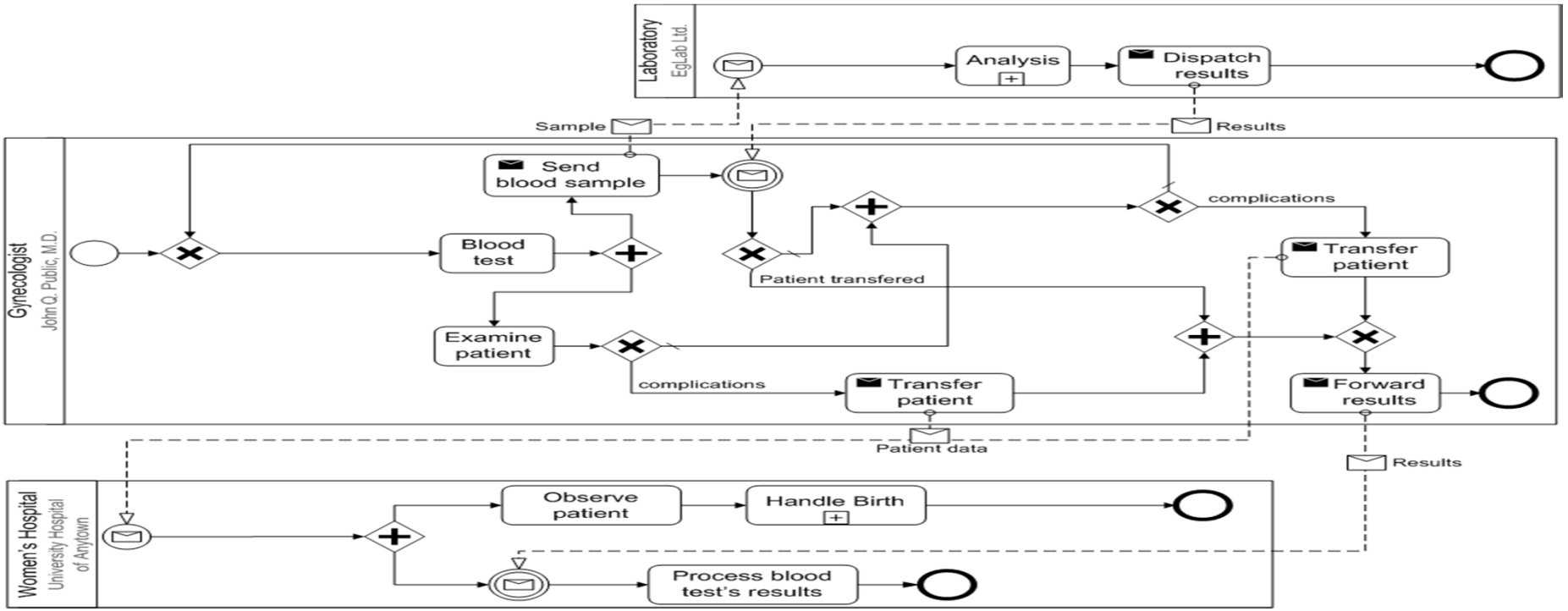
DBIS EXPERIENCE
processes for a flexible world

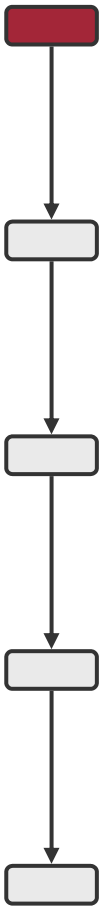
ulm university universität ulm



Collaboration and Interoperability Support for Agile Enterprises in a Networked World

Emerging Scenarios, Research Challenges, Enabling Technologies

Manfred Reichert



Motivation

Process-Aware Information Systems (PAIS)

Flexible PAIS

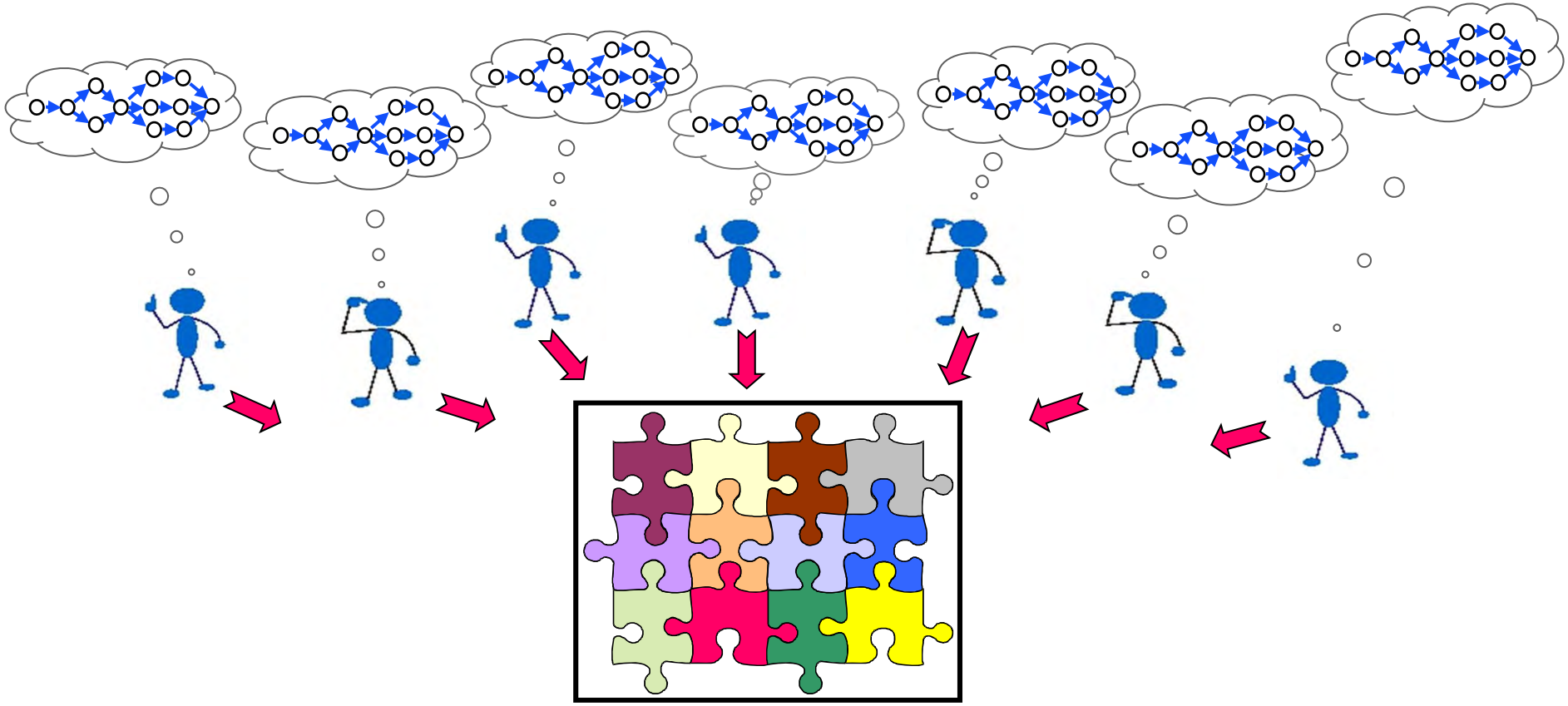
Enabling Flexibility for Cross-Organizational Processes

Some Technical Insights

Motivation

Current situation in many enterprises:

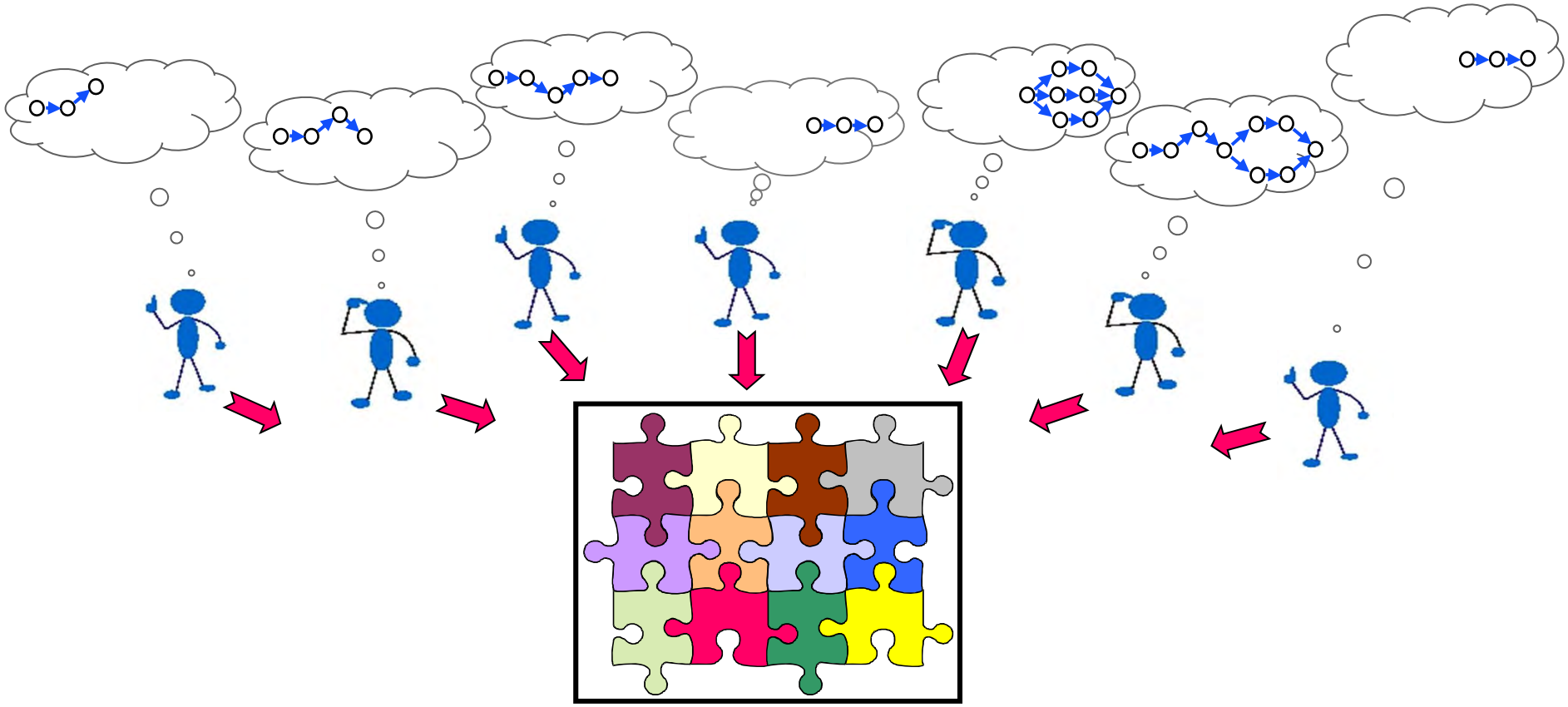
- users interact with monolithic, function-centric application systems
- processes only in the users' minds– with only partial knowledge of the process



Motivation

Vision of SOA

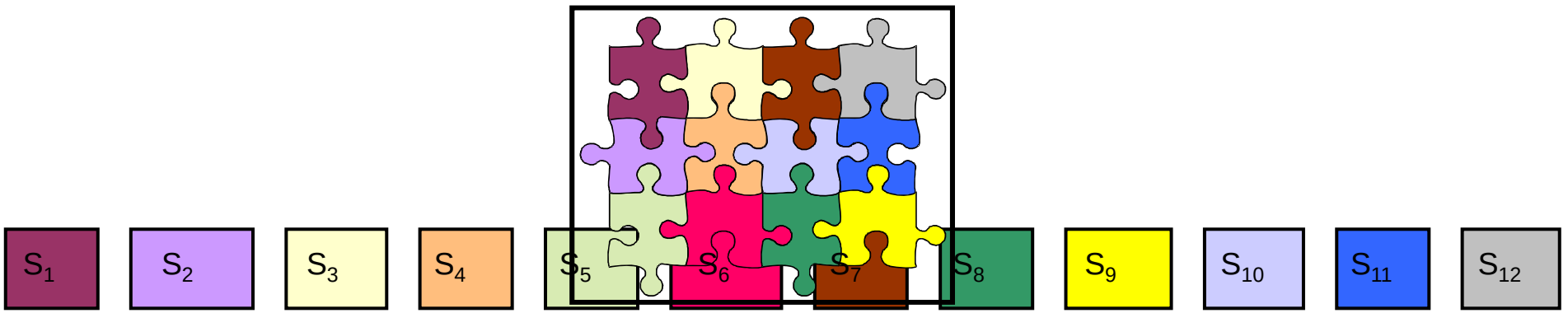
- modulurization of invokable application functions (“services”)



Motivation

Vision of SOA

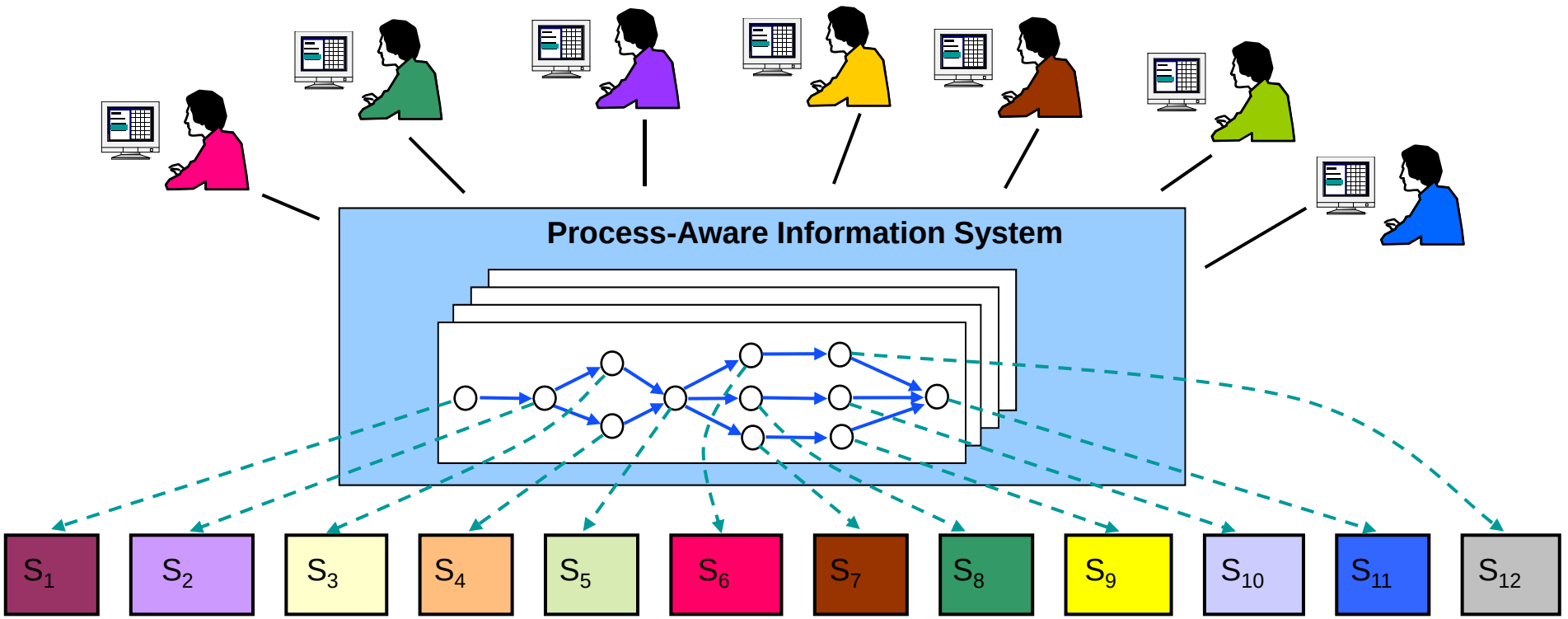
- modulurization of invokable application functions ("services")



Motivation

Vision of SOA

- modulurization of invokable application functions ("services")
- combined by explicitly defined processes
- whose execution is supported by a process-aware information system

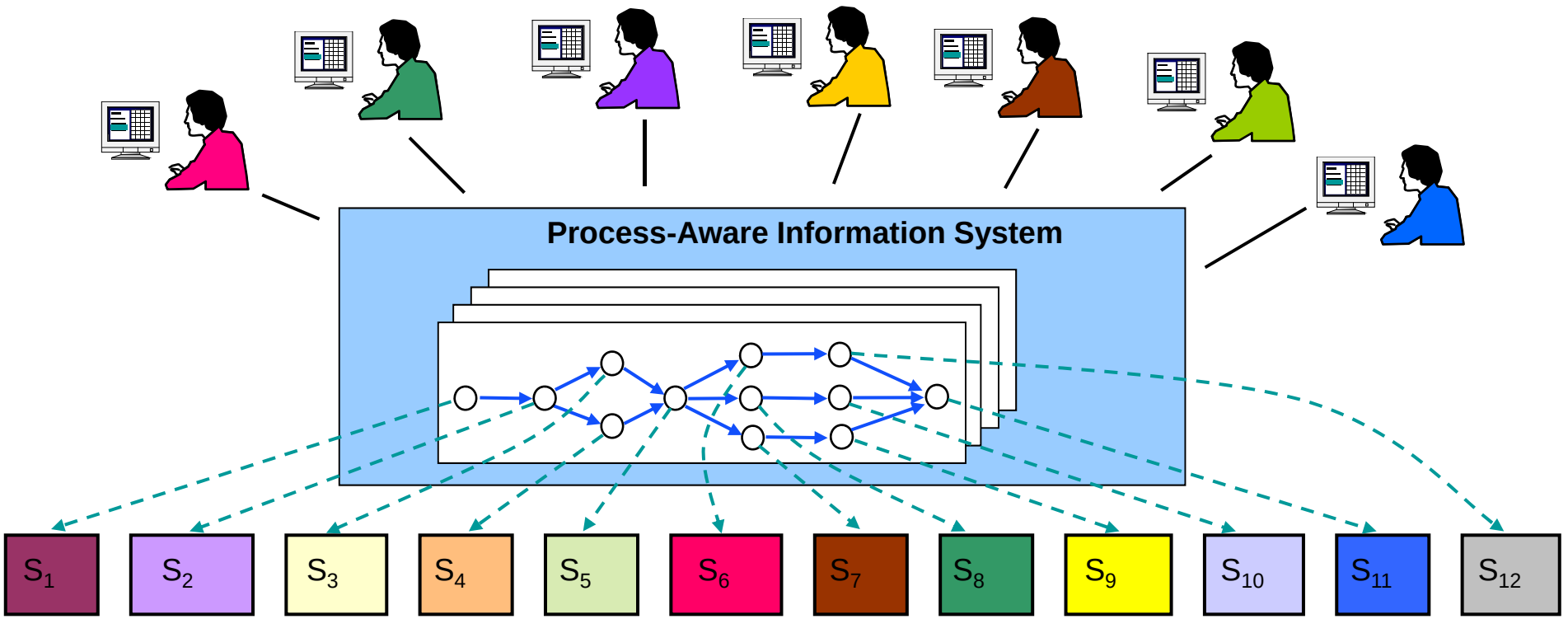


Motivation

Goals of SOA

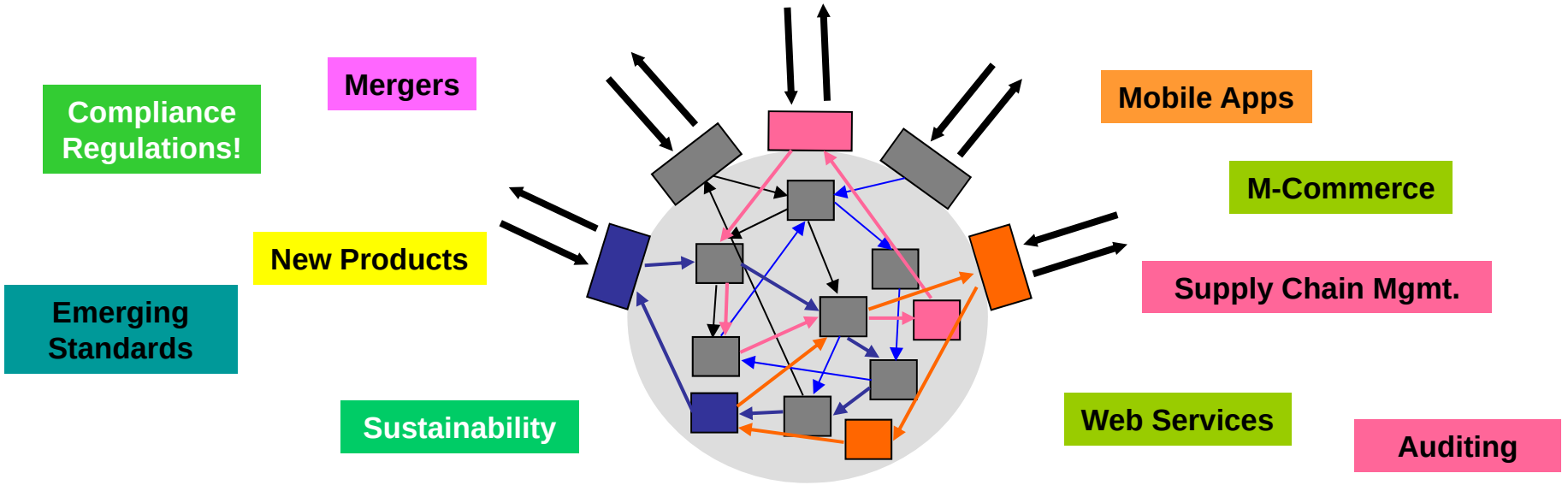
- improving process quality
- increasing **flexibility**
- …

?



Motivation

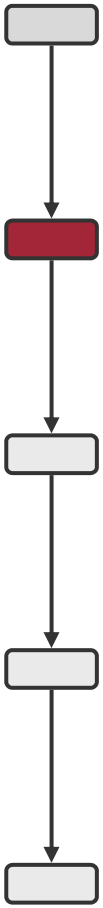
Environmental changes … – require new or adapted services
... which must be integrated with the EIS



The agile enterprise should be able to …

- rapidly set up and implement new business processes,
- quickly adapt existing business processes to changing needs
- flexibly intervene into the execution of single process instances (i.e., business cases) whenever required
- flexibly interact with partners and customers

⇨ ***Need for Flexible Process-Aware Information Systems***



Motivation

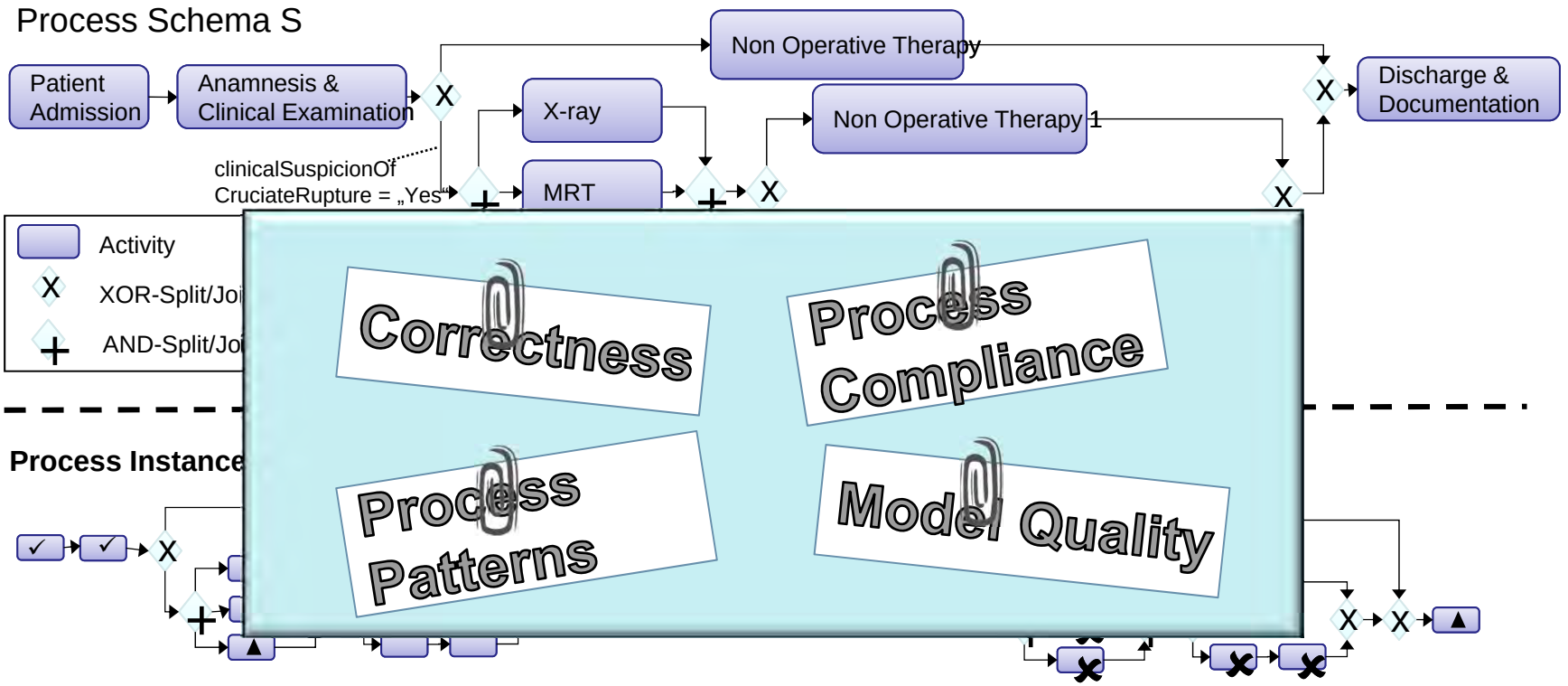
Process-Aware Information Systems (PAIS)

Flexible PAIS

Enabling Flexibility for Cross-Organizational Processes

Some Technical Insights

PAIS: Build-Time Issues



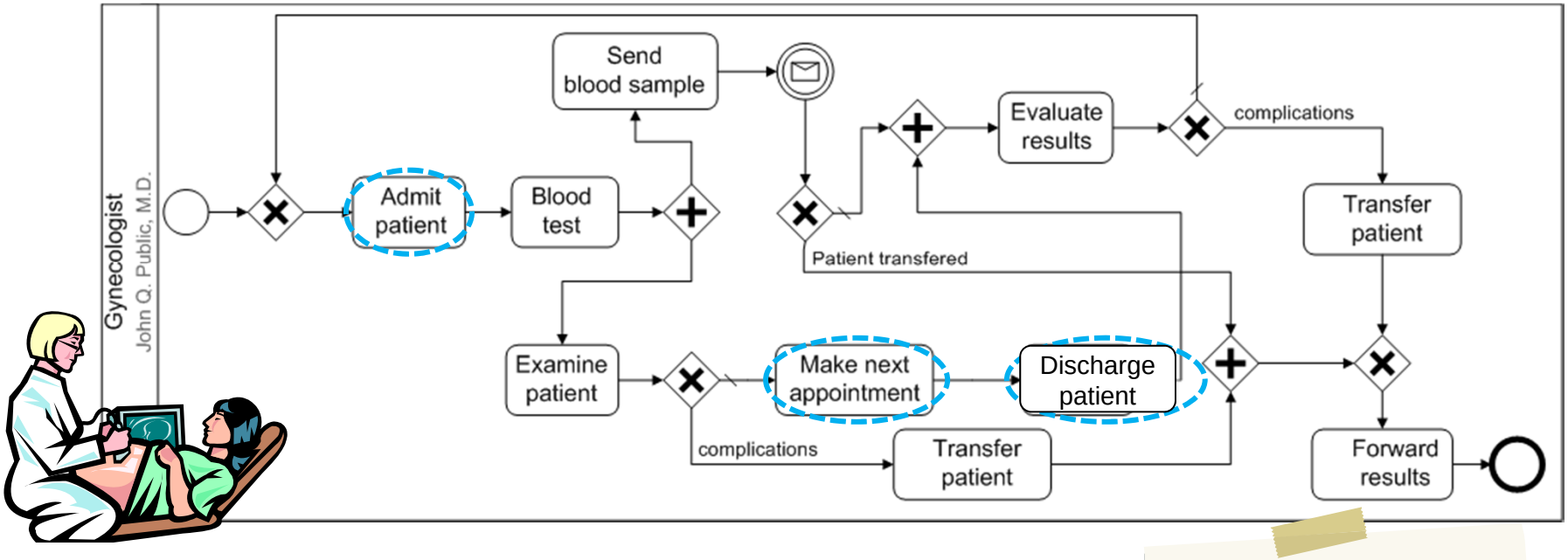
Execution Trace:
σ_1 = < „Patient Admission", „Anamnesis & Clinical Examination", „X-ray">

Execution Trace:
σ_2 = < „Patient Admission", „Anamnesis & Clinical Examination", „Non Operative Therapy">

Activity States: ▲ Activated ✓ Completed ✘ Skipped

PAIS: Process Compliance

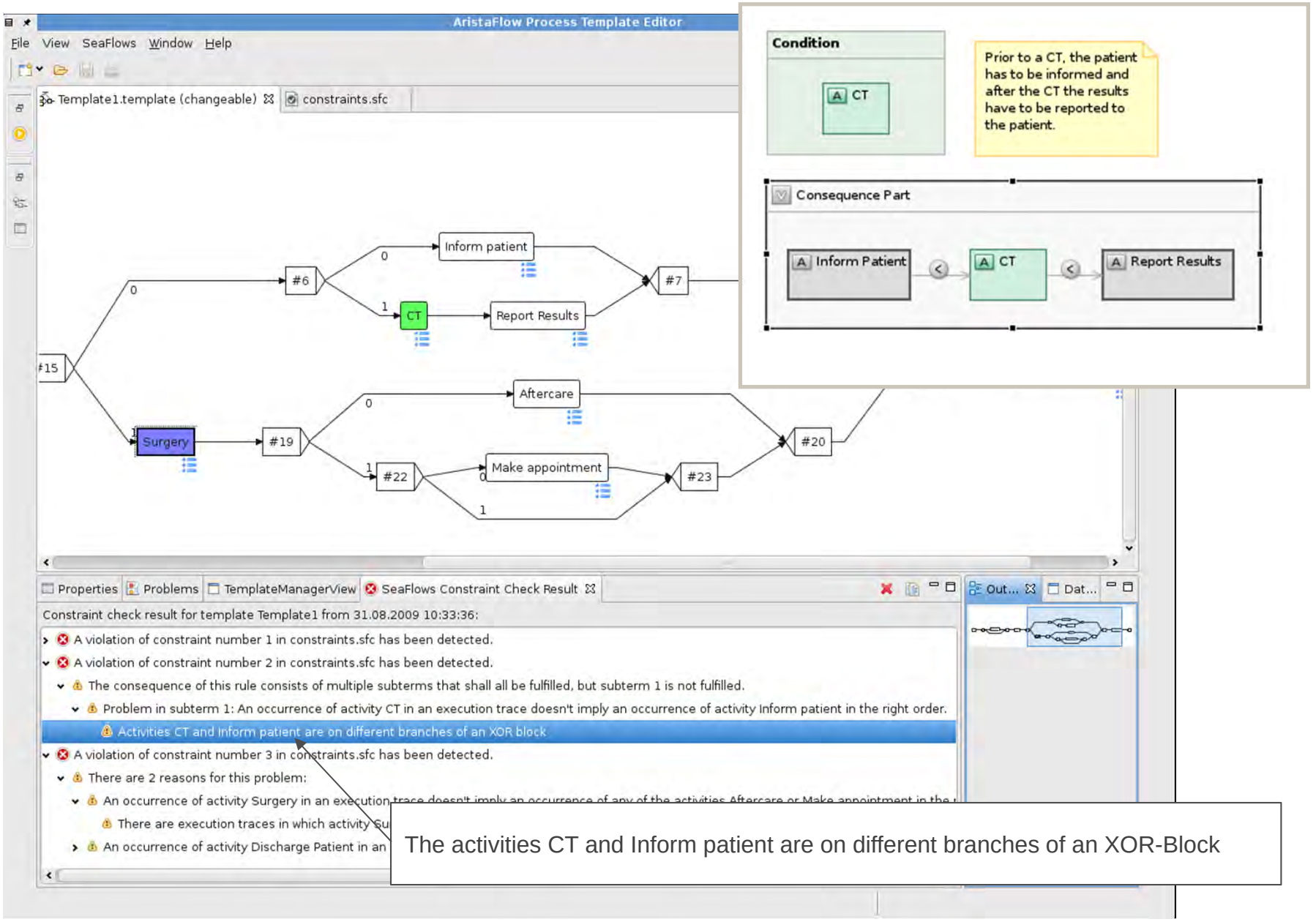
Process Compliance

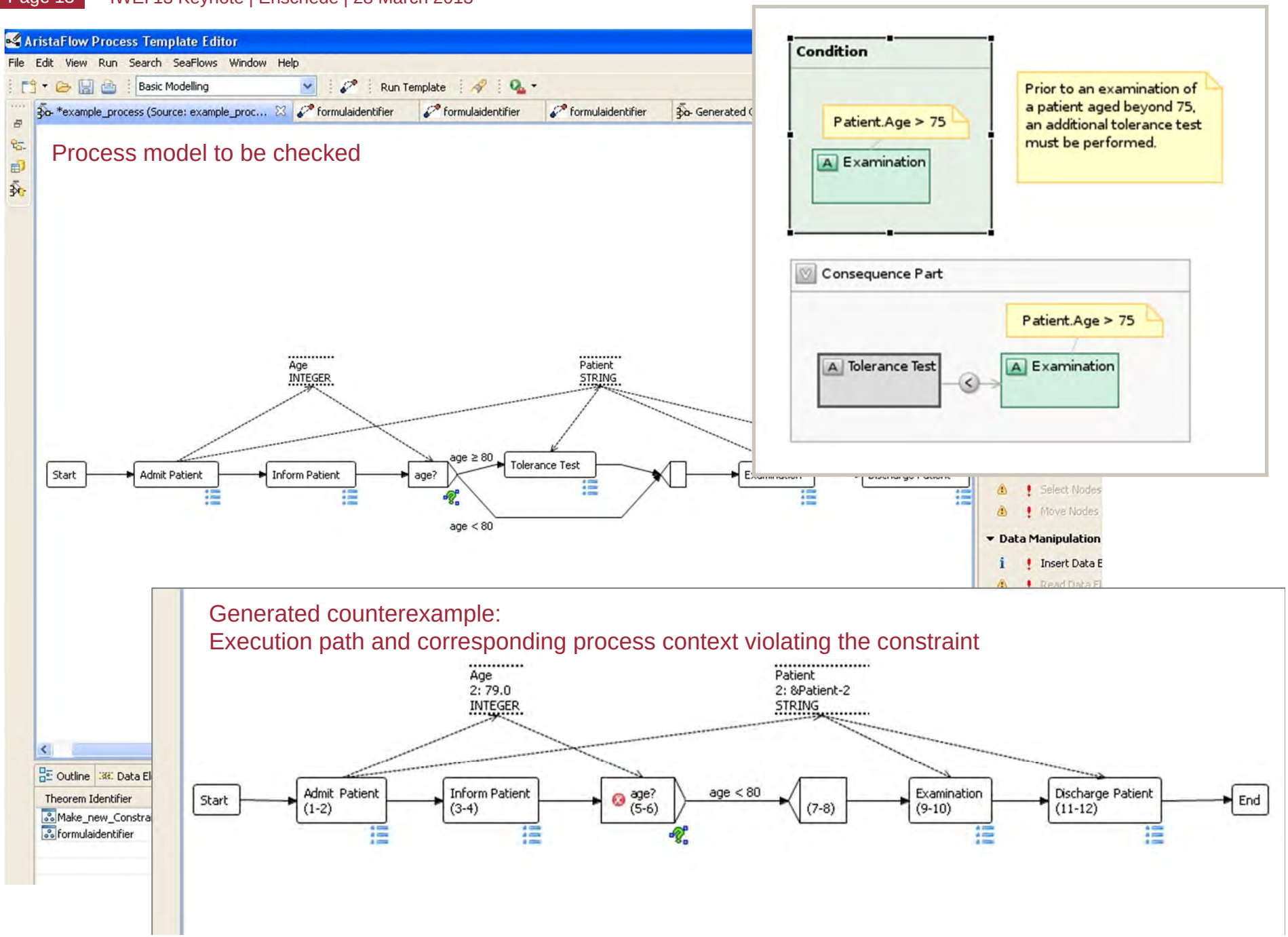


G(Admit_patient → (not Release_patient U Make_next_appointment))

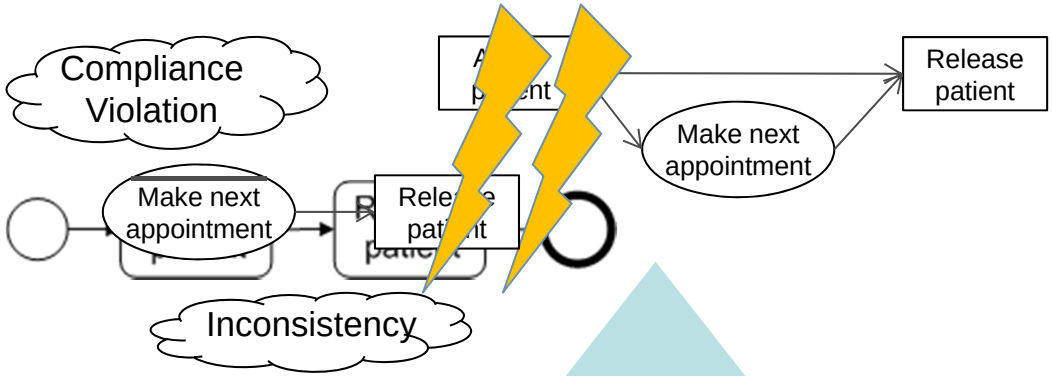
Guideline:
After admission, a patient should not be discharged without making the appointment for his next visit.

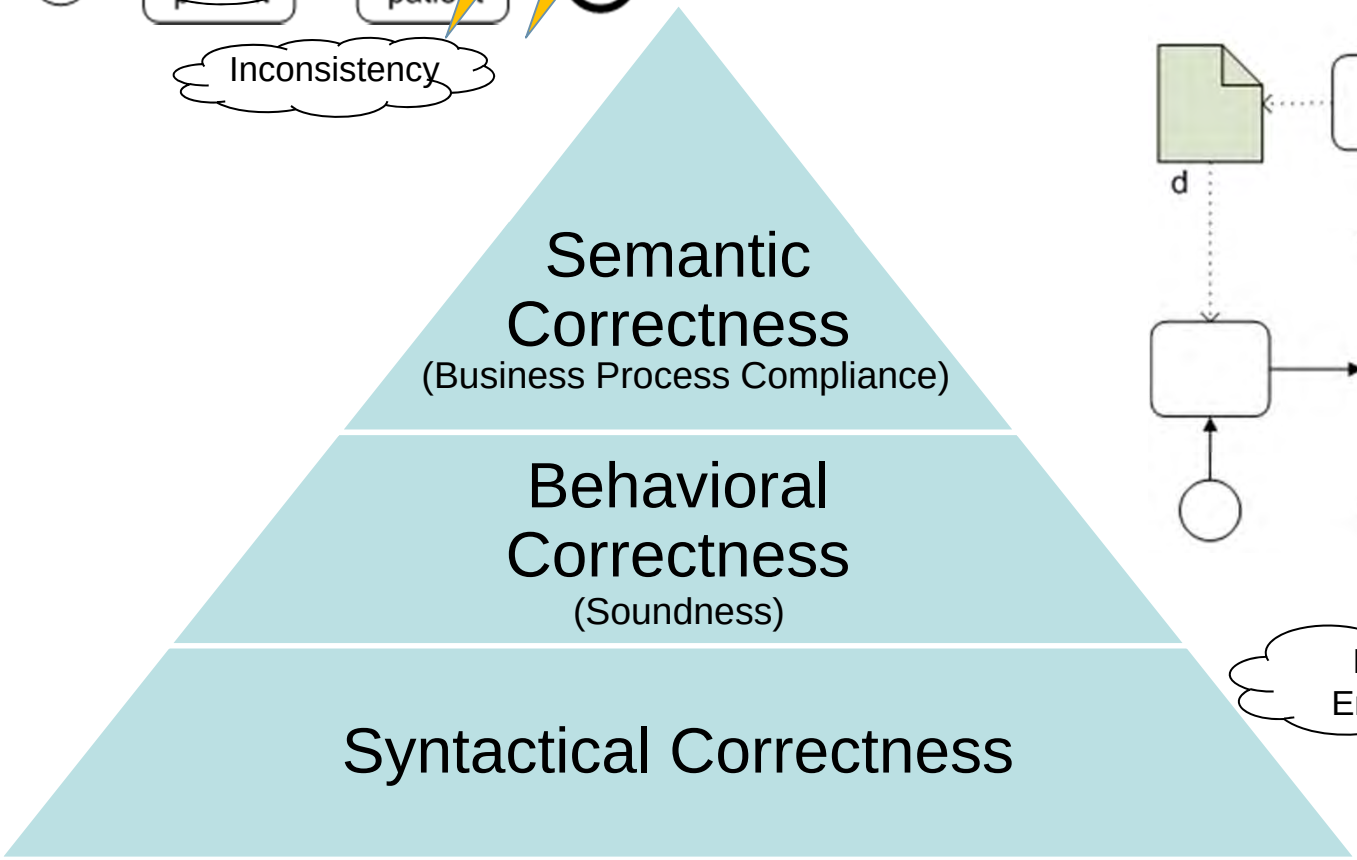
PAIS: Process Compliance

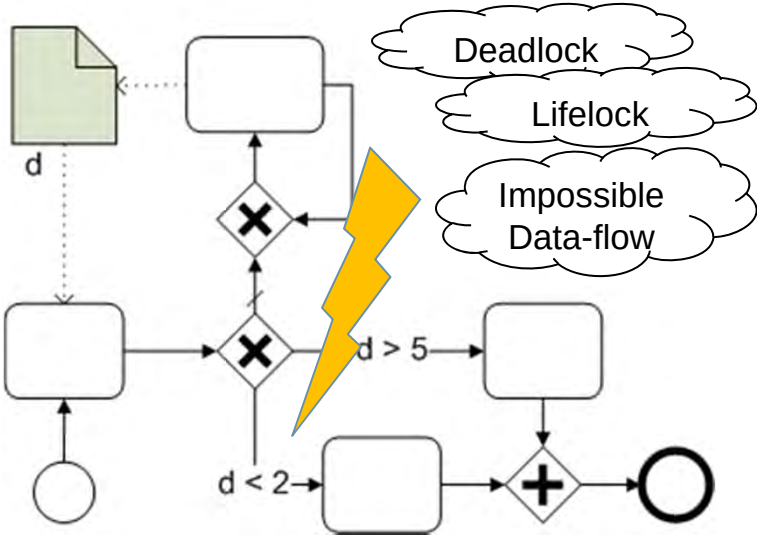


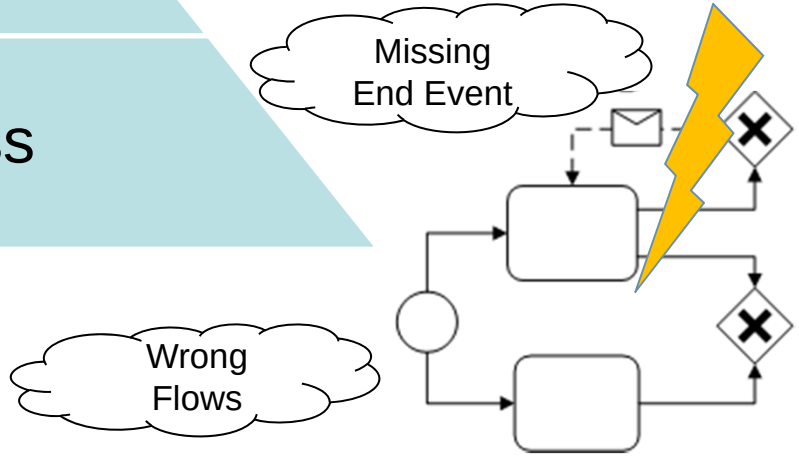

AristaFlow Process Template Editor
File Edit View Run Search SeaFlows Window Help
Basic Modelling
Run Template
*example_process (Source: example_proc...
formulaidentifier
formulaidentifier
formulaidentifier
Process model to be checked
Age
INTEGER
Patient
STRING
Start
Admit Patient
Inform Patient
age?
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
Select Nodes
Move Nodes
Data Manipulation
Insert Data E
Outline
Theorem Identifier
Make_new_Constra
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

PAIS: Levels of Correctness

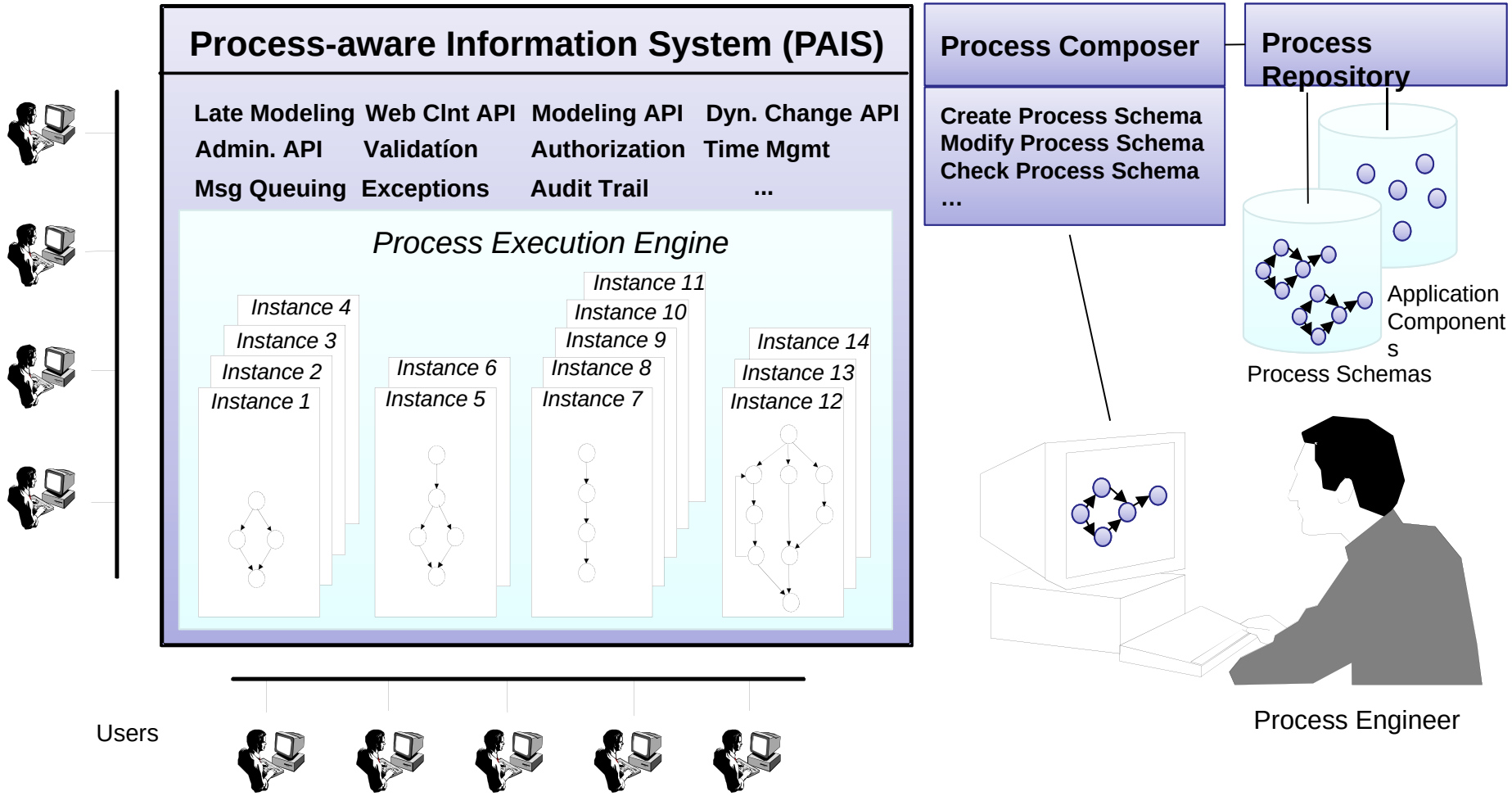




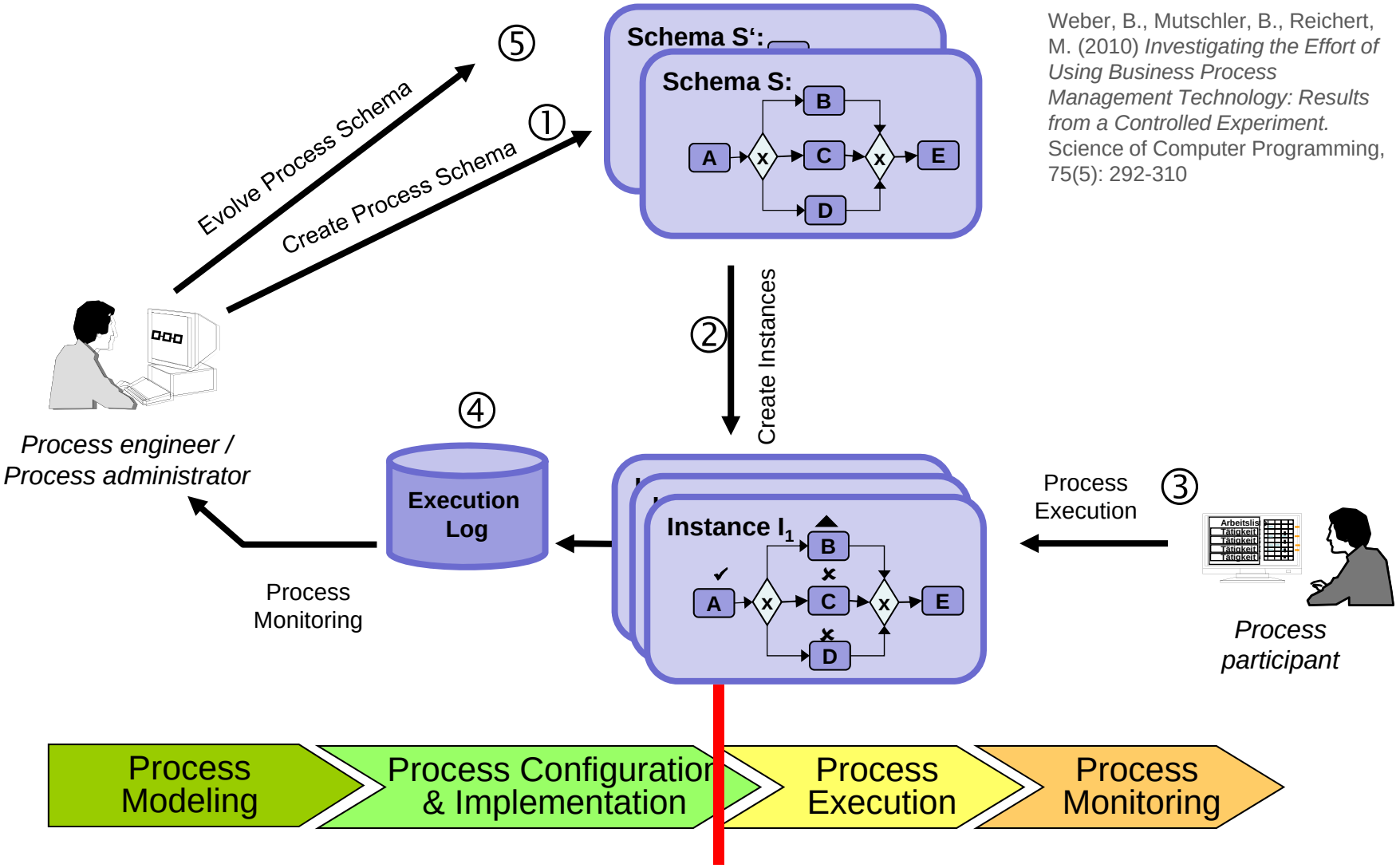




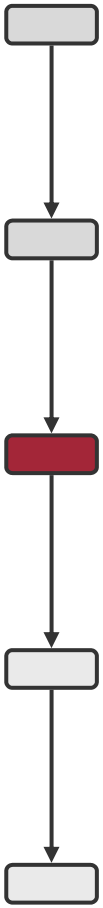
PAIS: Runtime Components



PAIS: The Process Lifecycle



Weber, B., Mutschler, B., Reichert, M. (2010) *Investigating the Effort of Using Business Process Management Technology: Results from a Controlled Experiment.* Science of Computer Programming, 75(5): 292-310



Motivation

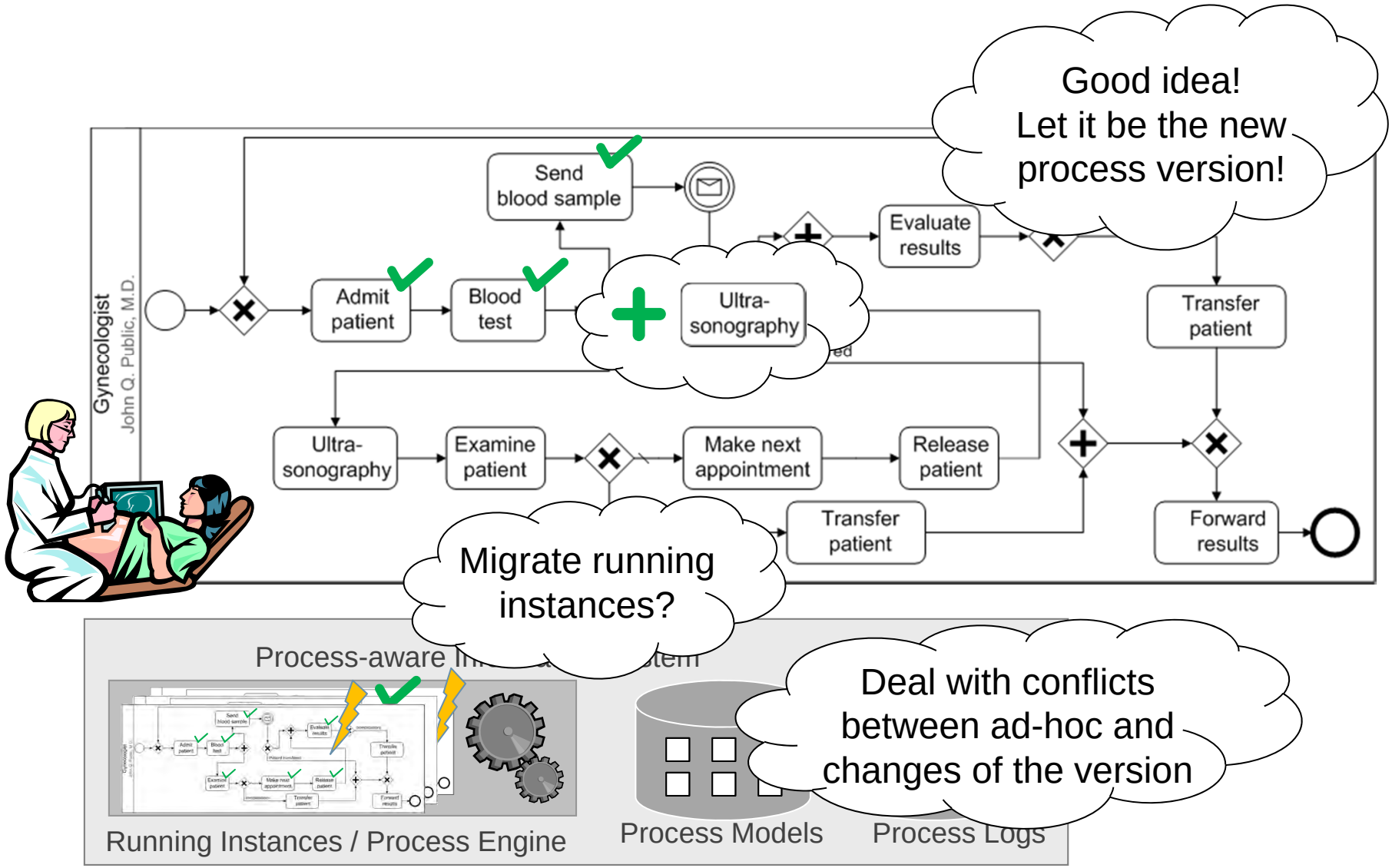
Process-Aware Information Systems (PAIS)

Flexible PAIS

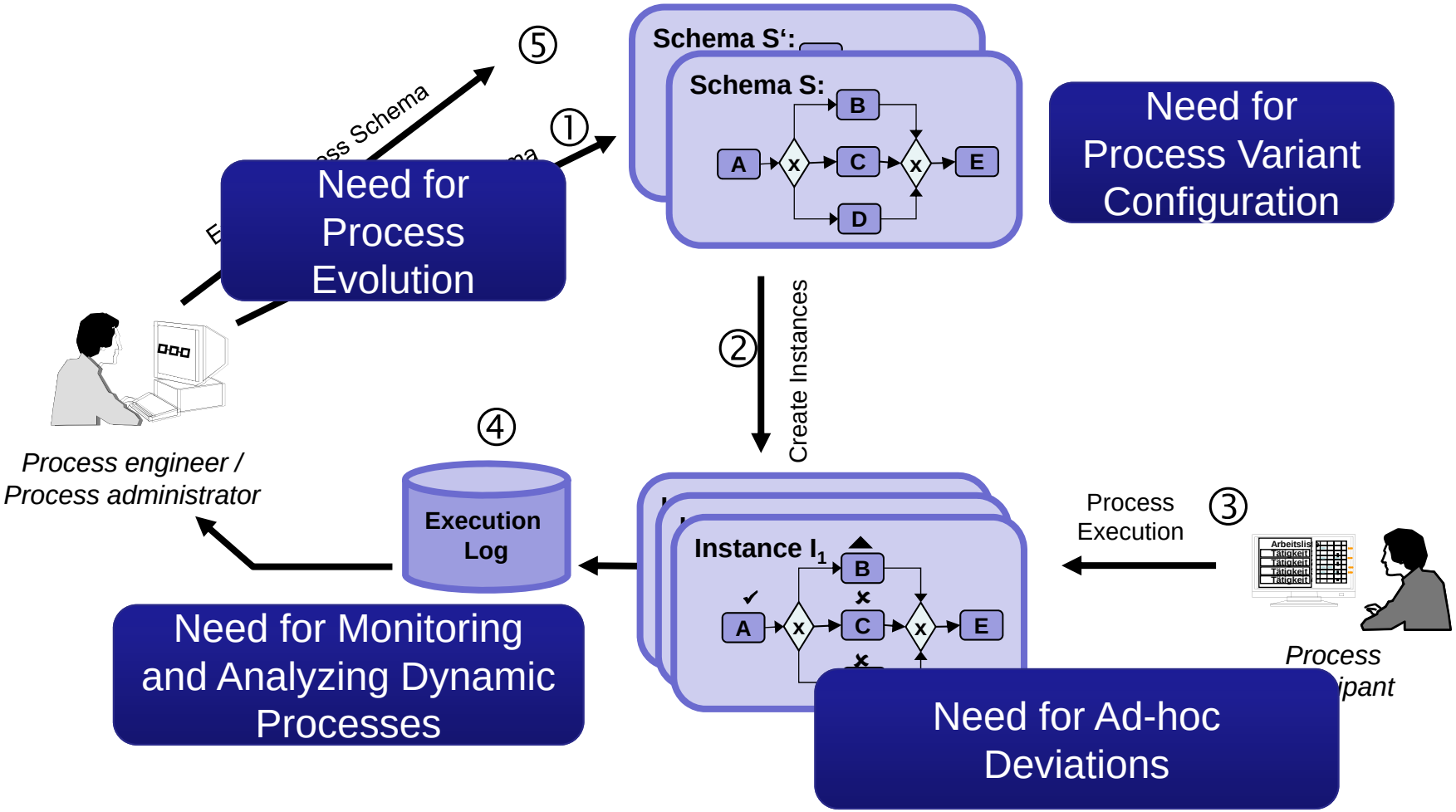
Enabling Flexibility for Cross-Organizational Processes

Some Technical Insights

Flexible PAIS: Enabling the Agile Enterprise

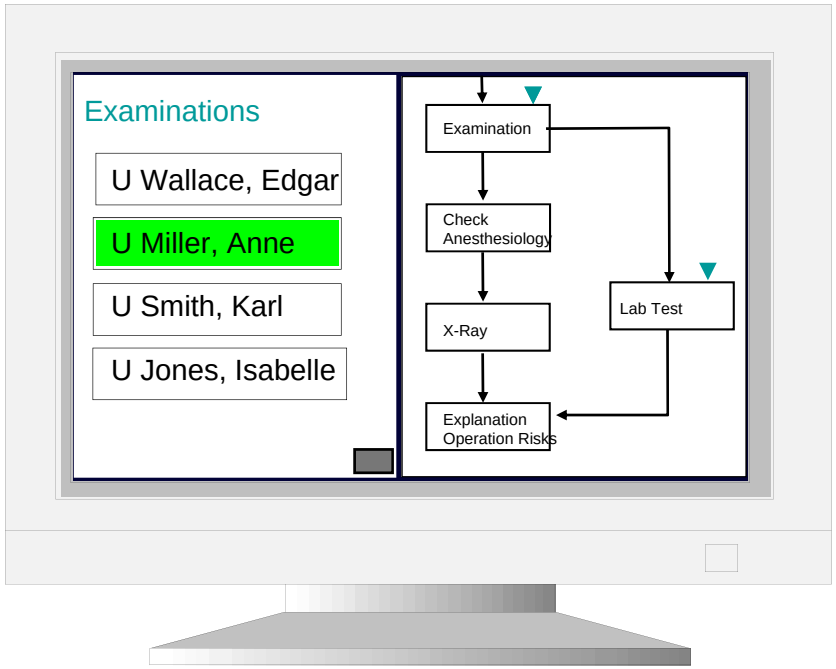


Flexible PAIS: Required Lifecycle Support



Reichert, M., Rinderle-Ma, S., Dadam, P. (2010) *Flexibility in Process-aware Information Systems.* LNCS Transactions on Petri Nets and Other Models of Concurrency, Vol. 2, pp. 115-135

Ad-hoc Changes



The Users' View

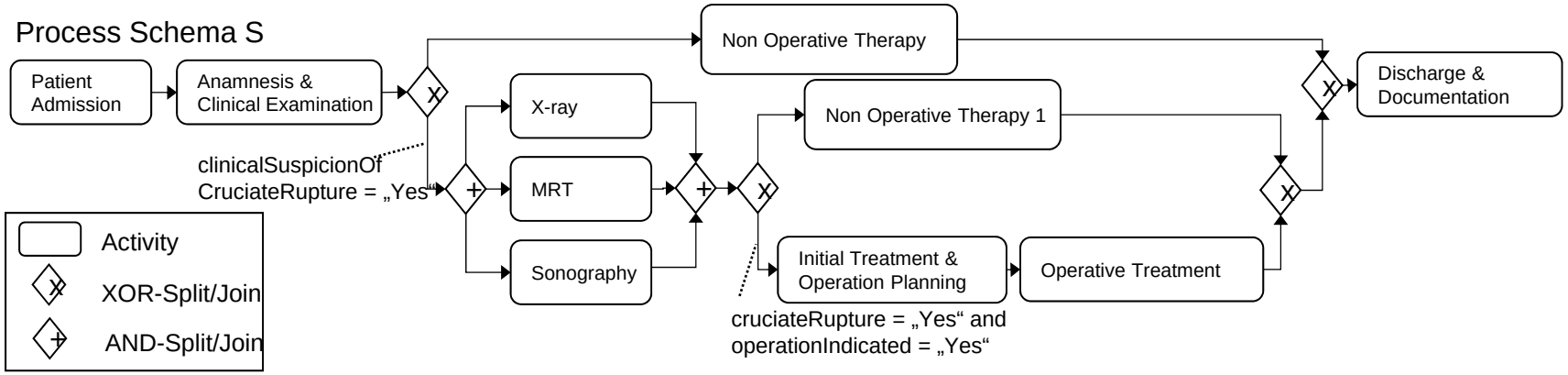
Reichert, Manfred and Dadam, Peter (1998) *ADEPTflex-Supporting Dynamic Changes of Workflows Without Losing Control.* Journal of Intelligent Information Systems, Special Issue on Workflow Management Systems, 10(2): 93-129, Kluwer

Ad-hoc Changes

System's View

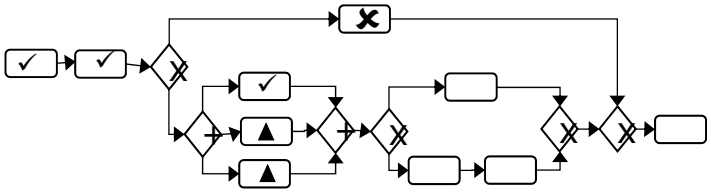
Process Type Level

Process Schema S



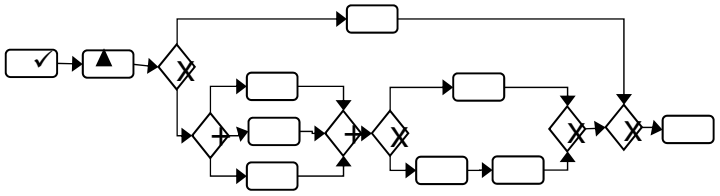
Process Instance Level

Process Instance I1



Execution Trace:
σ_1 = < „Patient Admission", „Anamnesis & Clinical Examination", „X-ray">

Process Instance I2



Execution Trace:
σ_2 = < „Patient Admission">

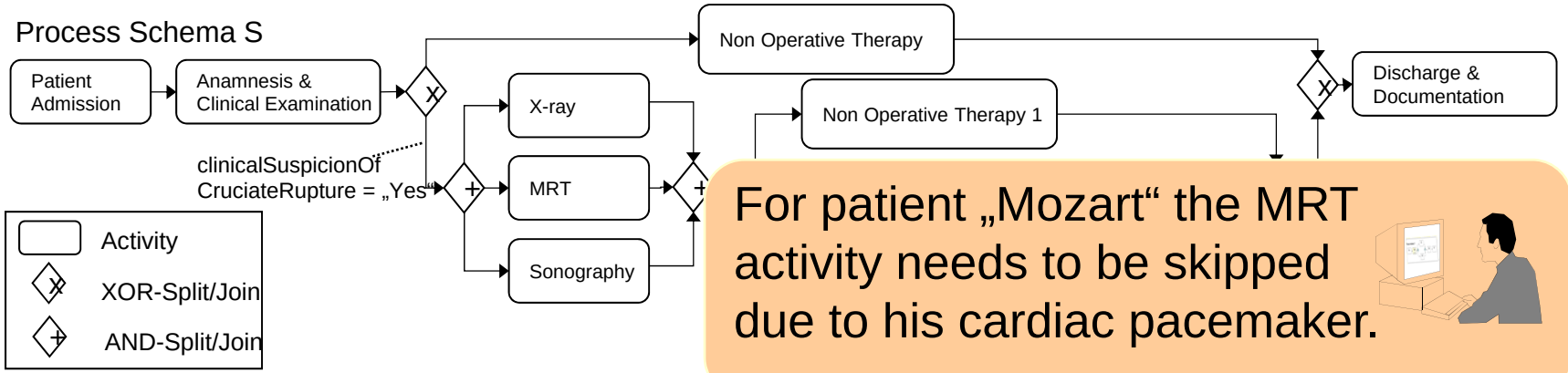
Reichert, Manfred and Dadam, Peter (1998) *ADEPTflex-Supporting Dynamic Changes of Workflows Without Losing Control.* Journal of Intelligent Information Systems, Special Issue on Workflow Management Systems, Vol. 10, No. 2, pp. 93-129

Ad-hoc Changes

System's View

Process Type Level

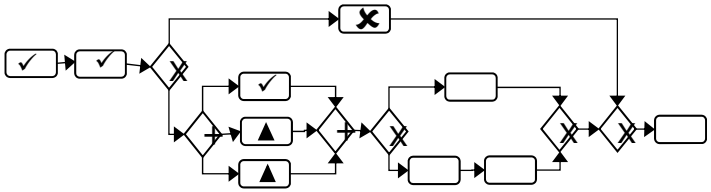
Process Schema S



For patient „Mozart" the MRT activity needs to be skipped due to his cardiac pacemaker.

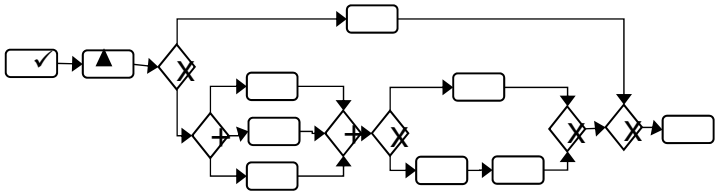
Process Instance Level

Process Instance I1



Execution Trace:
σ_1 = < „Patient Admission", „Anamnesis & Clinical Examination", „X-ray">

Process Instance I2



Execution Trace:
σ_2 = < „Patient Admission">

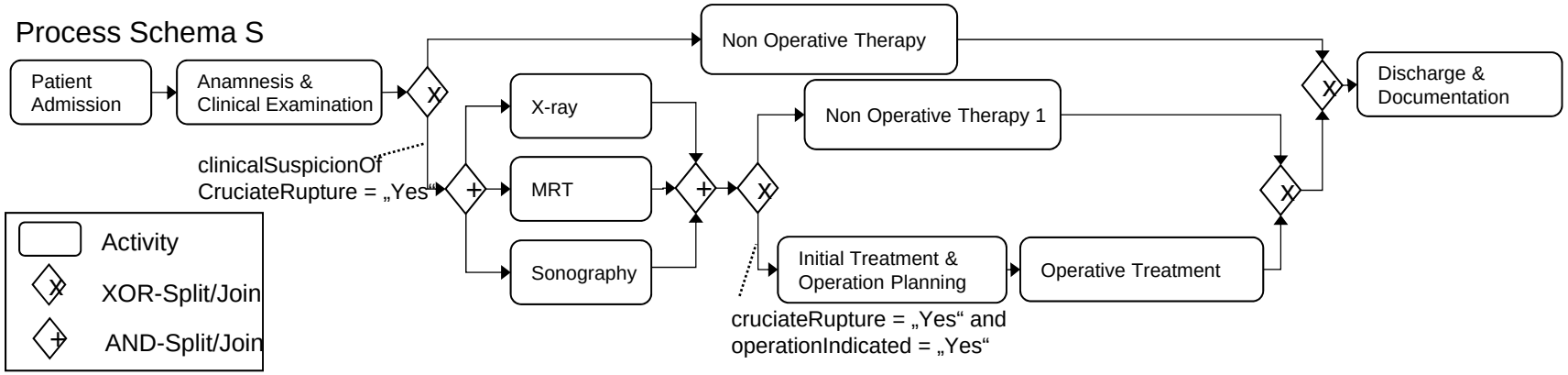
Reichert, Manfred and Dadam, Peter (1998) *ADEPTflex-Supporting Dynamic Changes of Workflows Without Losing Control.* Journal of Intelligent Information Systems, Special Issue on Workflow Management Systems, Vol. 10, No. 2, pp. 93-129

Ad-hoc Changes

System's View

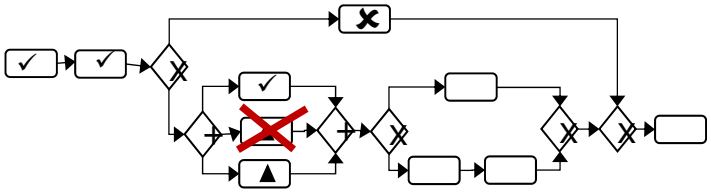
Process Type Level

Process Schema S



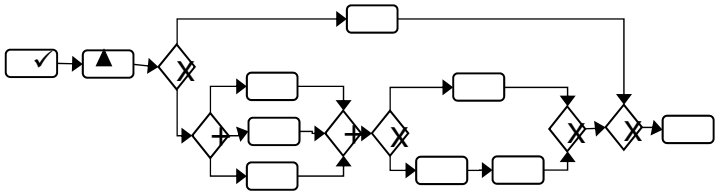
Process Instance Level

Process Instance I1



Execution Trace:
σ_1 = < „Patient Admission", „Anamnesis & Clinical Examination", „X-ray">

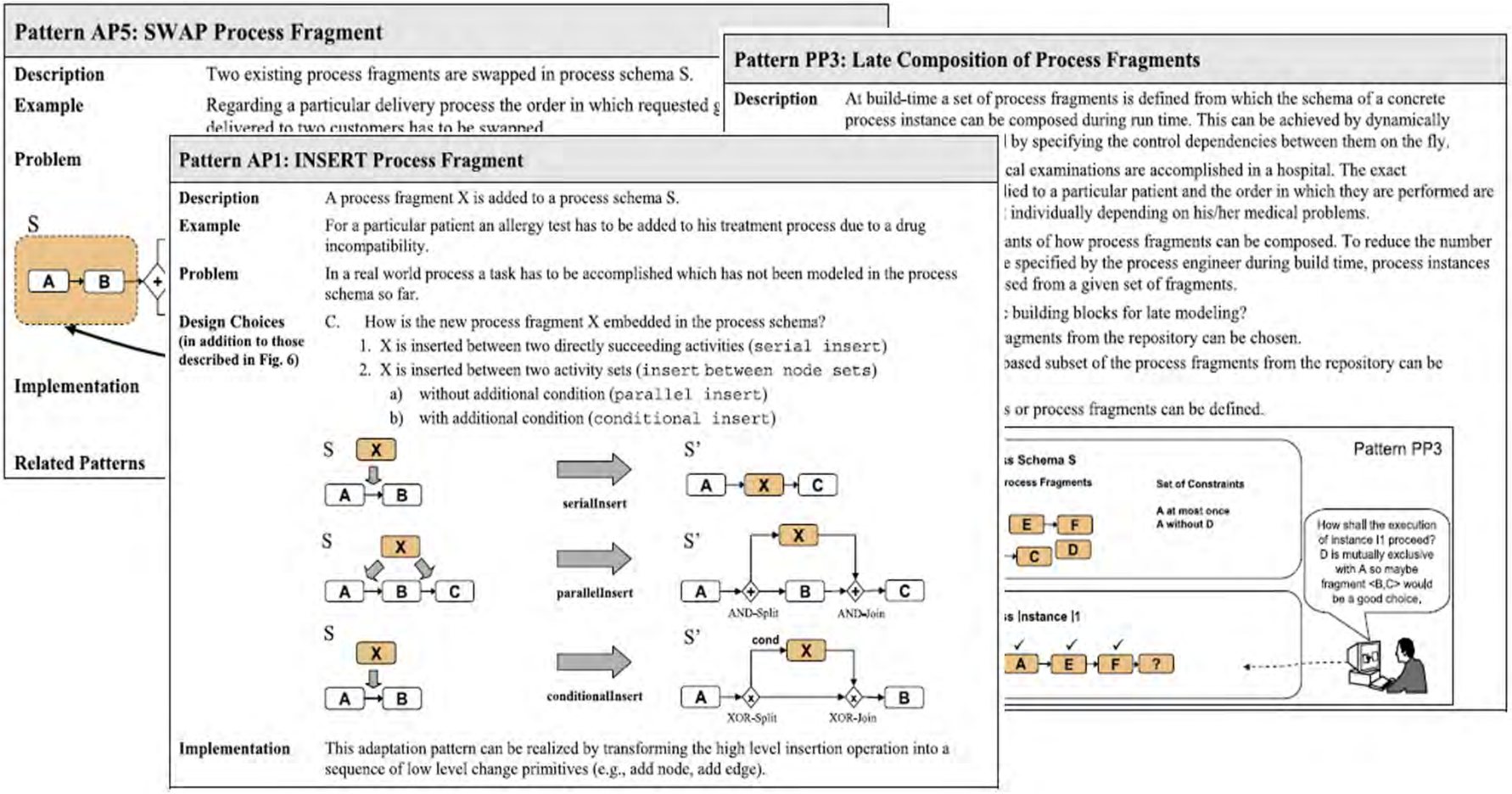
Process Instance I2



Execution Trace:
σ_2 = < „Patient Admission">

Reichert, Manfred and Dadam, Peter (1998) *ADEPTflex-Supporting Dynamic Changes of Workflows Without Losing Control.* Journal of Intelligent Information Systems, Special Issue on Workflow Management Systems, Vol. 10, No. 2, pp. 93-129

Ad-hoc Changes – Change Patterns



Pattern AP5: SWAP Process Fragment

Description Two existing process fragments are swapped in process schema S.

Example Regarding a particular delivery process the order in which requested g
delivered to two customers has to be swapped

Problem

S

A B +

Implementation

Related Patterns

Pattern AP1: INSERT Process Fragment

Description A process fragment X is added to a process schema S.

Example For a particular patient an allergy test has to be added to his treatment process due to a drug incompatibility.

Problem In a real world process a task has to be accomplished which has not been modeled in the process schema so far.

Design Choices (in addition to those described in Fig. 6)

C. How is the new process fragment X embedded in the process schema?

1. X is inserted between two directly succeeding activities (`serial insert`)
2. X is inserted between two activity sets (`insert between node sets`)
   a) without additional condition (`parallel insert`)
   b) with additional condition (`conditional insert`)

S: X, A, B → **serialInsert** → S': A, X, C

S: X, A, B, C → **parallelInsert** → S': A, +, X, B, +, C (AND-Split, AND-Join)

S: X, A, B → **conditionalInsert** → S': A, x, cond, X, x, B (XOR-Split, XOR-Join)

Implementation This adaptation pattern can be realized by transforming the high level insertion operation into a sequence of low level change primitives (e.g., add node, add edge).

Pattern PP3: Late Composition of Process Fragments

Description At build-time a set of process fragments is defined from which the schema of a concrete process instance can be composed during run time. This can be achieved by dynamically
by specifying the control dependencies between them on the fly.

cal examinations are accomplished in a hospital. The exact
lied to a particular patient and the order in which they are performed are
individually depending on his/her medical problems.

ants of how process fragments can be composed. To reduce the number
e specified by the process engineer during build time, process instances
sed from a given set of fragments.

building blocks for late modeling?

agments from the repository can be chosen.

based subset of the process fragments from the repository can be

s or process fragments can be defined.

Pattern PP3

is Schema S

rocess Fragments

Set of Constraints

A at most once
A without D

E F C D

How shall the execution of instance I1 proceed? D is mutually exclusive with A so maybe fragment <B,C> would be a good choice.

is Instance I1

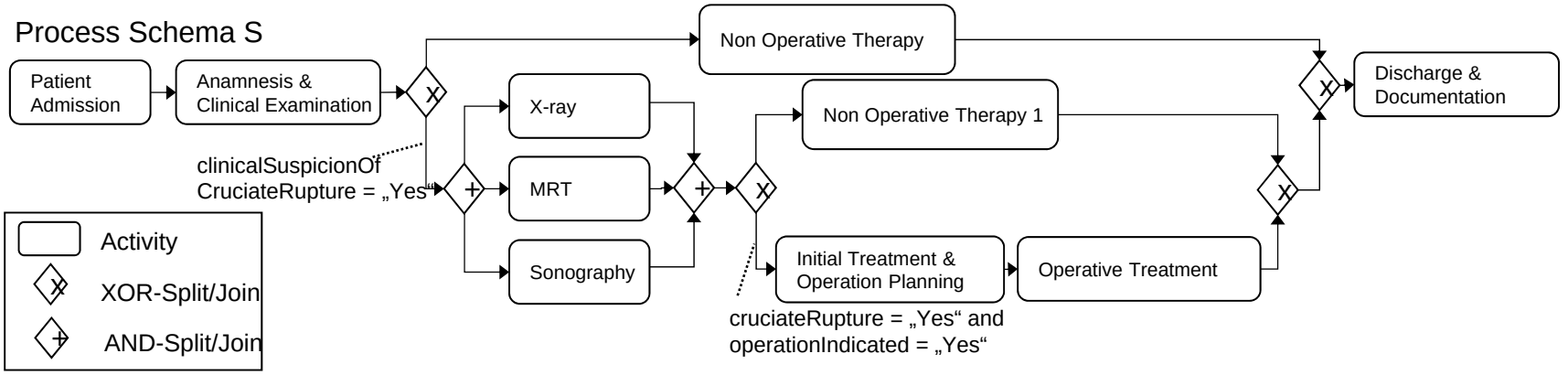
A E F ?

Weber, Barbara and Reichert, Manfred and Rinderle-Ma, Stefanie (2008) *Change Patterns and Change Support Features - Enhancing Flexibility in Process-Aware Information Systems .* Data and Knowledge Engineering, 66(3): 438-466, Elsevier Science

Ad-hoc Changes – Change Correctness

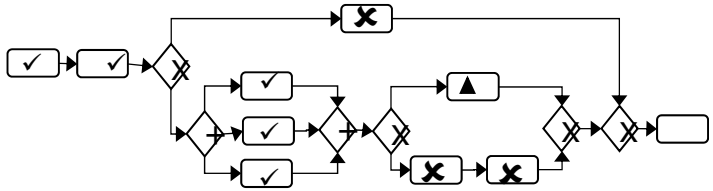
Process Type Level

Process Schema S



Process Instance Level

Process Instance I3

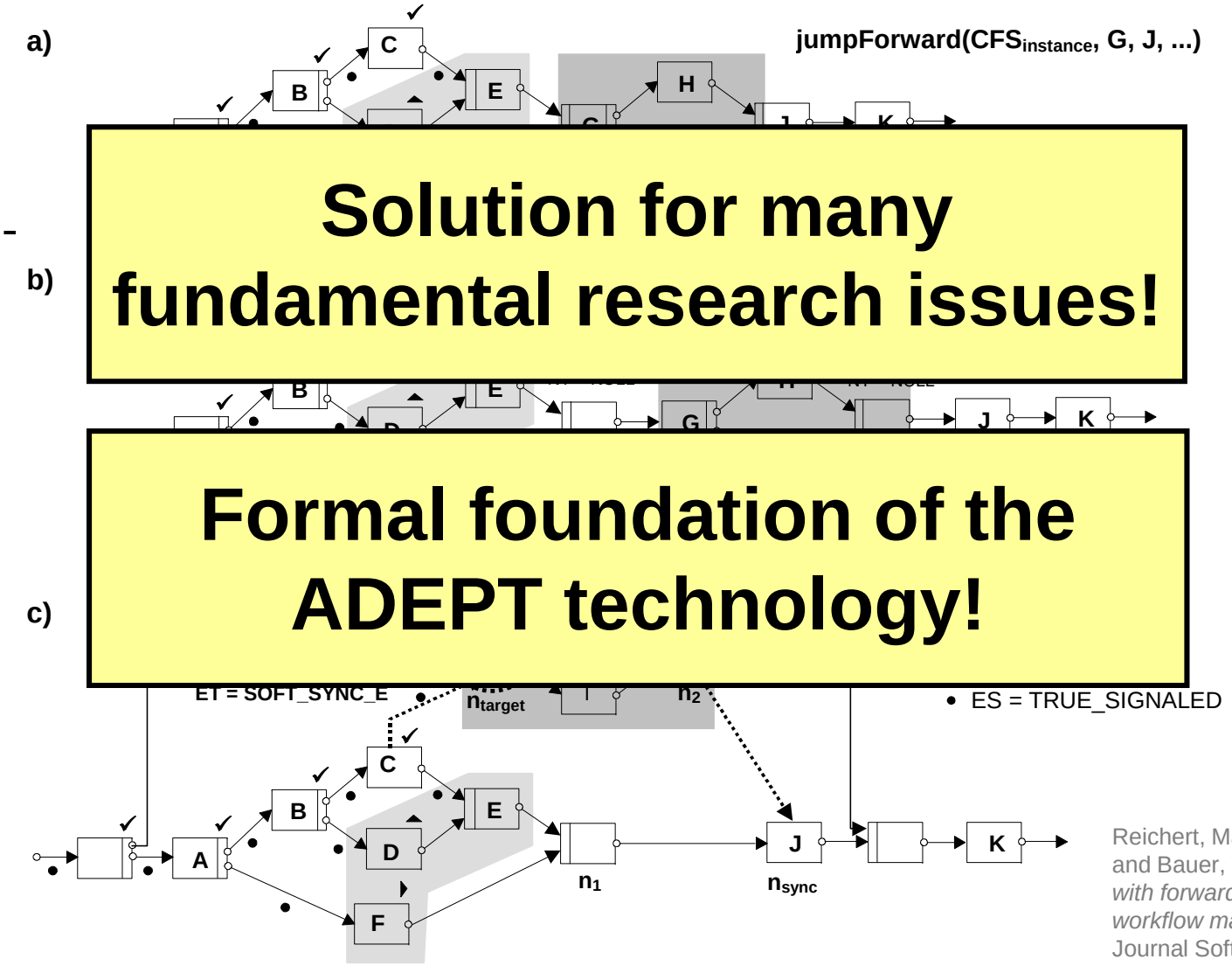


Execution Trace:
σ_3 = < „Patient Admission“, „Anamnesis & Clinical Examination“, „MRT“, „X-ray“, „Sonography“>

I3 is not compliant with change Delete (I3, MRT)

Rinderle, Stefanie and Reichert, Manfred (2004) *Correctness Criteria for Dynamic Changes in Workflow Systems: A Survey.* Data & Knowledge Engineering, Vol. 50, No. 1, pp. 9-34.

Ad-hoc Changes – The ADEPT Framework

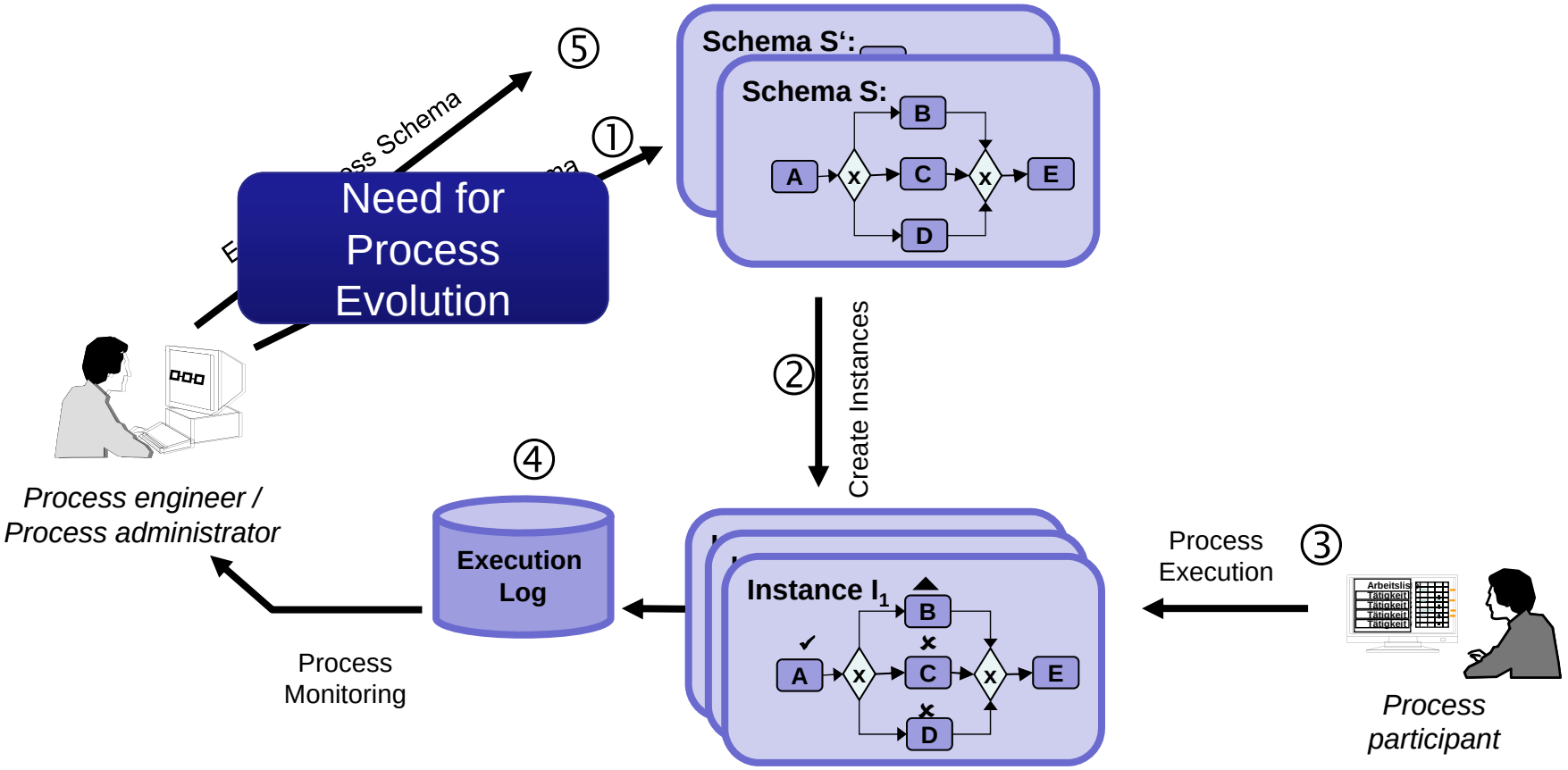


Solution for many fundamental research issues!

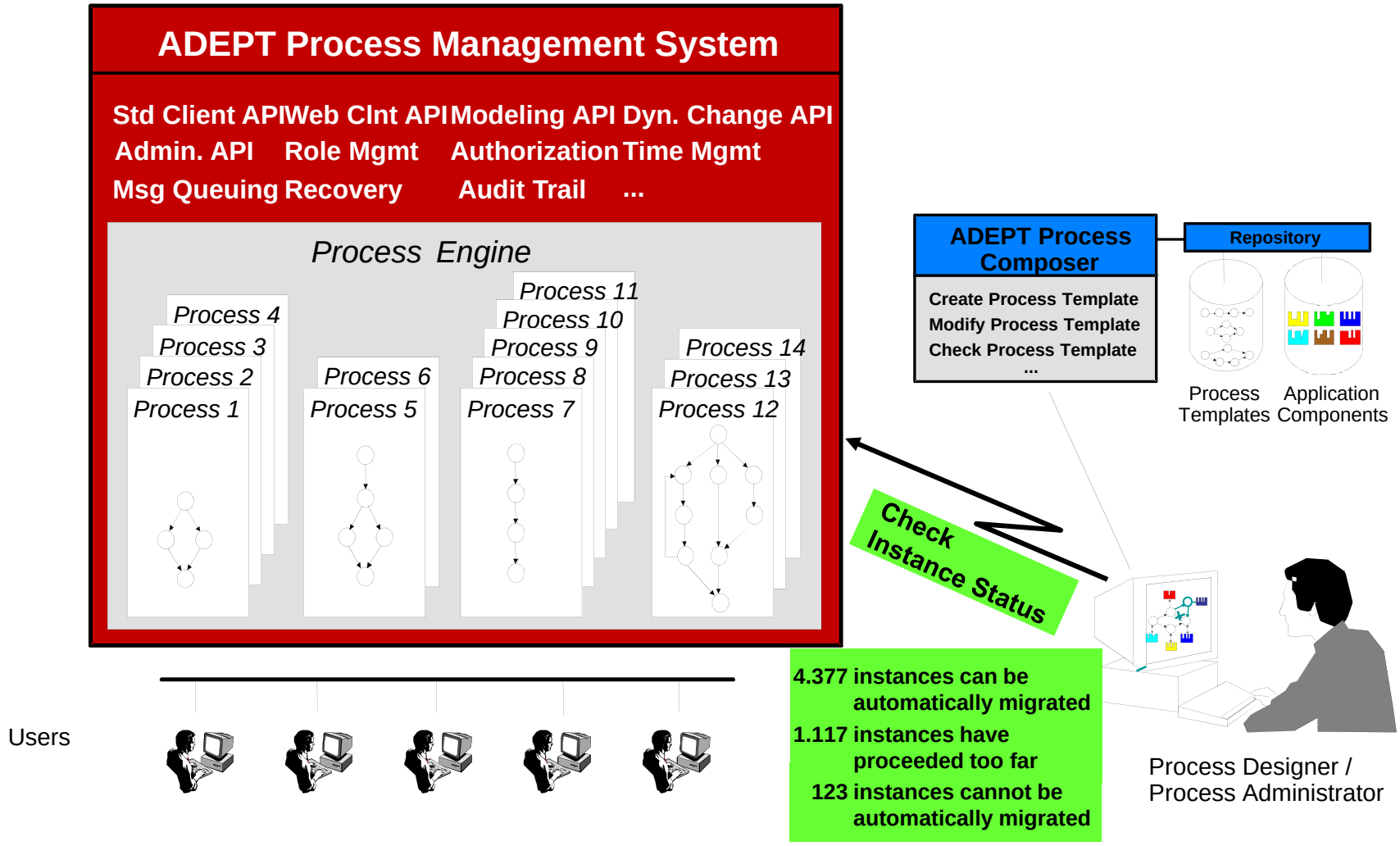
Formal foundation of the ADEPT technology!

Reichert, Manfred and Dadam, Peter and Bauer, Thomas (2003) *Dealing with forward and backward jumps in workflow management systems.* Int'l Journal Software and Systems Modeling (SOSYM), 2(1): 37-58

Flexible PAIS: Process Schema Evolution

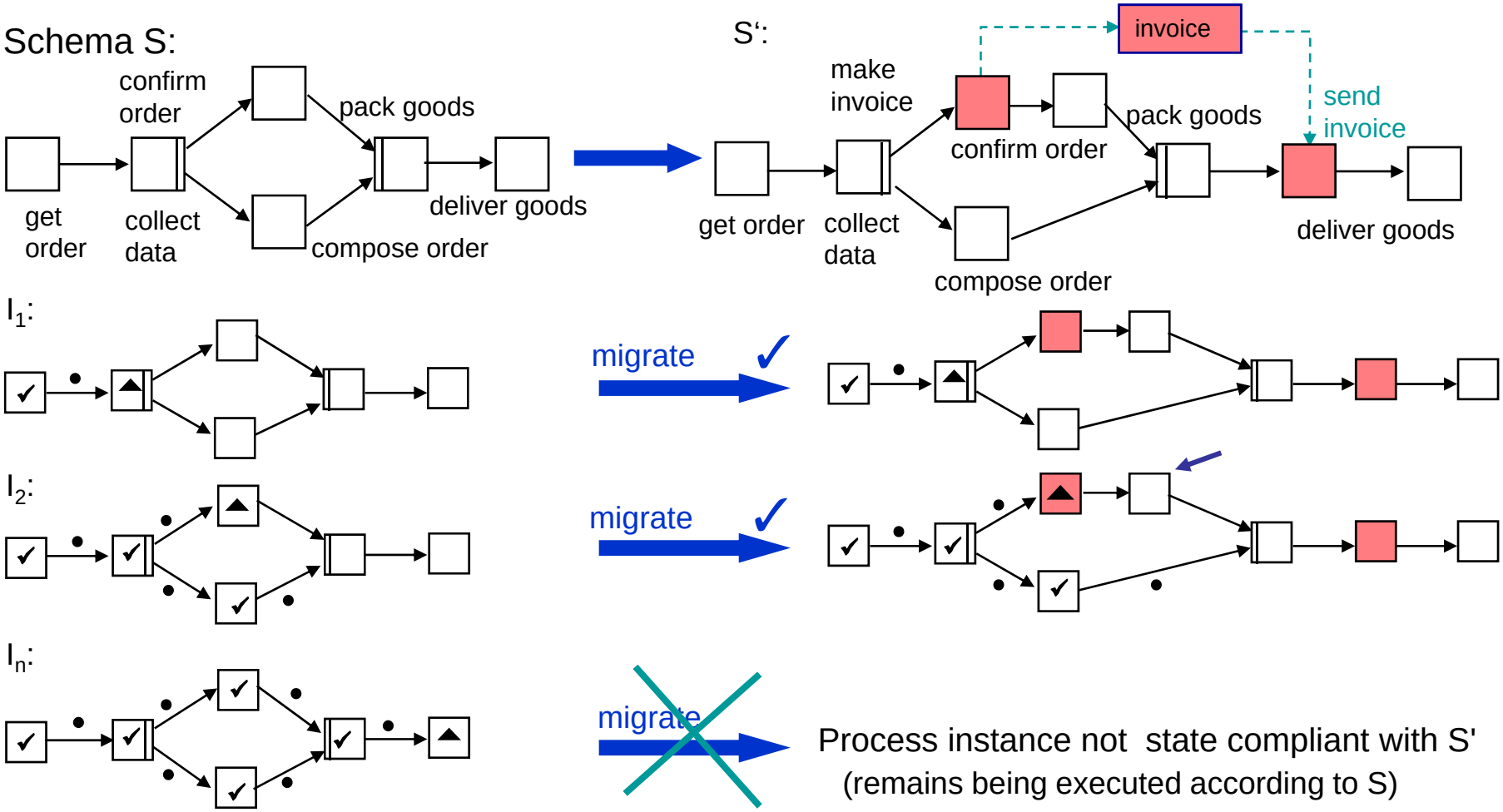


Process Schema Evolution – The User's View



Process Schema Evolution – The System's View

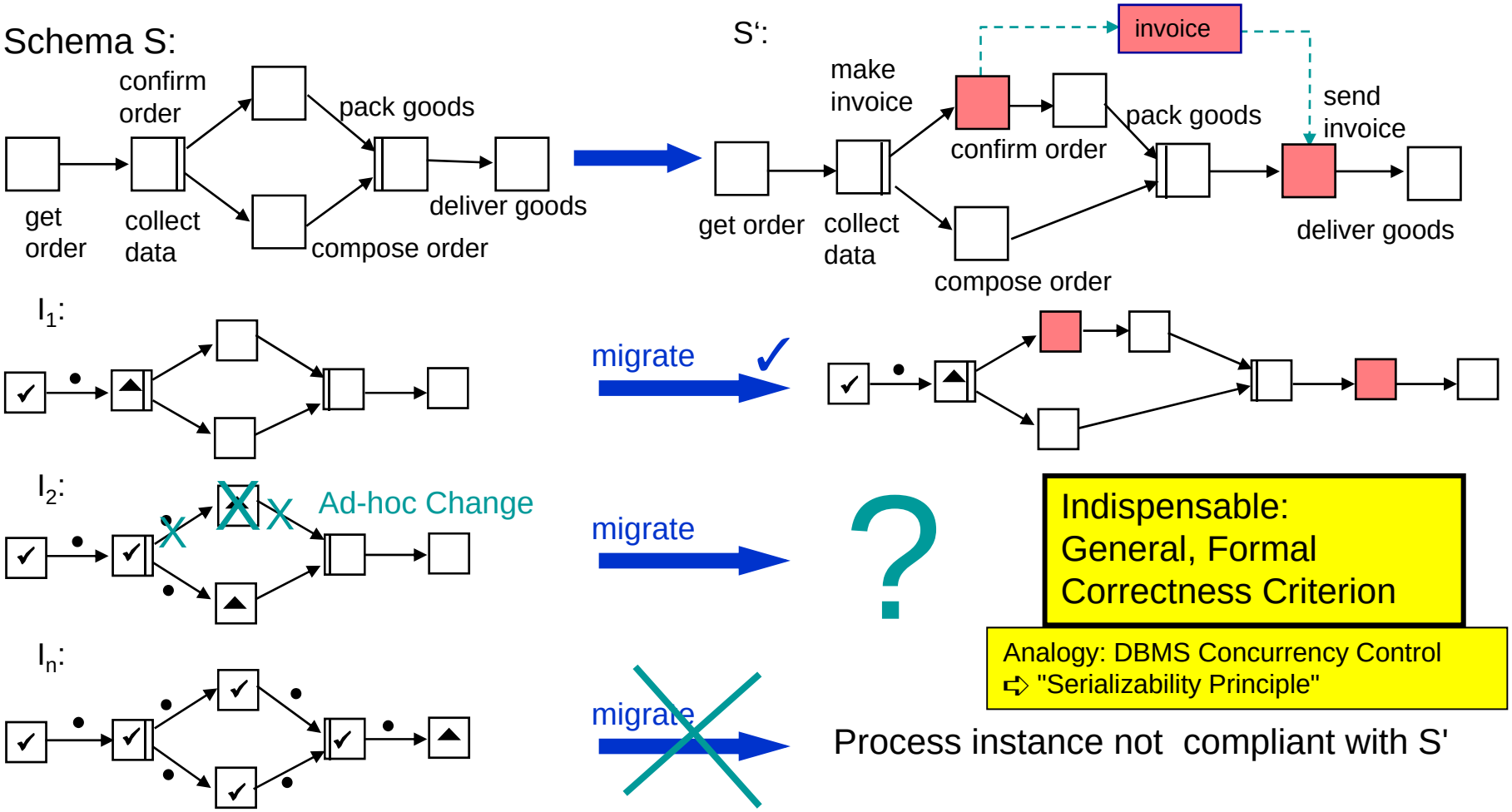
Fundamental Question: Under Which Conditions is a Migration Possible?



Rinderle, S., Reichert, M., Dadam, Peter (2004) *Flexible Support of Team Processes by Adaptive Workflow Systems.* Distributed and Parallel Databases, 16(1): 91-116

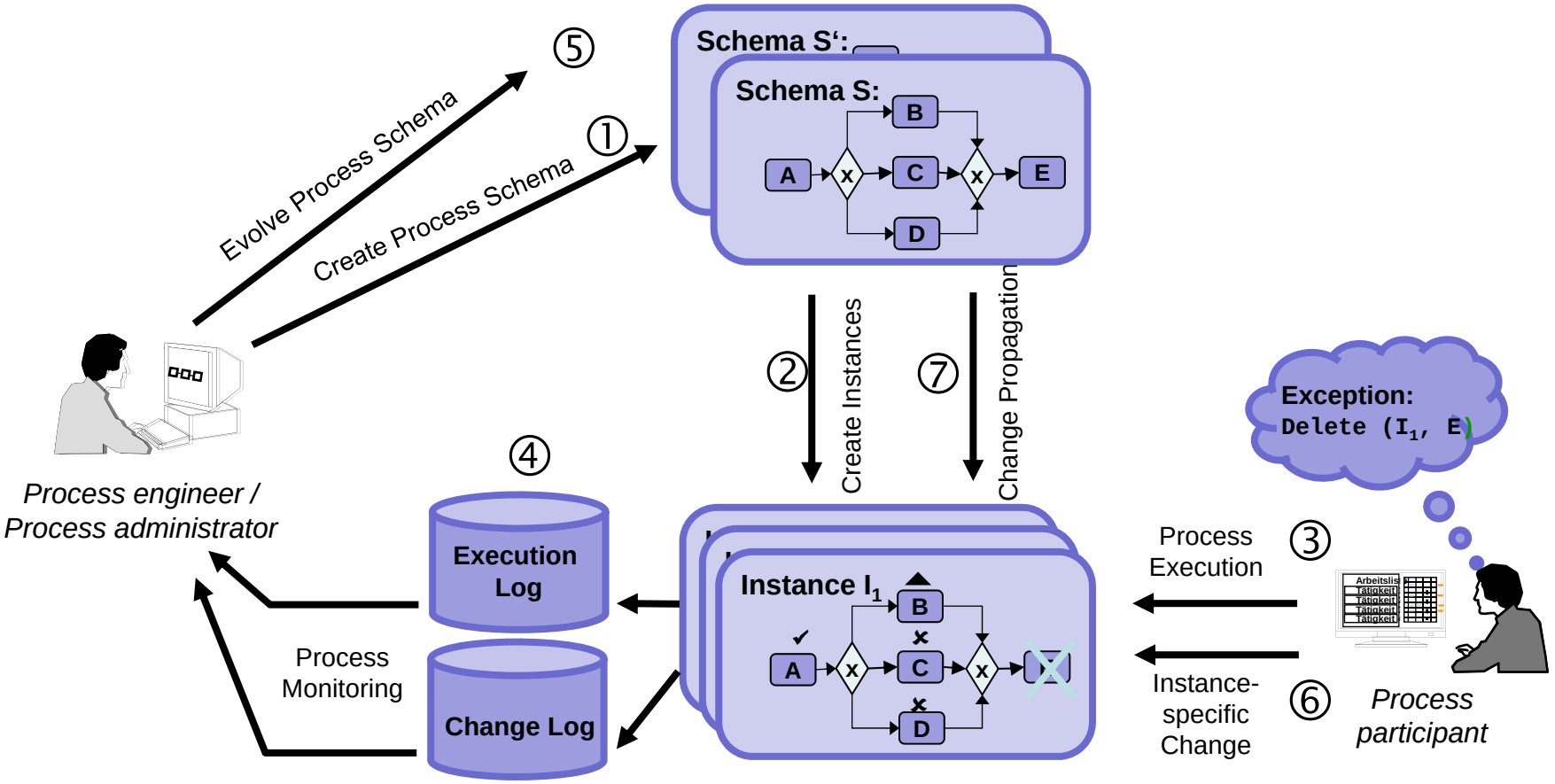
Process Schema Evolution – The System's View

Increased Complexity: Interplay with Ad-hoc Changes



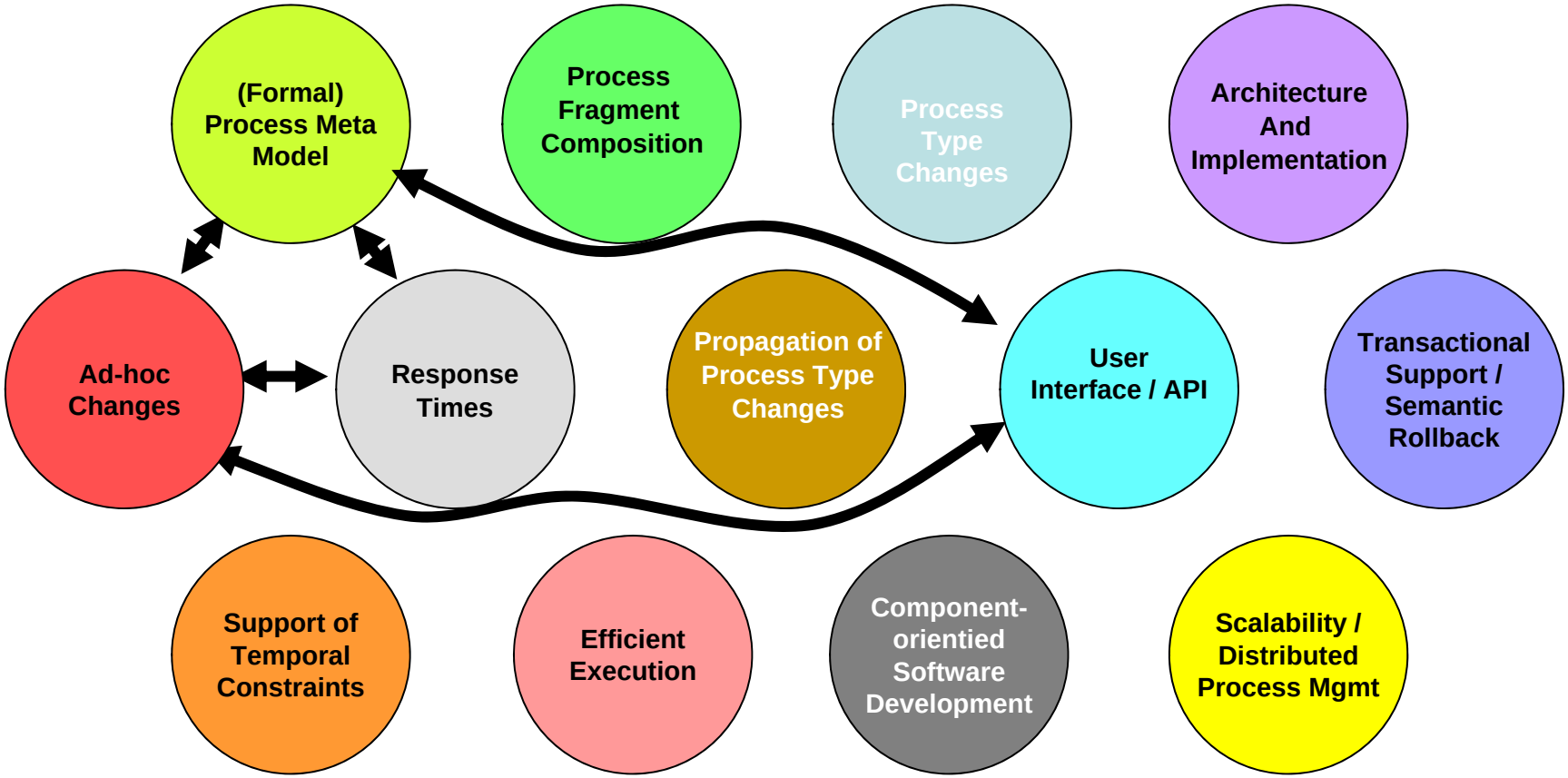
Rinderle, S., Reichert, M., Dadam, P. (2004) *Disjoint and Overlapping Process Changes: Challenges, Solutions, Applications.* In: Proc. CoopIS'04, Agia Napa, LNCS 3290,, pp. 101-121

Flexble PAIS: Extended Process Lifecycle Support



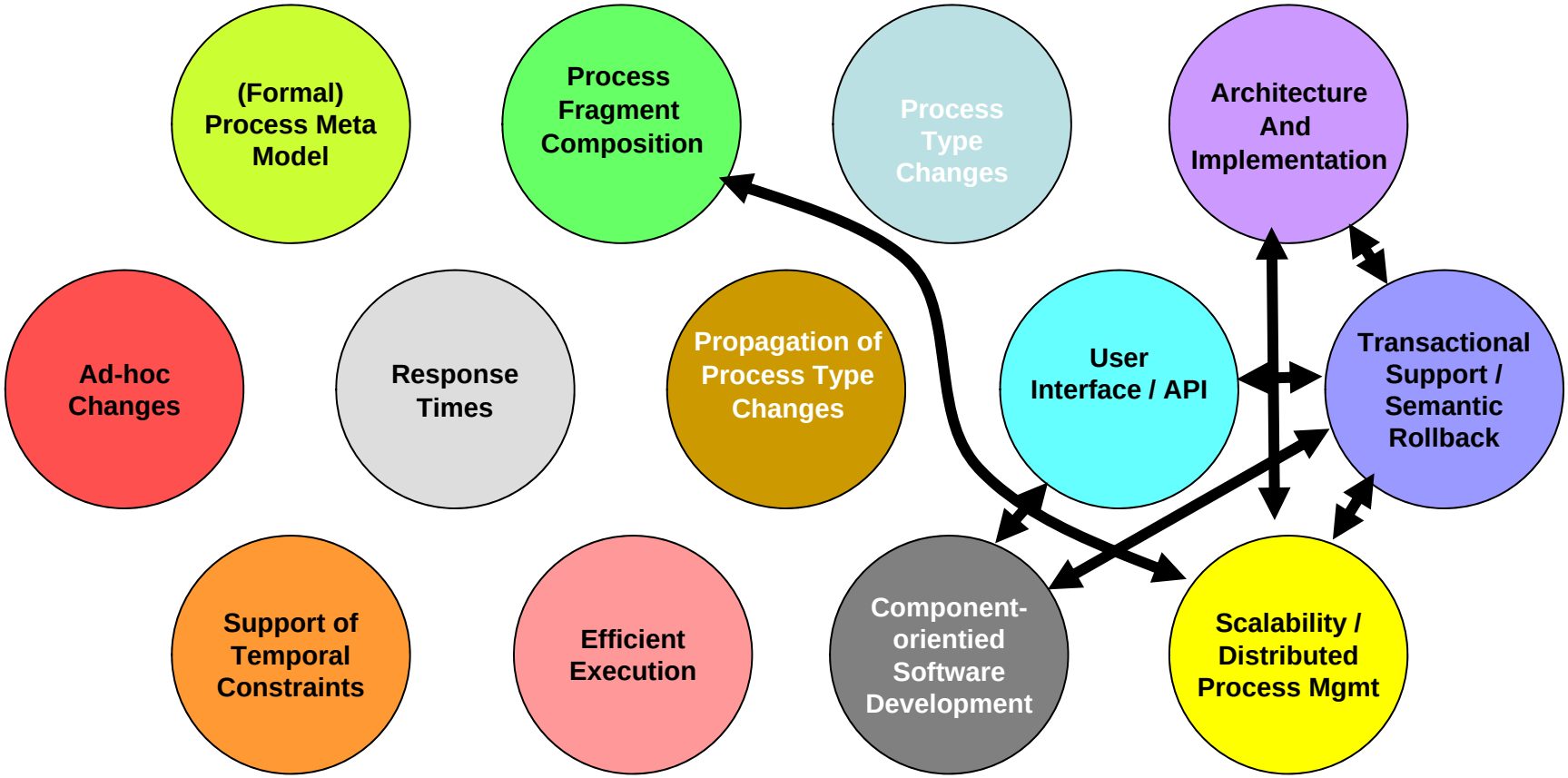
Weber, B., Sadiq, S., Reichert, M. (2009) *Beyond Rigidity - Dynamic Process Lifecycle Support: A Survey on Dynamic Changes in Process-aware Information Systems.* Computer Science - Research and Development, 23(2): 47-65, Springer.

Flexble PAIS: The ADEPT Framework



Dadam, Peter and Reichert, Manfred (2009) *The ADEPT Project: A Decade of Research and Development for Robust and Flexible Process Support - Challenges and Achievements.* Computer Science - Research and Development, Vol. 23, No. 2, pp. 81-97.

Flexble PAIS: The ADEPT Framework



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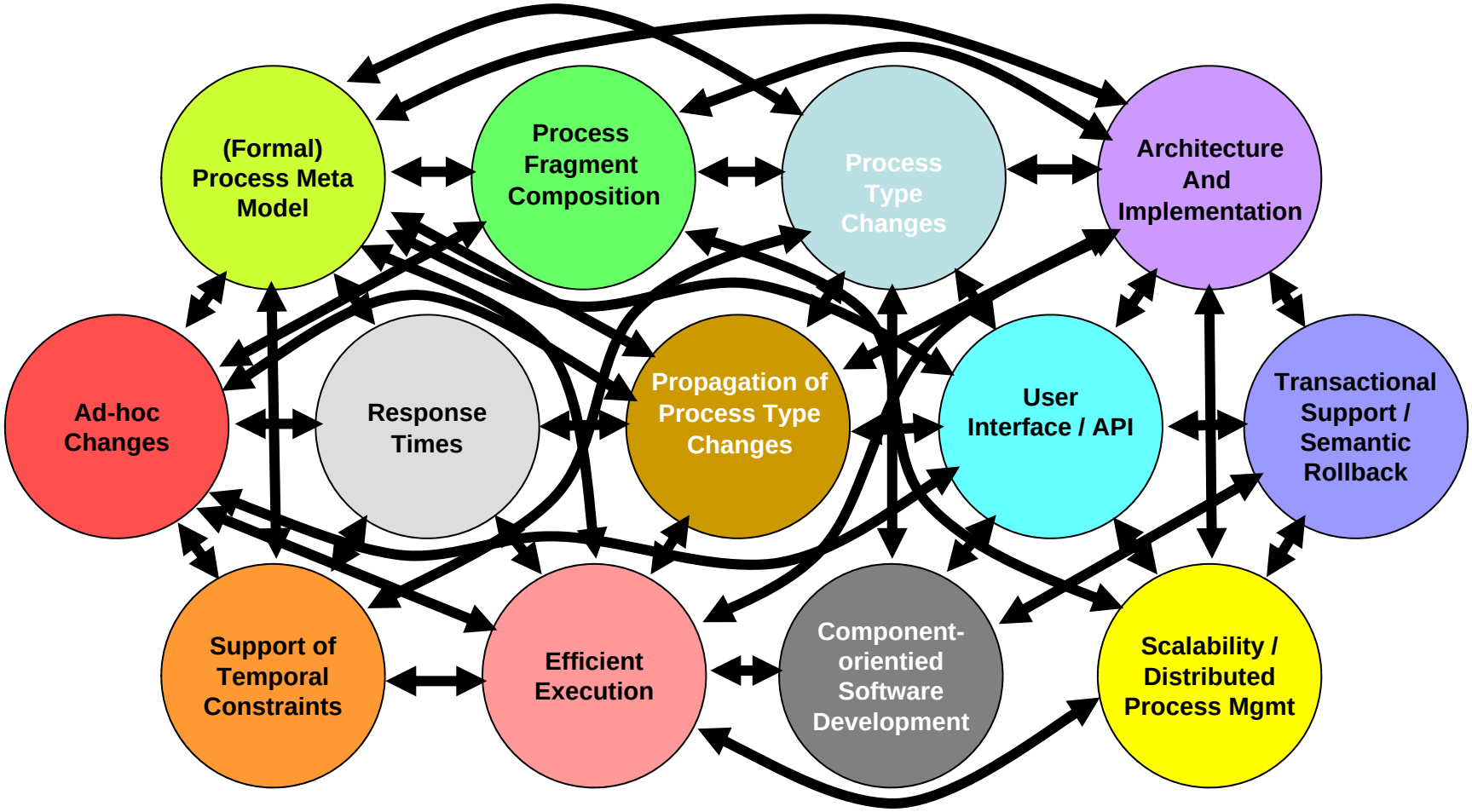
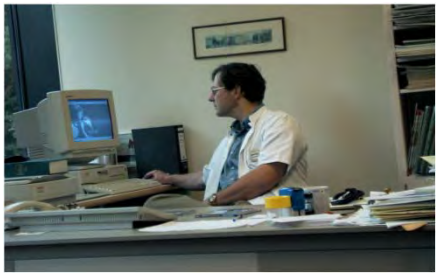


Dadam, Peter and Reichert, Manfred (2009) *The ADEPT Project: A Decade of Research and Development for Robust and Flexible Process Support - Challenges and Achievements.* Computer Science - Research and Development, Vol. 23, No. 2, pp. 81-97.

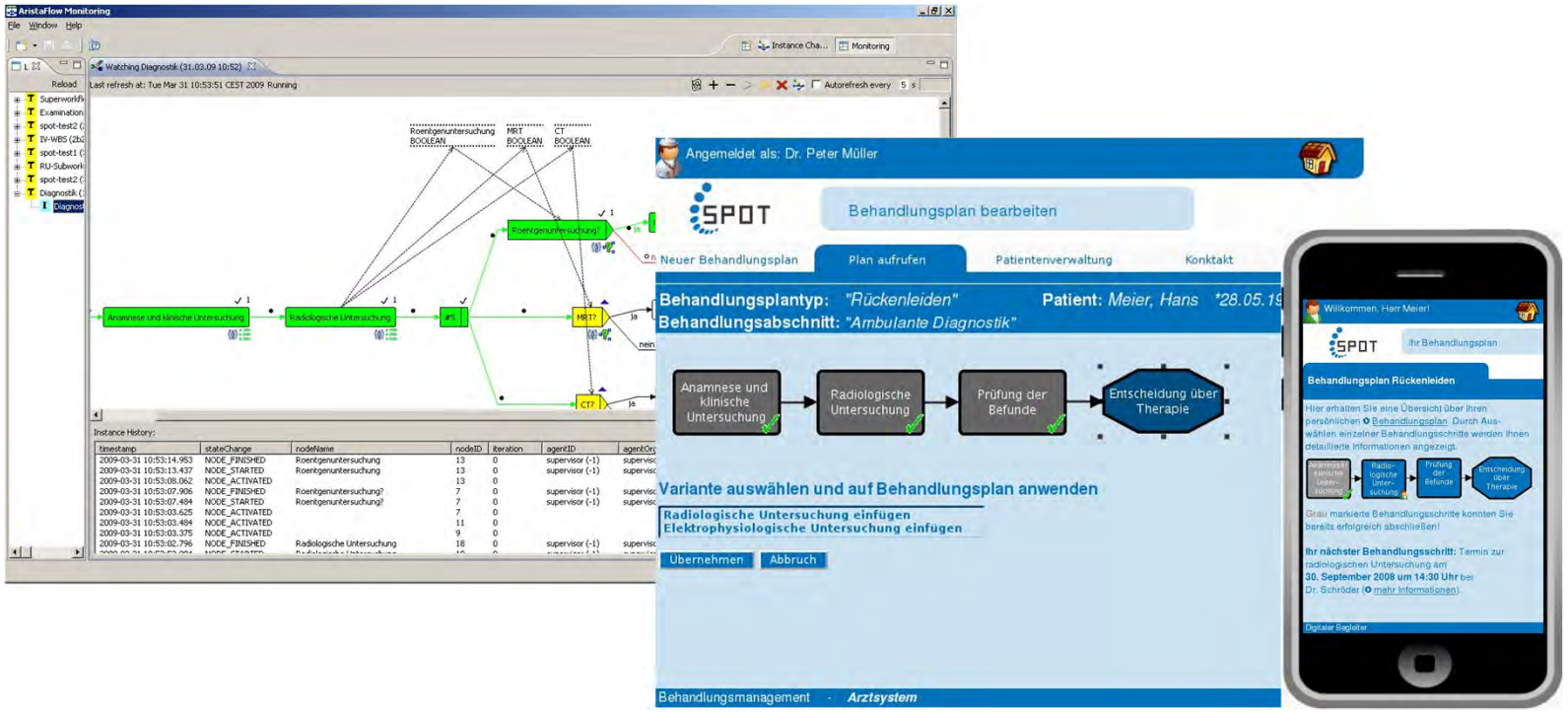
Flexible PAIS: Clinical Pathway Support



Flexible Support of Clinical Pathways with ADEPT

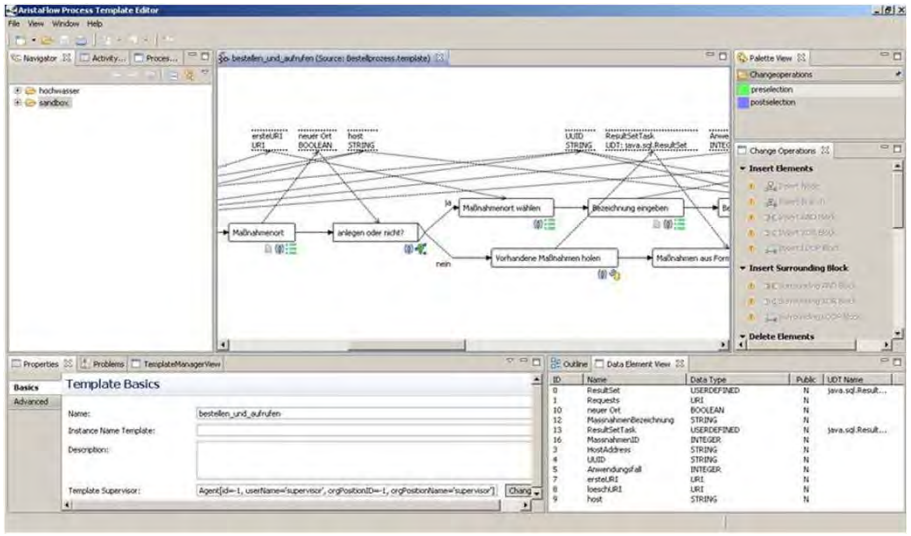
Partners:

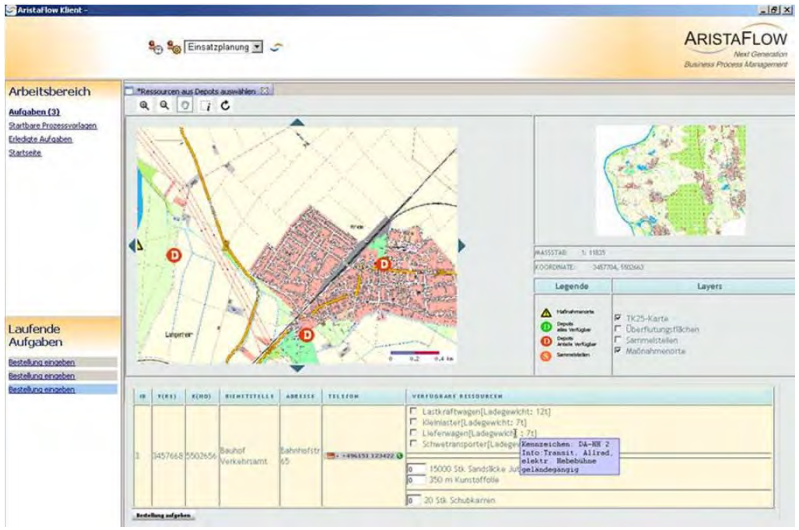
Jan Neuhaus, Claudia Reuter
Fraunhoferinstitut Dortmund



Flexible PAIS: Disaster Management

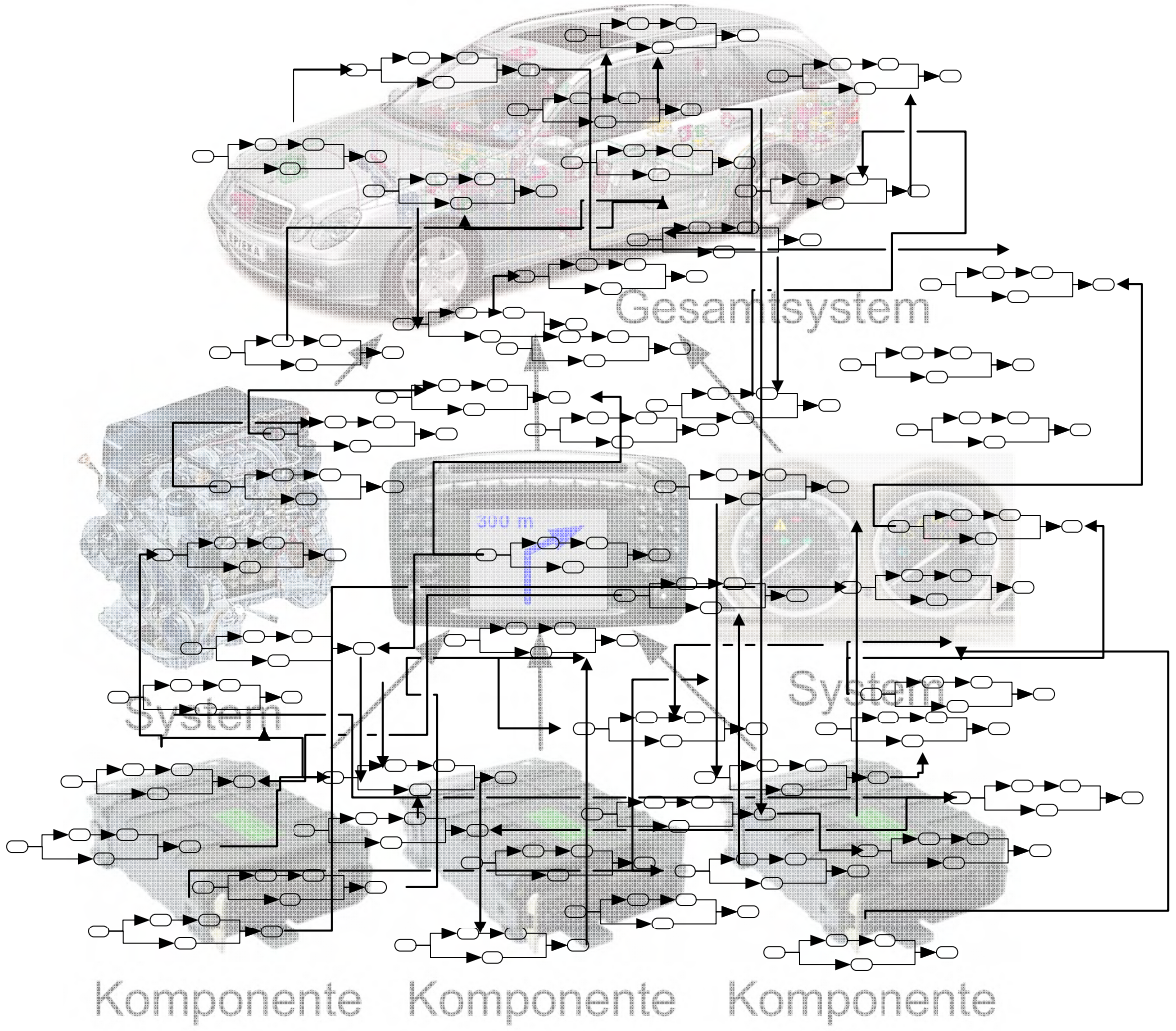
Process-aware, Cooperative Emergency Management for Water Infrastructures
Partner: TU Darmstadt





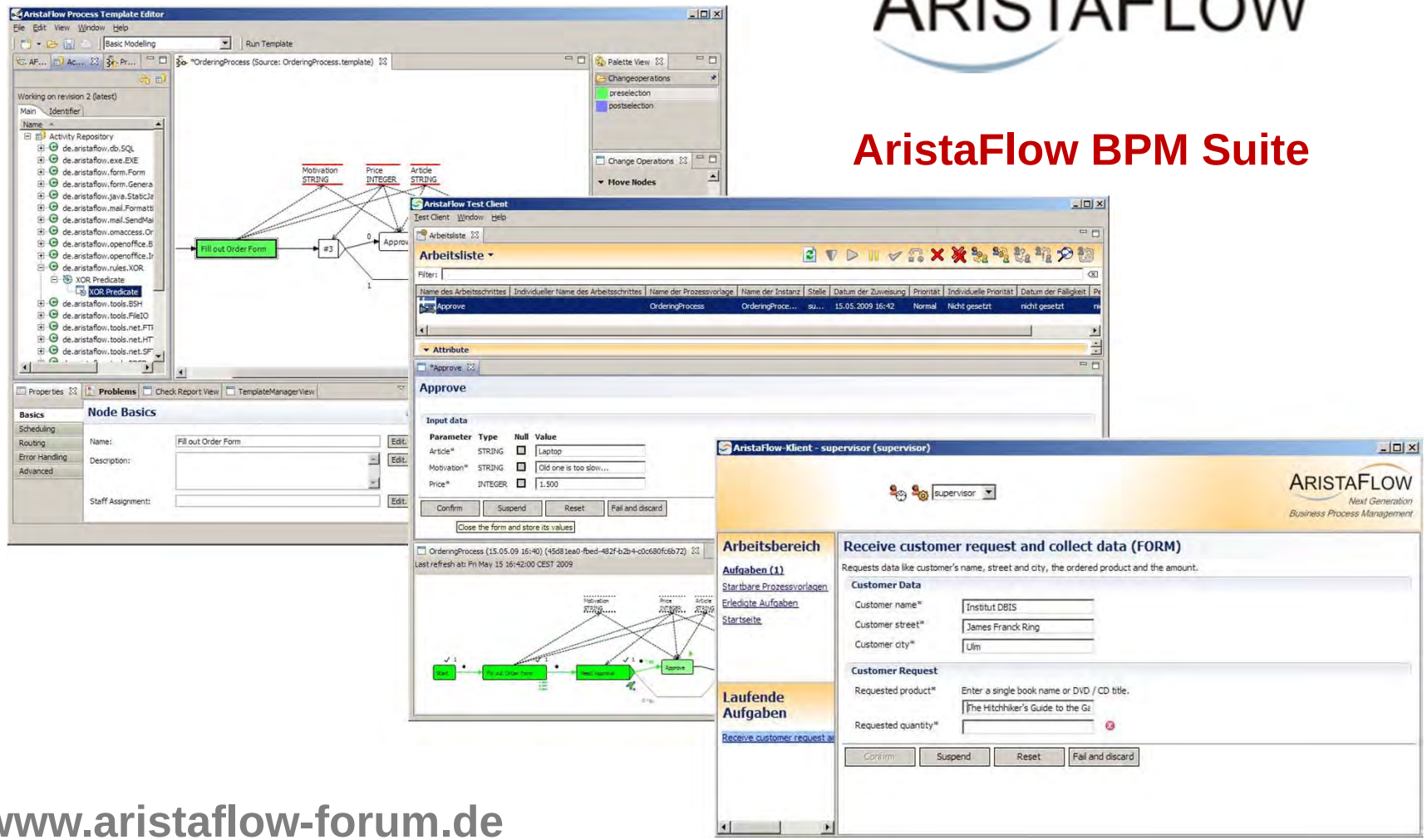
A. Wagenknecht; U. Rüppel: Improving Resource Management In Flood Response With Process Models and Web GIS. In: 16th TIEMS Conf., 2009

Flexible PAIS: E/E Engineering



Partner: Daimler AG

Flexible PAIS: Transfering ADEPT to Practice
The AristaFlow BPM Suite

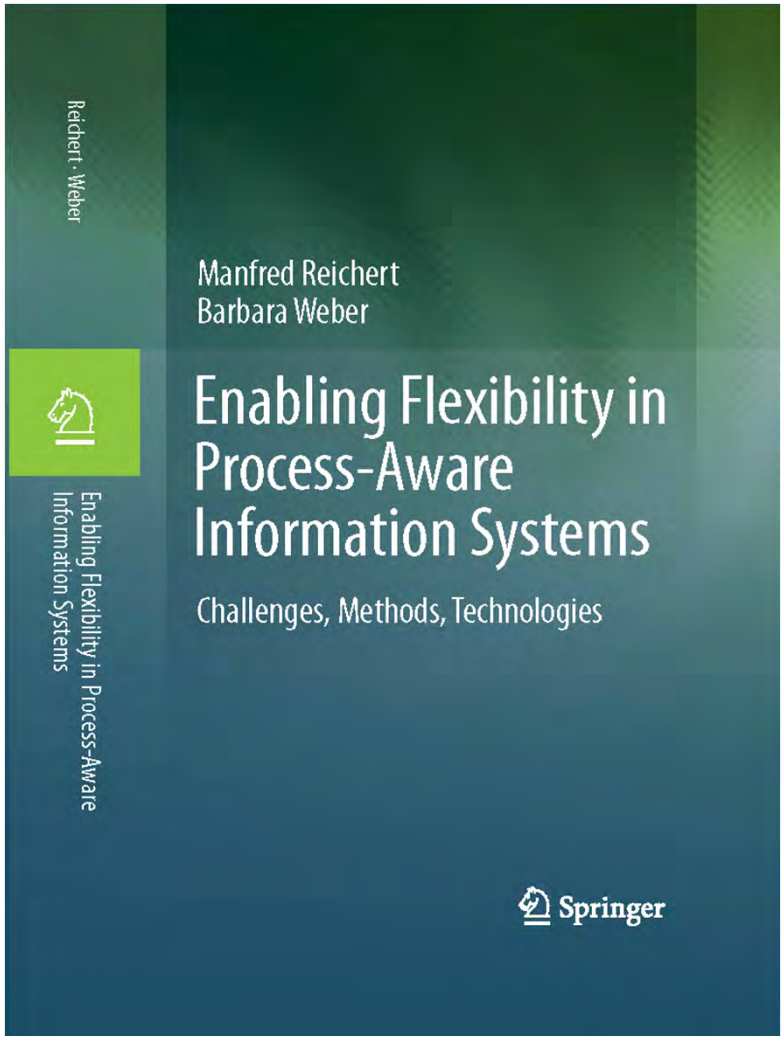


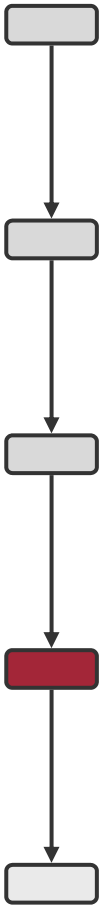
ARISTAFLOW

AristaFlow BPM Suite

www.aristaflow-forum.de

Flexible PAIS: Book





Motivation

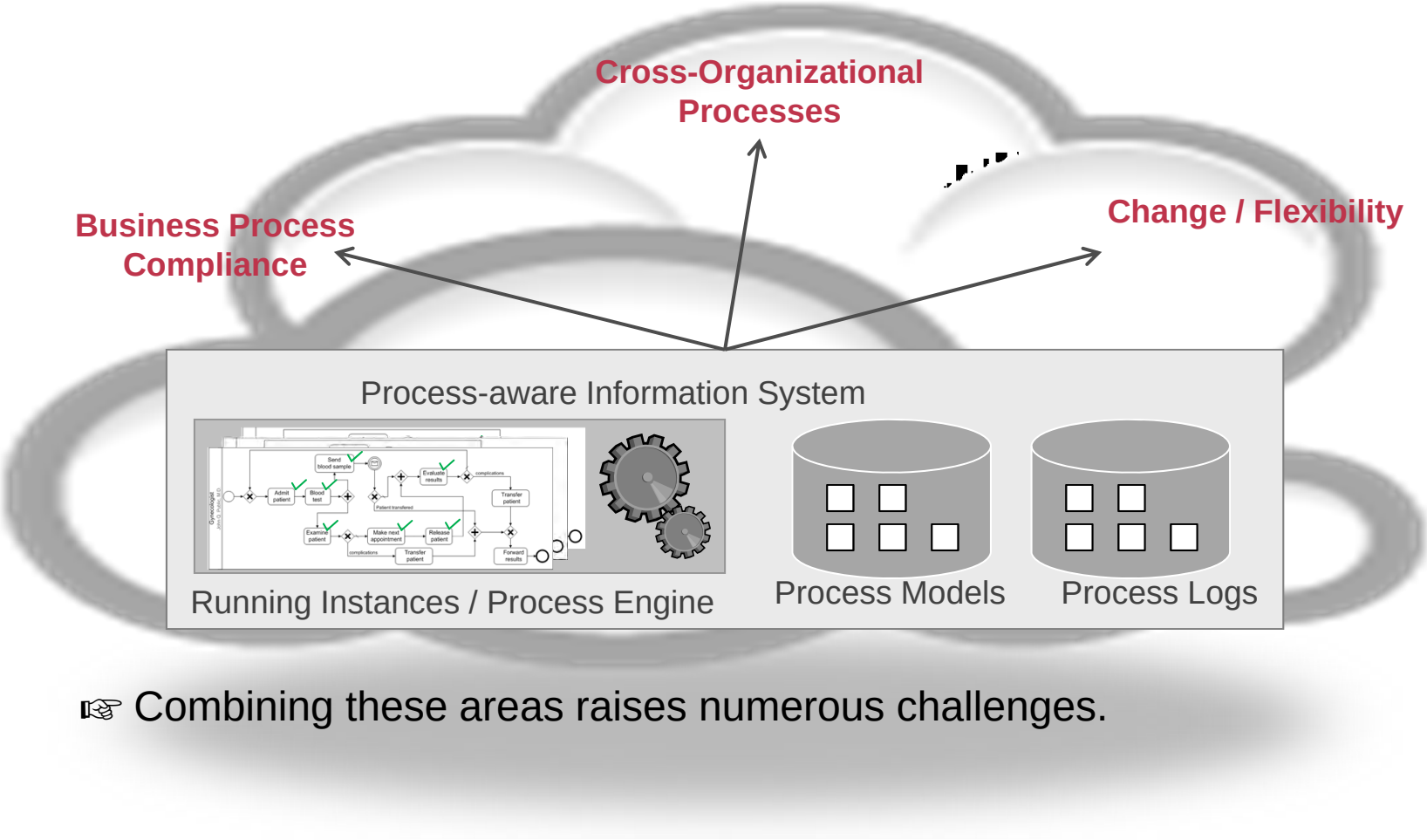
Process-Aware Information Systems (PAIS)

Flexible PAIS

Enabling Flexibility for Cross-Organizational Processes

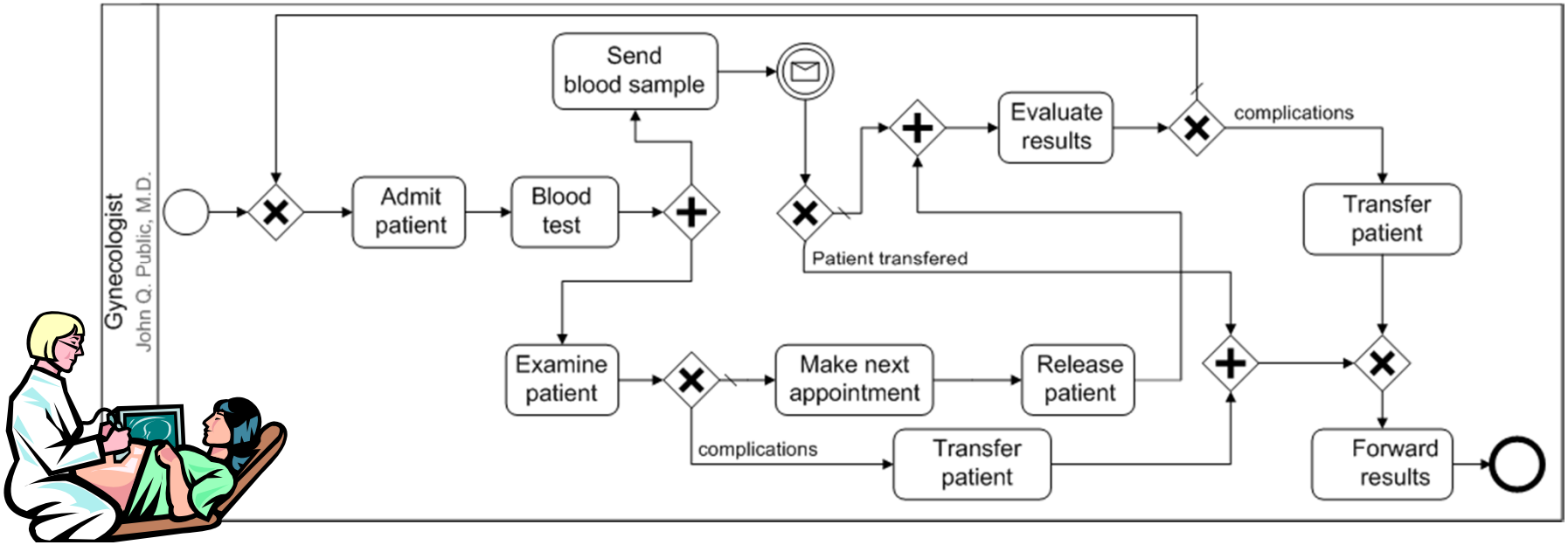
Some Technical Insights

Enabling Flexibility for Cross-Organizational Processes

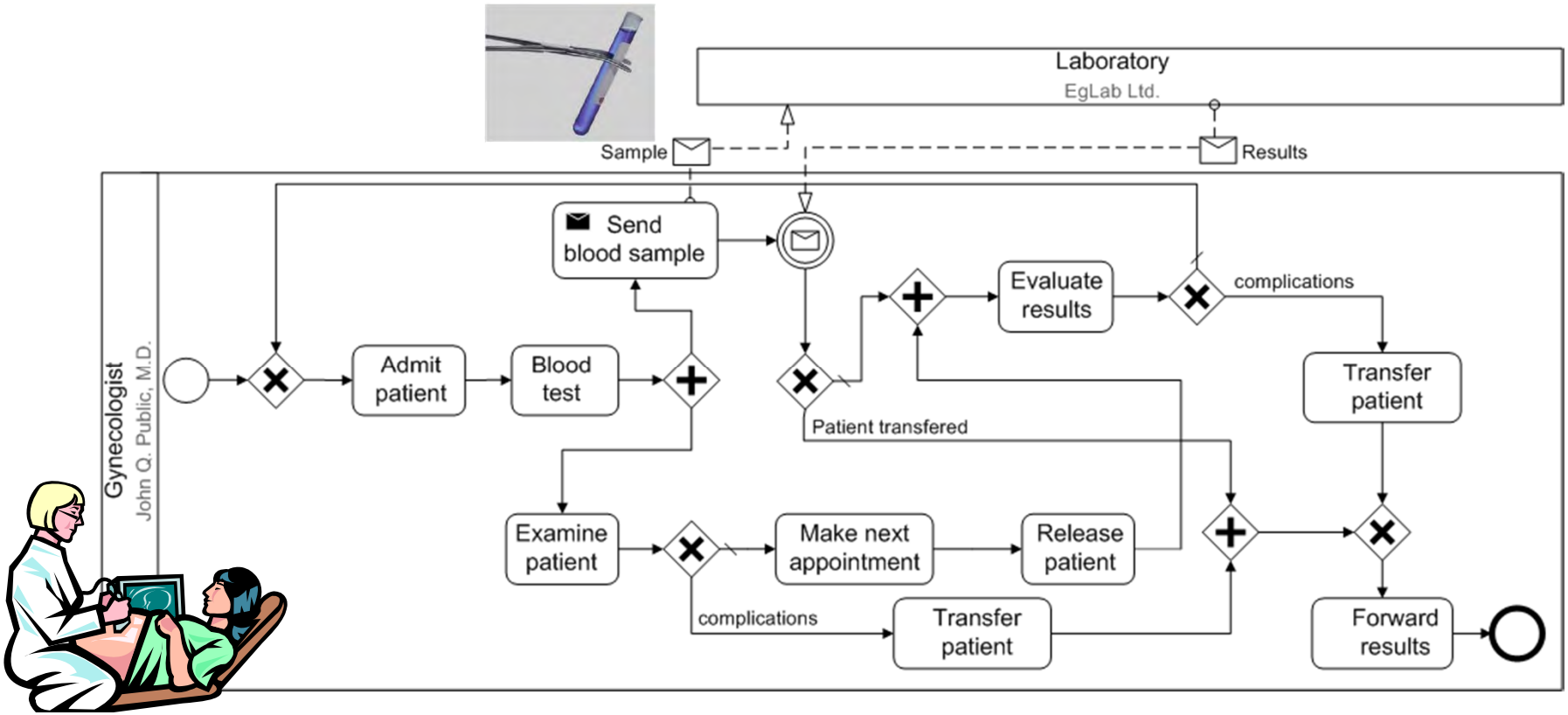


☞ Combining these areas raises numerous challenges.

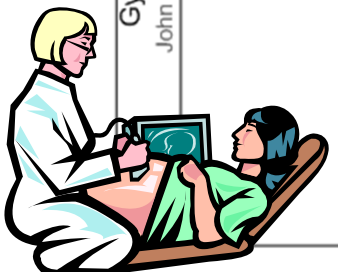
Cross-Organizational Processes

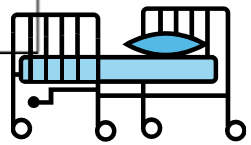


Cross-Organizational Processes

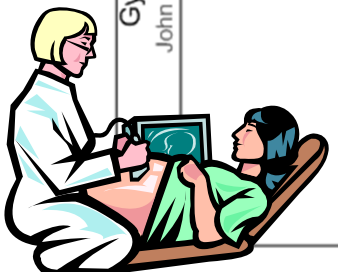


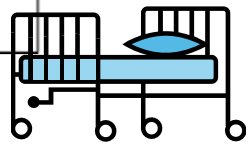
Cross-Organizational Processes



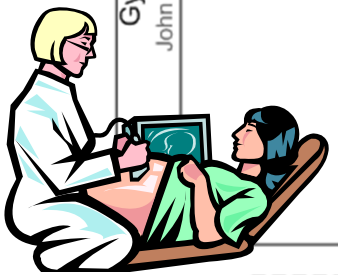


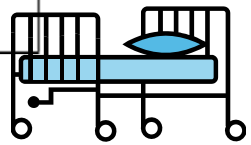
Cross-Organizational Processes



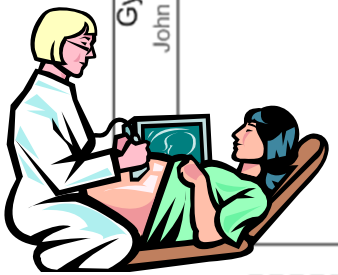


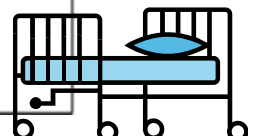
Cross-Organizational Processes



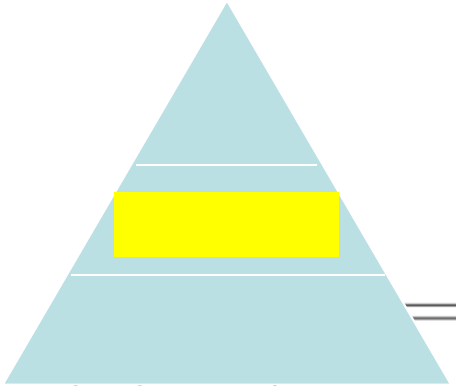


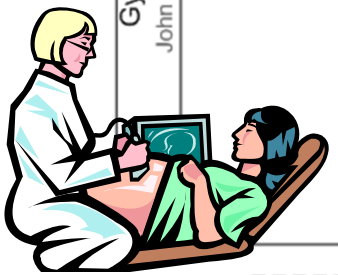
Cross-Organizational Processes

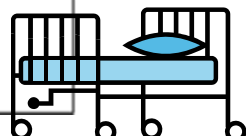




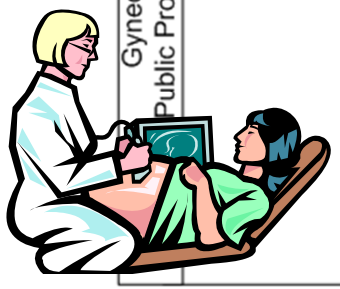
Cross-Organizational Processes: Correctness

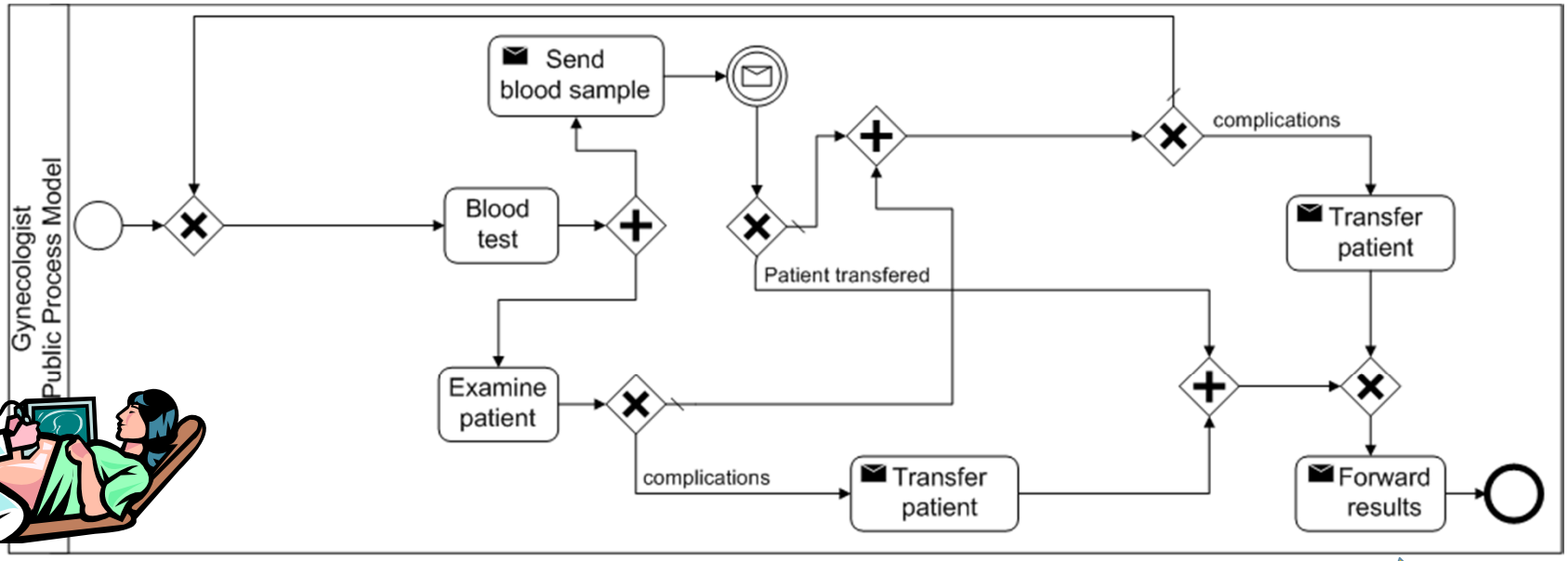


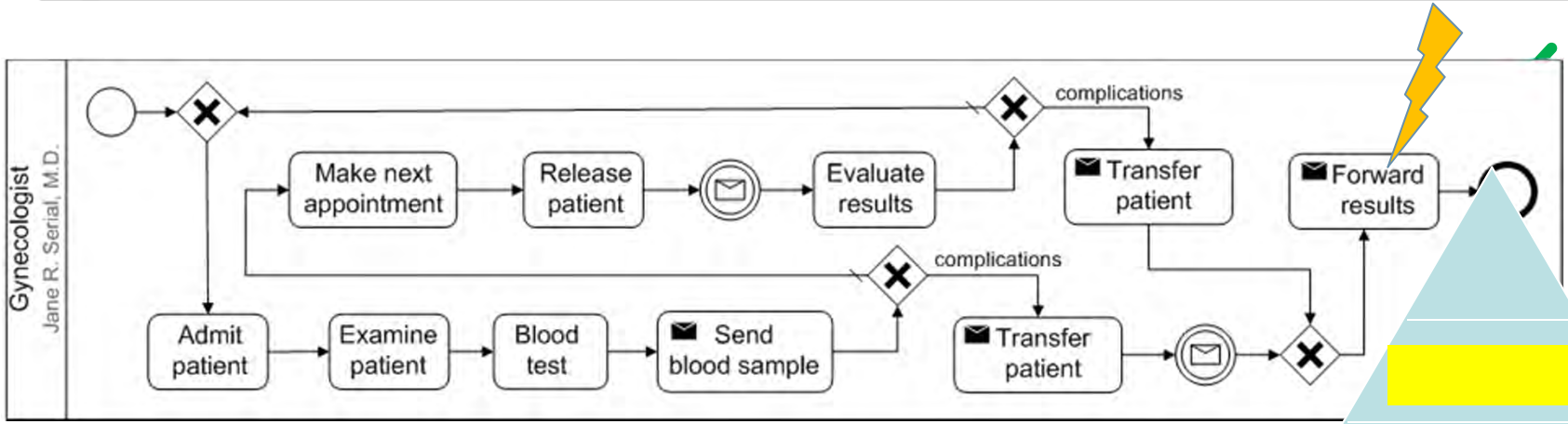


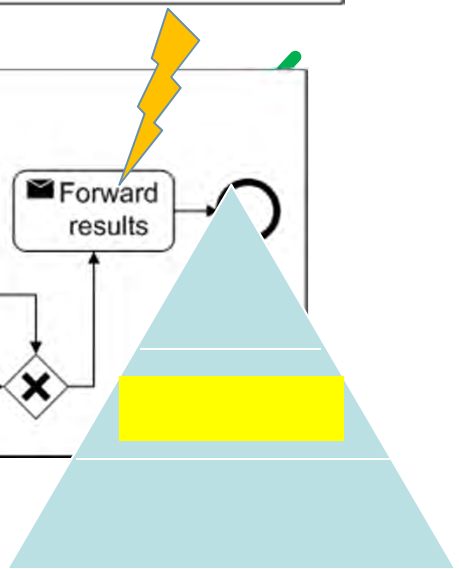


Cross-Organizational Processes: Correctness

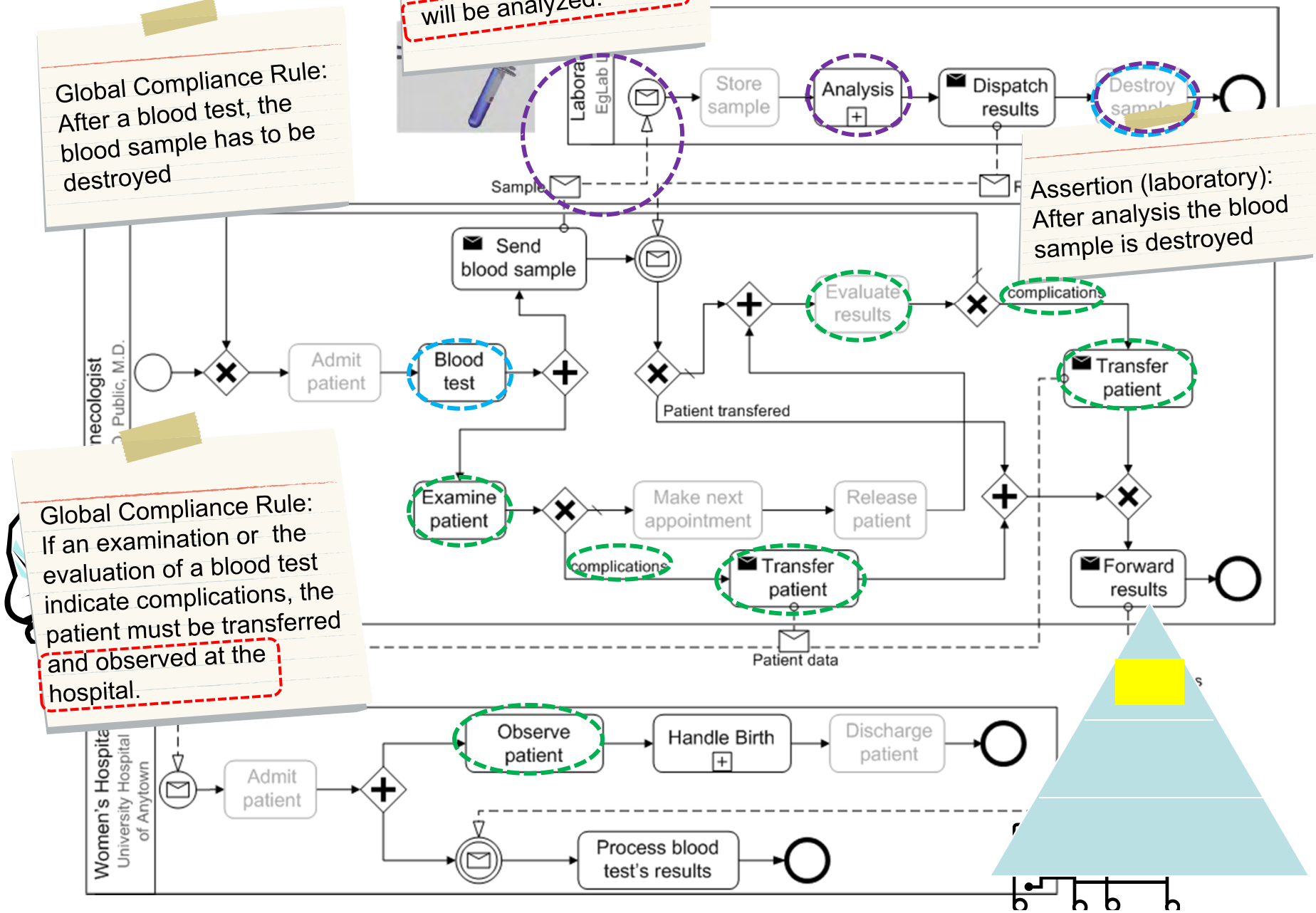




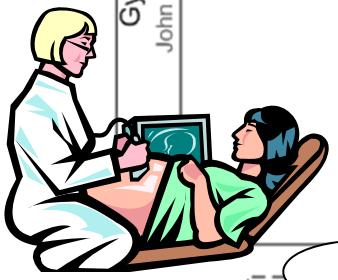


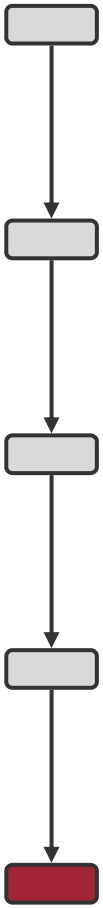


Cross-Organizational Processes: Correctness



Cross-Organizational Processes: Change





Motivation

Process-Aware Information Systems (PAIS)

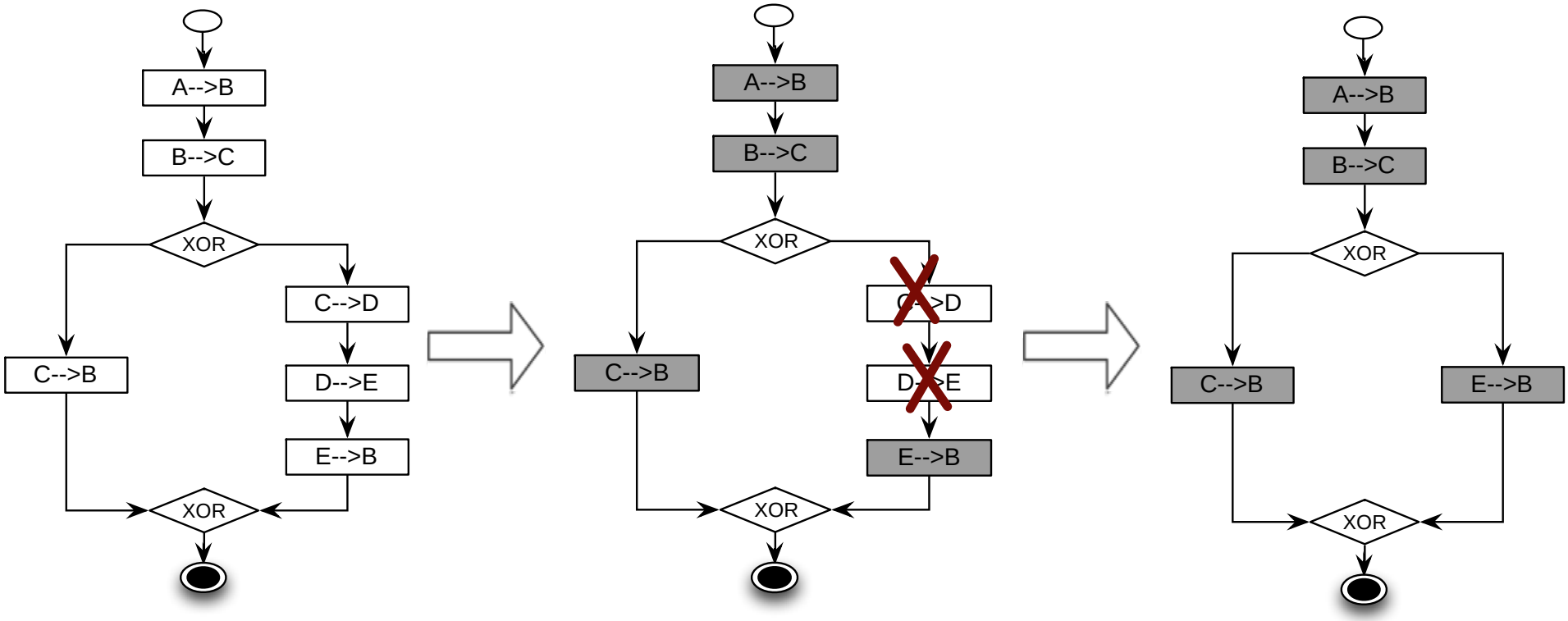
Flexible PAIS

Enabling Flexibility for Cross-Organizational Processes

Some Technical Insights

C³Pro Change and Compliance for Collaborative Processes

Basic Foundations

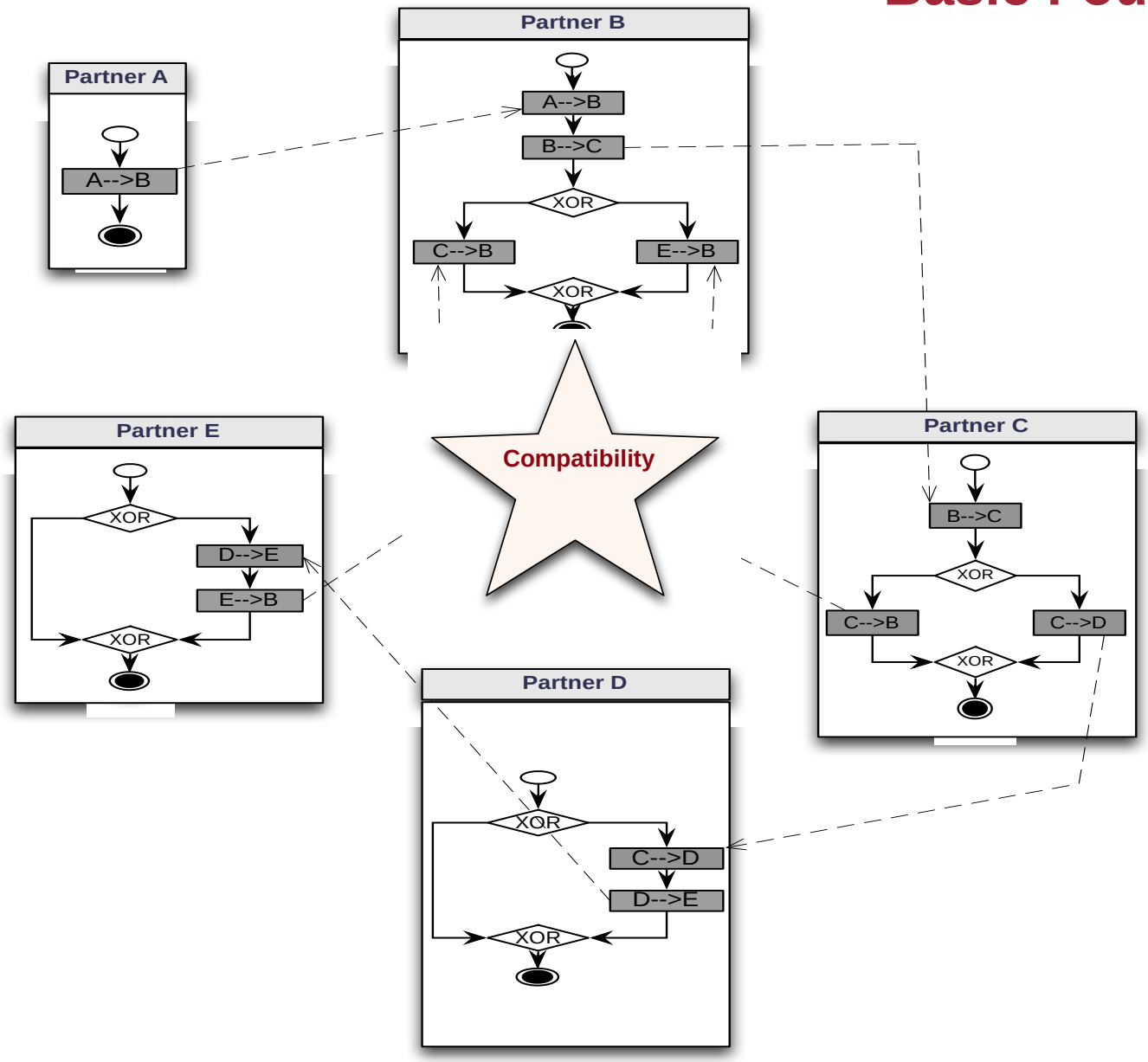


Global Choreography Model

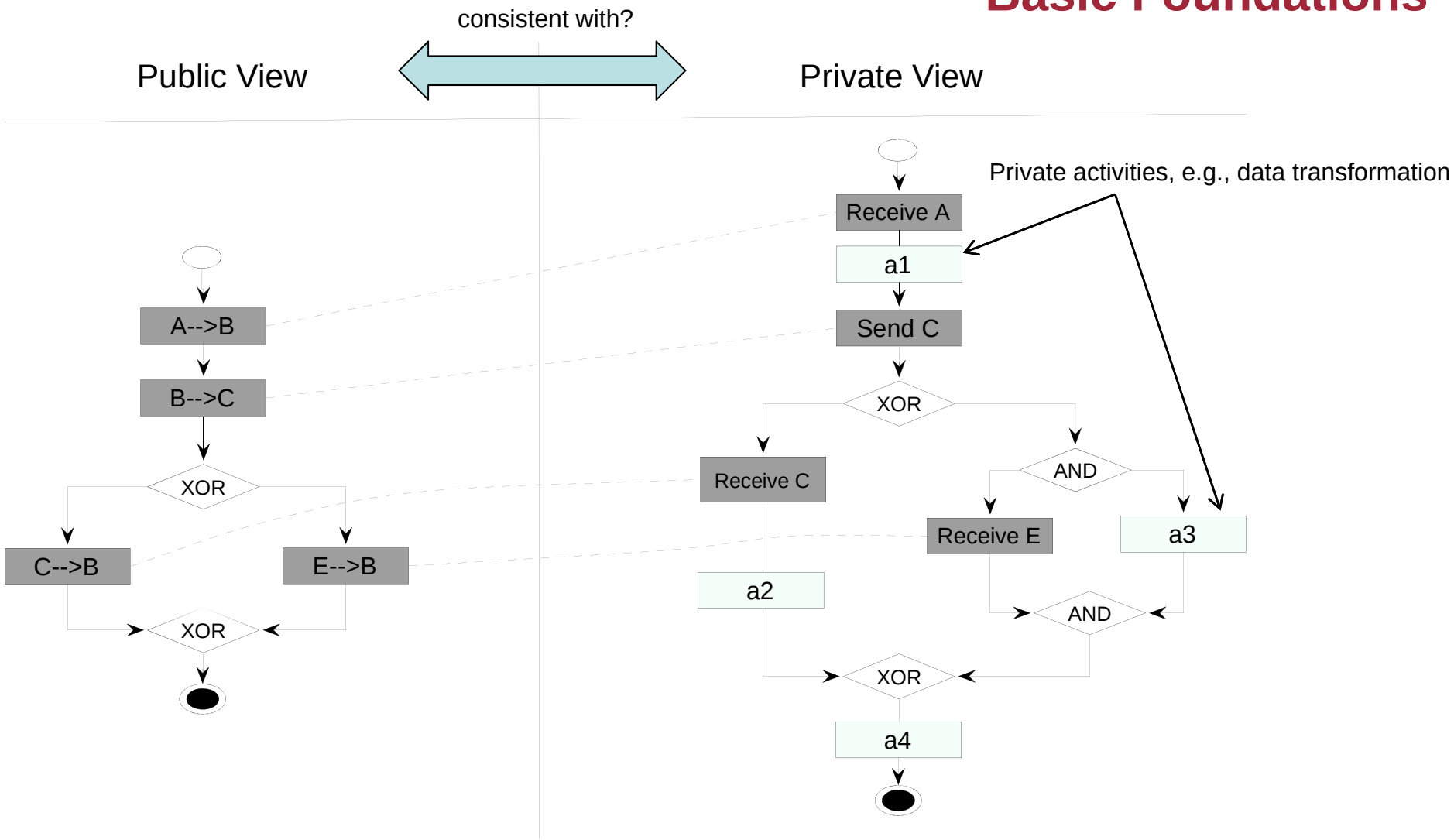
Model Abstraction

Public View of Partner B

Basic Foundations



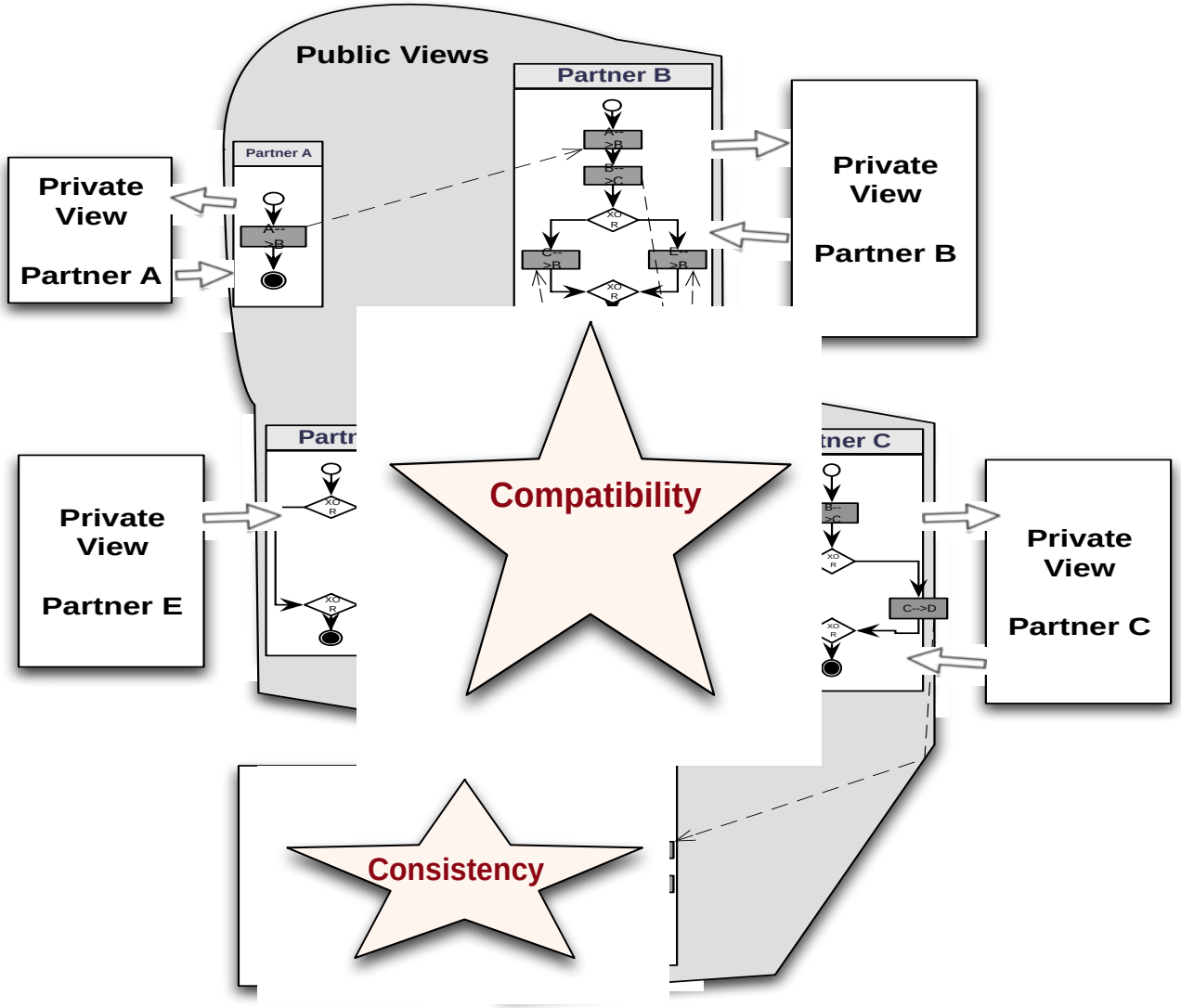
Basic Foundations



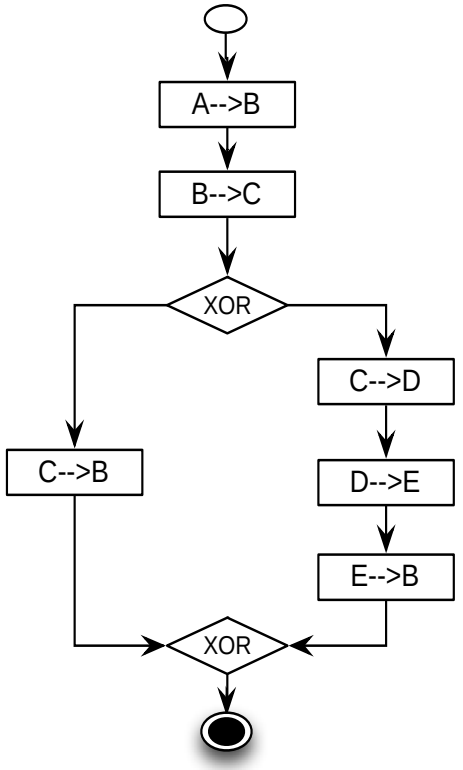
Public View of Partner B

Private View of Partner B

Basic Foundations



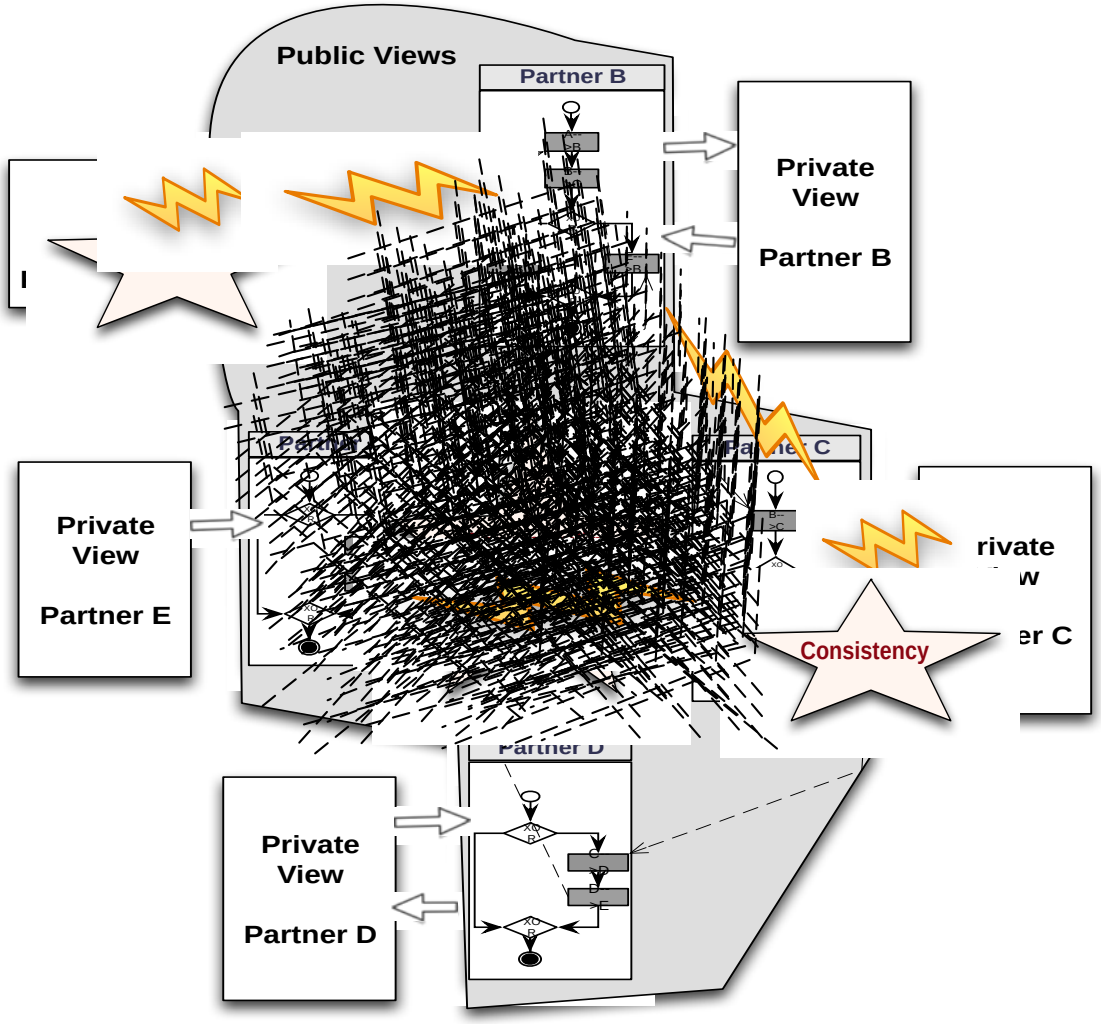
Global Schema



Global Choreography Model

Basic Foundations

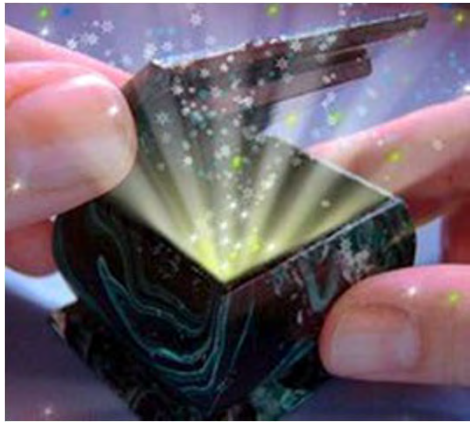
- Ok! and what is the problem then?



- ❑ Consistency
- ❑ Behavioral Compatibility
  - Waiting for a message which will never arrive
  - Sending message which will not be consumed
- ❑ Structural compatibility
- ❑ Transitivity effects
- ❑ Negotiation

Change Propagation

Choreography Model
+
Public views
+
Change Specification

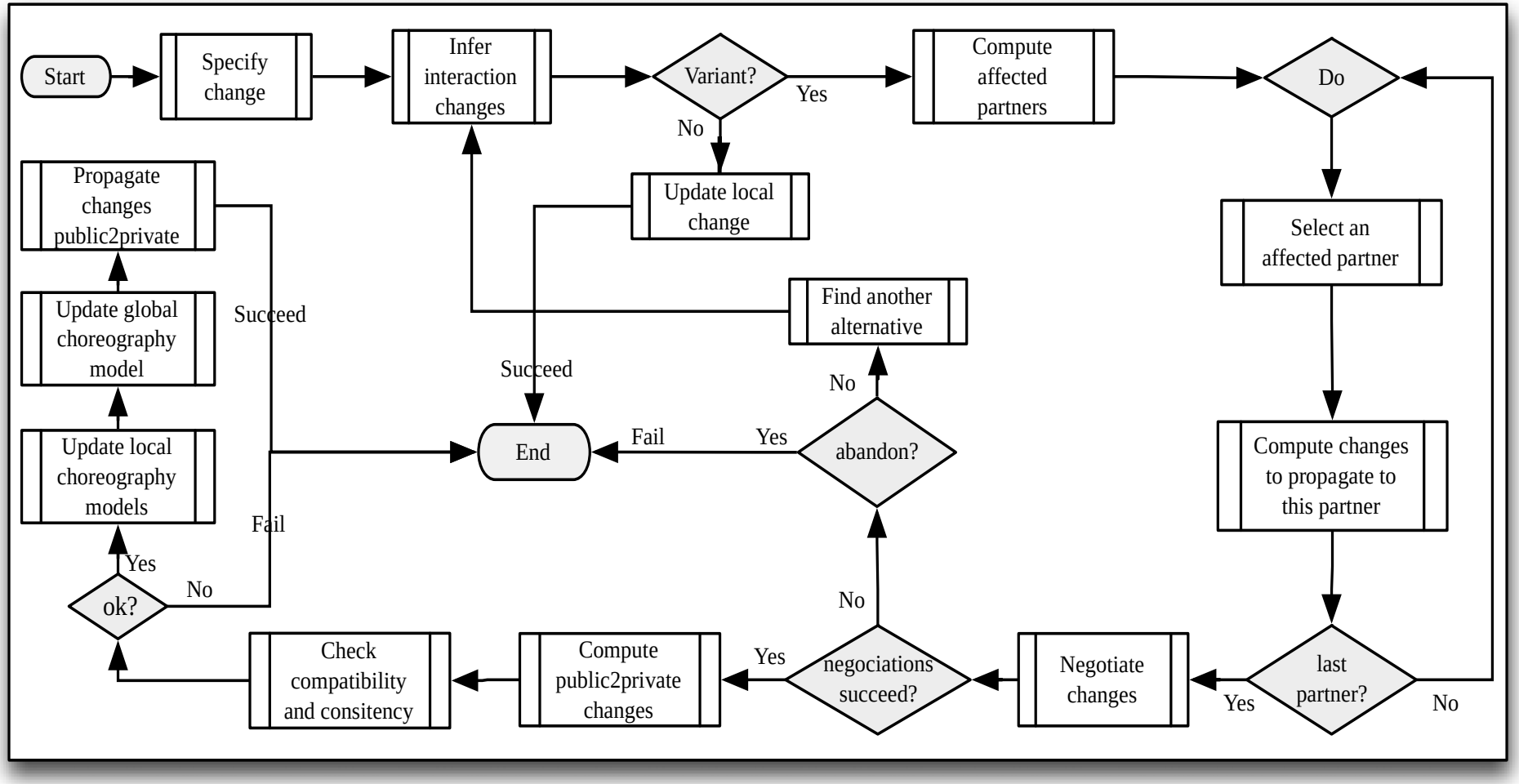


Partners affected by the change
+
Changes to be propagated

- Preserve Consistency
- Preserve Compatibility
- Transitive effects
- Negotiation

C³Pro Change and Compliance for Collaborative Processes

Change Propagation: Negotiation



Change Propagation: Change Patterns

INSERT(fragment, how, in, out)

- inserts a new fragment in a process model.

DELETE(fragment)

- Deletes an existing fragment from a process model.

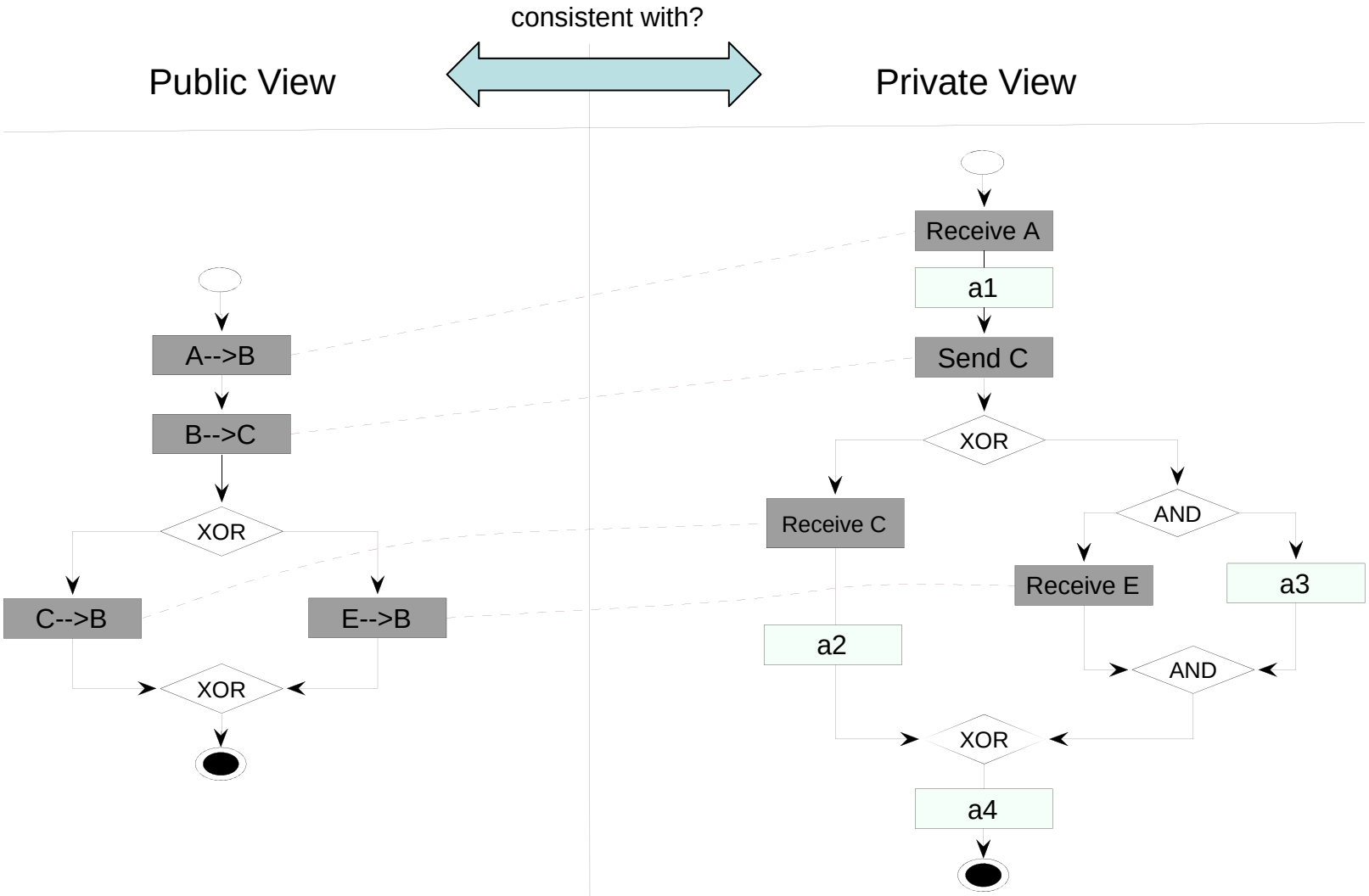
REPLACE(oldFragment, newFragment)

- Replaces an existing fragment by a new one in the process model.

UPDATE(activity, attribute, newValue)

- Updates the attributes of a single activity of a process model.
- *Attribute could be: partner, role, input, output, etc.*

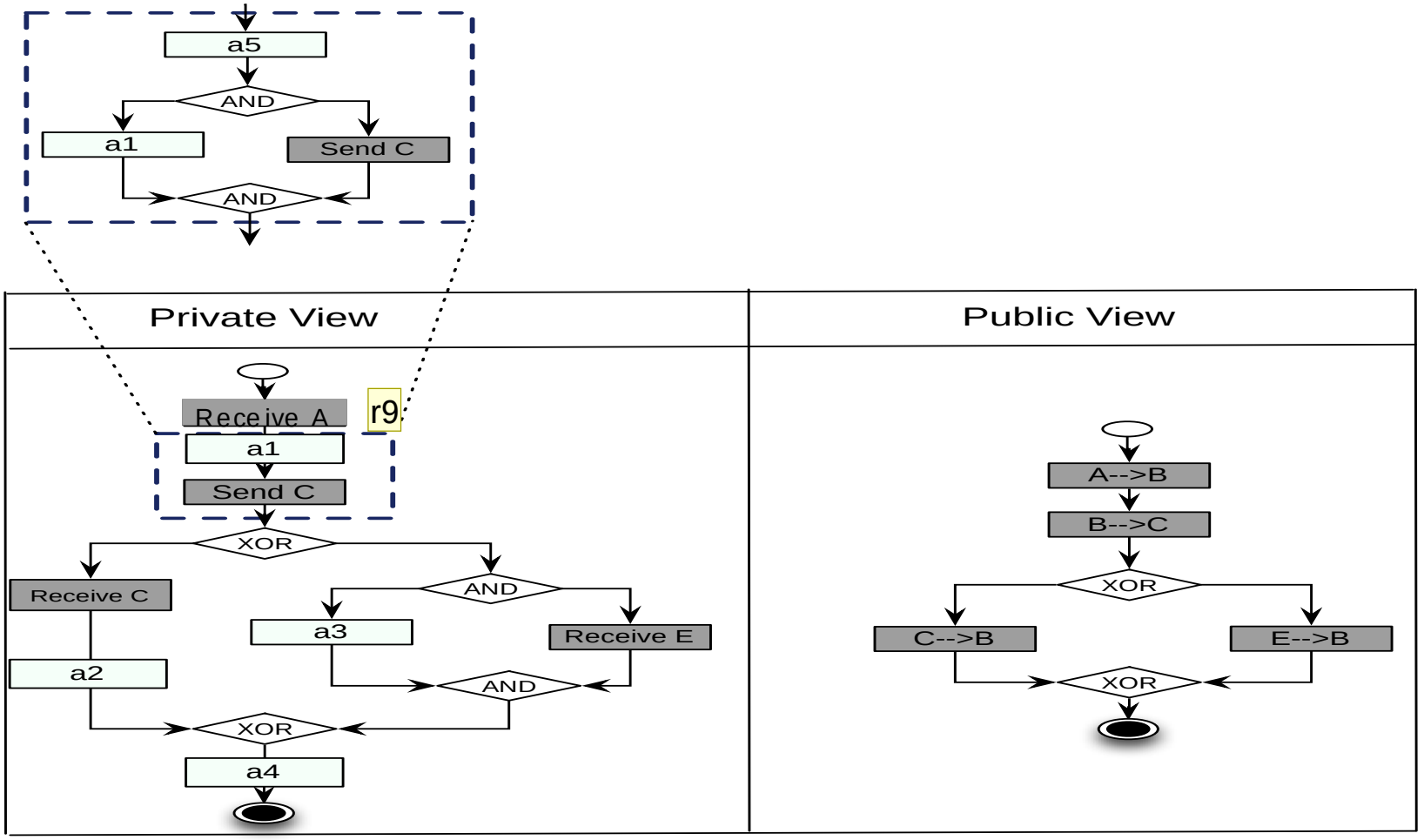
Change Propagation: Replace Pattern



Public View of Partner B

Private View of Partner B

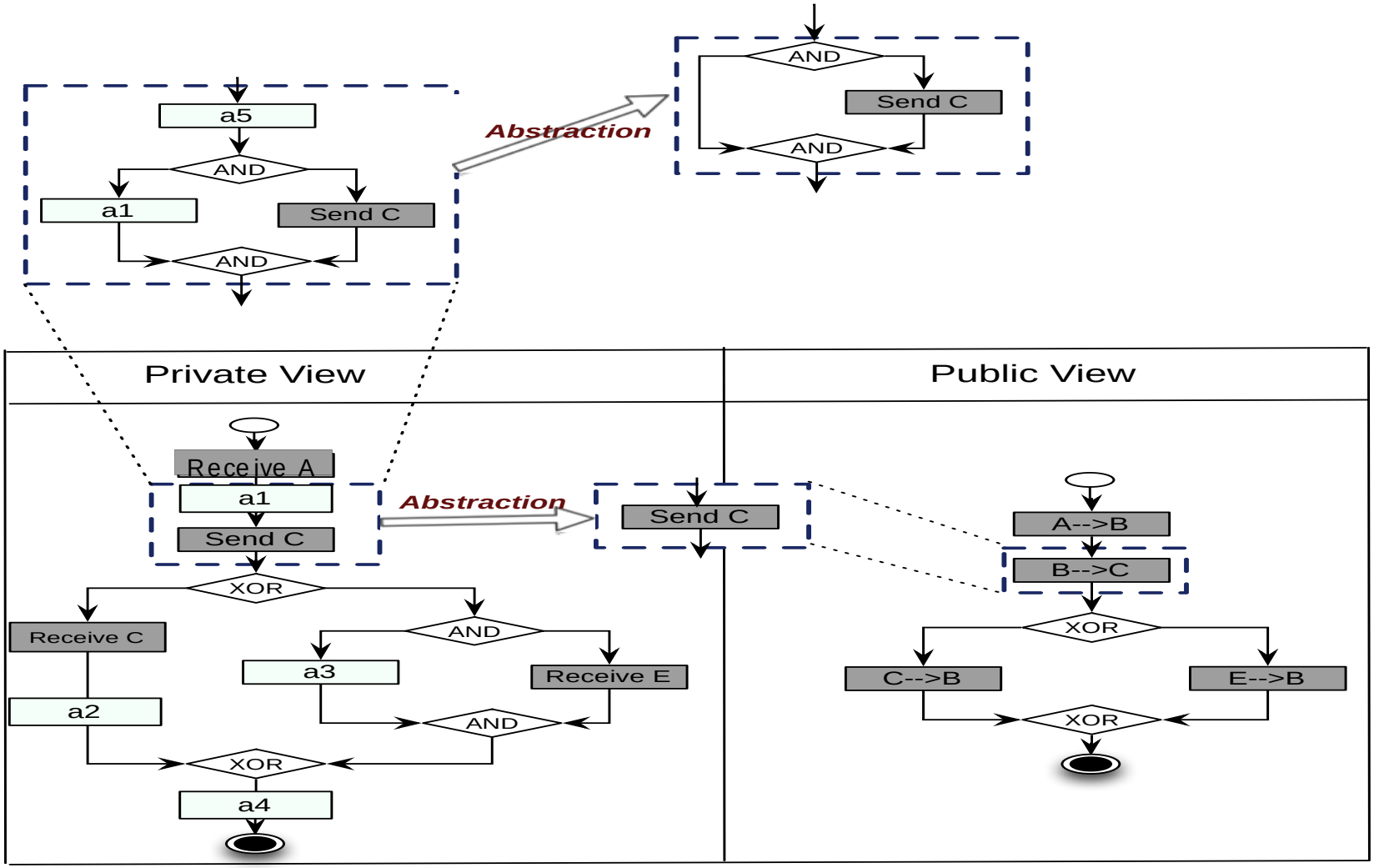
Change Propagation: Replace Pattern



r9 recieve a

reichert; 26.03.2013

Change Propagation: Replace Pattern



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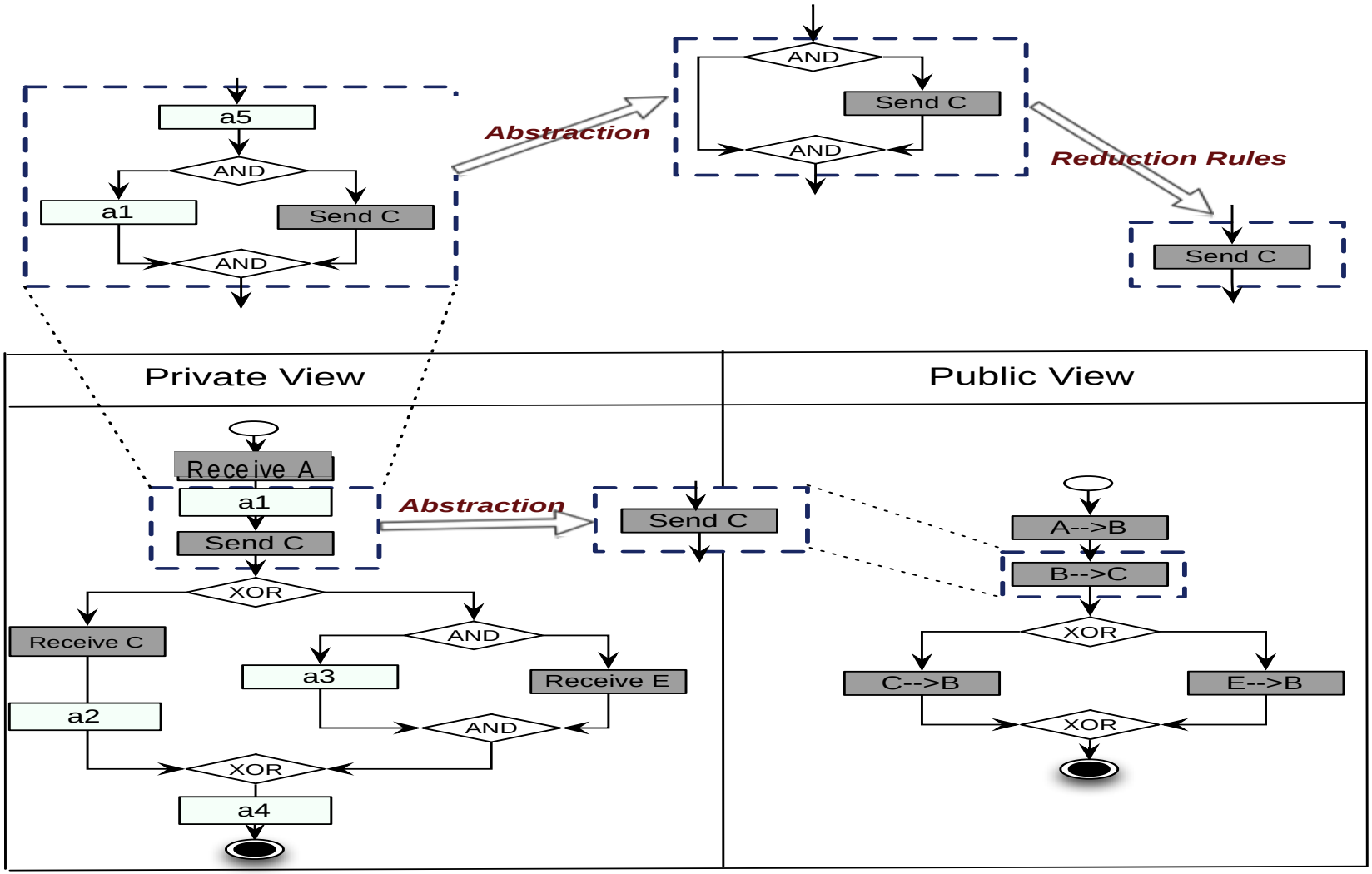

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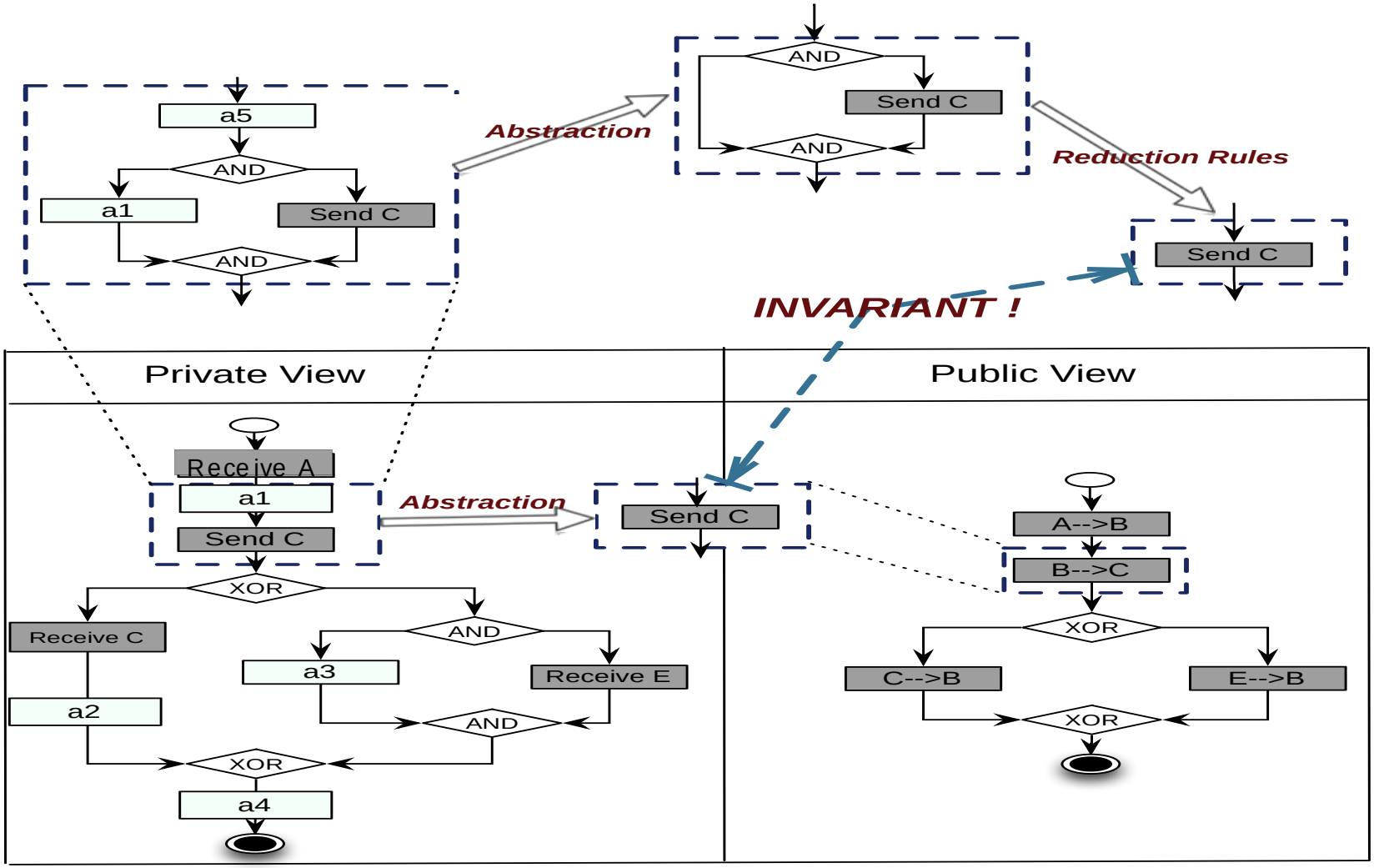
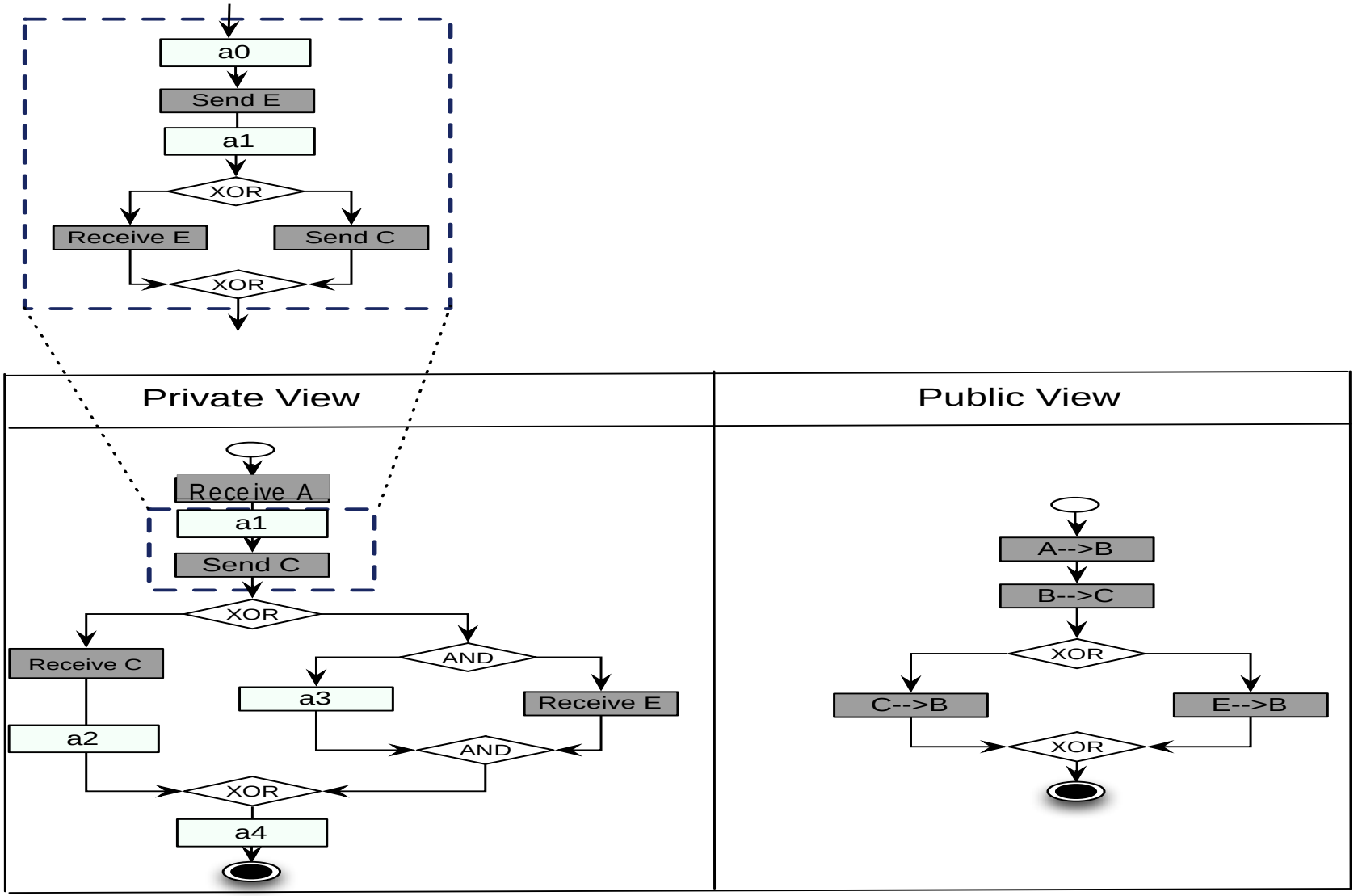
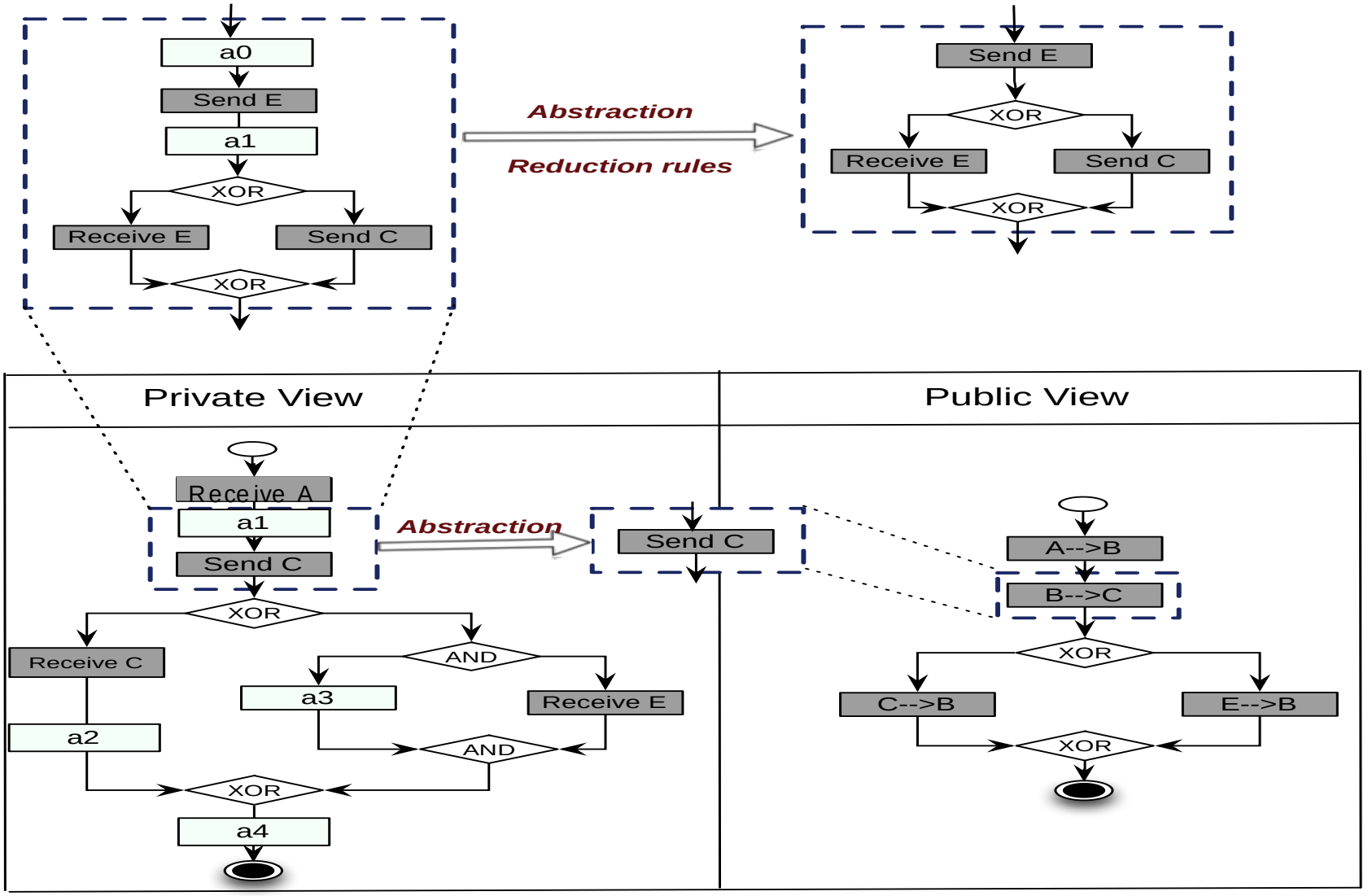


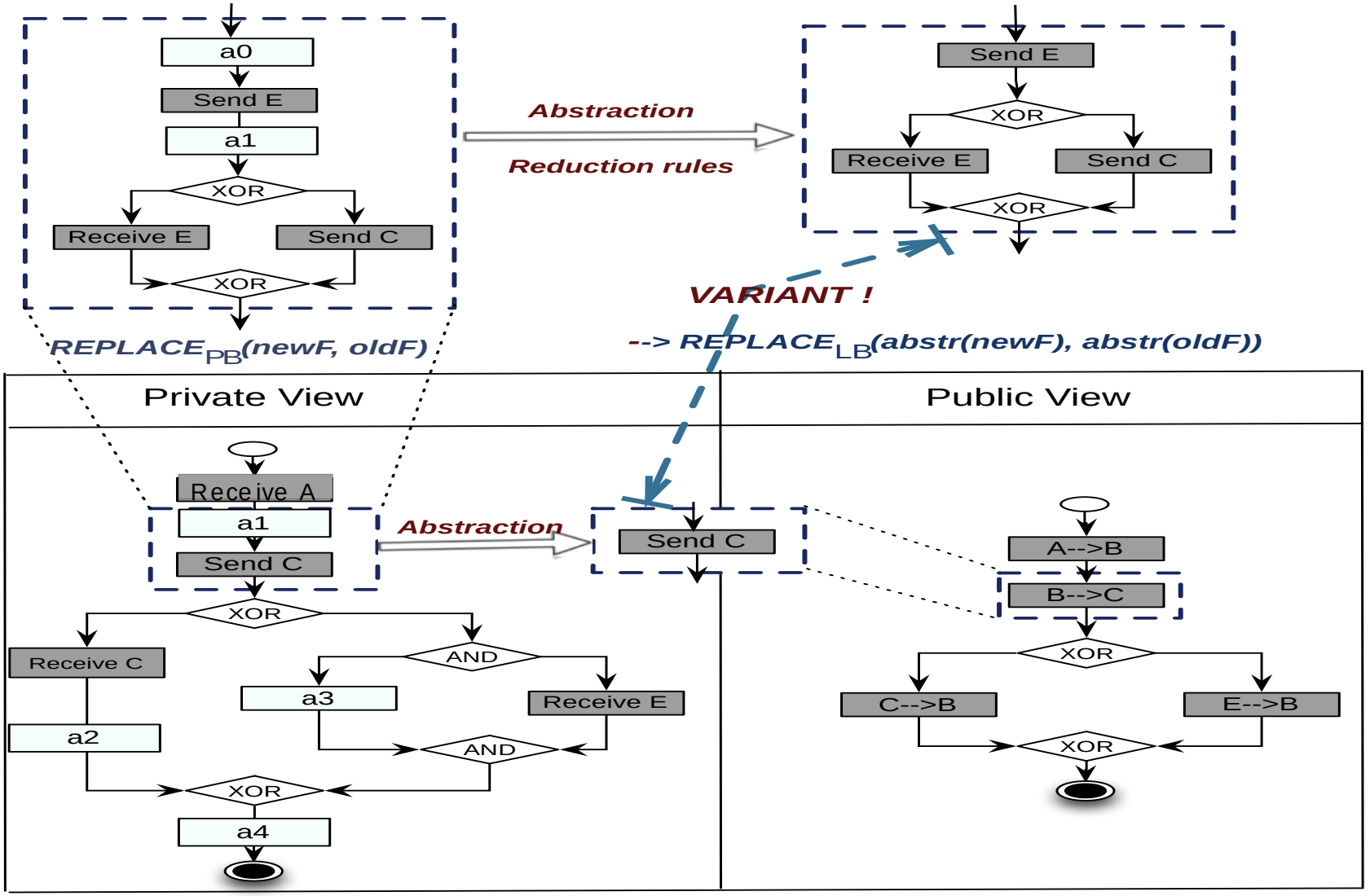
Change Propagation: Replace Pattern



Change Propagation: Replace Pattern



Change Propagation: Replace Pattern



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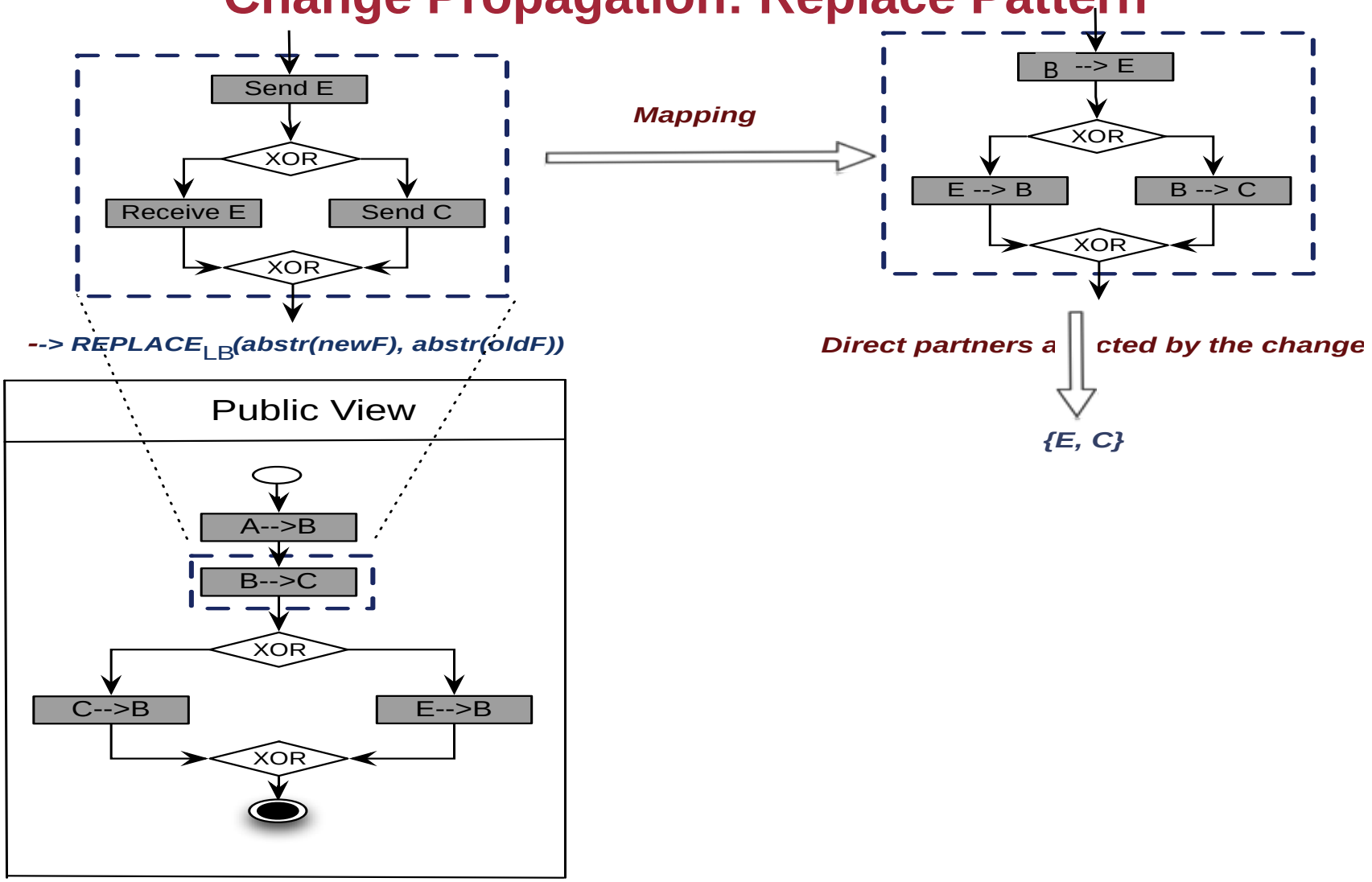

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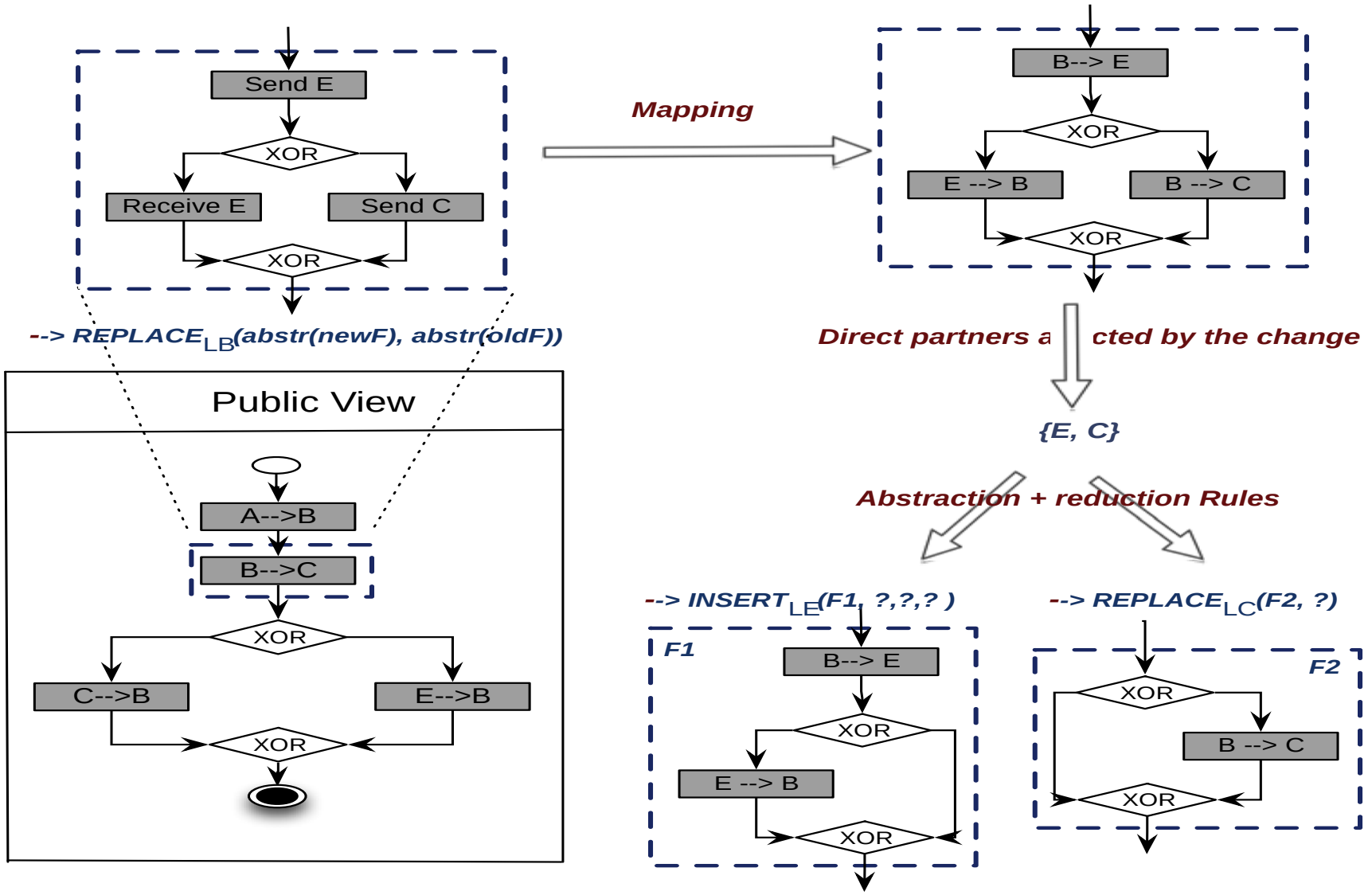

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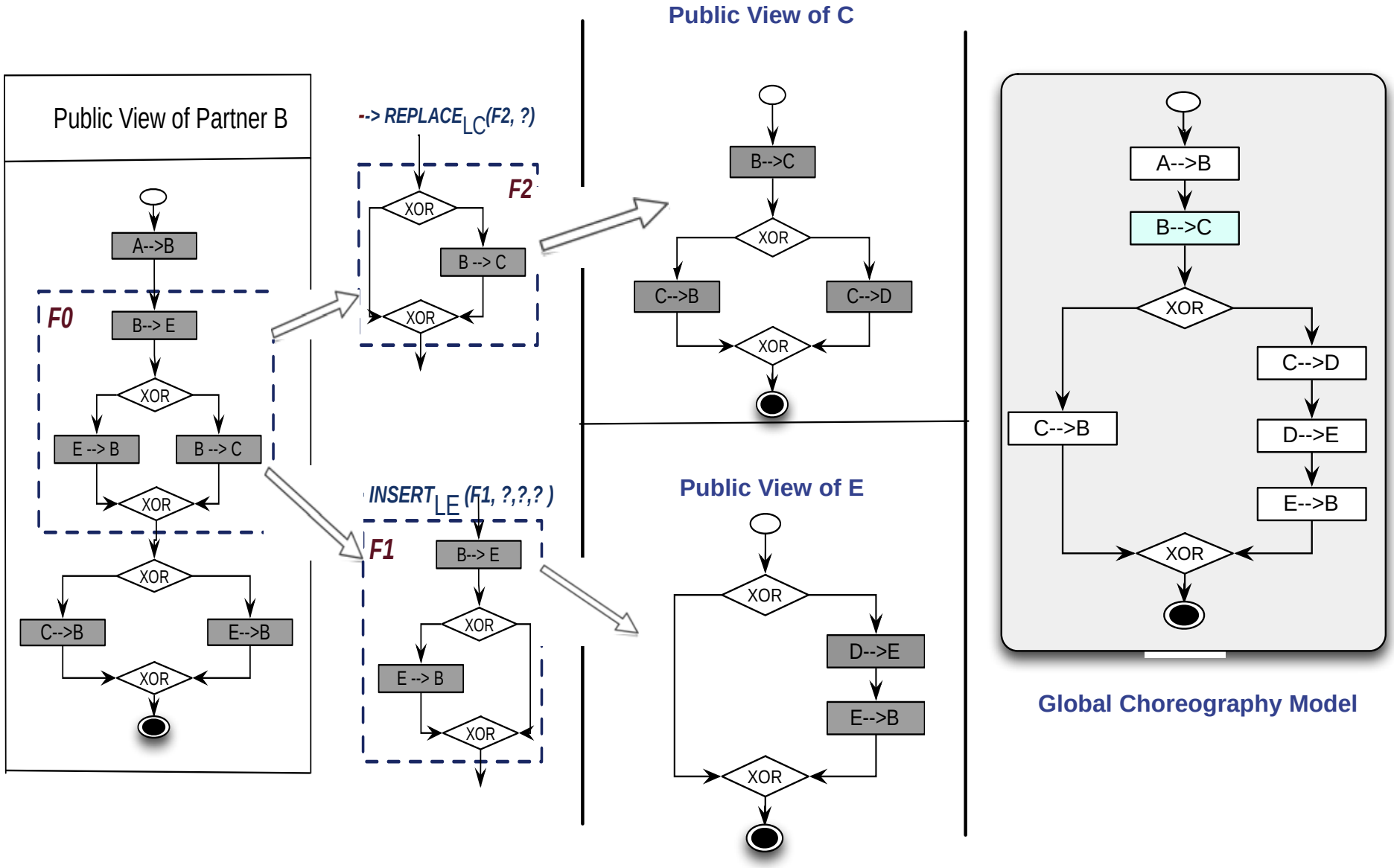
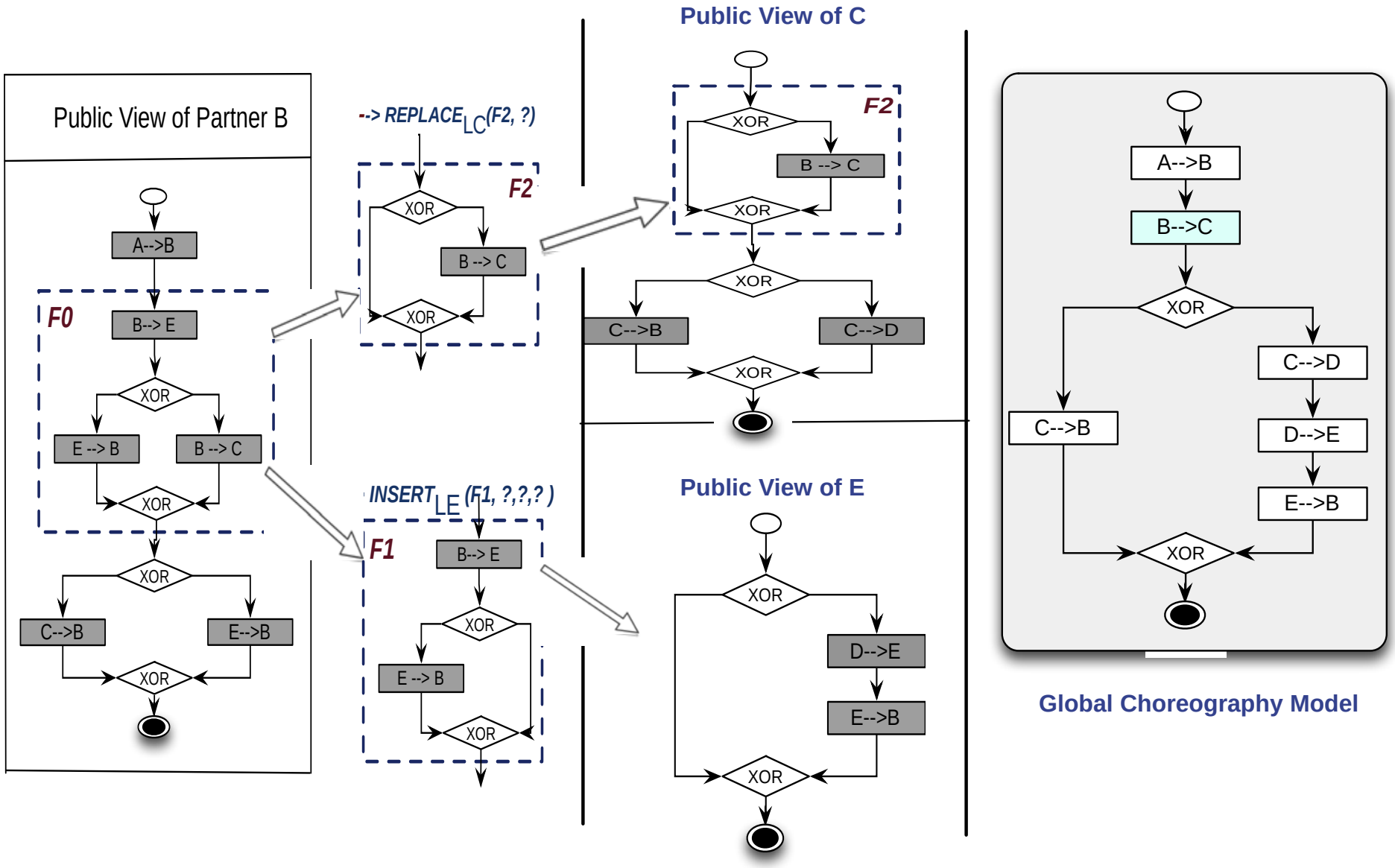


Change Propagation: Replace Pattern



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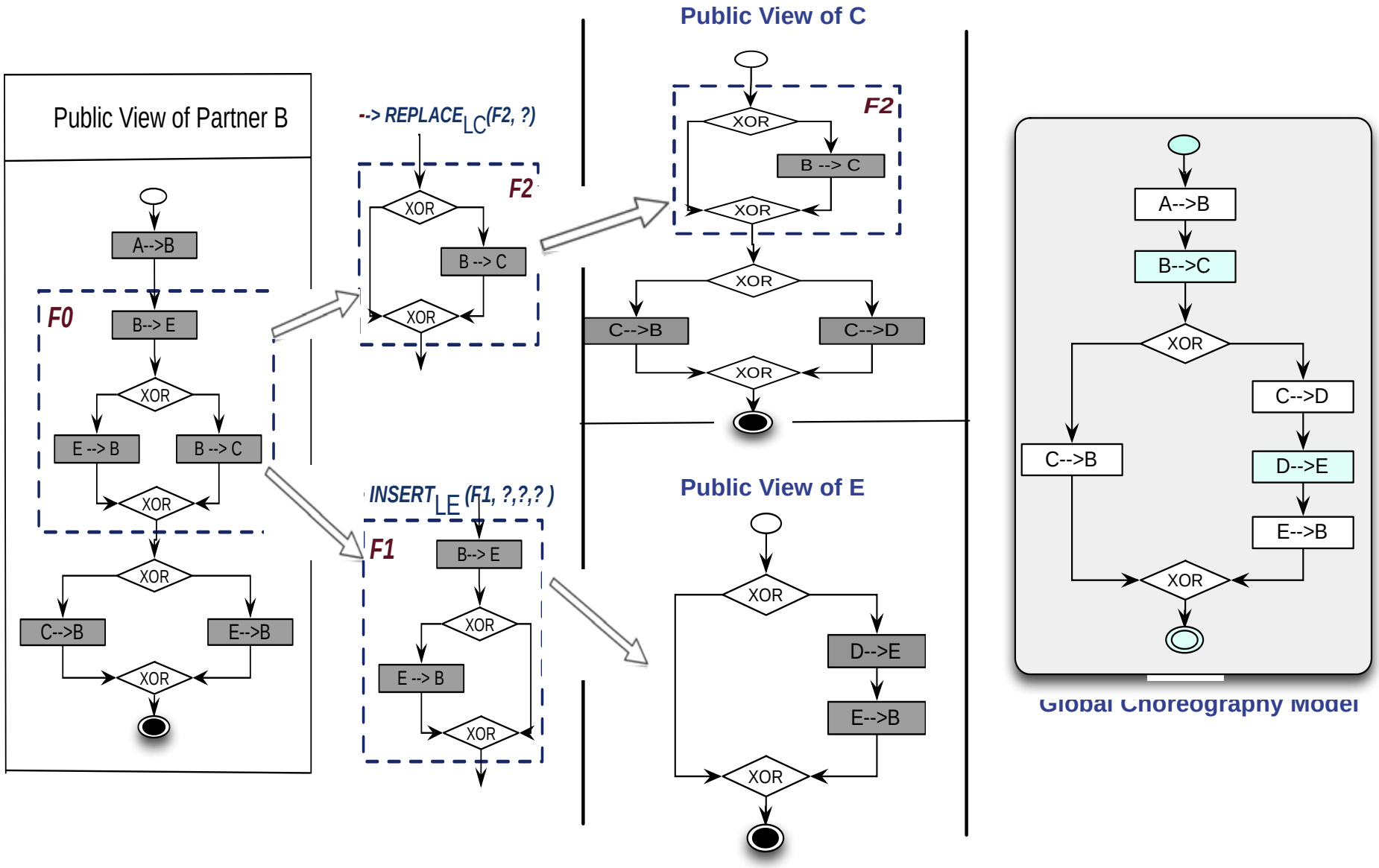
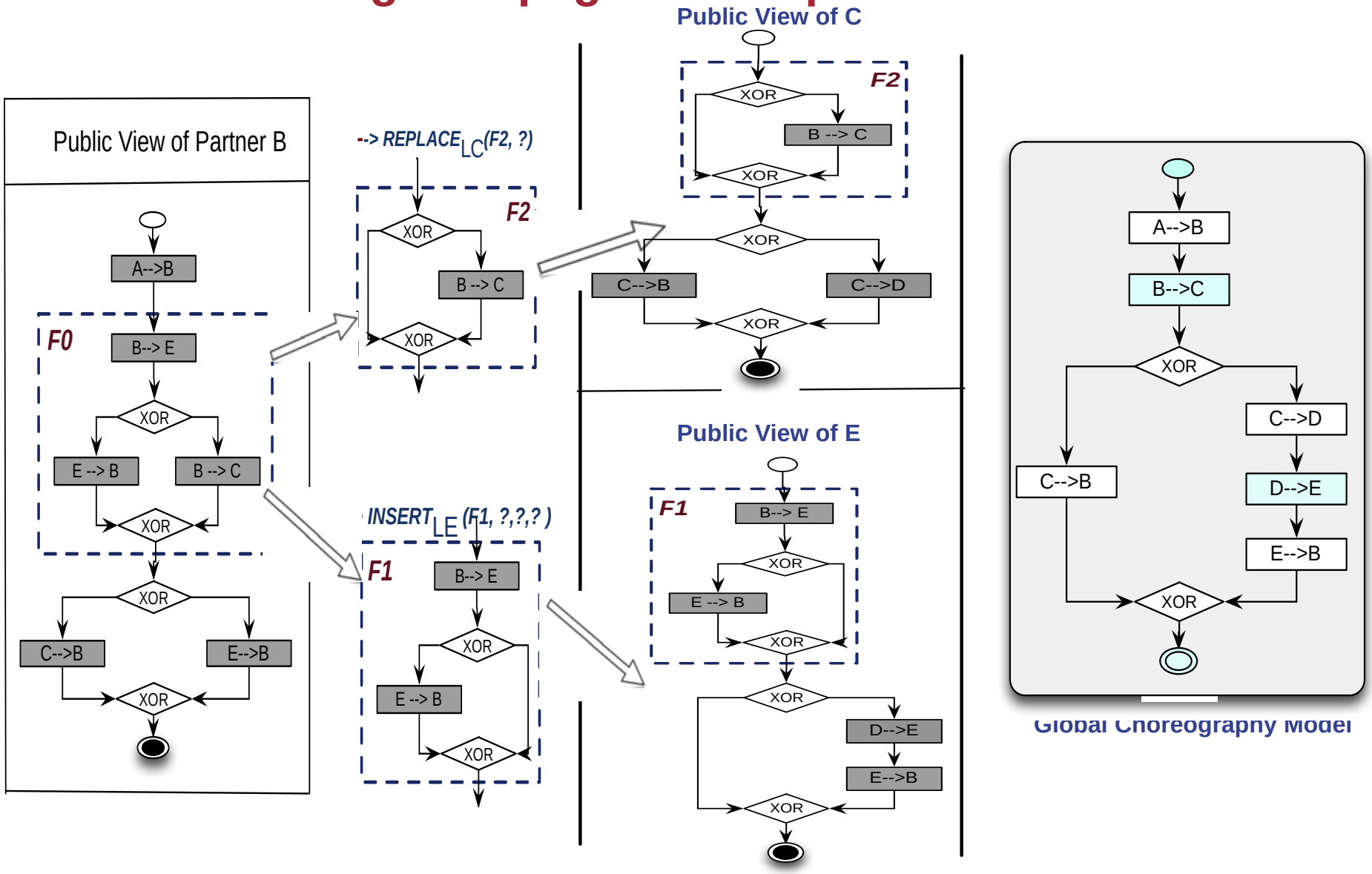


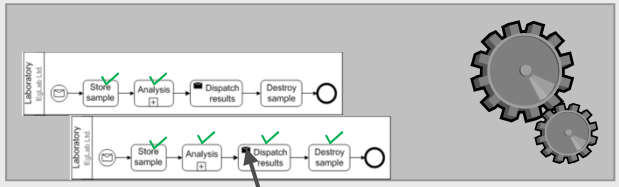
Change Propagation: Replace Pattern



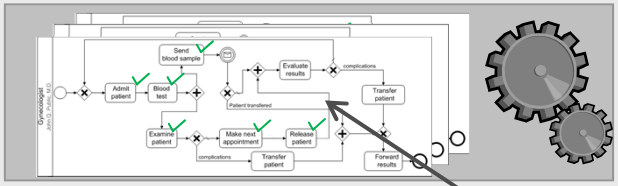
Other Issues

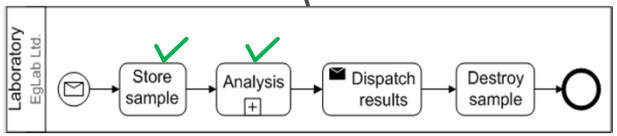
Which process instances can migrate to the new version?

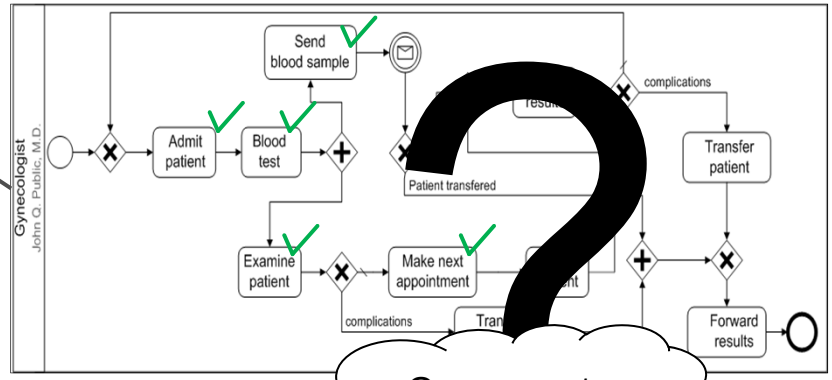
Process-aware Information System 2



Process-aware Information System 1







Concurrent Changes?

Process-aware Information System 3