The Next Wave of Research in Business Process Management

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Introduction:
The Agile Enterprise
Introduction: Process Example (1)

Process as driver of the enterprise!
Processes exist in all domains!

Introduction:
Process Example (2)
Introduction: What is BPM?

Business Process Management (BPM) is a discipline involving any combination of modeling, automation, execution, control, measurement, and optimization of business activity flows, in support of enterprise goals, spanning IT systems, employees, customers and partners within and beyond the enterprise boundaries.

Source: K. Swenson, BPM’14 Keynote
Introduction: BPM Lifecycle
Introduction: Process-Aware Information System

Process Development Tool
- Create Process Schema
- Modify Process Schema
- Check Process Schema
- ...

Process Repository
- Process Models
- Application Services

Process Execution Environment
- Late Modeling
- Web Client API
- Modeling API
- Dynamic Change API
- Authorization
- Time Management
- Validation
- Exceptions
- Audit Trail
- ...

Process Execution Engine
- Instance 1
- Instance 2
- Instance 3
- Instance 4
- Instance 5
- Instance 6
- Instance 7
- Instance 8
- Instance 9
- Instance 10
- Instance 11
- Instance 12
- Instance 13
- Instance 14

Process Engineer

Users
Introduction: The Business IT Alignment Gap

Huge discrepancy between the potential and the actual support of business processes by IT systems!
Real World Processes: Large Process Models

Example of an Automotive Engineering Process

Product Change Management
Real World Processes: Missing Alignment of Models at Business and IT Level

Business Level
Model created by domain expert

IT Level
Model created by IT expert
Real World Processes: High Process Variability

La Rosa et al.

Real World Processes: 
Large Collective Process Structures

Release Management Process for E/E Car Components

Real World Processes: Intra- vs. Cross-organizational Processes
Real World Processes: Need for Different Levels of Process Support

☐ Routine processes
  • Interdisciplinary cooperation among different people and organizational units to perform routine work

☐ Knowledge-intensive processes
  • Guided by available information
  • Dependent on domain-specific knowledge
  • Uncertainty, goal-orientation, emergence of work, evidenced guidelines, …


Business Process Modeling

Business Process Modeling: Compliance

Process model to be checked

Generated counterexample:
Execution path and corresponding process context violating the constraint
Process Compliance: Modeling Multiple Perspectives of Compliance Rules

Process Compliance: Ensuring Compliance for Cross-organizational and Evolving Processes


Business Process Modeling: Beyond the Control-Flow Perspective

Business Process Modeling: The ATAPIS Tool
Business Process Modeling: Emergence of Process Repositories

What kind of repository services are needed?
Business Process Modeling: Example: Process Model Abstraction

Step 1
Initial process schema with activities of user X marked

High-level Operation:
ShowMyActivities(user X)
- Define predicate pred.
- Find all activities where actor X is not involved in.
- Evaluate pred. $S = \{C, D, E, F, I, J, K, L, P\}$

Step 2
Multi-aspect Operation:
Reduce($S$)

Step 3
Single-aspect Operation:
$\text{REDUCECF}(S)$
- Find SESE components
  $S_1 = \{C, D, E\}$, $S_2 = \{F\}$,
  $S_3 = \{J, K\}$, $S_4 = \{I\}$,
  $S_5 = \{P\}$

Step 4
Elementary Operations:
$\text{RedSESE} \ S_1$
$\text{RedSESE} \ S_2$
$\text{RedSESE} \ S_3$
$\text{RedSESE} \ S_4$
$\text{RedSESE} \ S_5$

Step 5
Simplification Operations
Process-Aware Business IT Alignment
Process-Aware Business IT Alignment

Business IT Alignment Gap

Business Level

System Level

Evaluate Affected Parts

Service getPDMData

Service getPLData

HT_evaluate parts

Service store_Evaluation
Process-Aware Business IT Alignment

Change Management Process in the Automotive Domain (simplified)

Business process

1. Request Change
2. Evaluated Affected Parts
3. Specify Changes
4. Evaluate Changes
5. Make Decision
6. Record Decision
7. Implement Change

System process

HT = Human Task
Process-Aware Business IT Alignment

Relationships between business and system level need to be made explicit

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Process-Aware Business IT Alignment

Relationships between business and system level need to be made explicit
Process-Aware Business IT Alignment

Challenge: Flexible Handling of Top-Down and Bottom-Up Changes

HT = Human Task
Process-Aware Business IT Alignment

Business process

- Request Change
- Evaluate Affected Parts
- Specify Changes
- Evaluate Changes
- Make Decision
- Record Decision
- Implement Change

Transformation model

- Request Change
- Evaluate Affected Parts
- Specify Changes
- Evaluate Changes
- Make Decision
- Record Decision
- Implement Change

System process

- HT_Request_Change
- Service_getPDMData
- Service_getPLData
- HT_evaluate_parts
- Service_store_Evaluation
- HT_refine_change_request
- HT_decide_change_request
- Service_doc_change_PDM
- Service_doc_change_parts_list
- Service_MarkPartsAs_Changeable

HT = Human Task
Process-Aware Business IT Alignment
Process-Aware Business IT Alignment

**Business process**
- **Request Change** → **Evaluate Affected Parts** → **Specify Changes** → **Evaluate Changes** → **Estimate Costs** → **Make Decision** → **Record Decision** → **Implement Change**

**Transformation model**

**System process**
- **HT_Request_Change** → **Service_getPDMData** → **HT_evaluate_parts** → **Service_store_Evaluation** → **HT_refine_change_request** → **HT_decide_change_request** → **Service_doc_change_PDM** → **Service_doc_change_parts_list** → **Service_MarkPartsAsChangeable**
Process-Aware Business IT Alignment

Business process

1. Request Change
2. Evaluate Affected Parts
3. Specify Changes
4. Evaluate Changes
5. Evaluate Costs
6. Make Decision
7. Record Decision
8. Implement Change

Transformation model

1. Request Change
2. Evaluate Affected Parts
3. Specify Changes
4. Evaluate Changes
5. Evaluate Costs
6. Make Decision
7. Record Decision
8. Implement Change

System process

1. HT_Request Change
2. Service_getPDMData
3. HT_evaluate parts
4. Service_store_Evaluation
5. Service_refine_change_request
6. Service_refine_change_request
7. HT_cost_estimation
8. HT_decide_change_request
9. Service_store_Evaluation
10. Service_change_partList
11. Service_change_PDM
12. Service_MarkPartsAs_changeable

HT = Human Task
Process Flexibility

- Processes on the right side of the spectrum are mostly **knowledge-intensive**
- Knowledge-intensive processes are characterized by undpredictability, non-repeatability and emergence.
Flexibility Needs Along the Process Lifecycle

Traditional Process Lifecycle Support

1. need for process evolution
2. need for process participant
3. need for process execution
4. need for process adaptation
5. need for variability support

According to Weber & Reichert, 2009

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Flexibility Need: Variability

- Variability is typical for many domains and requires that processes are handled differently depending on the given context
- Drivers
  - Product and service variability
  - Differences in regulations
  - Different customer groups
  - Temporal differences

Example: Vehicle Repair
Process Variability Support: The Problem

[La Rosa et al]
Process Variability Support: Configurable Process Models
Process Variability Support:
Configuration through Pre-specified Adaptations

1. Changes are rather costly
2. Variants are difficult to maintain

Derive a new reference process model from the variants such that:

*Less adaptations are needed in future!*

Flexibility Need: Adaptation

• Ability to structurally adapt the schema of single cases (i.e. process instances) to a contextual change

• Drivers
  - Special situations
  - Exceptions

• Anticipation of Adaptation
  - Planned
  - Unanticipated
Process Adaptation Support

Enforcement:
Guardrails (on a road) prevent deviation, but also prevent anything not predicted.

Guidance: Guidelines (on a road) show people where to go, but do not prevent deviations if they are necessary.
Process Adaptation Support: The User Perspective

Exceptional case – we need an additional lab test!


Process Adaptation Support: The System Perspective

Process Type Level

Process Schema S

- Patient Admission
- Anamnesis & Clinical Examination
- X-ray
- Non Operative Therapy
- X-ray
- MRT
- Sonography
- Initial Treatment & Operation Planning
- Operative Treatment
- Discharge & Documentation

- Activity
- XOR-Split/Join
- AND-Split/Join

Process Instance Level

Process Instance I1

Execution Trace:
\[ \sigma_1 = \langle \text{Patient Admission}, \text{Anamnesis & Clinical Examination}, \text{X-ray} \rangle \]

Process Instance I2

Execution Trace:
\[ \sigma_2 = \langle \text{Patient Admission} \rangle \]
Process Adaptation Support: The System Perspective

For patient Mozart the MRT activity needs to be skipped due to his cardiac pacemaker.
Process Adaptation Support: Dynamic Changes

![Diagram of process adaptation support showing dynamic changes](image)

- **Diagram a):** Process Instance I, Activity States: Completed, Enabled.
- **Diagram b):** Process Instance I after moving activity C to the position between A and B.
- **Diagram c):** Process Instance I after placing activity C in parallel to activity B.
Process Adaptation Support:

Summary

Many other fundamental issues:

• Ensuring soundness of dynamic process changes
• Enabling adaptations based on model abstractions
• Providing proper end user assistance
• Balancing process flexibility and security

Process Evolution

"It is not the strongest of the species that survives, not the most intelligent that survives. It is the one that is the most adaptable to change."

Charles Darwin
Flexibility Need: Evolution

• Ability to change the implemented process when the business process evolves

• Drivers:

  - Changing Business Context
  - Changing Technological Context
  - Changing Legal Context
  - Organizational Learning
  - Design Errors
  - Technical Problems
  - Poor Internal Quality

Real-world Process

represented in

PAIS

cycle

provide feedback to
Process Evolution Support: The User’s View

Process-Aware Information System

- Std Client API
- Web Client API
- Modeling API
- Dynamic Change API
- Admin. API
- Role Management
- Authorization Time Management
- Message Queuing
- Recovery
- Audit Trail

Repository

ADEPT Process Composer
- Create Process Template
- Modify Process Template
- Check Process Template

Process Engine

- Process 1
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Check Instance Status

4,377 instances can be automatically migrated
1,117 instances have proceeded too far
123 instances cannot be automatically migrated

Process Designer / Process Administrator

Users
Process Flexibility: Transfering Research to Practice

Process Flexibility: Clinical Pathway Support with AristaFlow BPM Suite
Process Flexibility: Disaster Management with AristaFlow BPM Suite

Process-aware, Cooperative Emergency Management for Water Infrastructures

Lessons Learned?

Big Processes: The Challenge
Big Processes: Drivers

Modeling

Execution

Dynamic Adaptation

Exception Handling
Big Processes: The Corepro Approach

**Modellebene**

- Datenmodell
  - Data Model
- Life Cycle Coordination Model
  - Object Life Cycles / Life Cycle Coordination Model

**Instanzebene**

- Datenstruktur
  - Data Structure
- Datengetriebene Prozessstruktur
  - Data-driven Process Structure
Big Processes: The Corepro Approach

Object Life Cycles / Life Cycle Coordination Model

Data-driven Process Structure
Big Processes: The Corepro Approach

Data-driven Process Structure
Big Processes: The Corepro Approach
• Significant reduction of modeling efforts for process engineers
• Formal operational semantics allows for correct executability
• Soundness can be guaranteed on an abstracted level
Big Processes: The Corepro Approach

Auditor's inspection tool for enterprise process structures
BPM to Go: Mobile Process and Task Support
BPM to Go: Mobile Process and Task Support
BPM to Go:
Mobile Process and Task Support

- Context-specific execution of mobile activities, offline mode...
- Assignment of mobile activities (protocol-based)
- Connection abortion, device error, user behavior, resources

Process Management System

GSM, GPRS, UMTS, W-LAN

Patient treatment
BPM to Go:
MeDo – Mobile Process Support for Ward Rounds

BPM to Go in a Broader Context: Process-Driven Mobile Questionnaires
BPM and the Internet of Things
Smart Processes in the Cloud

Source: Mario Morales, IDC
BPM and the Internet of Things
Smart Processes in the Cloud
Process Science at Ulm University

Research Topics
- Adaptive & Flexible Processes
- Human-Centric Processes
- Data- and Time-Aware Processes
- Handling Process Variability
- Mobile Process & Task Support
- Smart Processes

Application Areas
- Healthcare
- Automotive Engineering
- Transport & Logistics
- Tourisms
- Sustainable Production
- ... (omitted)

Research Methods
- Design Research
- Formal Methods
- Innovative Prototypes
- Empirical Research

Methods, Concepts and Technologies for Next Generation Process Management Technology
Thank you!