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"An Approach to Business Process Model Structuredness Analysis: Errors Detection and Cost-Saving Estimation"

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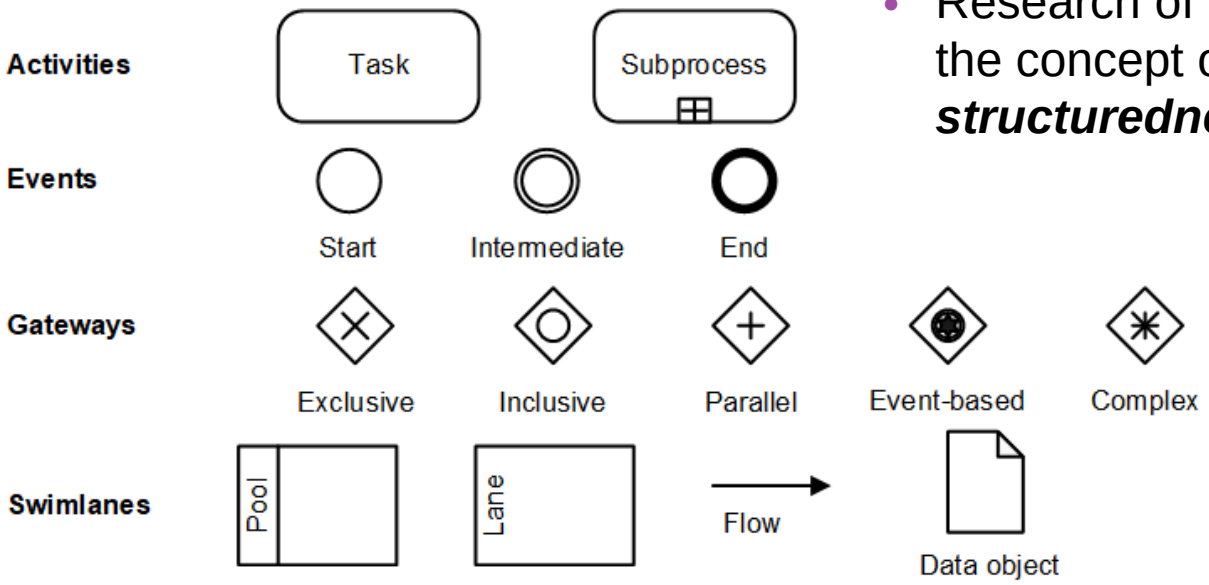
Introduction

- Business processes:
  - scenarios of activities, which execution is driven by events and decisions
  - chains of events, activities and decisions
- Business process models:
  - describe business processes as the graphical diagrams
  - help to design and analyze information system workflows
  - used as for communication among the stakeholders

- ***Quality of business process models is vital for*** the successful requirements gathering and further implementation or configuration of ***enterprise information systems***

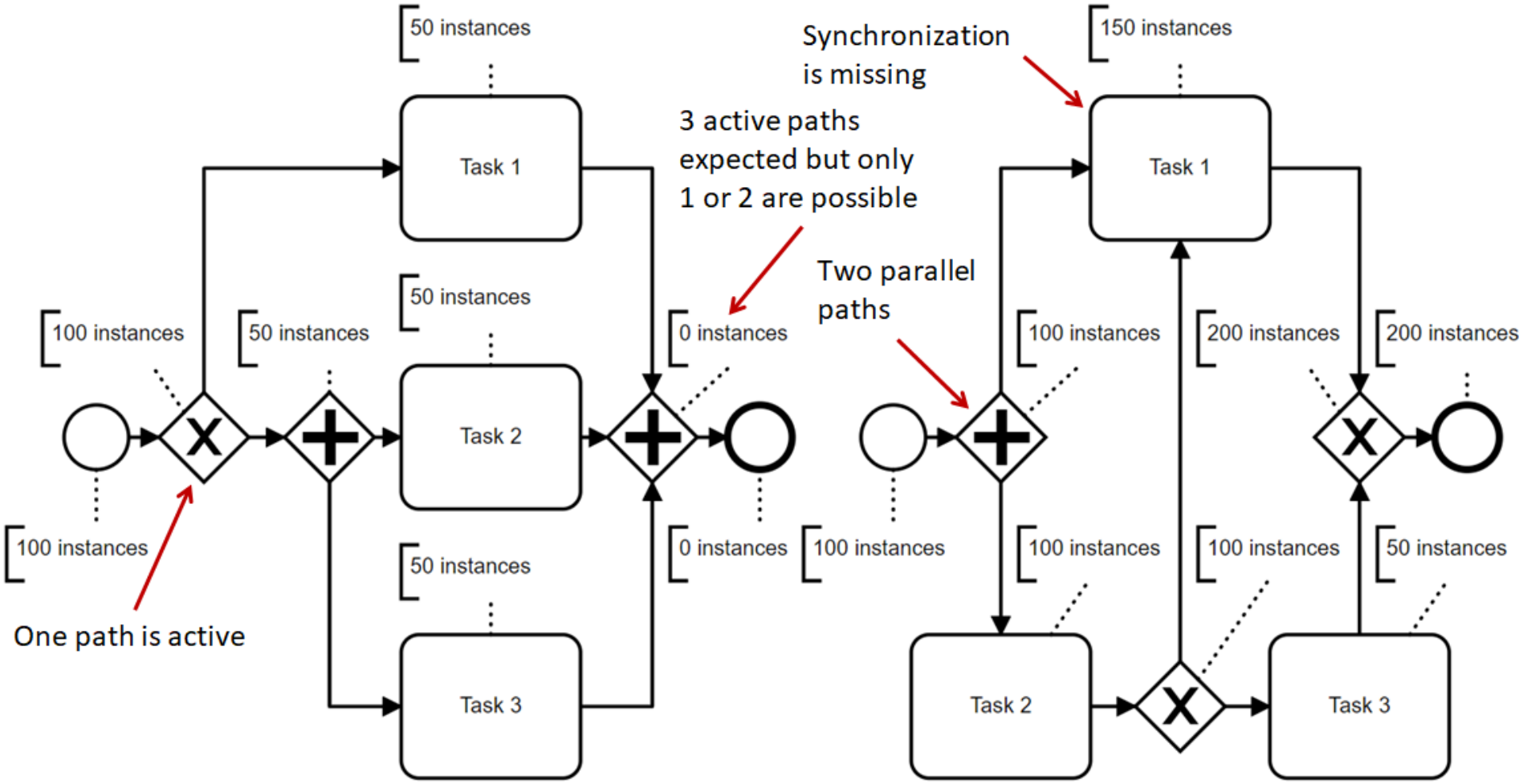
Related Work

- Business process model quality field:
  - SEQUAL Framework, The Guidelines of Modeling (GoM), Quality Framework for conceptual modeling, Seven Process Modeling Guidelines (7PMG) and others
- BPMN (Business Process Model and Notation) standard notation used to describe business processes



- Research of connector interplay includes the concept of business process model ***structuredness***
  - when each split-connector (gateway) matches a corresponding join-connector of the same type

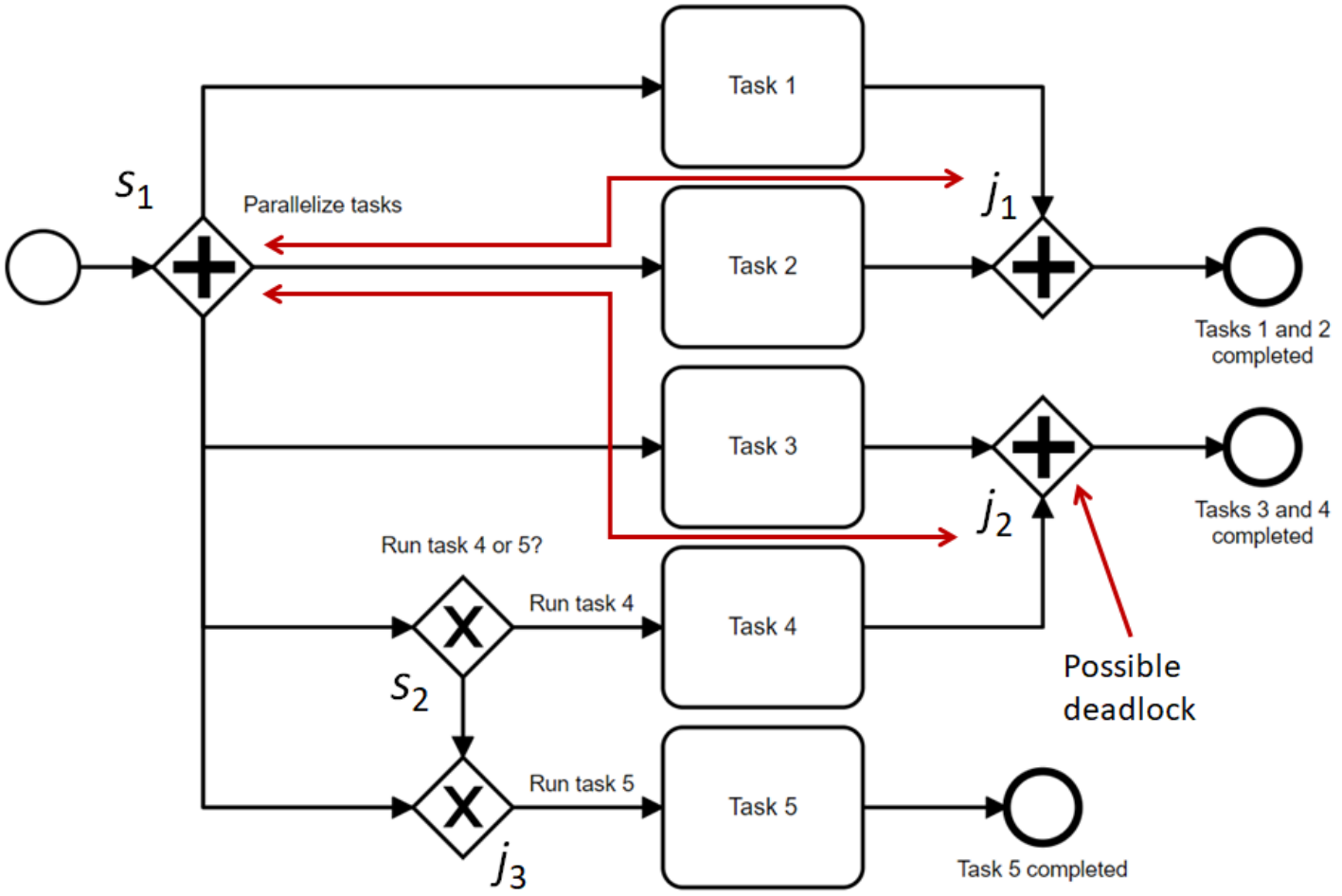
Problem Statement



Improved Gateway Mismatch Measure

The ***idea of structuredness*** (matching of each split-connector to a corresponding join-connector of the same type) ***is not relevant to the existing mismatch measure*** *MM*

In *MM* only numbers of flows are controlled through the degrees of gateways, but not the numbers of gateways



Detection of Business Process Modeling Errors

- Initial mismatch measure:

$$MM_l = \left| \sum_{c \in S_l} d(c) - \sum_{c \in J_l} d(c) \right|, \; l \in \{or, xor, and\}$$

$$MM = MM_{or} + MM_{xor} + MM_{and}.$$

- Improved measure:

$$MM'_l = \max\left\{ \left| \sum_{c \in S_l} d(c) - \sum_{c \in J_l} d(c) \right|, \left| |S_l| - |J_l| \right| \right\}.$$

- Errors detection model:

$$MM' = \sum_{l \in G} MM'_l + \sum_{l \in G} (|C_l| - |S_l| - |J_l|),$$

$$G = \{or, xor, and, event, complex\}$$

$$W = \sum_{l \in G} \max\left\{ \left| \sum_{c \in S_l} d(c) \cdot (1 - x_l^1) - \sum_{c \in J_l} d(c) \cdot (1 - x_l^2) \right|, \right.$$

$$\left. \left| |S_l| \cdot (1 - x_l^3) - |J_l| \cdot (1 - x_l^4) \right| \right\} + \sum_{l \in G} \left[(|C_l| - |S_l| - |J_l|) \cdot (1 - x_l^5) \right] \to \min_{x_l^i},$$

$$x_l^i \in \{0,1\}, \; i = \overline{1,5}, \; l \in G,$$

- x_1^l required changes of flows outgoing from split connectors of type $l \in G$
- x_2^l required changes of flows outgoing from join connectors of type $l \in G$
- x_3^l required changes of split connectors number of type $l \in G$
- x_4^l required changes of join connectors number of type $l \in G$
- x_5^l required re-arrangement measures for neither split nor joins of type $l \in G$

Estimation of Costs to Fix Detected Errors in Different Project Stages

- We can use computed x_i^l, $i = 1..5$, $l \in G$ values to estimate relative efforts and costs to fix errors in a COCOMO alike manner:

$$PE_s = \lambda_s \cdot H \cdot a \cdot \left(10^{-3} \cdot \sum_{l \in G} \sum_{i=1}^{5} x_l^i \right)^b, s = \overline{1,4},$$

- λ_s is the coefficient of efforts and costs

Project stage	Design	Implementation	Testing	Maintenance
λ_s	1	6.5	15	100

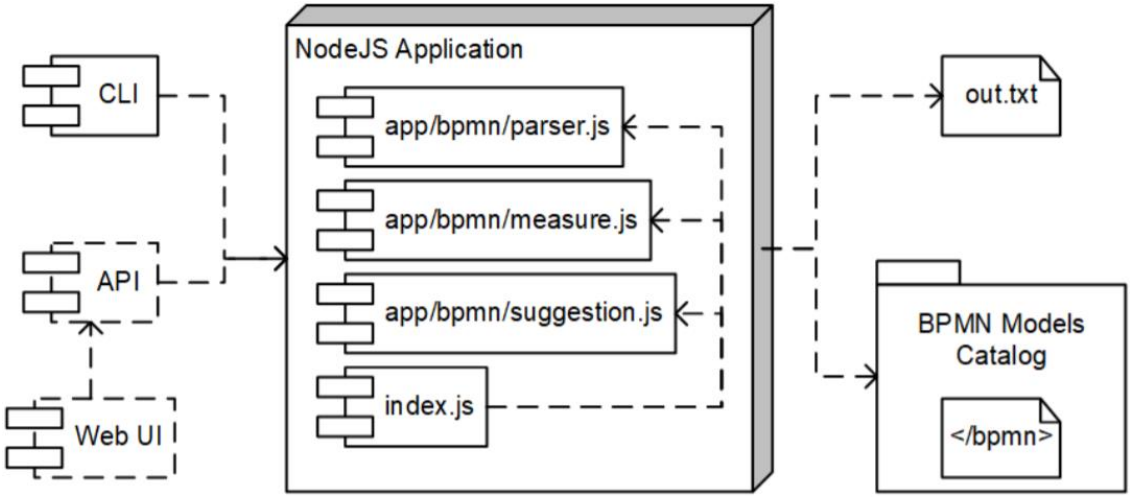
- a and b are COCOMO parameters

COCOMO Parameter	a	b
Easy	2.4	1.05
Medium	3	1.12
Complex	3.6	1.2

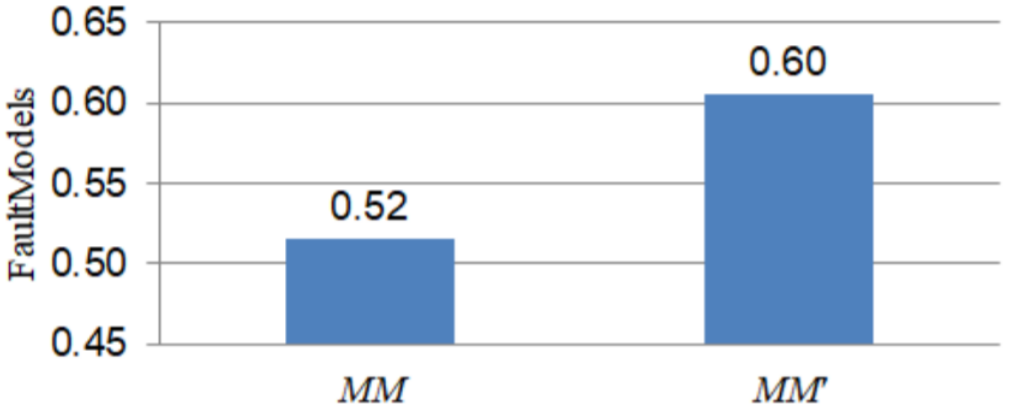
- $H = 152$ is the hours per person-month

Software Tool Development and Experimental Usage

- Test data set includes 6137 BPMN models of business processes:
  - Goods dispatch
  - Insurance recourse
  - Credit scoring
  - Self-service restaurant
- A simple NodeJS software tool was created to process such data volume

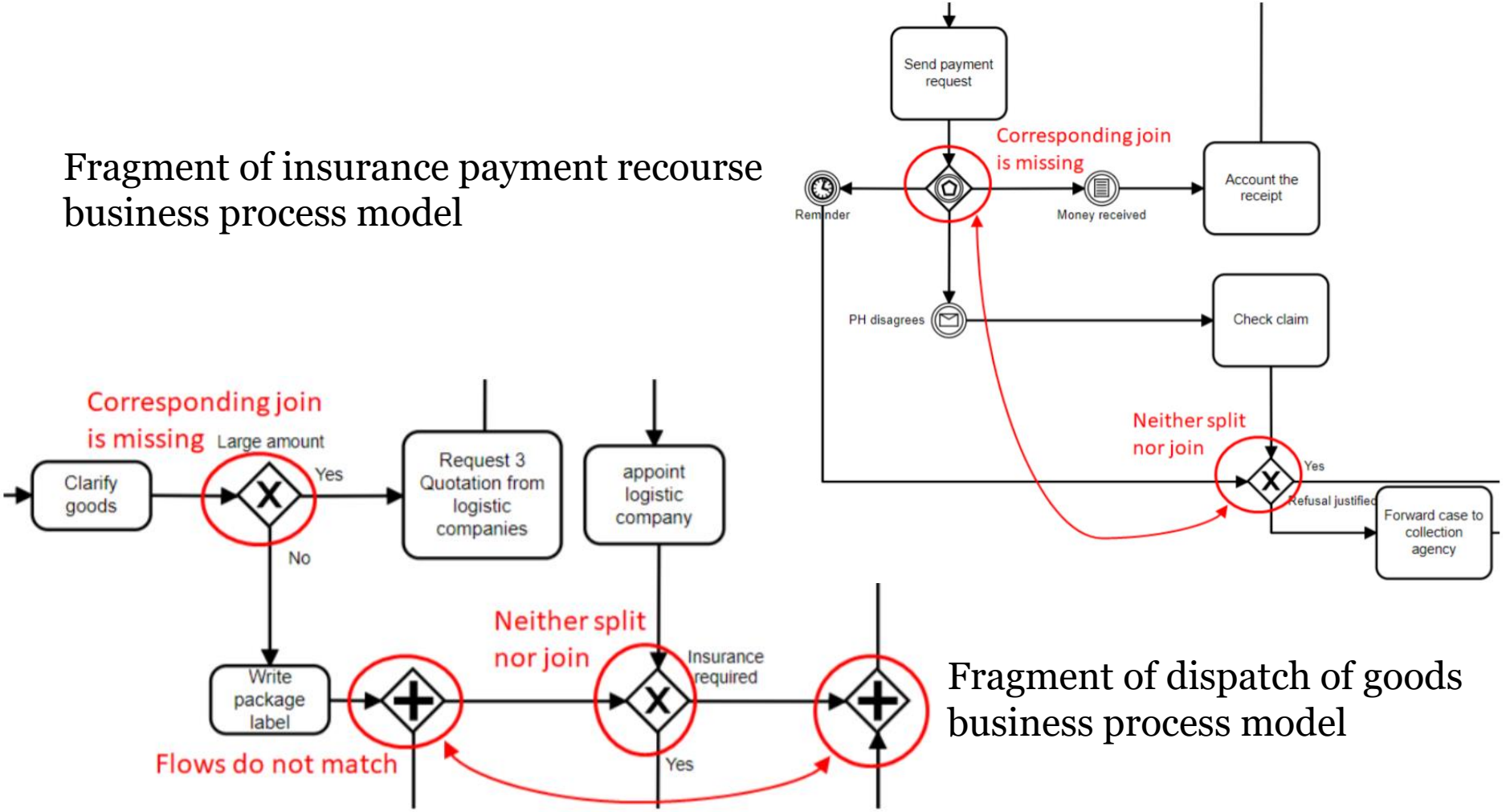


- Fault models were detected:
  - 3163 of 6137 using original measure
  - 3712 of 6137 using improved measure

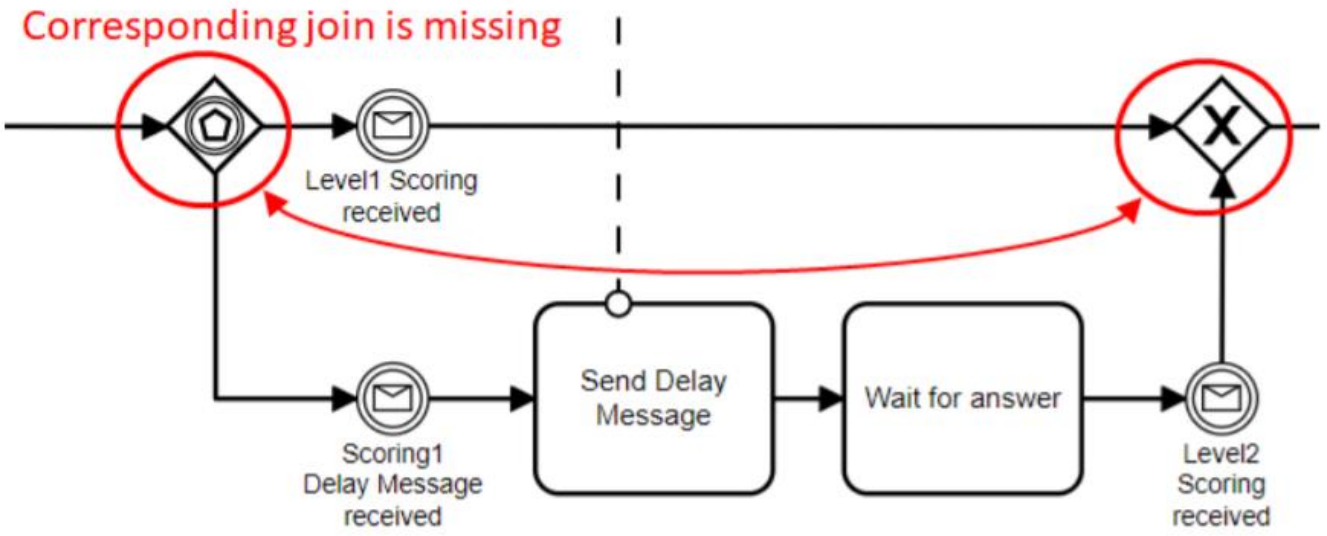


Sample Business Process Models and Detected Modeling Errors

Fragment of insurance payment recourse business process model

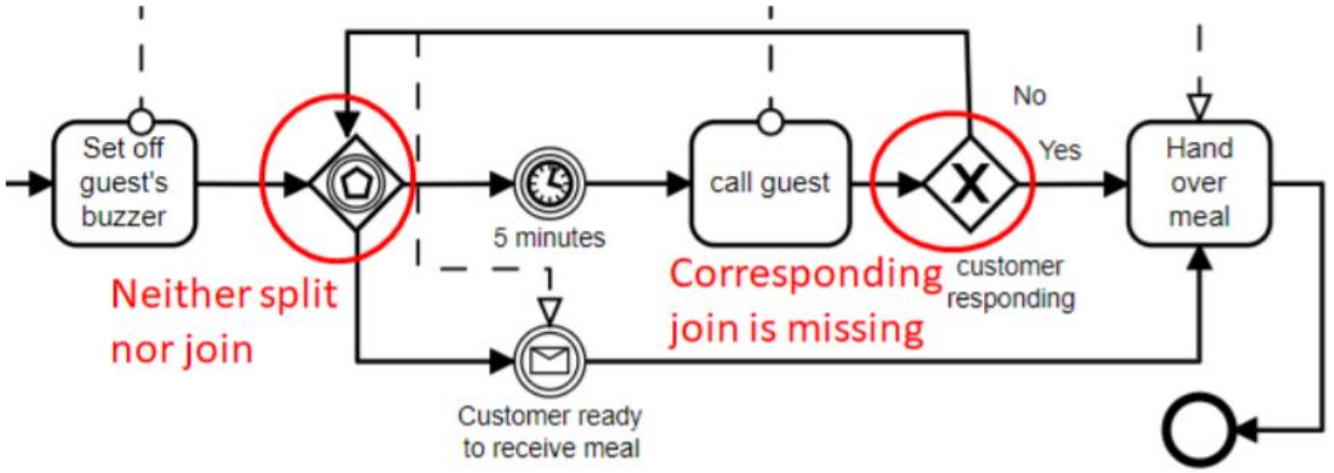


Fragment of dispatch of goods business process model

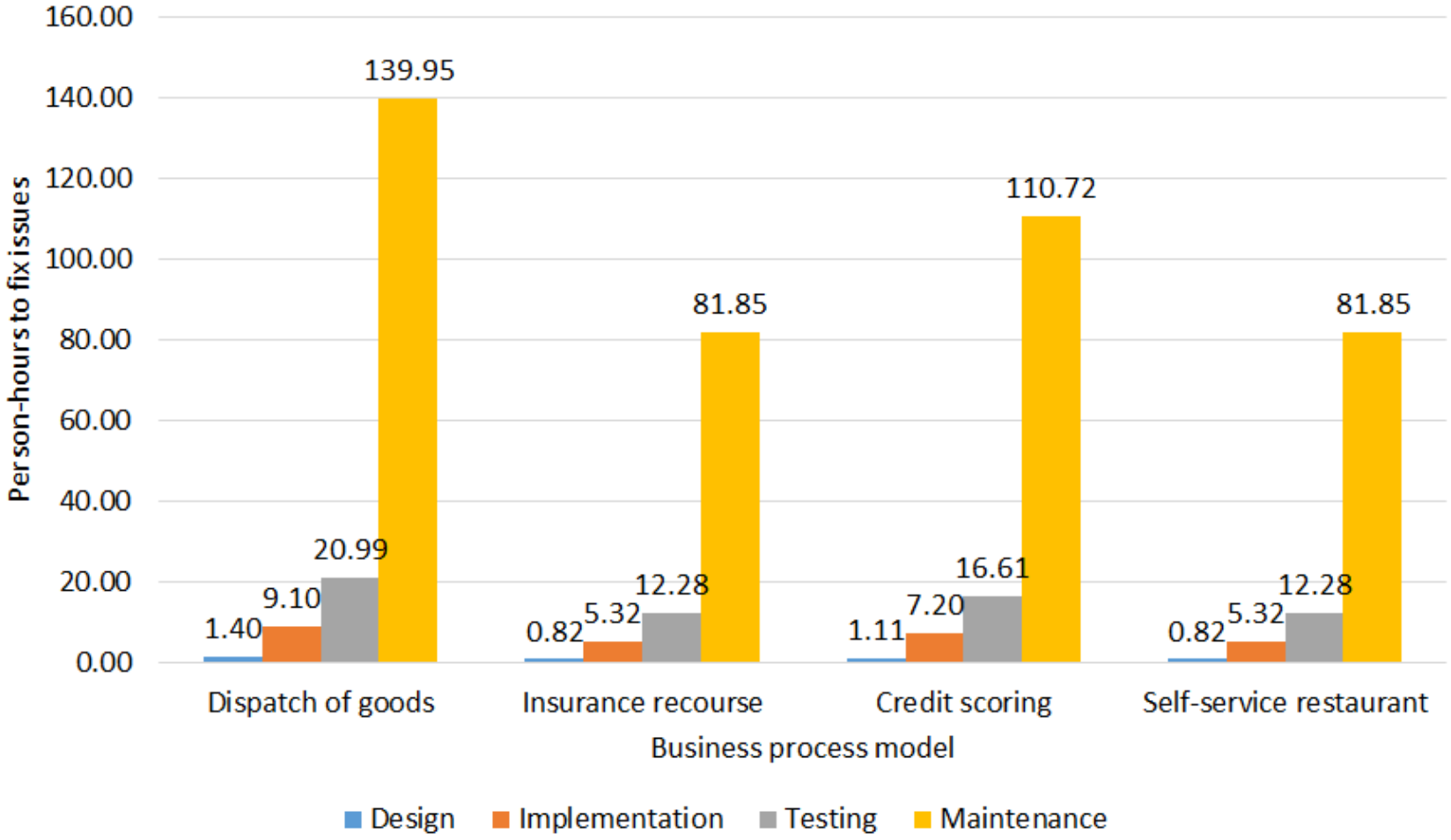


Fragment of credit scoring business process model

Fragment of self-service restaurant business process model



Estimation of Benefits from Business Process Model Improvement



- COCOMO parameters for “easy” projects were used (a = 2.4, b = 1.05)

Accuracy Evaluation of Suggested Business Process Model Improvements

- The main challenge is that in real-world BPMN models event-based and complex gateways can be mixed with simple gateways

$$Incorrect = x^3_{event} + x^4_{event} + x^3_{complex} + x^4_{complex},$$

$$Total = \left(\sum_{l \in G} \sum_{i=1}^{5} x^i_l \right),$$

$$Correct = Total - Incorrect,$$

- Accuracy could be evaluated as the following ratio of number of presumably correct suggestions to the total number of suggestions:

$$Accuracy = \frac{Correct}{Total} = \frac{Correct}{Correct + Incorrect} = \frac{13}{13+2} = 0.87.$$

- Hence, detected mismatches in “Insurance recourse” and “Credit scoring” models that include event-based gateways are considered as incorrect

Conclusion and Future Work

- The modified and improved mismatch measure for BPMN process models is proposed in order to find deadlocks and synchronization issues in organizational workflows
- Proposed errors detection model and software tool prototype may help to improve structuredness of BPMN models
- Obtained results demonstrate examples of detected structuredness errors of analyzed BPMN models
- Estimated efforts and cost-saving benefits demonstrate severity of mismatch errors in business process models if they won’t be fixed immediately and remain until testing or maintenance phases
- In future other business process modeling notations should be considered in addition to BPMN
- Also there should be elaborated methods and tools to get advanced recommendations or even to achieve automatic business process model transformation

THANK YOU FOR ATTENTION!