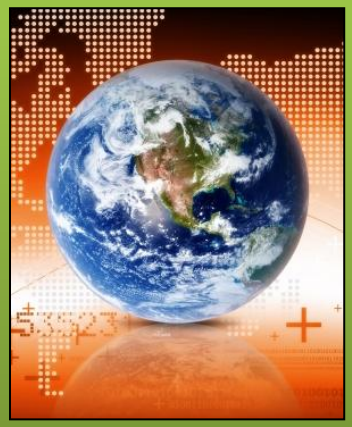
Mobile Human Computing Interaction in Industrial Environments

Improved Accessability



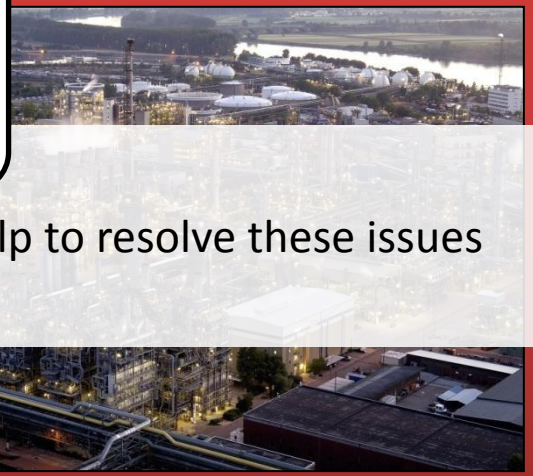
Homogeneous User Interface

Location Independence



Mobile Worker

Safety Critical Interactions



Risk of Information Overload

Interaction Zones: Use of **Context-Information** can help to resolve these issues

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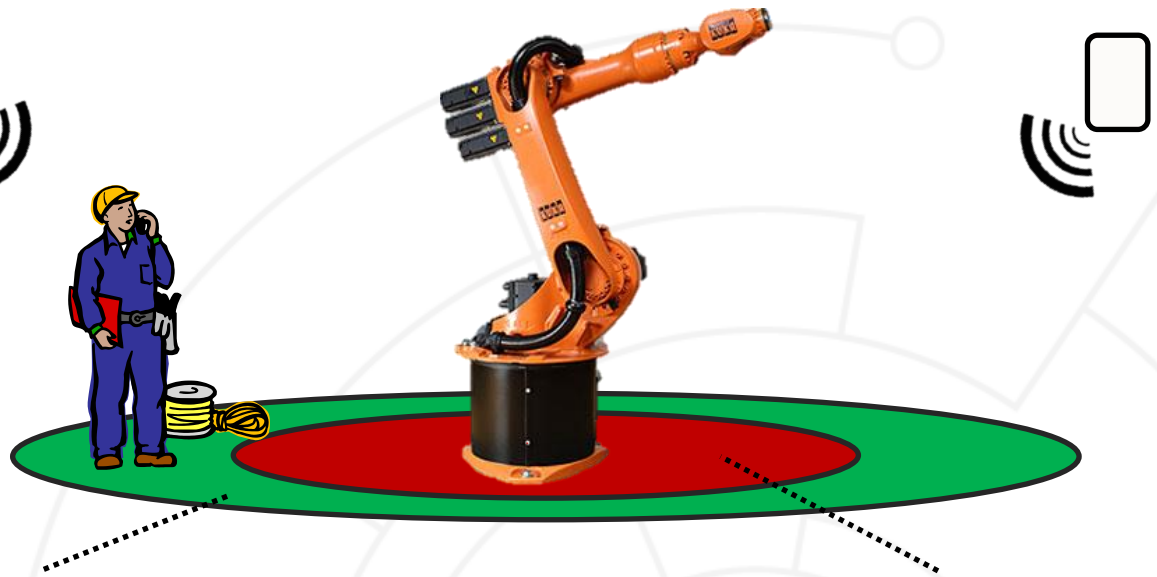
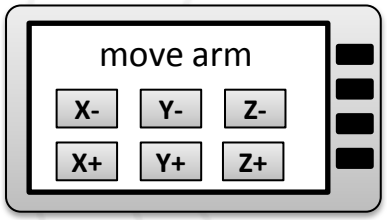
Location-based User Interface Adaptation – Hazardous interactions



1. Track user in environment
2. Match with interaction zones
3. Disable/Enable hazardous functions in interaction device



Universal Interaction Device

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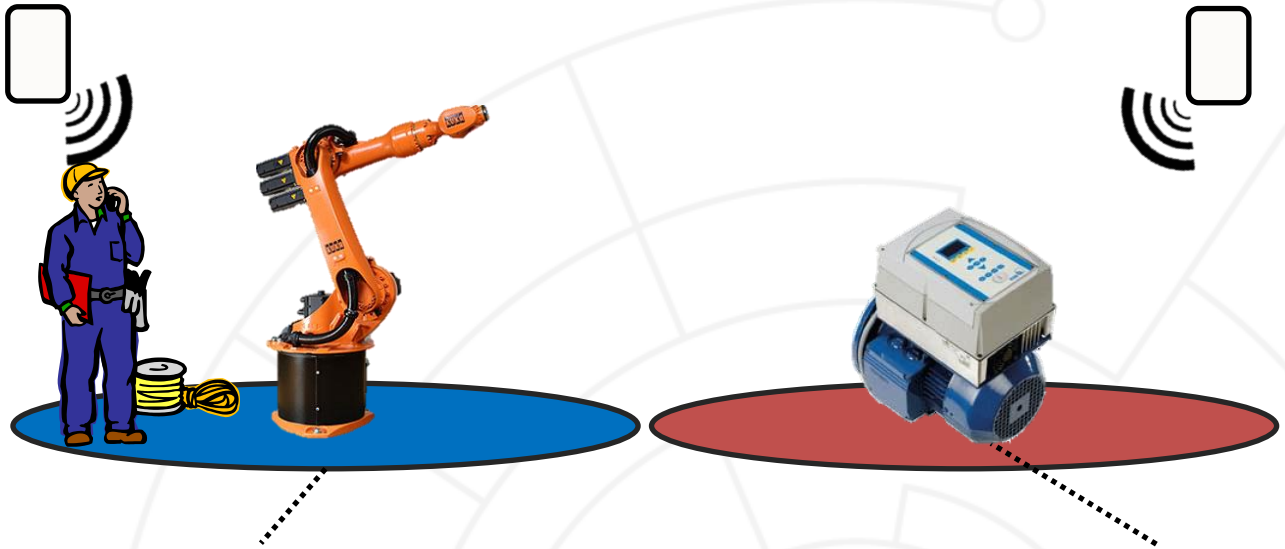
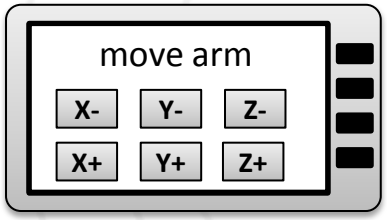
Location-based User Interface Adaptation – Workflow support



1. Track user in environment
2. Match with interaction zones
3. Display device functions



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Development Methodology

Related Work

Promises of MBUID: Use of semi-formal Methodologies to…

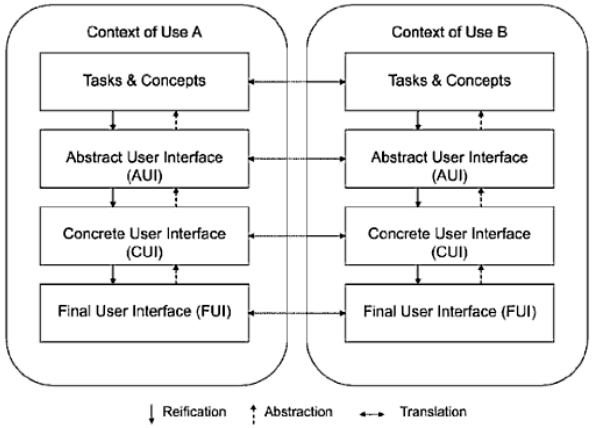
- give different perspectives on UI
- support seamless UI Engineering
- increase reuse and automation in E.-Process
- …

Shortcomings & Observations:

Review of Related Work shows that…

- different **types of models** are used.
- the **models expressiveness** varies.
- there is only **limited tool-support** in early phases.
- automatic generation often results in **unusable User Interfaces**.
- concepts only offer **limited flexibility** and manual intervention.
- **they often do not provide a clear separation of concerns in early phases**
- …

Architectures & Languages



CAMELEON Reference Framework

Dygimes **MASP** **TERESA**

Useware Architecture

UsiXML **MARIA**

Universal Remote Console

…

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Requirements

Methodology

- **Explicit Specification** of Task, Context, Dialog, Presentation and Adaption of User Interface!
- Integration of **Backend Functions** in Task Modeling Phase!
- Give Developer **more control in early development phases!**
- Clear separation of concerns:
  - Task Model → Functional Requirements
  - AUI Model → Interaction specification
  - Distinguish between **development time** and **run-time models**

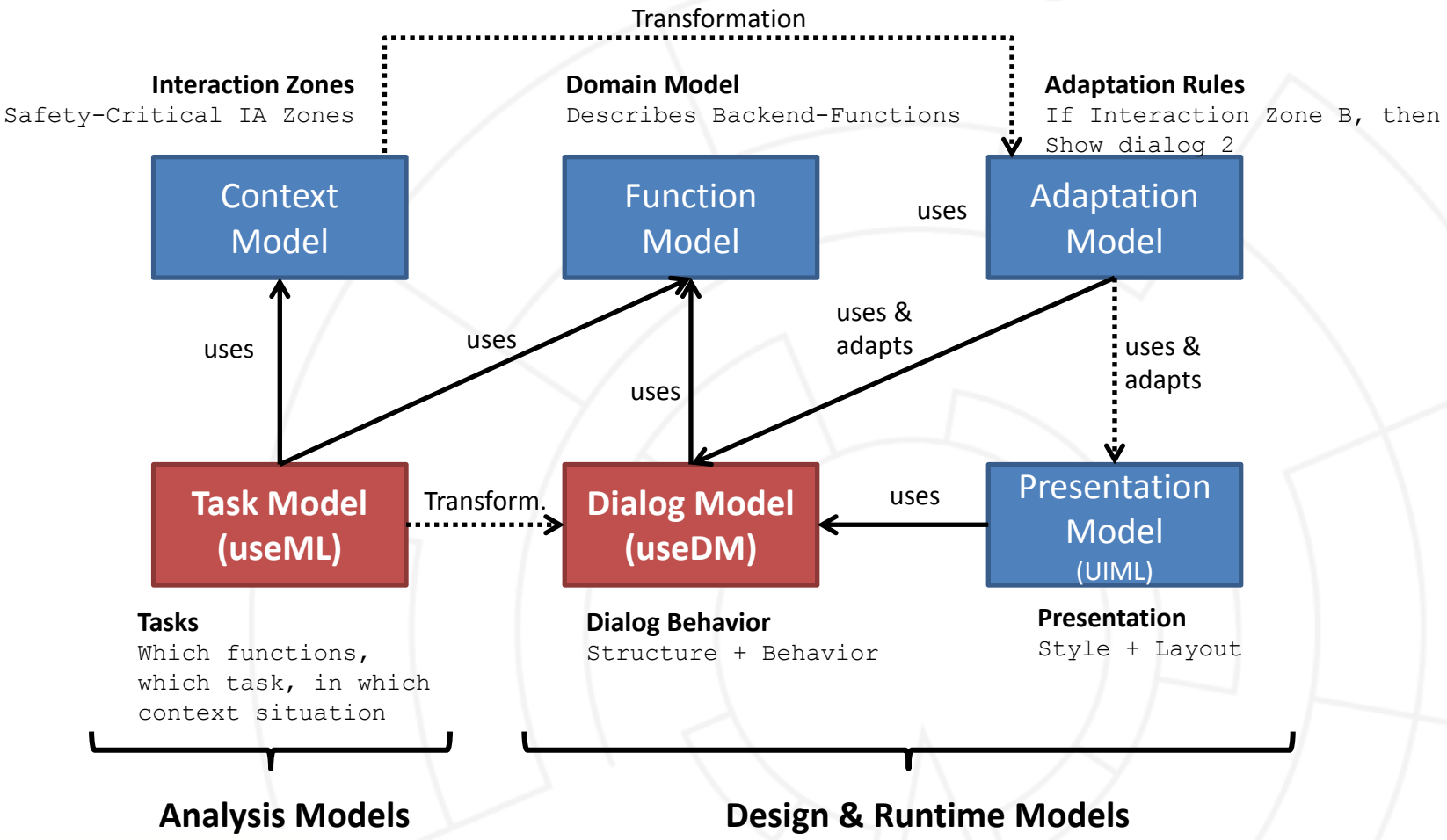
User Interface Description Language(s)

- Use of **Light-weight models!**
- **Avoid redundancies!**
- Provide **clear element mappings!**

Tool-Support

- Support **graphical modeling!**
- Support **interactive model transformation** in early development phases!
- Support **run-time Interpretation**!

SmartMote Meta-Model Architecture



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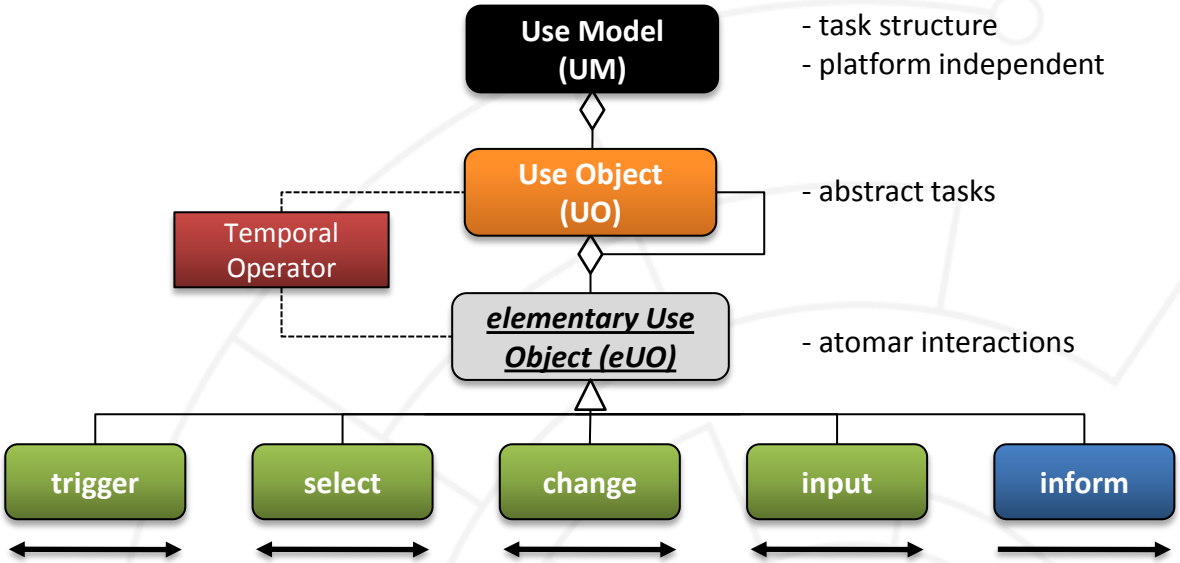
Useware Markup Language 2.0

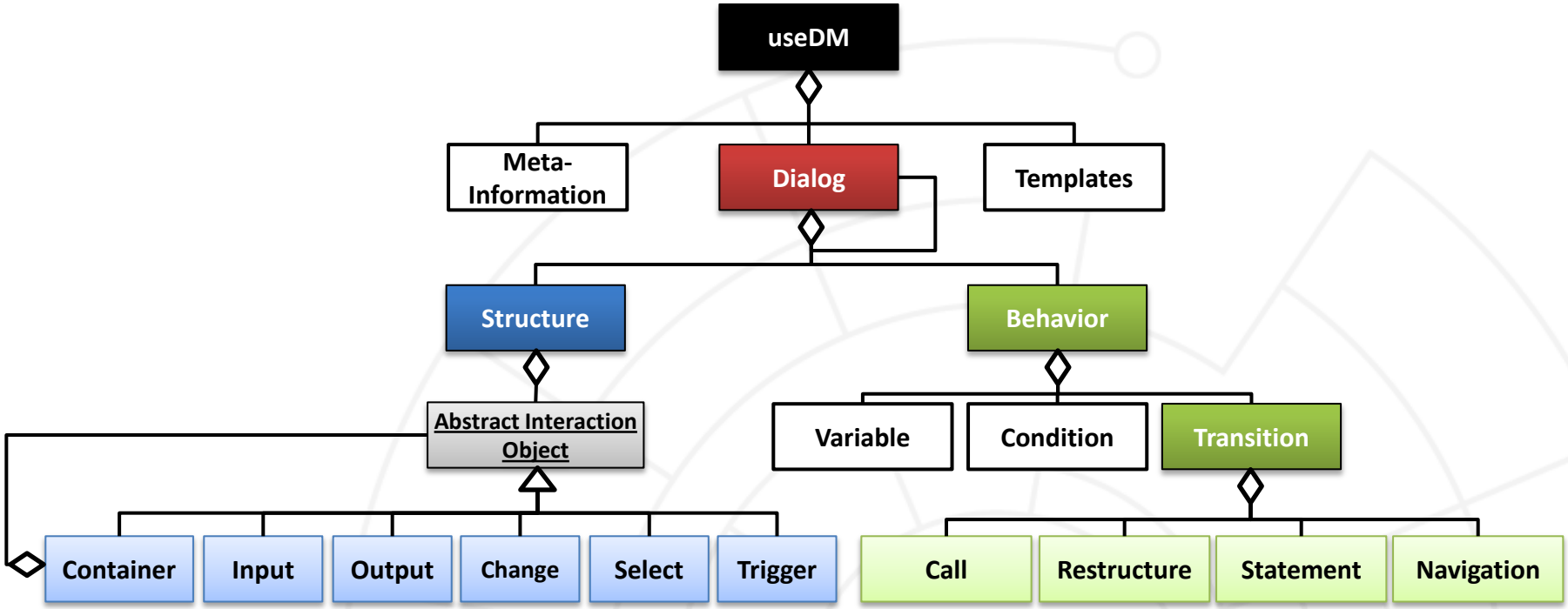


- Different tasks types (e.g. system task, interactive task)
- Elementary use objects → more detailed specification of interactive tasks
- Optionality and Cardinality
- Logical and temporal conditions (pre-conditions, invariants, post-conditions)
- 5 Temporal Operators

\+ **Interface to functional backend**

\+ **Read-/Write Collections**

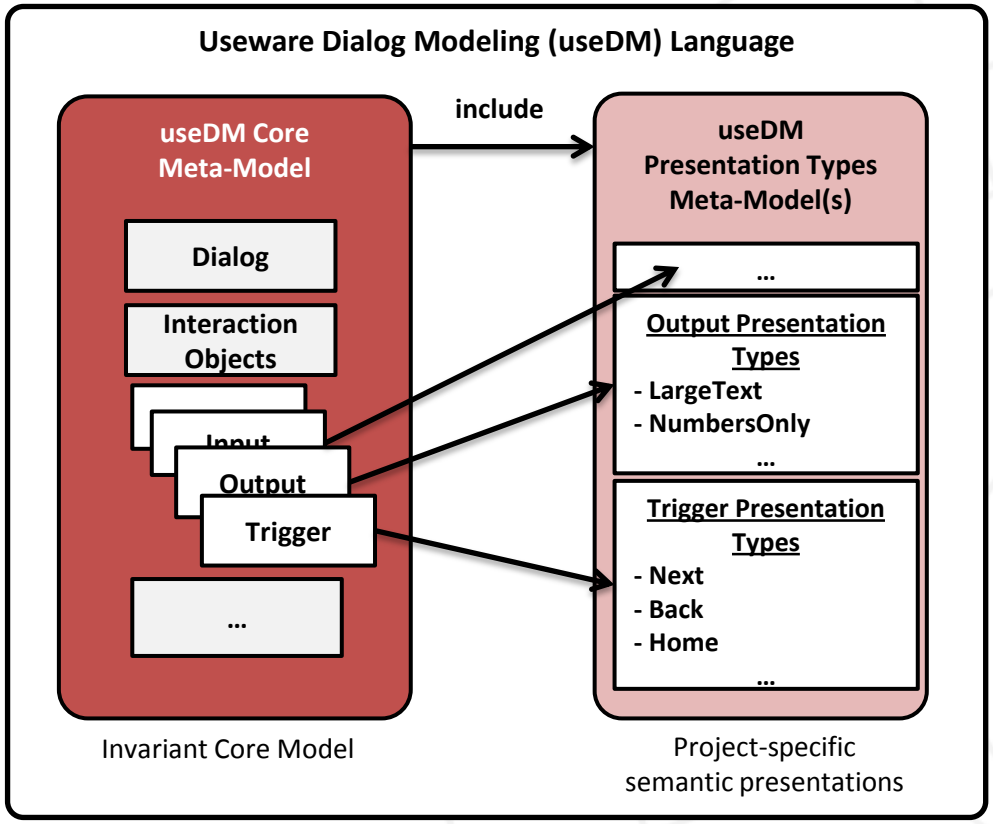
Useware Dialog Modeling (useDM) Core Meta-Model



- Modality-Independent Interactors
- Event-based Behavior Model
- Relative + absolute Navigation descriptions
- Enhanced Reuse concept via templates
- Extensible Presentation Semantics

Useware Dialog Modeling (useDM) Meta-Models

Use of **extendible**, **semantic Selectors**




```
<input id="iEnterSpeed" presentation-type="numberOnly" .../>
```

```
<input id="iEnterSpeed" presentation-type="textOnly" .../>
```

```
<input id="iEnterSpeed" presentation-type="shortText" .../>
```

```
<input id="iEnterSpeed" presentation-type="longText" .../>
```

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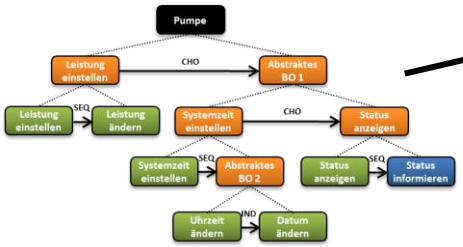
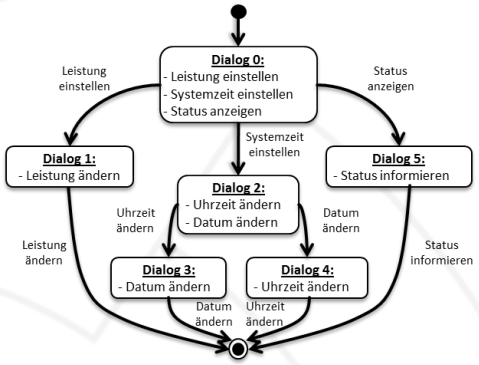
Concept Description Development Path – Task Modeling



Drag'n'Drop



Interactive Tool-Support
(Udit 2.0)

Edit Edit

Task Model (useML)

Transform

Dialog Model (useDM)

Core Analysis Model
Development Model

Core Design Model
Development + Run-time Model

Specify
- (Task-based) Functional Requirements
- Context Information

- Group Tasks → Dialogs
- Add Navigations
- Use Abstract Interaction Objects
- Specify Behavior
- Specify Adaptations

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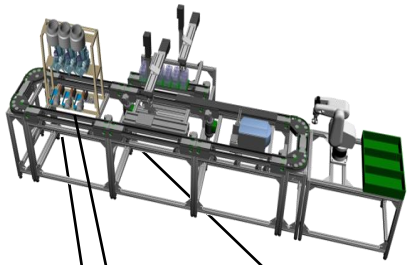
Example Use Case Task Modeling

Function Model



Operation getPower O
setPower I

Operation getMode O
setMode I

Operation .... O
... I

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Use Model

UO „Module A Settings“

UO „Pump Settings“

UO „Edit Pump Parameters“

eUO Input „Enter Speed“

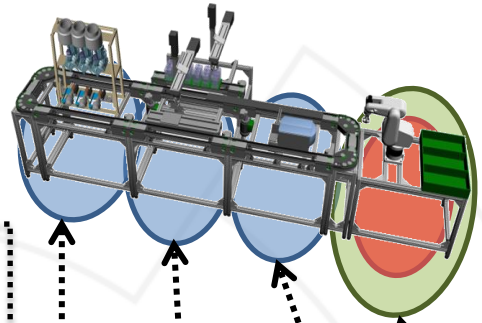
eUO Select „Pump Mode “

eUO Trigger „Power on/off“

<<availableAt>>

<<interlinkedWith>>

Context Model



Module A | Module B | Module C | Safe | Unsafe | Module D

Interaction Zones

Read-/Write Collection:
Read-/Write eUO Information at once

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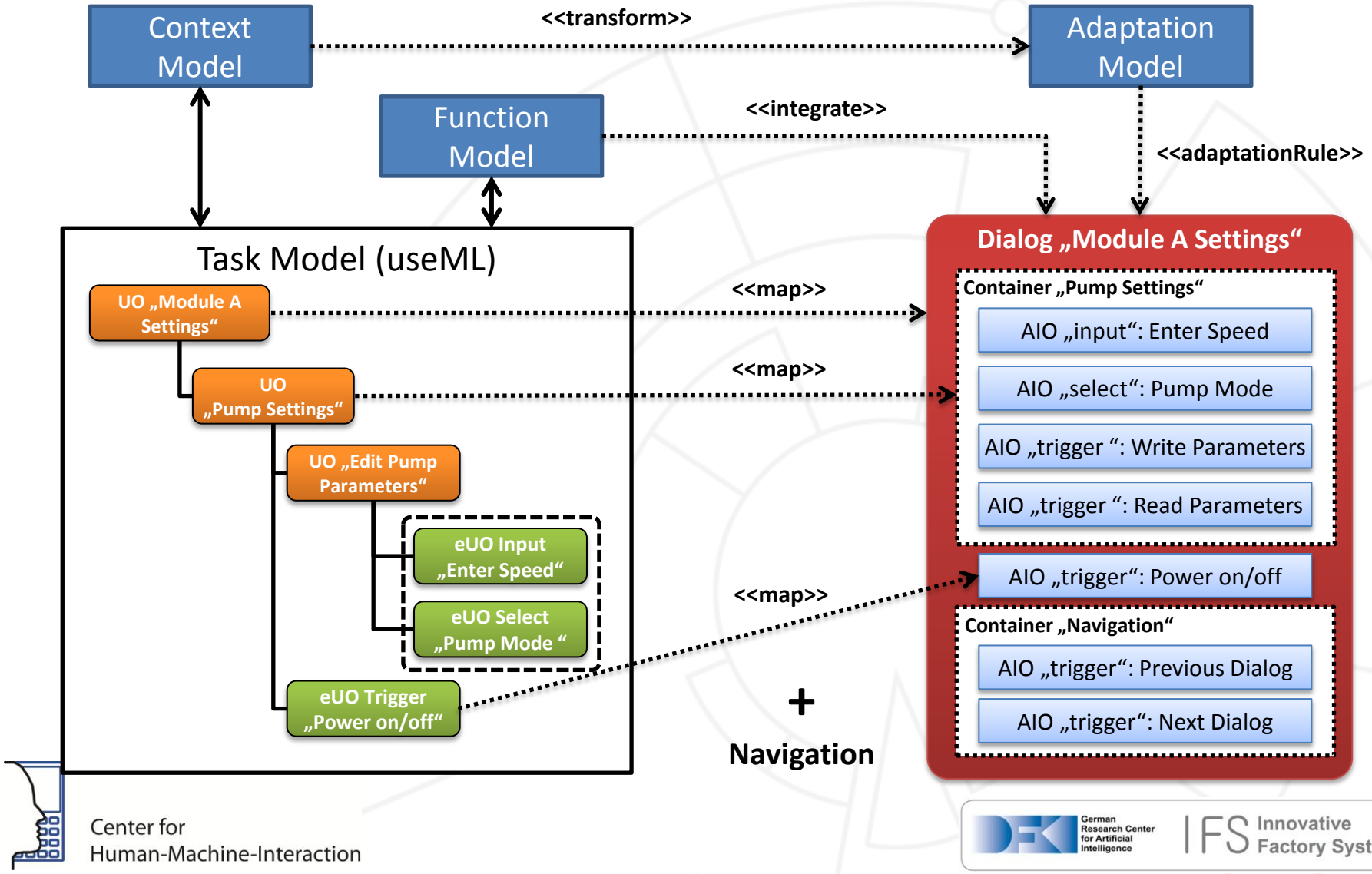
Example Use Case Dialog Modeling



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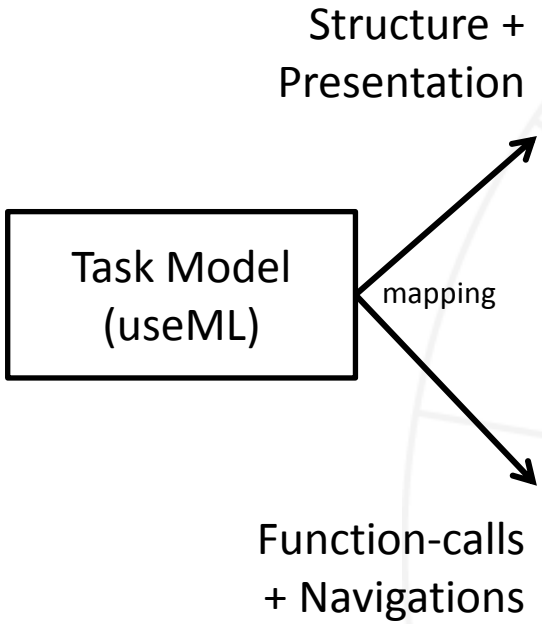
Mapping Example useDM



useDM XML Snippet

```
<dialog id="DialogA" title=„Dialog A Settings">
<structure>
   <container id=„cPumpSettings" title=„Pump Settings">
   <input title="Enter Speed:" id="iEnterSpeed"
      presentation-type="numberOnly" variable-ref="varEnterSpeed"/>
   …
   <trigger title="Write Parameters" id="tWriteParameters" onTriggered="writeValues"/>
   <trigger title="Read Parameters" id="tReadParameters" onTriggered="readValues"/>
   </container>
   <trigger title="Letztes Modul" id="back"
      presentation-type="previous-dialog" onTriggered="previousModule"/>
   <container id="cNavigation" title="Navigation" presentation-type="navigation">
   …
   </container>
</structure>
<behavior>
   <variable id="varEnterSpeed" datatype="string"/>
   <transition id="readValues">
      <call function-name=„pump_getSpeed">
         <return-value variable-ref="varEnterSpeed"/>
      </call>
   </transition>
   <transition id="previousModule">
      <relative-target type="previous-dialog"/>
   </transition>
   …
</behavior>
</dialog>
```

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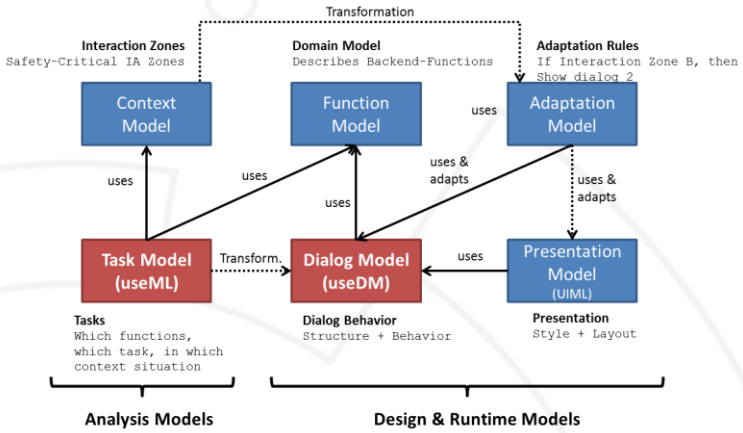
Summary and Conclusion

- **Addressed Problems**
  - **Explicit Specification** of Task, Context, Dialog, Presentation and Adaption of User Interface!
  - Integration of **Backend Functions** in Task Modeling Phase!
  - Give Developer **more control in early development phases!**
  - Provide a **clear separation of concerns**!



- **Issues Out of Scope**
  - Automatic Layouting
  - Multi-Modal Fusion

- **Future Work**
  - **Finish & Publish tool-support:**
    - Udit 2.0 (estimated: July 2012)
    - Renderer (estimated: May 2012)
  - **Evaluation of Modeling Concept**

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