

# BPM: Quo Vadis? Future Research Directions

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# BPM uptake



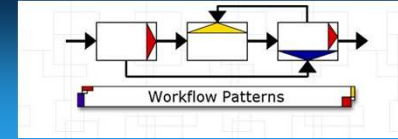
- **Assumption:** The uptake of BPM is going to increase significantly in the coming years
  - More use in existing areas
  - Adoption in new areas, even new industries
- For research this means that we have to deal with the challenges that this increased uptake brings



- **Conceptual**
  - Workflow Patterns (control-flow, data, resource, exceptions)
- **Formal**
  - Workflow nets
  - YAWL
- **Technological**
  - YAWL environment

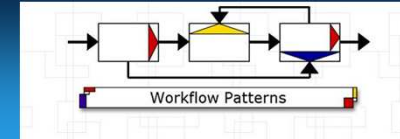
*Do not reinvent the wheel .....*

# Patterns reflection



- Started in 1999, joint work TU/e and QUT
- Objectives:
  - Identification of workflow modelling scenarios and solutions
  - Benchmarking
    - Workflow products (MQ/Series Workflow, Staffware, etc)
    - Proposed standards for web service composition (BPML, BPEL)
    - Open source offerings (jBPM, OpenWFE, Enhydra Shark))
    - Process modelling languages (UML, BPMN)
  - Foundation for selecting workflow solutions
- Home Page: [www.workflowpatterns.com](http://www.workflowpatterns.com)
- Primary publication:
  - W.M.P. van der Aalst, A.H.M. ter Hofstede, B. Kiepuszewski, A.P. Barros, “Workflow Patterns”, *Distributed and Parallel Databases* 14(3):5-51, 2003. *most cited paper in DAPD according to Web of Science, Scopus, Google Scholar, one of the most cited papers in the field*
- Influenced commercial and open source offerings, used in official selection processes, taught at universities all over the world, etc ..

# Patterns reflection: Lessons learnt



- Defining patterns is worthwhile, they provide deep insight into new and fuzzy domains
- Defining patterns is time-consuming and difficult
  - Conceptually challenging
  - Tool evaluations
  - Validation (e.g. through interaction with experts)
- Acceptance is hard
- Usually highly-cited

# BPM challenges



- **Model management**
  - Dealing with large collections of process models
  - Dealing with very large process models
- **Intelligent Monitoring**
  - Proper visualisation of large collections of running cases
  - Early warnings for potential problems (prediction)
- **Business Process Improvement**
  - How to determine the best to-be alternative?
  - How to correct incorrect process models?
- **Process Annotations**
  - Cost, Risk, Quality
- **Security**
  - Privacy, trust, confidentiality
- **Connections to other types of systems**
  - Knowledge management, scheduling systems, etc

# Model Management



- Dealing with large collections of process models
  - How to efficiently retrieve process models?
  - How to determine process model similarity?
  - How to query a repository in an intuitive manner?
  - How to deal with process language heterogeneity?
  - How to provide versioning support?
  - *Initiatives: APROMORE, BeeHiveZ*

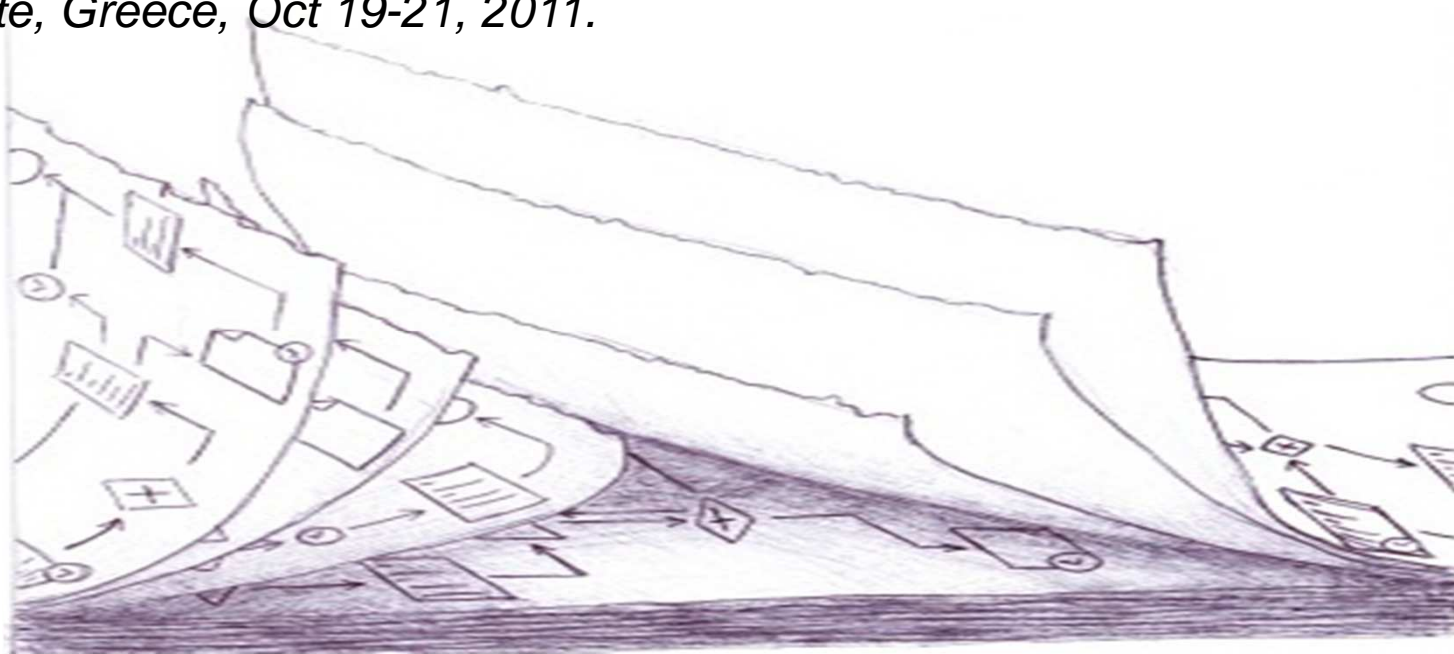


# Model Version Management



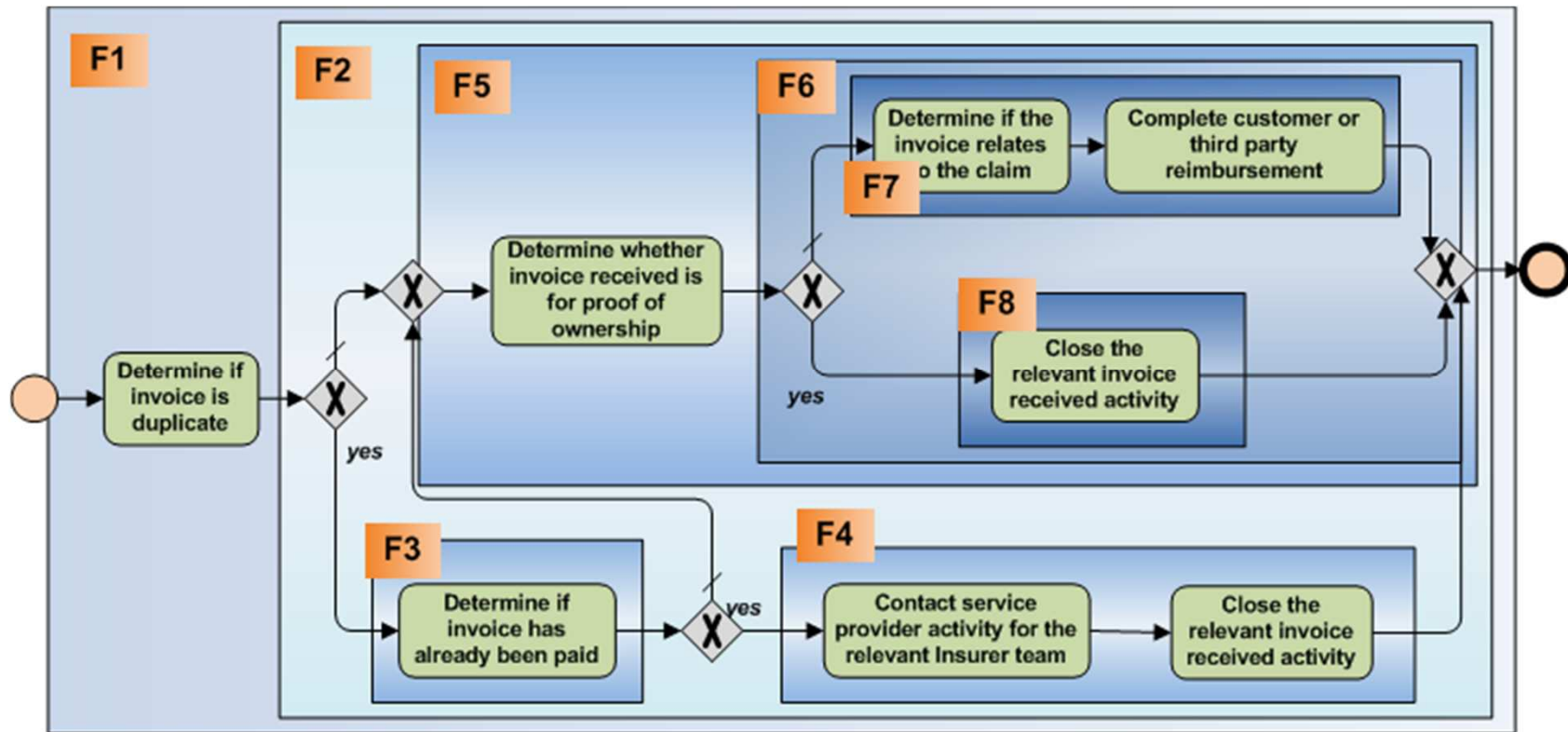
How to provide versioning support for model collections?  
How to store the models to optimise storage space and retrieval?  
How to deal with changes?

*C. Ekanayake, M. La Rosa, A.H.M. ter Hofstede, M.-C. Fauvet. [Fragment-based Version Management for Repositories of Business Process Models](#). Accepted for 19<sup>th</sup> International Conference on Cooperative Information Systems (CoopIS 2011), Crete, Greece, Oct 19-21, 2011.*





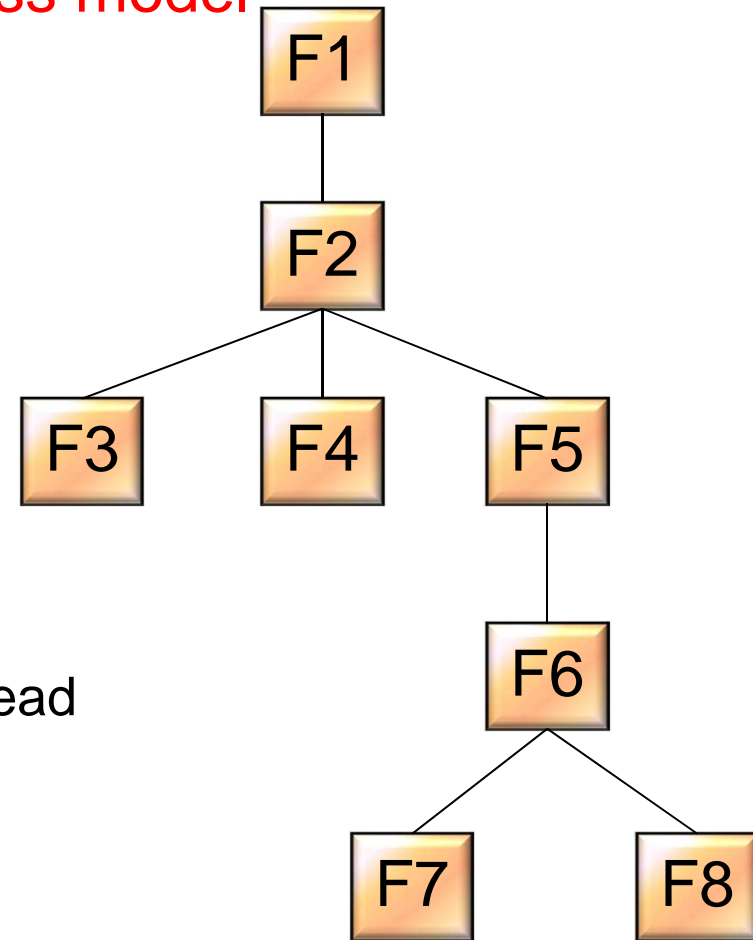
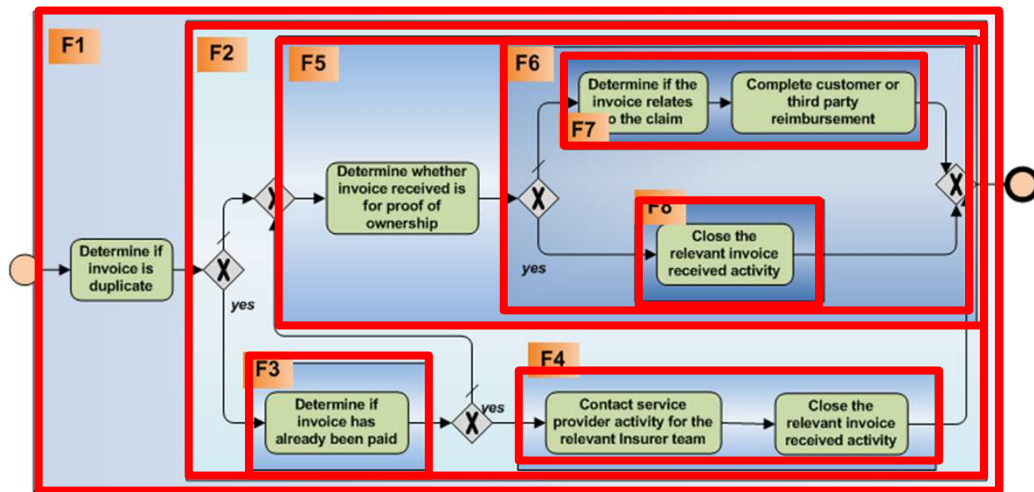
# Model Version Management



# Model Version Management



## Construction of the RPST of a process model



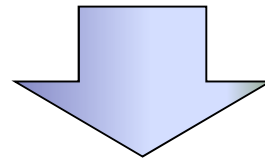
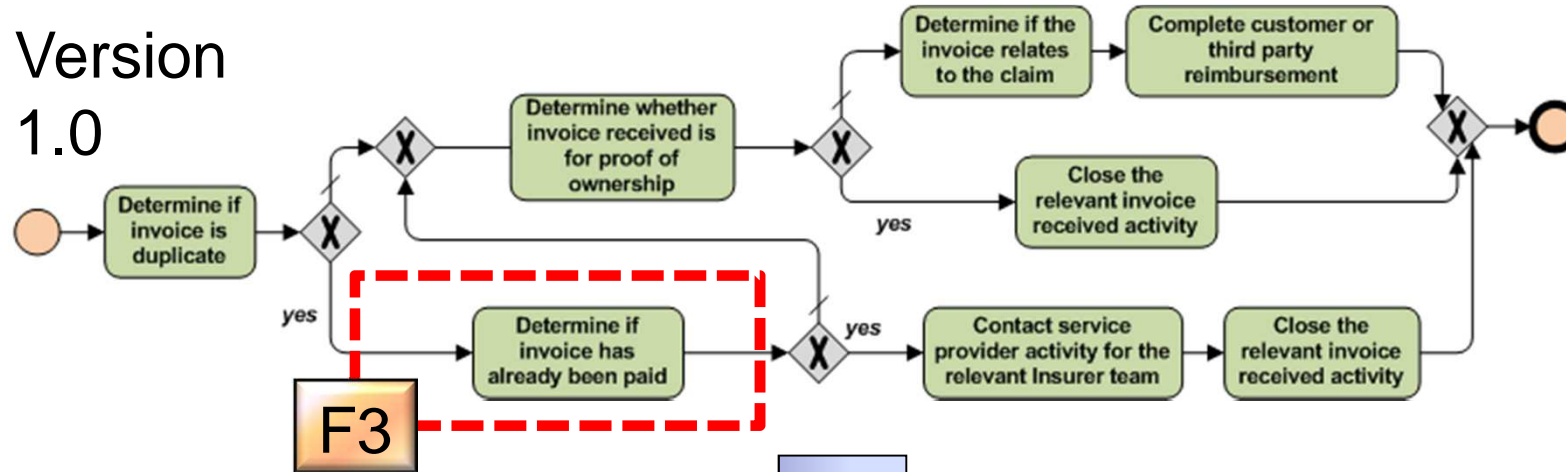
Fragments are stored in the repository, instead of complete process models.

Any process models can be constructed by retrieving its root fragment (e.g. F1) and following the composition relationships.

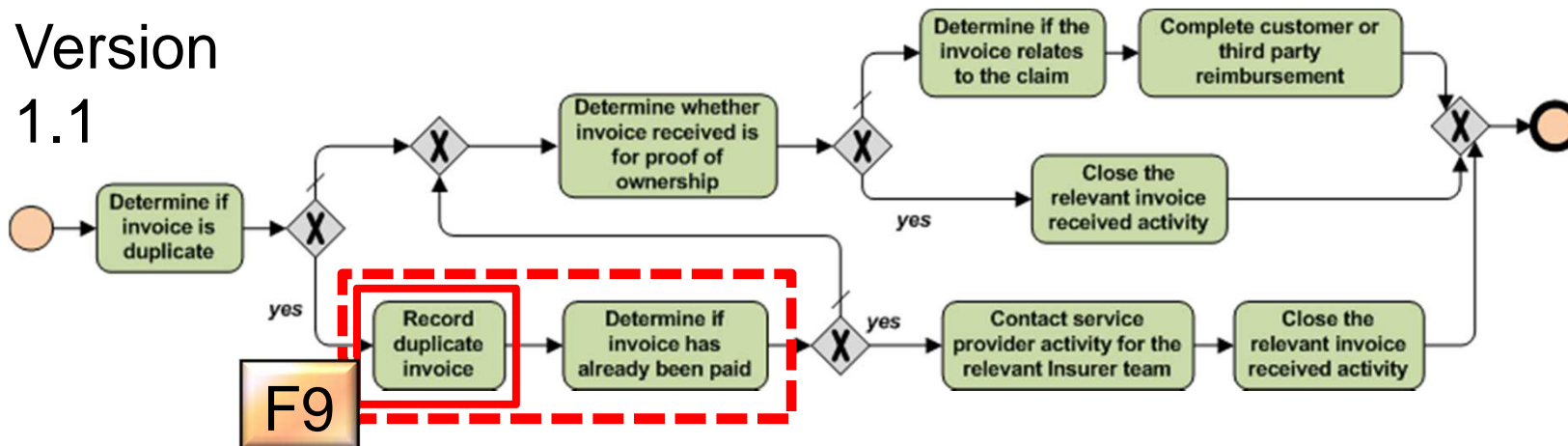
# Model Version Management



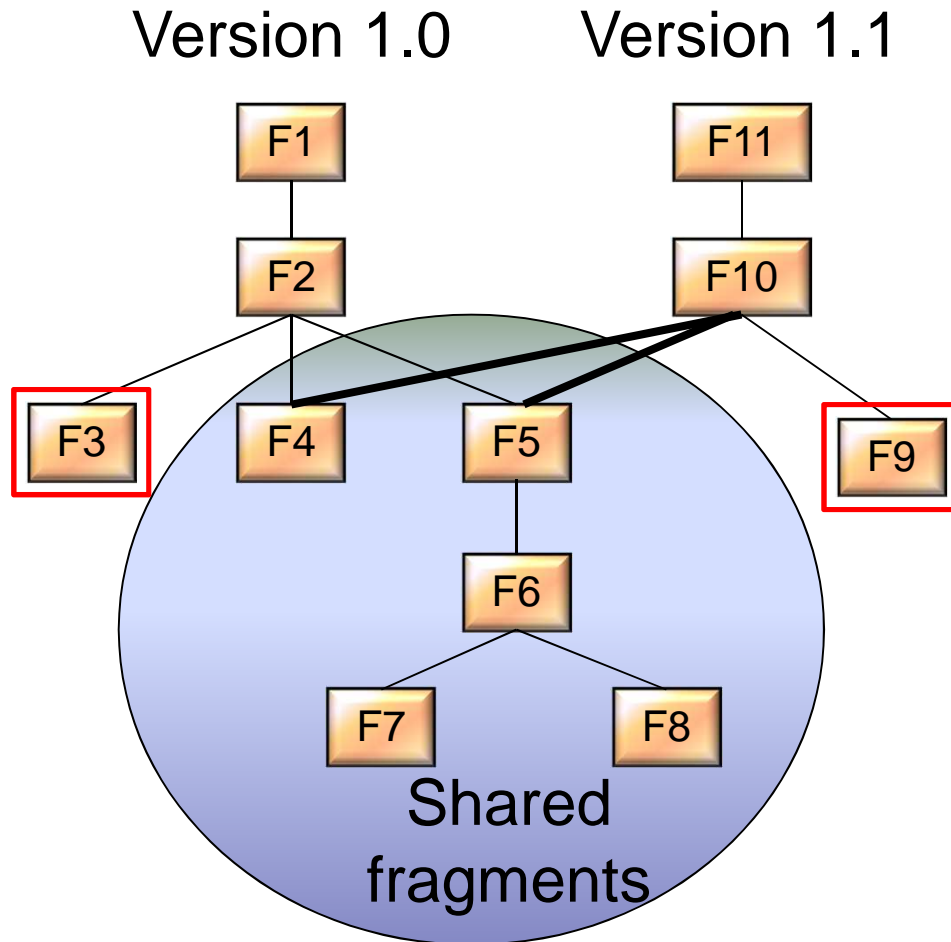
Version 1.0



Version 1.1



# Model Version Management



All unchanged fragments are shared between versions (e.g. F4, F5, F6, F7, F8)

New fragments are added only for changed fragments and their ascendant fragments. (e.g. F9, F10, F11)

# Model Version Management



Process name:  
**Home insurance**

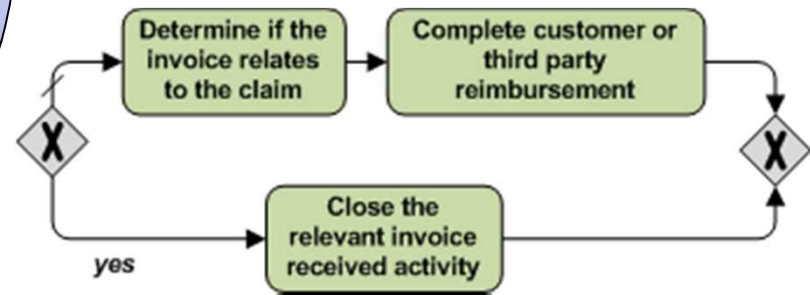
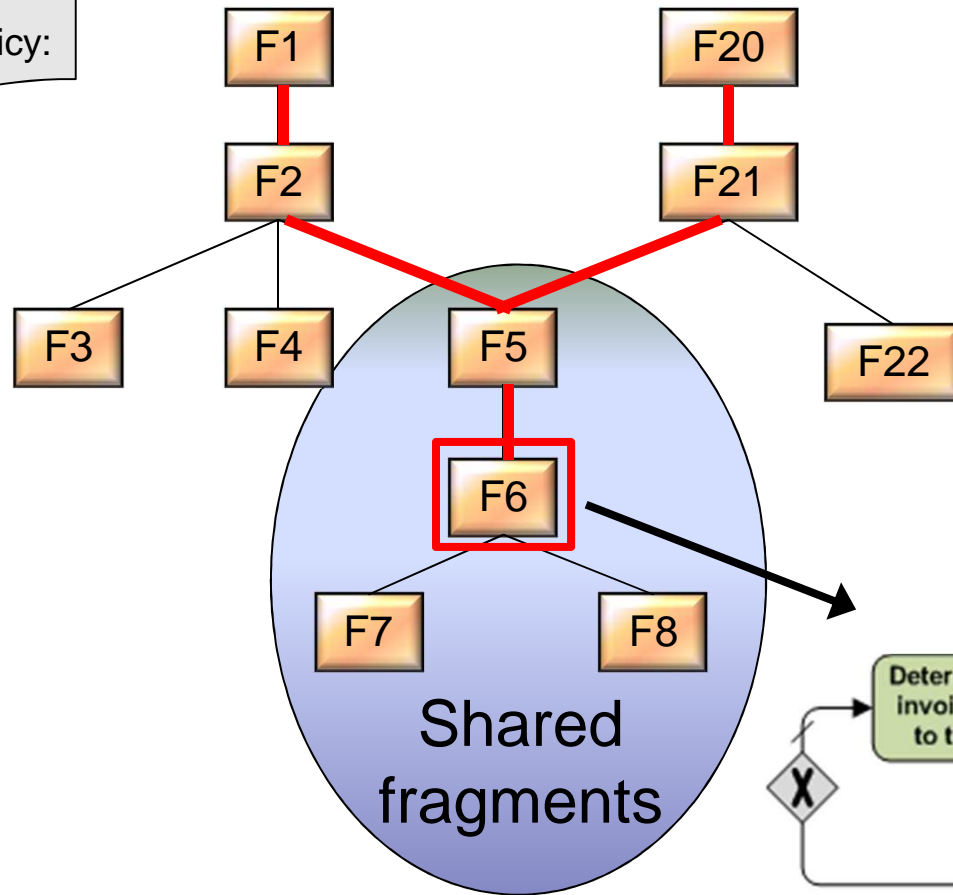
Propagation policy:  
**Instant**

Home insurance  
**Version 1.1**

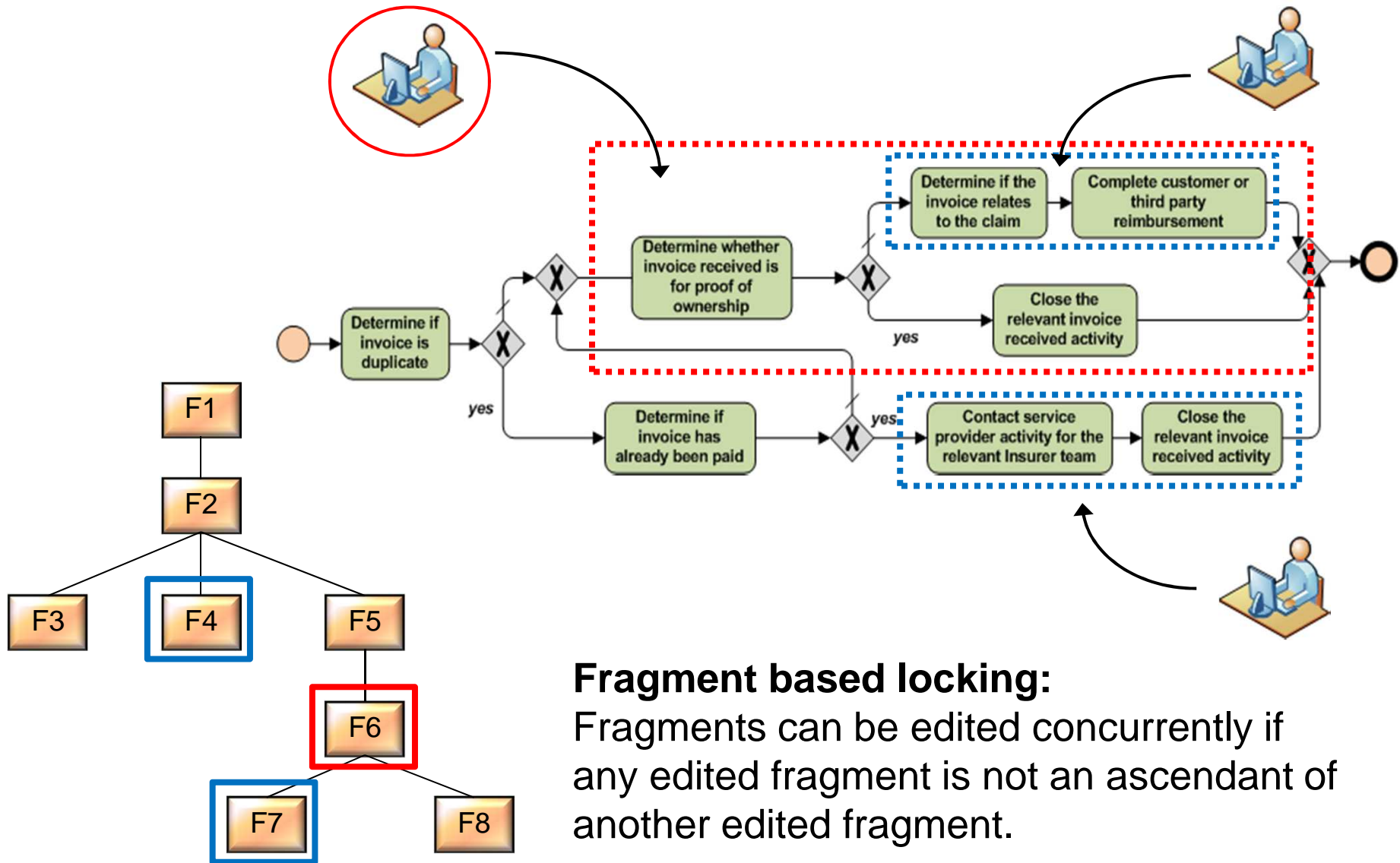
Motor insurance  
**Version 1.1**

Process name:  
**Motor insurance**

Propagation policy:  
**Instant**



# Model Version Management



## Fragment based locking:

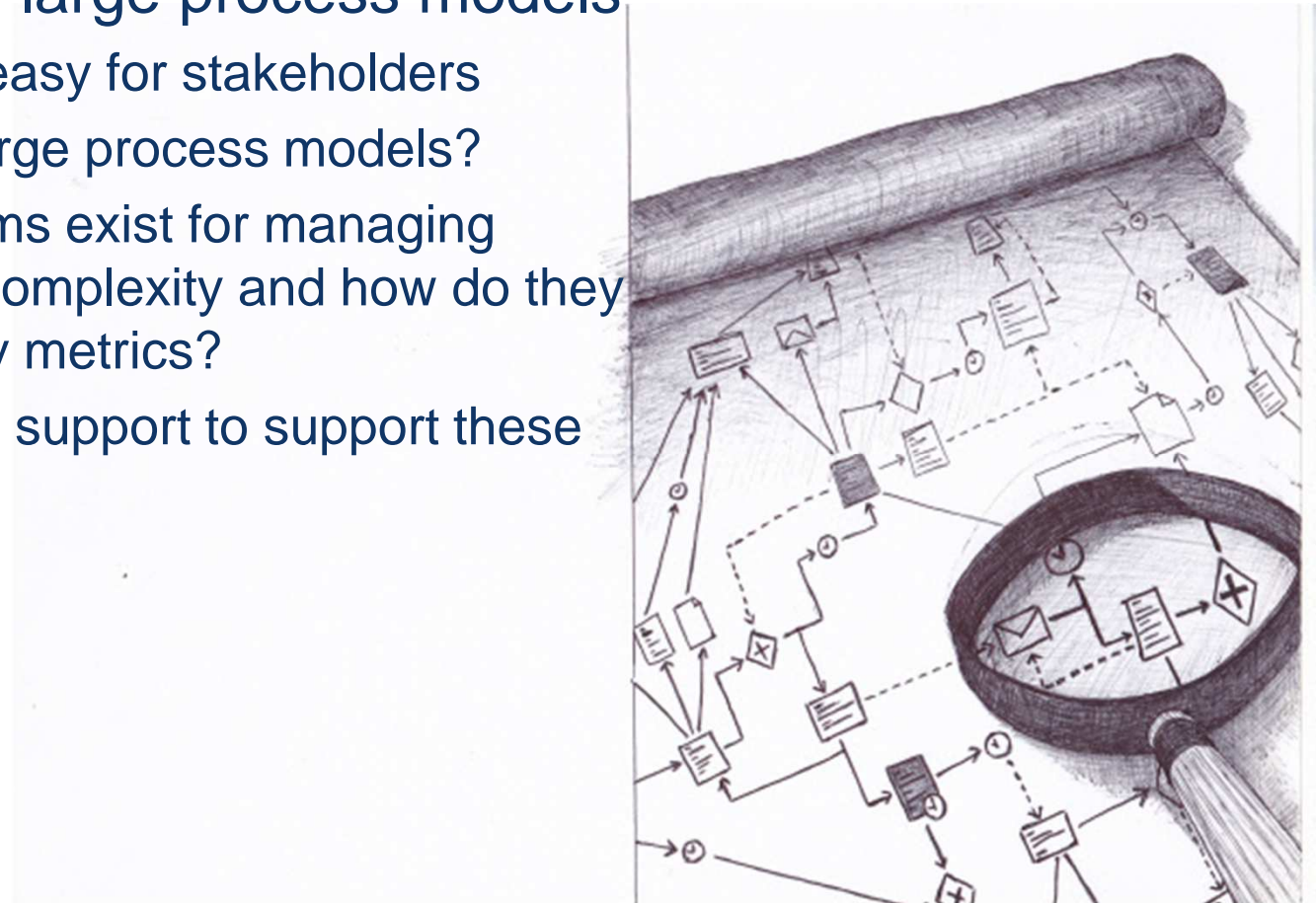
Fragments can be edited concurrently if any edited fragment is not an ascendant of another edited fragment.



# Model Management



- Dealing with very large process models
  - How to make it easy for stakeholders to understand large process models?
  - What mechanisms exist for managing process model complexity and how do they affect complexity metrics?
  - How to offer tool support to support these mechanisms?



# Sample Research: Presentation Patterns



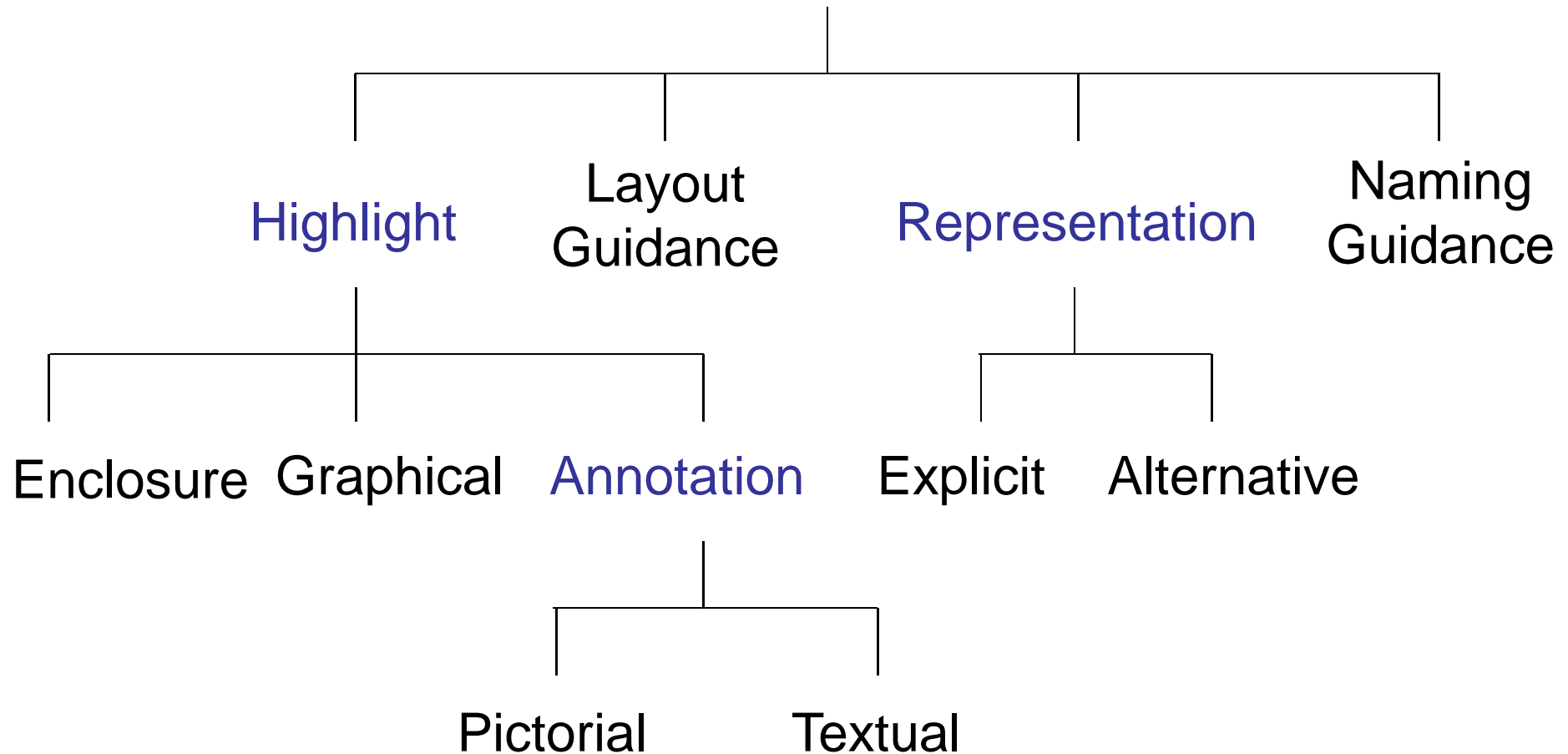
- Presentation patterns can be classified into:
  - Patterns that only affect the presentation of a model (i.e. its *concrete syntax*)
  - Patterns that may affect the storage of a model (i.e. may change its *abstract syntax*)

## Key publications:

- Marcello La Rosa, Arthur H.M. ter Hofstede, Petia Wohed, Hajo A. Reijers, Jan Mendling and Wil M.P. van der Aalst. [Managing Process Model Complexity via Concrete Syntax Modifications](#). *IEEE Transactions on Industrial Informatics*, 7(2):255-265, May 2011. (invited paper)
- M. La Rosa, P. Wohed, J. Mendling, A.H.M. ter Hofstede, H.A. Reijers, W.M.P. van der Aalst. [Managing Process Model Complexity via Abstract Syntax Modifications](#). *IEEE Transactions on Industrial Informatics*, accepted August 2011.



# Overview Concrete Syntax Patterns

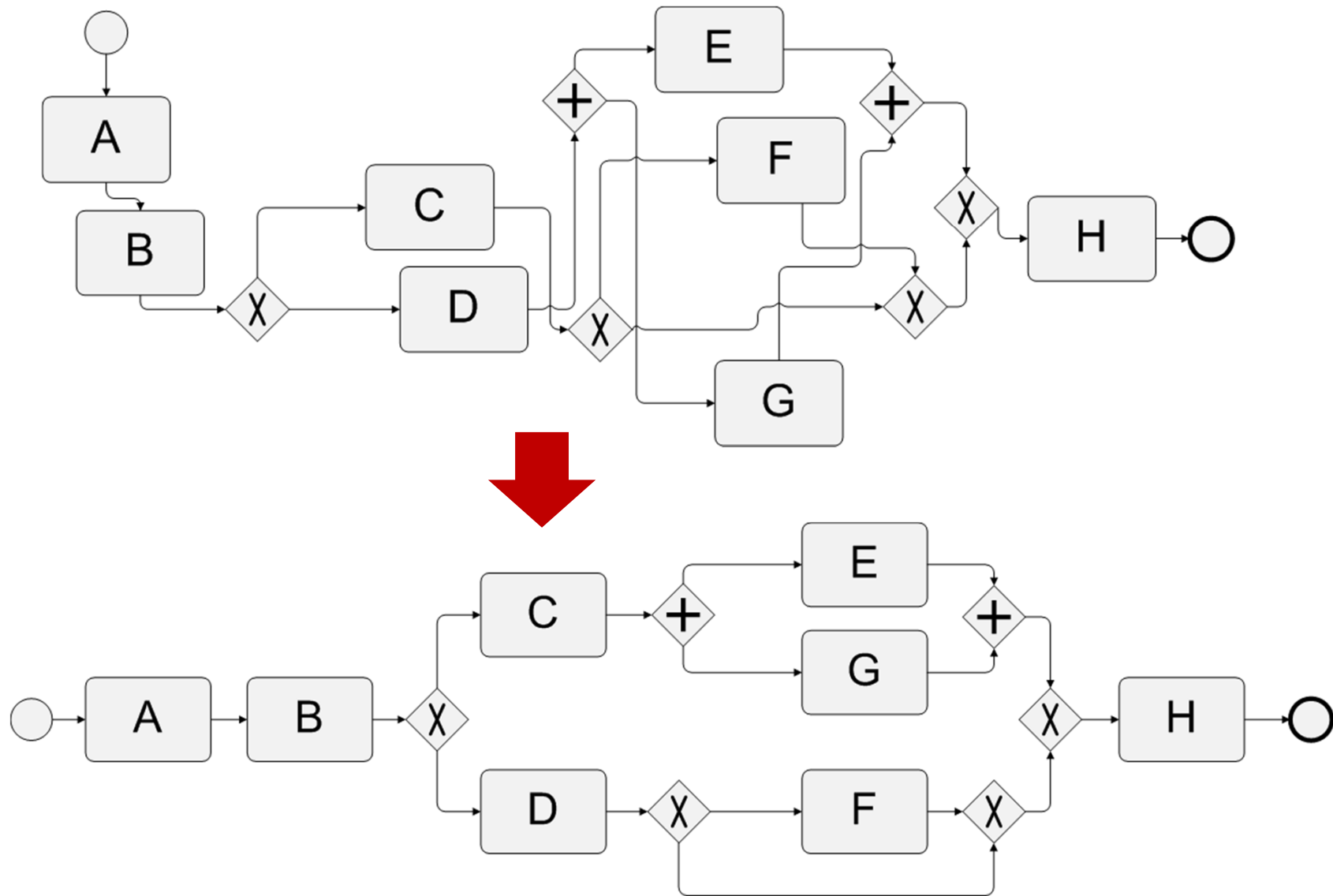


# Pattern CS 1: Layout Guidance



- Description
  - The availability of layout conventions or advice to organize the various model elements on a canvas. These include
    - indications on the orientation,
    - alignment and spacing of model elements in the 2D plane.
- Purpose
  - to reduce clutter,
  - especially in large process models or models that have undergone a number of updates.

# Pattern CS 1: Layout Guidance

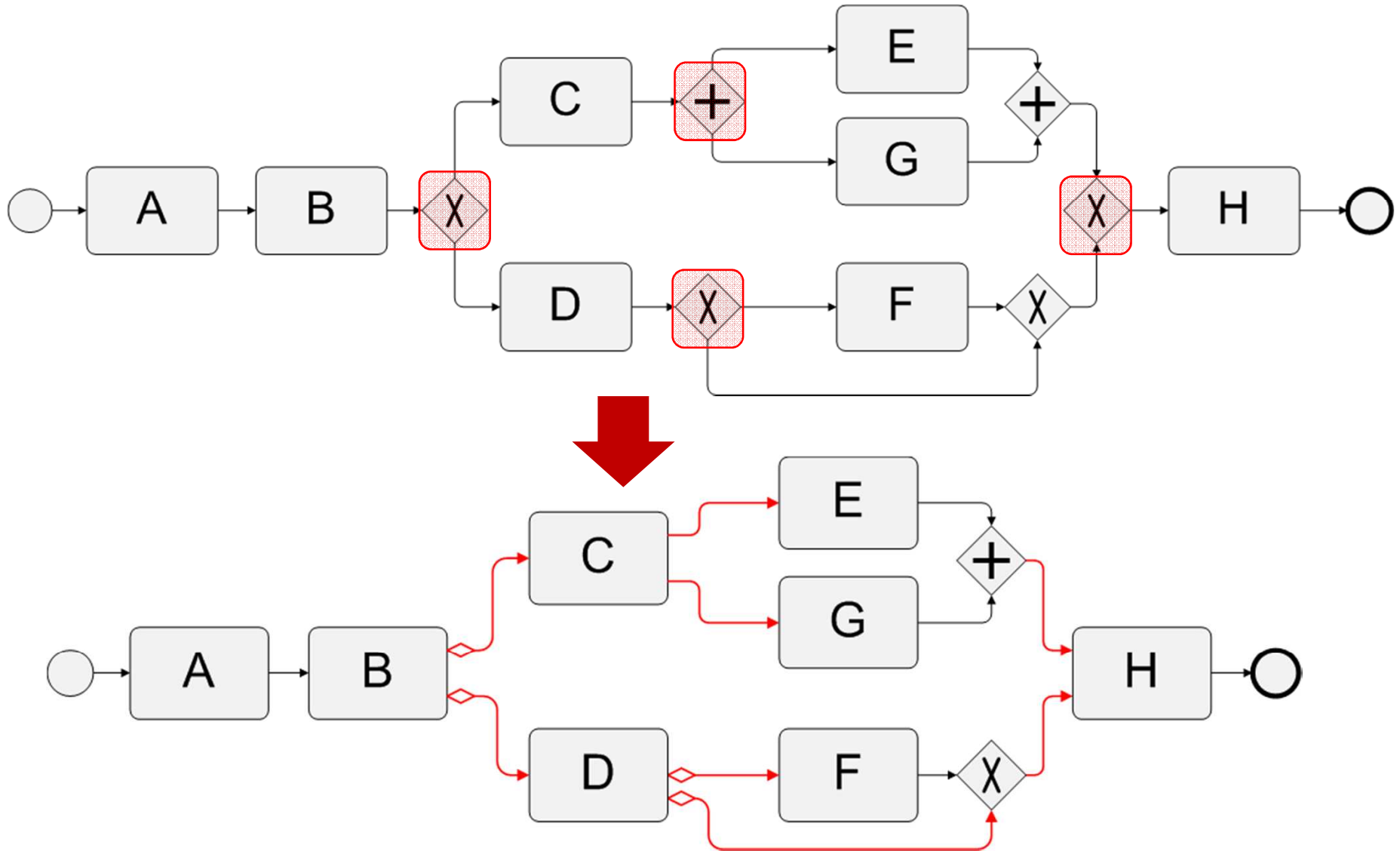


# Pattern CS 7: Alternative Representation

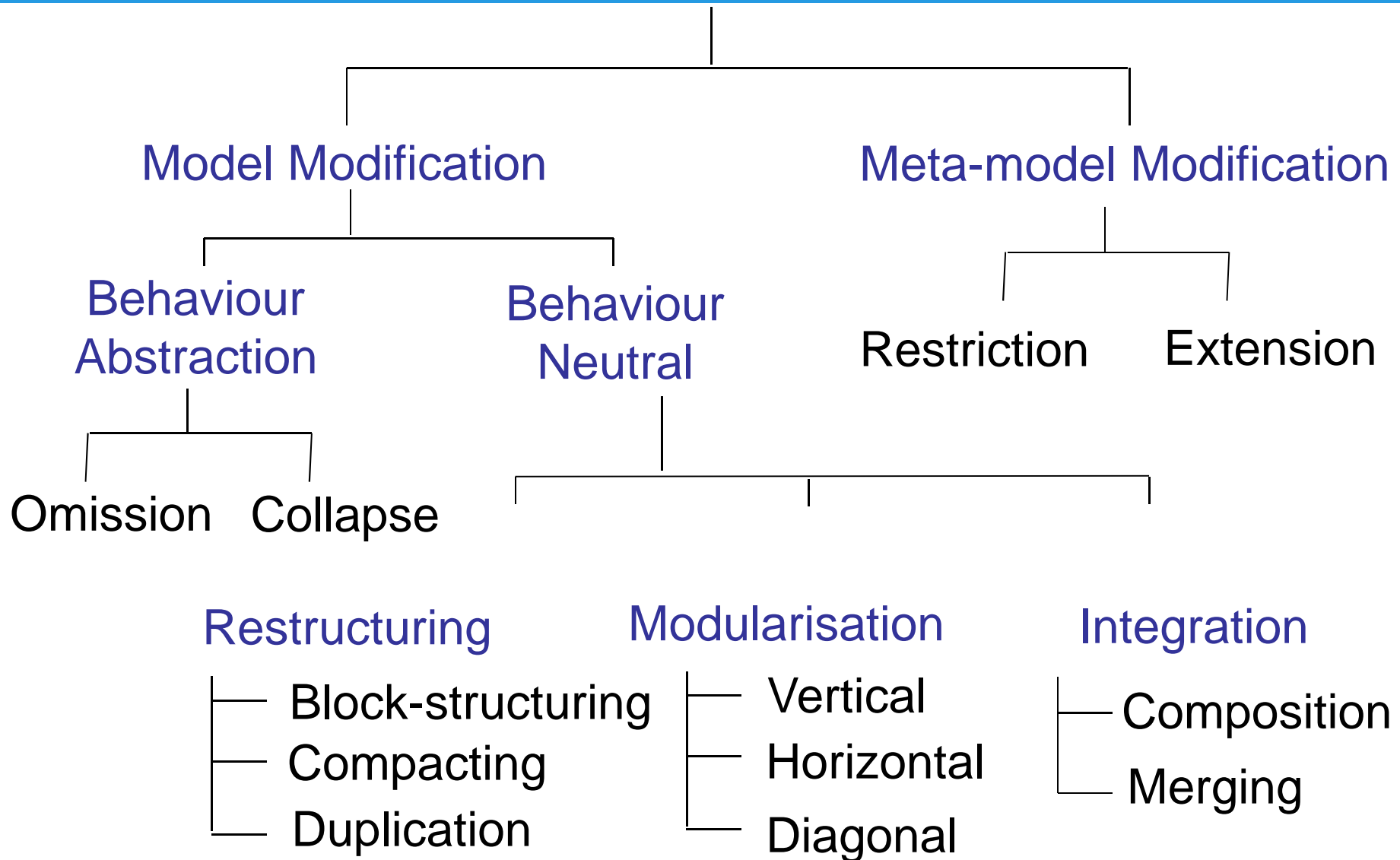


- Description
  - the ability to capture process modeling concepts without the use of their primary graphical notation.
- Purpose
  - to avoid cluttering and
  - potentially reduce model size, especially in large or complex models.

# Pattern CS 7: Alternative Representation



# Overview Abstract Syntax Patterns

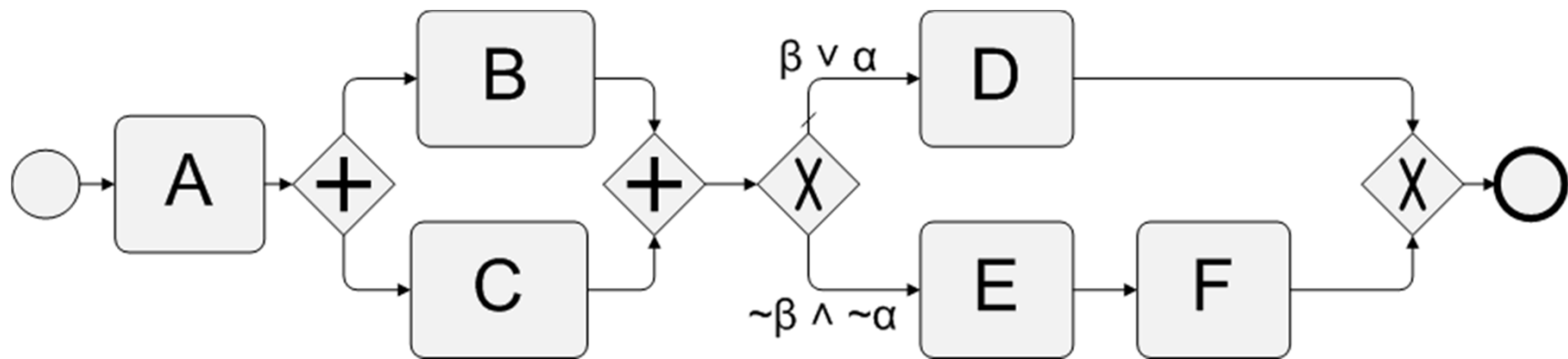
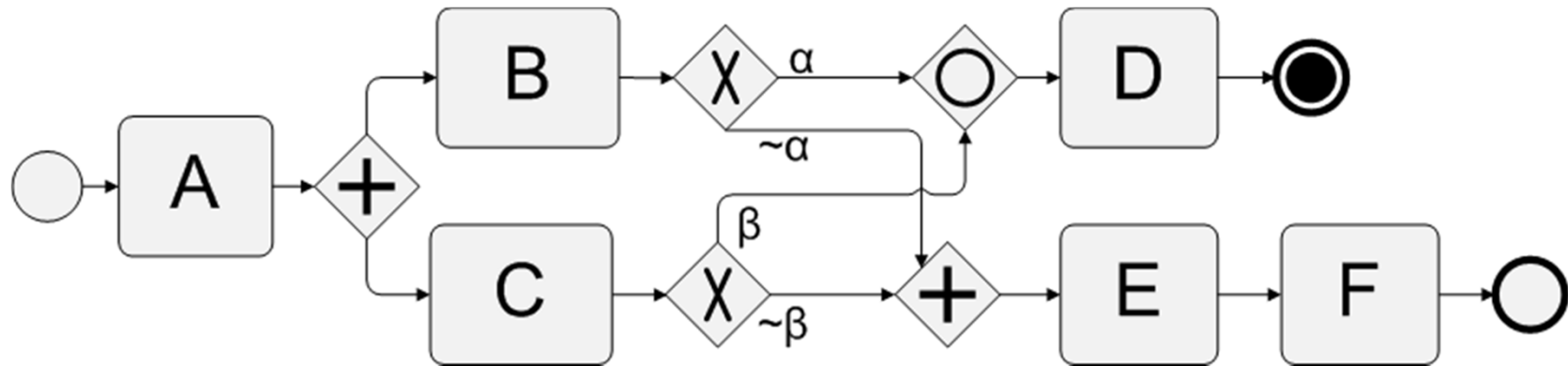


# Pattern AS 1: Structuring



- Description
  - This pattern refers to the availability of methods or algorithms to structure a process model in **blocks**.
  - In a block-structured process model, each split element has a corresponding join element of the same type, split-join pairs are properly nested, and loops have a unique entry and a unique exit point.
- Purpose
  - To increase structuredness in a process model

# Pattern AS 1: Structuring



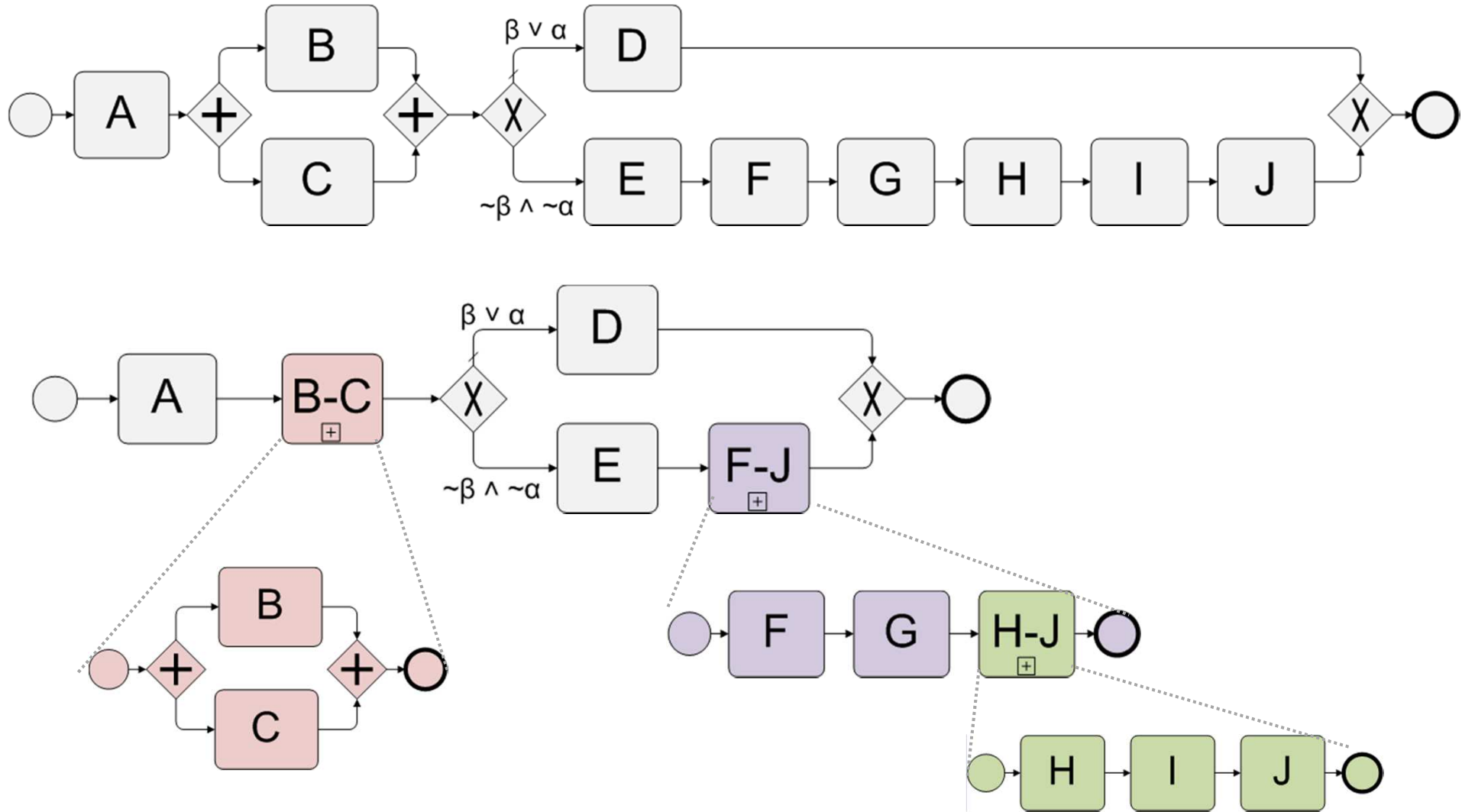


# Pattern AS 4: Vertical Modularization



- Description:
  - This pattern captures features to decompose a model in vertical modules, i.e. **sub-processes**, according to a hierarchical structure.
- Purpose:
  - To increase understandability of large process models by "hiding" process details into sub-levels.
  - To foster reuse by being able to refer to a sub-process from several places within the same process.
  - Models maintenance is also increased, as a change introduced in a sub-process is only reflected in one place.

# Pattern AS 4: Vertical Modularization

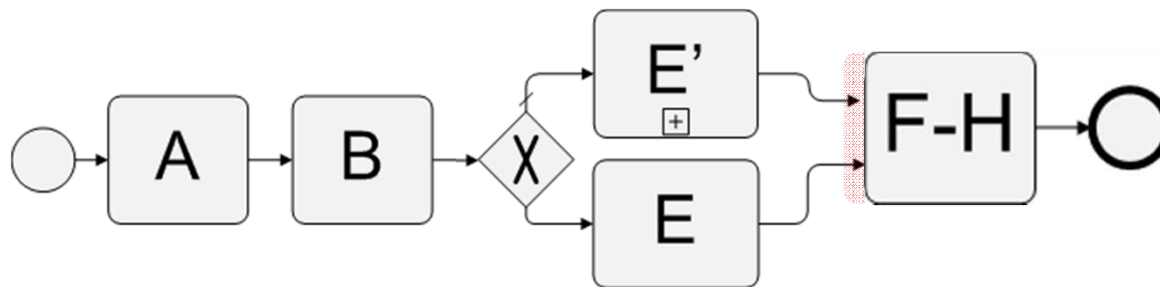
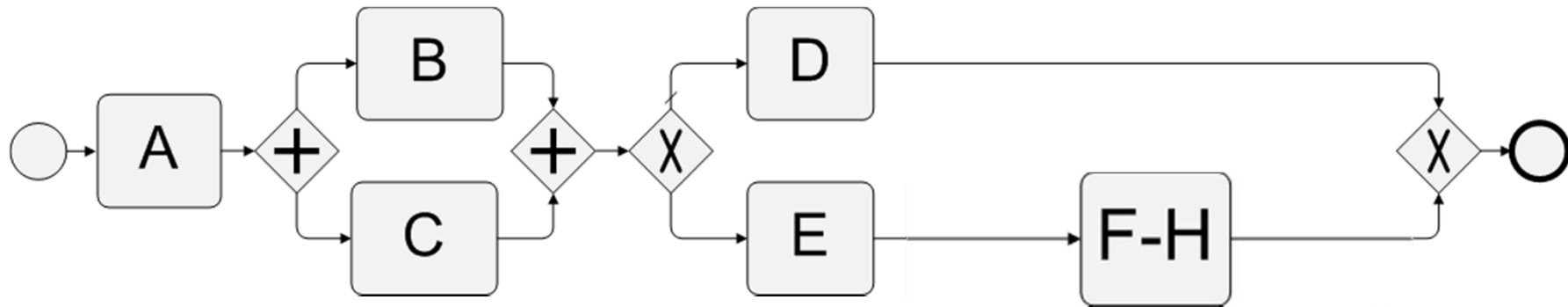


# Pattern AS 5: Horizontal Modularization



- Description:
  - Horizontal breakdown of a process model into multiple modules.
  - These modules can either be organized as **peer models** communicating via predefined protocols, or as **sequential** models.
- Purpose:
  - To enable distribution of responsibilities to different teams of users/developers (hence, facilitates collaboration).
  - To foster reuse of models in different constellations.

# Pattern AS 5: Horizontal Modularization

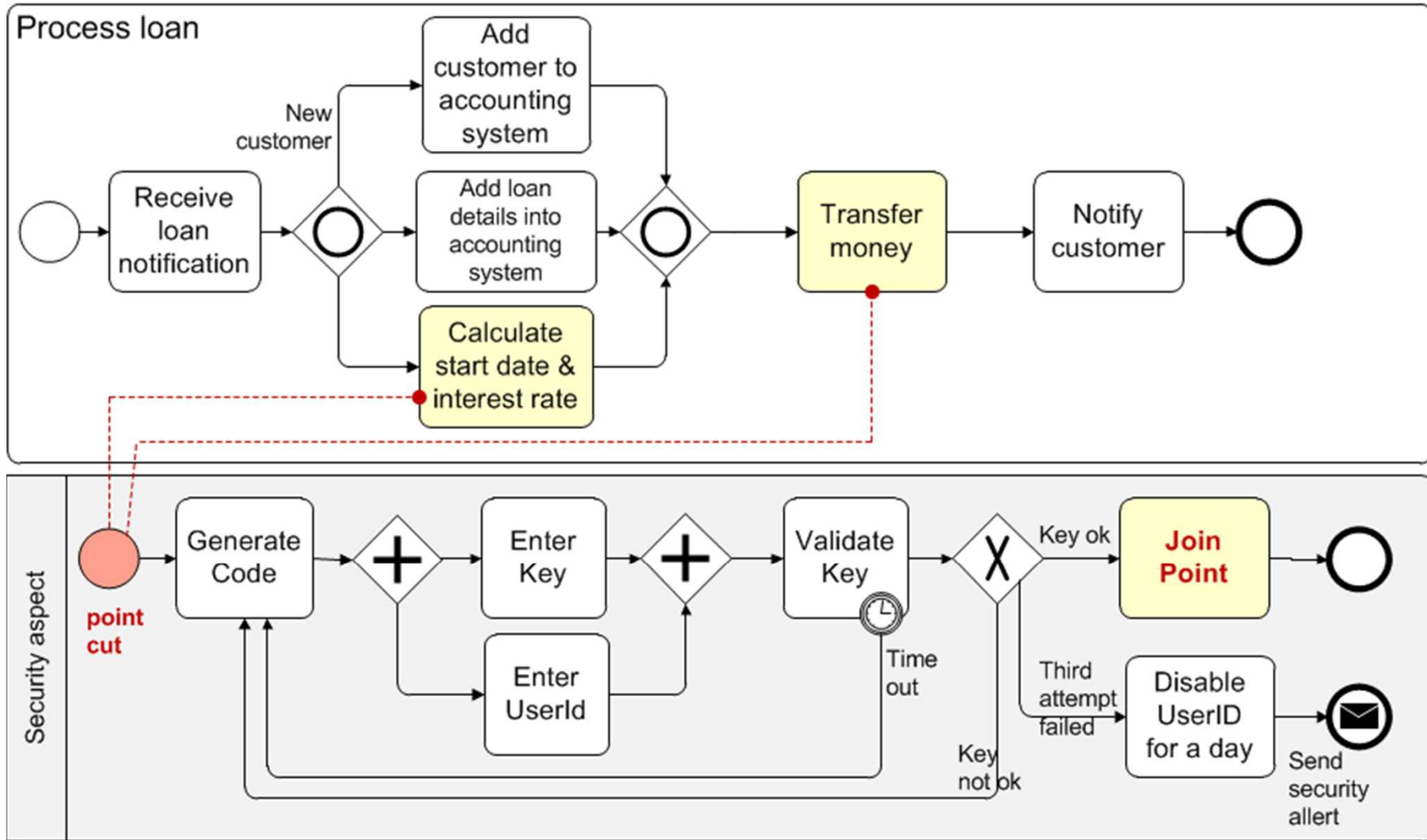


# Pattern AS 6: Orthogonal Modularization



- Description:
  - A decomposition along the **crosscutting concerns** of a modeling domain, which are scattered across several model elements or process models.
  - Examples of concerns are security, privacy and exception handling.
- Purpose:
  - To enable separation of concerns and facilitate maintenance of individual, concern-specific process models.

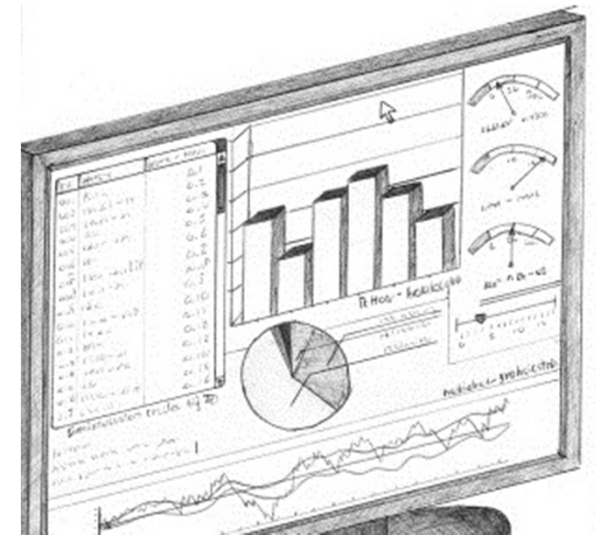
# Pattern AS 6: Orthogonal Modularization: Aspect orientation



# Intelligent Monitoring



- Dealing with large number of running cases
  - How to provide a meaningful overview?
    - E.g. worklist visualisation
    - (de Leoni, van der Aalst, ter Hofstede)
  - How to highlight potential problems?
  - How to predict potential problems?
    - E.g. recent work on case completion time predictions
      - B. van Dongen, R. A. Crooy, and W.M.P. van der Aalst, Cycle Time Prediction: When Will This Case Finally Be Finished? Proceedings of CoopIS 2008, OTM 2008, Part I. LNCS vol. 5331, pp. 319-336, Springer, 2008.
      - W.M.P. van der Aalst, M. Pesic, and M. Song. Beyond Process Mining: From the Past to Present and Future. Proceedings of CAiSE 2010, pp. 38-52, Springer, 2010.
      - W.M.P. van der Aalst, M.H. Schonenberg, and M. Song. Time Prediction Based on Process Mining. Information Systems 36(2): 450-475, 2011.
  - How to escalate appropriately?



# Intelligent Monitoring Sample Research



- Visualisation of current work items and resources on maps
- Maps may be any type of map (e.g. geographical map, timeline, Gantt chart, organisational hierarchy etc)
- Distance metric
  - Determines the degree of closeness to a work item (can be familiarity, urgency, geographical distance, etc)
  - Independent of the map chosen!!
- Challenge: How to scale properly?

*Key publication:*

*Massimiliano de Leoni, Wil M.P. van der Aalst, Arthur H.M. ter Hofstede.  
Visual Support for Work Assignment in Process-Aware Information Systems.  
Proceedings of BPM 2008, Milan, Italy, pages 67-83. Springer Verlag.*



# Geographical Map I



Configuration Layers visualization

Brisbane Assess objects Disaster Management

Available metrics: Familiarity Zoom Update

Other work-items:

Case Id	Task Id	Task Description	Enablement time
190	Take_Photos_4	Take Photos	Mar:19 15:31:23



# Geographical Map II



Configuration Layers visualization

Brisbane Assess objects Disaster Management

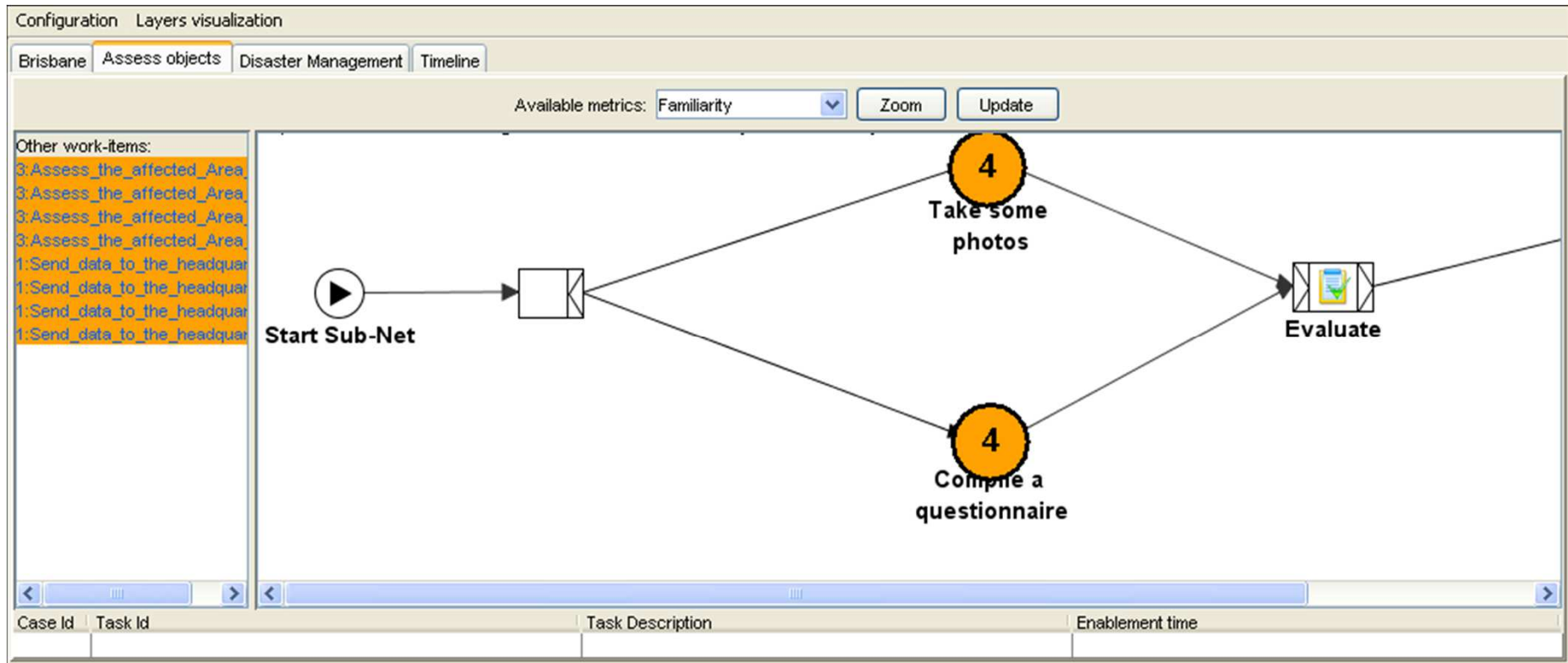
Available metrics: Familiarity Zoom Update

Other work-items:

Case Id Task Id Task Description Enablement time

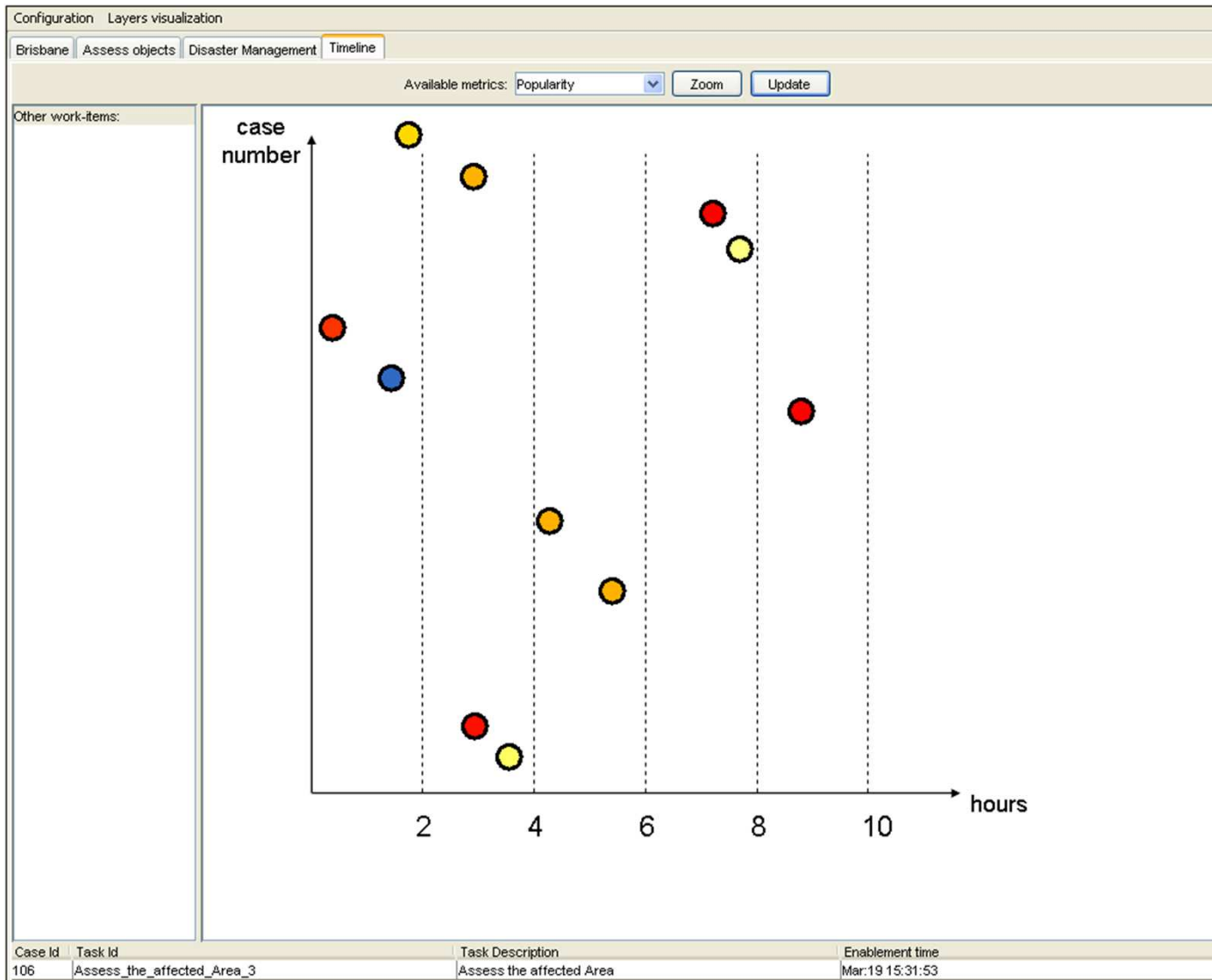
190	Take_Photos_4	Take Photos	Mar:19 15:31:23
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# The Process Model as a Map

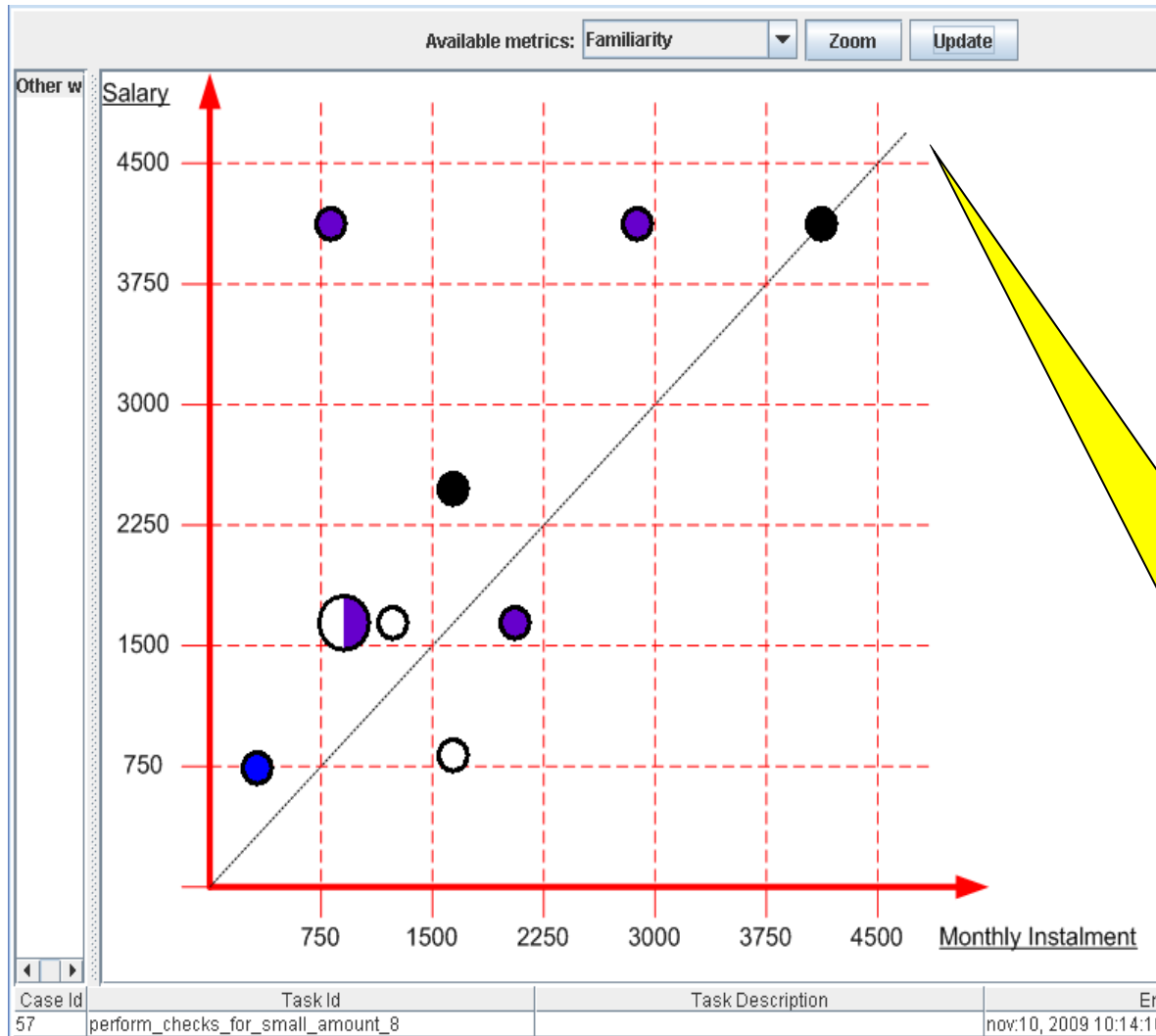




# Deadlines



# Bank Loans



- Application process for bank loans.
- Maps can visualise work items involving loan applications with more chances to be accepted .

Work items under line  $y = x$  refer to applications that should have less chance of being accepted.

# Movies of Process Histories



- Logs contain valuable information about the execution of process models
- Visualisation is a powerful tool that humans use for understanding
- Idea: can we make a movie out of a process log?

## *Key publication:*

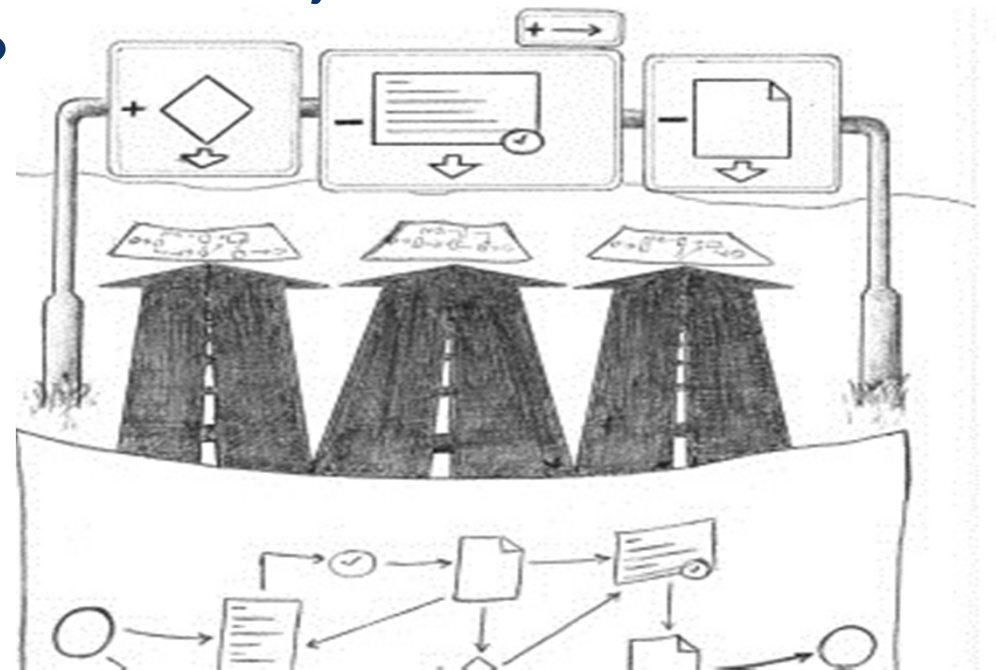
*Wil M.P. van der Aalst, Massimiliano de Leoni, Arthur H.M. ter Hofstede: Process Mining And Visual Analytics: Breathing life into business process models.*

*In: Alexandru Floares (Ed.), Computational Intelligence. Hauppauge, NY, USA. Nova Science Publishers, Inc (to appear). See also BPM Center Report BPM-11-16.*

# Business Process Improvement



- “as-is”-models vs “to-be”-models
- “Devil’s Quadrangle” (N. Brand and H. van der Kolk. Workflow Analysis and Design. Kluwer Bedrijfswetenschappen, 1995 (*in Dutch*))
  - Cost, Time, Flexibility, Quality
- Foundational research by Hajo Reijers (LNCS book in 2003) – most recently PhD thesis by Mariska Netjes
- How to generate alternatives?
  - art rather than a science
- How to choose to-be-model?
- Techniques:
  - Simulation
  - Analytical approach (e.g. genetic algorithms)



# Sample Research: Automated Error Correction



- Much research has been conducted in the area of process model verification, particularly determining soundness
- An open problem has been how to correct a model that is not sound
- Challenge: how to preserve user intentions?
- Clearly a “fuzzy” approach is required
- Simulated annealing turns out to be a promising approach

## *Key publication*

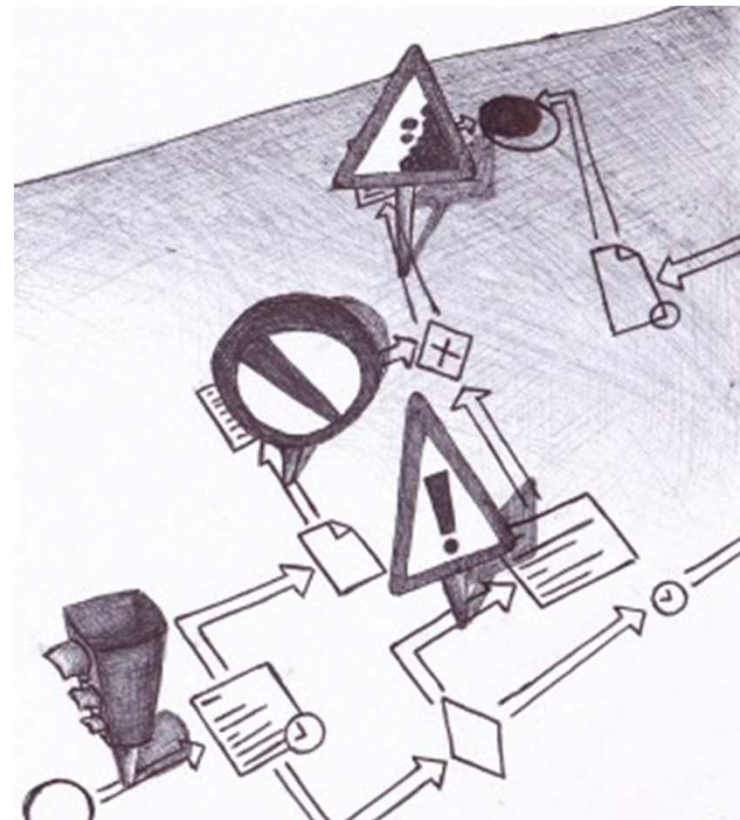
*Mauro Gambini, Marcello La Rosa, Sara Migliorini, and Arthur H.M. ter Hofstede. Automated Error Correction of Business Process Models. Proceedings of the 9th International Conference on Business Process Management, Clermont-Ferrand, France, 2011. Springer Verlag.*



# Process Annotation



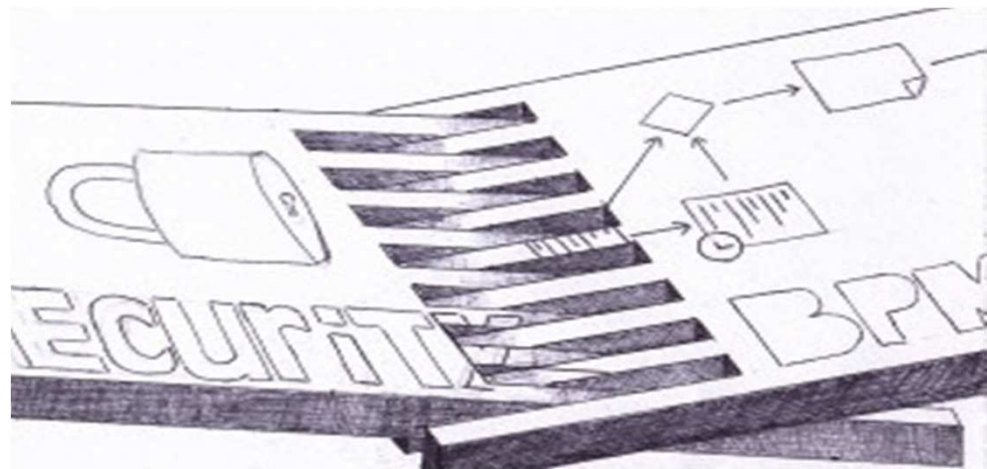
- Process Modeling concepts have more or less crystalized
- Can we exploit the increased scope of BPM to connect to other areas, e.g.
  - Risk management
  - Knowledge management
- Can we gather more information beneficial for organisational decision making, e.g.
  - Cost
  - Goals
- How can annotations influence process executions?
- How can they be mined?



# Security



- Security covers a broad spectrum of issues ranging from technological considerations to policy considerations
- With the increased uptake of BPM, new areas may impose their own security requirements, e.g.
  - Healthcare domain (privacy, trust)
  - Military applications (confidentiality, availability)
  - Social networks (privacy)



# Sample research: Privacy in Healthcare

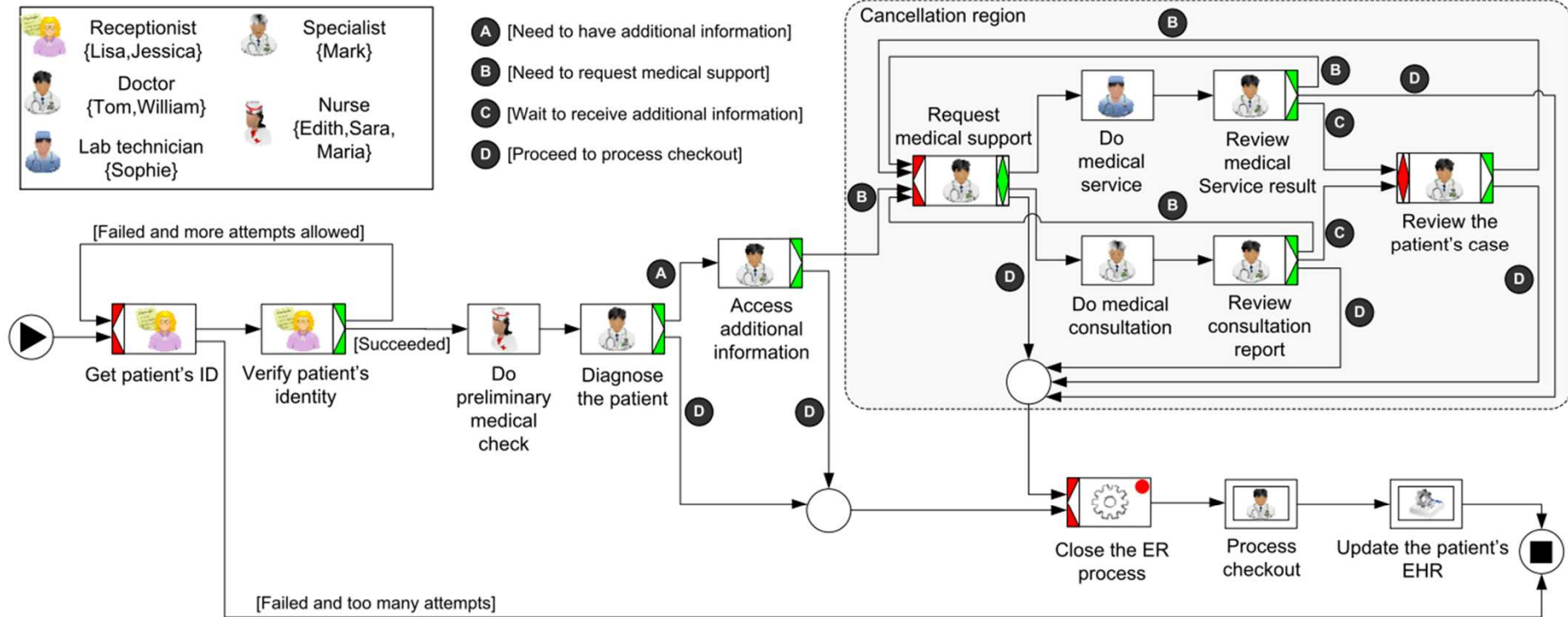


- How to manage privacy considerations irt medical data in a workflow setting?
  - How to present medical data? (e.g. hide, generalise)
  - How to allocate work? (e.g. avoid conflict of interest)
  - Access to externally stored privacy policies (direct support for pull patterns)

## *Key publication:*

*B. Alhaqbani, M. Adams, C. Fidge, and A.H.M. ter Hofstede. [Privacy-Aware Workflow Management](#). BPM Center Report BPM-09-06, BPMcenter.org, 2009.*

# A Sample Process Model: Hospital Emergencies



# Not Showing Sensitive Data



Verify Patient Information

Patient\_ID\_is\_Verified:

Patient\_ID\_does\_not\_belong\_to\_the\_patient:

PersonalInformation

Name: Frank Thomas

Address: 10 Apps Street, Land, NSW 2099

Sex: Male

MaritalStatus: Married

BloodType: O+

DateOfBirth: 23/06/1965

DataOfBirth: only shown to Lisa

(a) Frank's form as presented to Jessica

(b) Frank's form as presented to Lisa

## Frank's Personal Information Form

# Showing More General Data



William sees the diagnosis “Chlamydia”, while Tom sees the more general diagnosis “Bacterial infection”

Field	William's View (a)	Tom's View (b)
Date	10/04/2007	10/04/2007
Diagnosis	Chlamydia	Bacterial infection
Medication 1		Azithromyein
Medication 2		Panadol
Symptom		Lower abdominal pain

(a) Frank's form as presented to William

(b) Frank's form as presented to Tom

## Frank's Medical History Form

# Connections to other types of systems



- Knowledge Management Systems
  - Use of organisational memory
  - Updating of organisational memory
- Scheduling Systems
  - For example:
    - Scheduling operations in a hospital (Perikles project, GECKO, Germany)
    - Plant maintenance management
- Calendar Systems
  - Resource availability
  - More advanced scheduling of work (incl. location-awareness)



# Sample Research: PLM

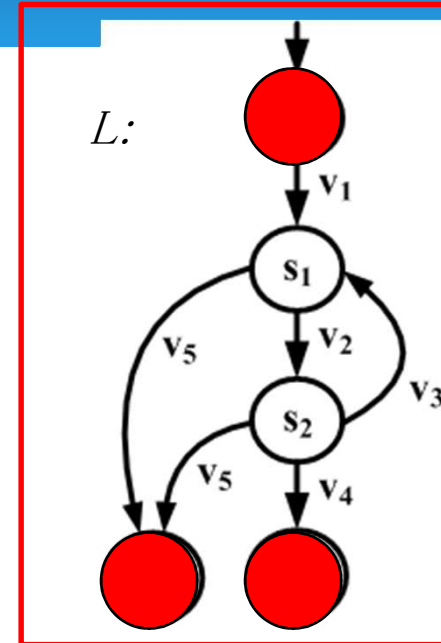
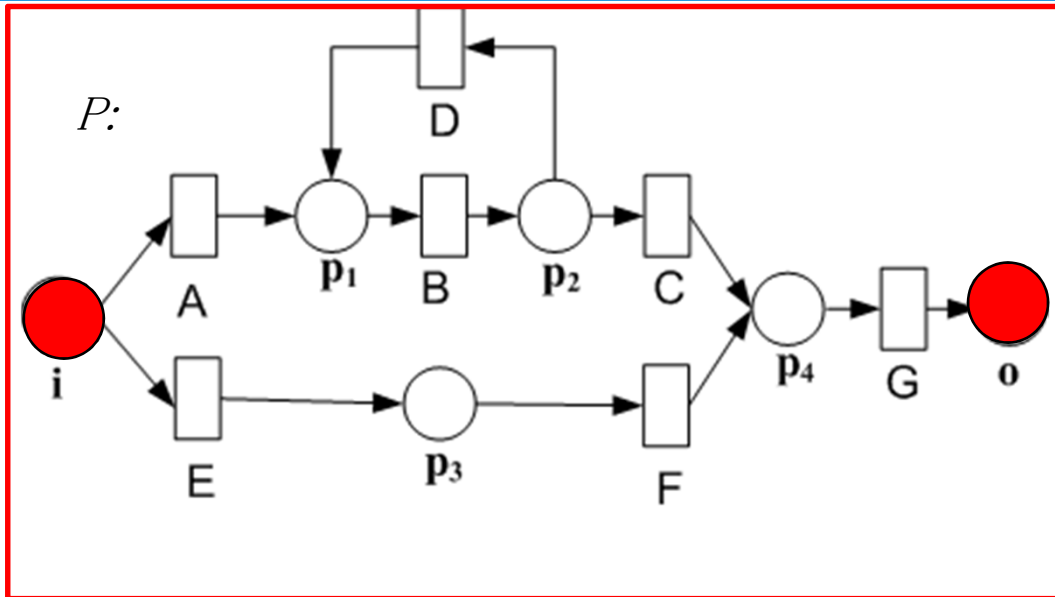


- Product Lifecycle Management (PLM)
- Managing versions of design objects through object lifecycles
- Workflow management provides support for the design process
- Tasks have associated privileges, notably execution of versioning operations
- How can correctness between object-lifecycles, workflows, and privileges be guaranteed?

*Z. Wang, A.H.M. ter Hofstede, C. Ouyang, M. Wynn, J. Wang, X. Zhu.  
[How to Guarantee Compliance between Workflows and Product Lifecycles?](#) BPM Center Report BPM-11-10, BPMcenter.org, 2011.*



# Consistency between PLM lifecycles, workflows and workflow annotations

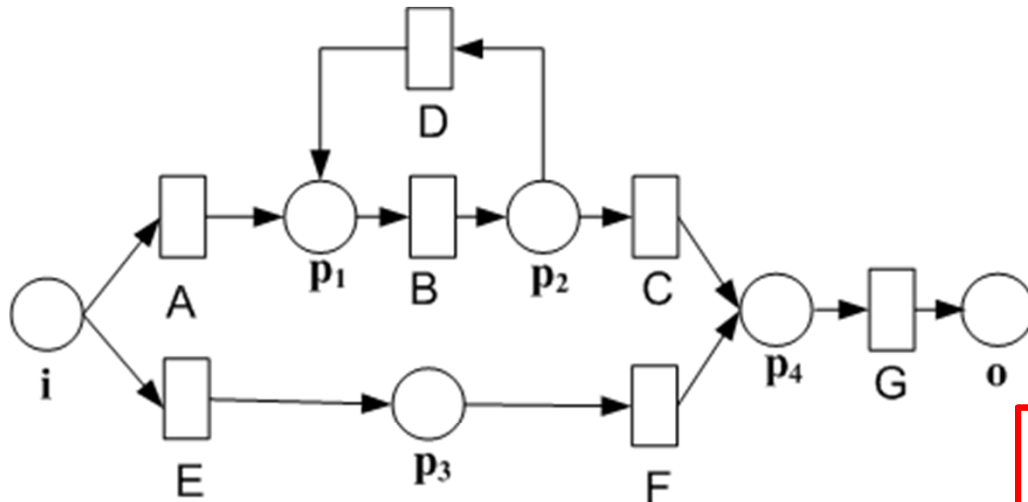


- Marking of VWF-net ( $M, s$ )
- Initial marking of VWF-net ( $M_0, s_0$ )
- Final marking of VWF-net ( $M_f, s_f$ )

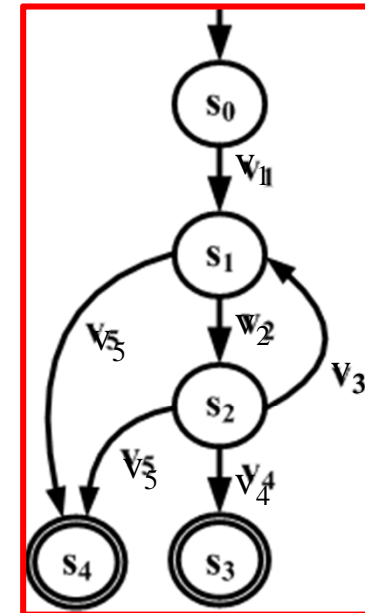
## Versioning Annotations

Task	version operations	state pairs
A, E, F	null	null
B	$\{v_1, v_2\}$	$\{(s_0, s_2)\}$
C	$\{v_2, v_3\}$	$\{(s_2, s_2)\}$
D	$\{v_4, v_5\}$	$\{(s_2, s_3), (s_2, s_4)\}$

# Approach - Syntactical compliance



$\{v_1, v_2, v_3, v_4, v_5\}$

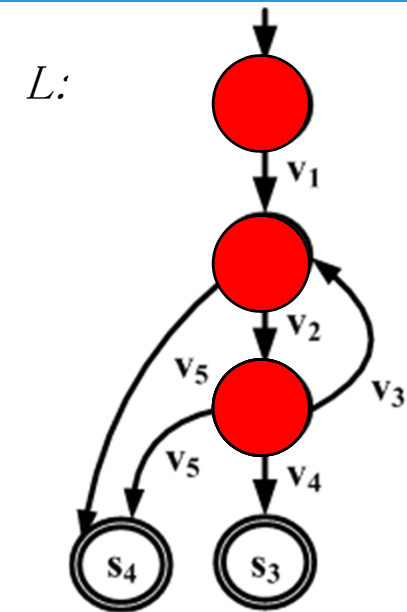
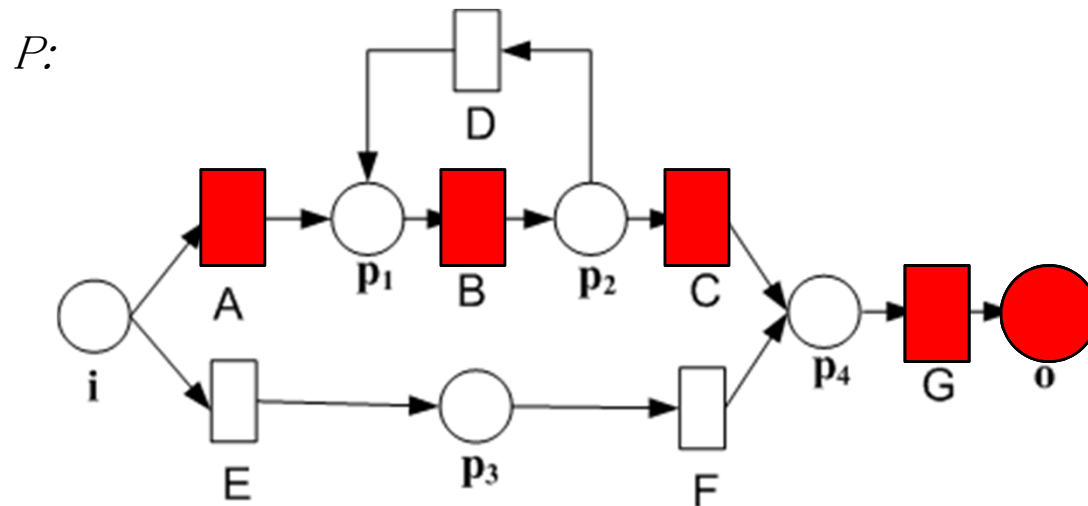


- Empty annotation consistency
- **Version operation assignment completeness**
- Local object path existence
- No locally assigned dead version operation
- No dead object state transition
- Global object path existence

## Versioning Annotations

Task	version operations	state pairs
A, E, F	null	null
B	$\{v_1, v_2\}$	$\{(s_0, s_2)\}$
C	$\{v_2, v_3\}$	$\{(s_2, s_2)\}$
D	$\{v_4, v_5\}$	$\{(s_2, s_3), (s_2, s_4)\}$

# Approach - Behavioural compliance



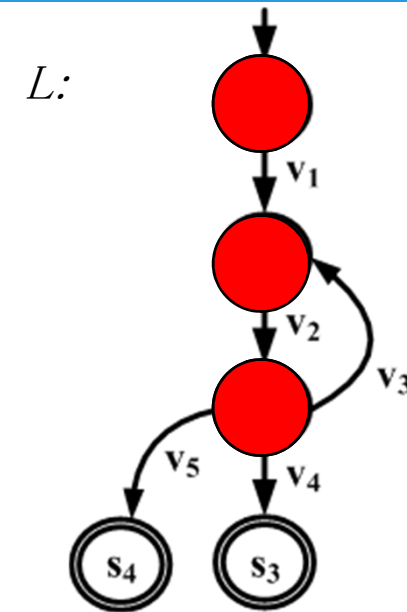
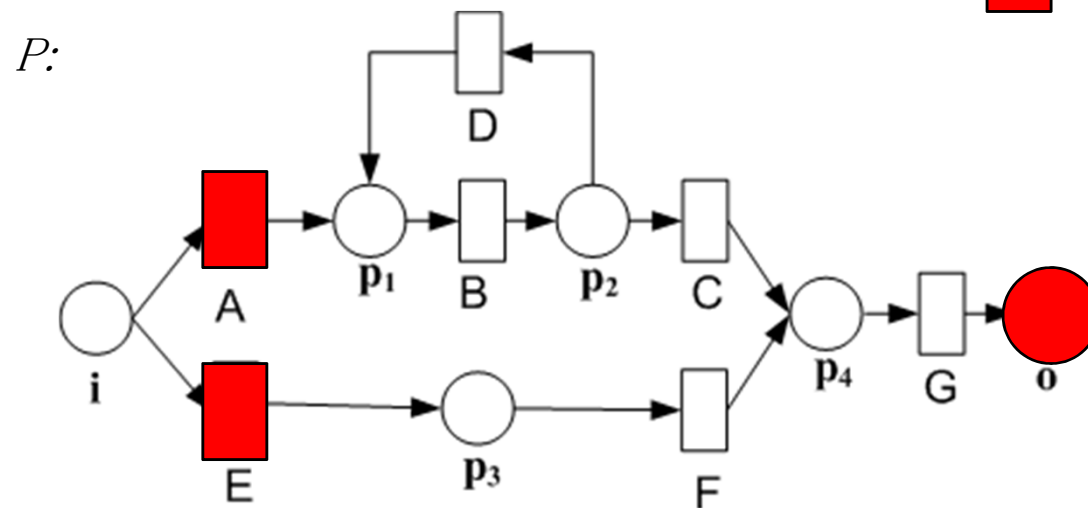
## Behavioural compliance:

- *Option to complete*
- *No dead tasks*
- *No unused versioning annotations*

### Versioning Annotations

Task	version operations	state pairs
A,D,E, F	null	null
B	{v <sub>1</sub> ,v <sub>2</sub> }	{{(s <sub>0</sub> , s <sub>2</sub> )}}
C	{v <sub>2</sub> ,v <sub>3</sub> }	{{(s <sub>2</sub> , s <sub>2</sub> )}}
G	{v <sub>2</sub> , <del>v<sub>2</sub></del> , <del>v<sub>3</sub></del> }	{{(s <sub>2</sub> , s <sub>3</sub> ), (s <sub>2</sub> , s <sub>4</sub> ), (s <sub>2</sub> , s <sub>2</sub> )}}

# Approach - Behavioural compliance



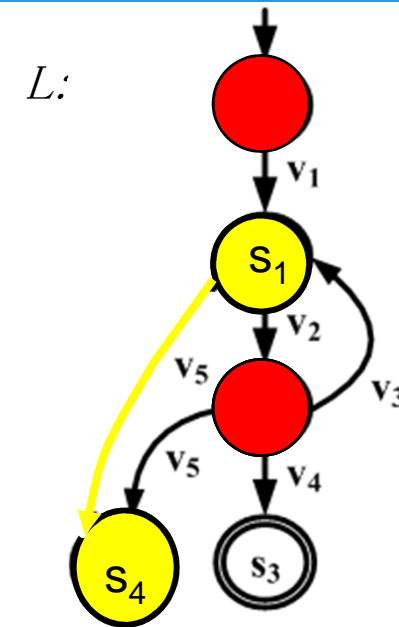
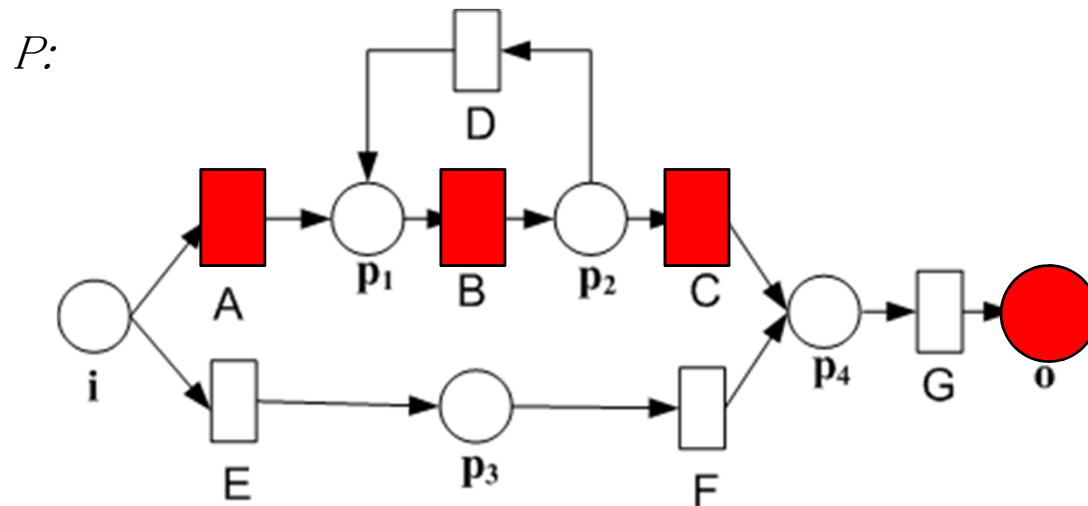
## Behavioural compliance:

- *Option to complete*
- *No dead tasks*
- *No unused versioning annotations*

## Versioning Annotations

Task	version operations	state pairs
A,C,D,E	null	null
B	$\{v_1, v_2\}$	$\{(s_0, s_2)\}$
F	$\{v_2, v_3\}$	$\{(s_2, s_2)\}$
G	$\{v_4, v_5\}$	$\{(s_2, s_3), (s_2, s_4)\}$

# Approach - Behavioural compliance



## Behavioural compliance:

- Option to complete
- No dead tasks
- No unused versioning annotations

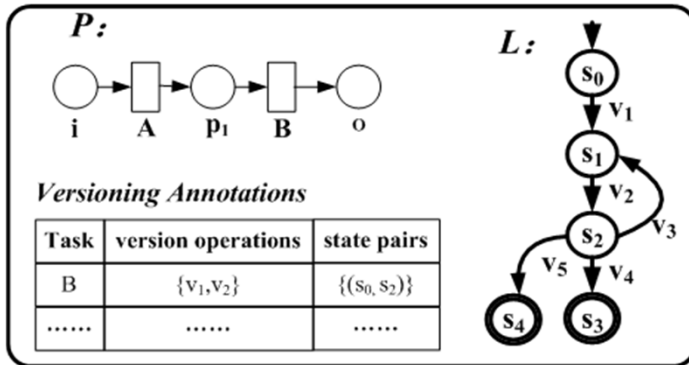
## Versioning Annotations

Task	version operations	state pairs
A,D,E, F	null	null
B	{v <sub>1</sub> ,v <sub>2</sub> }	{(S <sub>0</sub> , S <sub>2</sub> )}
C	{v <sub>2</sub> ,v <sub>3</sub> }	{(S <sub>2</sub> , S <sub>2</sub> )}
G	<b>{v<sub>4</sub>,v<sub>5</sub>}</b>	{(S <sub>2</sub> , S <sub>3</sub> ), (S <sub>2</sub> , S <sub>4</sub> ), (S <sub>1</sub> , S <sub>4</sub> )}

# Approach - Behavioural Compliance Checking

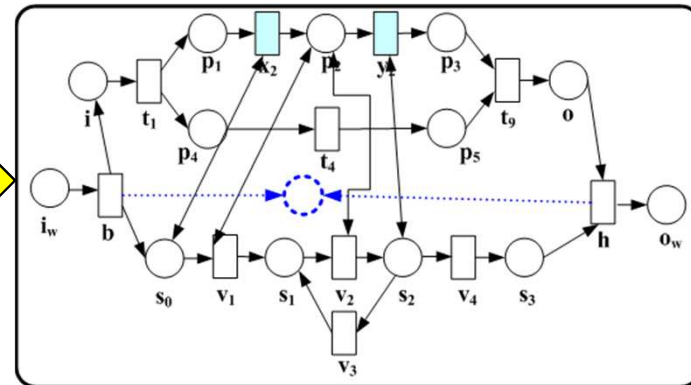


VWF-net:

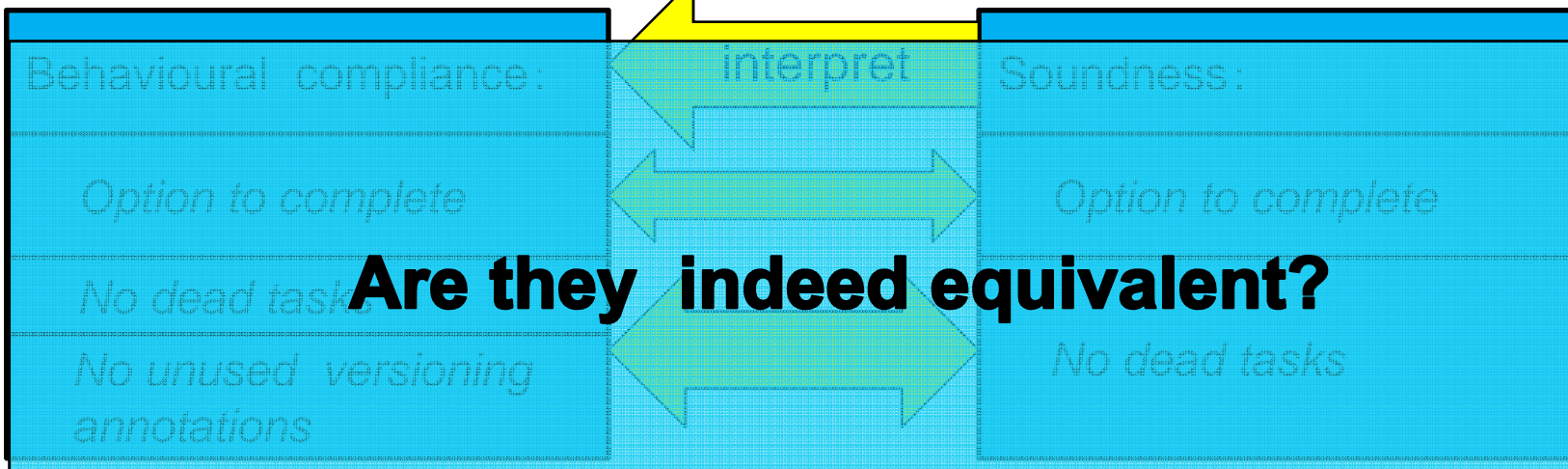


transform

WF-net:



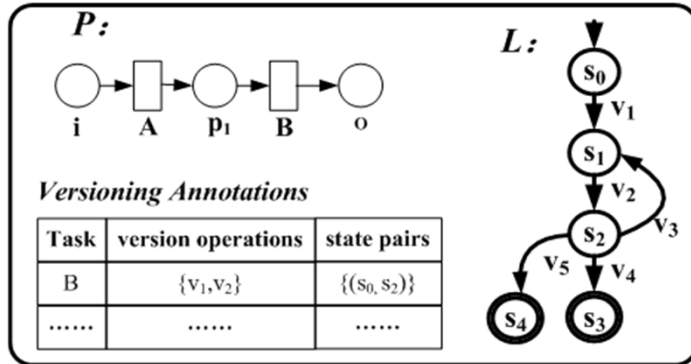
check



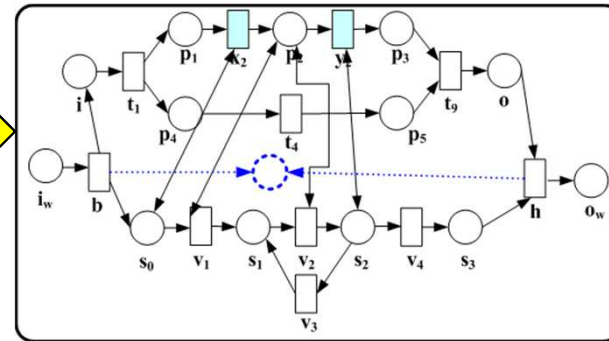
# Approach – Correctness Proof



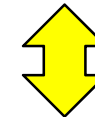
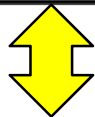
VWF-net:



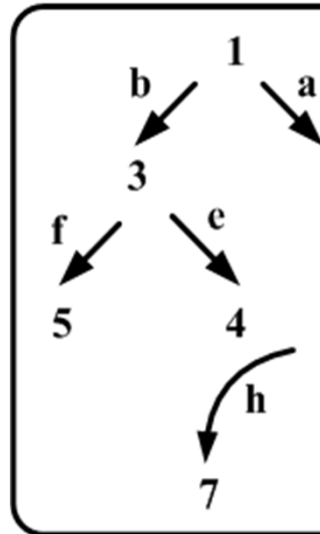
WF-net:



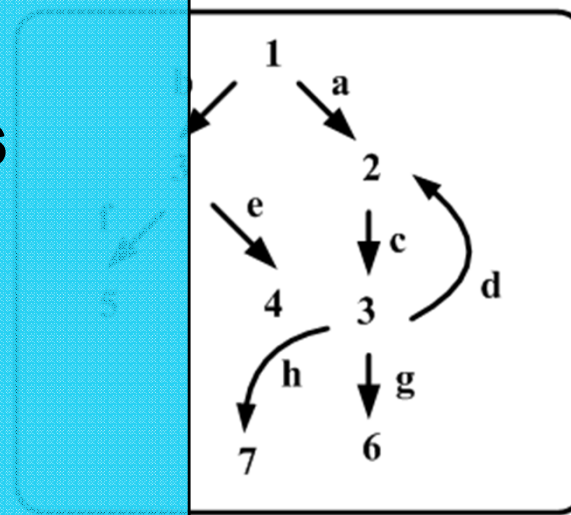
transform



*L<sub>VWF</sub>* (Labeled Transition System)



*L<sub>WF</sub>* (Labeled Transition System)



**4 Propositions**  
**9 Lemmas**  
**2 Theorems**

# Considerations for New Research



- Pick the “right” research problem
  - Proper trade-off between pay-off and amount of work required
  - Do not reinvent the wheel
  - Is it likely there would be interest from practice in this work, now or in the future?
  - Can the work be (properly) validated?
  - Consider your personal (or team) strengths (formal, empirical, conceptual, experimental, technological)
- Is your approach really practical?
  - Suitability vs expressiveness
  - Computational complexity
- Link to existing established approaches where possible
  - E.g. do not introduce your own new process modelling notation
  - Do not base yourself on an esoteric approach (use citation analysis to determine how established some work really is)
- Think of validation **before** you start the work



# Research Software Artifacts



- Software can be a valuable research artifact
- Open sourcing software has many benefits:
  - Increased chance of paper acceptance
  - Making impact
  - Receiving feedback
  - Achieving successful (international) collaboration
  - Getting help

# Research Software Artifacts



- There are a number of large open source software initiatives in BPM
  - Process Mining
    - ProM ([www.processmining.org](http://www.processmining.org))
  - Process Automation
    - YAWL ([www.yawlfoundation.org](http://www.yawlfoundation.org))
  - Process Modelling
    - Oryx ([oryx-project.org/](http://oryx-project.org/))
  - Large Process Model Repositories
    - AProMoRe ([www.apromore.org](http://www.apromore.org))
    - BeeHiveZ (<http://code.google.com/p/beehivez/>)

# Research Software Artifacts: Mining



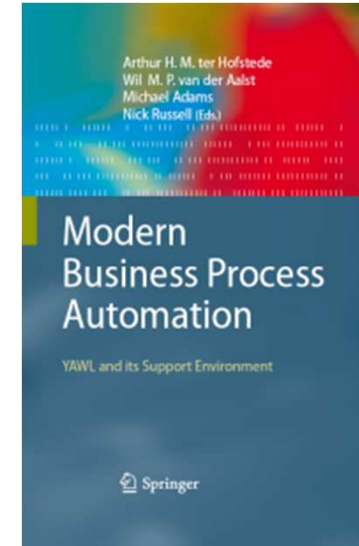
- ProM ([www.processmining.org](http://www.processmining.org))
- Real industrial/governmental applications
- Typical objectives
  - Process discovery
  - Conformance
  - Enhancement
- Framework approach
  - Easy to develop and maintain your own plug-ins
- Highly cited and widely used in academia
- Recent textbook by Wil van der Aalst (“Process Mining: Discovery, Conformance and Enhancement of Business Processes”, Springer 2011)
- Many international collaborators and contributors



# Research Software Artifacts: Automation



- YAWL ([www.yawlfoundation.org](http://www.yawlfoundation.org))
- Based on the well-known workflow patterns
- Formal foundation (CPN)
- Strong support for verification
- Strong support for flexibility
  - Dynamic workflow
  - Declarative workflow
  - Exception handling
  - Process Configuration
- Was/is used in teaching in at least 30 institutions
- Most cited paper in the journal *Information Systems*
  - 200+ citations in Web of Science
- Used in industry
- Considerable international collaboration
- Service-Oriented Architecture: extensions can be built as services



# Research Software Artifacts: Large Process Model Repositories - I



- AProMoRe ([www.apromore.org](http://www.apromore.org))
  - Many international collaborators
    - Queensland University of Technology (Australia)
    - Eindhoven University of Technology (The Netherlands)
    - Humboldt-University Berlin (Germany)
    - Hasso-Plattner Institut (Germany)
    - Tartu University (Estonia)
    - University of Grenoble (France)
    - Stockholm University (Sweden)
  - Generic process modelling format
  - Strong current support for BPMN and EPCs
  - Future support for YAWL, Petri nets, BPEL

# The Fact



- Enterprises in various industries tend to collect thousands of business process models over time:
  - Thousands of activities and related artefacts
  - Numerous stakeholders with different skills and responsibilities

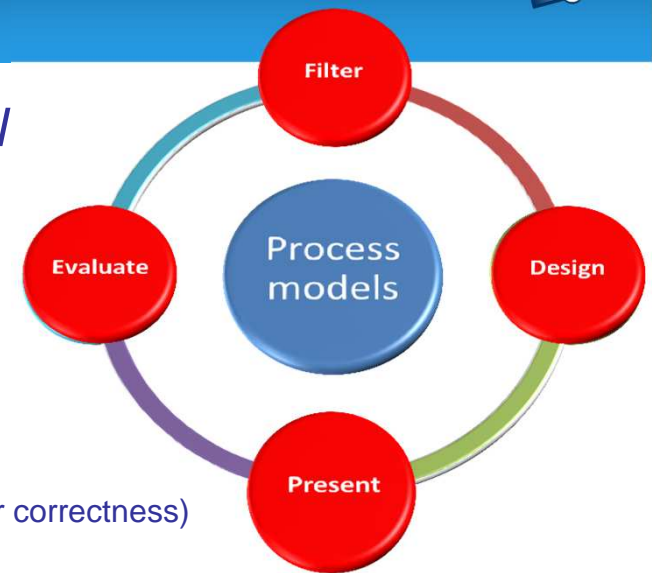


- Difficult to keep track of such volumes of models (*“model management”*), especially due to:
  - Overlapping content across models
  - Evolving content over time (legacy models vs. new versions)
  - Different modelling notations, e.g. EPCs, BPMN, Protos, BPEL...
  - Different modelling purposes and granularity
  - Different modelling guidelines

# Apromore's vision



Facilitating the management of *large process model collections*, by providing advanced features in the following service areas:



## Evaluation

establish adherence to various quality notions

(e.g. check your process compliance against established benchmarks or their correctness)

## Advanced Filtering

query for similarities or exact matches

(e.g. rank all your processes based on their similarity, query your repository for clones or approximate matches)

## Clever Design

control the creation and evolution of process models

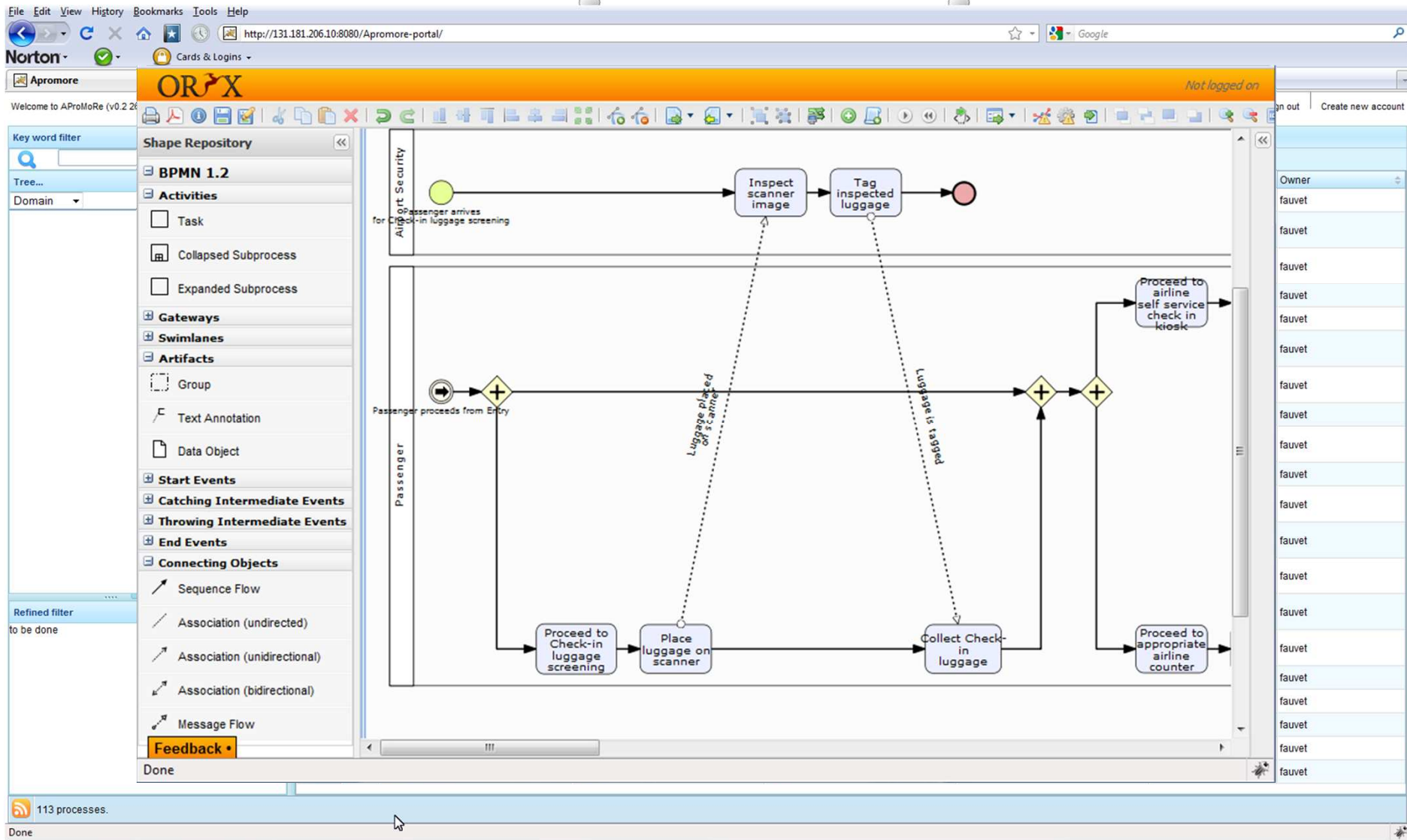
(e.g. create new processes by merging or configuring existing models, or improve them based on recommendations)

## Enhanced Presentation

improve the understanding of process models

(e.g. use colors, layouts or abstraction mechanisms to present your models to a given audience, or visualize contextual information)

# Architecture: SaaS over SOA



Meta-data...



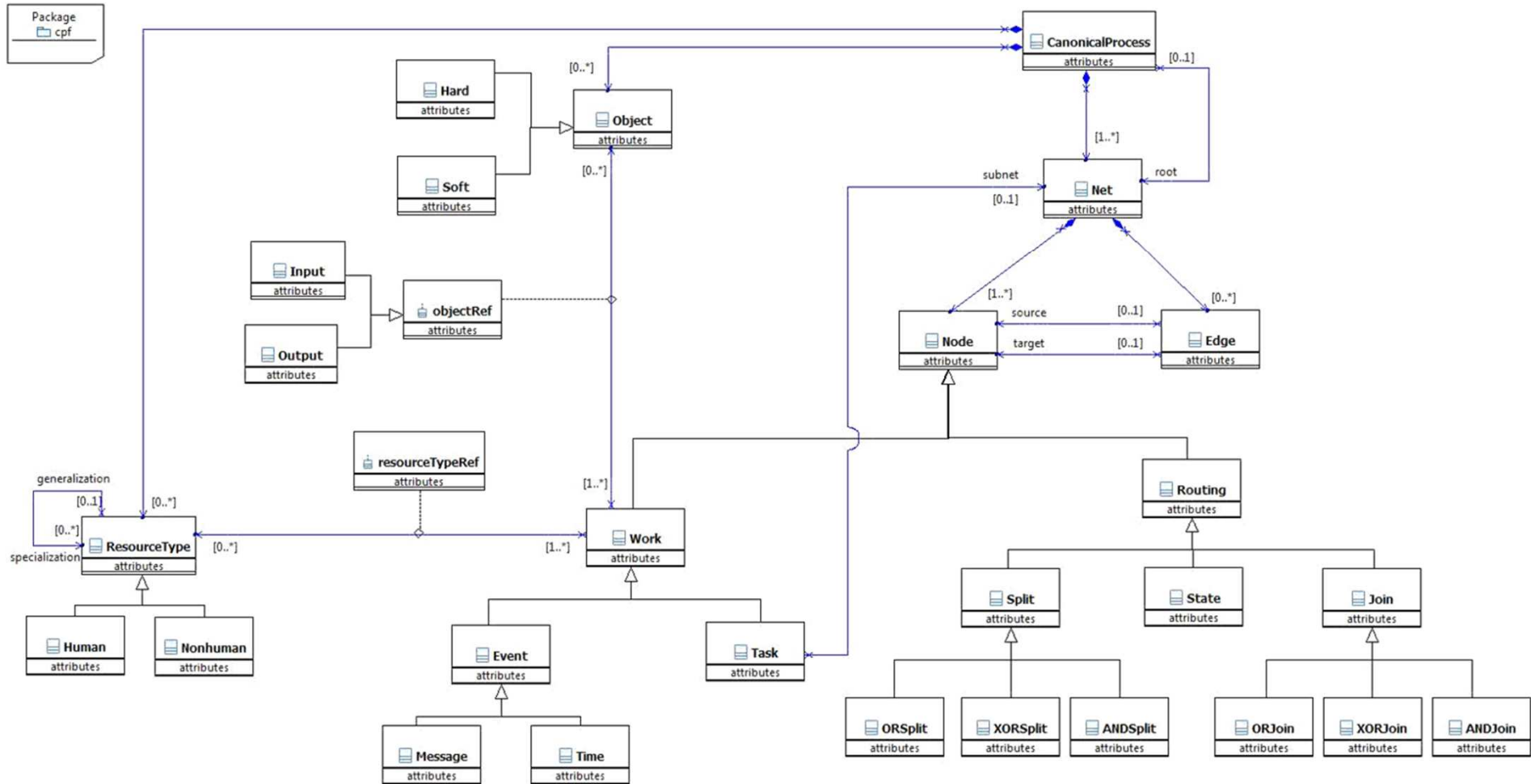
# Canonical format: the power of losing



Common process representation as **directed attributed graph**:

1. *Standardization* – cross-language operations can be performed directly and concatenated
2. *Interchangeability* – non structural aspects captured by meta-data → swap notations or semantics at (almost) no cost
3. *Flexibility* – inheritance mechanism → different algorithms can work at different abstraction levels

# Canonical format: a glimpse



# Conversion chart (excerpt)



Language	Concrete construct	Canonical representation
EPC	<p>(X)OR Connector</p> <p>Function</p> <p>Event</p>	<p>Work @: -&gt; A</p> <p>(X)ORSplit @: -&gt; P</p> <p>Edge @: -&gt; C<sub>1</sub></p> <p>Edge @: -&gt; C<sub>2</sub></p> <p>● = Node          → = Edge          -c<sub>x</sub> = Edge with attribute condition="c<sub>x</sub>"          @: = annotation          → = refers to [concrete element]</p>
BPMN	<p>Task</p>	<p>Work @: -&gt; A</p> <p>XORJoin @: -&gt; A<sub>J</sub></p> <p>ANDSplit @: -&gt; A<sub>S</sub></p> <p>A<sub>J</sub> = join behavior of A      A<sub>S</sub> = split component of A</p>
	<p>Conditional Flow</p> <p>Default Flow</p> <p>c<sub>x</sub> = Flow Condition</p>	<p>Work @: -&gt; A</p> <p>ORSplit @: -&gt; A<sub>S</sub></p> <p>(c<sub>3</sub>), default</p> <p>-default- = Edge with attribute default="true"</p>
WF-Net / Protos	<p>Transition / Activity</p>	<p>Work @: -&gt; A</p> <p>ANDJoin @: -&gt; A<sub>J</sub></p> <p>ANDSplit @: -&gt; A<sub>S</sub></p>
Protos	<p>c<sub>1</sub> c<sub>2</sub></p> <p>c<sub>3</sub> c<sub>4</sub></p> <p>c<sub>x</sub> = Connection Condition</p>	<p>Work @: -&gt; A</p> <p>(X)ORJoin @: -&gt; A<sub>J</sub></p> <p>(X)ORSplit @: -&gt; A<sub>S</sub></p> <p>Note: the type of split and join (XOR or OR) can be determined only if this is explicitly set in a Protos Activity</p>
YAWL	<p>AND-join OR-split</p> <p>Task</p> <p>c<sub>1</sub> c<sub>2</sub></p> <p>c<sub>x</sub> = Flow Predicate</p>	<p>Work @: -&gt; A</p> <p>ANDJoin @: -&gt; A<sub>J</sub></p> <p>ORSplit @: -&gt; A<sub>S</sub></p>





- BPM is an exciting field
  - Strong academic interest
  - Potential to make real impact in industry
  - Scope for fundamental and applied research
- While its foundations have (more or less) crystallised, there are many research possibilities
- Many interesting challenges arise from the scale of process modelling efforts in large Chinese corporations
- Try and align yourself with main initiatives and build links with established groups
- The first Chinese BPM conference provides an opportunity to build a strong network of researchers interested in BPM
  - *Use this opportunity!*

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## Questions?

