Process- and Resource-Aware Information Systems

Cristina Cabanillas
Vienna University of Economics and Business, Austria
Motivation – PAIS: Process-Aware Information System

Business Process Perspectives

- Functional
- Operational
- Behavioural
- Organisational
- Informational

Business Process Perspectives

- Functional
- Behavioural
- Organisational
- Informational
- Operational
Research Questions

RQ1: Which are the operations involved in human resource management in business processes?

RQ2: Are there other factors that affect the way in which the operations are addressed?

RQ3: Which is the existing support on the theoretical and practical sides?
**Framework**

**INPUT INFORMATION**
- Organisational Models (Resources, Groups, Relations)
- Business Process (Models)
- Policies, Constraints, Regulations

**OPERATION TYPE**
- Run-Time Resource Analysis
- Process Monitoring
- Design-Time Resource Analysis
- Process Analysis
- Resource Allocation
- Process Implementation
- Resource Reconfiguration
- Process Redesign
- Post-execution Resource Analysis
- Resource Assignment
- Process Discovery

**ACTIVITY TYPE**
- Resource-aware process model
- Process Implementation
- Process Redesign

**PROCESS TYPE**
- Process Redesign
- Process Implementation
- Process Monitoring
- Process Discovery
- Process Analysis
- Resource Allocation
- Resource Reconfiguration
- Resource Assignment
- Post-execution Resource Analysis
- Process Discovery
- Process Implementation
- Process Redesign
- Resource Allocation
- Resource Reconfiguration
- Resource Assignment
- Post-execution Resource Analysis
- Process Discovery
Framework

**INPUT INFORMATION**
- Organisational Models (Resources, Groups, Relations)
- Business Process (Models)
- Policies, Constraints, Regulations

**OPERATION TYPE**
- Run-Time Resource Analysis
- Process Monitoring
- Design-Time Resource Analysis
- Process Analysis
- Post-execution Resource Analysis
- Resource Assignment
- Process Discovery
- Resource Allocation
- Process Implementation
- Resource Reconfiguration
- Process Redesign

**PROCESS TYPE**
- Process Redesign
- Process Implementation
- Process Monitoring
- Process Discovery
- Process Analysis

**ACTIVITY TYPE**
- Resource-aware process model

**RQ1**
Framework – Operation types

### Imperative process model

- Request work trip
- Approve work trip

#### Research group
- Post-Doc
- Professor

#### Process WorkTrip

```plaintext
use group Post-Doc
use group Professor

process WorkTrip {
    task Request work trip
    task Approve work trip
    ensure role(Request work trip, Post-Doc)
    ensure role(Approve work trip, Professor)
    ensure sequence(Request work trip, Approve work trip)
}
```
Analysis Operations

Q1. Who can request a work trip?
Q2. Is SB involved in this process?

A1. ARS, CDC, JG, CC
A2. No

...
Framework – Operation types

INPUT INFORMATION
- Organisational Models (Resources, Groups, Relations)
- Business Process (Models)
- Policies, Constraints, Regulations

OPERATION TYPE
- Post-execution Resource Analysis
- Resource Assignment
- Run-Time Resource Analysis
- Process Monitoring
- Resource Allocation
- Process Implementation
- Design-Time Resource Analysis
- Process Analysis
- Resource Reconfiguration
- Process Redesign
- Resource-aware process model

Shall we change something?
Framework – Operation types

Organisational Models
(Resources, Groups, Relations)

Business Process (Models)

Policies, Constraints,
Regulations

INPUT INFORMATION

OPERATION TYPE

Post-execution Resource Analysis
Resource Assignment
Process Discovery

Resource-aware process model

Run-Time Resource Analysis

Process Monitoring

Design-Time Resource Analysis

Process Analysis

Resource Allocation

Process Implementation

Resource Reconfiguration

Process Redesign

Optimization criteria

Potential performers: ARS, CDC, JG, CC

Actual performer: CDC

Who should perform this instance?

Request work trip

Approve work trip

Research group

Post-Doc

Professor

Professor

Post-Doc

Post-Doc
Framework – Operation types

[Diagram showing the process of operation types, including input information, operation type, and optimization criteria.]

Potential performers: JM, AP

Actual performer: AP

Who should perform this instance?

Optimization criteria
Framework – Operation types

Q1. Who can approve a work trip?
Q2. Who can *still* be involved in this process?

Analysis Operations

A1. ARS, CDC, JG, CC
A2. JM, AP

…
Framework – Activity types

Collaborative activities

Individual activities
Framework

**INPUT INFORMATION**
- Organisational Models (Resources, Groups, Relations)
- Business Process (Models)
- Policies, Constraints, Regulations

**OPERATION TYPE**
- Run-Time Resource Analysis
- Process Implementation
- Process Monitoring
- Resource Allocation
- Resource Reconfiguration

**ACTIVITY TYPE**
- Post-execution Resource Analysis
- Resource Assignment
- Process Discovery
- Design-Time Resource Analysis
- Process Analysis

**PROCESS TYPE**
- Resource-aware process model

**RQ2**
Framework – Process types

Routine processes

Flexible processes
## Support RQ3

<table>
<thead>
<tr>
<th>Operation type</th>
<th>Resource Mining</th>
<th>Resource Assignment</th>
<th>Design-Time Analysis</th>
<th>Resource Allocation</th>
<th>Run-Time Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Routine</td>
<td>Flexible</td>
<td>Routine</td>
<td>Flexible</td>
<td>Routine</td>
</tr>
<tr>
<td>Individual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Tool</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Collaborative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tool</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- Creation patterns
- Role mining
- Staff mining
- DPILMiner
## Support

### RQ3

<table>
<thead>
<tr>
<th>Operation type</th>
<th>Resource Mining</th>
<th>Resource Assignment</th>
<th>Design-Time Analysis</th>
<th>Resource Allocation</th>
<th>Run-Time Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Routine</td>
<td>Flexible</td>
<td>Routine</td>
<td>Flexible</td>
<td>Routine</td>
</tr>
<tr>
<td>Individual</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Concept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Concept</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Collaborative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tool</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Activity type
- Creation patterns
- Role mining
- Staff mining
- DPILMiner
- Modelling
- Expressive p.
- Textual vs. graphical
- RAL/RALph
- DPIL
- RALTeam
<table>
<thead>
<tr>
<th>Operation type</th>
<th>Resource Mining</th>
<th>Resource Assignment</th>
<th>Design-Time Analysis</th>
<th>Resource Allocation</th>
<th>Run-Time Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Routine Flexible</td>
<td>Routine Flexible</td>
<td>Routine Flexible</td>
<td>Routine Flexible</td>
<td>Routine Flexible</td>
</tr>
<tr>
<td>Individ.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Tool</td>
<td>√</td>
<td>√</td>
<td>~</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Coll.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tool</td>
<td>-</td>
<td>~</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Activity type:
- Creation patterns
- Role mining
- Staff mining
- DPILMiner
- Modelling
- Expressive p.
- Textual vs. graphical
- RAL/RALph
- DPIL
- RALTeam
- Analysis operations
### Support

**RQ3**

<table>
<thead>
<tr>
<th>Operation type</th>
<th>Resource Mining</th>
<th>Resource Assignment</th>
<th>Design-Time Analysis</th>
<th>Resource Allocation</th>
<th>Run-Time Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexible</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~</td>
<td>~</td>
</tr>
</tbody>
</table>

#### Process type

- **Individual**
  - Concept: ✓ ✓ ✓ ~ ~ ~ ~ ~ ~
  - Tool: ✓ ✓ ✓ ~ ~ ~ ~ ~ ~

- **Collaborative**
  - Concept: - ~ ~ - - - - -
  - Tool: - ~ ~ - - - - -

#### Activity type

- **Operation type**
  - Routine: ✓ ✓ ✓ ~ ~ ~ ~ ~ ~
  - Flexible: ✓ ✓ ✓ ~ ~ ~ ~ ~ ~

- **Resource Mining**
  - Creation patterns
  - Role mining
  - Staff mining
  - DPILMiner

- **Resource Assignment**
  - Modelling
  - Expressive p.
  - Textual vs. graphical
  - RAL/RALph
  - DPI
  - RALTeam

- **Design-Time Analysis**
  - Analysis operations

- **Resource Allocation**
  - Push&Pull patterns
  - Petri nets
  - Greedy
  - Simple processes
  - ASP

- **Run-Time Analysis**
## RQ3: Support

<table>
<thead>
<tr>
<th>Operation type</th>
<th>Resource Mining</th>
<th>Resource Assignment</th>
<th>Design-Time Analysis</th>
<th>Resource Allocation</th>
<th>Run-Time Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Routine</td>
<td>Flexible</td>
<td>Routine</td>
<td>Flexible</td>
<td>Routine</td>
</tr>
<tr>
<td>Individual</td>
<td>Concept</td>
<td>√</td>
<td>√</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td></td>
<td>Tool</td>
<td>√</td>
<td>√</td>
<td>~</td>
<td>~</td>
</tr>
<tr>
<td>Collaborative</td>
<td>Concept</td>
<td>-</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Tool</td>
<td>-</td>
<td>~</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Activity type
- Creation patterns
- Role mining
- Staff mining
- DPILMiner
- Modelling
- Expressive p.
- Textual vs. graphical
- RAL/RALph
- DPIL
- RALTeam
- Analysis operations
- Push&Pull patterns
- Petri nets
- Greedy
- Simple processes
- ASP
- Analysis operations
Conclusions

- Framework for moving from PAIS to PRAIS
- 3 aspects affecting resource management: operations, activity types, process types
- Current situation:
  - Most developed operations: resource mining and resource assignment
  - Optimizations in resource allocation convenient in current BPMS
  - Resource analysis hardly supported
  - Conceptual support better than tooling support

- Limitations of this work:
  - No exhaustive systematic literature review
  - Scope of research: BPM
PRAIS Project

Project kickoff (01/04/2017)

Allocation integrated with individual assignments (30/11/2017)

Resource assignment techniques validated (31/05/2018)

Resource mining for discovery & improvement supported (31/12/2018)

Individual resource assignment supported (30/06/2017)

Teamwork assignment supported (31/03/2018)

Teamwork allocation supported (31/07/2018)

Continuous (re)planning supported - Project completed (31/03/2019)

http://ai.wu.ac.at/prais-project
### INPUT INFORMATION
- Organisational Models (Resources, Groups, Relations)
- Business Process (Models)
- Policies, Constraints, Regulations

### PROCESS TYPE
- Process Redesign
- Process Implementation
- Process Monitoring
- Process Analysis
- Design-Time Resource Analysis
- Process Discovery
- Run-Time Resource Analysis
- Resource Allocation
- Resource Reconfiguration

### ACTIVITY TYPE
- Post-execution Resource Analysis
- Resource Assignment
- Resource-aware process model

### OPERATION TYPE
- Process Implementation
- Process Redesign

### Resource Mining

<table>
<thead>
<tr>
<th></th>
<th>Routine</th>
<th>Flexible</th>
<th>Routine</th>
<th>Flexible</th>
<th>Routine</th>
<th>Flexible</th>
<th>Routine</th>
<th>Flexible</th>
<th>Routine</th>
<th>Flexible</th>
</tr>
</thead>
</table>
| **Indi-\v
dual**          | Concept | ✓        | ✓       | ✓        | ~       | ~        | ~       | ~        | ~       | ~        |
|                     | Tool    | ✓        | ✓       | ✓        | ~       | ~        | ~       | ~        | ~       | ~        |
| **Colla-\v
borative**        | Concept | -        | ~       | ~        | -       | ~        | -       | -        | -       | -        |
|                     | Tool    | -        | ~       | ~        | ~       | ~        | ~       | ~        | ~       | ~        |

**Tool**

- Use of tools in the process.”

**cristina.cabanillas@wu.ac.at**