

HUMBOLDT-UNIVERSITÄT ZU BERLIN



Action Patterns in Business Process Models

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Agenda

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- Motivation
- Preliminary Concepts
- Co-occurrence action patterns
- Behavioral action patterns
- Evaluation with SAP Reference Model
- Conclusion

Motivation (I)

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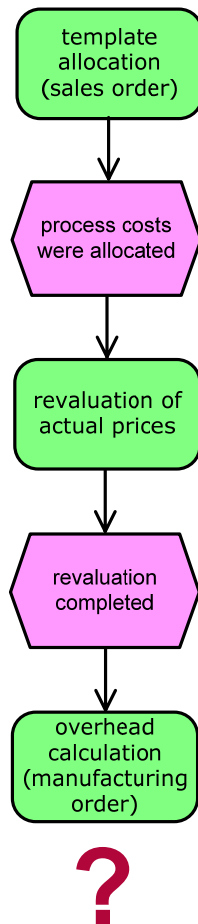
In enterprises the modelers are of different skills and backgrounds.

An enterprise often maintains a large repository of process models.

An important problem is to assure the high quality of process models.

Motivation (II)

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One aspect of process model quality is if the model is complete from a business point of view. An example question is if all actions typically appearing in this business process present in the current model.

How to suggest the modeler which model elements are missing in the designed model from a perspective of business semantic?

Idea!

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Let us derive information for user support from existing models ...

... and capture it in **action patterns** – groups of actions which often appear together in business processes.

Actions in Process Models

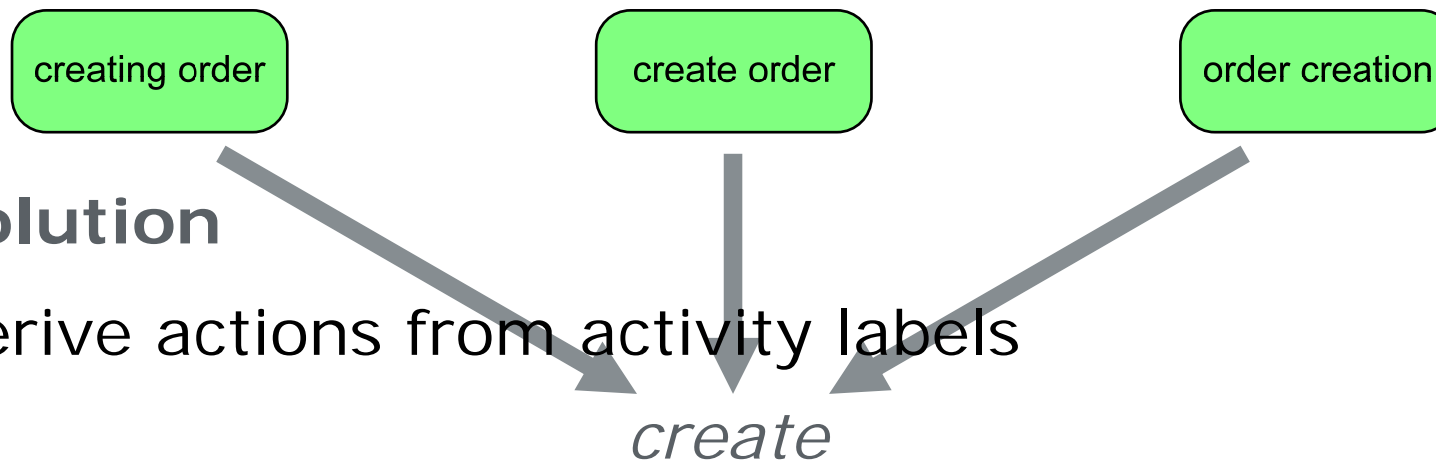
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Observation

Labels of model element capture the process business semantics.

Challenge

Several labels capture similar meaning

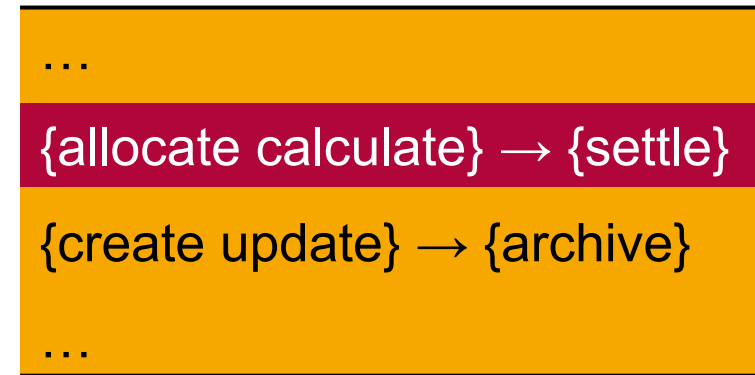
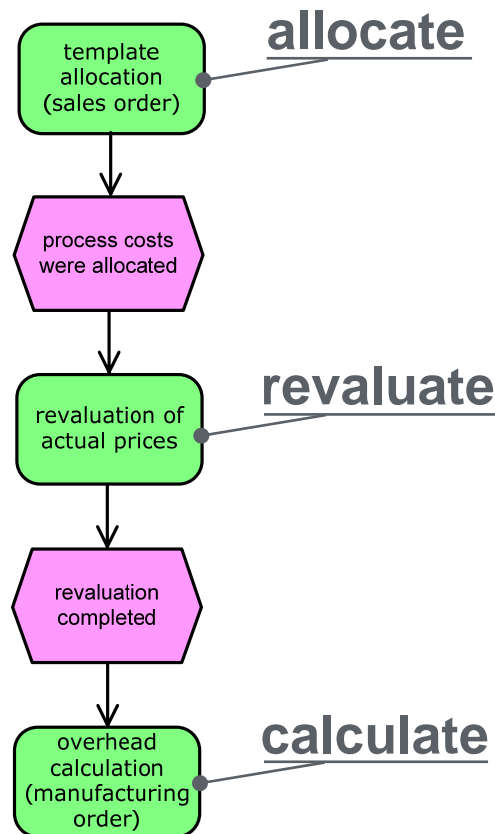


Solution

Derive actions from activity labels

Modeler Assistance

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Assumptions

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1. Process model collection is large enough
2. Activity label signifies an action
3. A mechanism interpreting an activity label as an action exists

Auxiliary Concepts

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Alphabet of labels

Γ

creation of order

send notification

book hotel receive order

update report

verify customer

Alphabet of terms

\mathcal{T}

create

send

validate

process

receive

order

client

close

update hotel

invoice

approve

notification

Process Model

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Process model is a tuple $PM = (A, G, F, s, e, t, l)$

A is a finite nonempty set of activities

G is a finite set of gateways

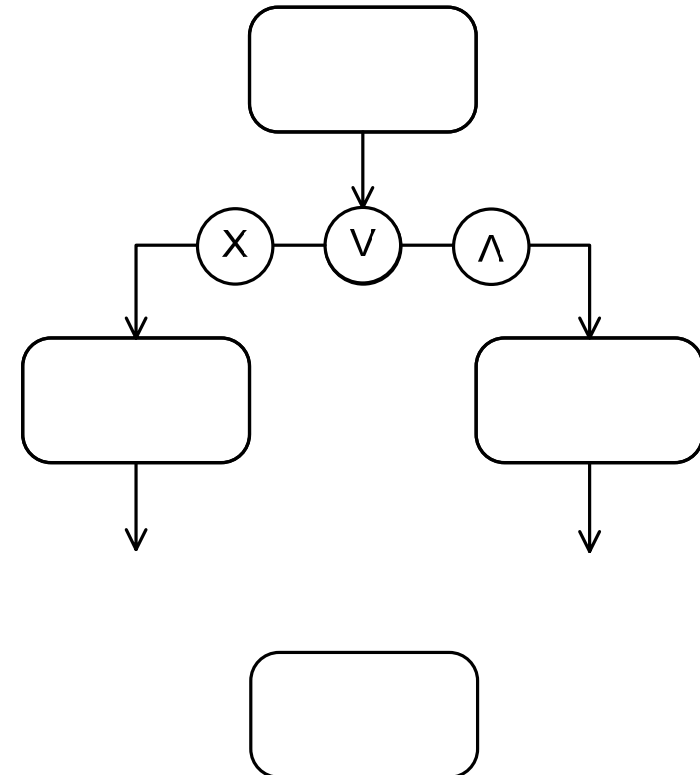
$t : G \mapsto \{and, or, xor\}$

F is a flow relation

s is the only start activity

e is the only end activity

$l : A \mapsto \Gamma$



Action Function

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Action function $v : \Gamma \mapsto \mathcal{T}$ derives an action from a label

update report \rightarrow update

verify customer \rightarrow verify

send notification \rightarrow send

creation of order \rightarrow create

Process Model Collection


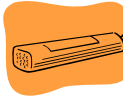




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Process model collection is a tuple $C = (\mathcal{PM}, V)$

- \mathcal{PM} is a nonempty finite set of process models
- V is the set of all actions in the model collection

Association Rule Learning

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\mathcal{I} a set of items      

 T a transaction, $T \subseteq \mathcal{I}$

\mathcal{C} a collection of transactions

  X set of items $X \subseteq \mathcal{I}$

T satisfies X , if $X \subseteq T$

Support $\text{supp}(\text{}) = 40$

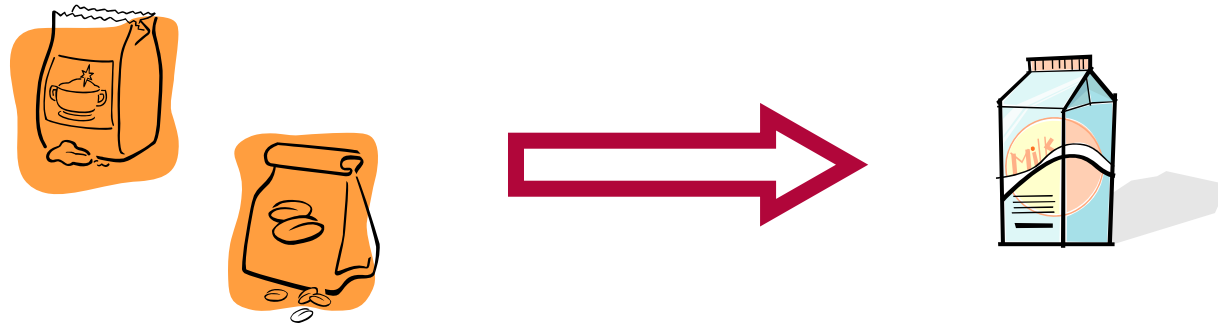
$\text{supp}(\text{ }) = 30$



Association Rule

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An **association rule** in a collection \mathcal{C} is an implication of the form $X \Rightarrow Y$, where $X \cap Y = \emptyset$ and $X, Y \subset \mathcal{I}$.



Confidence $\text{conf}(\text{coffee bags} \Rightarrow \text{milk}) = 0.75$

Co-occurrence Action Patterns

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- An action is an item
- A process model is a transaction
- A process model collection is a transaction collection

Co-occurrence Action Pattern

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$CAP = (R, \text{minsup}, \text{minconf})$ is

a **co-occurrence action pattern** in process model collection $C = (\mathcal{PM}, V)$, where:

- R is an association rule $X \Rightarrow Y$, where $X, Y \subset V$
- minsup is the required minimal support
- minconf is the required minimal confidence

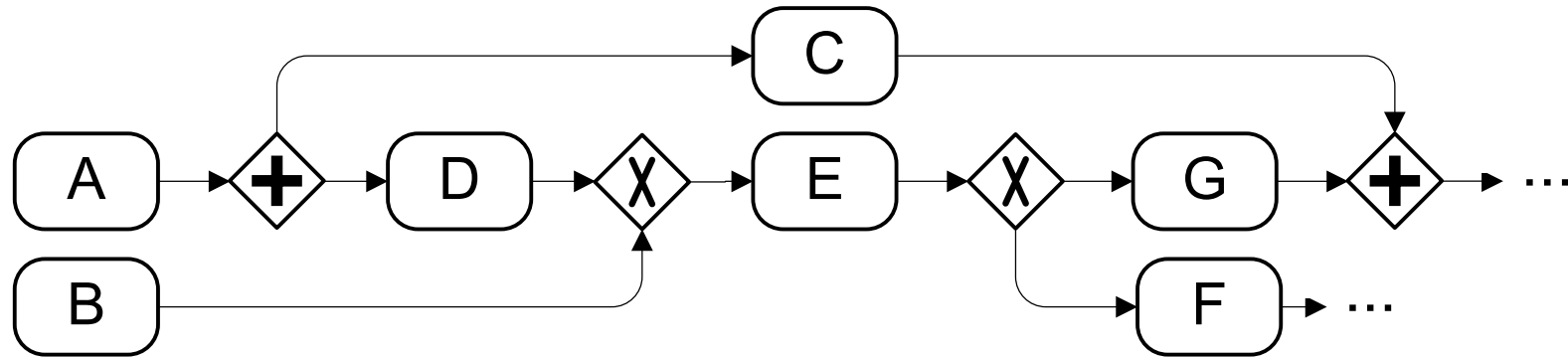
Co-occurrence action patterns

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antecedent	consequent
pick	process
level	evaluate
permit	process
archive enter	process
allocate calculate	settle

Weak Order Relation

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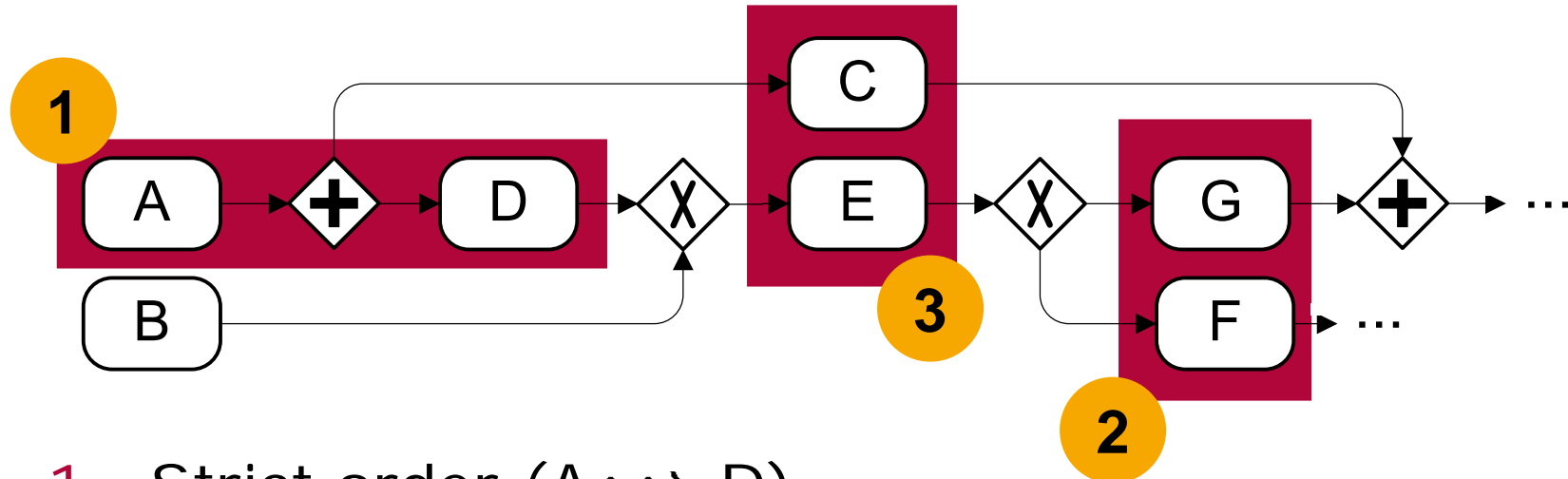
Activities a and b are in **weak order** relation, if there is a trace in which b occurs after a .

We denote weak order relation as $a \succ b$

Example: $A \succ D$

Behavioral Profile

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1. Strict order ($A \rightsquigarrow D$)
Reverse strict order ($D \rightsquigarrow^{-1} A$)
2. Exclusiveness ($F + G$)
3. Observation concurrency ($C \parallel E$)

Behavioral profile is the set of the **3** relations.

Behavioral Action Patterns

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- A behavioral relation is an item
- A process model containing a co-occurrence action pattern is a transaction
- Process models containing a co-occurrence action pattern is a transaction collection

Behavioral Action Pattern

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$BAP = (R, minsup, minconf)$ is a **behavioral action pattern** in process model collection $C = (\mathcal{PM}, V)$, where:

- R is a rule $X \Rightarrow Y$, where

$$X, Y \subset V \times \{\rightsquigarrow, \rightsquigarrow^{-1}, +, ||\} \times V$$

X and Y action pairs for which behavioral relations are specified

- $minsup$ is the required minimal support
- $minconf$ is the required minimal confidence

Behavioral action pattern

{allocate, calculate, settle}



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antecedent	consequent
allocate \rightsquigarrow calculate	allocate \rightsquigarrow settle, calculate \rightsquigarrow settle

Approach Evaluation

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Goals

- I. check if it is possible to derive action patterns from a collection of process models
- II. learn which support and confidence values are encountered in practice

Means

Model Collection: SAP Reference Model

SAP Reference Model

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- ... captures business processes supported by SAP R/3
- ... captures 29 functional branches of an enterprise
- ... contains 604 Event-driven process chains (EPCs)
- ... model element labels are in English

Co-occurrence pattern number

25

minsup \ minconf	2	3	4	5	6	7	8	9
0.55	511373	6979	2247	665	550	34	23	13
0.65	510498	6104	2070	591	497	26	16	9
0.75	483415	4923	1477	505	421	19	11	6
0.85	483135	4643	1197	460	417	15	10	5
0.95	483093	4601	1155	418	375	5	1	0

Co-occurrence pattern number

26

minsup \ minconf	2	3	4	5	6	7	8	9
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0.85	483135	4643	1197	460	417	15	10	5
0.95	483093	4601	1155	418	375	5	1	0

Co-occurrence action patterns

$minconf = 0.95$ and $minsup = 7$



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antecedent	consequent
pick	process
level	evaluate
permit	process
archive enter	process
allocate calculate	settle

Evaluation Discussion

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- *supp* and *conf* values are small
... the vocabulary contains synonyms
- some action patterns identify process variants
- the number of derived action patterns is reasonable

Conclusion

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Contributions

- Action pattern concept
- Action patterns derivation
- Validation with SAP Reference Model

Future work

- Automatic action derivation
- Similar actions clustering
- Advanced algorithms for behavioral profiles derivation



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Thank you!