Managing Flexibility Challenges for Composite Service

Scenarios, Technologies, Tools

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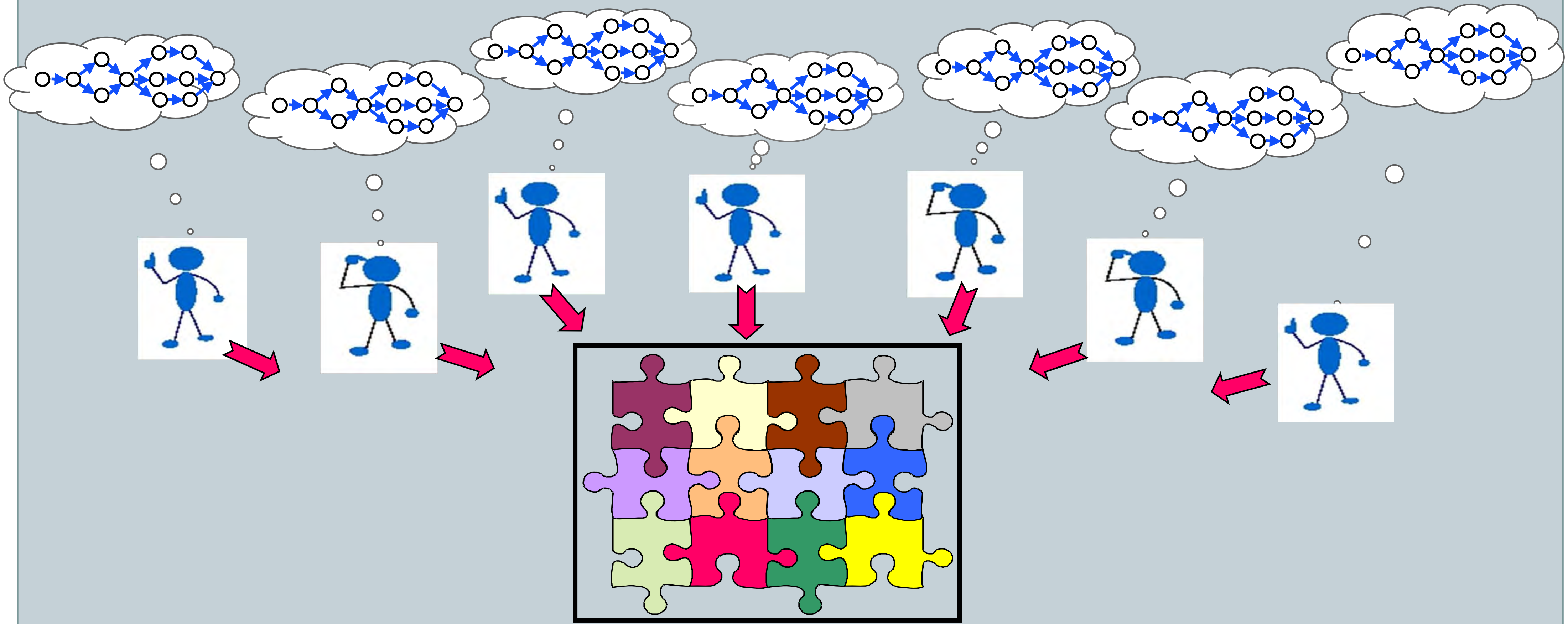
www.process-flexibility.com

Content

- Part 1: Introduction
- Part 2: Process-Aware Information Systems
- Part 3: Flexibility Issues
- Part 4: Flexibility Support for Pre-specified Process Models
- Part 5: Loosely-specified Process Models

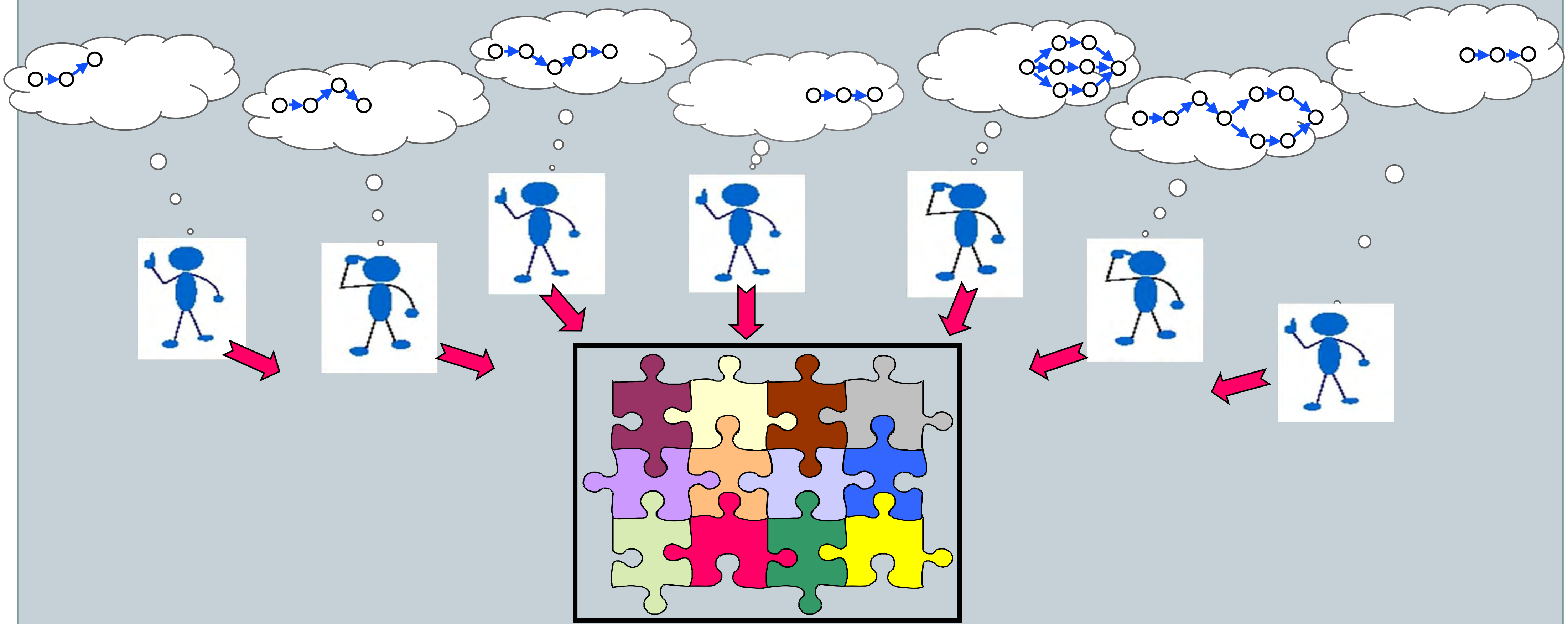
Introduction

- **Current situation in many enterprises:**
  - users interact with monolithic, function-centric application systems
  - processes only in the users' minds – with only partial process knowledge



Introduction

- **Service-oriented Architectures**
  - modularization ☞ invokable application services



- **Service-oriented Architectures**
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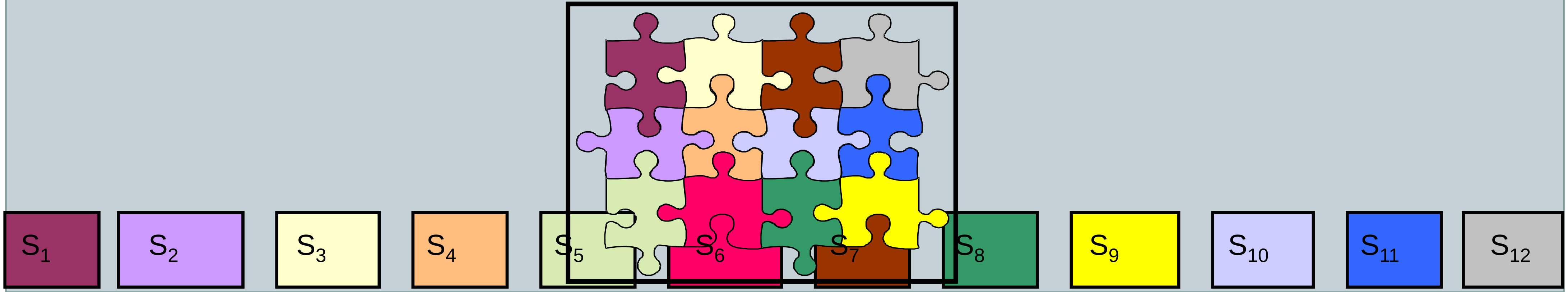
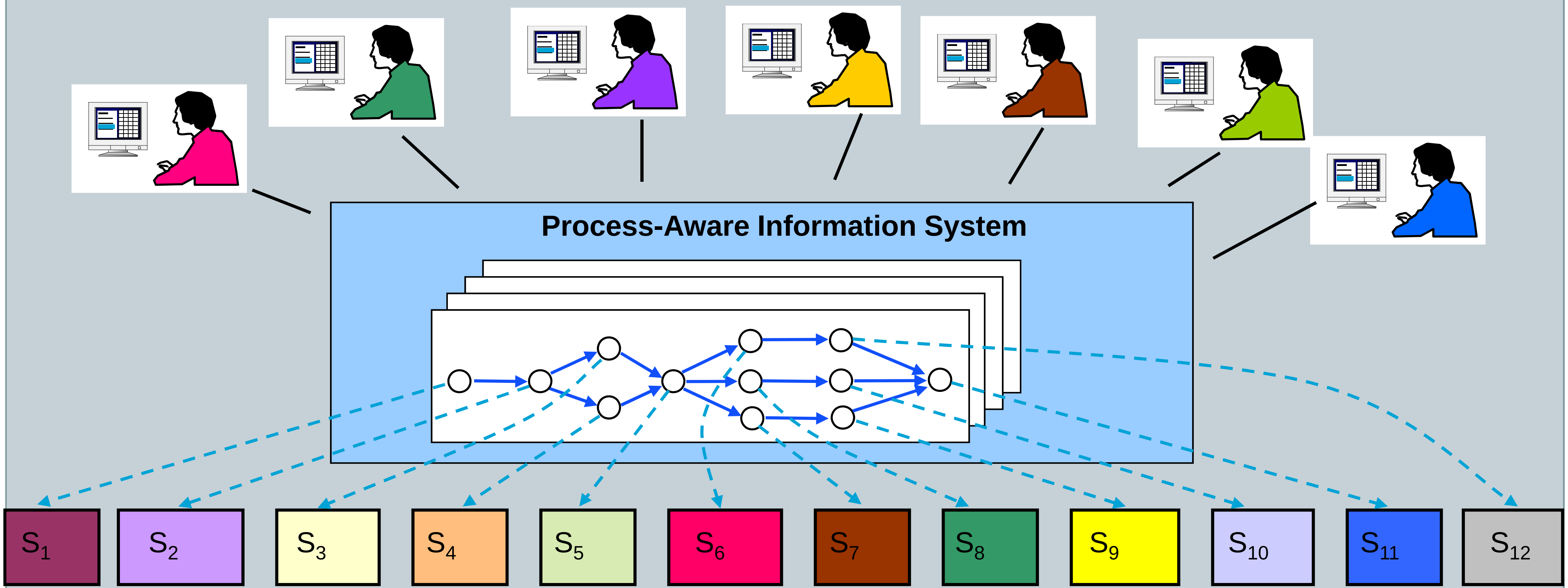
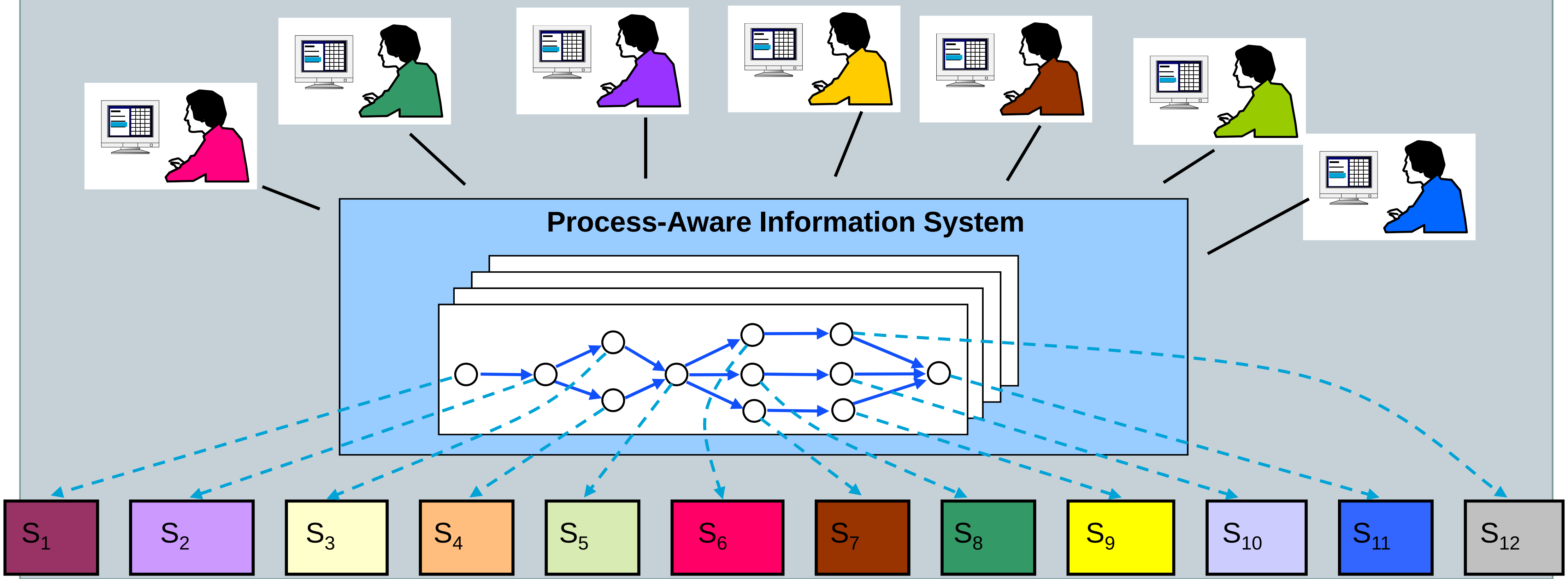


- **Service-oriented Architectures**
  - modularization ☞ invokable application services
  - combined by explicitly defined processes
  - whose execution is supported by a process-aware information system



- **Goals of Service-oriented Architectures**
  - improving process quality
  - increasing **flexibility**
  - ...

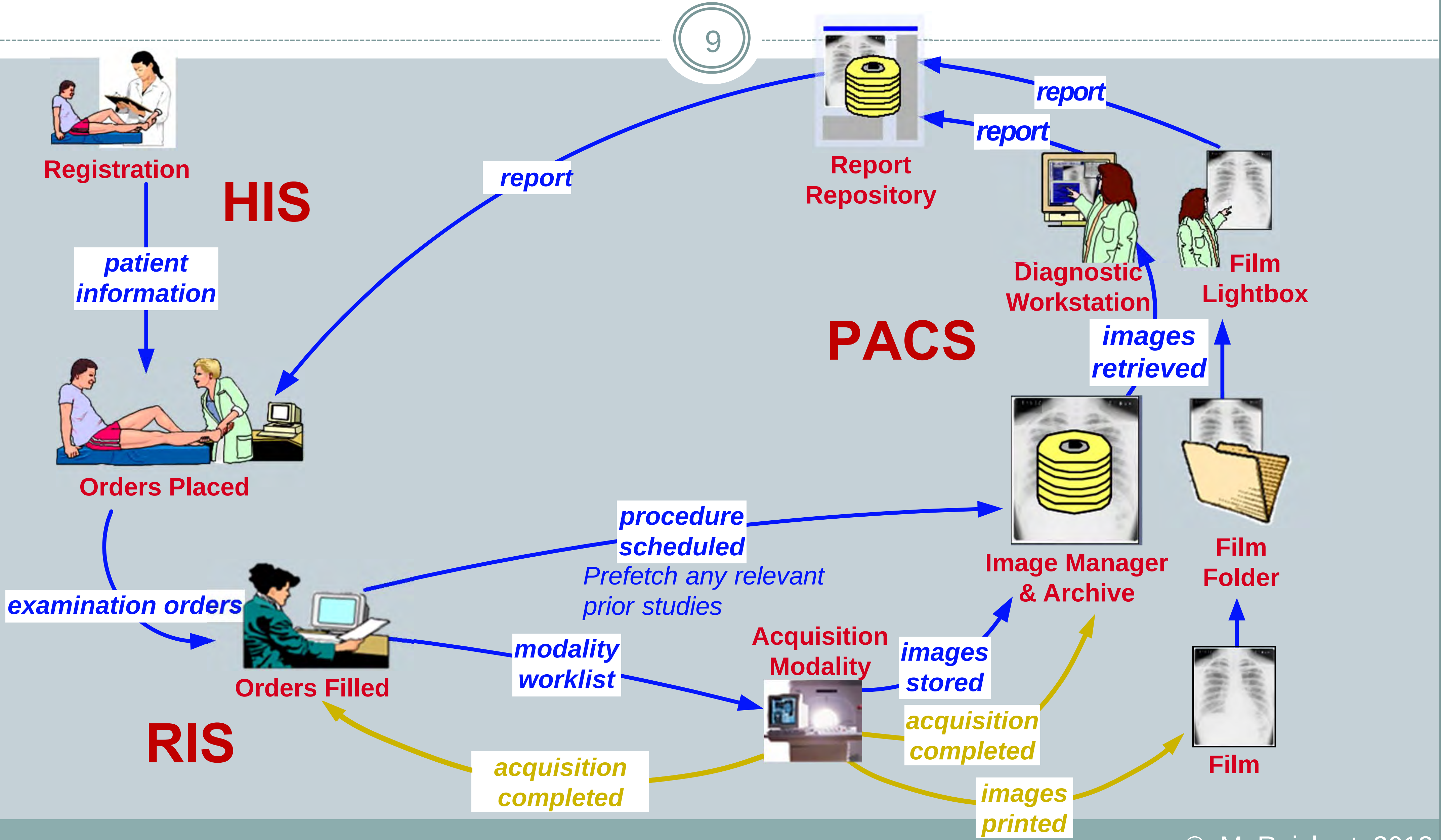
?



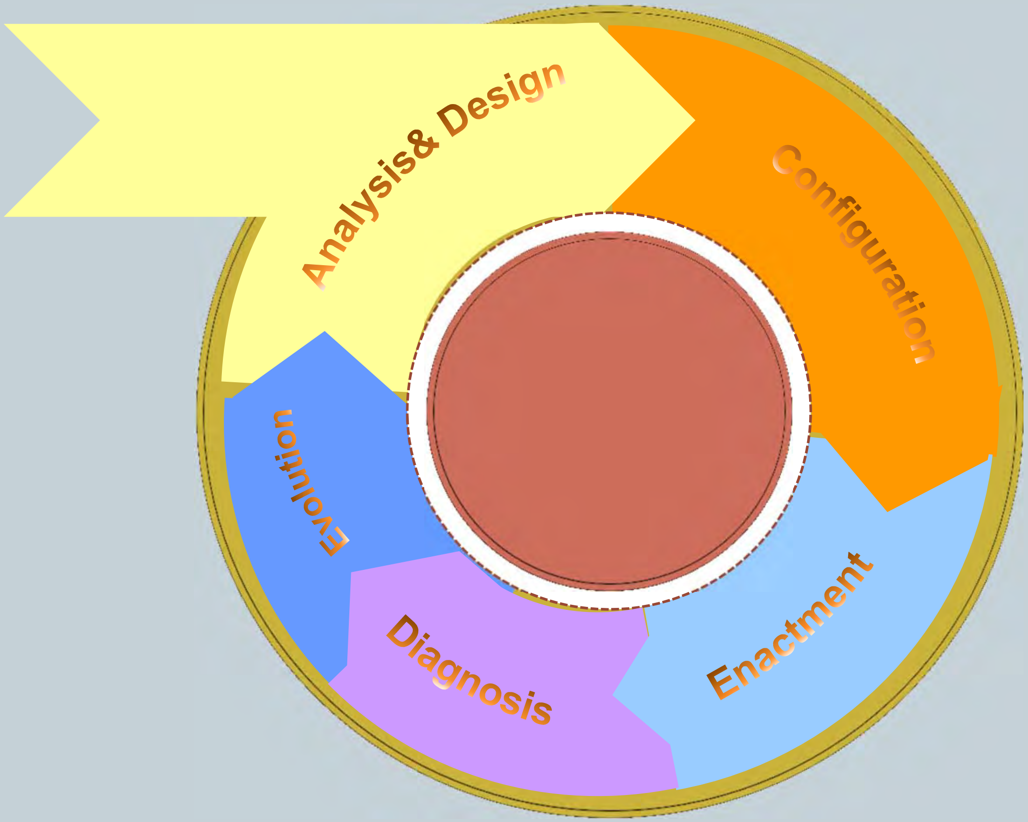
Process-Aware Information Systems

Basic Concepts and Correctness Notions

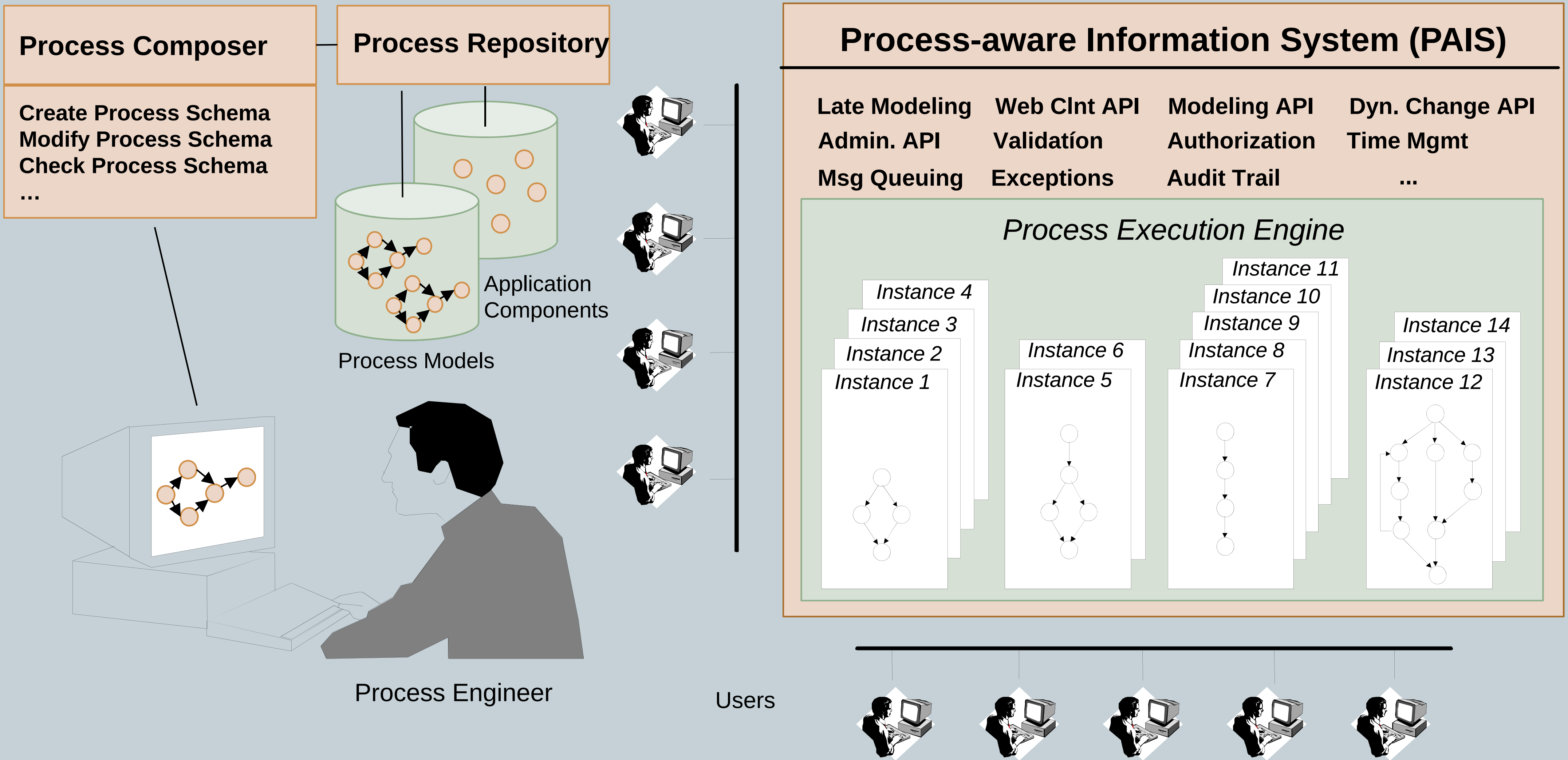
A Simple Healthcare Process



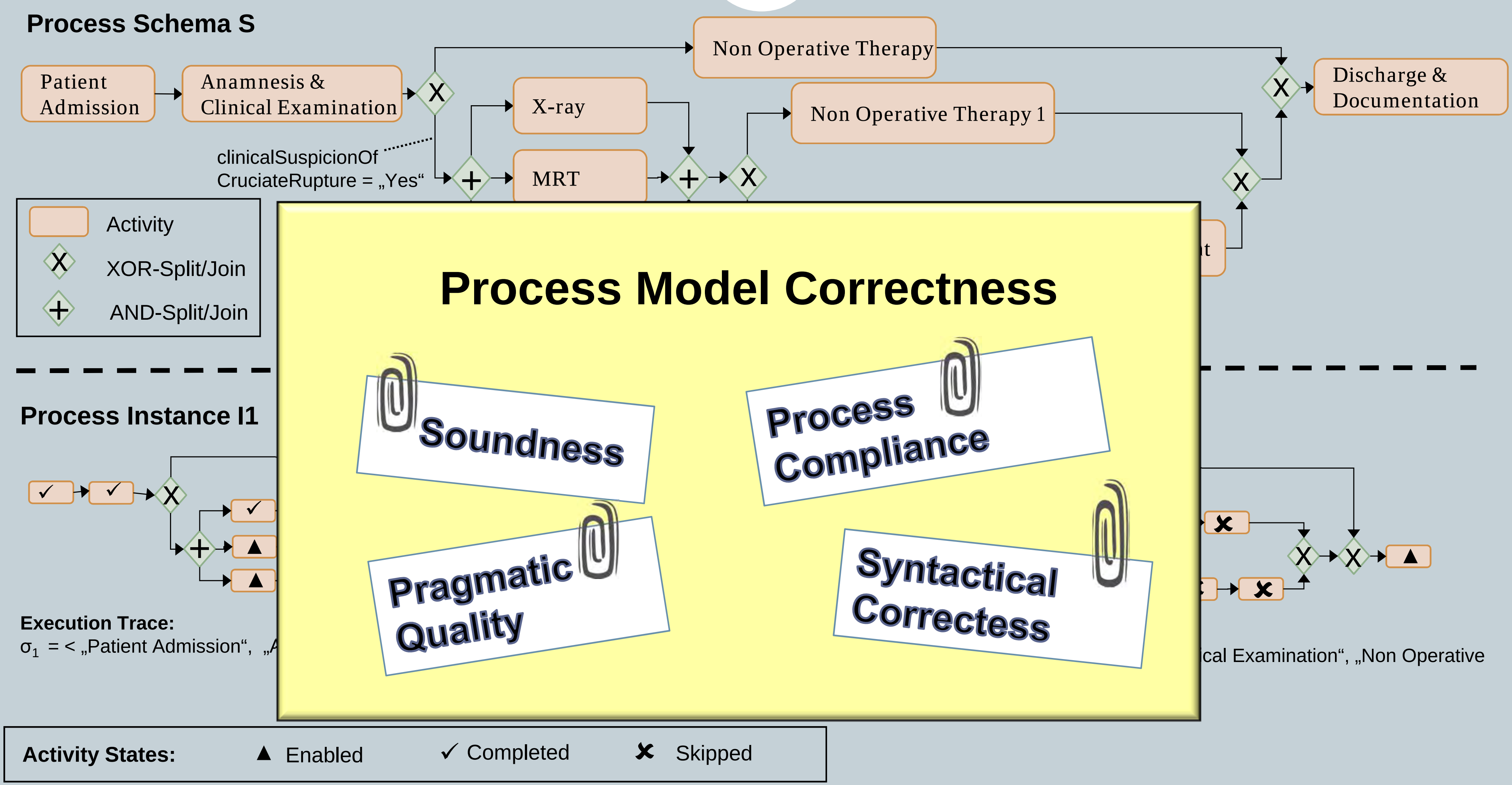
Business Process Lifecycle



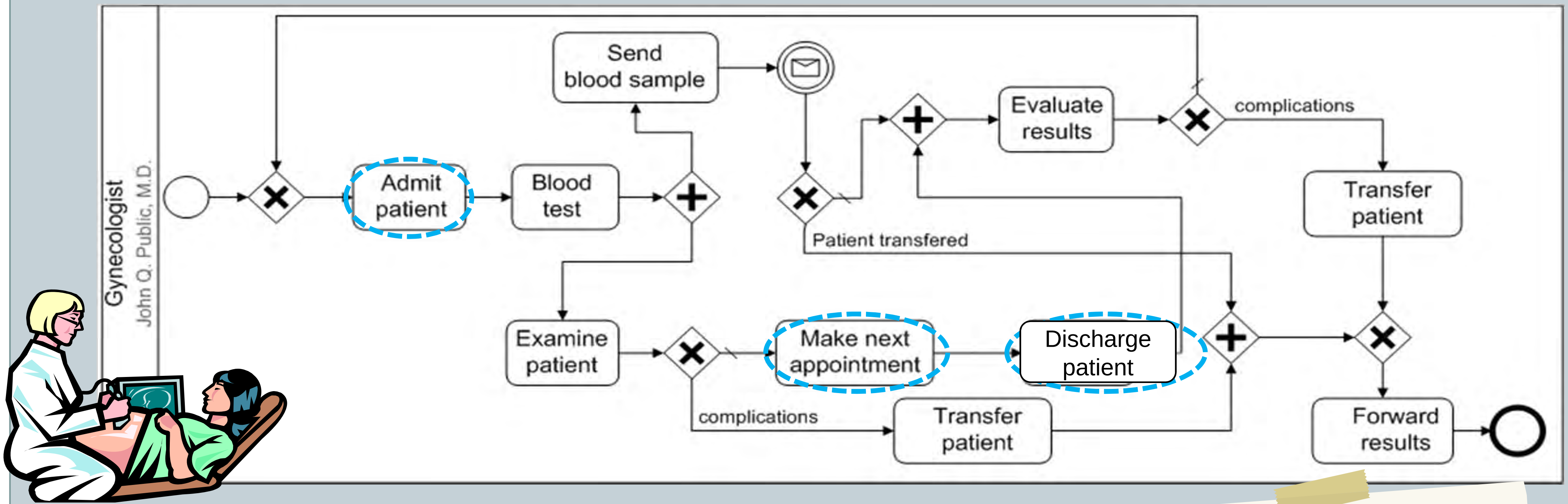
Process-aware Information System



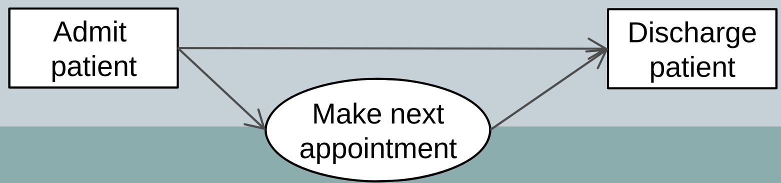
A Process Model and Related Instances



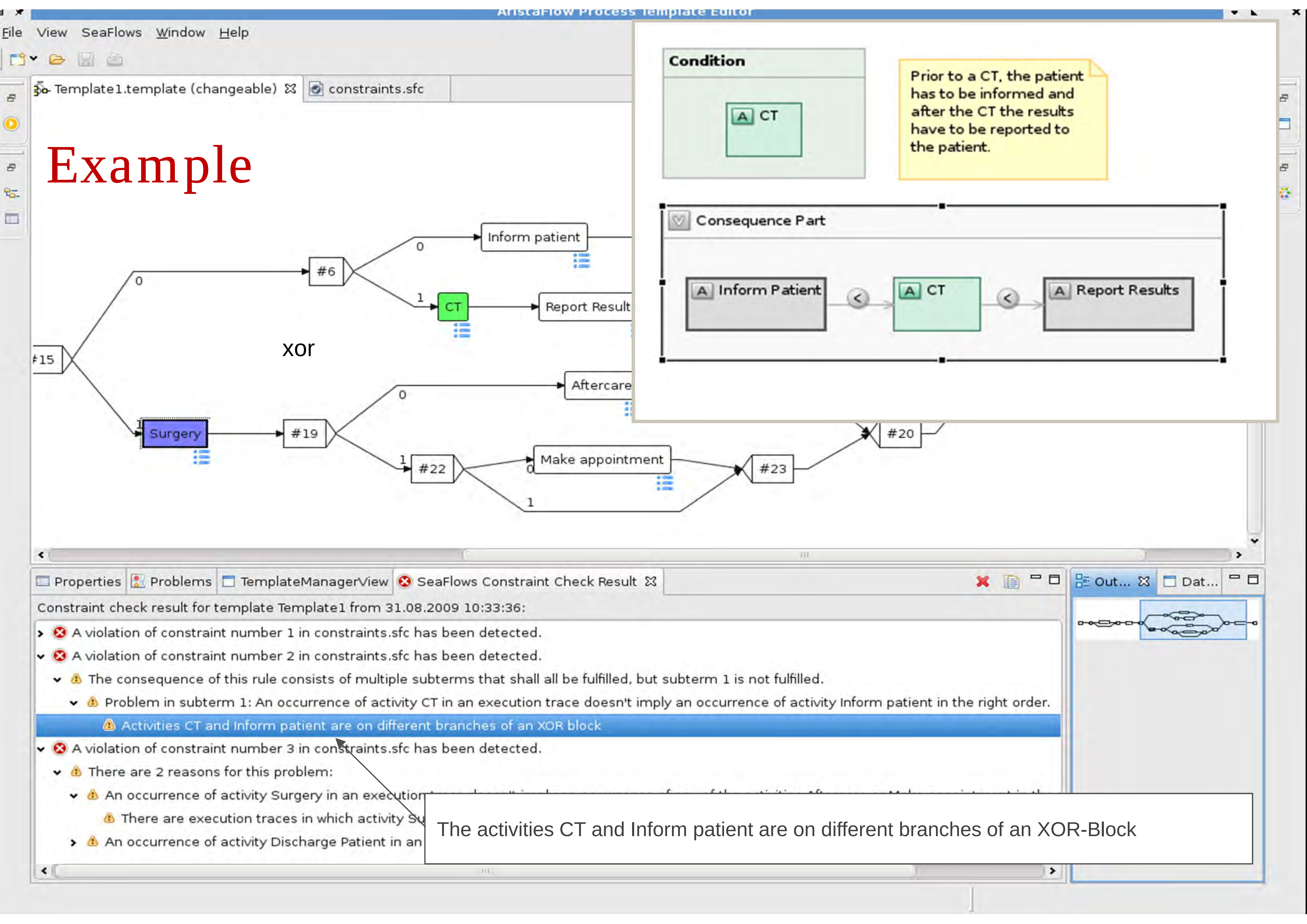
Business Process Compliance



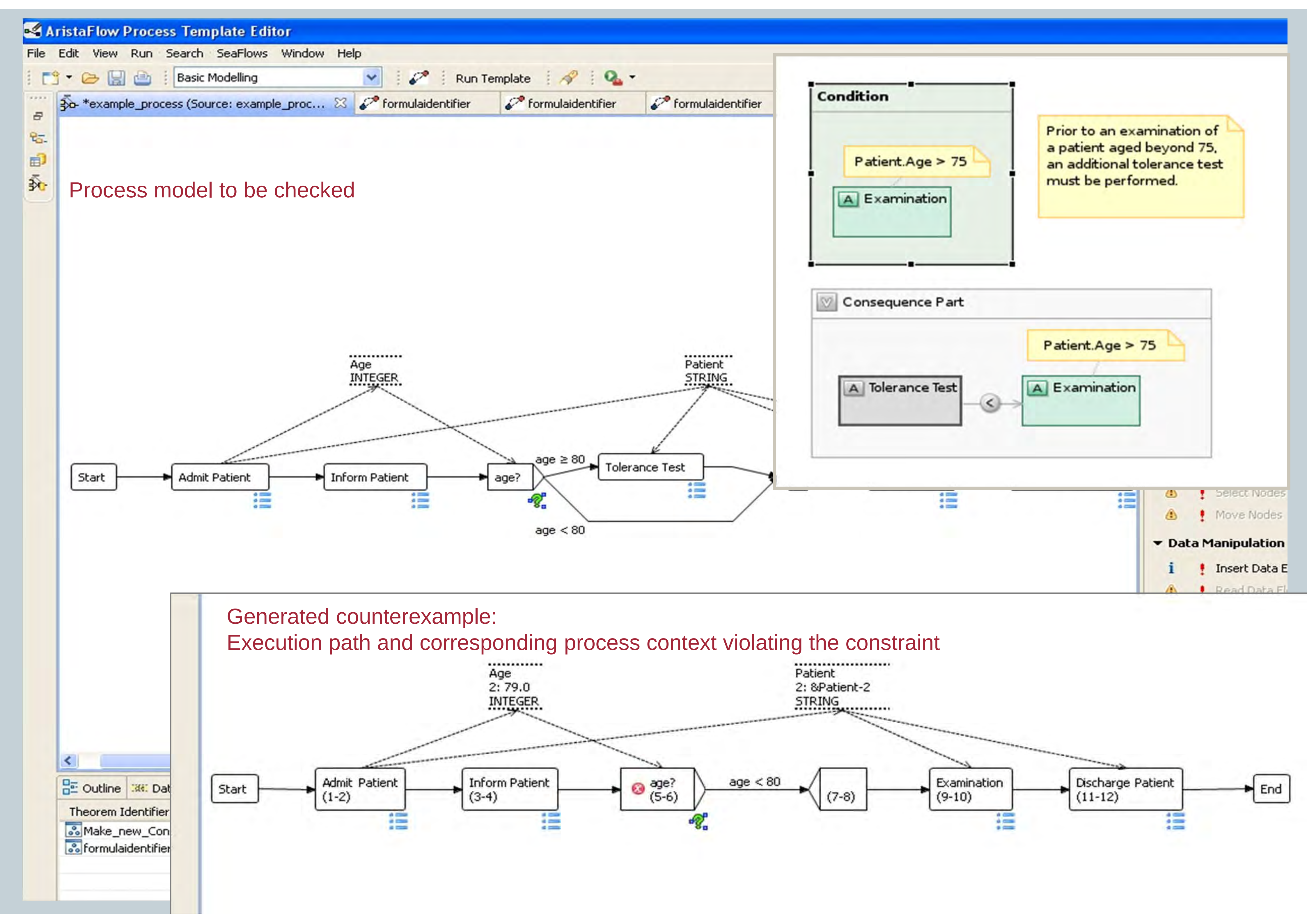
G(Admit_patient → (not Release_patient U Make_next_appointment))



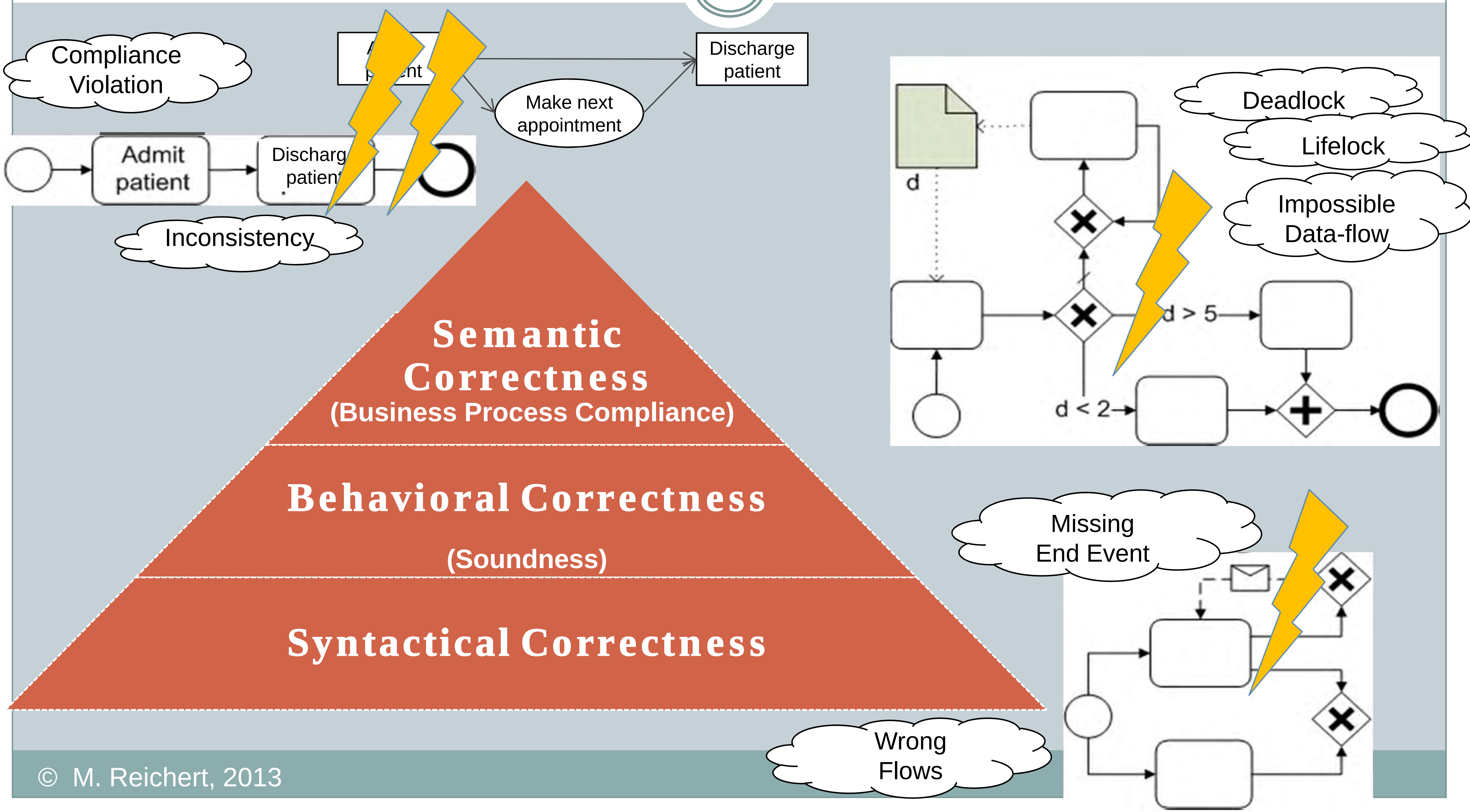
Guideline:
After admission, a patient should not be discharged without making the appointment for his next visit.



AristaFlow Process Template Editor
File View SeaFlows Window Help
Template1.template (changeable)
constraints.sfc
Example
Inform patient
#6
0
1
CT
Report Result
#15
xor
Aftercare
Surgery
#19
#22
Make appointment
#23
#20
Condition
CT
Prior to a CT, the patient has to be informed and after the CT the results have to be reported to the patient.
Consequence Part
Inform Patient
CT
Report Results
Properties
Problems
TemplateManagerView
SeaFlows Constraint Check Result
Out...
Dat...
Constraint check result for template Template1 from 31.08.2009 10:33:36:
A violation of constraint number 1 in constraints.sfc has been detected.
A violation of constraint number 2 in constraints.sfc has been detected.
The consequence of this rule consists of multiple subterms that shall all be fulfilled, but subterm 1 is not fulfilled.
Problem in subterm 1: An occurrence of activity CT in an execution trace doesn't imply an occurrence of activity Inform patient in the right order.
Activities CT and Inform patient are on different branches of an XOR block
A violation of constraint number 3 in constraints.sfc has been detected.
There are 2 reasons for this problem:
An occurrence of activity Surgery in an execution
There are execution traces in which activity Su
An occurrence of activity Discharge Patient in an
The activities CT and Inform patient are on different branches of an XOR-Block


AristaFlow Process Template Editor
File Edit View Run Search SeaFlows Window Help
Basic Modelling
Run Template
*example_process (Source: example_proc...
formulaidentifier
formulaidentifier
formulaidentifier
Process model to be checked
Age
INTEGER
Patient
STRING
Start
Admit Patient
Inform Patient
age?
age ≥ 80
Tolerance Test
age < 80
Condition
Patient.Age > 75
Examination
Prior to an examination of a patient aged beyond 75, an additional tolerance test must be performed.
Consequence Part
Patient.Age > 75
Tolerance Test
Examination
Data Manipulation
Insert Data E
Outline
Theorem Identifier
Make_new_Con
formulaidentifier
Generated counterexample:
Execution path and corresponding process context violating the constraint
Age
2: 79.0
INTEGER
Patient
2: &Patient-2
STRING
Start
Admit Patient
(1-2)
Inform Patient
(3-4)
age?
(5-6)
age < 80
(7-8)
Examination
(9-10)
Discharge Patient
(11-12)
End

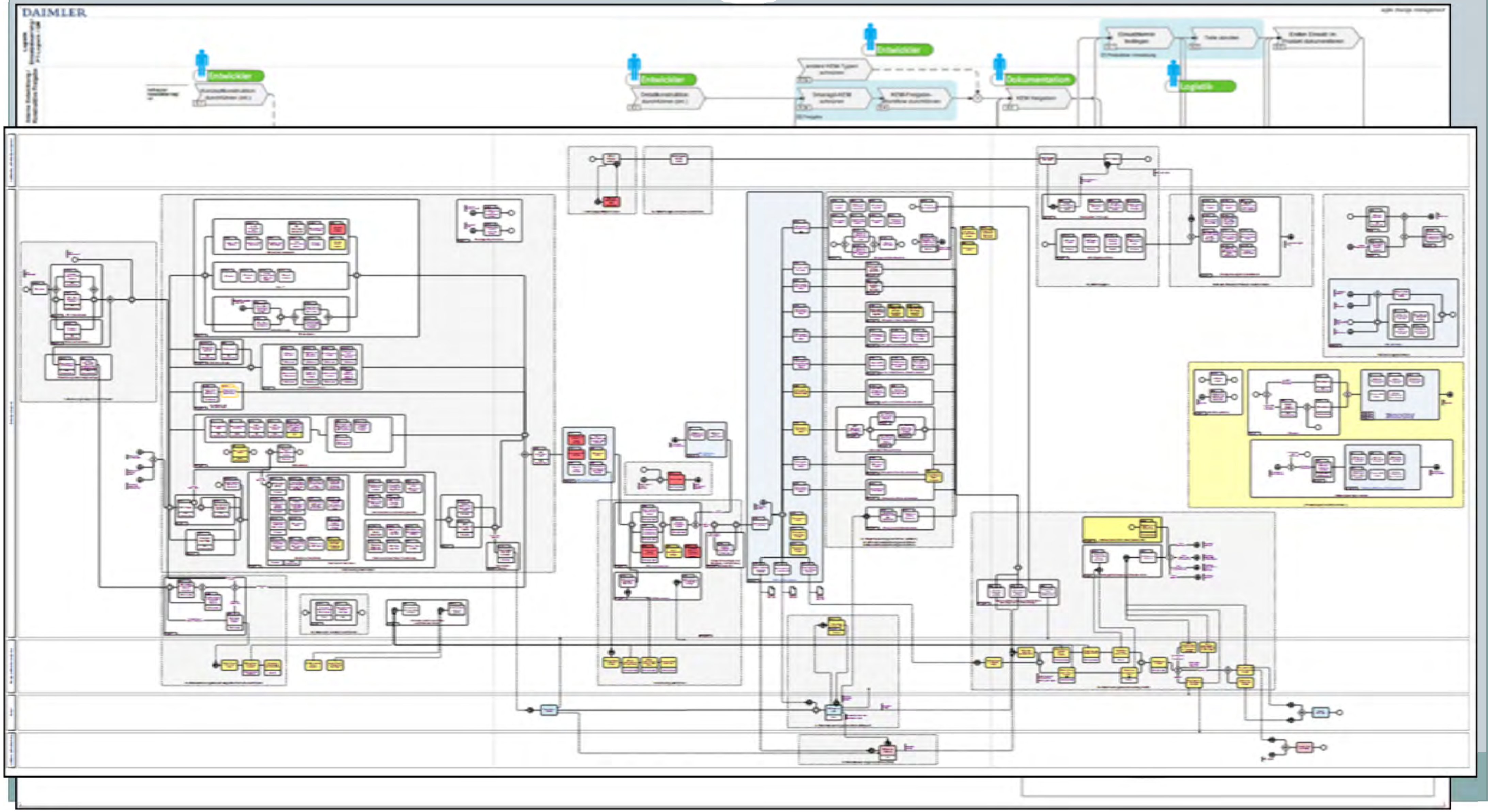
Levels of Process Model Correctness



Process-Aware Information Systems

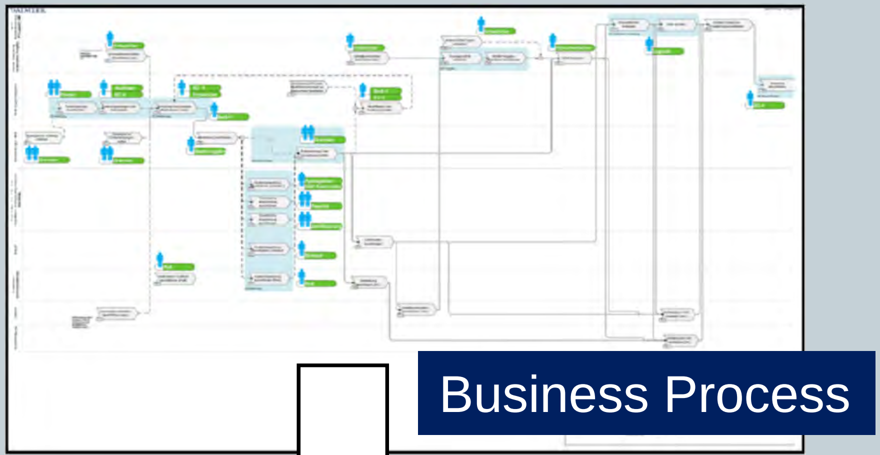
Business vs. IT Level

A Real-World Modeling Scenario

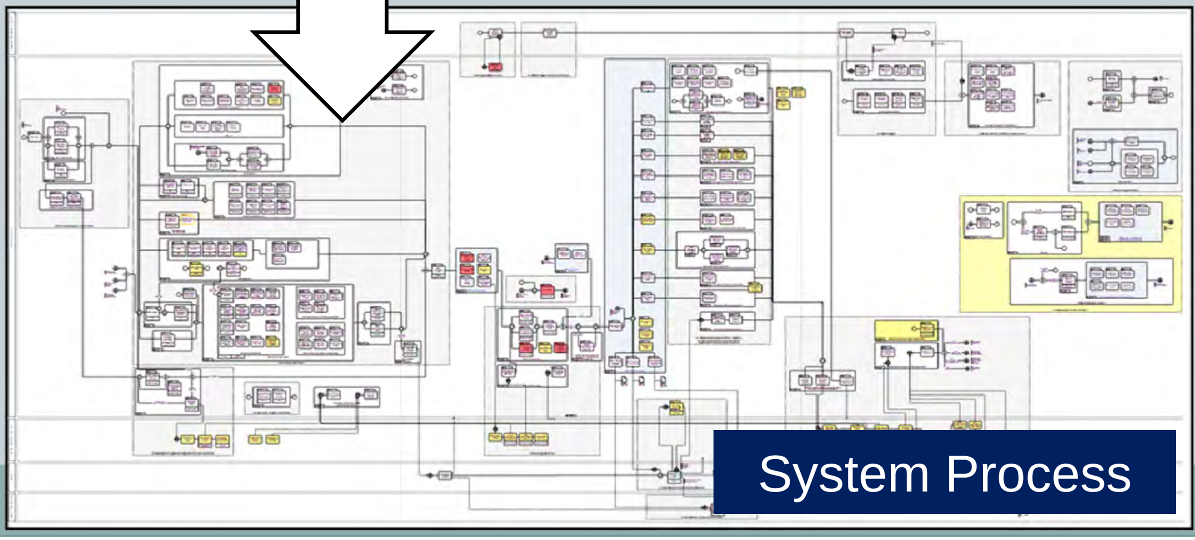


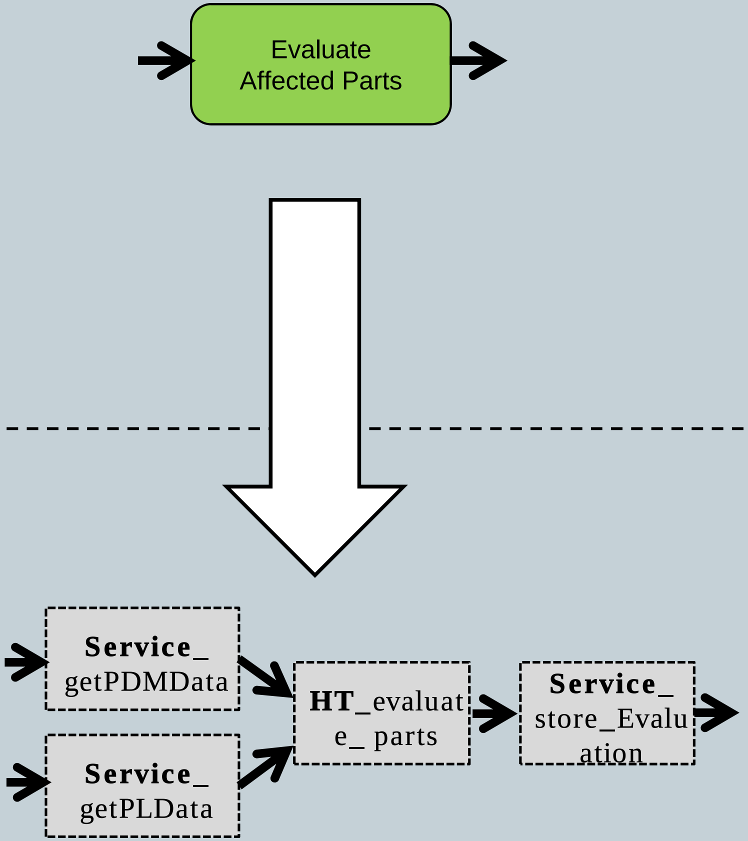
Business IT Alignment Gap

Business Level



IT Level

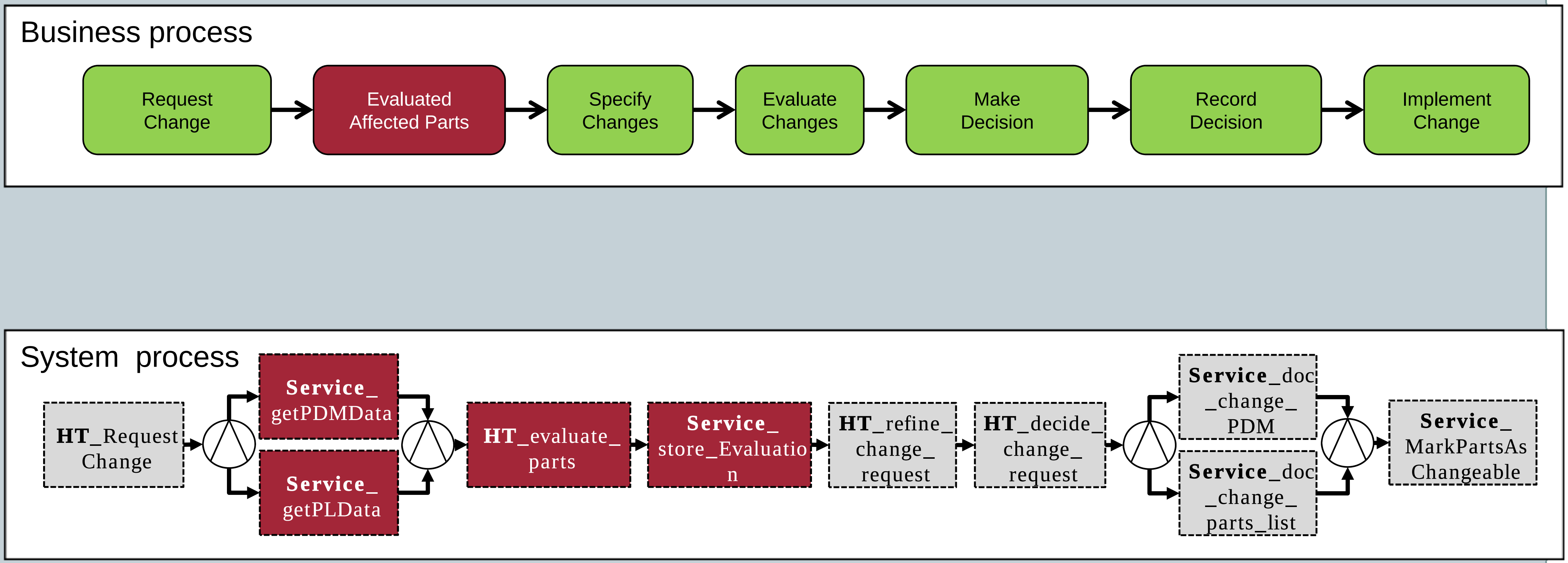




[BBR13a, BBR13b]

Need for Integrated Process Modeling

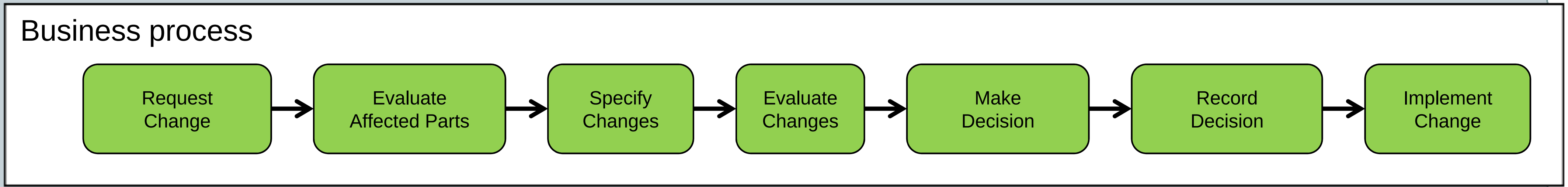
Change Management Process in the Automotive Domain (simplified)

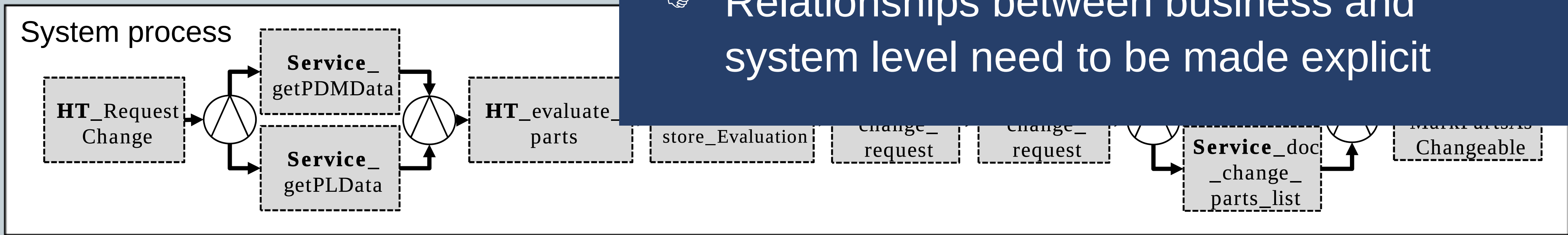


HT = Human Task

[BBR13a, BBR13b]

Need for Integrated Process Modeling

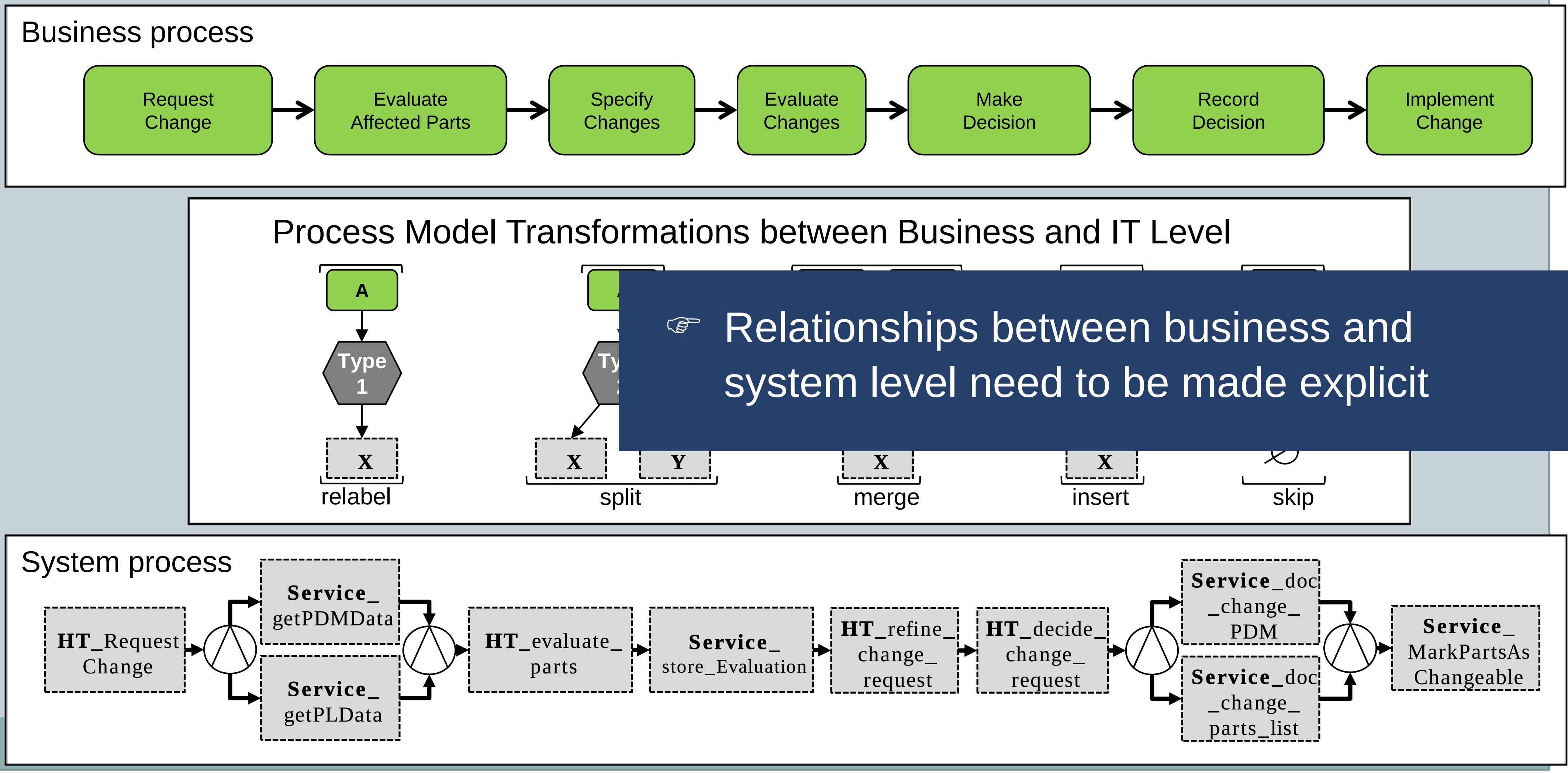




☞ Relationships between business and system level need to be made explicit

HT = Human Task

Need for Integrated Process Modeling



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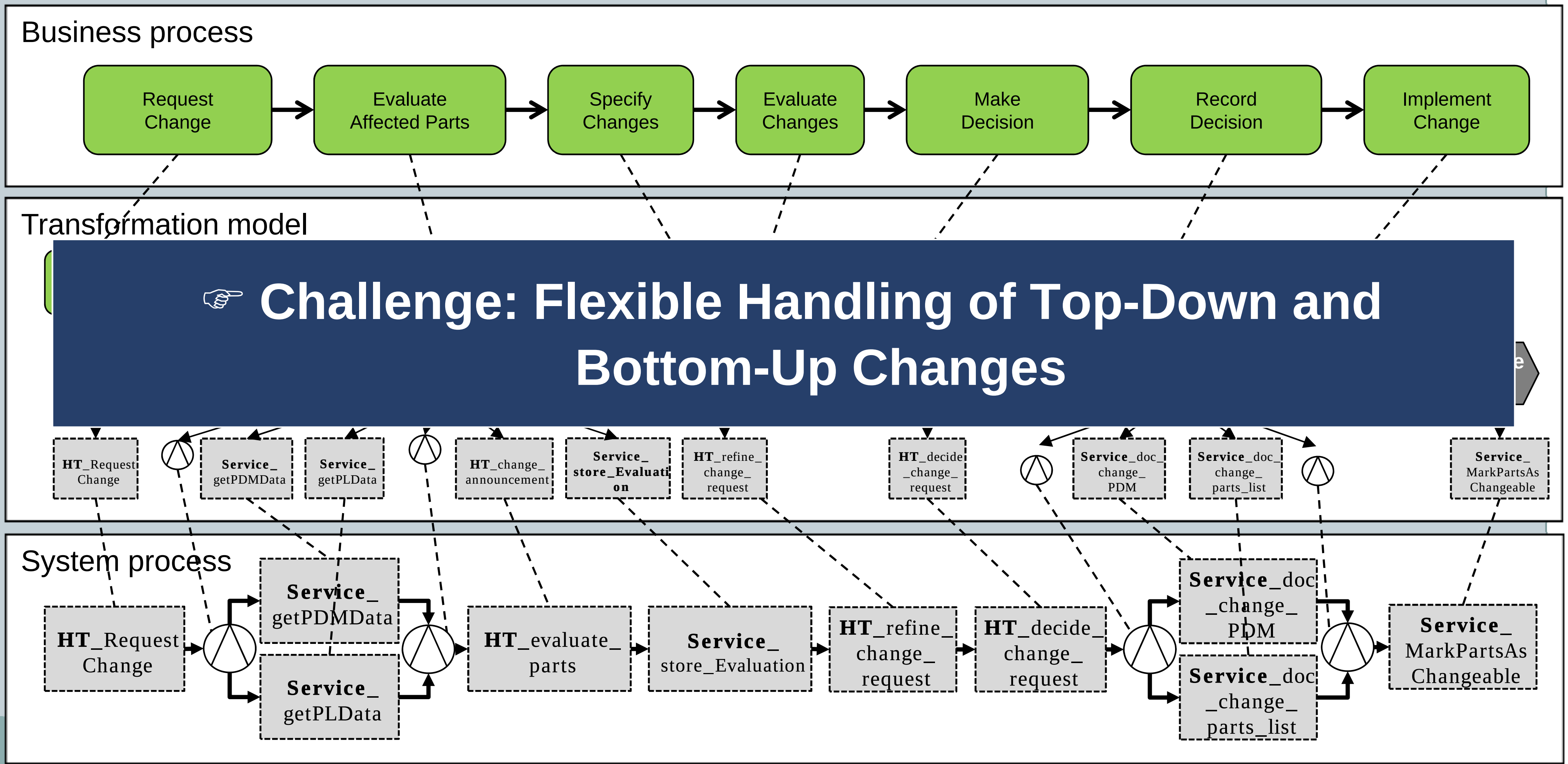
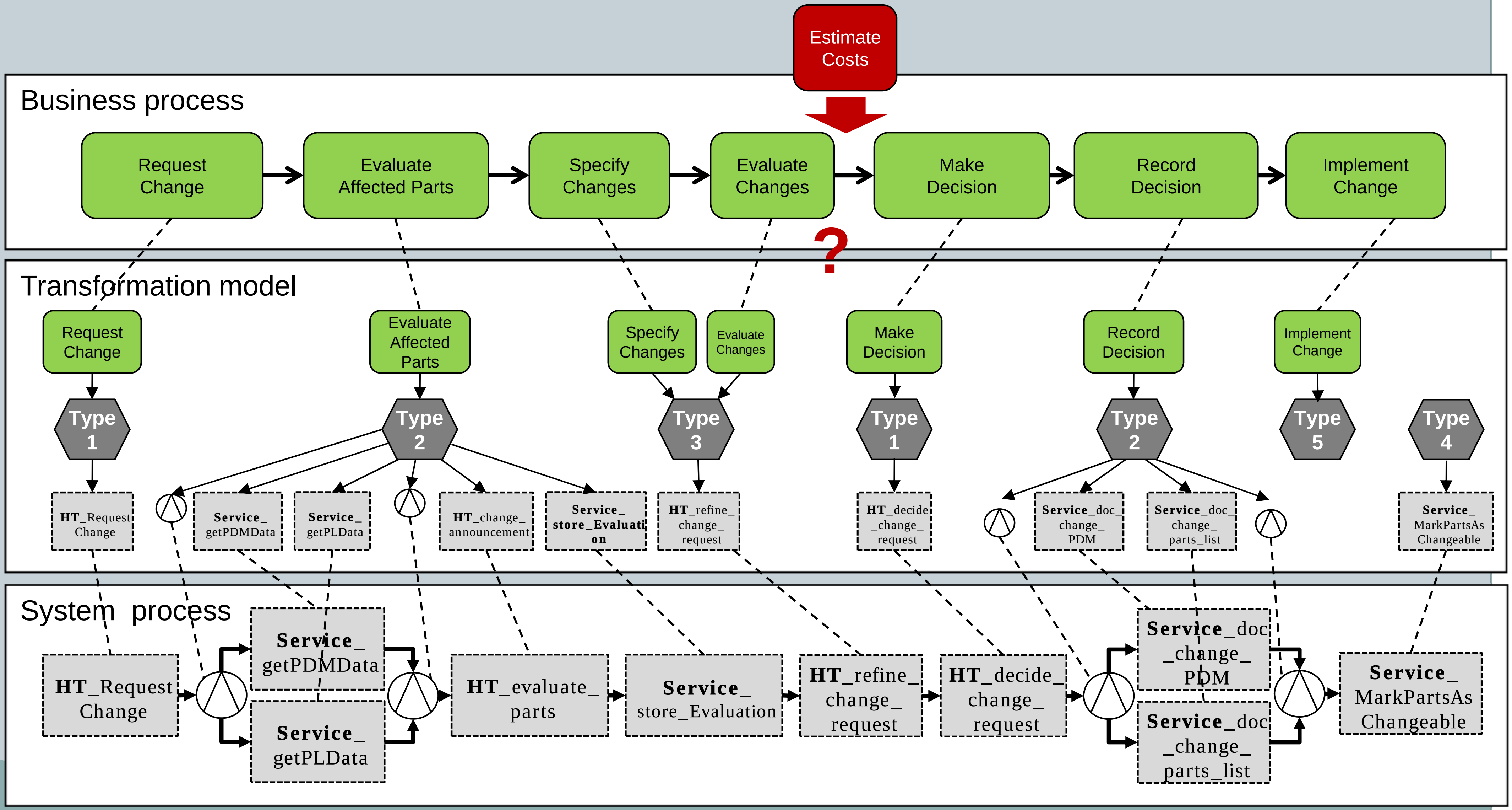
Need for Integrated Process Modeling



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

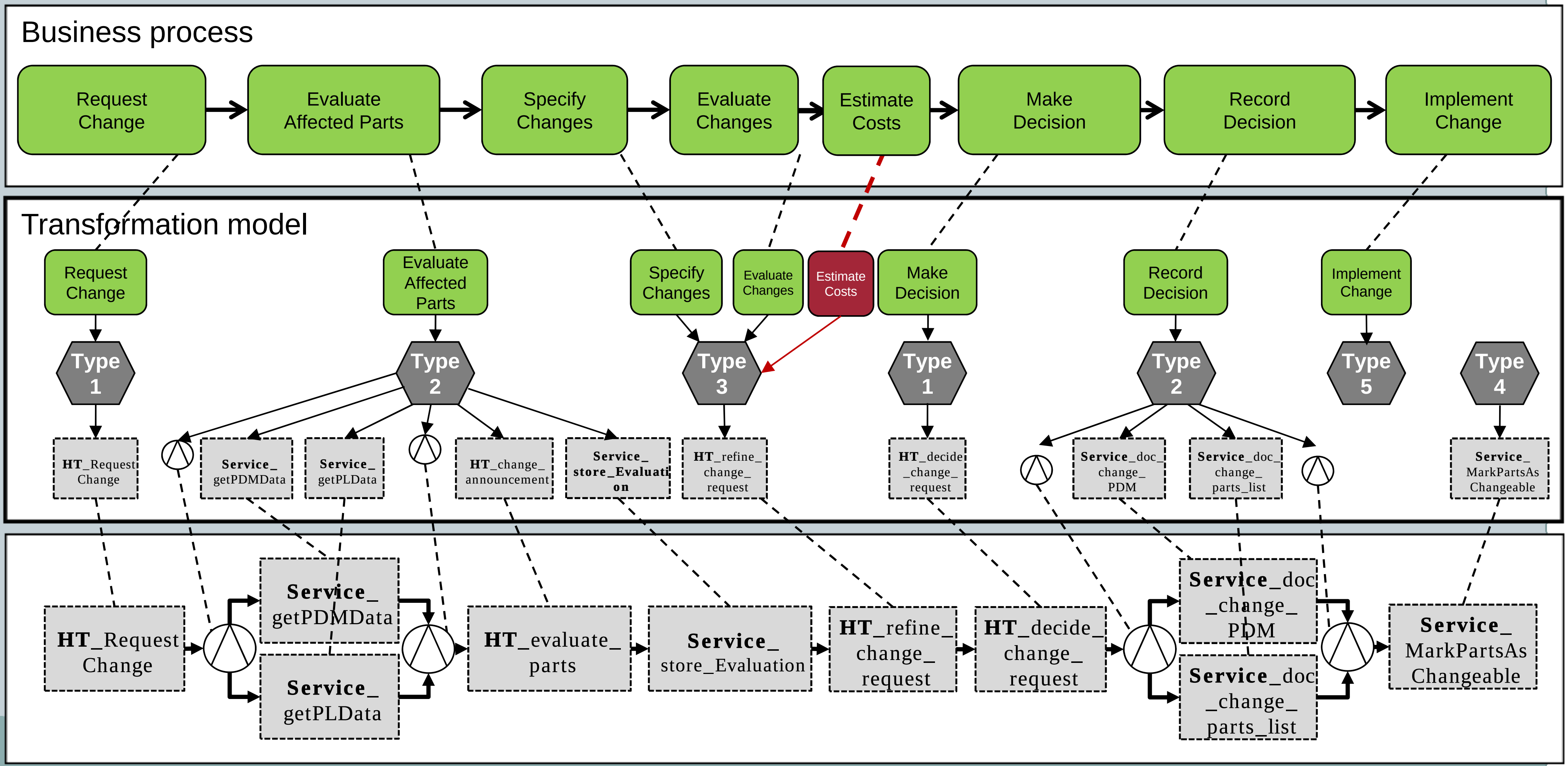
HT = Human Task

Flexibility and Process Evolution



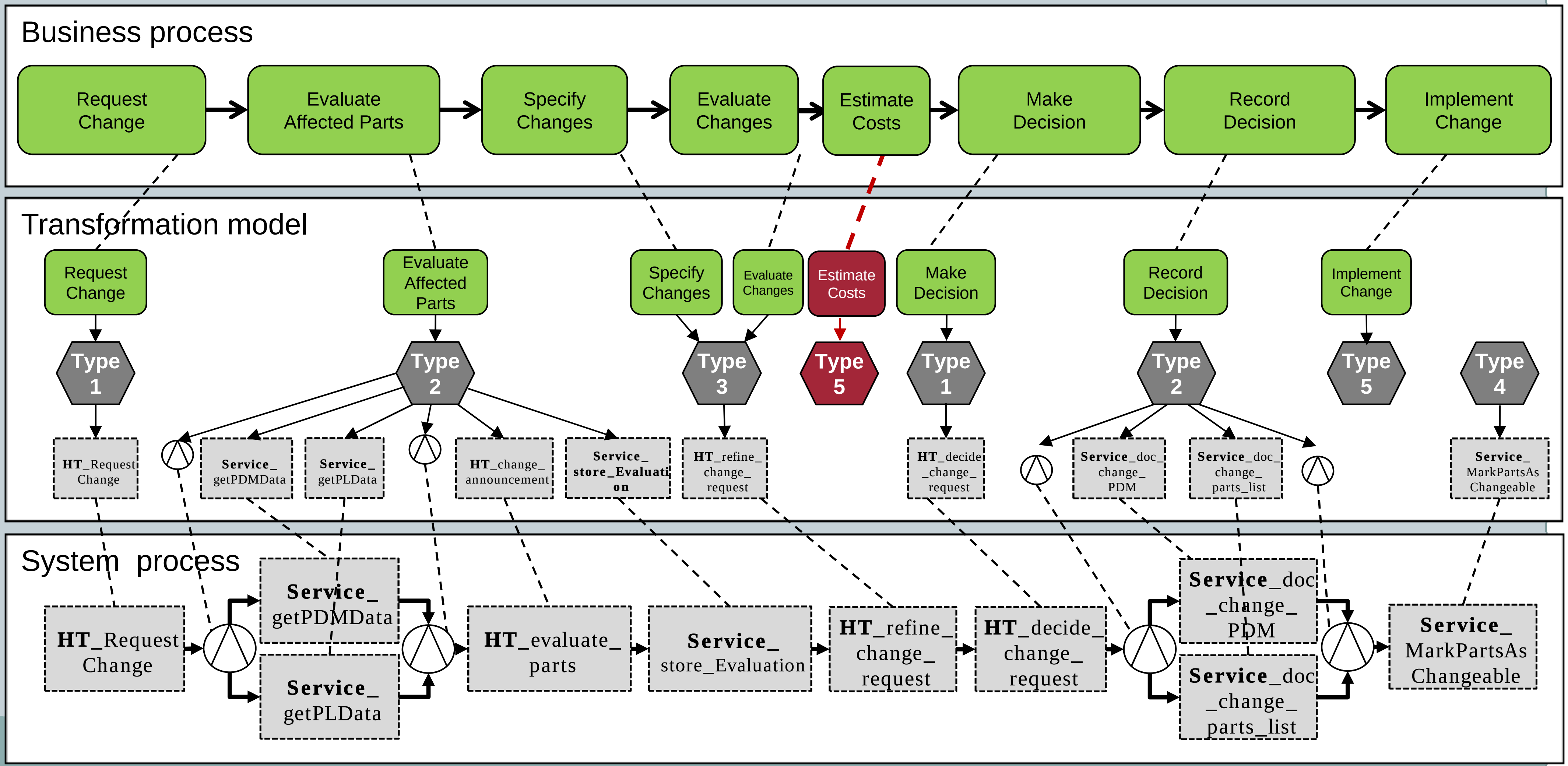
HT = Human Task

Flexibility and Process Evolution



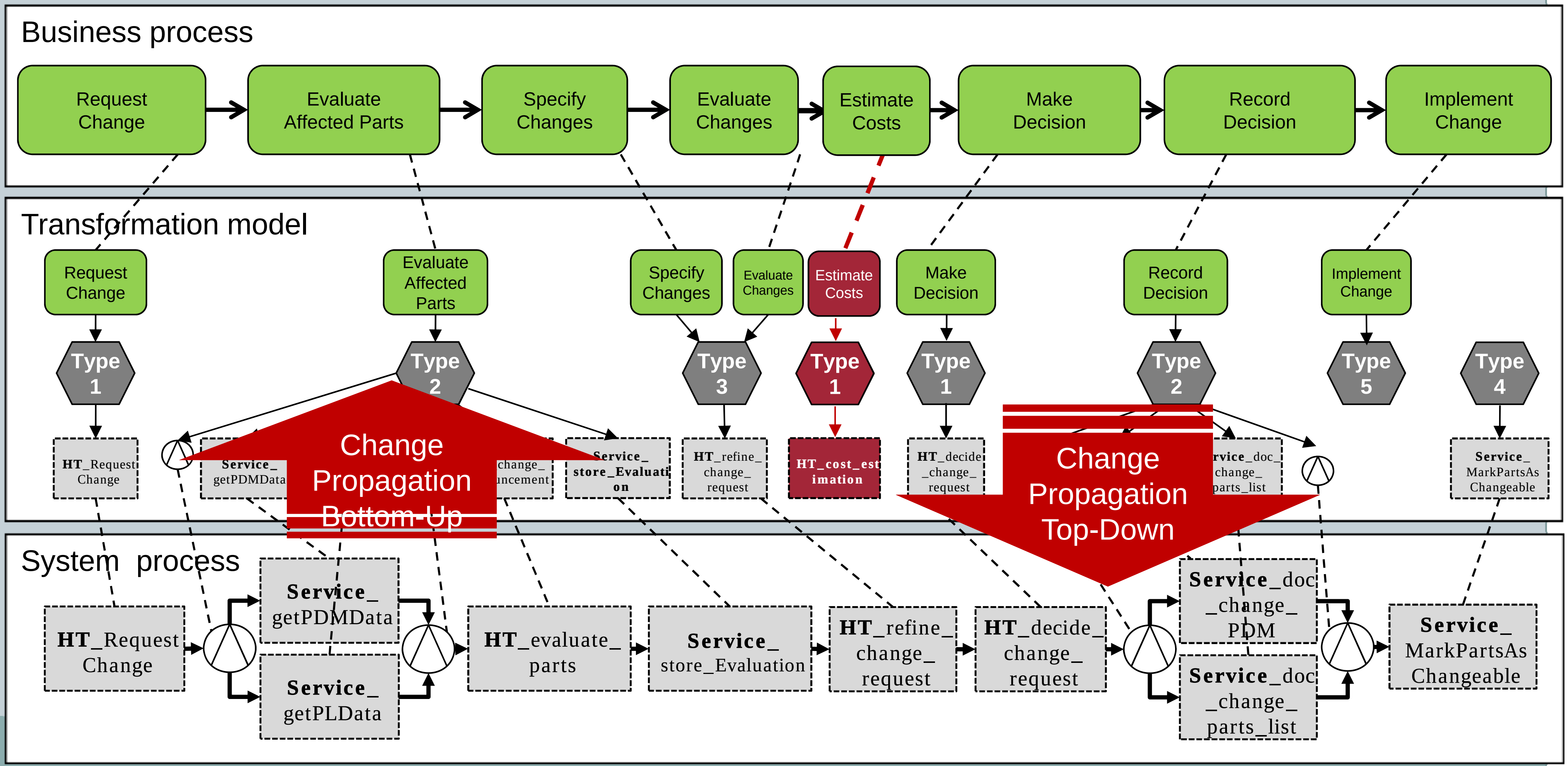
HT = Human Task

Flexibility and Process Evolution



HT = Human Task

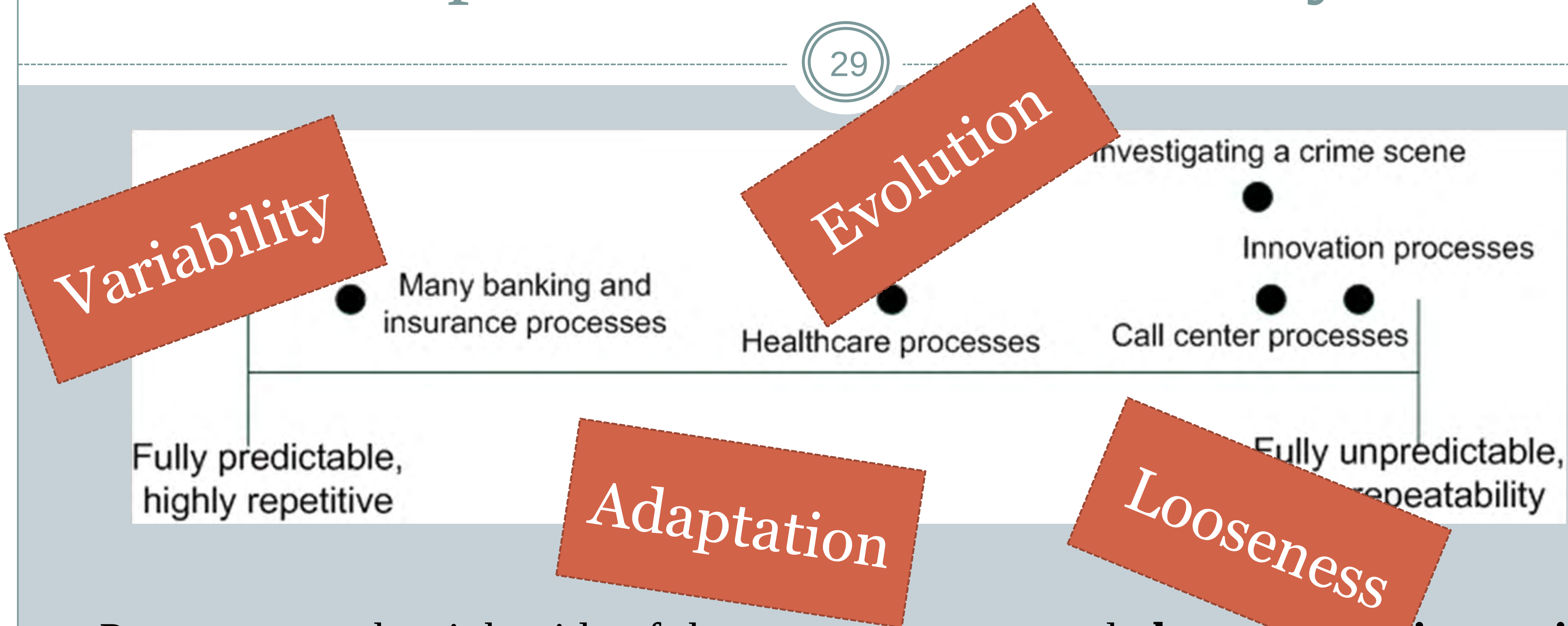
Flexibility and Process Evolution



HT = Human Task

Flexibility Issues

Process Spectrum and Flexibility Needs



- Processes on the right side of the spectrum are mostly **knowledge-intensive**
  - **Unpredictability:** Course of action depends on situation-specific parameters
  - **Non-repeatability:** Two process instances hardly look the same
  - **Emergence:** Future course of action depends on knowledge gained through activity execution

Variability

- Variability is typical for many domains and requires that processes are handled differently depending on the particular context

- Drivers
  - Product and service variability
  - Differences in regulations
  - Different customer groups
  - Temporal differences

Example: Vehicle Repair

Looseness

- Knowledge-intensive processes cannot be fully pre-specified, but require loose specifications

- Drivers
  - Unpredictability
  - Non-Repeatability
  - Emergence

Example: Treatment Processes in a Hospital

Adaptation

- Ability to adapt the process and its structure to temporary events

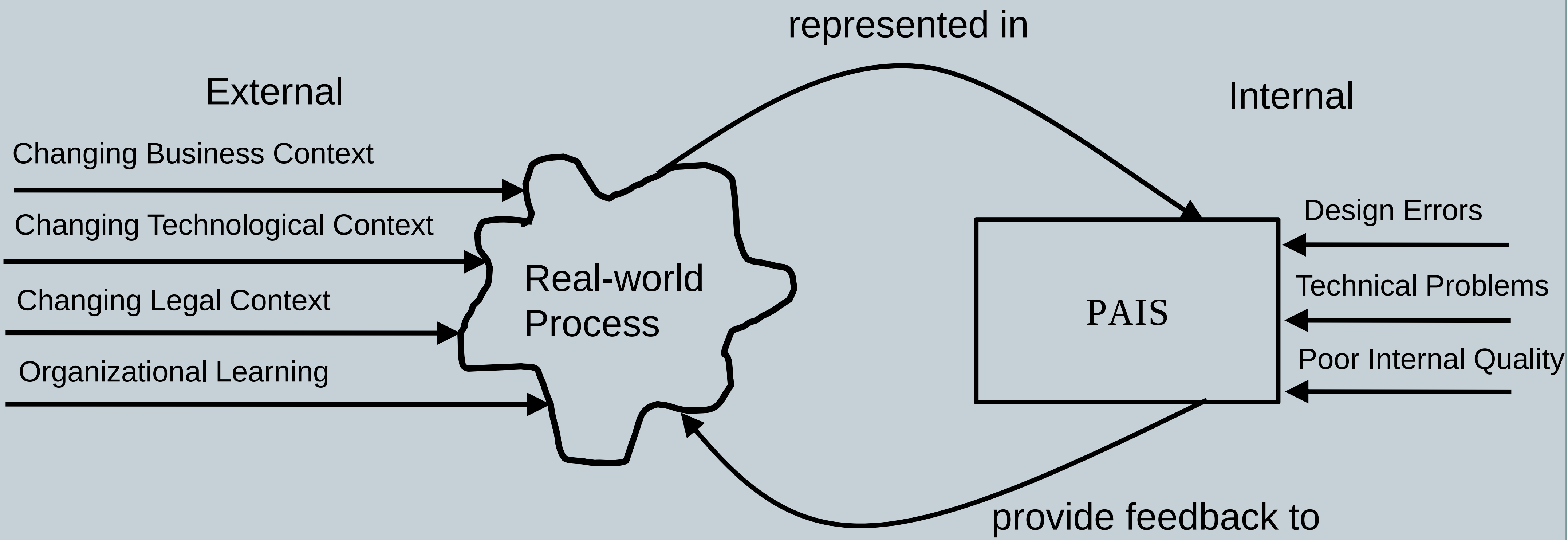
- Drivers
  - Special Situations
  - Exceptions

- Anticipation of Adaptation
  - Planned
  - Unanticipated

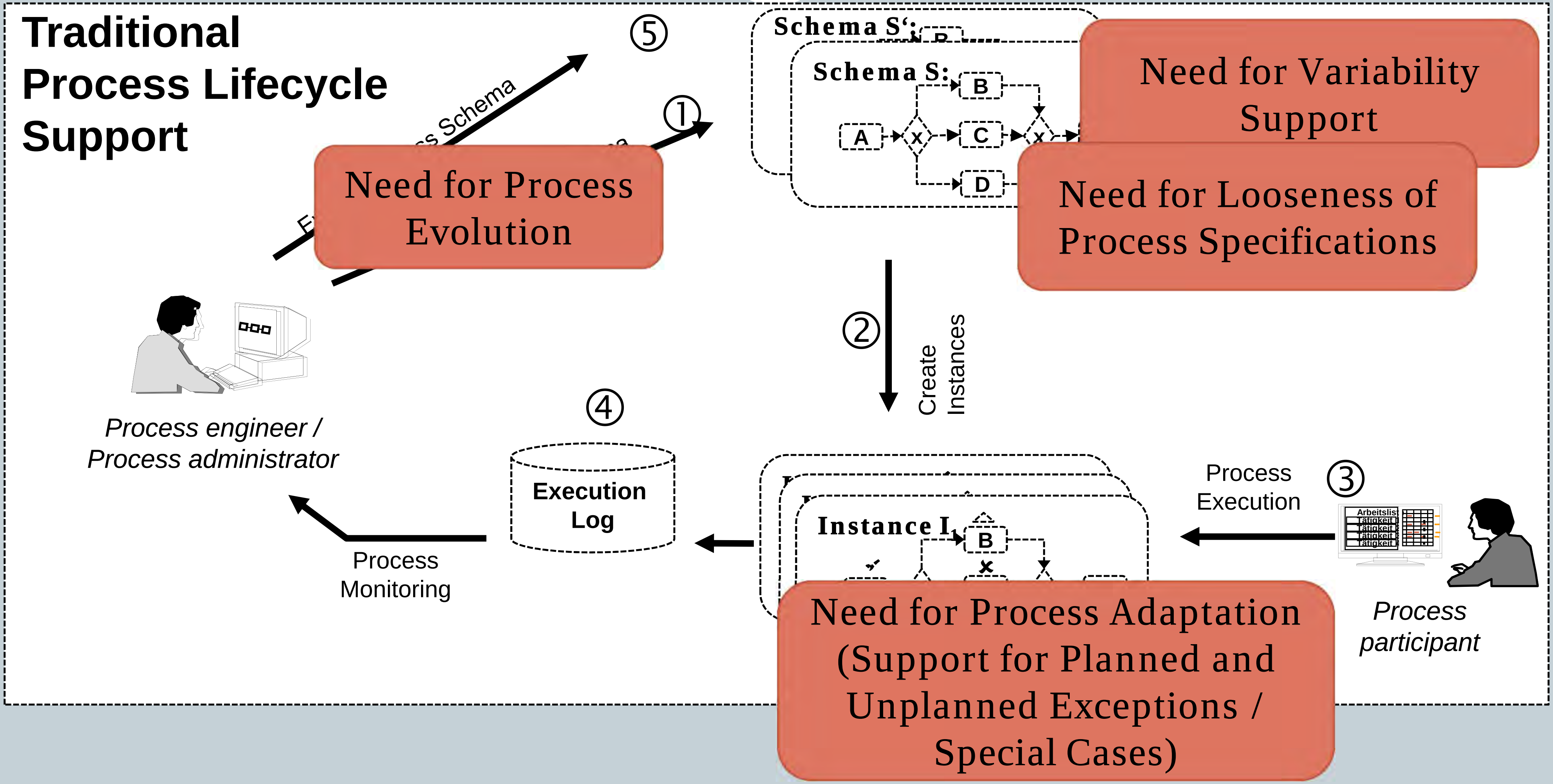
Example: Examination Procedures in a Hospital

Evolution

- Ability of the implemented process to change when the business process evolves
- Drivers



Flexibility Issues along the Process Lifecycle



[WRW+09]

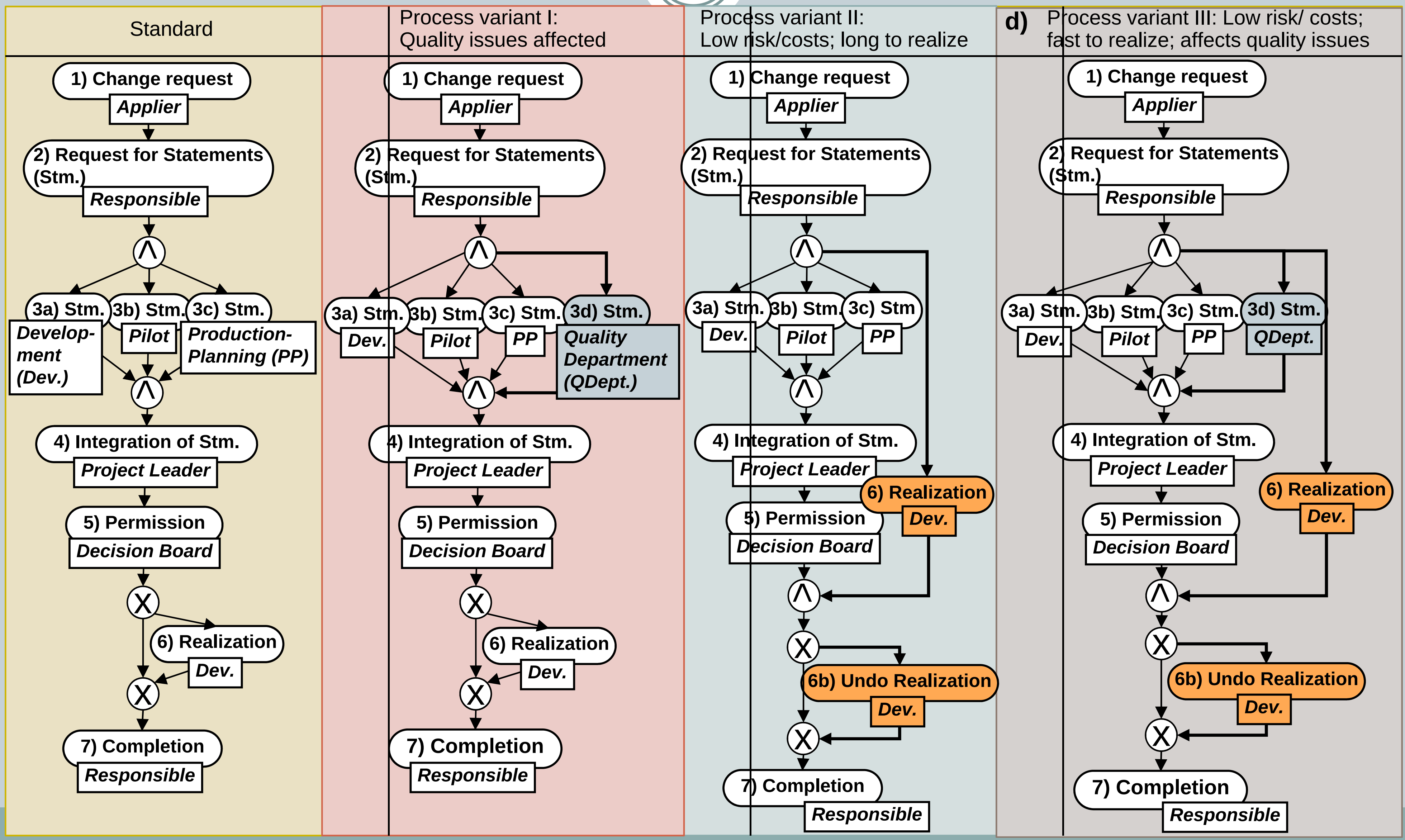
Flexibility Needs and Technological Requirements

Flexibility Need	Dimension	Technological Requirement
Variability		Configuration
Looseness		Loosely-specified processes
Adaptation	Planned Unplanned	Exception Handling Ad-hoc Changes
Evolution	Deferred Evolution Immediate Evolution Poor Internal Quality Organizational Learning	Versioning Process Instance Migration Refactoring Monitoring, Analysis and Mining

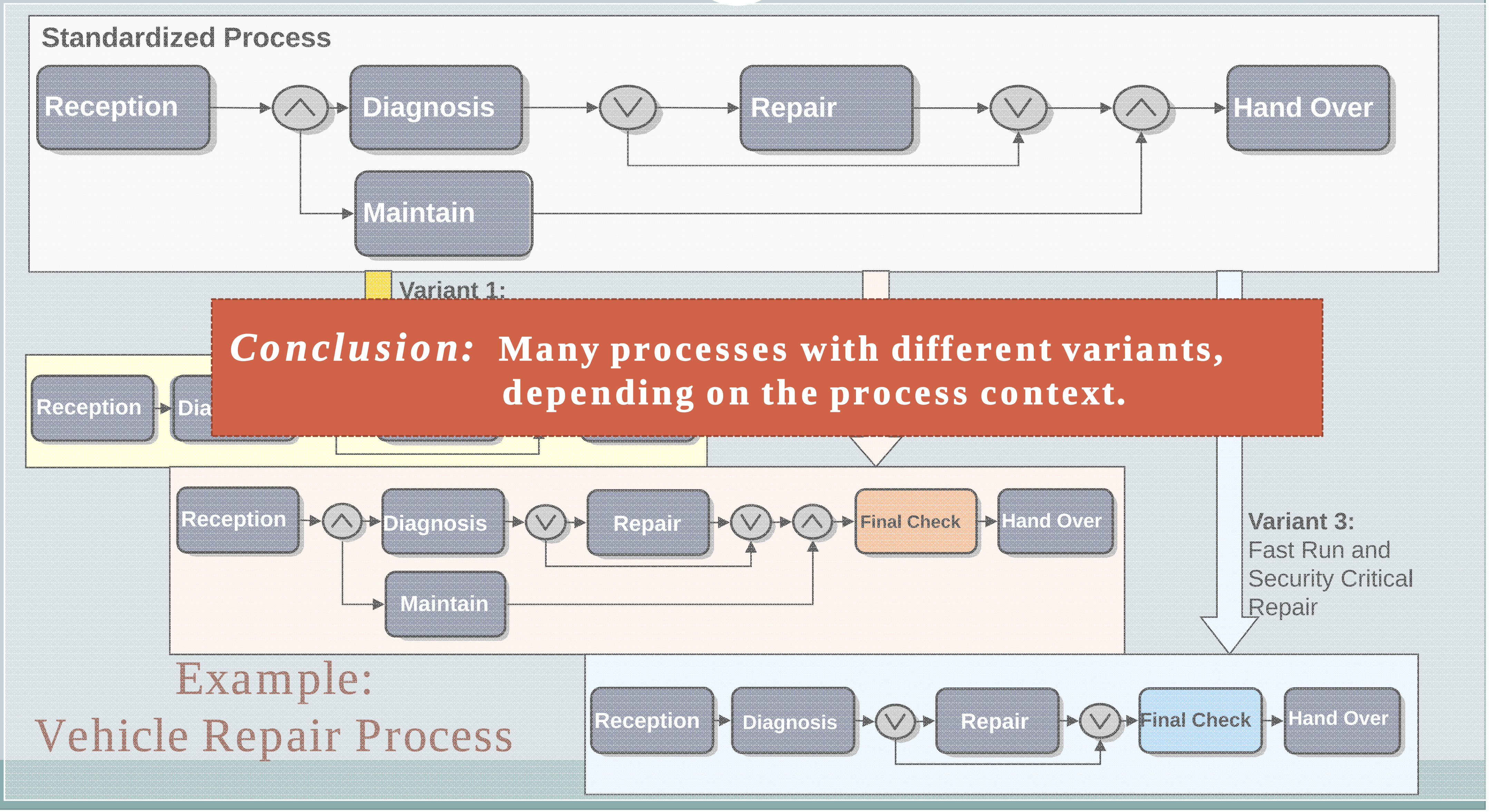
Flexibility Support for Pre-Specified Process Modells

Process Configuration and Process Variants

Example: Change Management Process

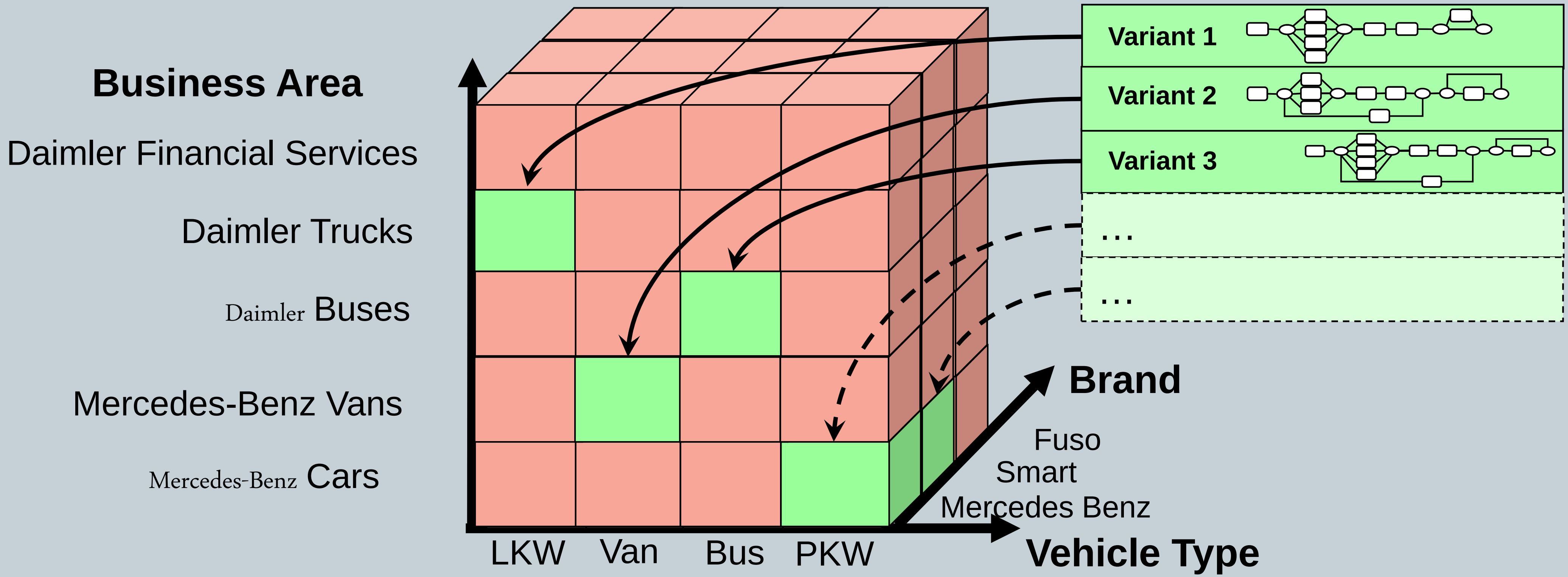


Example: Vehicle Repair Process



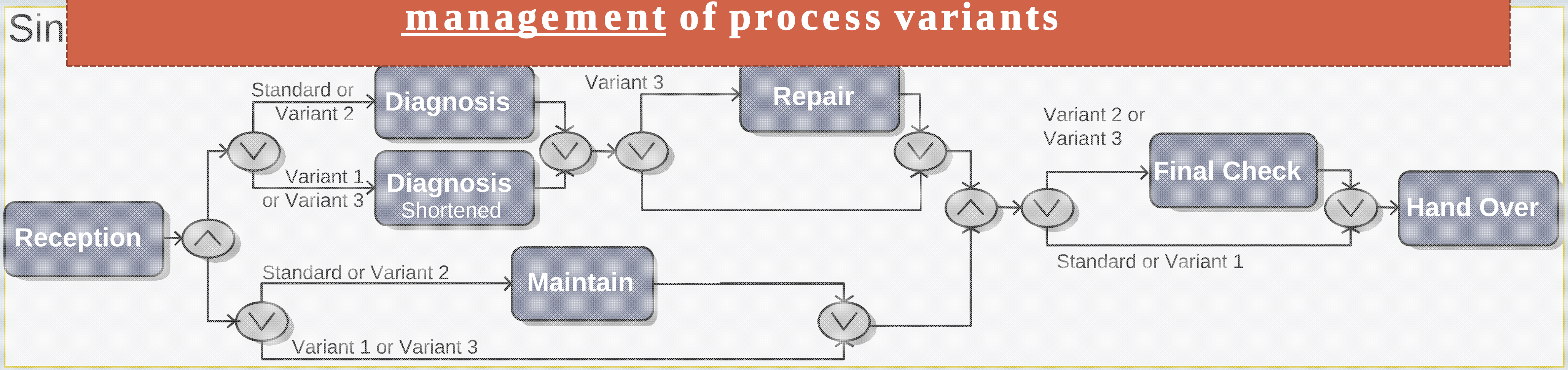
Conclusion: **Many processes with different variants, depending on the process context.**

Context-Driven Process Configuration



Configuration Support in Existing BPM Tools

Conclusion: **Both approaches can be supported by commercial BPM tools, but do not enable <u>transparent</u> and <u>explicit management</u> of process variants**

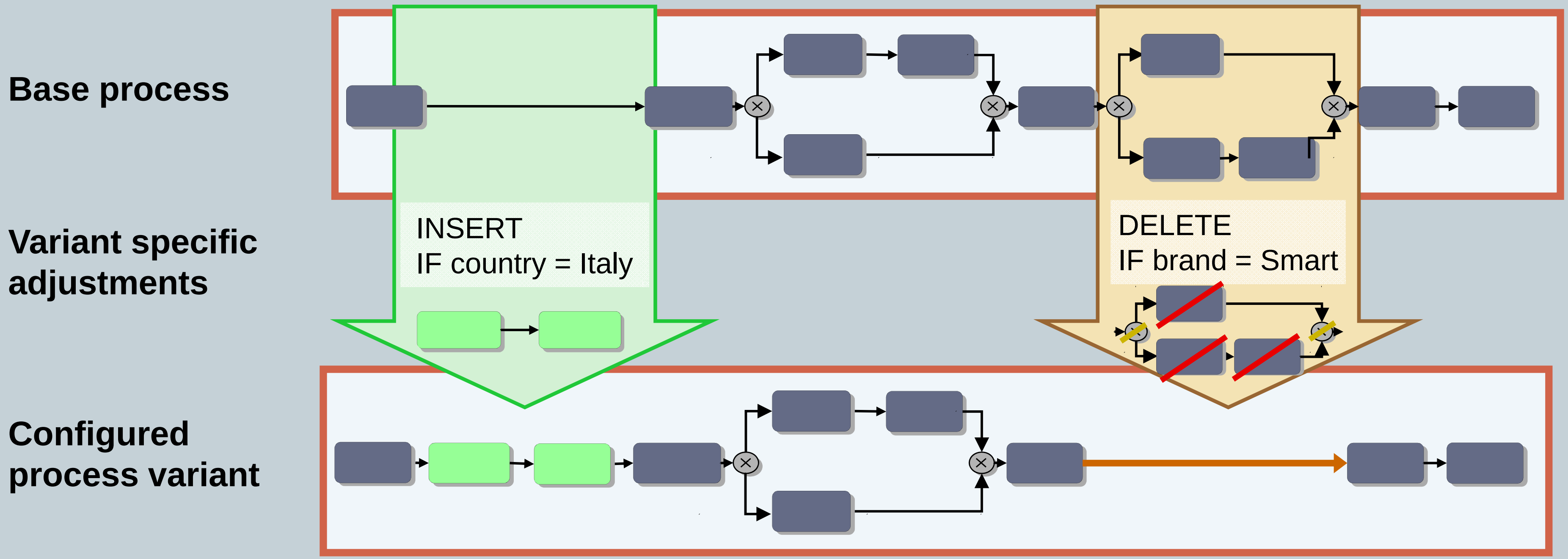


Two Main Approaches for Capturing Process Variability

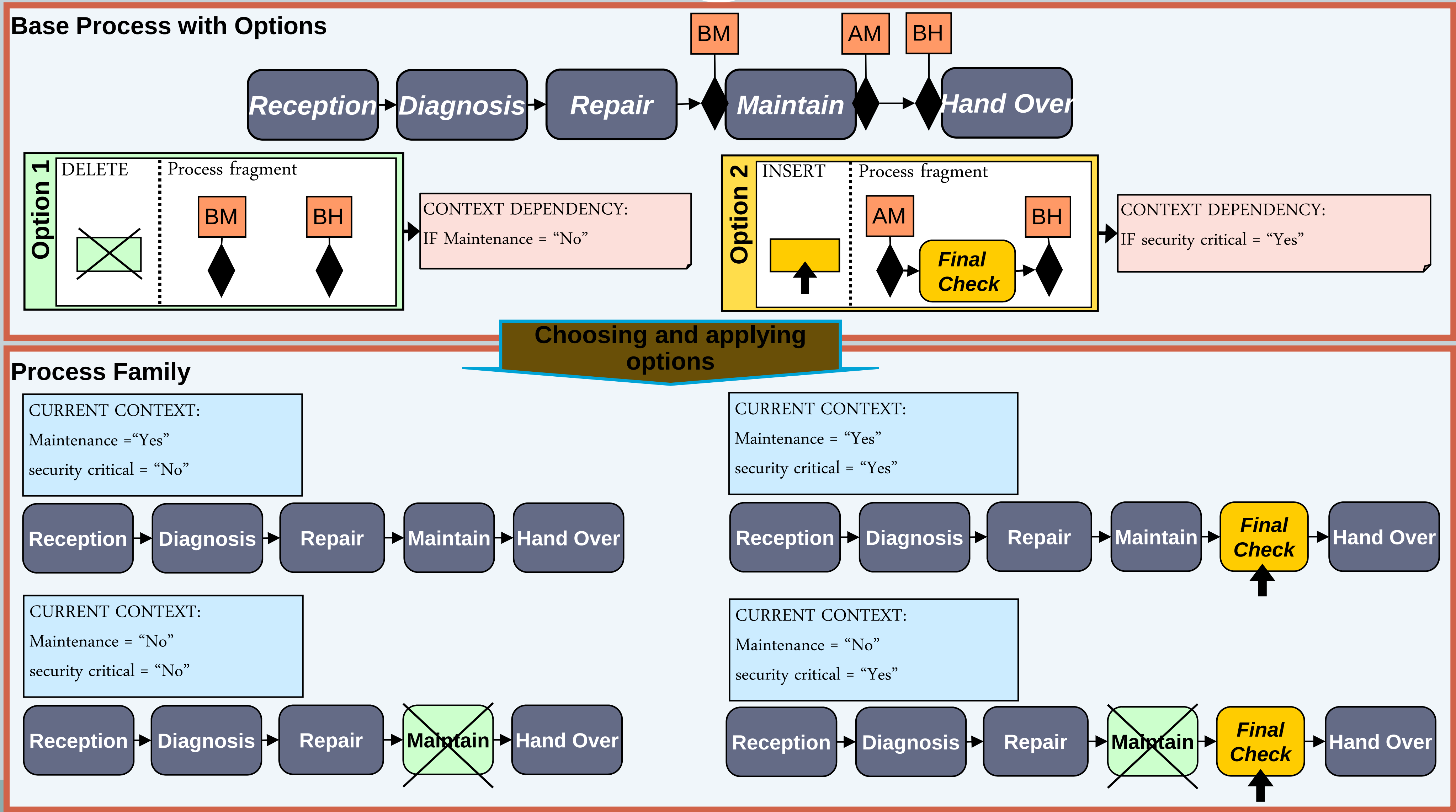
- Structural Approaches

- Behavioral Approaches

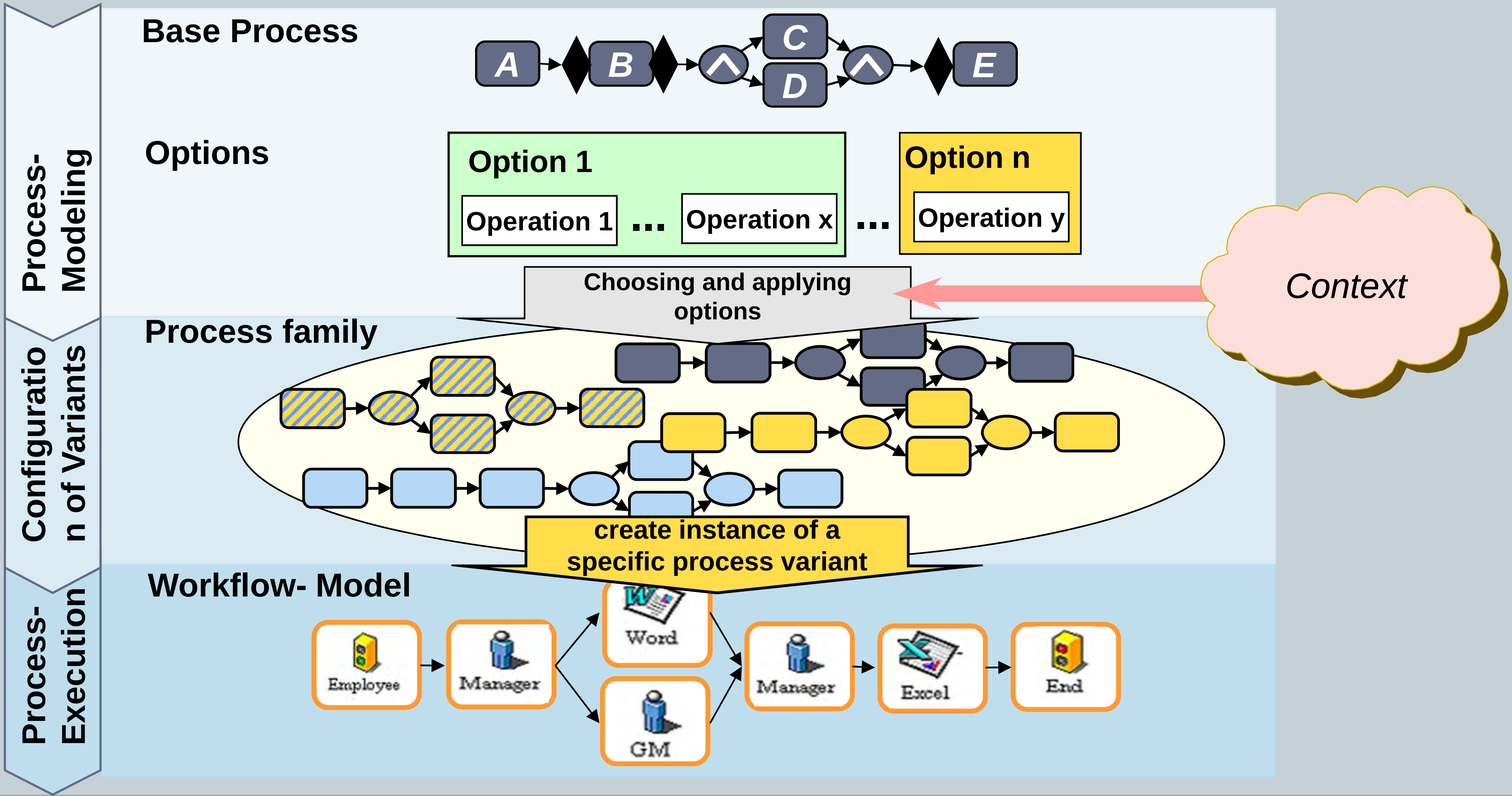
Structural Process Configuration



Structural Process Configuration



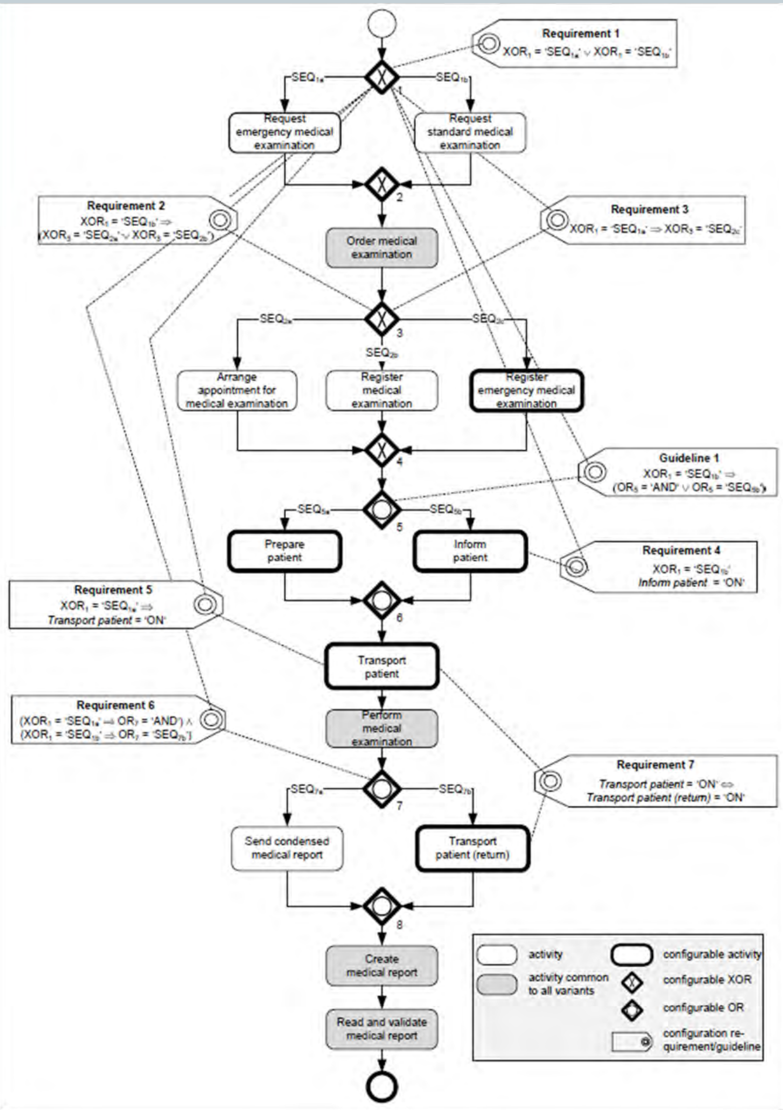
Structural Process Configuration

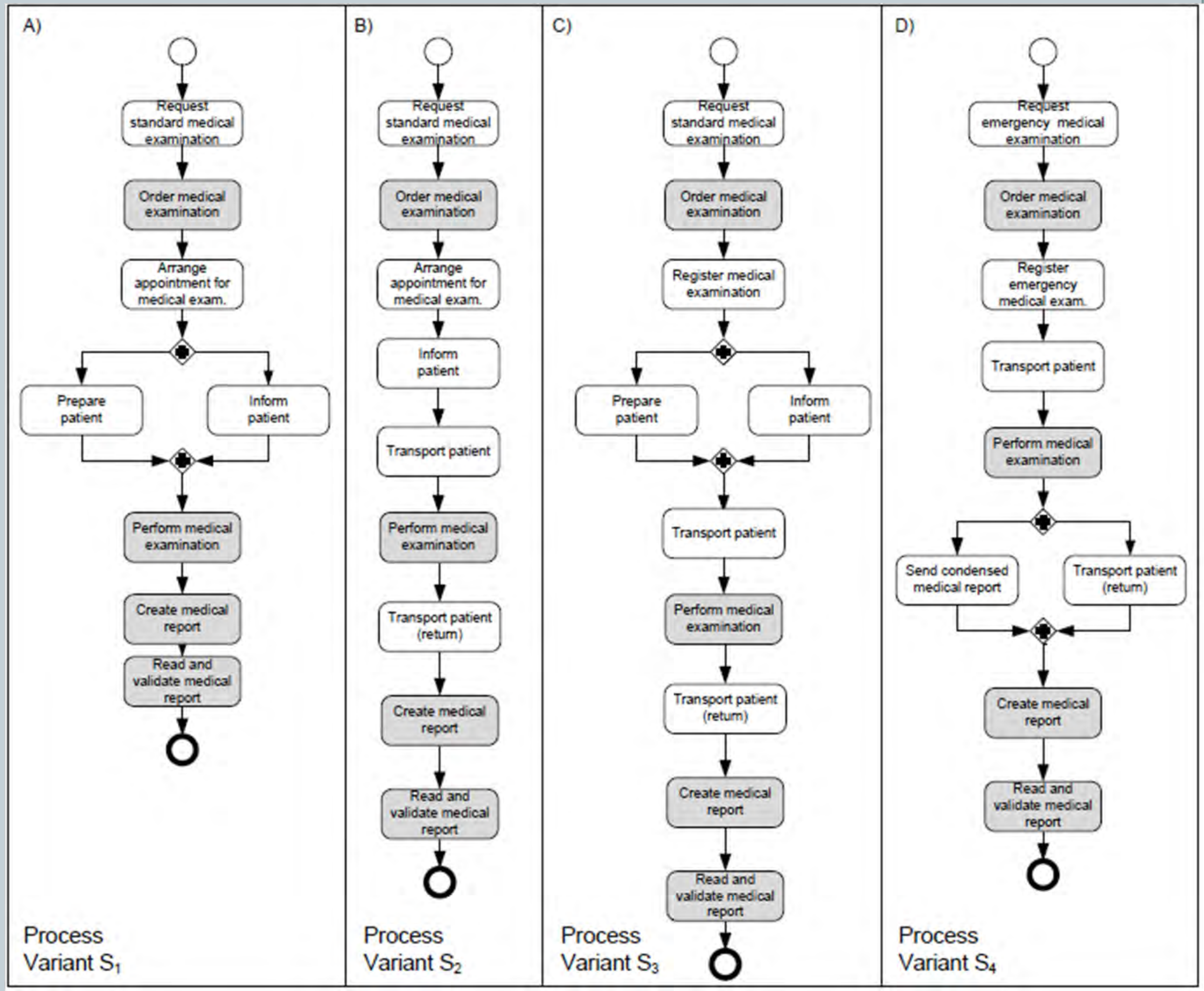


Two Main Approaches for Capturing Process Variability

- Structural Approaches
- Behavioral Approaches

Behavioral Process Configuration

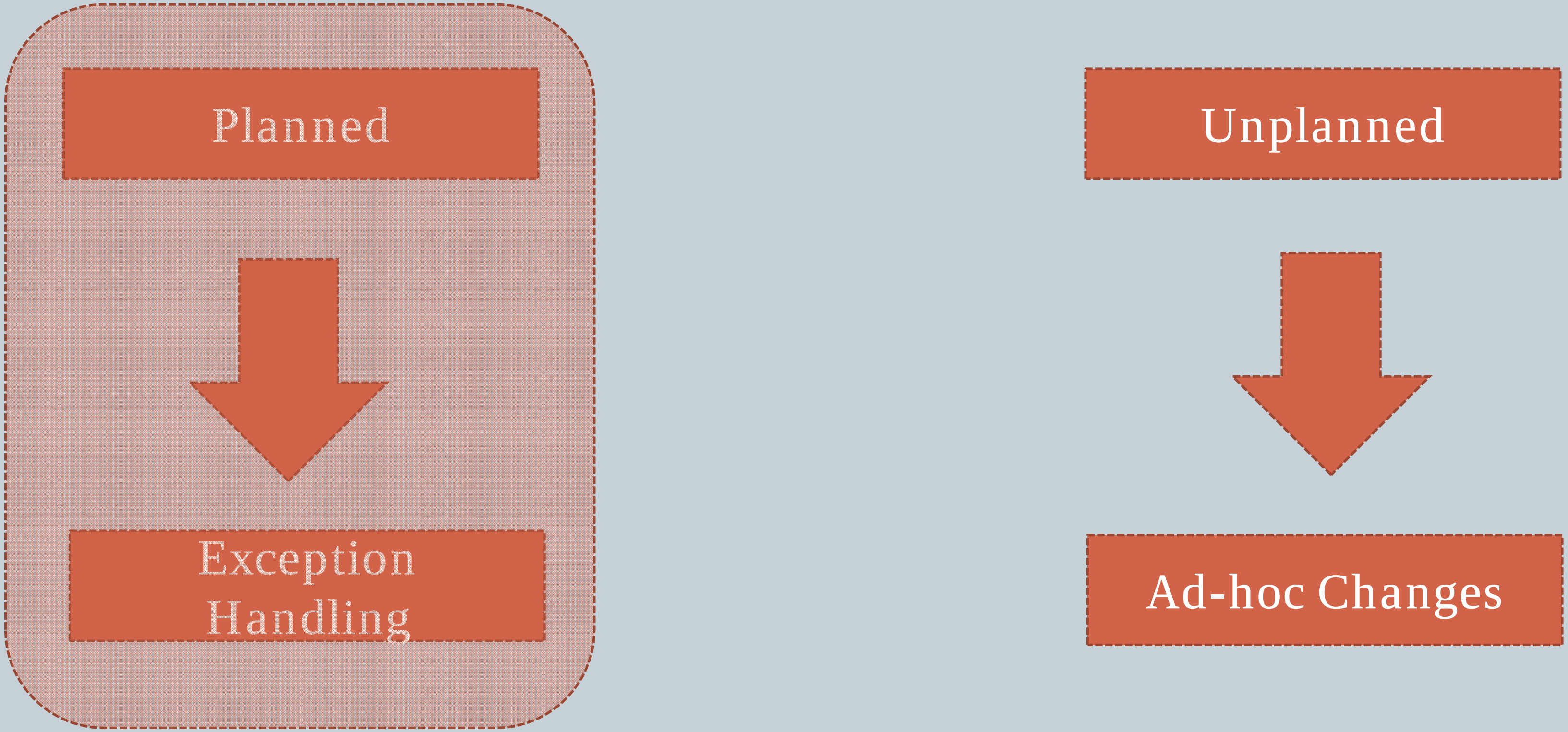




Flexibility Support for Pre-Specified Process Modells

Exception Handling

Process Adaptations



Exception Handling in PAIS

I will skip respective techniques for handling planned execptions in this tutorial and refer to our text book instead!

Sources

Activity F

Technical | Semantical

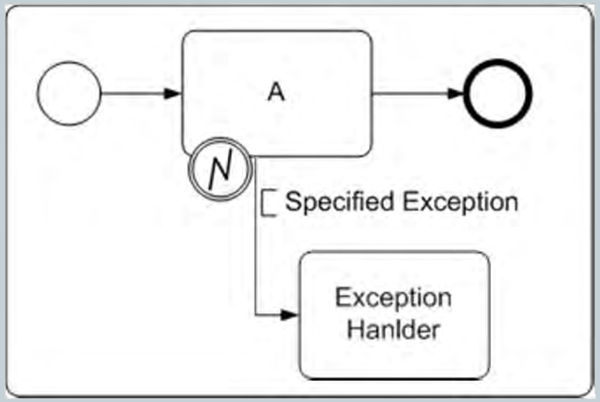
Deadline Expiry

Resource Unavailability

Inconsistence real-world / PAIS

Constraint Violations

exception



a suitable handler is chosen

dler

ves

nordered

Add Behavior

Deferred Fixing | Immediate Fixing

Retry | Exception-driven Rework

Cancelling Behavior

Reject | Compensate

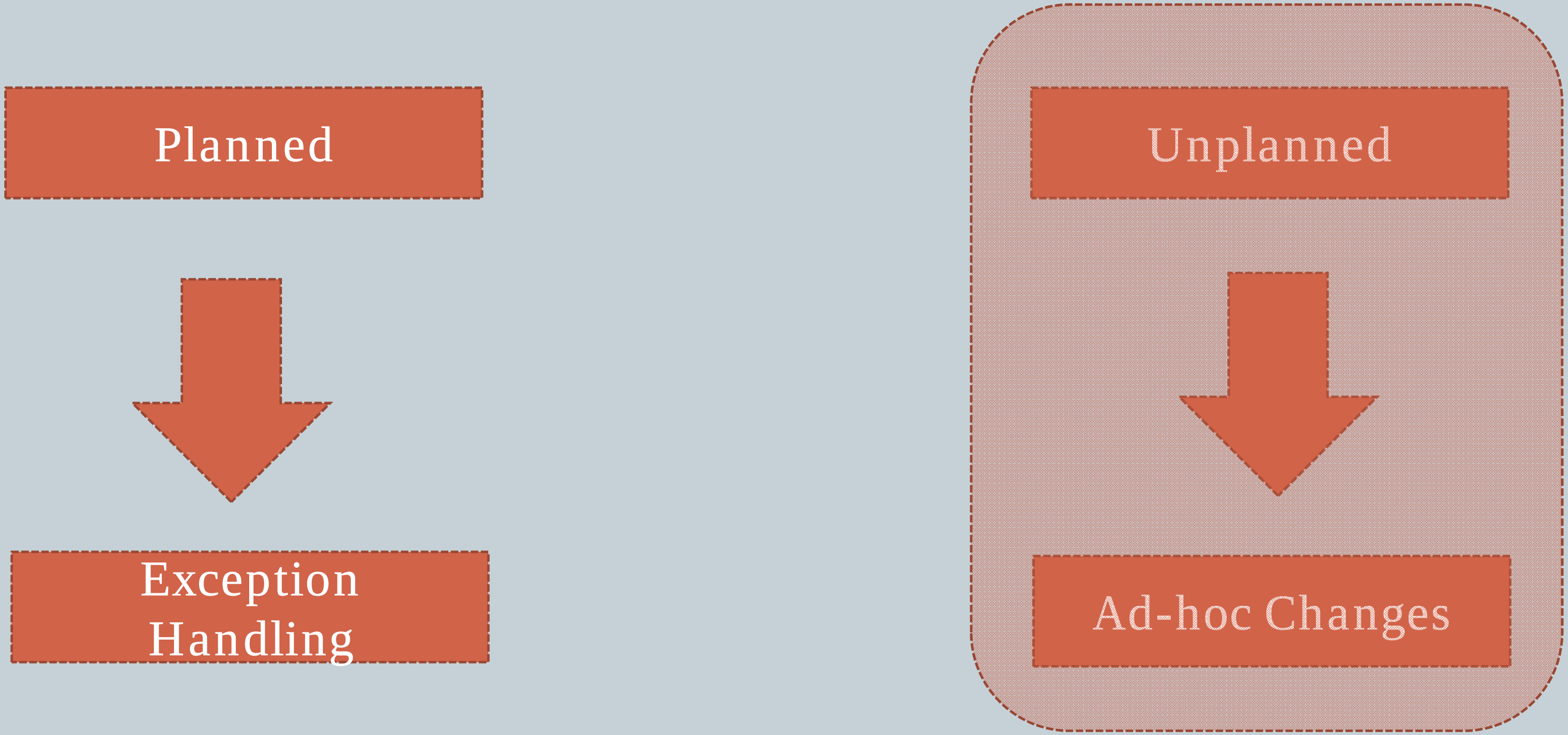
Resource Patterns

Delegate | Escalate | ...

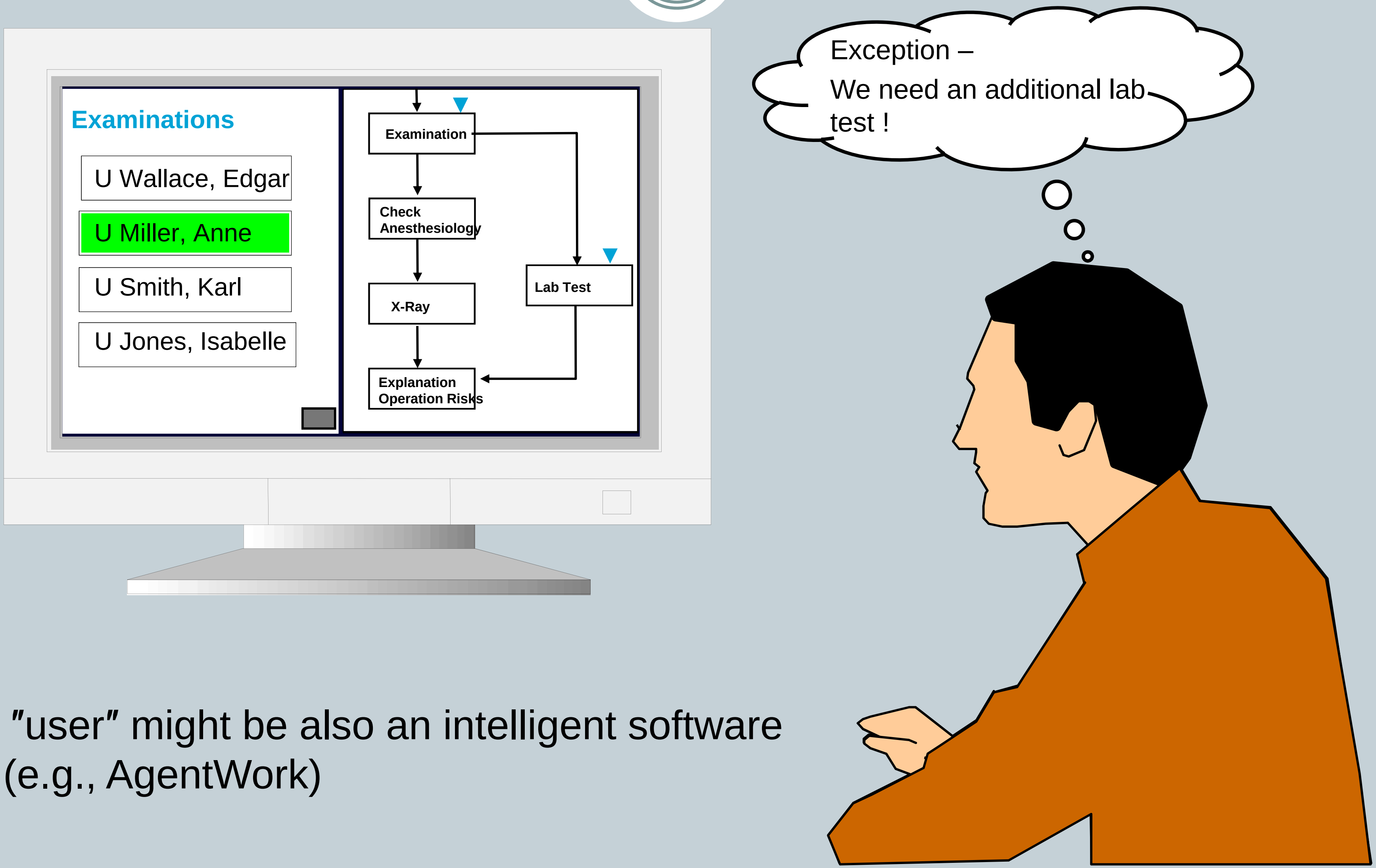
Flexibility Support for Pre-Specified Process Modells

Handling Unforeseen Exceptions

Process Adaptations

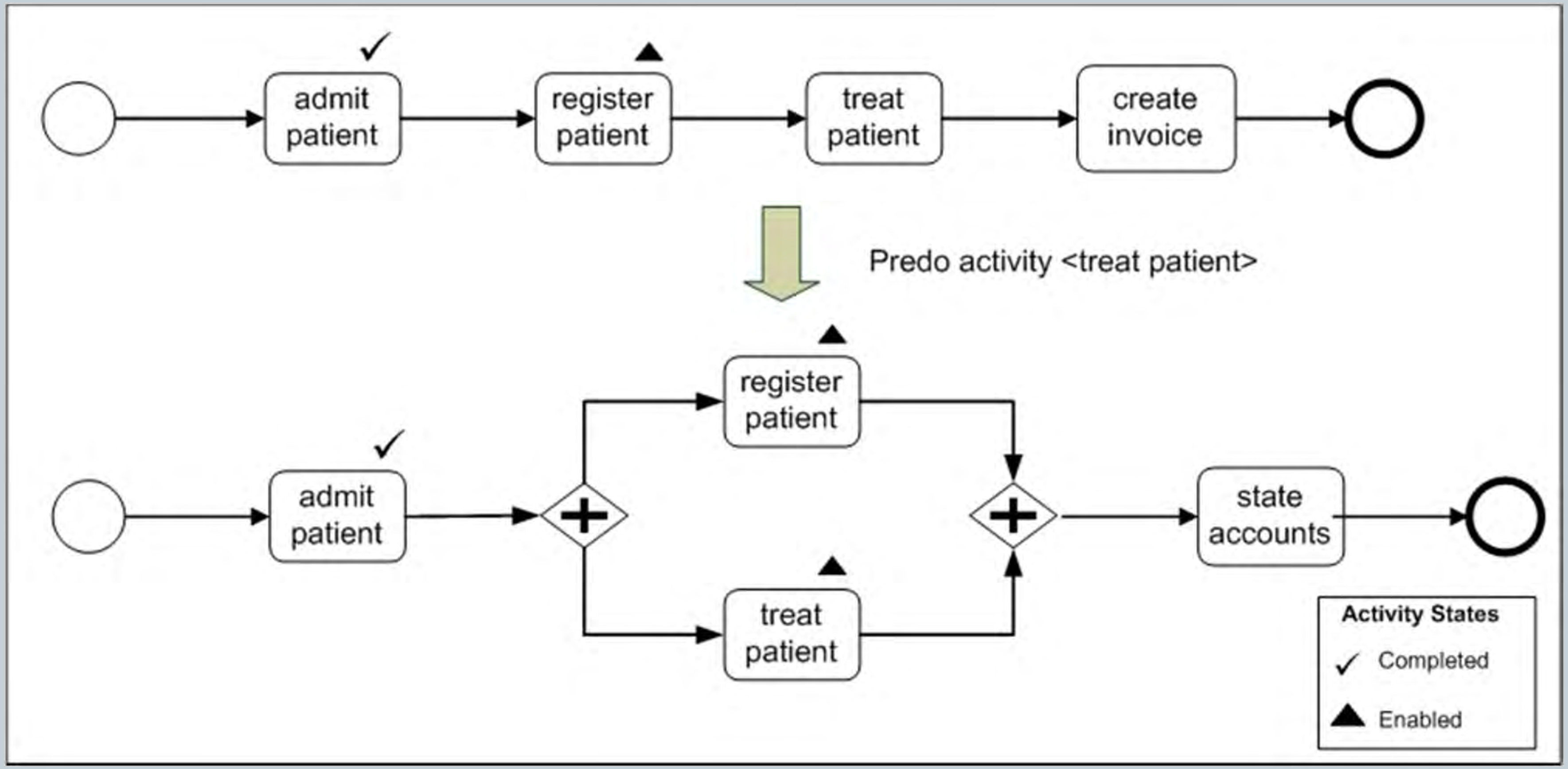


User View on an Ad-hoc Process Change

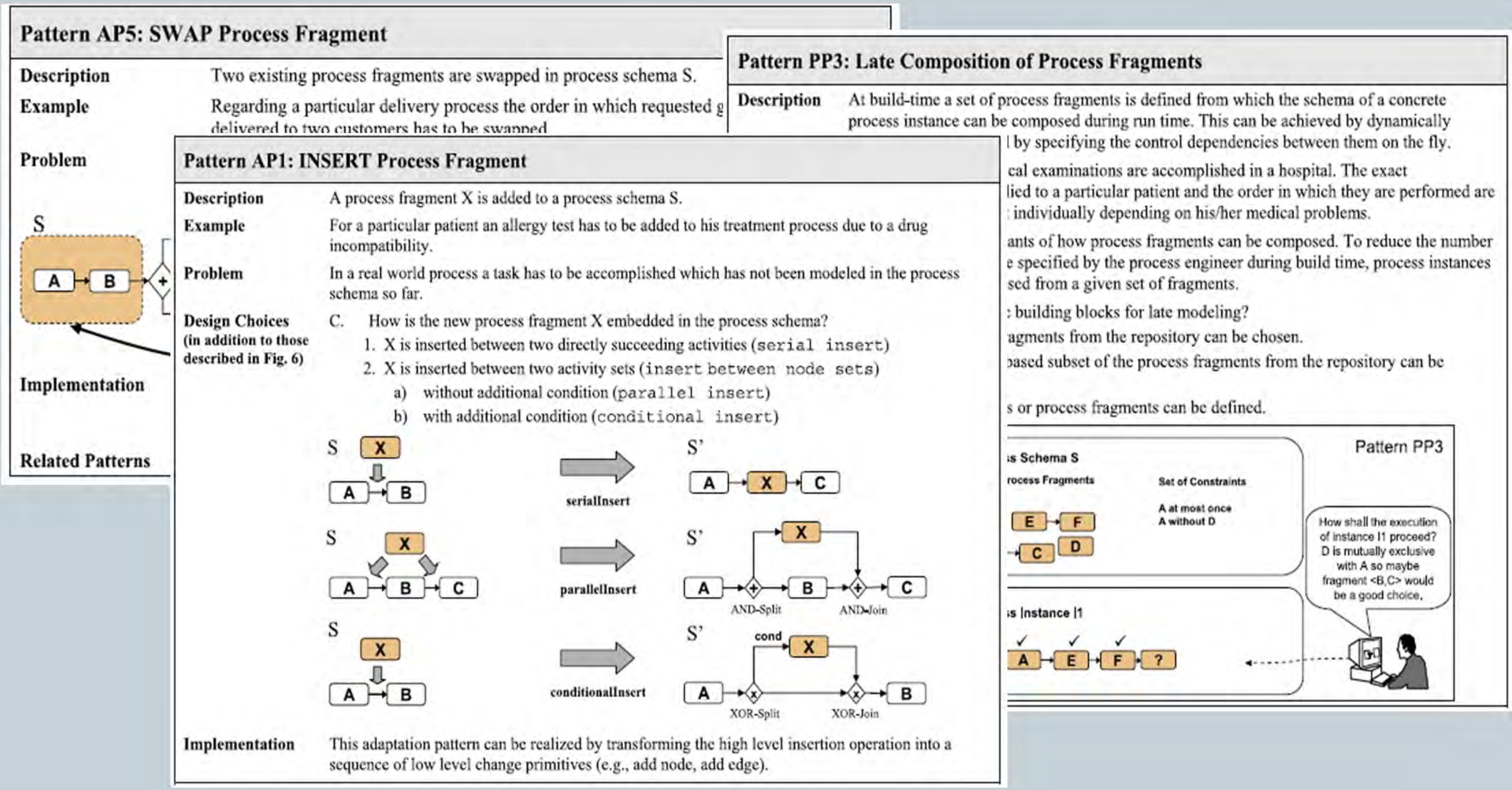


… the "user" might be also an intelligent software agent (e.g., AgentWork)

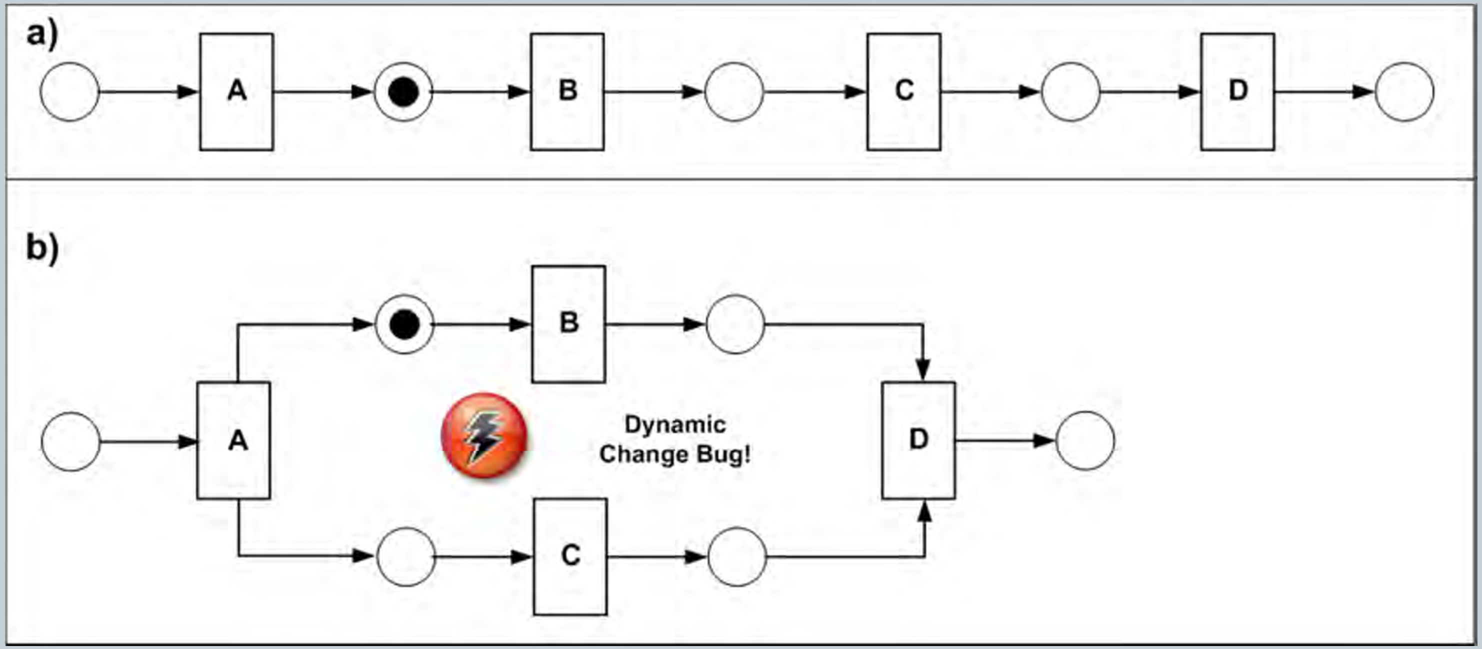
Behavioral Changes Require Structural Process Model Adaptations



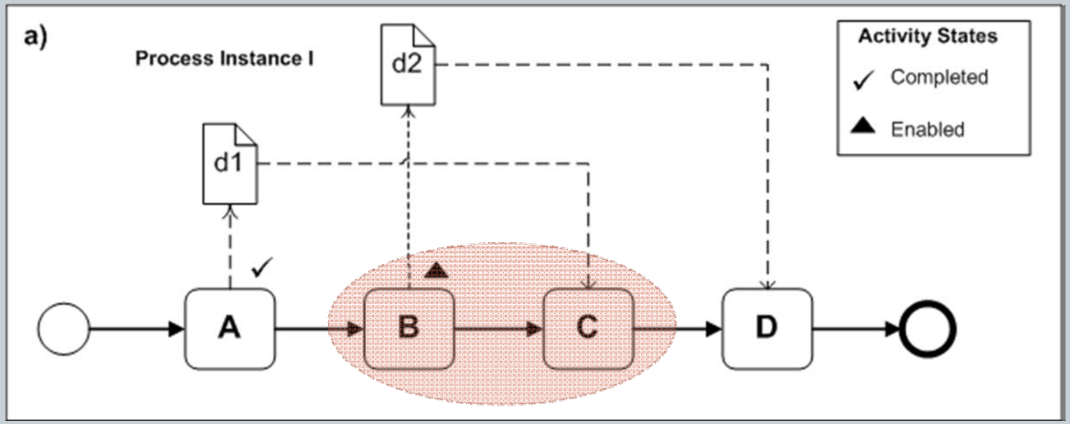
Structural Process Model Adaptations: Change Patterns

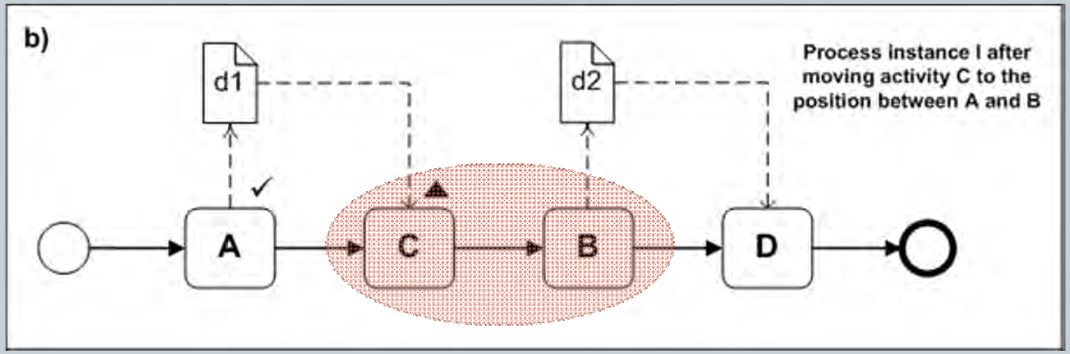


Dynamic Change Bug

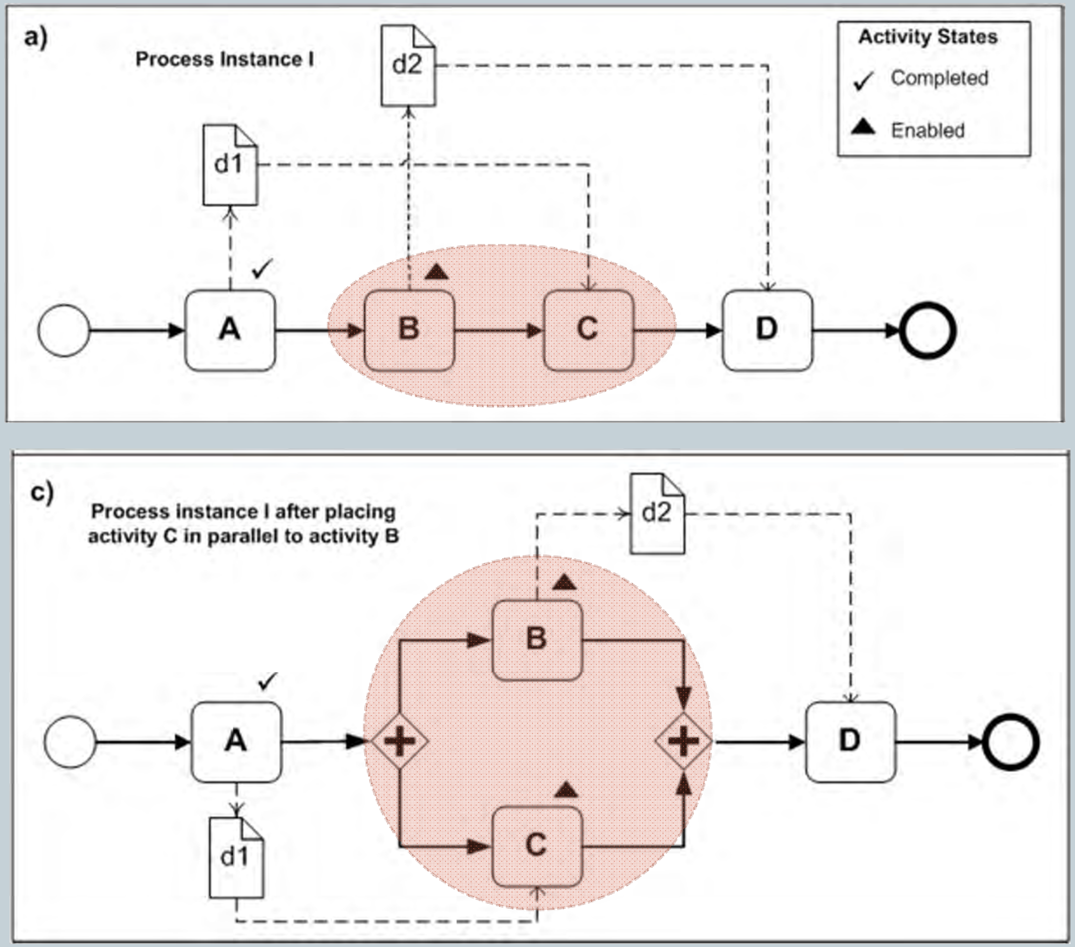


Behavioral Changes Require Adaptations of the Process Instance State



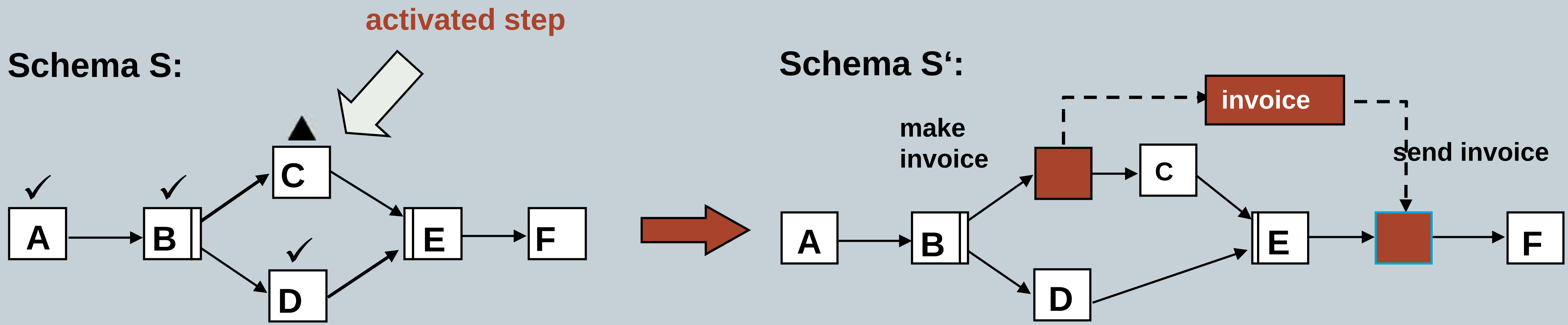


Behavioral Changes Require Adaptations of the Process Instance State



Behavioral Changes Must not Violate Process Model Soundness and Proper Instance Execution

Ensuring Dynamic Correctness



May the depicted schema change be propagated to the process instance?

Need for general correctness criterion

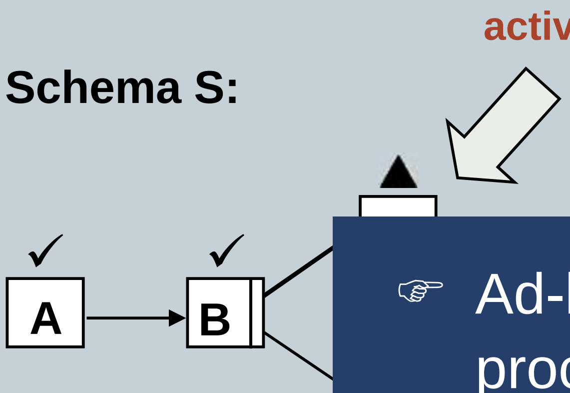
⇨State Compliance

[ReDa98, RRW08a, RRD04a, RRD04b]

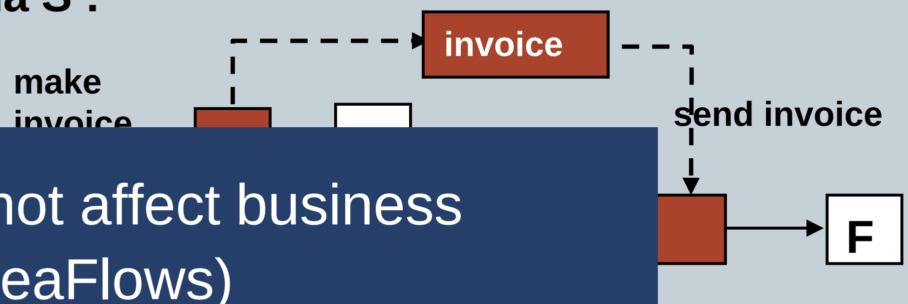
Behavioral Changes Must not Violate Process Model Soundness and Proper Instance Execution

Ensuring Dynamic Correctness

Schema S:



Schema S':



- ☞ Ad-hoc changes must also not affect business process compliance (e.g., SeaFlows)
- ☞ How to assist users in applying ad-hoc changes (e.g., CBRFlow, ProCycle)?
- ☞ How to automate such instance changes (e.g., AgentWork)

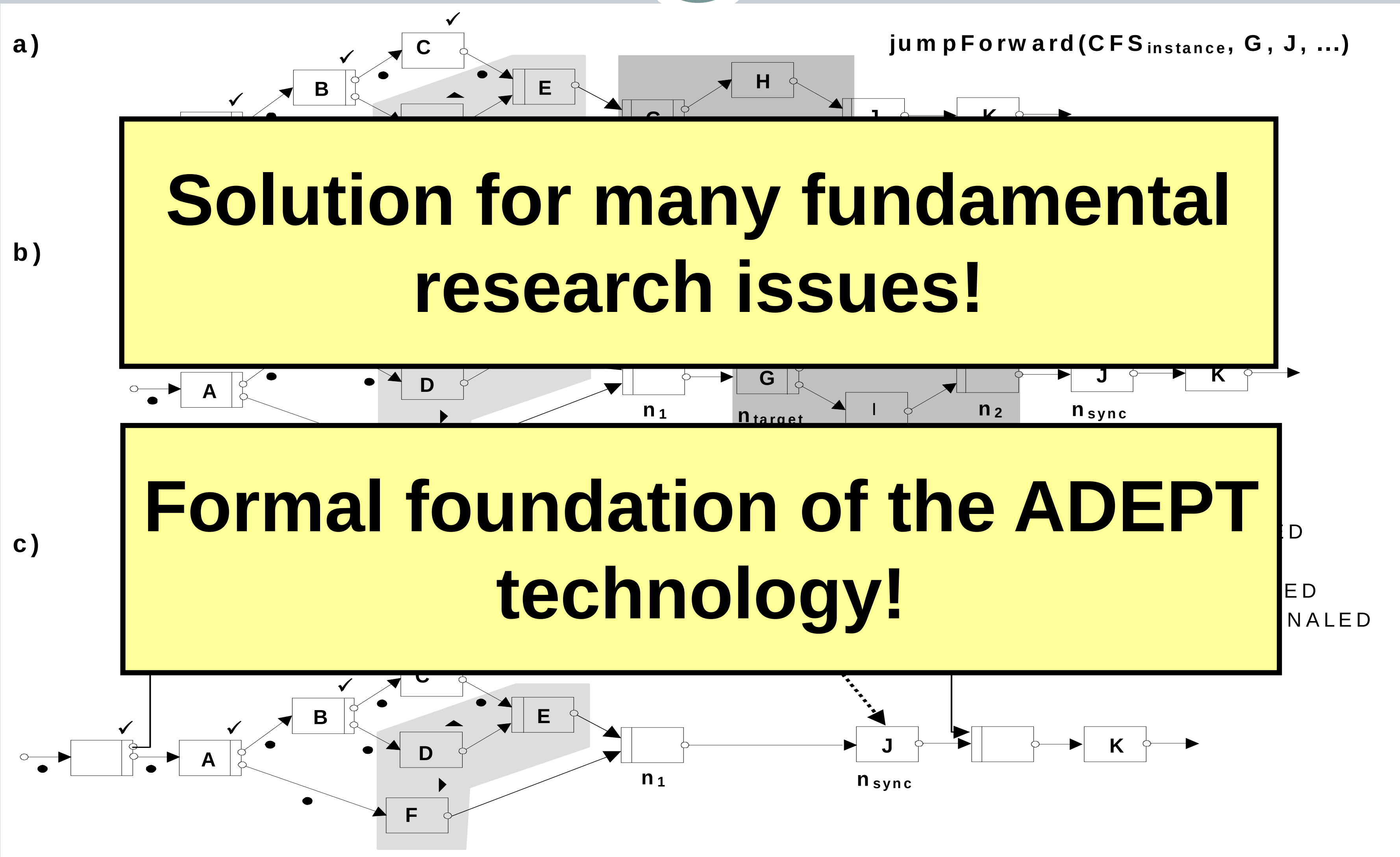
<A> , <B> , <D

More complica

Further challenges: **- How to efficiently check for state compliance?**
- How to efficiently migrate process instances?

[RRD04a, RRD04b]

The ADEPT Framework

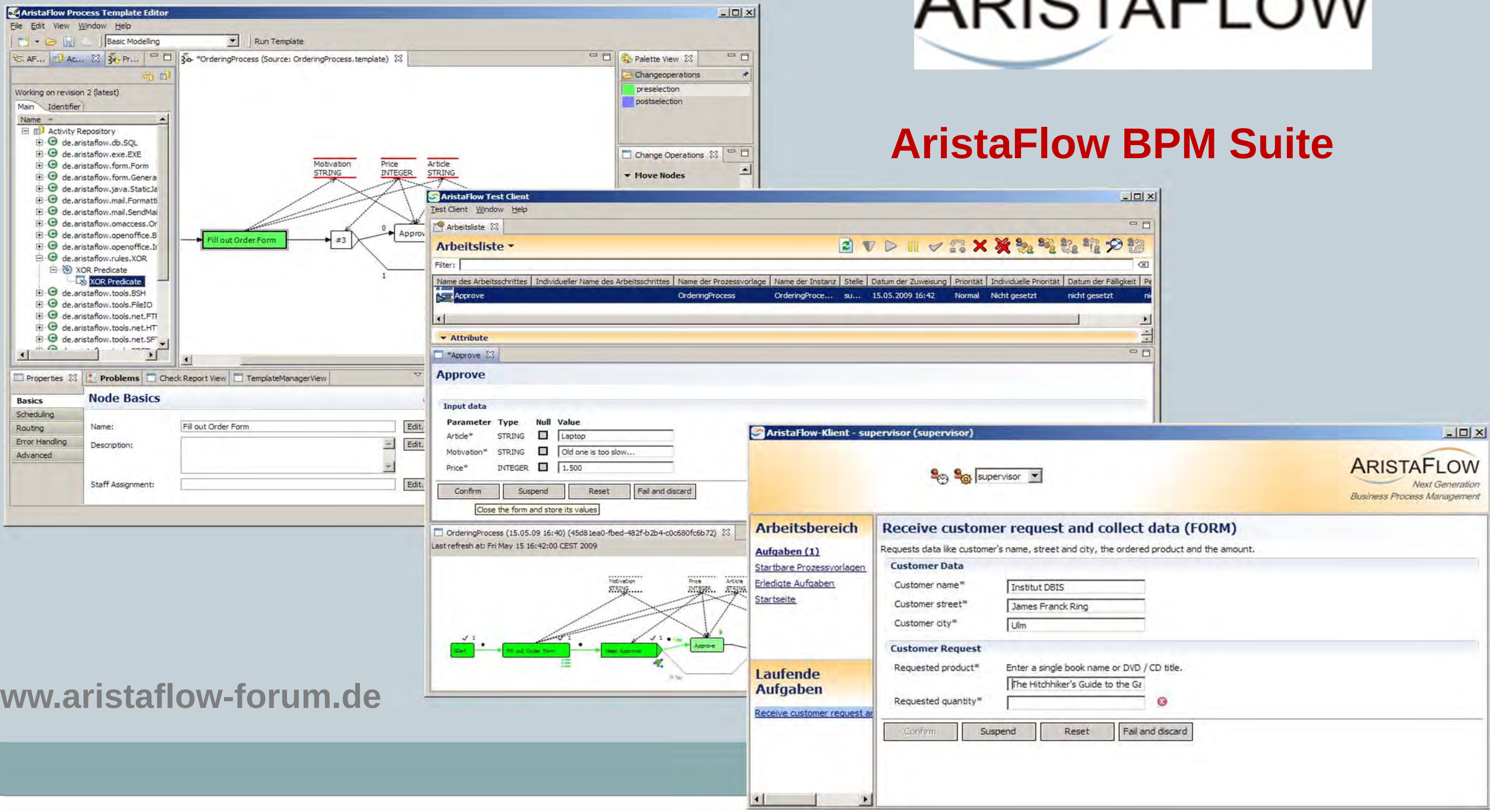


Solution for many fundamental research issues!

Formal foundation of the ADEPT technology!

… and its transfer to industrial practice

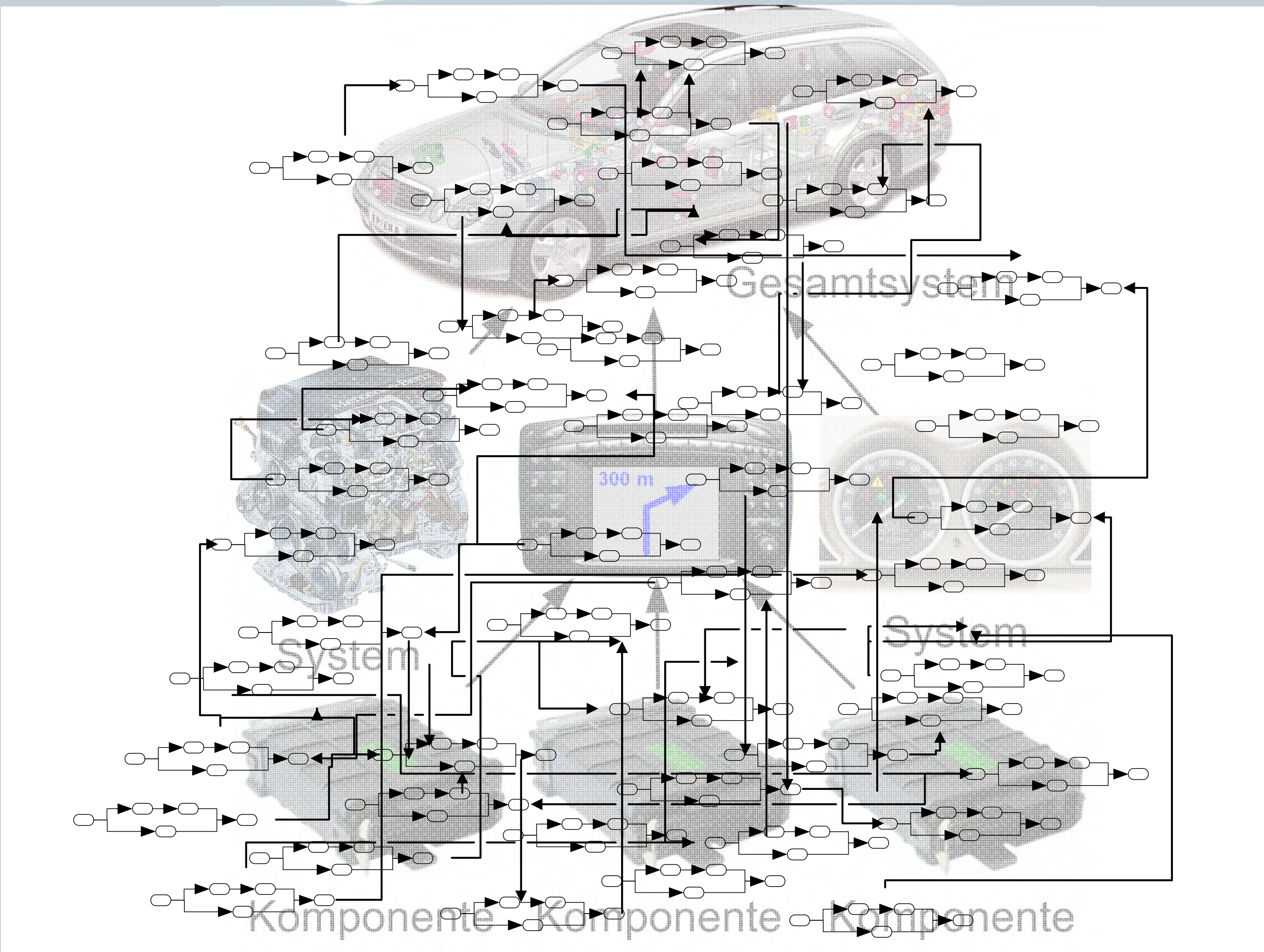
AristaFlow BPM Suite



www.aristaflow-forum.de

Challenge: Adapting Large Process Structures

- Modeling
- Execution
- Dynamic Adaptation
- Exception Handling

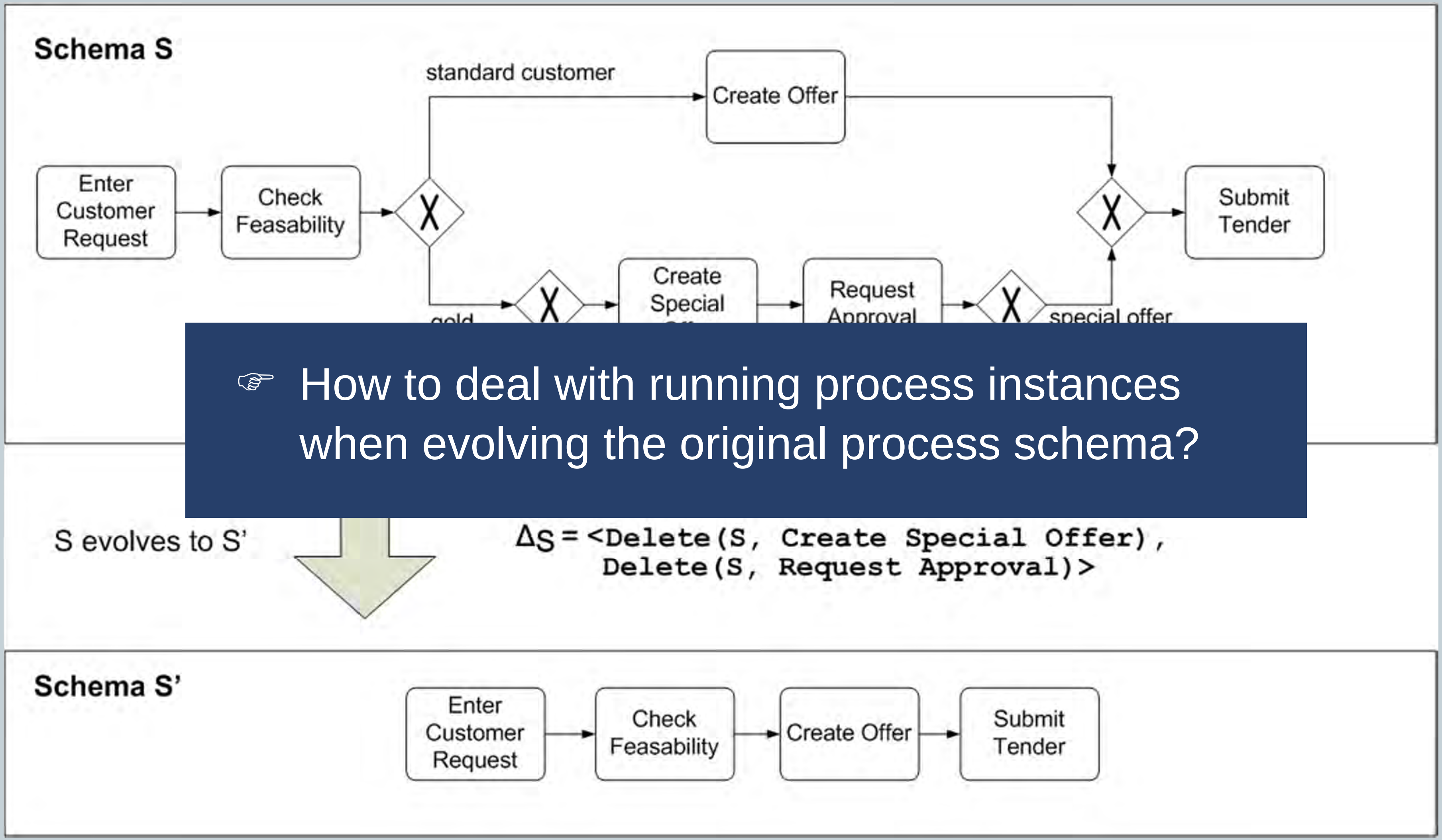


see Corepro and Proclets projects

Flexibility Support for Pre-Specified Process Modells

Process Schema Evolution

Schema Evolution: Changes at the Process Type Level

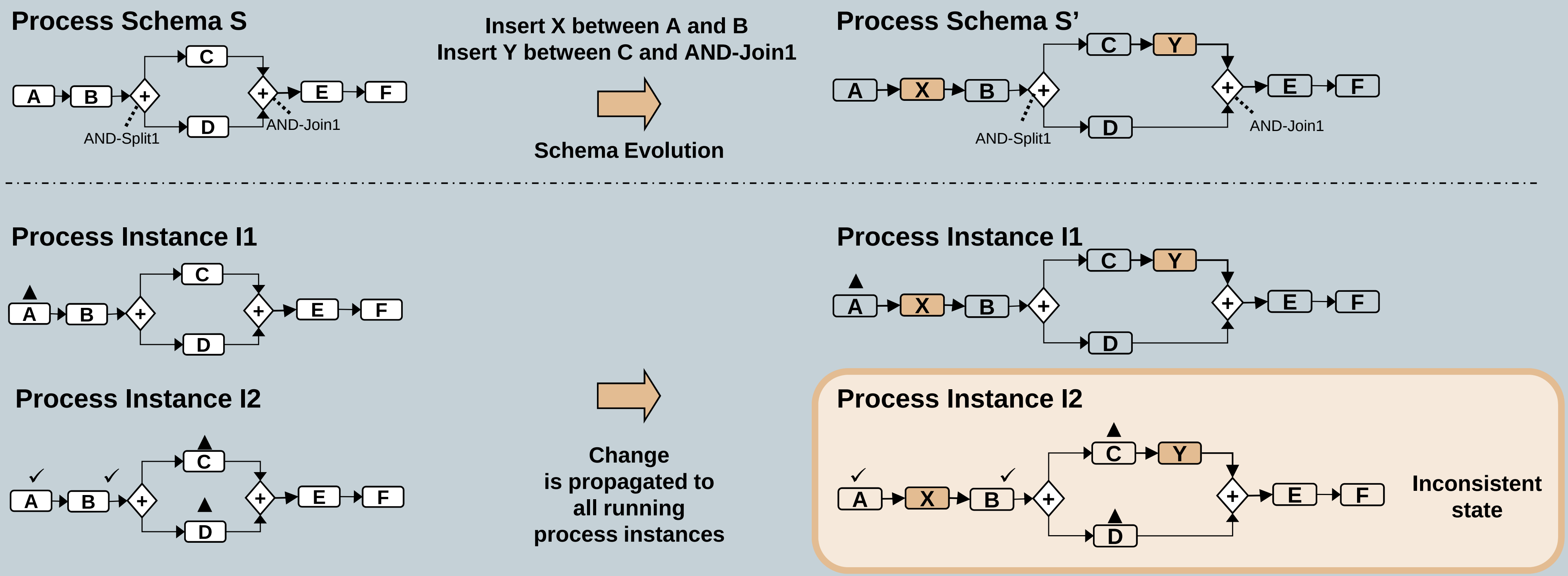


☞ How to deal with running process instances when evolving the original process schema?

Scenario 1 - No Version Control

- Schema is overwritten and instances are migrated

Type change overwrites schema S

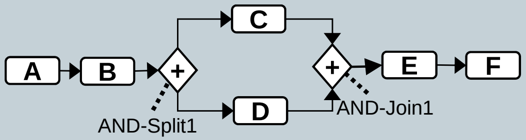


Scenario 2 - Version Control

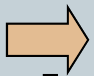
- Co-existence of instances of different schema versions

Type change results into a new version of schema S

Process Schema S

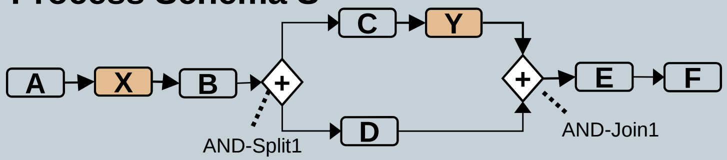


Insert X between A and B
Insert Y between C and AND-Join1



Schema Evolution

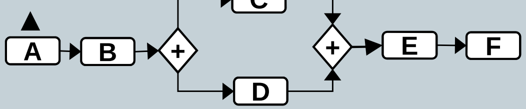
Process Schema S'



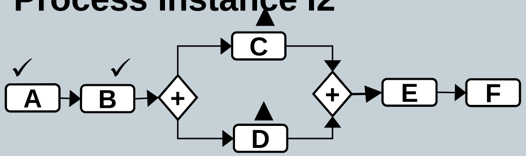
Old instances remain with schema S

Instances created from S (before schema evolution)

Process Instance I1

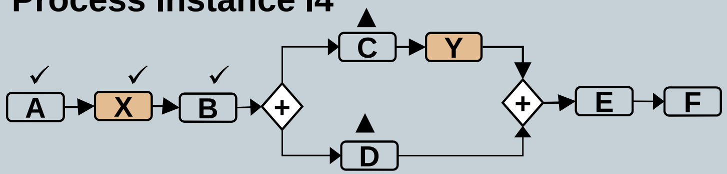


Process Instance I2

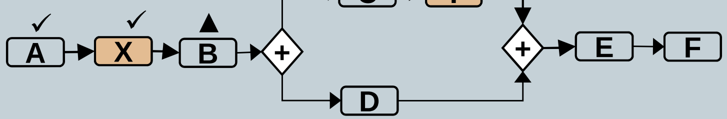


Instances created from S' (after schema evolution)

Process Instance I4



Process Instance I5

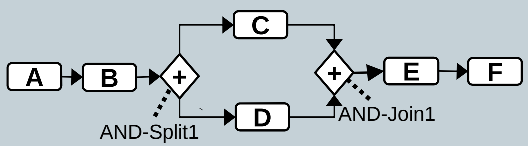


Scenario 3 – Instance Migration

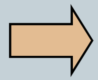
- Compliant instances are migrated to the new schema

Type change results into a new version of schema S

Process Schema S

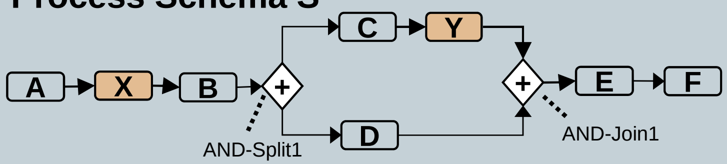


Insert X between A and B
Insert Y between C and AND-Join1



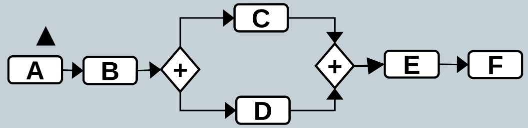
Schema Evolution

Process Schema S‘

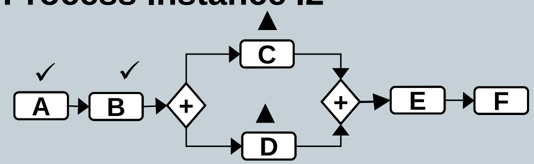


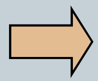
Migration of compliant process instances to S’

Process Instance I1



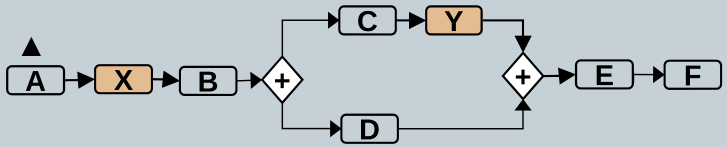
Process Instance I2





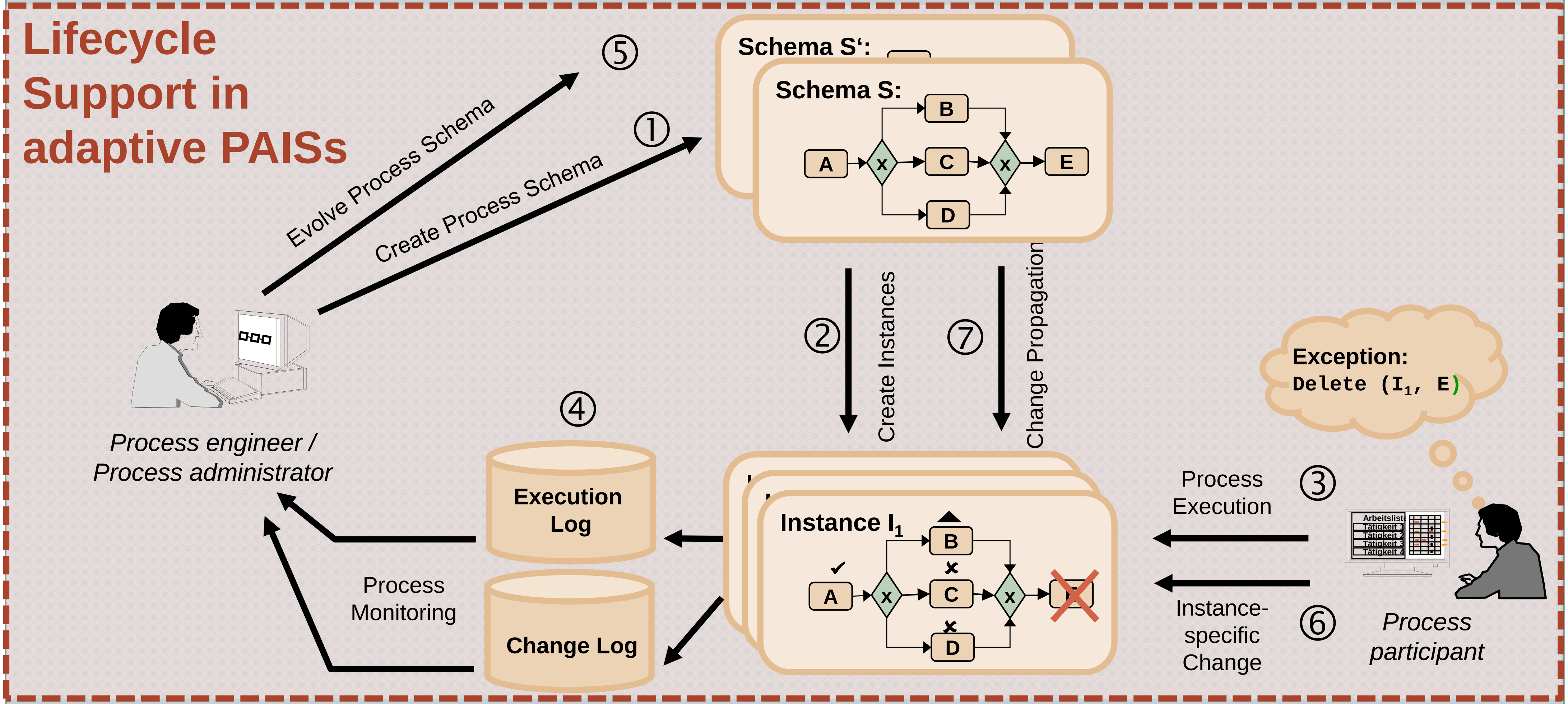
Propagation of compliant process instances to schema S’ (incl. state adaptations)

Process Instance I1



Process Instance I_2 not compliant with S’

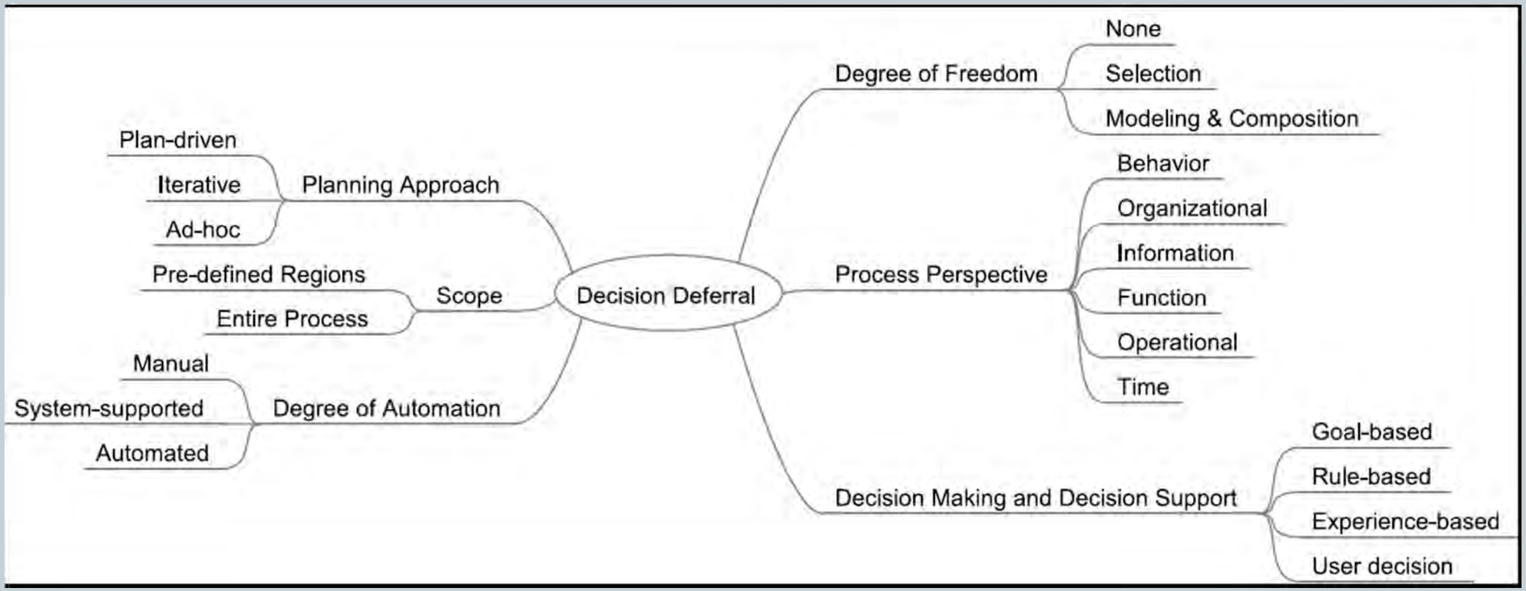
[RRD04a]


Lifecycle
Support in
adaptive PAISs
⑤
Evolve Process Schema
①
Create Process Schema
Schema S':
Schema S:
B
A
x
C
x
E
D
Process engineer /
Process administrator
②
Create Instances
⑦
Change Propagation
Exception:
Delete (I1, E)
④
Execution
Log
Change Log
Process
Monitoring
Instance I1
B
A
x
C
x
E
D
Process
Execution
③
Instance-
specific
Change
⑥
Process
participant

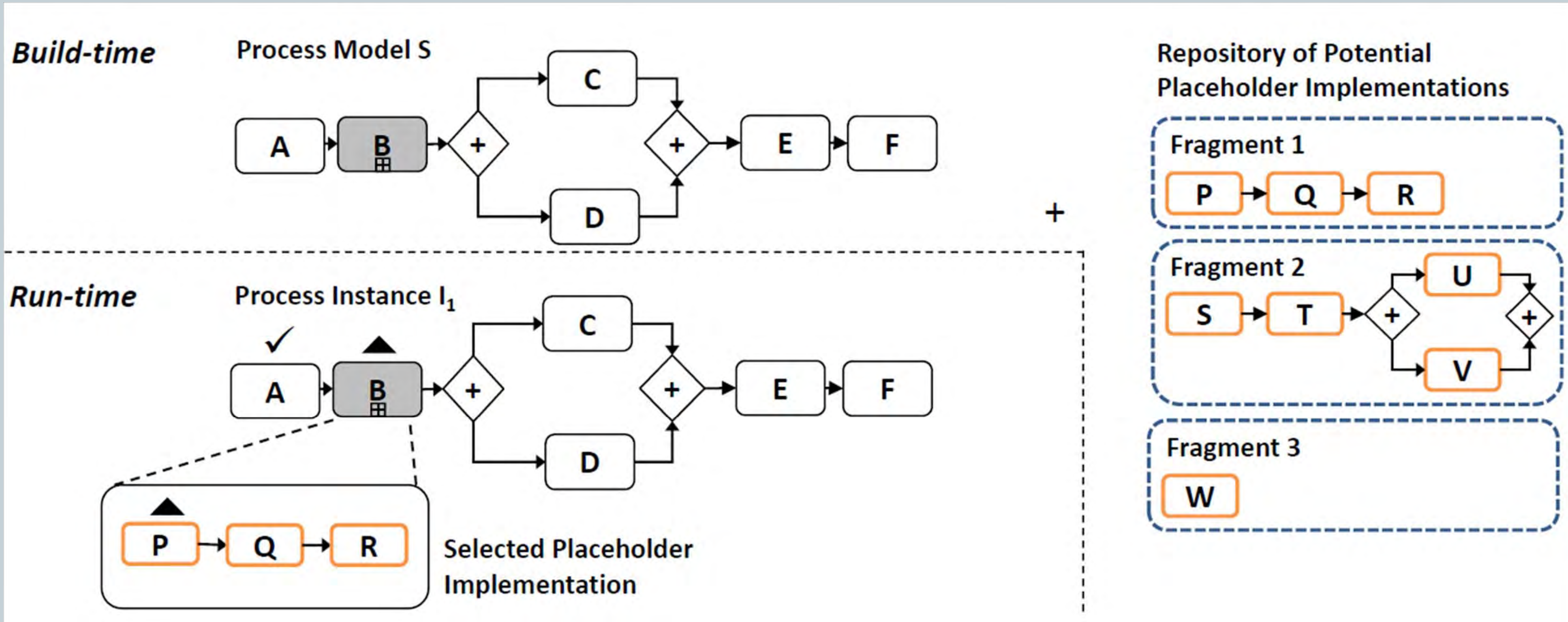
Loosely Specified Processes

Loosely specified Processes

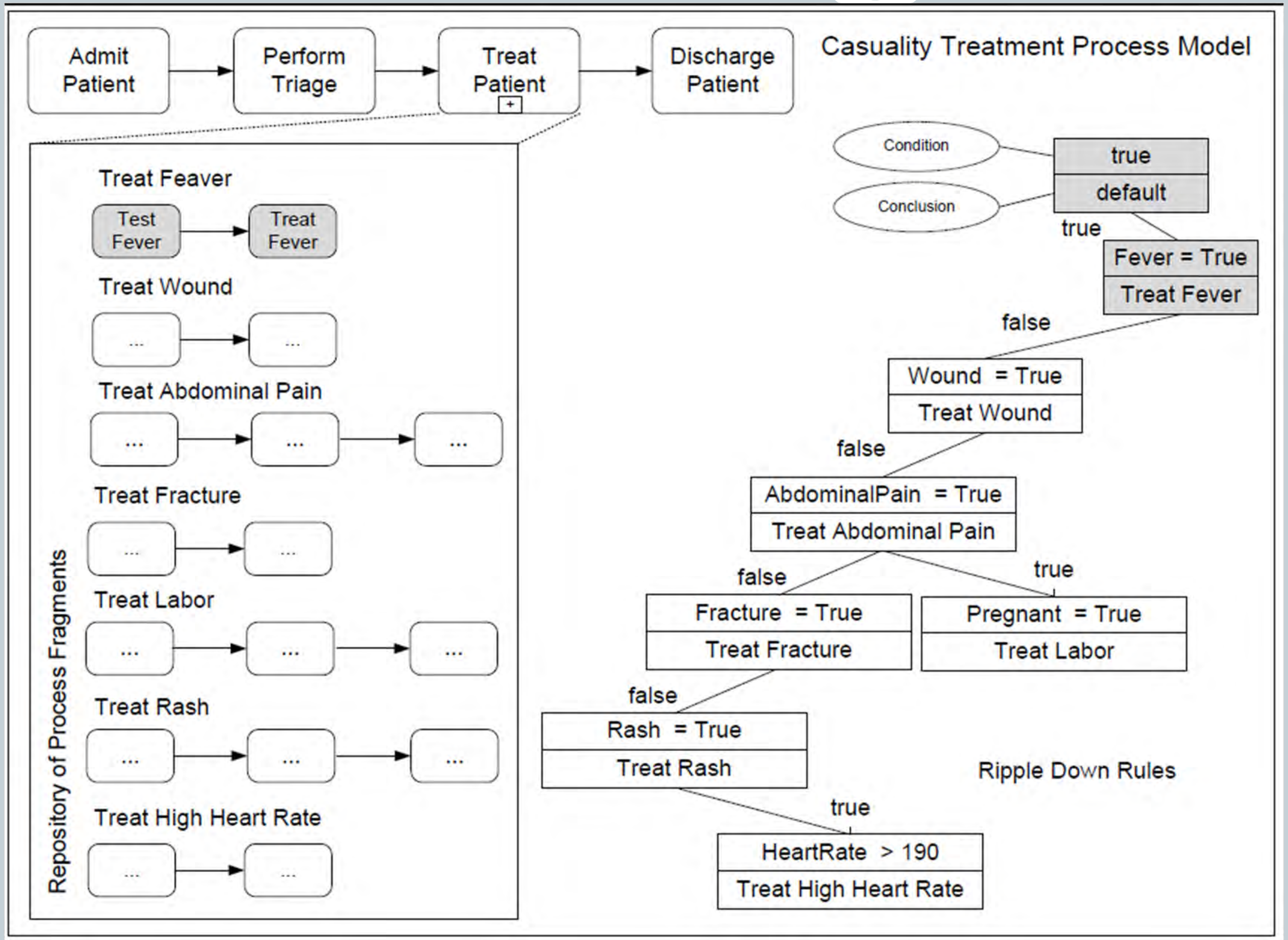
- To deal with unpredictability, non repeatability and emergence loosely specified processes keep (parts) of the process unspecified during build-time
- Loosely specified processes are characterized by *decision deferral* ☞ *taxonomy of decision deferral*



Late Selection Pattern

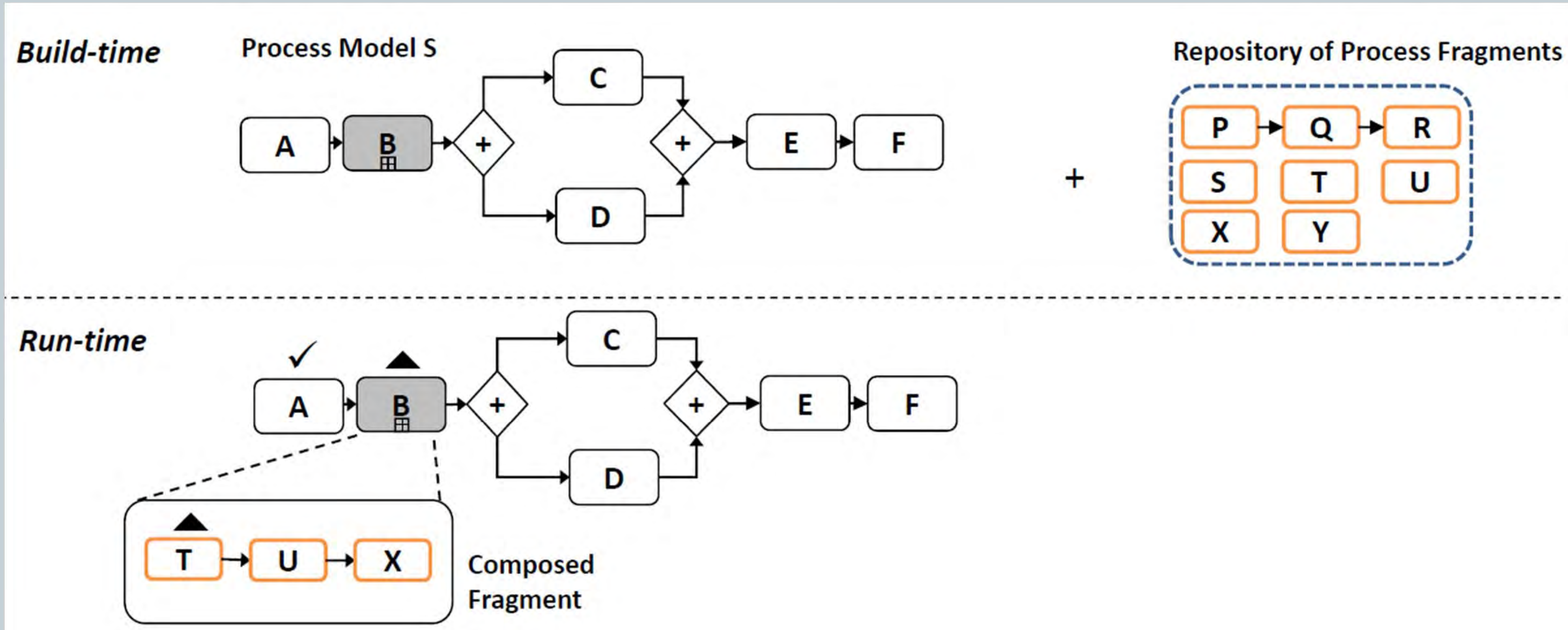


Late Selection – The Worklets Approach

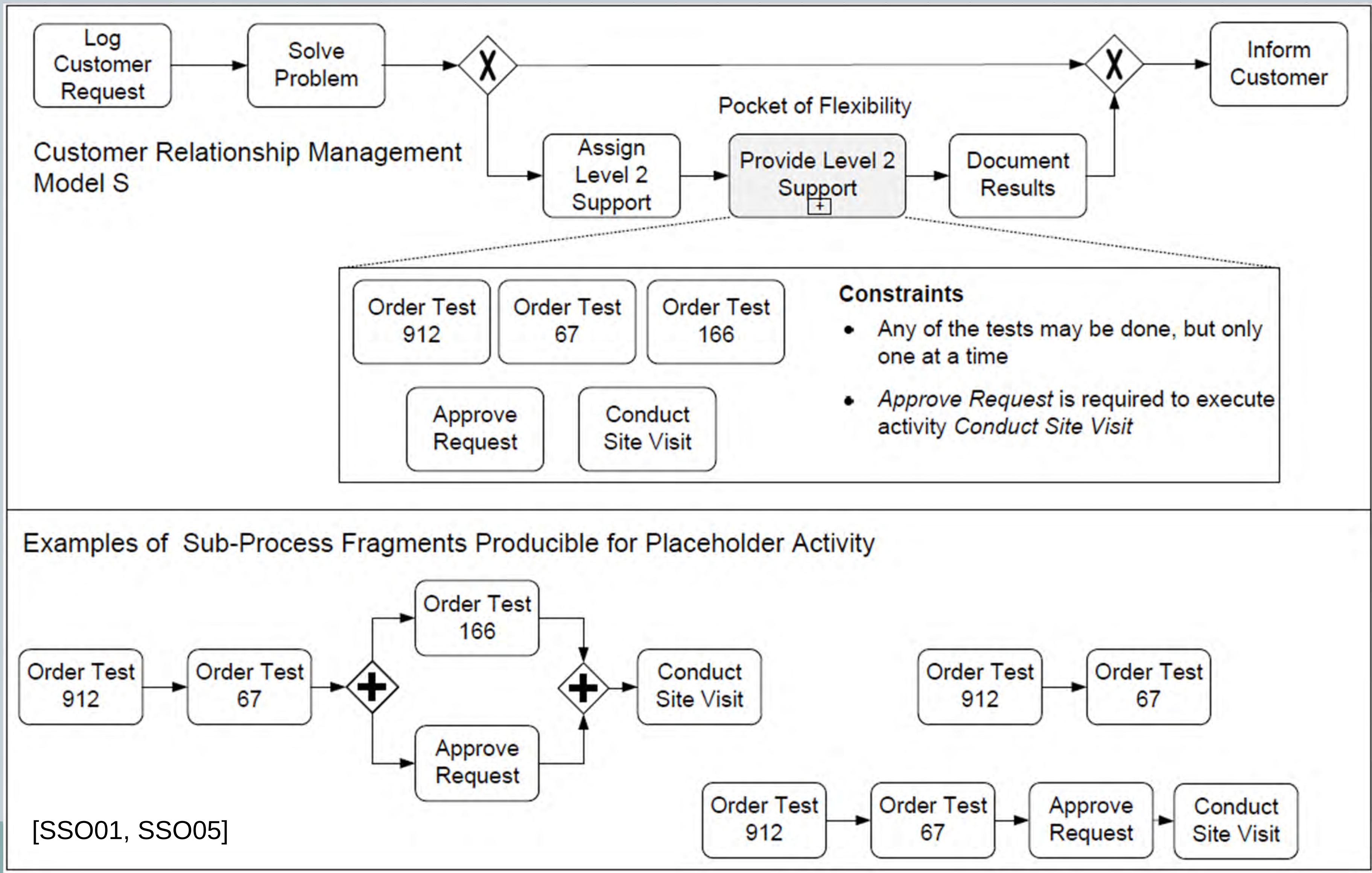


[AHE+06]

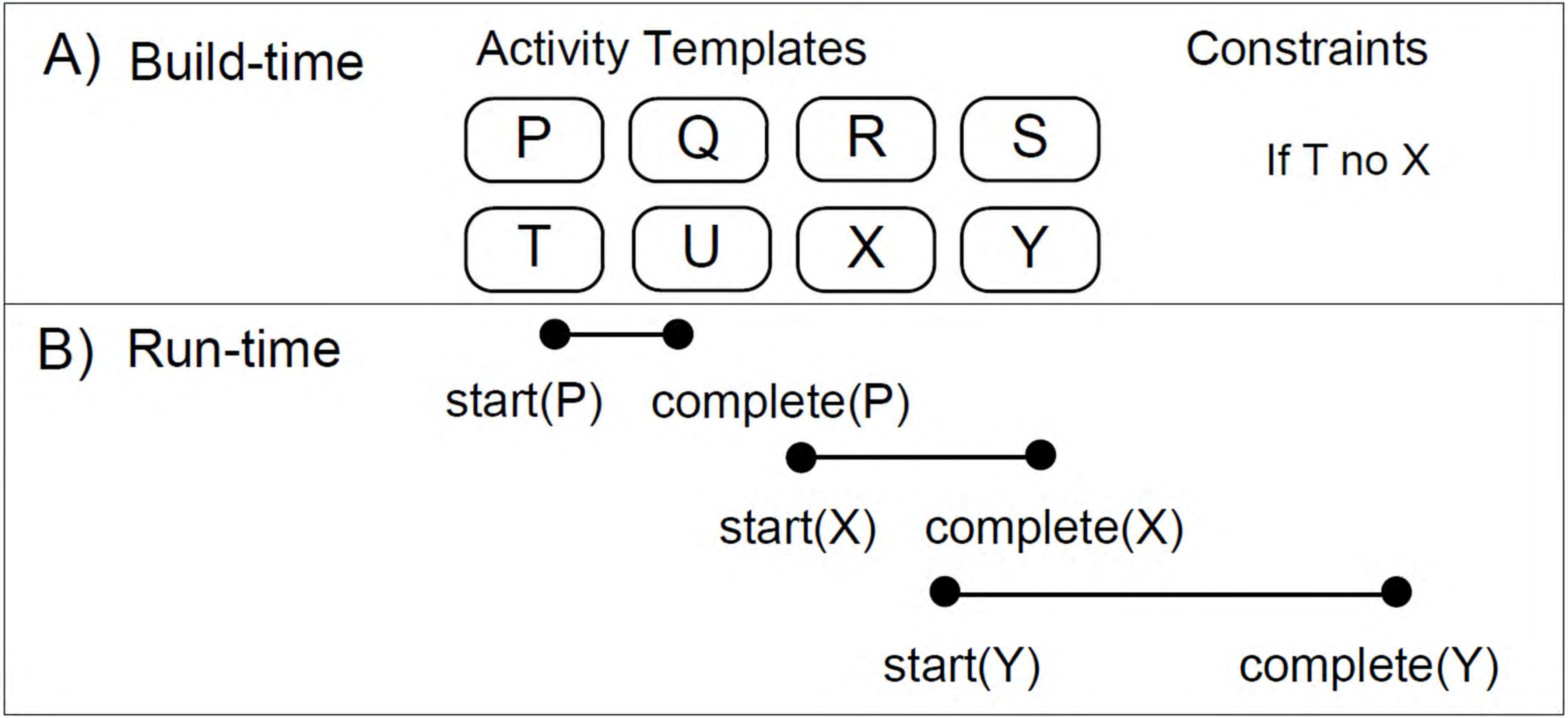
Late Modeling



Late Modeling – Pockets of Flexibility

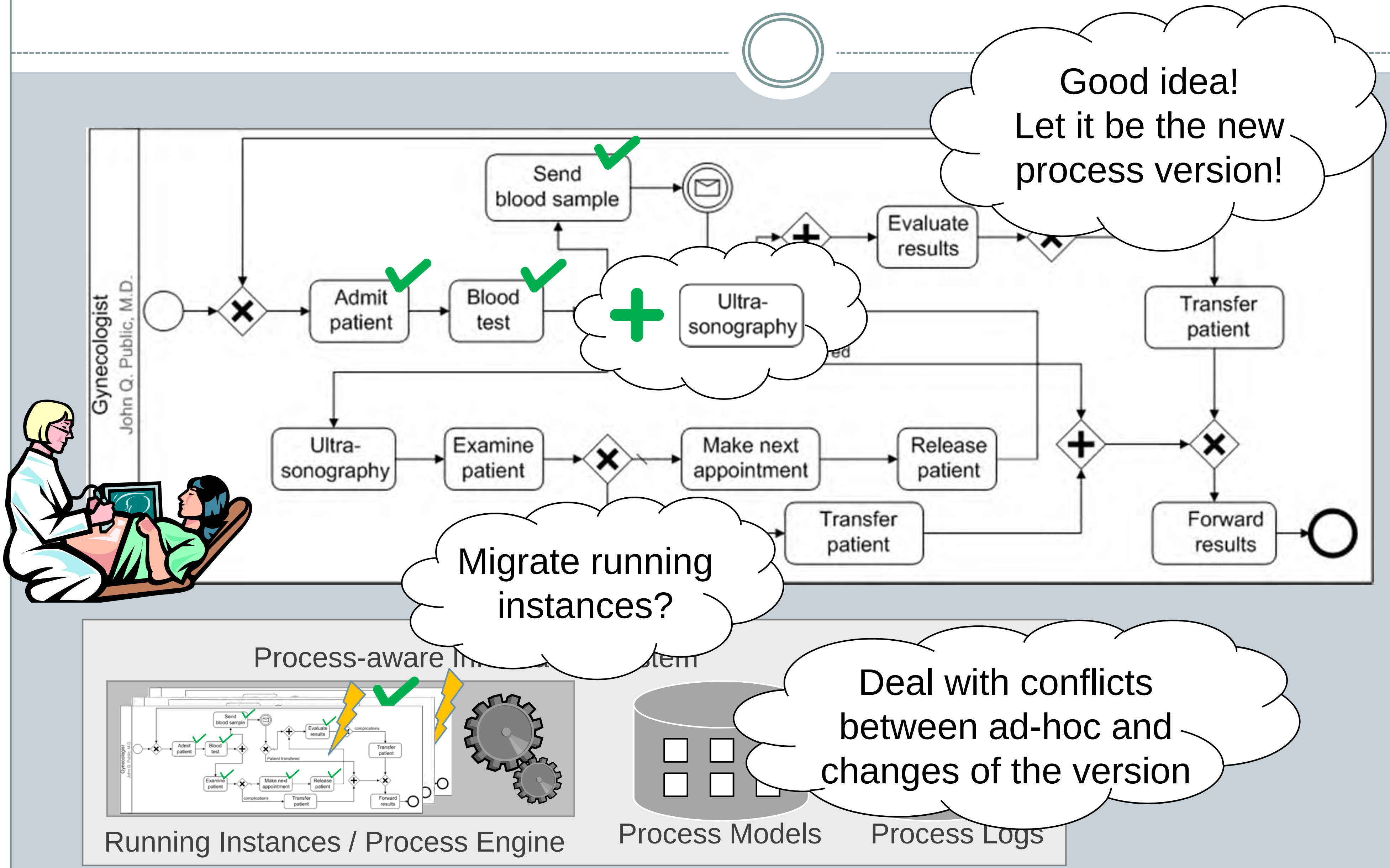


Ad-hoc Composition - Declare

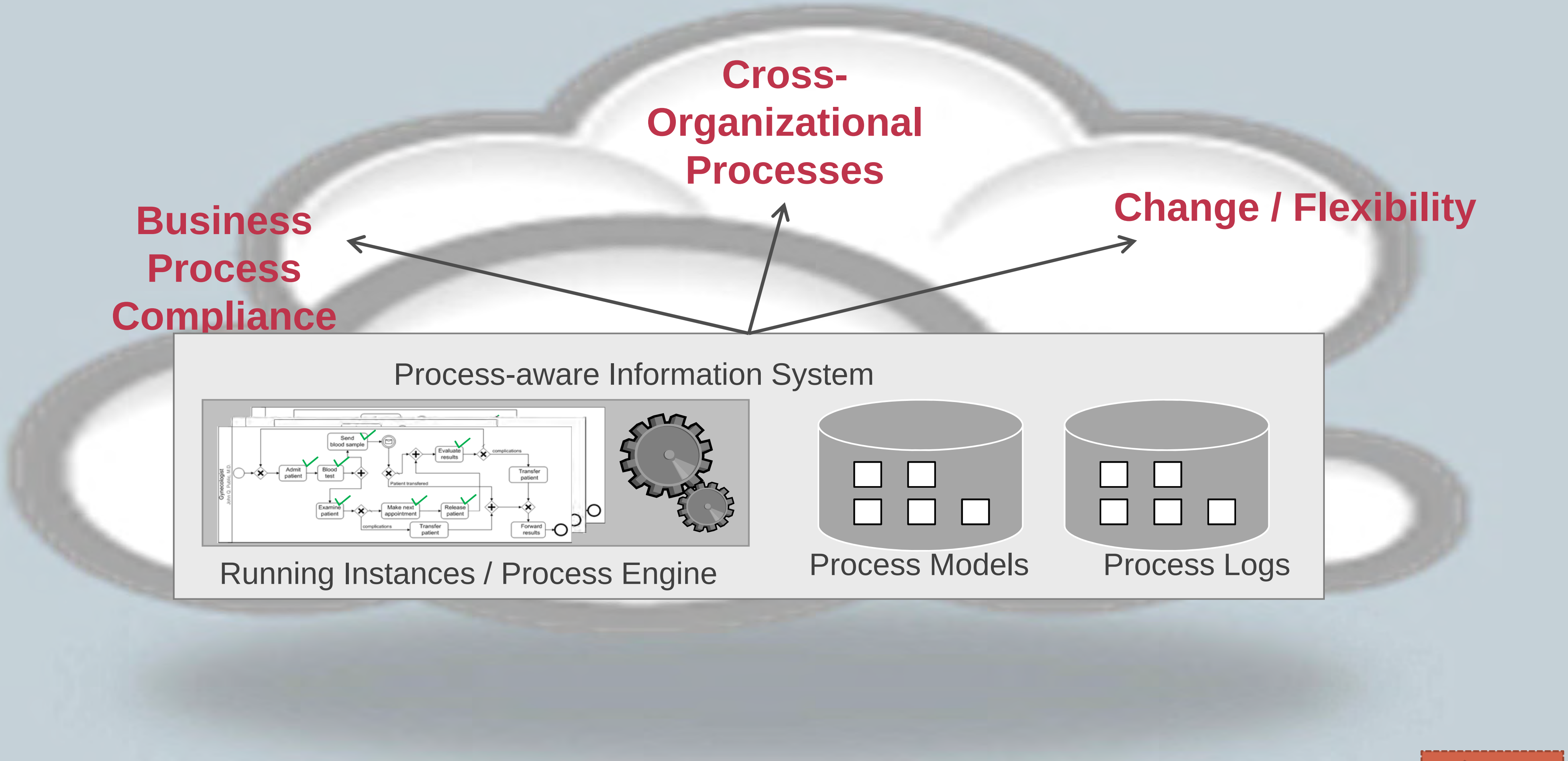


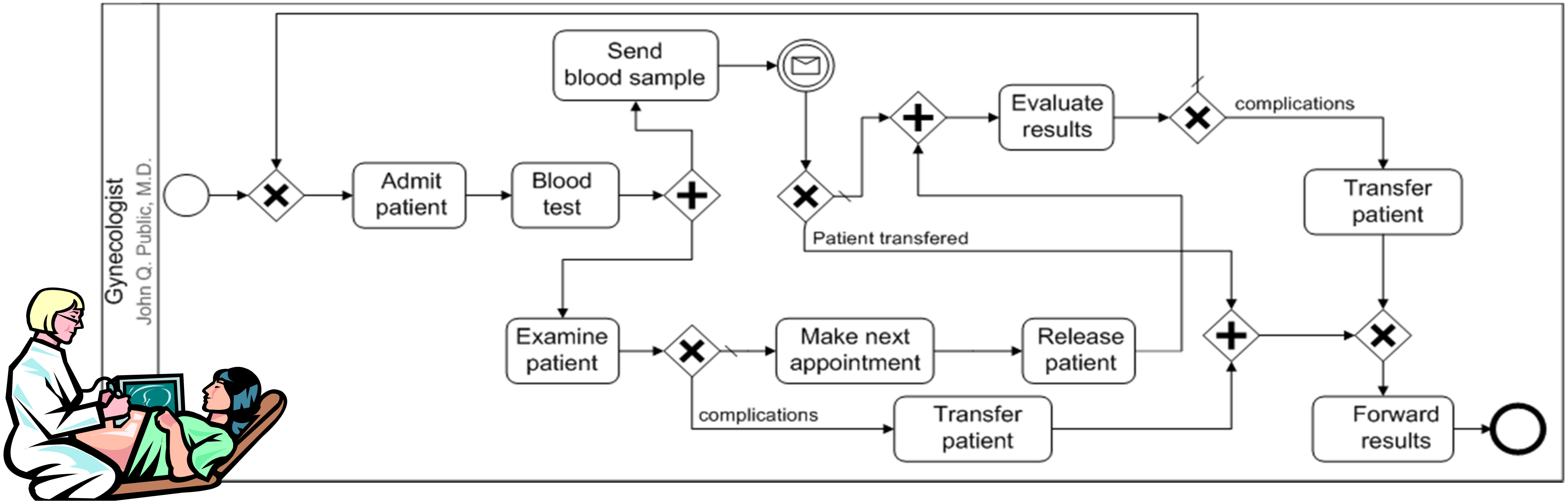
Summary & Outlook

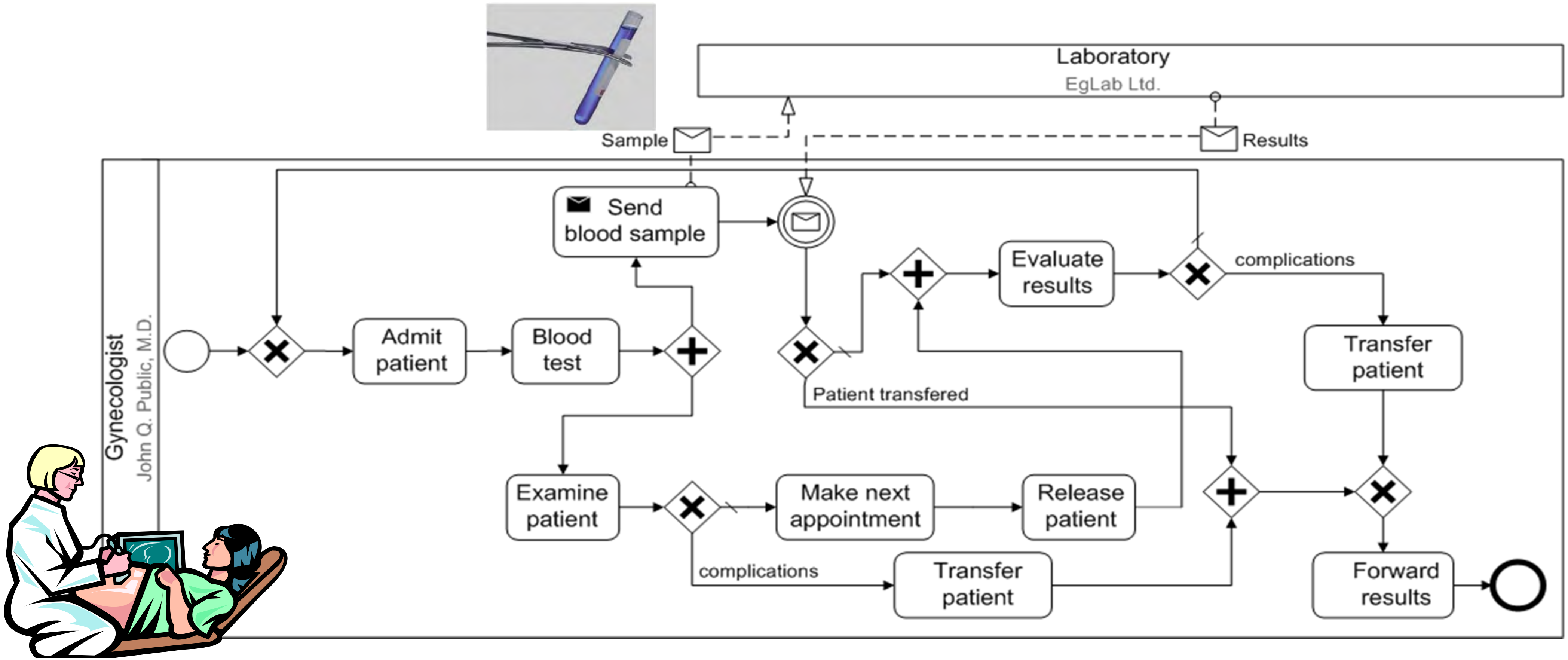
Summary & Outlook



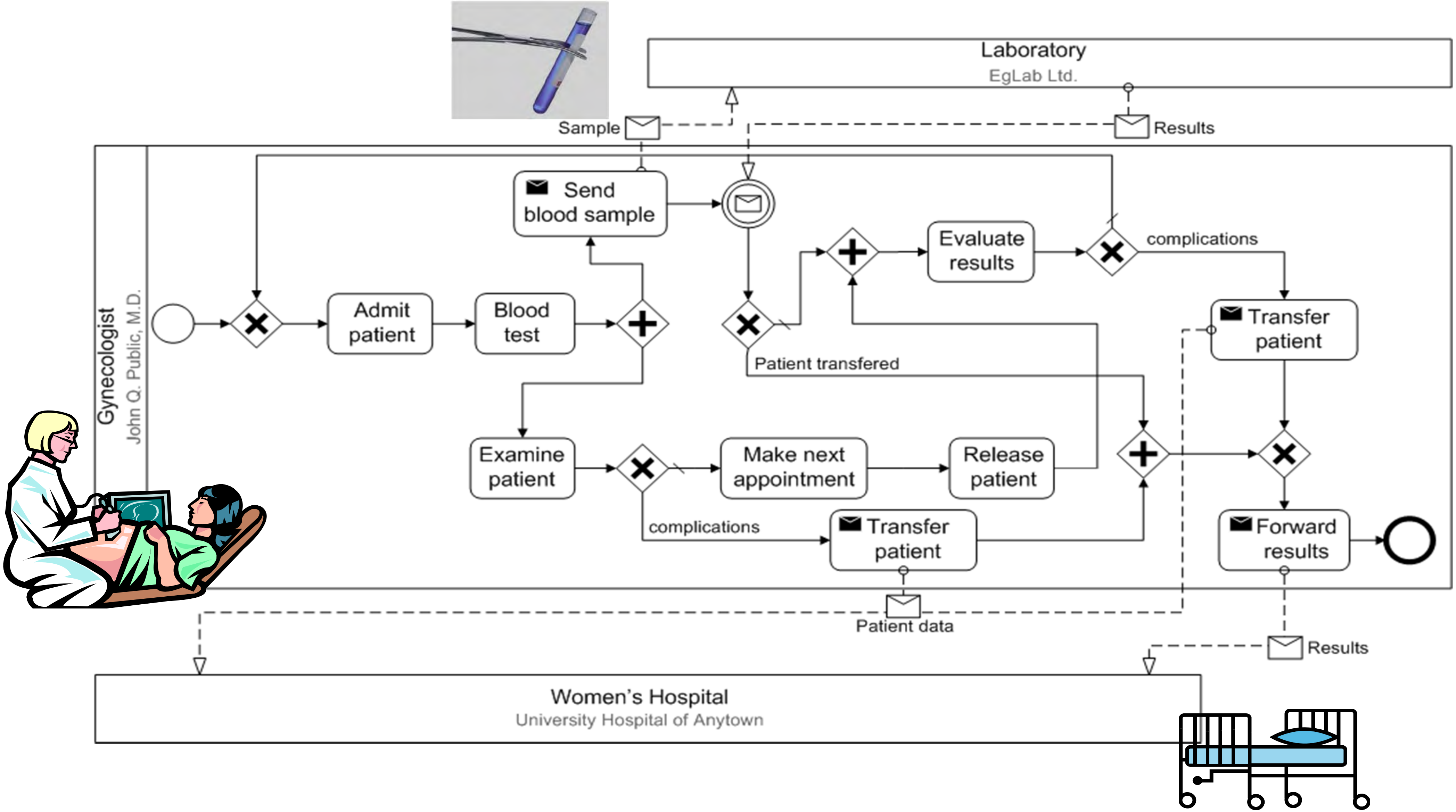
Summary & Outlook



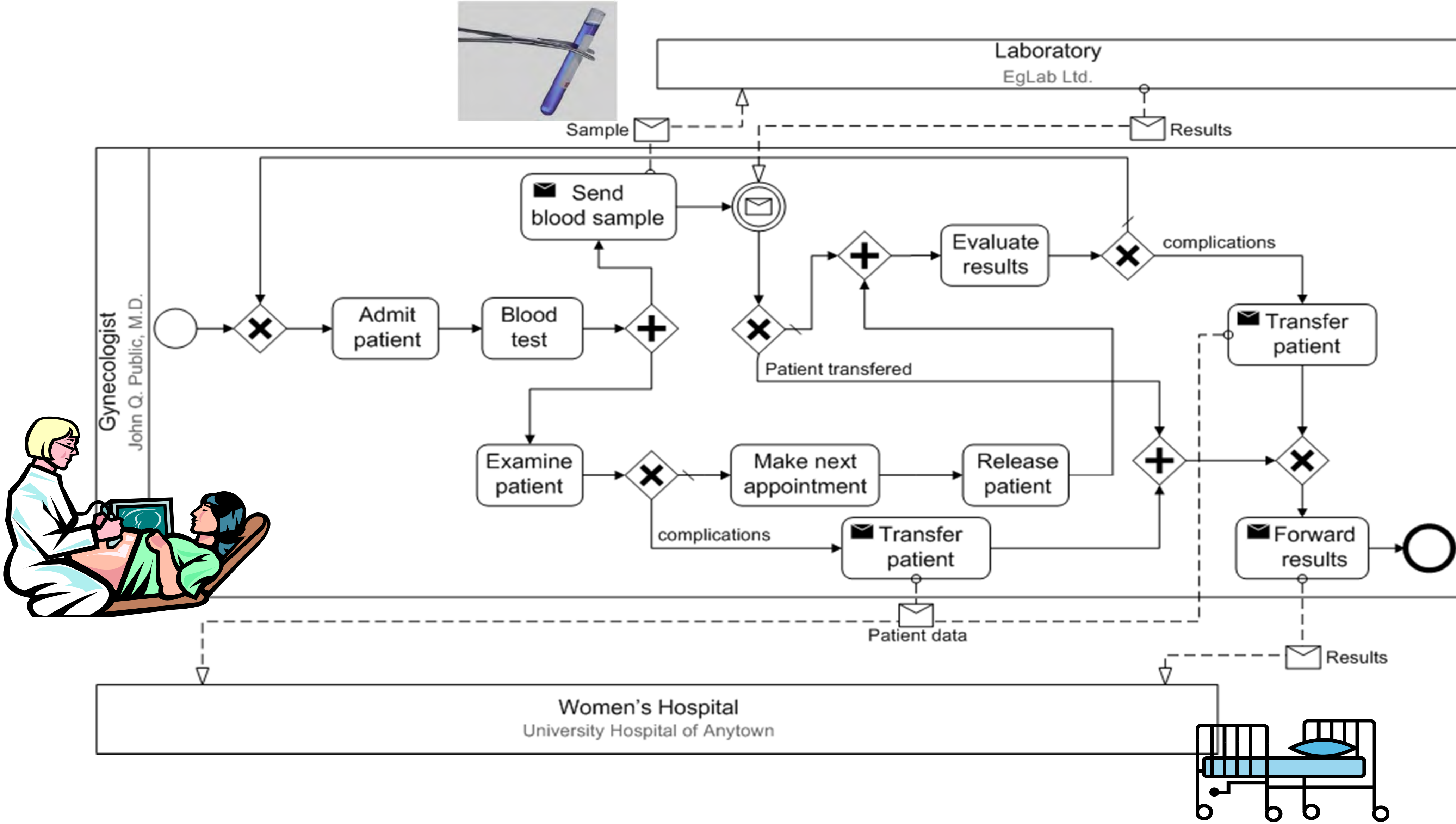

Gynecologist
John Q. Public, M.D.
Send
blood sample
Admit
patient
Blood
test
Evaluate
results
complications
Transfer
patient
Patient transfered
Examine
patient
Make next
appointment
Release
patient
complications
Transfer
patient
Forward
results

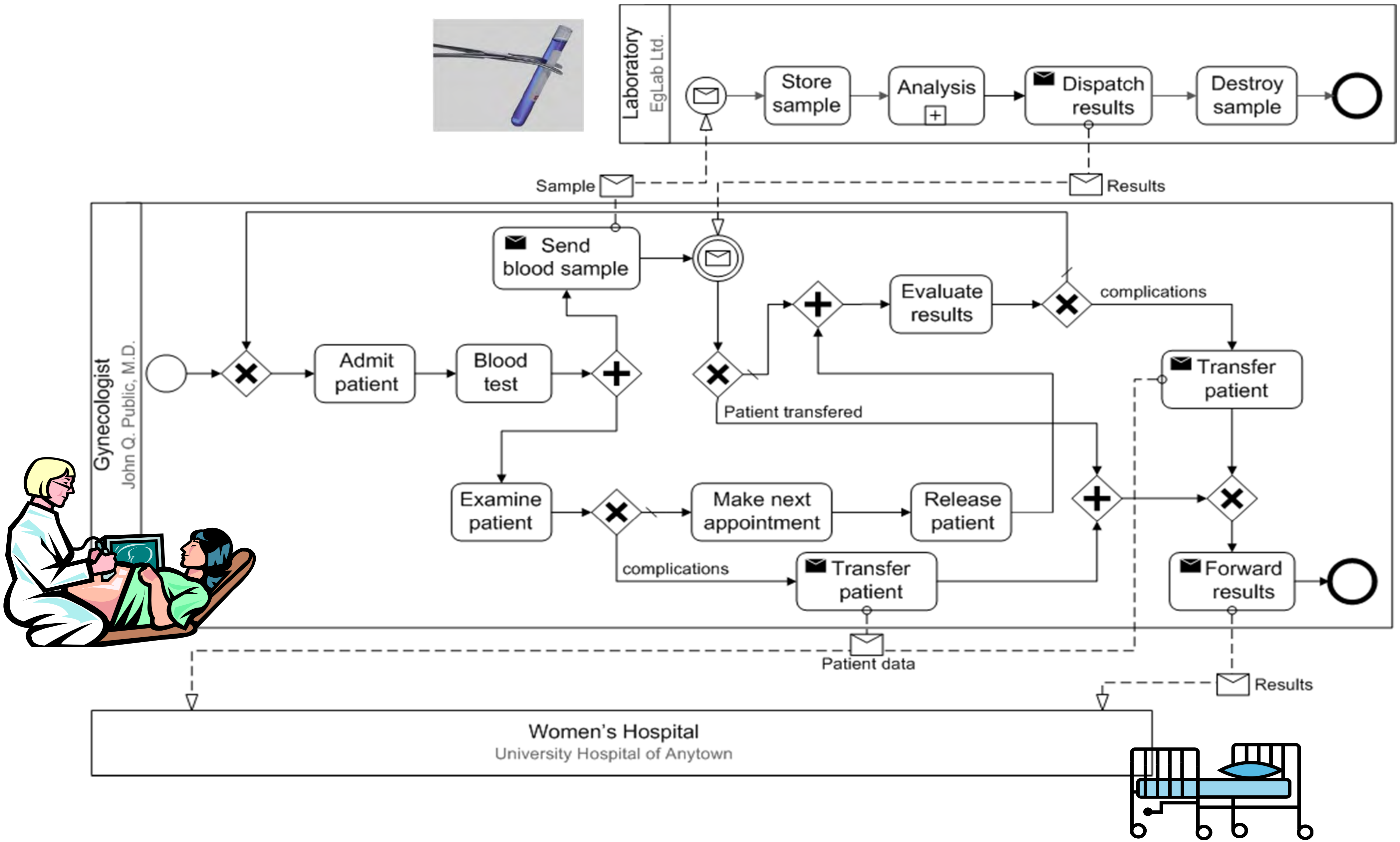


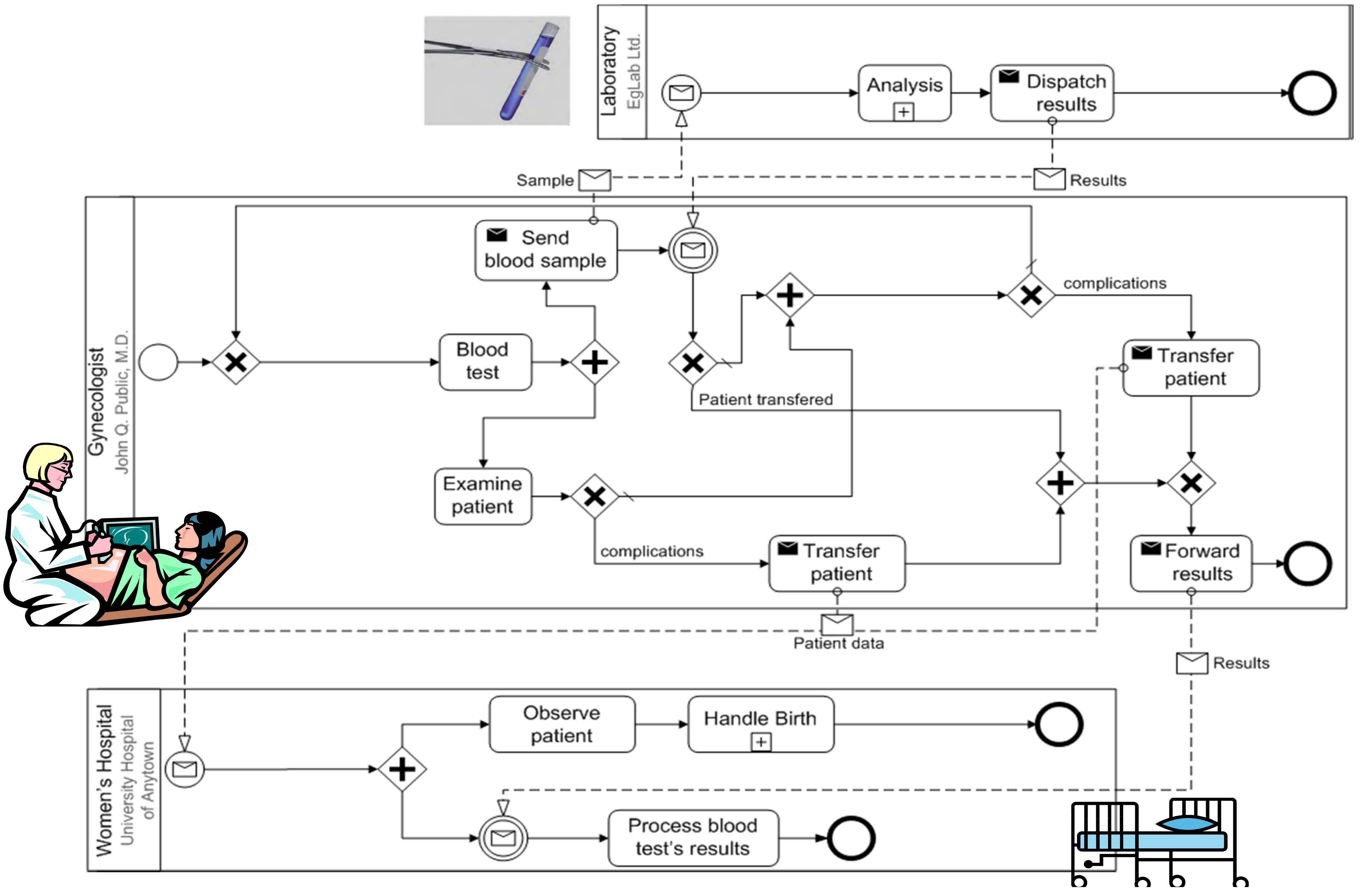
Laboratory
EgLab Ltd.
Sample
Results
Gynecologist
John Q. Public, M.D.
Send blood sample
Admit patient
Blood test
Evaluate results
complications
Transfer patient
Patient transfered
Examine patient
Make next appointment
Release patient
complications
Transfer patient
Forward results



Laboratory
EgLab Ltd.
Sample
Results
Gynecologist
John Q. Public, M.D.
Send blood sample
Admit patient
Blood test
Evaluate results
complications
Transfer patient
Patient transfered
Examine patient
Make next appointment
Release patient
complications
Transfer patient
Forward results
Patient data
Results
Women's Hospital
University Hospital of Anytown

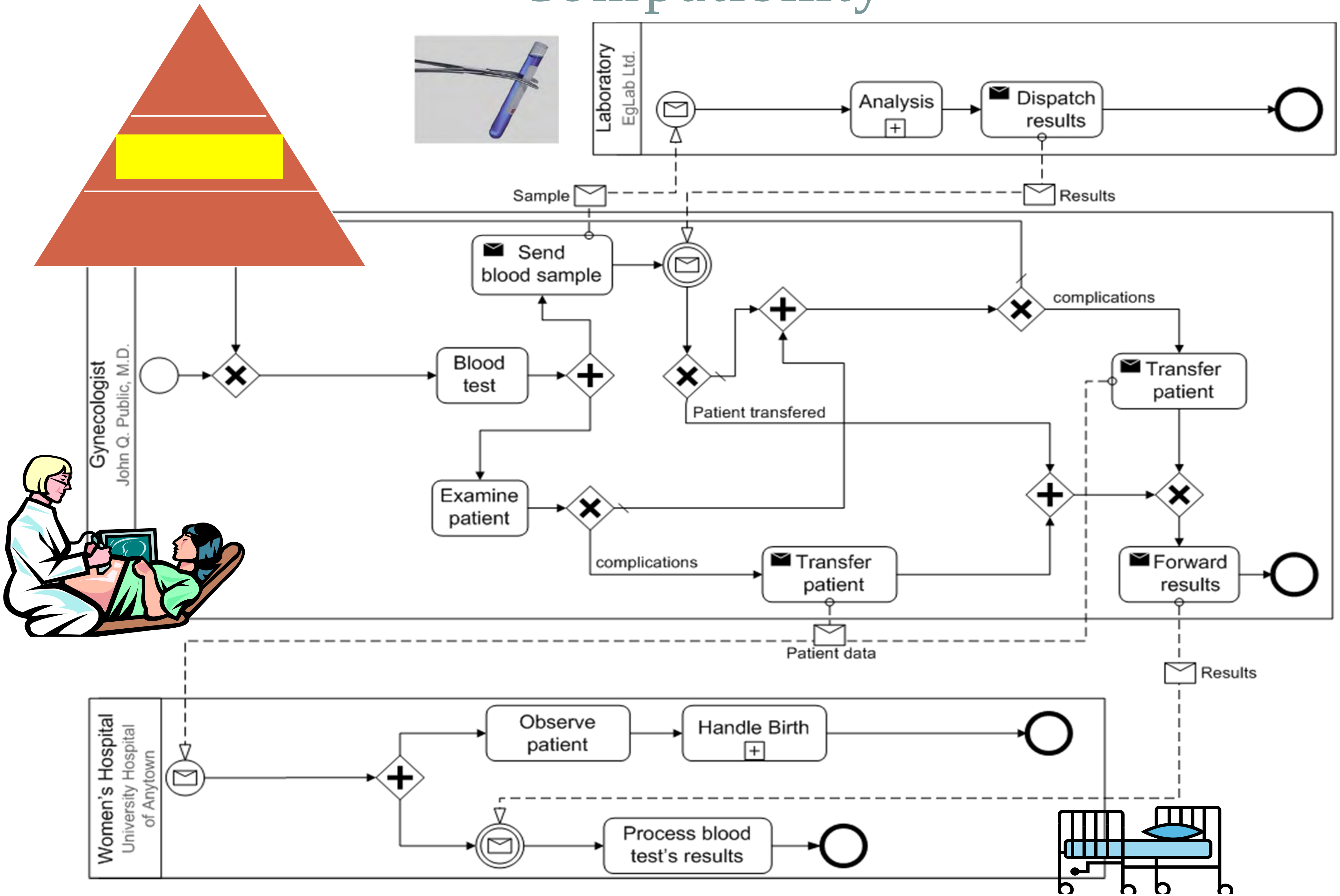

Laboratory
EgLab Ltd.
Sample
Results
Gynecologist
John Q. Public, M.D.
Send blood sample
Admit patient
Blood test
Evaluate results
complications
Transfer patient
Patient transfered
Examine patient
Make next appointment
Release patient
complications
Transfer patient
Forward results
Patient data
Results
Women's Hospital
University Hospital of Anytown


Laboratory
EgLab Ltd.
Store sample
Analysis
Dispatch results
Destroy sample
Sample
Results
Gynecologist
John Q. Public, M.D.
Send blood sample
Evaluate results
complications
Admit patient
Blood test
Transfer patient
Patient transfered
Examine patient
Make next appointment
Release patient
complications
Transfer patient
Forward results
Patient data
Results
Women's Hospital
University Hospital of Anytown

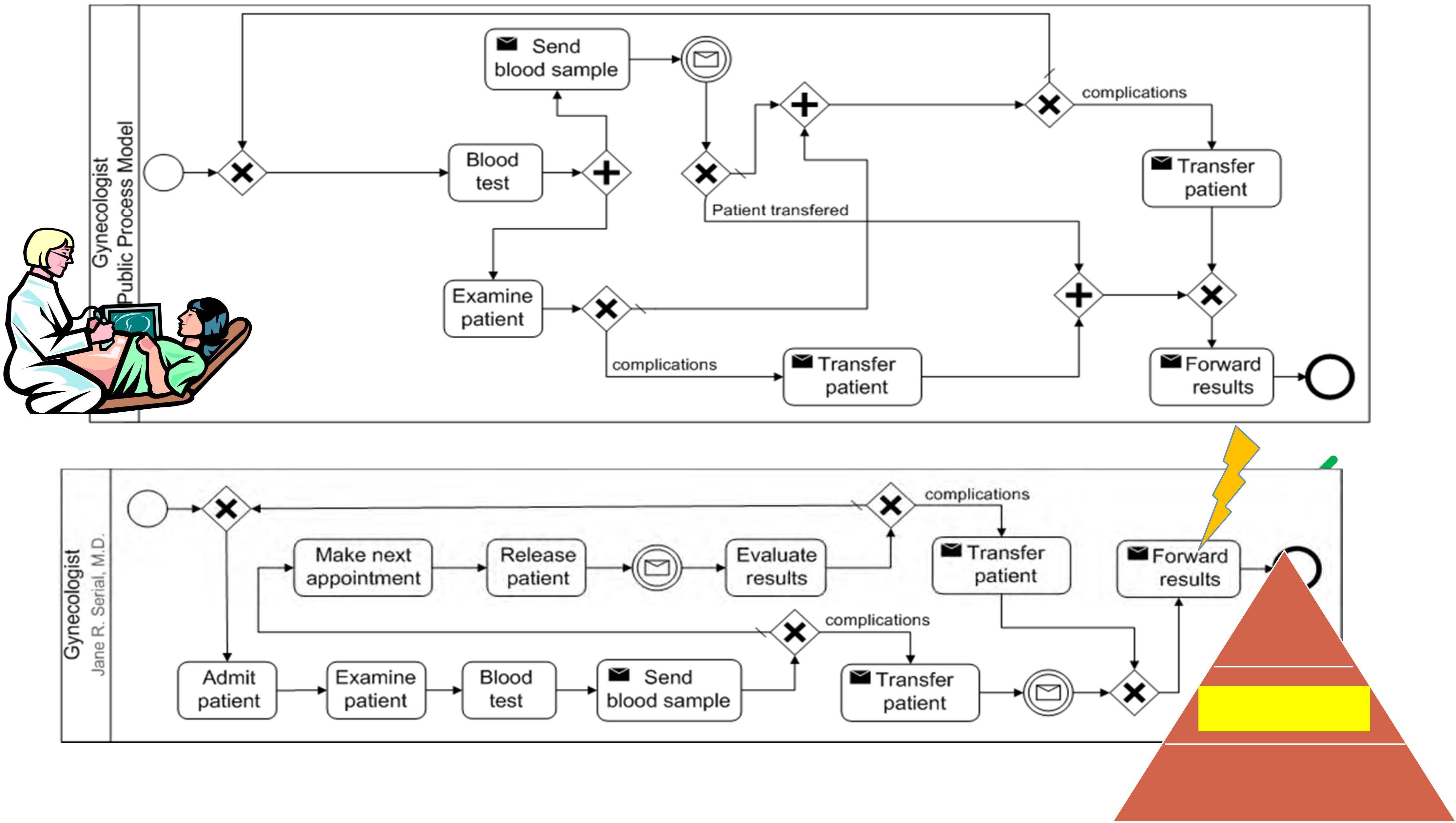


Laboratory
EgLab Ltd.
Analysis
Dispatch results
Sample
Results
Gynecologist
John Q. Public, M.D.
Send blood sample
Blood test
Examine patient
complications
Patient transfered
Transfer patient
Forward results
complications
Transfer patient
Patient data
Results
Women's Hospital
University Hospital of Anytown
Observe patient
Handle Birth
Process blood test's results

Compatibility



Conformance



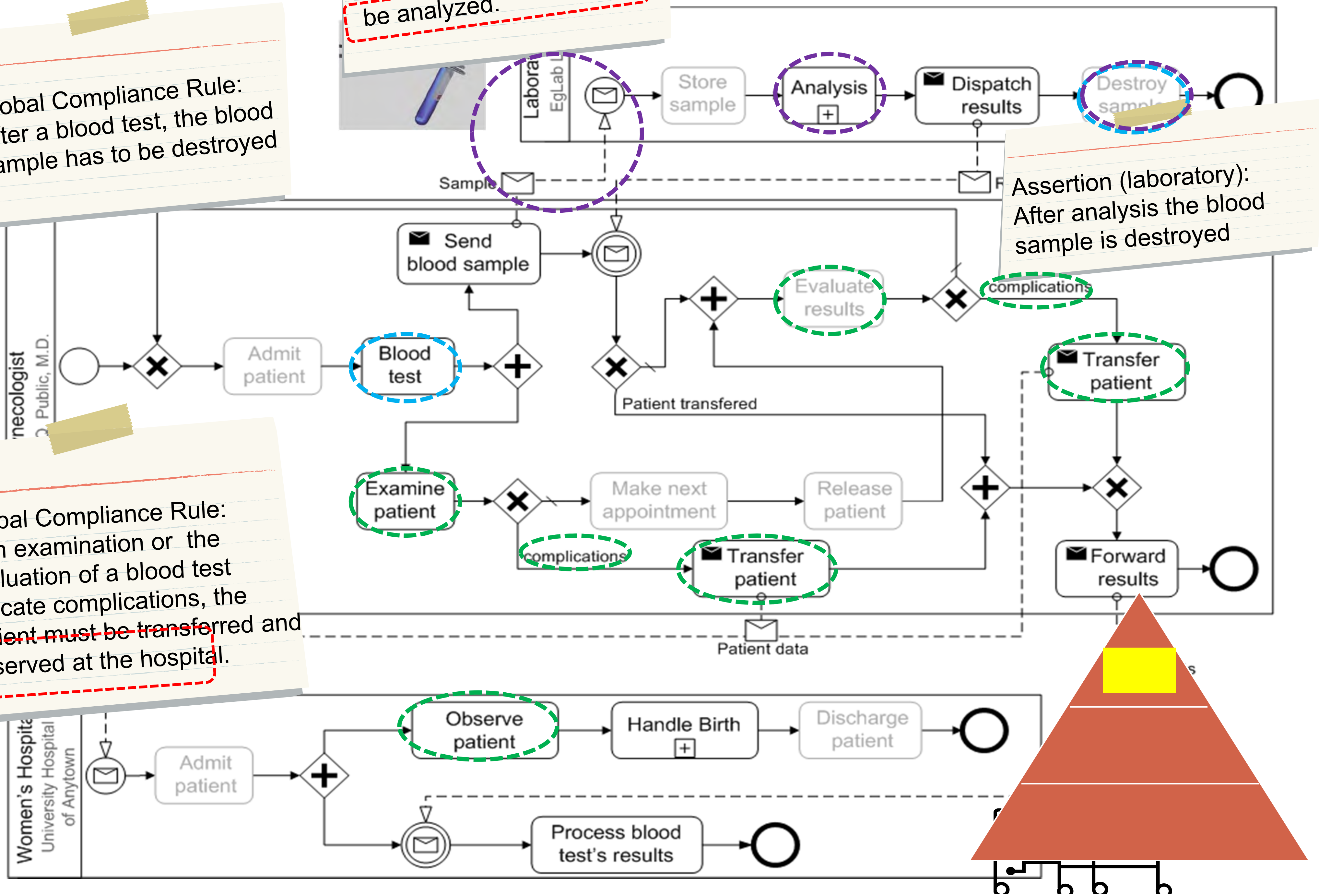
Cross- … nal Compliance

Assertion (laboratory):
Received blood samples will be analyzed.

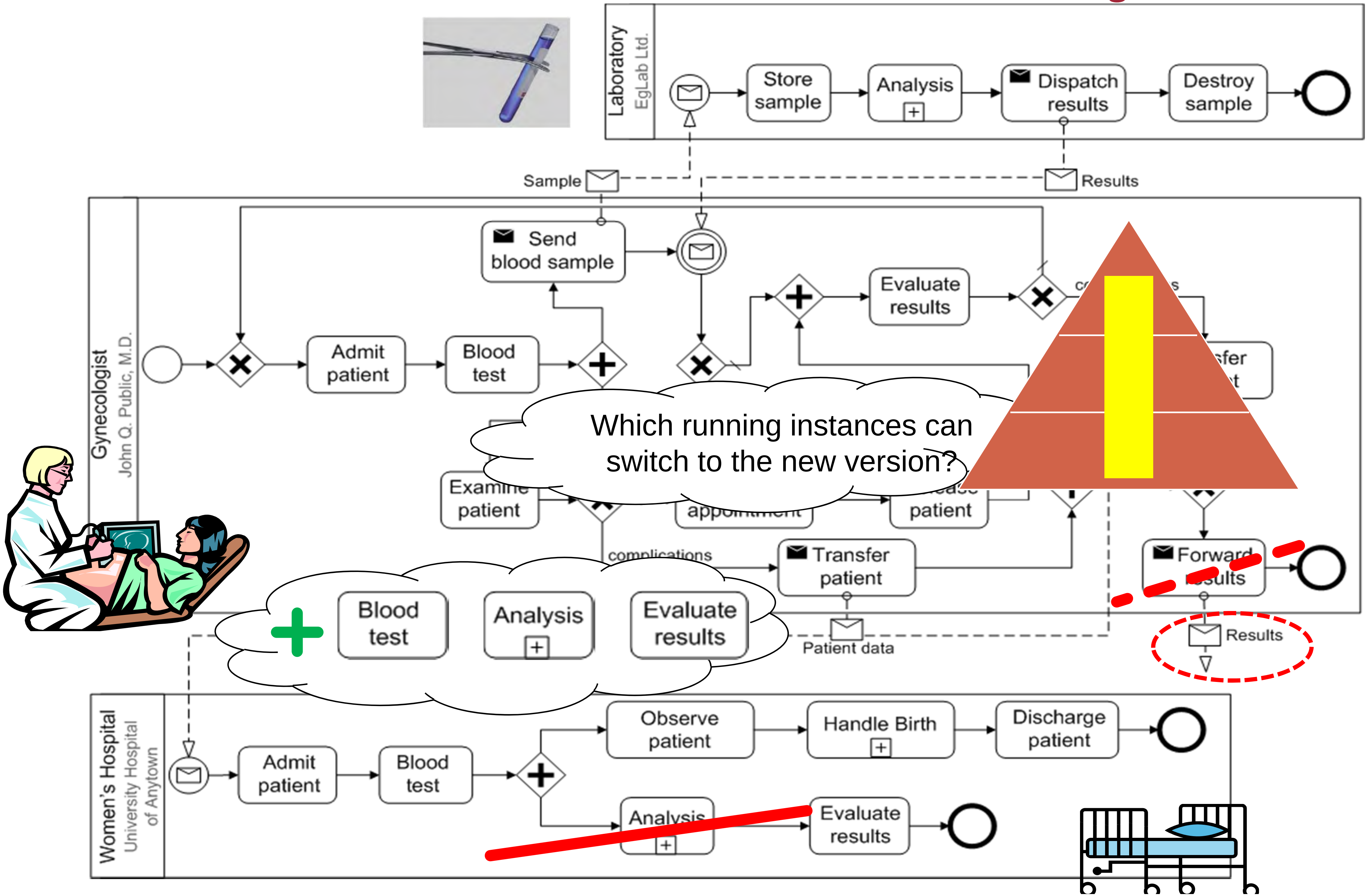
Global Compliance Rule:
After a blood test, the blood sample has to be destroyed

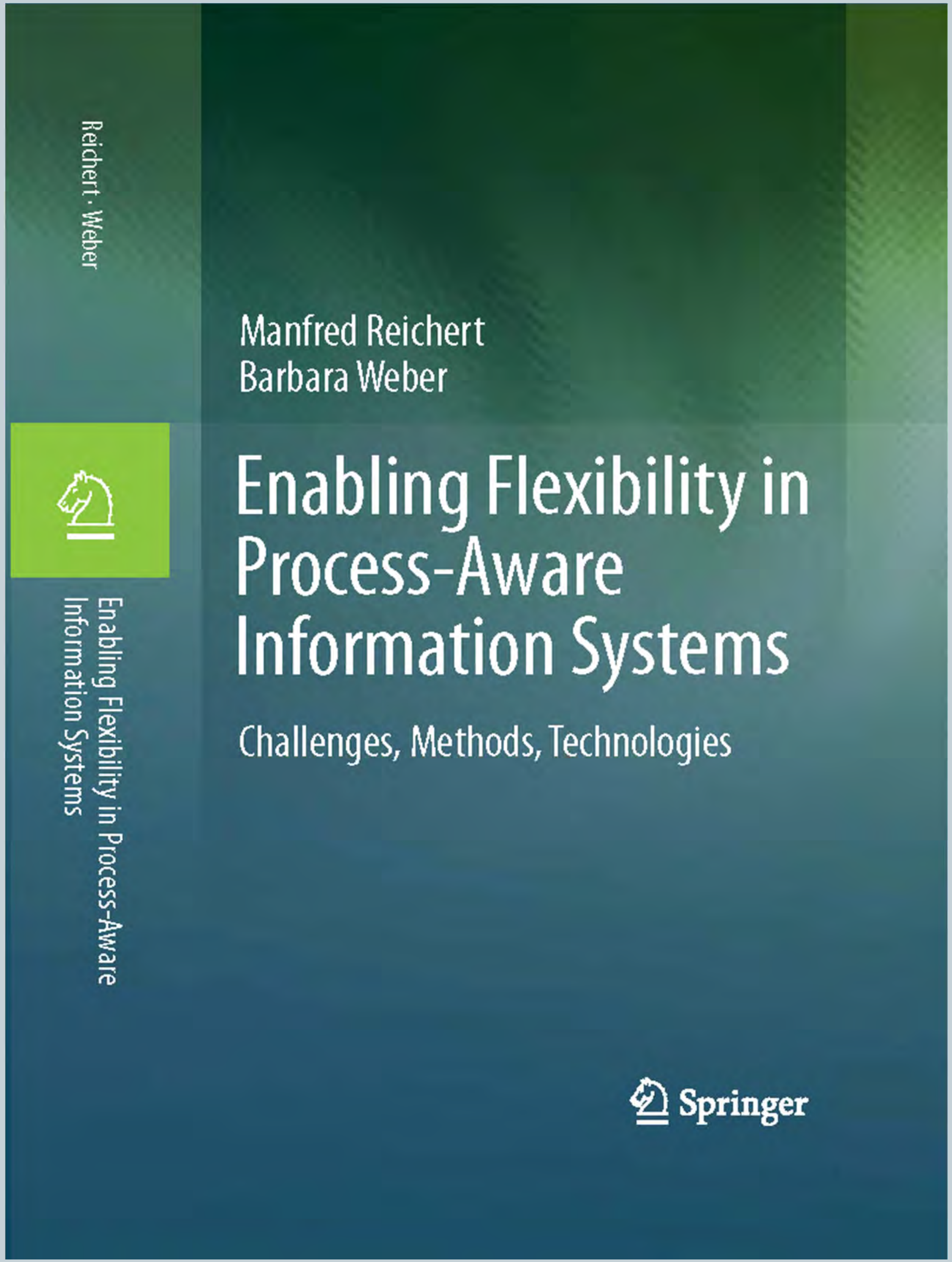
Assertion (laboratory):
After analysis the blood sample is destroyed

Global Compliance Rule:
If an examination or the evaluation of a blood test indicate complications, the patient must be transferred and observed at the hospital.



Cross-Organizational Processes: Change




Reichert · Weber
Manfred Reichert
Barbara Weber
Enabling Flexibility in Process-Aware Information Systems
Challenges, Methods, Technologies
Springer
Enabling Flexibility in Process-Aware Information Systems

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