(Meta-)Modeling of Process-Oriented Information Systems

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Outline

1. HERA: Process-oriented, cross-organisational e-government
   1.1 Motivation
   1.2 Characteristics of an application scenario
   1.3 Interaction patterns
   1.4 Model-driven approach
   1.5 Conclusions

2. Transfer to other application areas
   2.1 Medical Workbench
   2.2 Innovation Management

3. Overall conclusions & open issues
E-Government: Portals vs. End-to-End Processes (1)
E-Government: Portals vs. End-to-End Processes (2)
Example: Company Tax Declaration Process

- Trustee
- Auditor
- Tax office SG
- Tax office SZ

- media breaks inquiries
- inefficient
- intransparent
- error-prone

Company
Goal: Cross-organisational process integration

- Trustee
- Auditor
- Tax office SG

seamless e-government process

- Company
- Tax office SZ
Goal: Cross-organisational information integration
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Process has many ad hoc parts
Process consists of 3 main parts
Sub-processes as collaboration contexts

responsible for sub-processes

process-oriented

Draw up annual accounts

File tax declaration

Tax assessment

collaboration-oriented

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KES 2011
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Generic interaction patterns (1)

request information:

- possibly with a time limit and escalation measures
- pending requests can be removed with the proper authorisation
Generic interaction patterns (2)

confirm information:

- special case: confirm via (electronic) signature
- possibly with a time limit and escalation measures
- pending requests can be removed with the proper authorisation
Generic interaction patterns (3)

send information to take notice:
Generic interaction patterns (4)

send information for further processing / sub-process transition:
sender.sendInformationForProcessing

sender is subprocess-owner?

yes

all preconditions satisfied?

no

yes

informationSent

receiver.receiveInformationForProcessing

no
Permitted activities depend on user role and context

**auditor**: supplementary information request to accounting

`requestInfo( info: text, addressee: accounting ): accountingExtract`

**auditor**: send information for correction details to accounting

`sendInfo( info: text, addressee: accounting )`
Permitted activities depend on user role and context

<table>
<thead>
<tr>
<th>Gewinnsteuer Prozess</th>
<th>Buchhalter</th>
<th>Steuerberater</th>
<th>Revisor</th>
<th>Stv Haupt-KT</th>
<th>Stv Neben-KT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unterzeichnungsberechtigter</td>
<td>Start</td>
<td>- Buchhalterabschluss verwenden (Korrektur)</td>
<td>- Nachforderung an Buchhalter</td>
<td>- Aufklärung Korrektur</td>
<td>-</td>
</tr>
<tr>
<td>Buchhalter in Prüfung</td>
<td>- Buchhalterabschluss verwenden (Korrektur)</td>
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<tr>
<td>Gewinnverwendung vorschlagen</td>
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</tr>
</tbody>
</table>

**auditor**: request confirmation that the records are complete


precondition:  sub-process = “auditing”

& no pending supplementary requests or correction details
Permitted activities depend on user role and context

**auditor: propose how to allocate profits**

confirmInfo(info: text, addressee: accounting): confirmation

precondition: sub-process = “auditing” & ∃ x: completenessDeclaration(x)
Permitted activities depend on user role and context

**tax accountant: submit tax declaration**

```
sendInfoForProcessing( records: taxData, addressee: taxOffice )
```

precondition: sub-process = “file tax declaration”
& no pending supplementary requests
& tax data is complete
& tax declaration is signed
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HERA: Web-based platform

→ process & collaboration support
→ data exchange

HERA: Company tax declaration

- Scheduling
- Records management
- Plausibility checking

(send balance sheet to auditor) → (send revisions to accounting) → (approve annual balance sheet) → (send closing report) → (submit additionally requested documents)

Company Trustee Auditor Tax office

Accounting system Accounting system ... Assessment system

Plausibility checking
Records management
Scheduling
Screen shot of HERA user interface
Model-driven approach

E-Government Reference System

Application Models

HERA: Company tax declaration

Scheduling | Records management | Plausibility checking
---|---|---
send balance sheet to auditor | send revisions to accounting | approve annual balance sheet | send closing report | submit additionally requested documents

Company | Trustee | Auditor | Tax office

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Driven by application-specific models

Collaboration Process Web Client
- Hera Adapter

Collaboration Process Web Client
- Hera Adapter

Business Application
- Hera Adapter

Business Application
- Hera Adapter

Collaboration Process Server

Rule Engine

Identity & Access Management

DMS

Collaboration Process Instances

Collaboration Process Definition

Users

Organisations & Roles

HERA Bus

Service Registry

Driven by application-specific models
Meta-model hierarchy (1)

E-Government Meta model ($M_2$) defines Domain-Specific Language ($L_1$) expressed-in Design Time$_1$

$\text{System}$ represents $\text{Model (}M_1\text{): Company Tax Declaration Process}$ instance-of $\text{Model (}M_0\text{): Company Tax Declaration Process Instances}$

$\text{Runtime Data}$ represents $\text{Model (}M_1\text{): Company Tax Declaration Process}$ instance-of $\text{Model (}M_0\text{): Company Tax Declaration Process Instances}$

$\text{Model (}M_1\text{): Company Tax Declaration Process}$ defines Application-Specific Language ($L_0$) expressed-in Design Time$_2$

Run Time
What is a meta-model?

A meta-model defines the language from which to form a model.

A model is an instance of the associated meta-model.

diagram:
- **CollaborationSubProcess**
- **fileTaxDeclaration**
- **fileTaxDeclaration-1**

- a set of sub-process types
- instance-of
- a set of sub-process instances
- instance-of
- a sub-process instance

**Meta-model**

**Model**

**Run time model instance**
Process meta model

Process Metamodell

**CollaborationProcess**

- **CollaborationSubProcess**
  - **InteractionPattern**
    - **RequestInformation**
    - **SendInformationForProcessing**

**Constraint**

- guards
- can_execute

**starts_with**

**ends_with**

**is_a**

- 0..1 allows_actions
- 0..1 ends_with
Model elements

E-Government Meta model ($M_2$)

- Collaboration process meta model
- Data meta model
- Organisation structure meta model

**Finite state machines:**
- interaction patterns

**Rule schemata:**
- process structure
- preconditions for interaction pattern instances
- visibility of interaction pattern instances

**Description logics:**
- object types
- meta data terminology
Hierarchy for model element “InteractionPattern”

- InteractionPattern
  - is-a
  - instance-of
    - SendInformation
      - instance-of
        - a set of types
        - a sub-set of types
        - a set of instances
        - an instance

- proposeAllocationOfProfits
  - instance-of
    - model instance

- proposeAllocationOfProfits -1
  - instance-of
    - an instance

- Meta-model
  - Model
  - Run time
Hierarchy for model element “ProcessStructure”
Meta-model hierarchy (2)
Model-driven system generation

E-Government Reference System

System

Model (M₁):
Company Tax Declaration Process

Runtime Data
Collaboration Process Definition
Organisations & Roles

E-Government Meta model (M₂)

Domain-Specific Language (L₁)

represents
defines
modelling
expressed-in
data structure generation

belongs-to
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Benefits for company tax declaration (1)

*Process transparency:*
Process participants can always look up current process status.

*Faster communication:*
due to seamless and instantaneous electronic information delivery

*Complete records file:*
Records file is completely in electronic format.

*Correct processes:*
Integrity constraints help to ensure correct processes.
Benefits for company tax declaration (2)

Elimination of errors:
no media breaks

Elimination of duplicate efforts:
by triggering several (sub-)processes from the same data, like
- tax on profits
- value-added tax
Main contributions

• Web-based support of cross-organisational end-to-end e-government processes

• Combine process control and collaboration support

• Interaction patterns: controlling collaboration while retaining necessary degree of freedom

• High degree of reusability of approach through
  - reference architecture
  - model-driven approach
Future work

• **Domain-specific language** for e-government applications

• Framework for **editor generation** from DSL

• Integrate **information provision and capturing** into interaction patterns

• Transfer and generalise approach to **other domains**
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Hospital: Fragmented processes and information supply

- Laboratory tests
  - Lab data
- Physiotherapy
  - Patient data: physiotherapy
- Medication
  - Patient data: medication history
- Admission surgery
  - Patient data: surgery
- Evidence-based knowledge
Medical workbench centered around the clinical pathways
Medical workbench: characteristics

- information supply along clinical pathways: electronic patient record
- knowledge supply along clinical pathways: evidence-based medicine
- clinical pathways as weakly structured processes
- cross-organisational processes: admission and discharge management with subsequent after care
Reference model for a medical workbench

Hospital Davos  Hospital Basel  Hospital Flawil
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A staged innovation process model: Classical

IDEA
- Must meet and should meet criteria
  - Market
  - Technical
  - Soft Financials

Stage 1
- Gate 1: Initial Screen
  - Preliminary Assessment
  - Market and technical reactions

Stage 2
- Gate 2: Second Screen
  - Definition
    - Detailed Market Studies
    - Operation/ Legal Reviews
    - Detailed Technical Appraisals
    - Build Business Case
    - Product definition - project justification - project plan

Stage 3
- Gate 3: Business Case Decision
  - Development
    - Product
    - Development of Test/ Marketing Operations plans
    - Cost Analysis
    - Monitor Market and Customer Feedback
  - Quality checks on previous activities
  - Action plan for new stage o. k.
  - Protocol o. k.

Stage 4
- Gate 4: Post Development
  - Validation
    - In-house Tests
    - Customer Tests
    - Trial Production
    - Test Marketing
    - Total Business/ Financial Reviews
  - Overall detailed financial/ business checkpoints
  - Quality checks on previous activities
  - Action plan for last stage o. k.

Stage 5
- Gate 5: Pre-Commercialization
  - Commercialization
    - Implement Operations Plan
    - Implement Market Launch Plan
  - Review
    - Actual vs. expected
    - Critical Assessment of total project

A staged innovation process model: New approach
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Overall conclusions & open issues

• Creating and maintaining information systems by: meta-modeling + reference system

• How does reference modeling relate to meta modeling?

• How does a reference system correspond to a meta model instance?

• How to calibrate between meta model size and size of meta model taxonomy?