

International Conference on Business Process Management

# **Integrating Process Learning and Process Evolution – A Semantics Based Approach**

Stefanie Rinderle, Barbara Weber,  
Manfred Reichert, Werner Wild

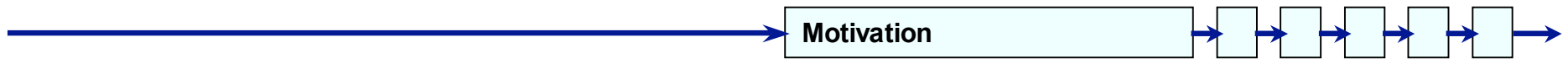
Nancy, September 6th 2005

# Outline

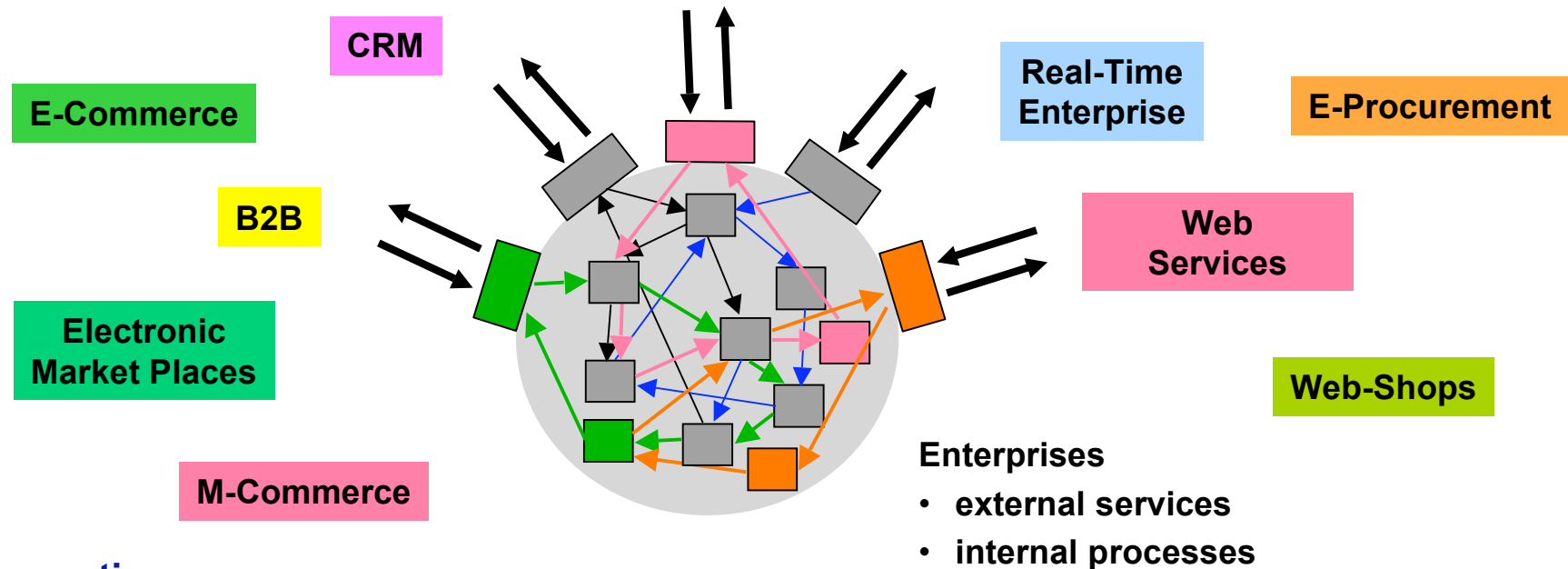


- ⇒ 1. Motivation
- 2. The Process Life Cycle
- 3. Providing Process Change Semantics through CCBR
- 4. Process Learning and Seamless Process Evolution
- 5. Case-Base Evolution
- 6. Summary and Outlook
- Appendix: References

# Situation in Practice (1)



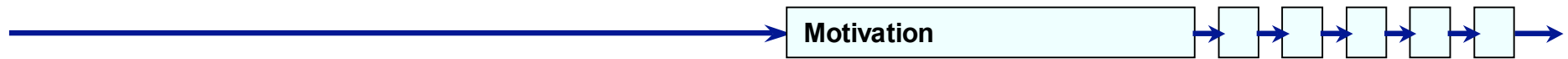
Permanently arising new „trends“ – require new products and services  
 ... which must be integrated



## questions:

- u How quickly can new processes be implemented?
  - u At which costs? – Change risk?
  - u How expensive are process changes in the sequel?
  - u How to avoid the maintenance trap?
- } [ **Challenges!**

## Situation in Practice (2)



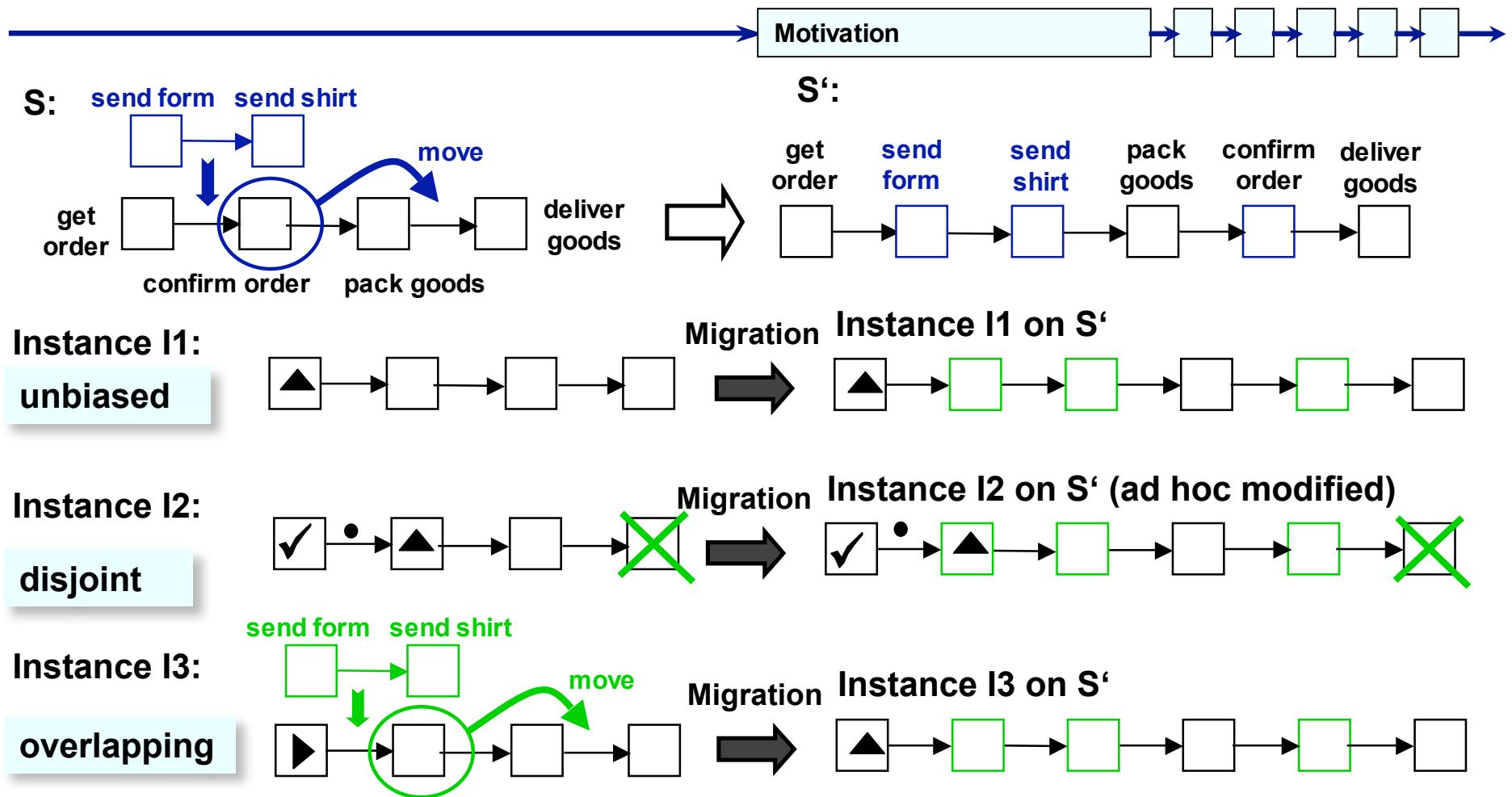
### $\pi$ Processes with long duration

- leasing contracts (3 – 5 years)
- medical treatments (up to several months)
- ...

### $\pi$ Consequence: processes have to be frequently adapted

- new laws
- new medical treatment
- operational reorganization
- ...

# Adaptive Process Management



## Complete Framework at Syntactical Level

# Outline



1. Motivation

⇒ 2. The Process Life Cycle

3. Providing Process Change Semantics through CCBR

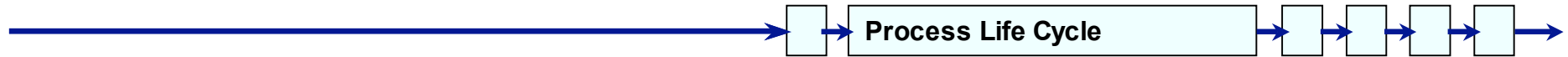
4. Process Learning and Seamless Process Evolution

5. Case-Base Evolution

6. Summary and Outlook

Appendix: References

## Challenges

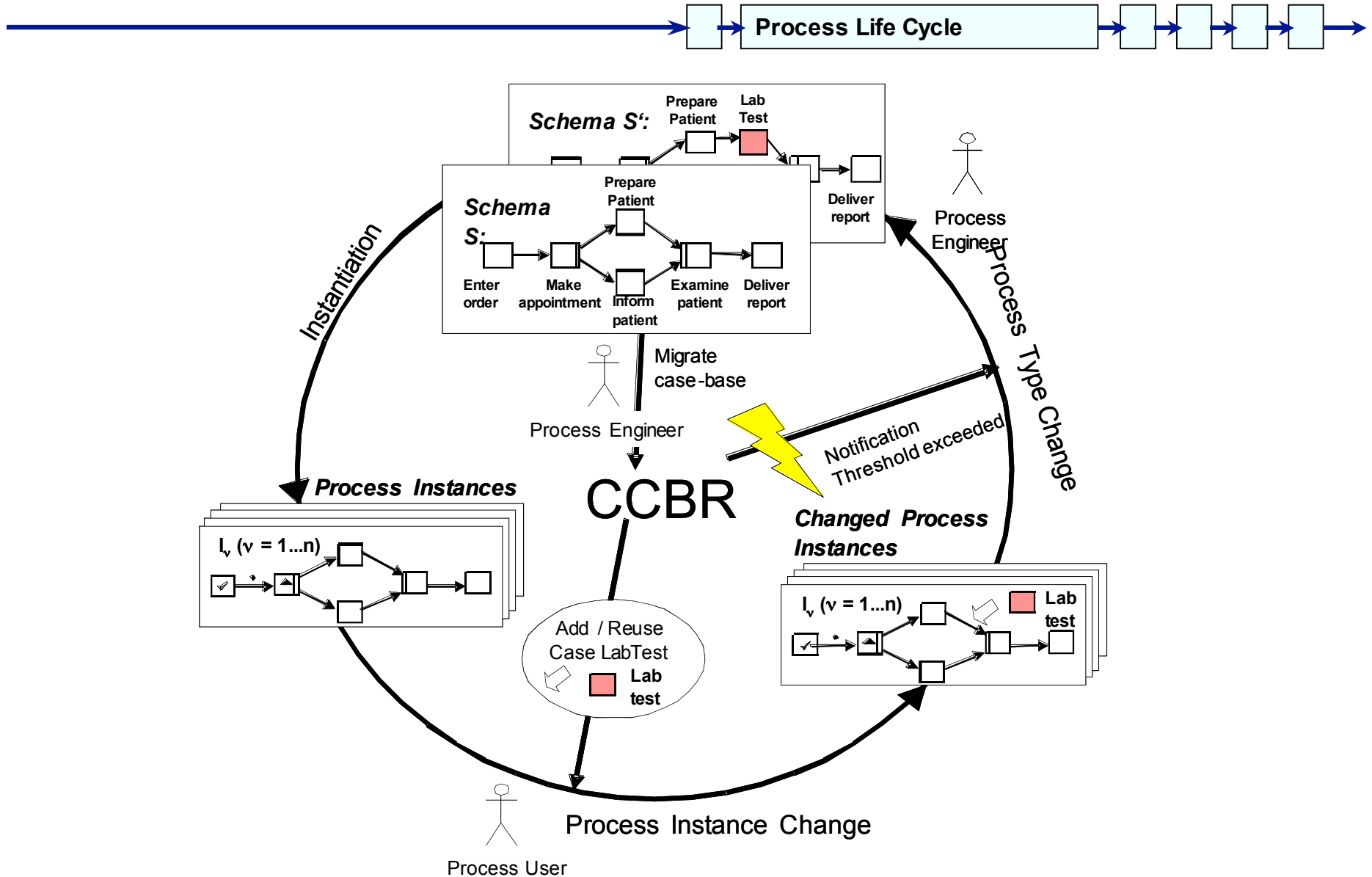


### Semantic Process Change Support:

- $\pi$  Explaining / Documenting Process Instance Changes
- $\pi$  Reviewing Reasons for Previous Process Instance Changes
- $\pi$  Re-using Previous Process Instance Changes
- $\pi$  Deriving Suggestions for Process (Type) Optimizations
- $\pi$  Automatic Process Instance Migration

## Combining Adaptive PMS with Case-Based Reasoning

# The Big Picture





# Outline



1. Motivation

2. The Process Life Cycle

➡ 3. Providing Process Change Semantics through CCBR

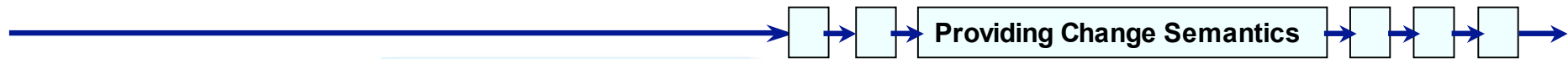
4. Process Learning and Seamless Process Evolution

5. Case-Base Evolution

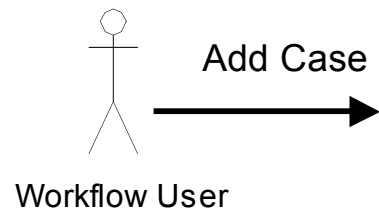
6. Summary and Outlook

Appendix: References

# Enriching Process Instance Changes Using CCBR



## Add Case



Title:

Description:

Question-Answer Pairs

Question	Answer
Patient hasdiabete?	Yes
What is the patient's age?	> 40

Actions

Operation Type	Subject	Parameters
sInsert	LabTest	S, PreparePatientExaminePatient

SelectOperation Type:

SelectActivity/Edge:

Please Answer the Questions

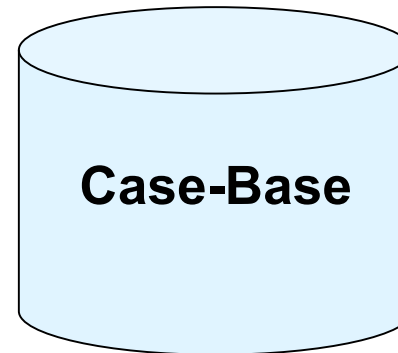
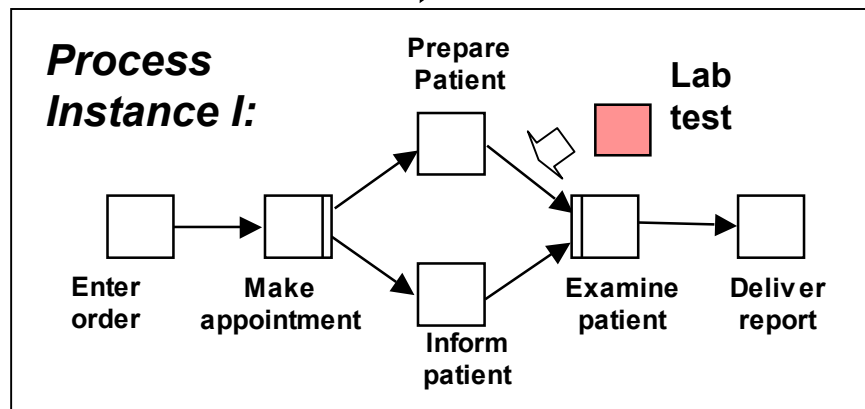
Question	Answer
Patient hasdiabete?	Yes
What is the patient's age?	> 40

Display List of Cases

CaseID	Title	Similarity	Reputation Score
125	Lab Testrequired	100%	25

Insert (LabTest, Prepare Patient, Examine Patient)

## Retrieve Case



# Outline



1. Motivation

2. The Process Life Cycle

3. Providing Process Change Semantics through CCBR

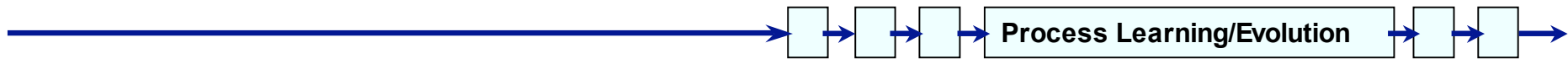
⇒ 4. Process Learning and Seamless Process Evolution

5. Case-Base Evolution

6. Summary and Outlook

Appendix: References

# Performing Process Type Changes (1)



**Process Instance I:**

Enter order → Make appointment → Prepare Patient → Examine patient → Deliver patient

Lab test

Process User

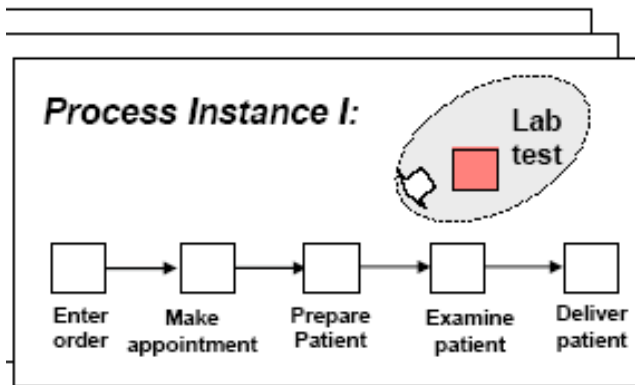
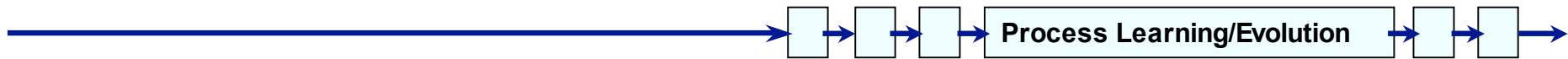
Case ID: 1  
Title: Lab test required  
Reuse Frequency: 104 Reputation Score: 104

Question-Answer Pairs	
Question	Answer
Does the patient have diabetes?	Yes
What is the patient's age?	> 40

Actions		
Operation Type	Subject	Parameters
LabTest	LabTest	S, PreparePatient, Examine Patient

- Different Scenarios:**
- Equivalent cases
  - Same actions but different reasons
  - Partially overlapping actions

# Performing Process Type Changes (2)



**serial insert at process instance level**

Case ID:

Title:

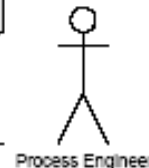
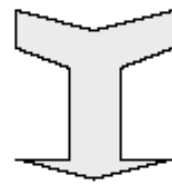
Reuse Frequency:  Reputation Score:

Question-Answer Pairs

Question	Answer
Patient has diabetes?	Yes
What is the patient's age?	> 40

Actions

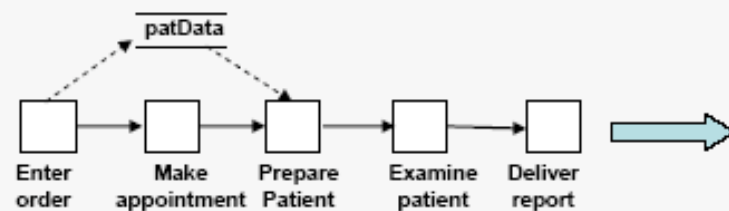
Operation Type	Subject	Parameters
sinsert	LabTest	S, PreparePatient, Examine Patient



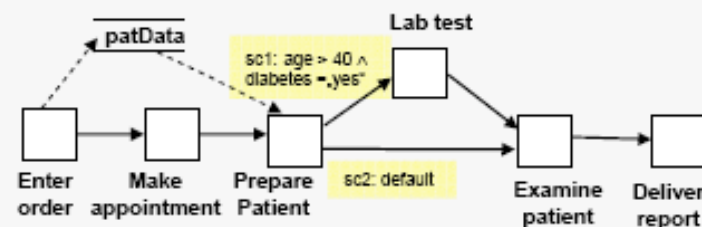
Perform Process Type Changes

**conditional insert at process type level**

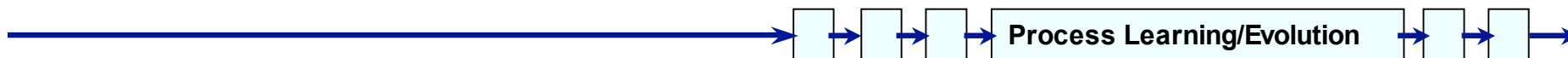
Schema Version  $S := S(T,1)$



Schema Version  $S' := S(T,2)$

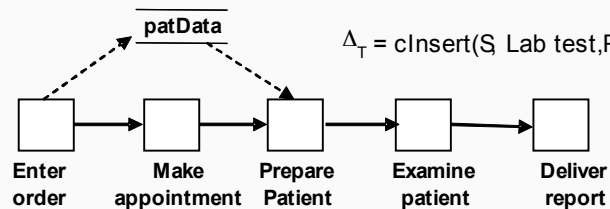


# Performing Process Type Changes

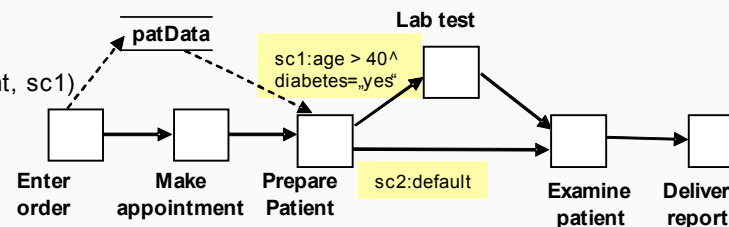


## Process Type Level:

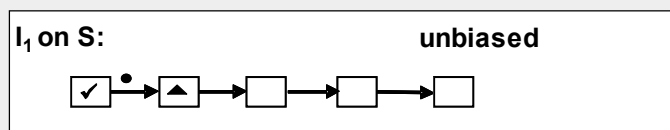
Schema Version  $S := S(T,1)$



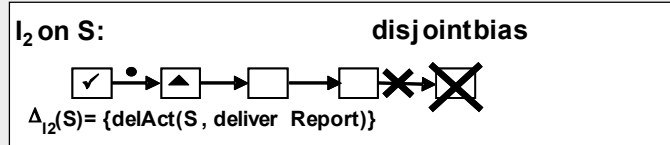
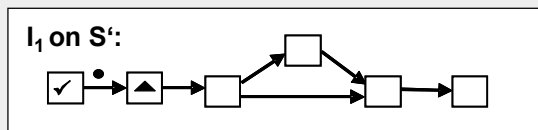
Schema Version  $S' := S(T,2)$



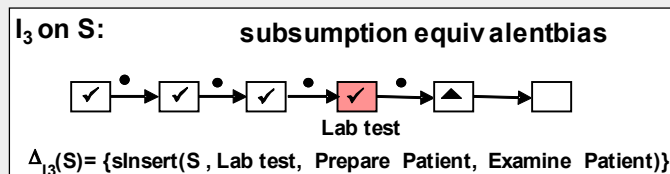
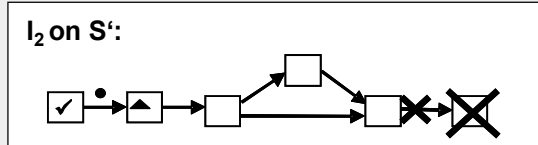
## Process Instance Level:



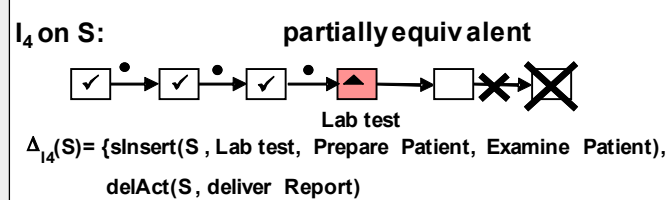
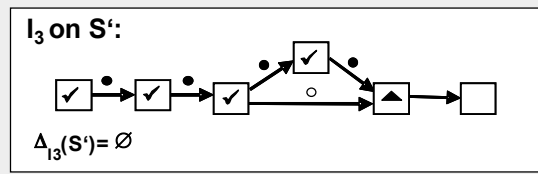
Migration Policy 1:  
adapt markings



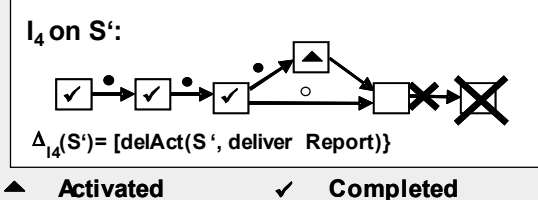
Migration Policy 2:  
adapt markings +  
keep bias on  $S'$



Migration Policy 3:  
adapt markings +  
bias on  $S' = \emptyset$



provides suggestion  
to user



▲ Activated      ✓ Completed

# Outline



1. Motivation

2. The Process Life Cycle

3. Providing Change Semantics through CCBR

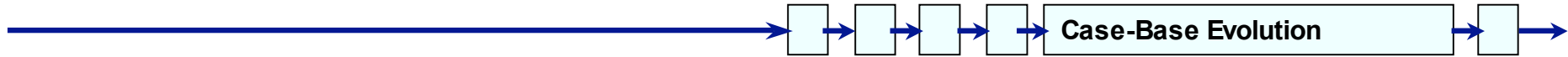
4. Process Learning and Seamless Process Evolution

⇒ 5. Case-Base Evolution

6. Summary and Outlook

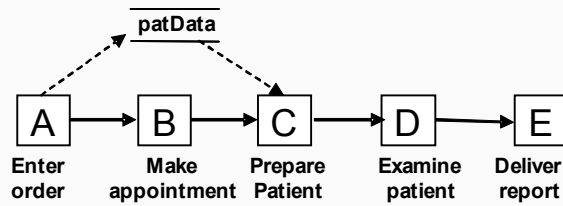
Appendix: References

# Case-Base Migration



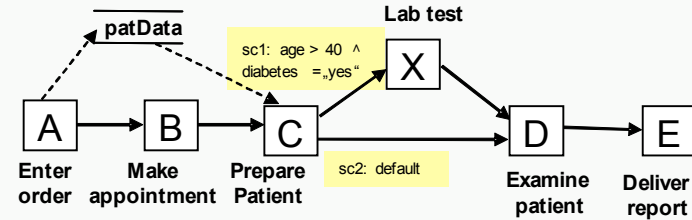
## Process Type Level:

Schema Version  $S := S(T,1)$

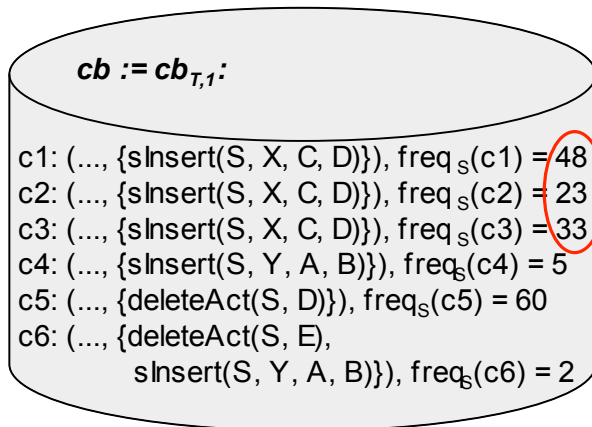


Schema Version  $S' := S(T,2)$

ProcessType Change  $\Delta_T$

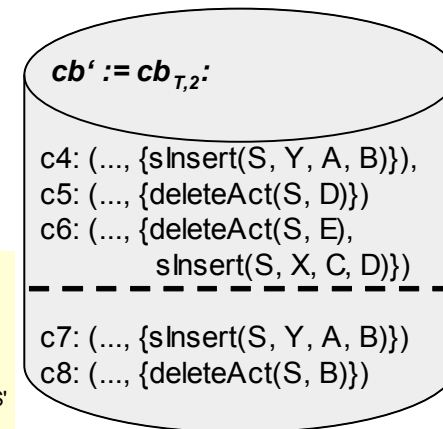


$$\Delta_T = \text{cInsert}(S, \text{Lab test}, \text{PreparePatient}, \text{ExaminePatient}, \text{sc1})$$



## Migration

c1, c2, c3 dropped by process engineer  
 c4, c6 automatically transferred  
 c5 transferred by process engineer  
 c7, c8 new cases for instances based on S'





# Outline



1. Motivation

2. The Process Life Cycle

3. Providing Change Semantics through CCBR

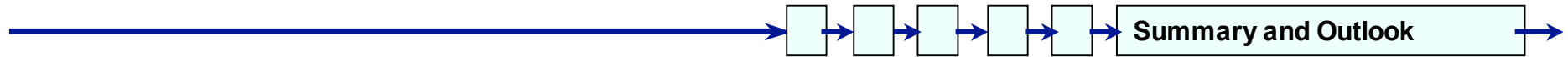
4. Process Learning and Seamless Process Evolution

5. Case-Base Evolution

⇒ 6. Summary and Outlook

Appendix: References

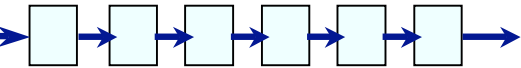
## Summary and Outlook



- π Combining Adaptive Process Management and CCBP results in
  - μ Full Life Cycle Support
  - μ Explanation of Process Instance Changes
  - μ Derivation of Process Type Changes
  - μ Process Instance and Case-Base Migration
  
- π Future Work:
  - μ Implementation
  - μ Combination with Process Mining Techniques

**THANK YOU FOR YOUR ATTENTION!**

## Own Publications:



S. Rinderle, M. Reichert, and P. Dadam. *Correctness Criteria for Dynamic Changes in Workflow Systems – A Survey*. Data and Knowledge Engineering, Special Issue on Advances in Business Process Management 50(1):9–34 (2004)

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

S. Rinderle, M. Reichert, and P. Dadam. *Disjoint and Overlapping Process Changes: Challenges, Solutions, Applications*. In Proc. Int'l Conf. CoopIS'04, pp. 101–120, Ayia Napa, Cyprus, October 2004

S. Rinderle, M. Reichert, and P. Dadam. *On Dealing with Structural Conflicts between Process Type and Instance Changes*. In Proc. Int'l Conf. BPM'04, pp. 274–289, Potsdam, 2004


M. Reichert, S. Rinderle, and P. Dadam. *On the Common Support of Workflow Type and Instance Changes under Correctness Constraints*. In Proc. Int'l Conf. CoopIS'03, pp. 407–425, Catania, Italy, November 2003

S. Rinderle, M. Reichert, and P. Dadam. *Evaluation of Correctness Criteria for Dynamic Workflow Changes*. In Proc. Int'l Conf. BPM'03, pp. 41–57, Eindhoven, The Netherlands, 2003

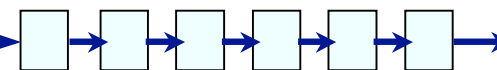
S. Rinderle and P. Dadam. *Schema Evolution in Workflow Management Systems*. Informatik Spektrum, 26(1):17–19, 2003. (in German)

S. Rinderle, M. Reichert, and P. Dadam. *Supporting Workflow Schema Evolution by Efficient Compliance Checks and Automatic Migration of Workflow Instances*. Informatik - Forschung und Entwicklung, 17(4):177–197, 2002. (in German)

## References(1)

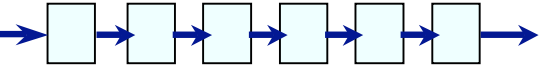
- 
- [Aals01] v. d. Aalst, W.: *Exterminating the dynamic bug: A concrete approach to support workflow change*. Information Systems Frontiers 3:279-317 (2001)
- [AaBa02] v. d. Aalst, W.; Basten, T.: *Inheritance of workflows: An approach to tackling problems related to change*. Theoretical Computer Science 270: 125-203 (2002)
- [AaHe02] v. d. Aalst, W.; v. Hee, K.: *Workflow Management*. MIT Press (2002)
- [AgMi00] Agostini, A.; De Michelis, G.: *Improving Flexibility of Workflow Management Systems*. In Proc. BPM 2000, LNCS 1806, Springer (2000), pp. 218-234
- [CCPP98] Casati, F.; Ceri, S.; Pernici, B.; Pozzi, G.: *Workflow evolution*. Data and Knowledge Engineering 24: 211-238 (1998)
- [EdHo00] Edmond, D.; ter Hofstede, A.: *A Reflective Infrastructure for Workflow Adaptability*. Data and Knowledge Engineering 34: 271-304 (2000)
- [EKR95] Ellis, C.; Keddara, K., Rozenberg, G.: *Dynamic change within workflow systems*. In: Proc. Int'l Conf. on Org. Systems (COOCS '95), Milpitas pp. 10-21 (1995)
- [FRF02] Fent, A.; Reiter, H.; Freitag, B.: *Design for change,: Evolving workflow specifications in ULTRAflow*. In: Proc. CAISE '02, pp. 516-534 (2002)

## References(2)



- [JoHe98] Joeris, G.; Herzog, O.: *Managing evolving workflow specifications*. In: Proc. Int'l Conf. on Coop. Inf. Systems (CoopIS '98), New York City, pp. 310-321 (1998)
- [KAS03] Kochut, K.; Arnold, J.; Sheth, A.; Miller, J.; Kraemer, E.; Arpinar, N.; Cardoso, J.: *IntelliGEN: A distributed workflow system for discovering protein-protein interactions*. Distributed and Parallel Databases 13:43-72 (2003)
- [KrGe99] Kradolfer, M.; Geppert, A.: *Dynamic workflow schema evolution based on workflow type versioning and workflow migration*. In: Proc. CoopIS, Edinburgh pp. 104-114, (1999)
- [ReDa98] Reichert, M.; Dadam, P.: *ADEPTflex – supporting dynamic changes of workflows without losing control*. Journal of Intelligent Inf. Systems 10 (1998) 93-129
- [RRD03] Rinderle, S.; Reichert, M.; Dadam, P.: *Evaluation of Correctness Criteria For Dynamic Workflow Changes*. In: Int'l Conf. on BPM'03, Eindhoven, The Netherlands, June (2003)
- [RRD03a] Reichert, M.; Rinderle, S.; Dadam, P.: *On the Common Support of Workflow Type and Instance Changes Under Correctness Constraints*. In: Int'l Conf. CoopIS'03, Catania, Sicily, November (2003)
- [RRD04] Rinderle, S.; Reichert, M.; Dadam, P.: *Flexible Support Of Team Processes By Adaptive Workflow Systems*. Distributed and Parallel Databases 16(1): 91-116 (2004).

## References(3)



- [RRD04a] Rinderle, S.; Reichert, M.; Dadam, P.: *Correctness Criteria for Dynamic Workflow Changes – A Survey*. Data & Knowledge Engineering, Special Issue on Advances in Business Process Management 50(1): 9-34 (2004).
- [RRD04b] Rinderle, S.; Reichert, M.; Dadam, P.: On Dealing With Structural Conflicts Between Process Type and Instance Changes. 2nd Int'l Conf. On Business Process Management, Potsdam, June 2004.
- [SMO00] Sadiq, A.; Marjanovic, O.; Orłowska, M.: *Managing change and time in dynamic workflow processes*. Int'l Journal Coop IS 9 (2000)
- [Wesk01] Weske, M.: *Formal foundation and conceptual design of dynamic adaptations in a workflow management system*. In: Proc. 34th Hawaii Intl'l Conf. on System Sciences (HICSS-34) (2001)