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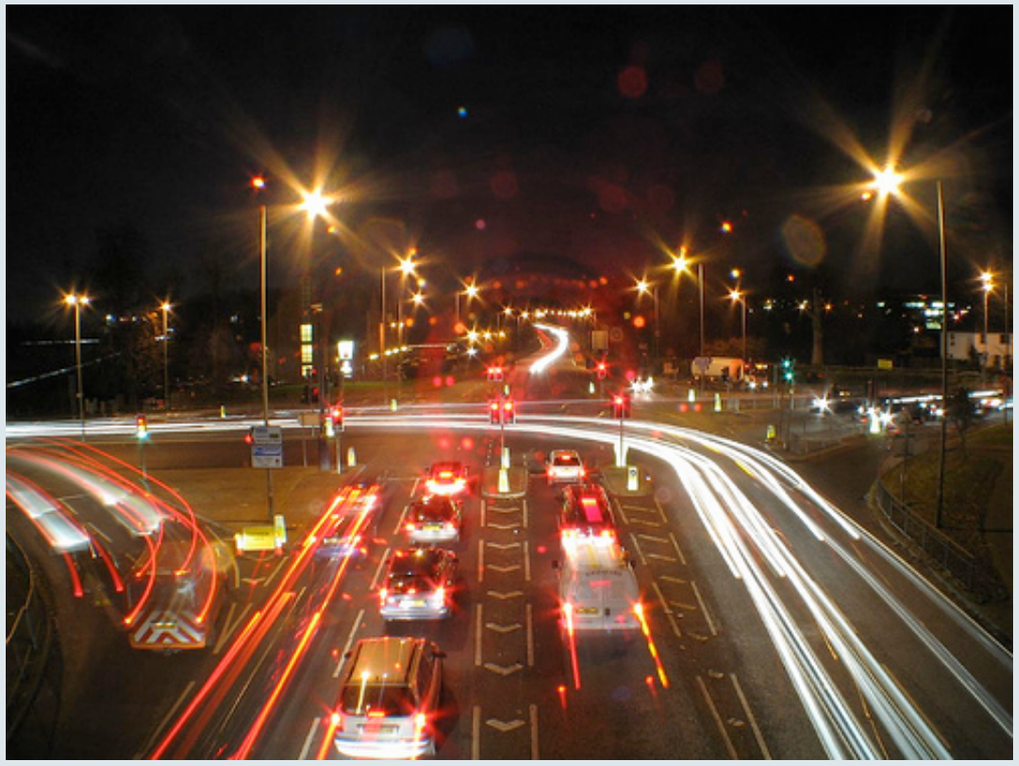
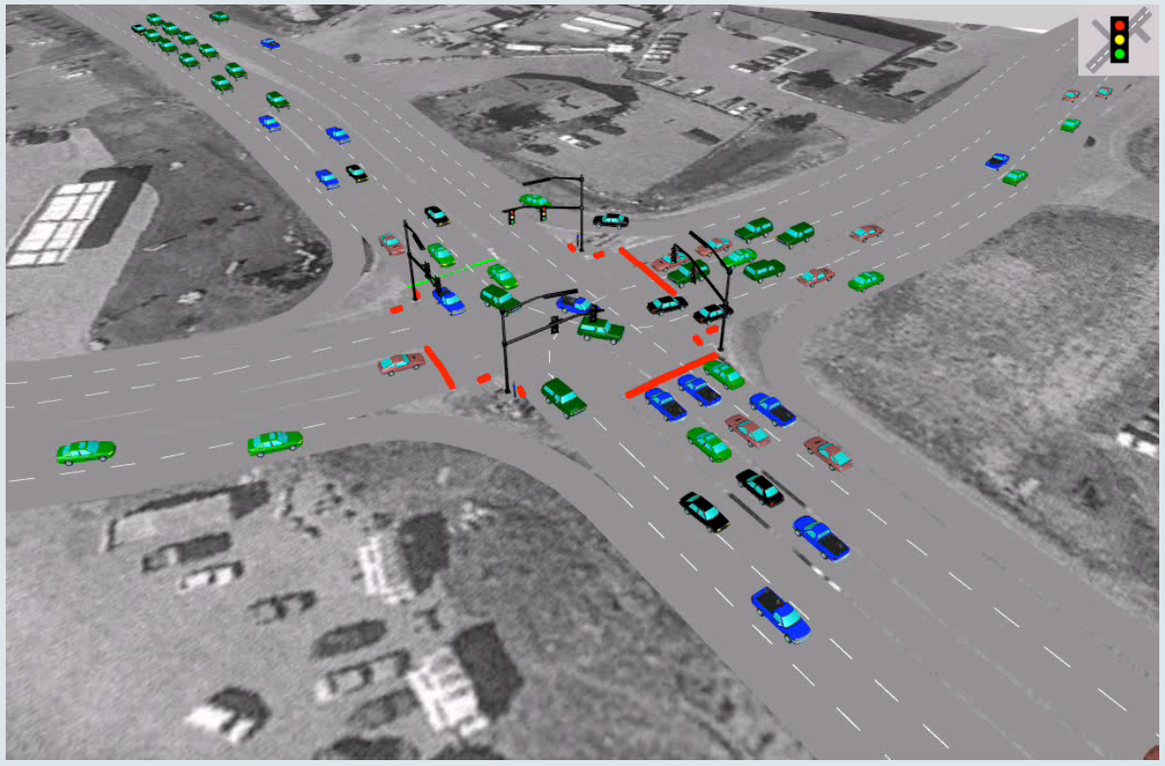
Workflow Simulation for Operational Decision Support

A. Rozinat, M.T. Wynn, W.M.P. van der Aalst,
A.H.M. ter Hofstede, and C.J. Fidge

Motivation

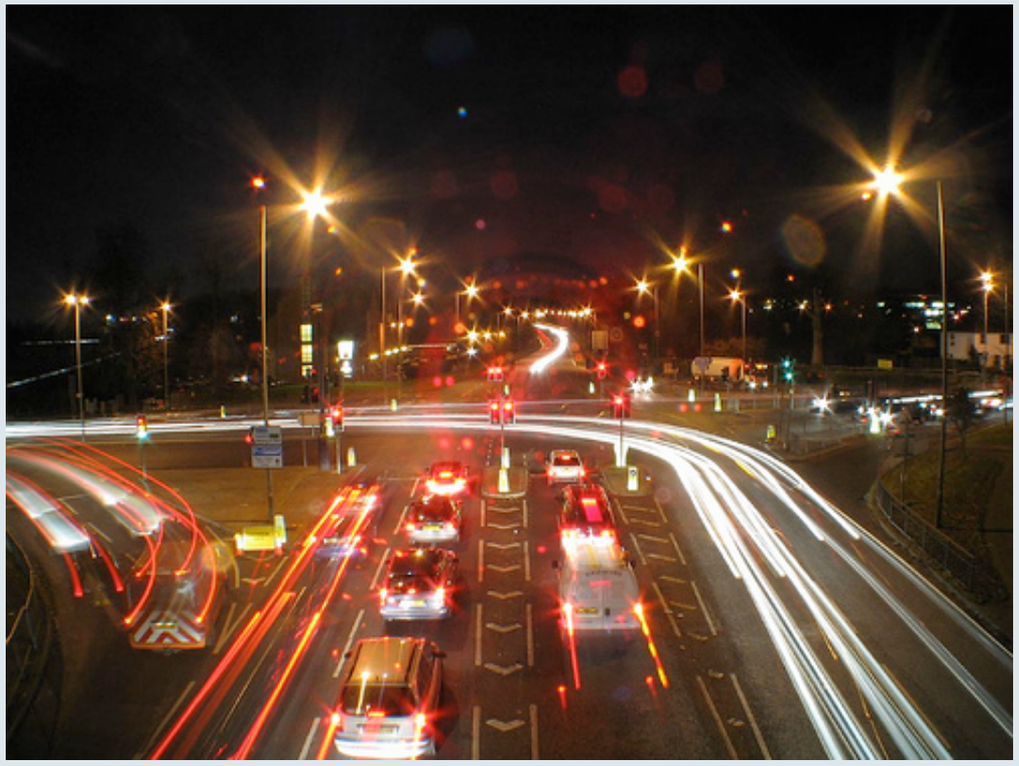


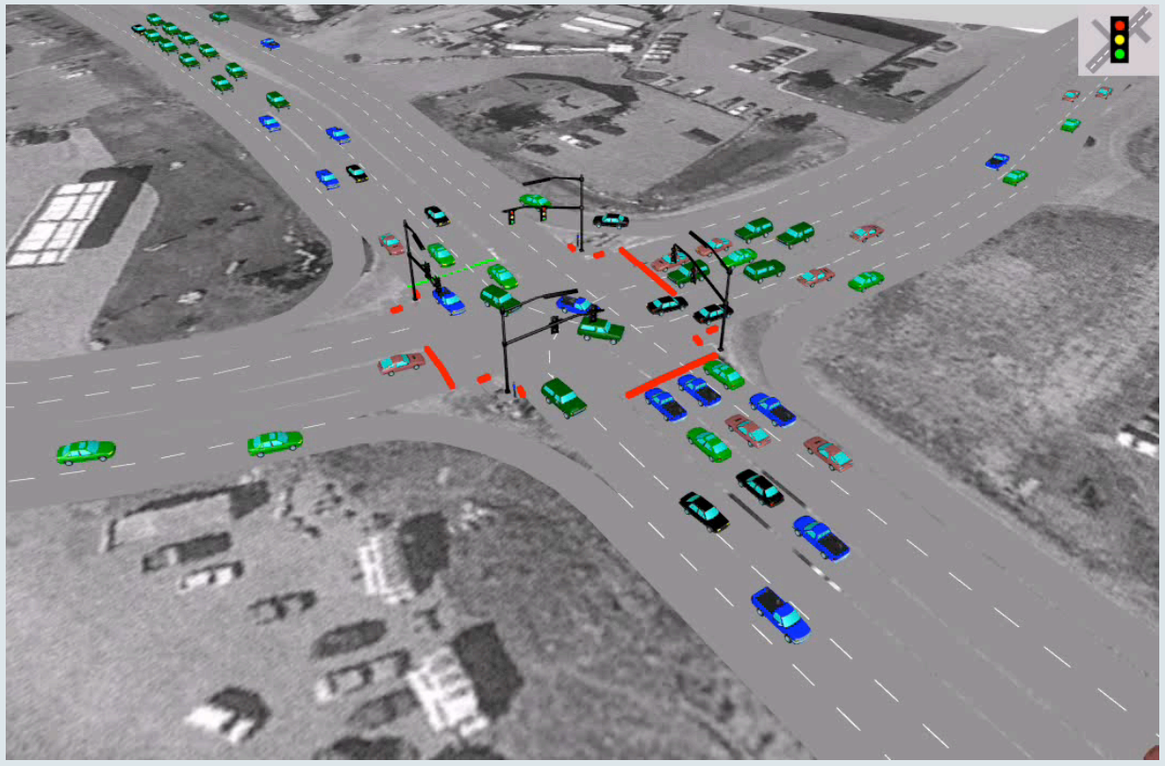


- Simulation **enables "what-if" analysis** (flow time, service level, utilization, ..., waiting time)
- Exploration of process redesigns by simulating their effects

"Despite the interest in business process simulation - the actual use by end-users is limited. Why is this?"

Motivation





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Outline

1. Three Common Pitfalls
2. Our Approach
3. Realization through YAWL and ProM
4. Discussion

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1. Three Common Pitfalls

1) Modeling from scratch

2) Incorrect modeling of resources

3) Focus on design rather than operational decision making

➡ Here we address 1) and 3) by

- integrating existing artifacts that can be extracted from a workflow system
- incorporating the current state of a workflow system

W.M.P. van der Aalst, J. Nakatumba, A. Rozinat, and N. Russell. Business Process Simulation: How to get it right? *BPM Center Report BPM-08-07*, BPMcenter.org, 2008.

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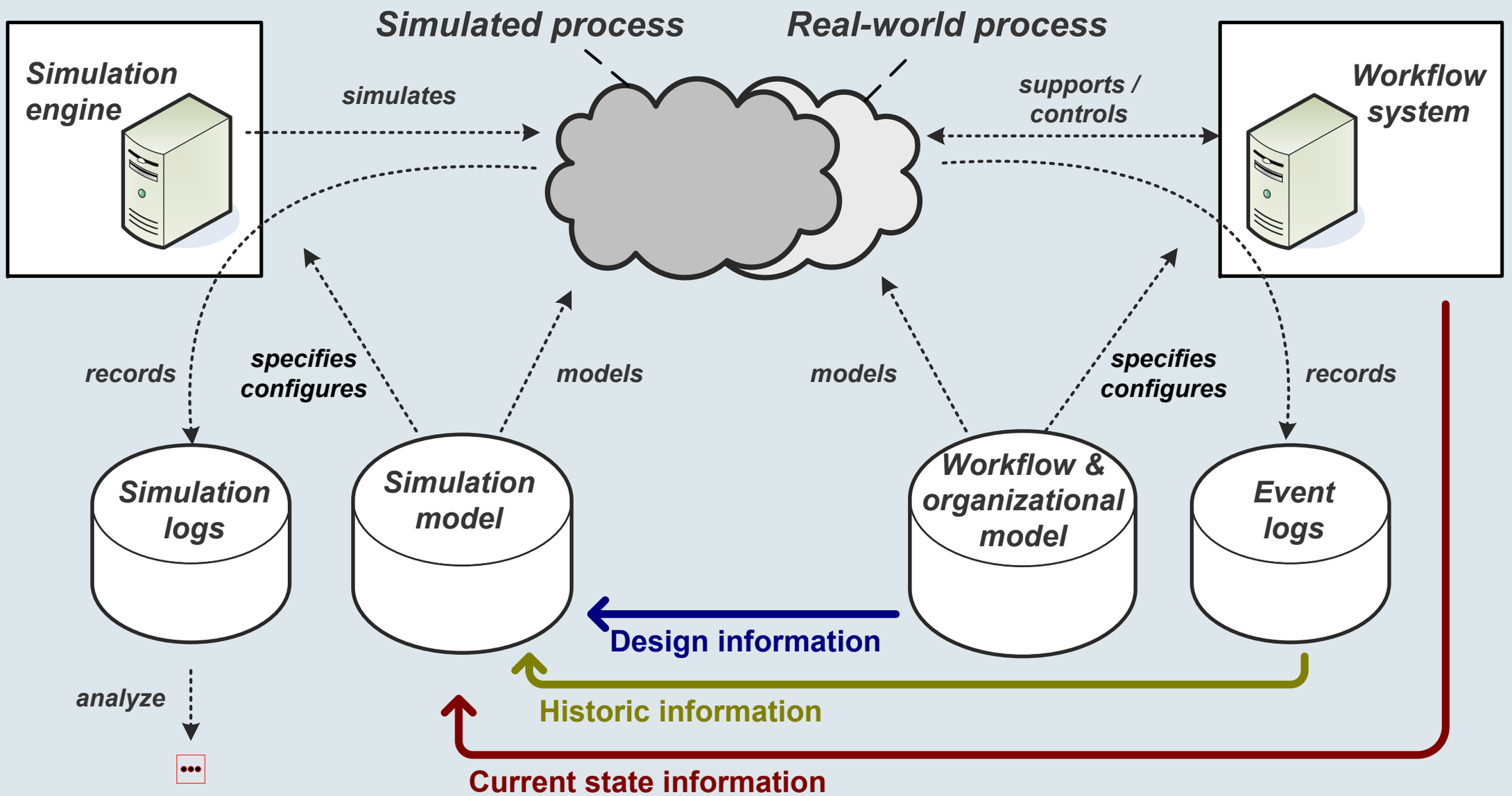
2. Our Approach



2. Our Approach

Design information *(obtained from the workflow and organization model used to configure the workflow system)*	**Historic information** *(extracted from event logs containing information on the actual execution of cases)*	**State information** *(based on information about cases currently being enacted using the workflow system)*
• control and data flow (activities and causalities) • organizational model (roles, resources, etc.) • initial data values • roles per task	• data value range distributions • execution time distributions • case arrival rate • availability patterns of resources	• progress state of cases (state markers) • data values for running cases • busy resources • run times for cases

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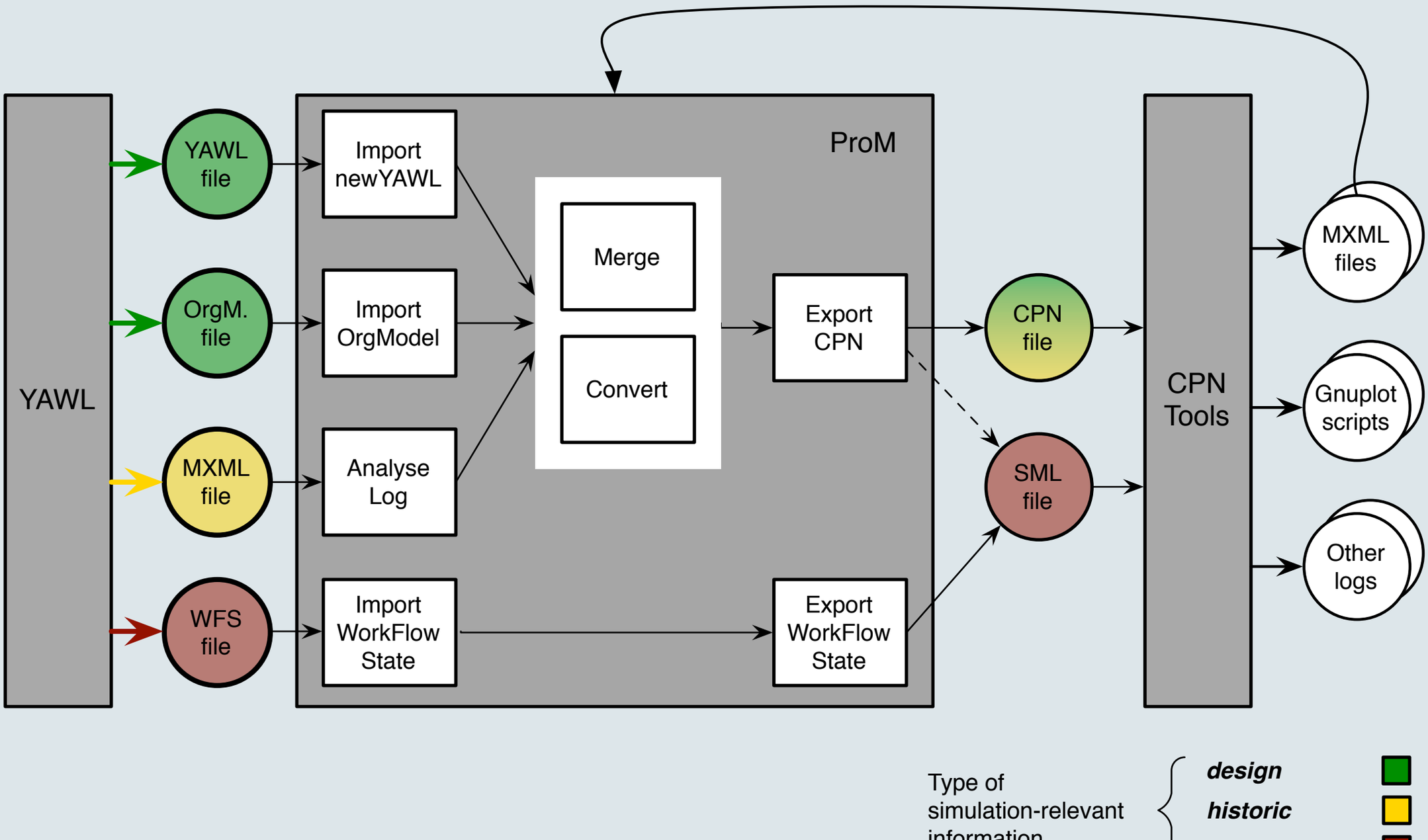
1. Three Common Pitfalls
2. Our Approach
3. **Realization through YAWL and ProM**
    1. **Architecture**
    2. Extracting simulation-relevant information
    3. Generating the simulation model
    4. Loading the current state
    5. Analyzing simulation logs
4. Discussion

3.1 Architecture



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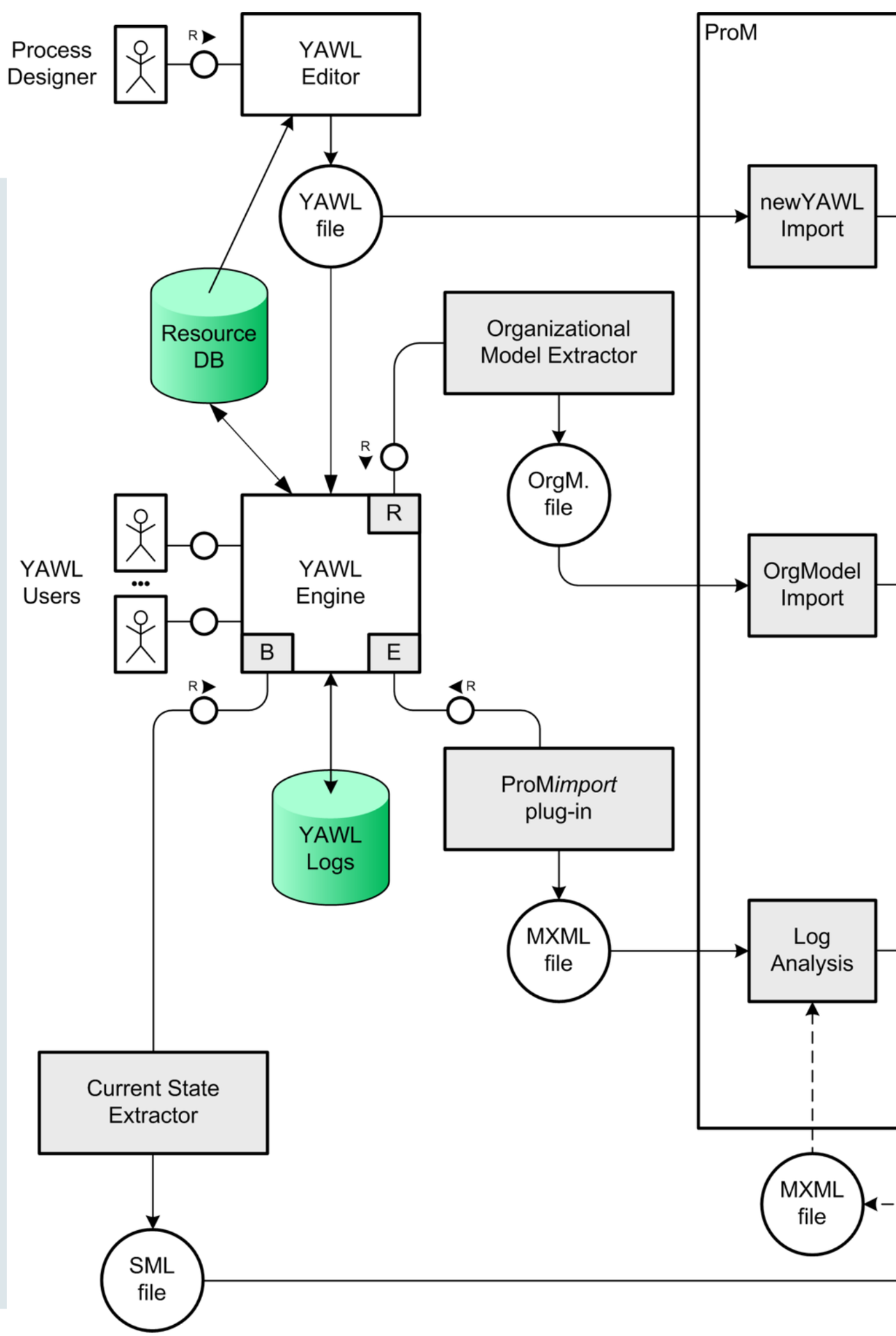
3.2 Extracting Simulation-relevant Information

- Export information:

  (a) design
  (b) historic
  (c) current state

- Using interfaces to YAWL engine: R, B, and E



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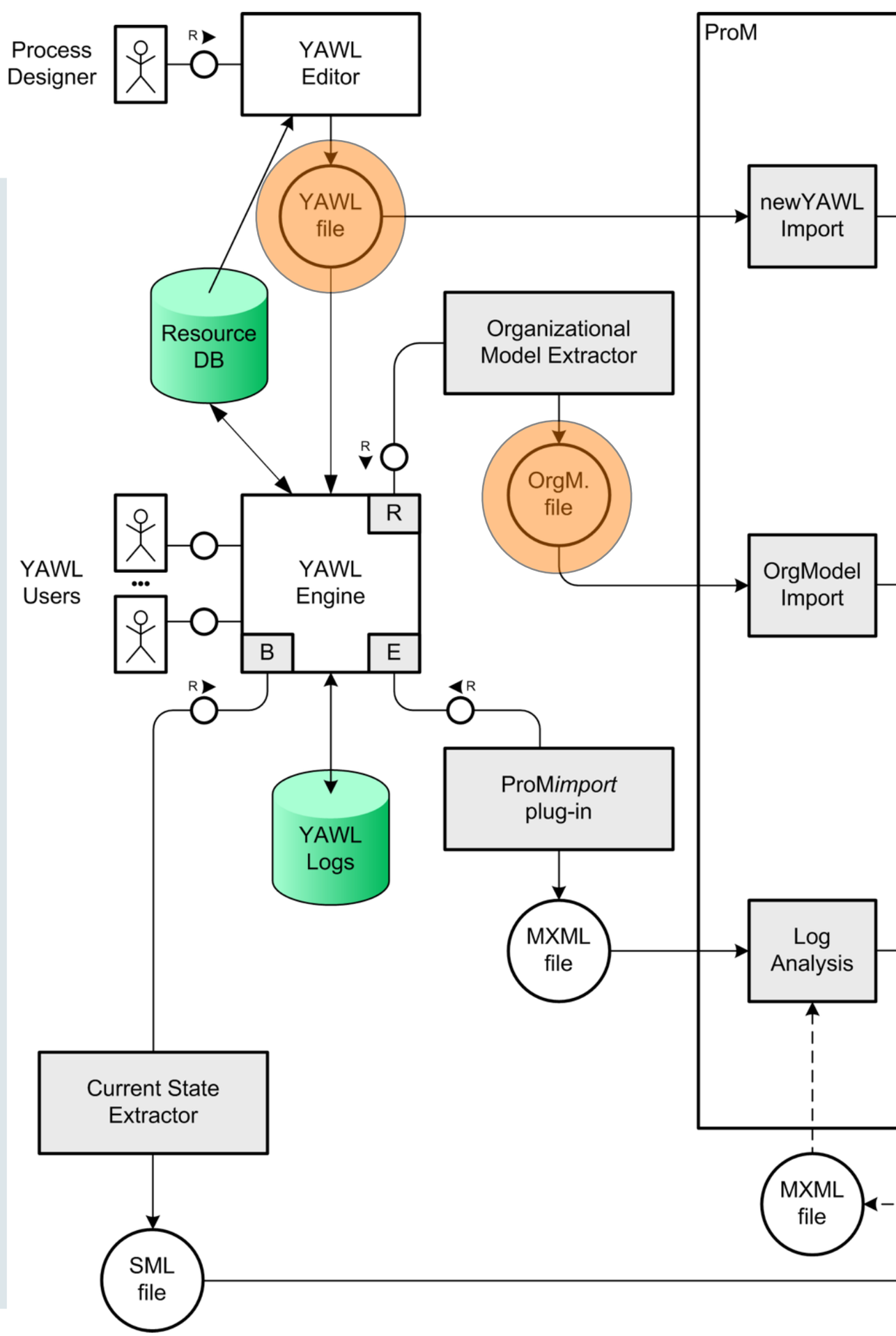

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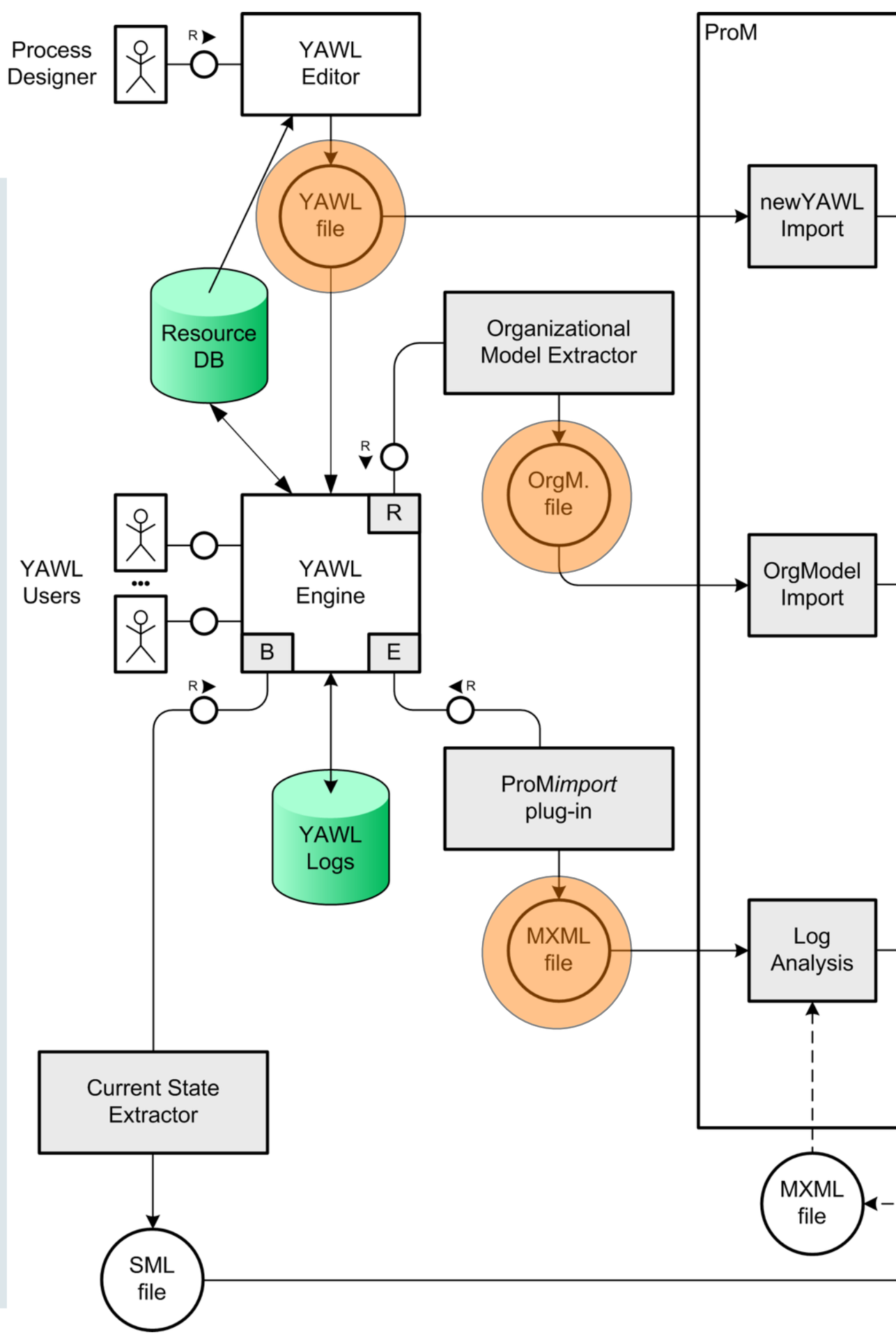

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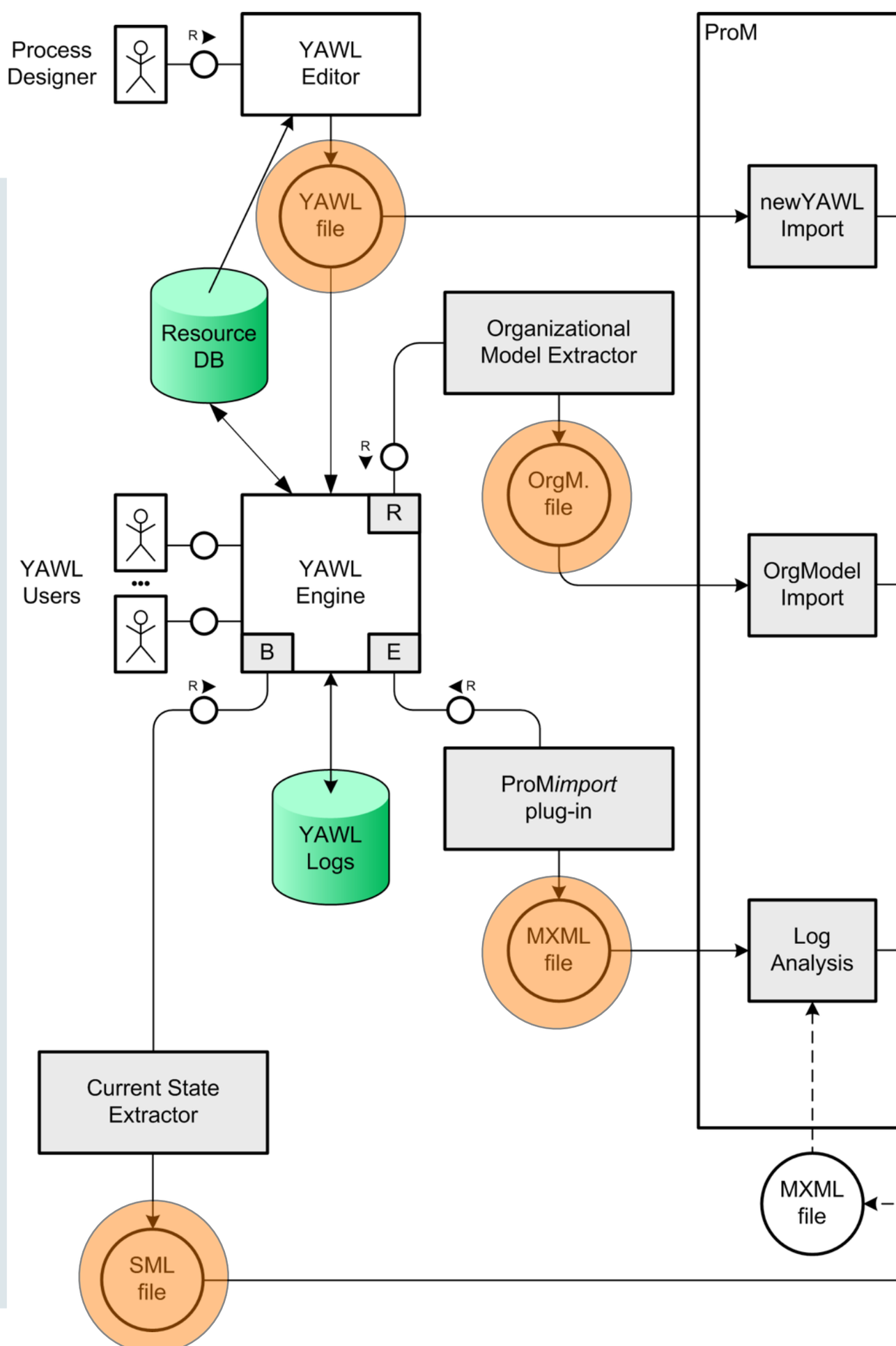

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3.3 Generating the Simulation Model

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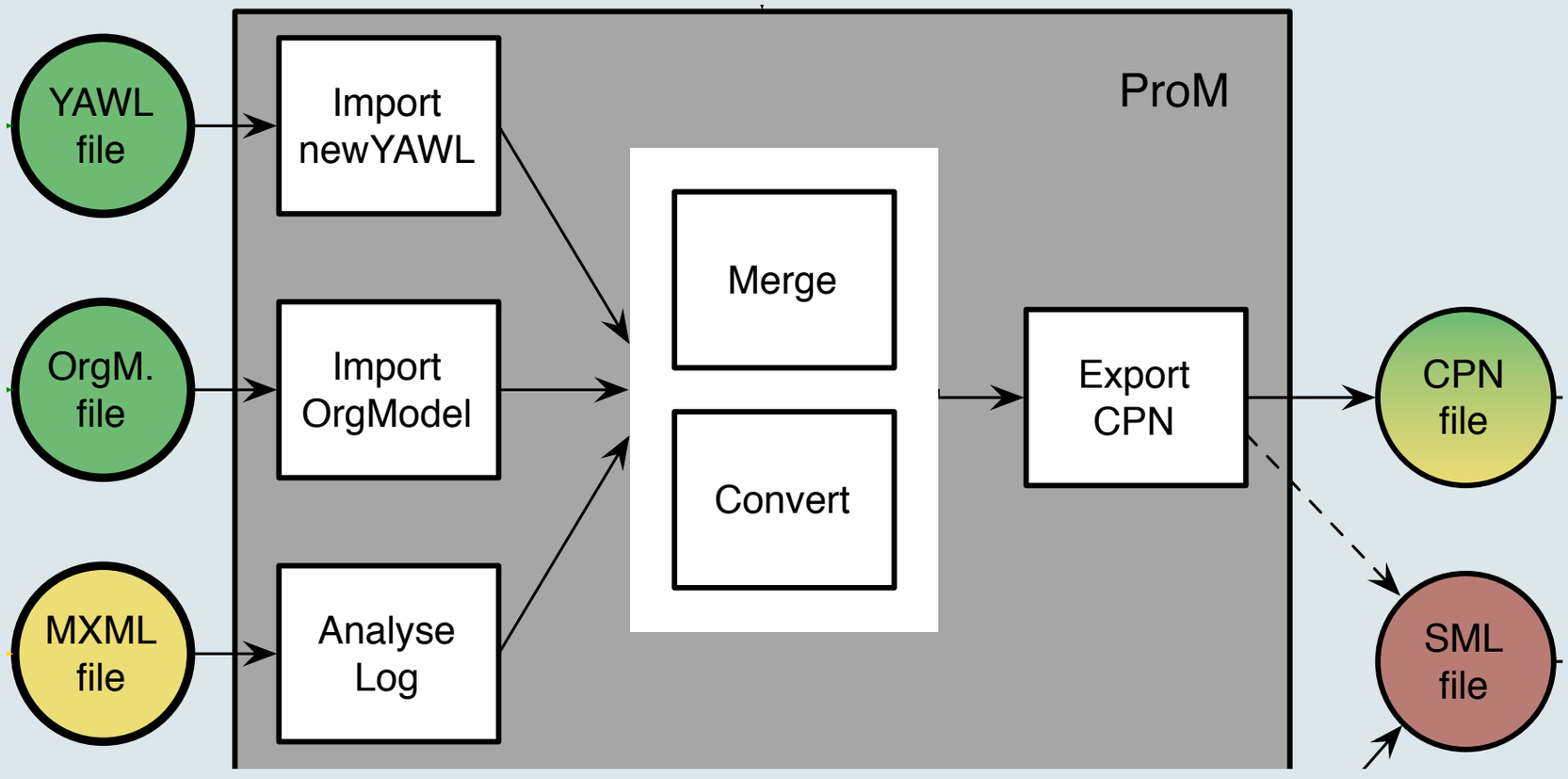
   - wf model
   - org model
   - event log
2. Merge
3. Convert
4. Export



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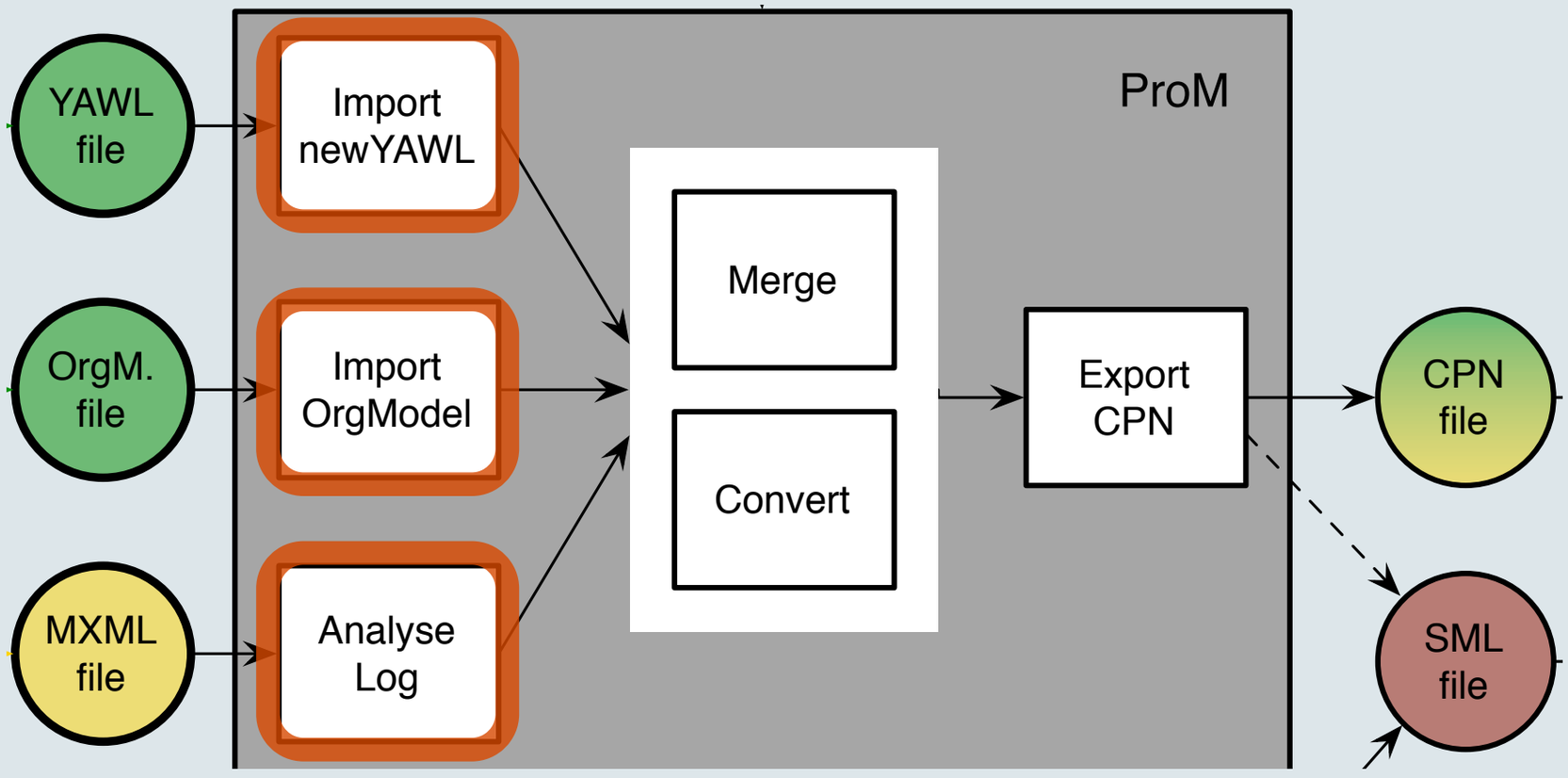

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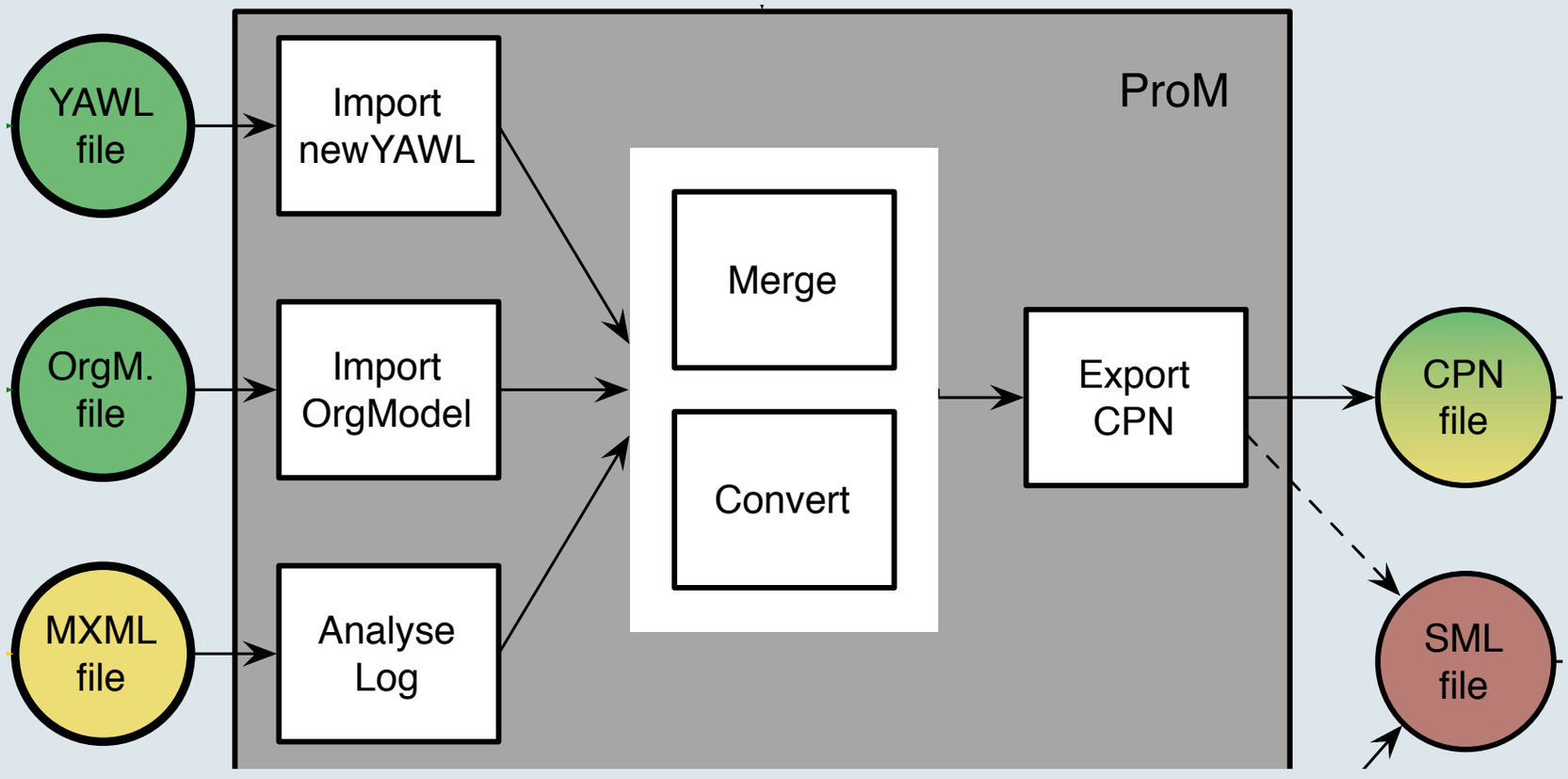

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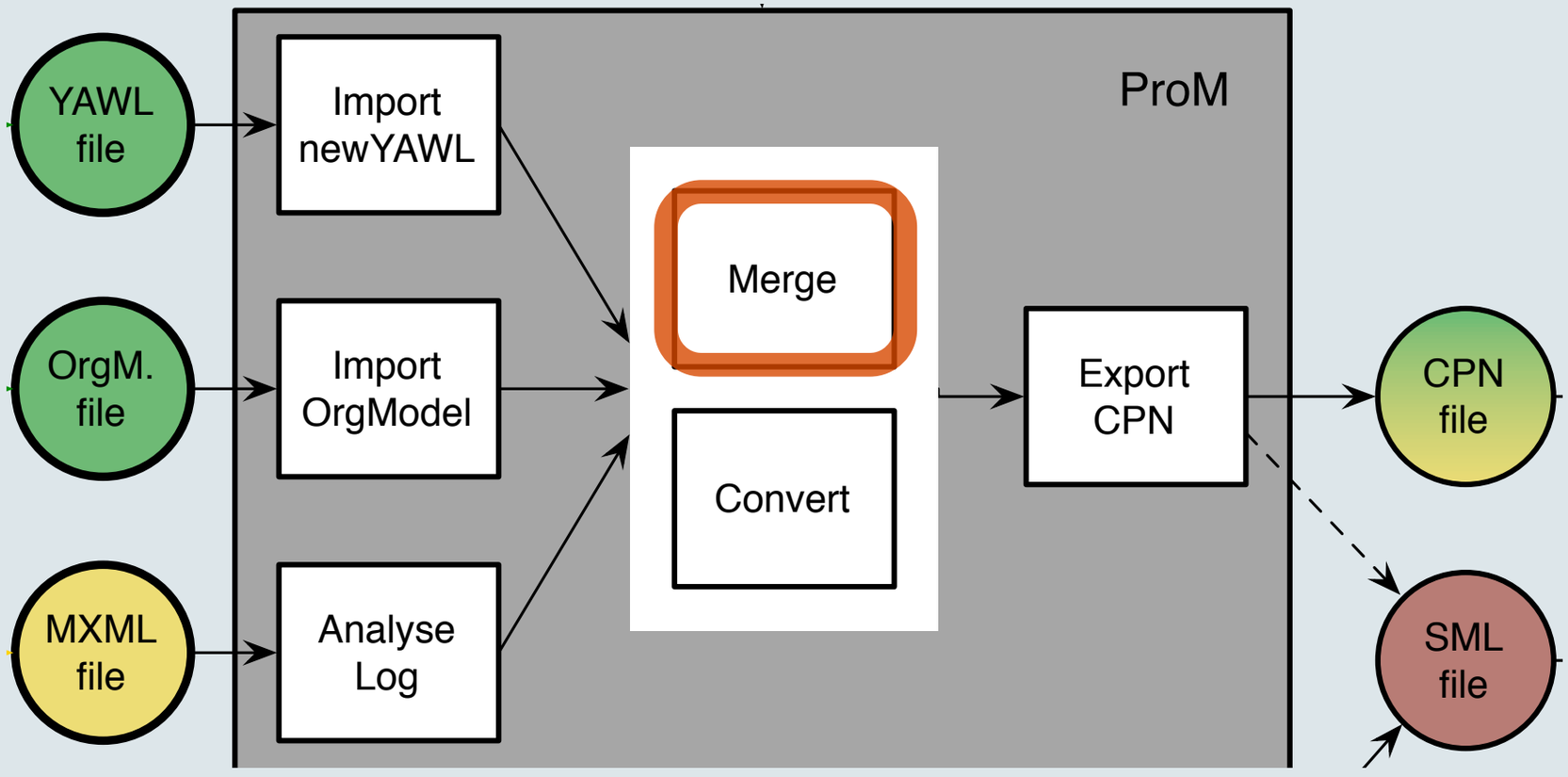

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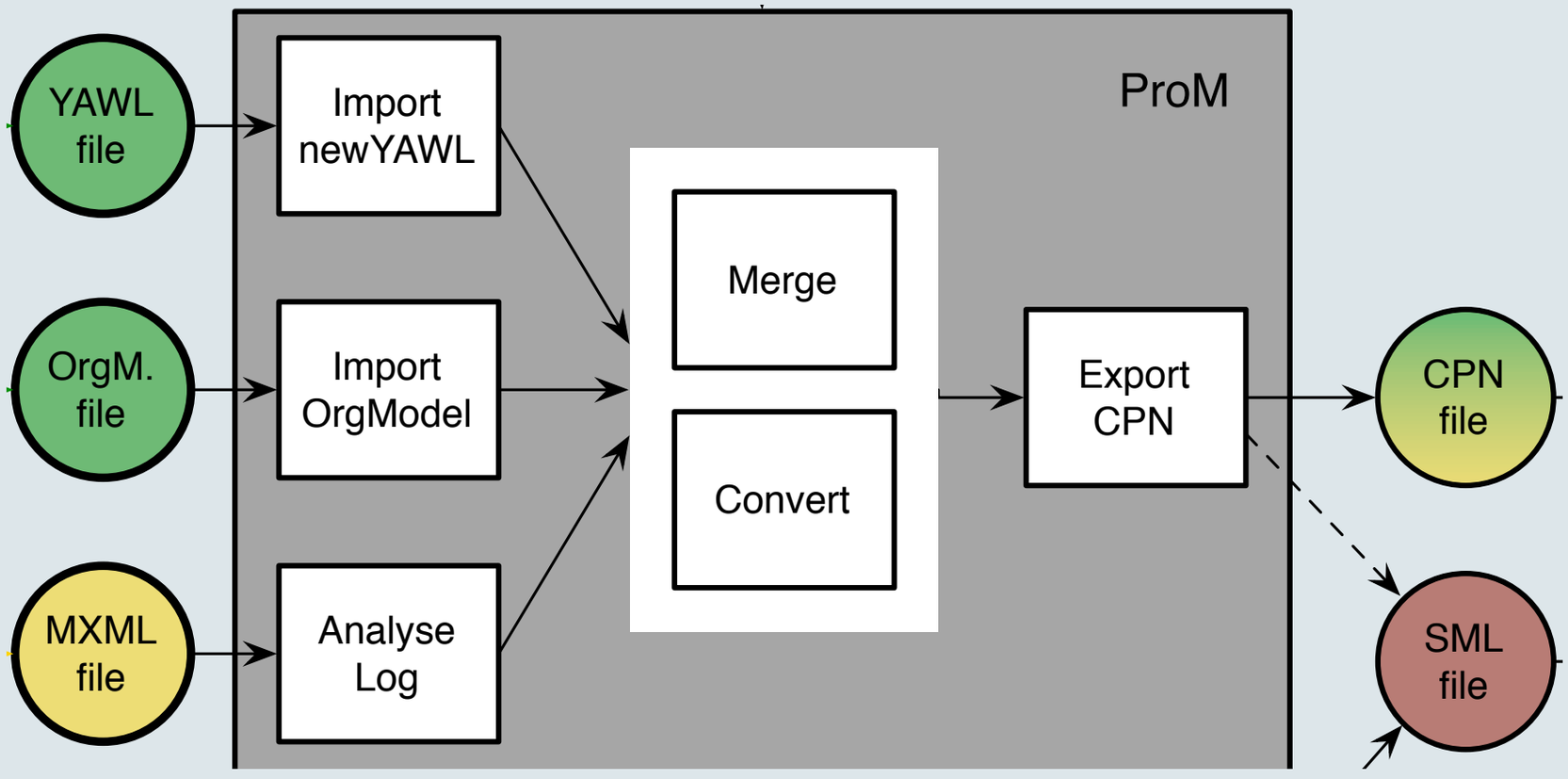

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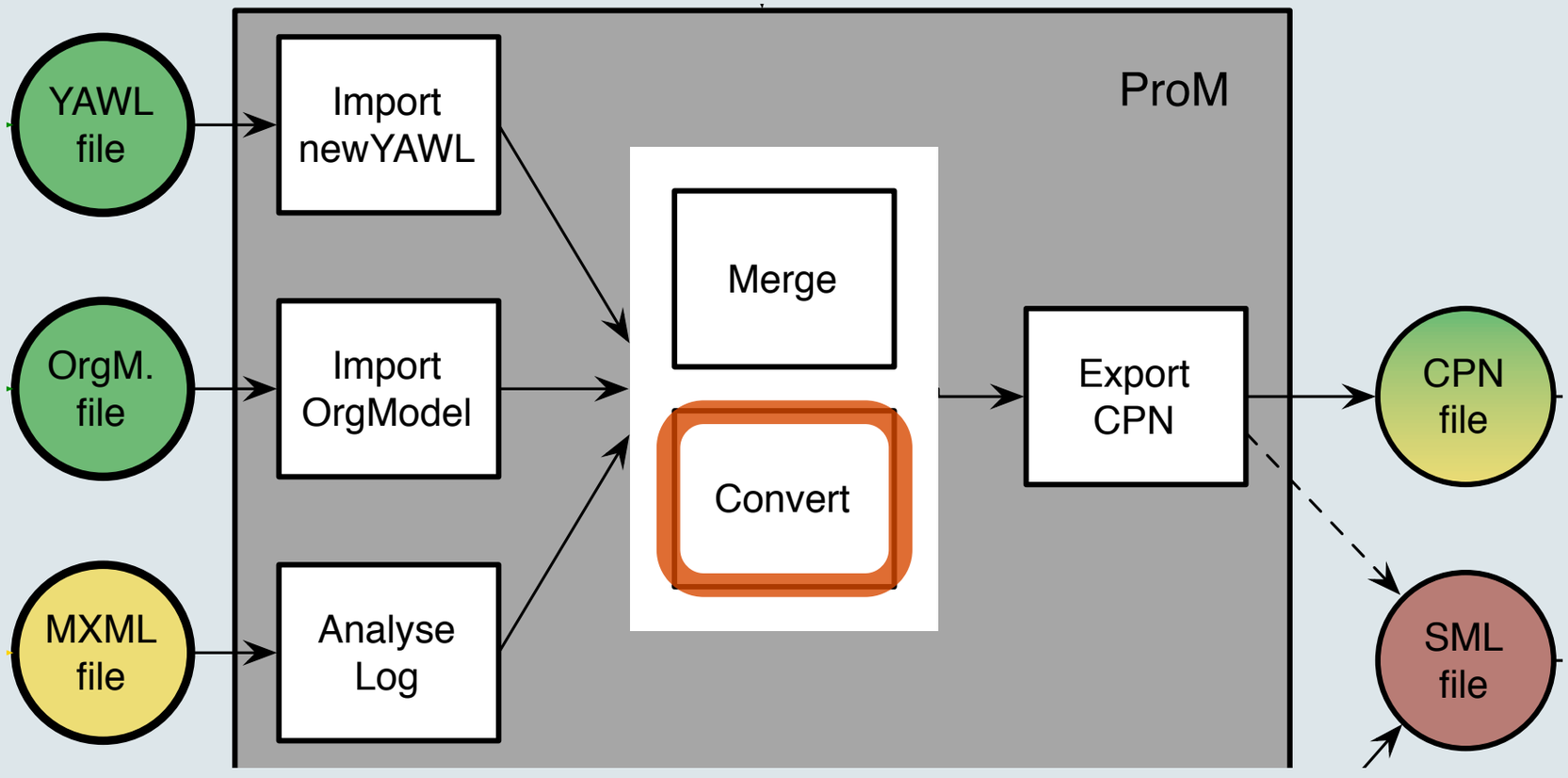

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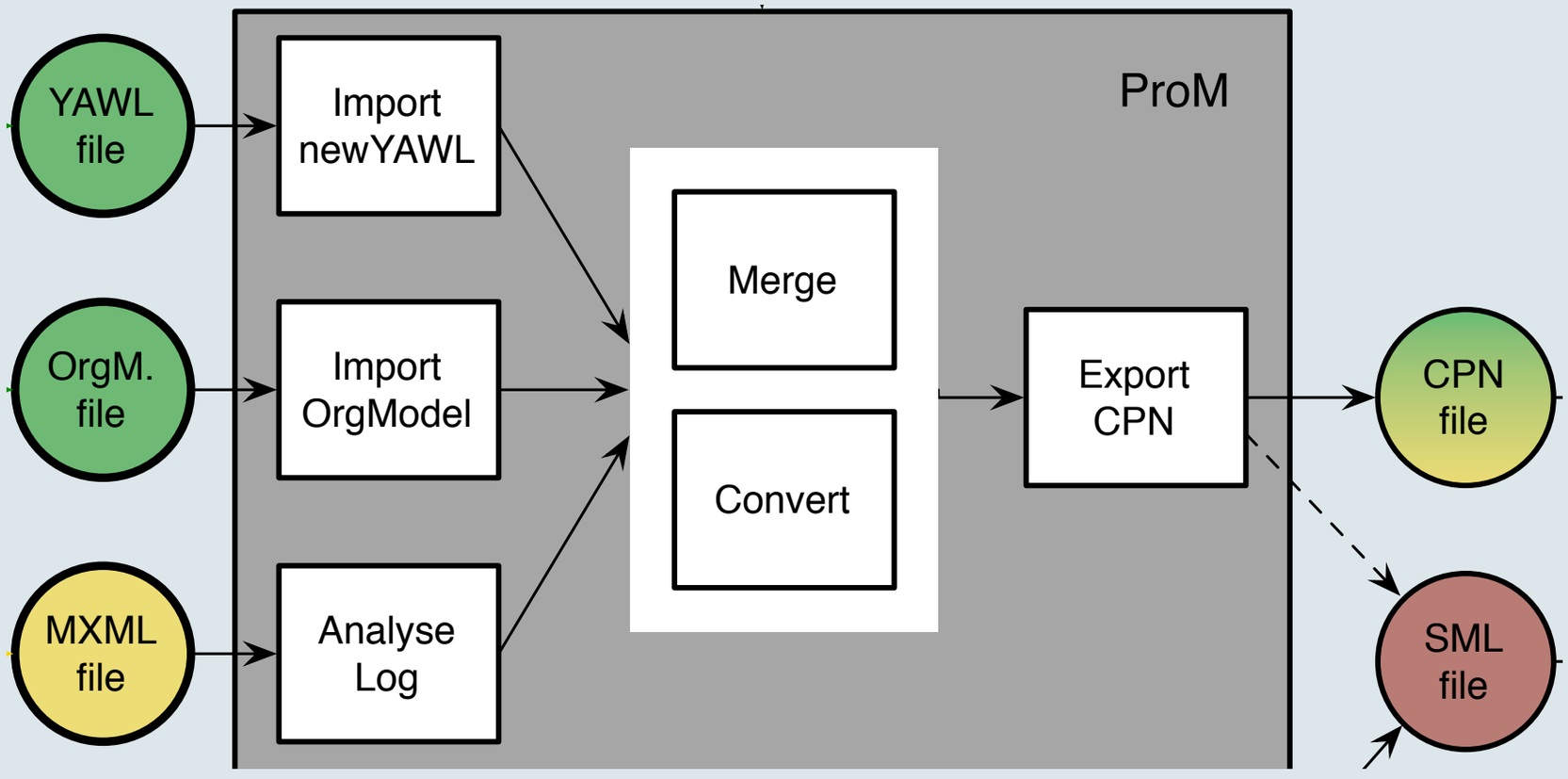

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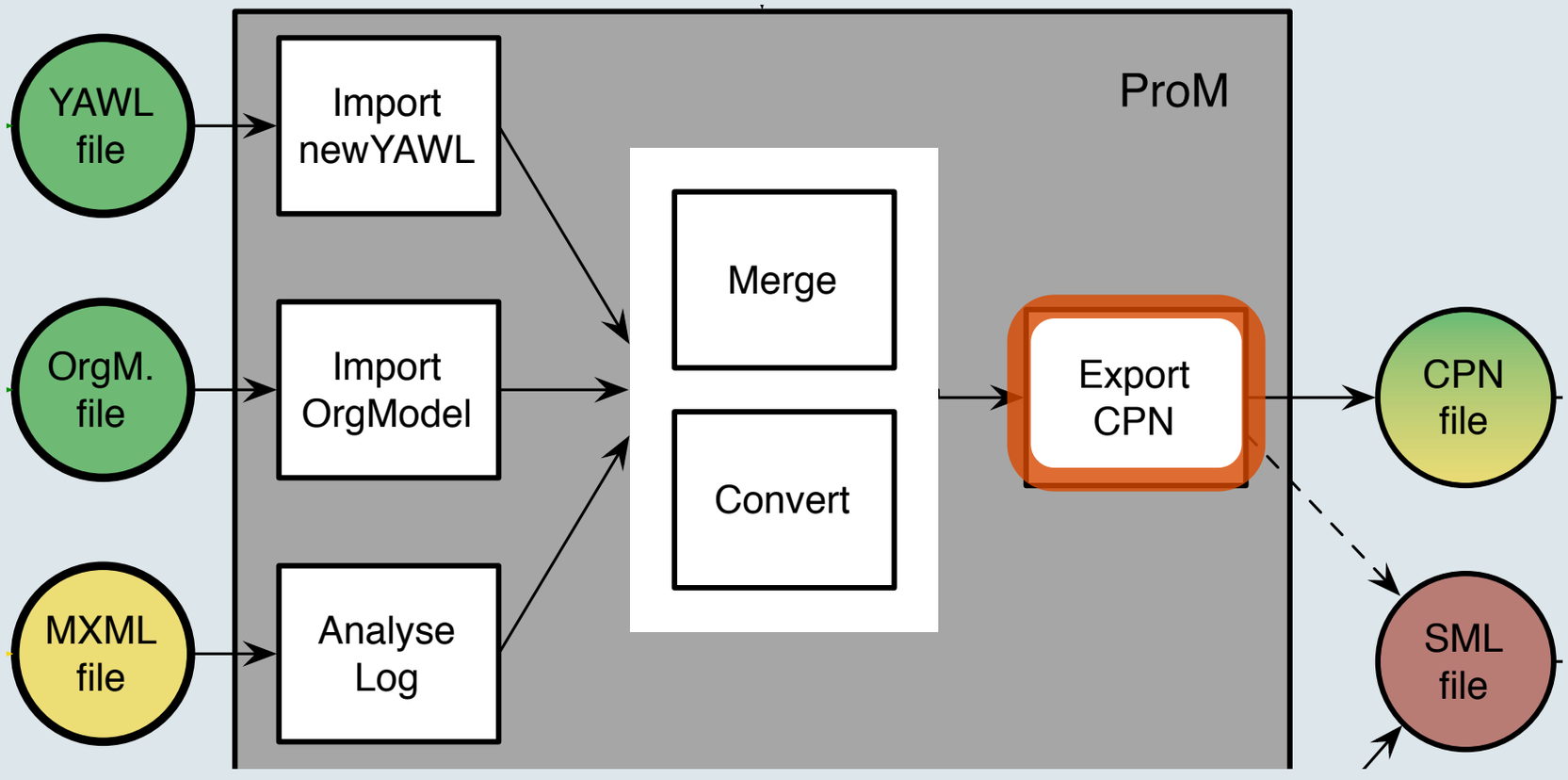

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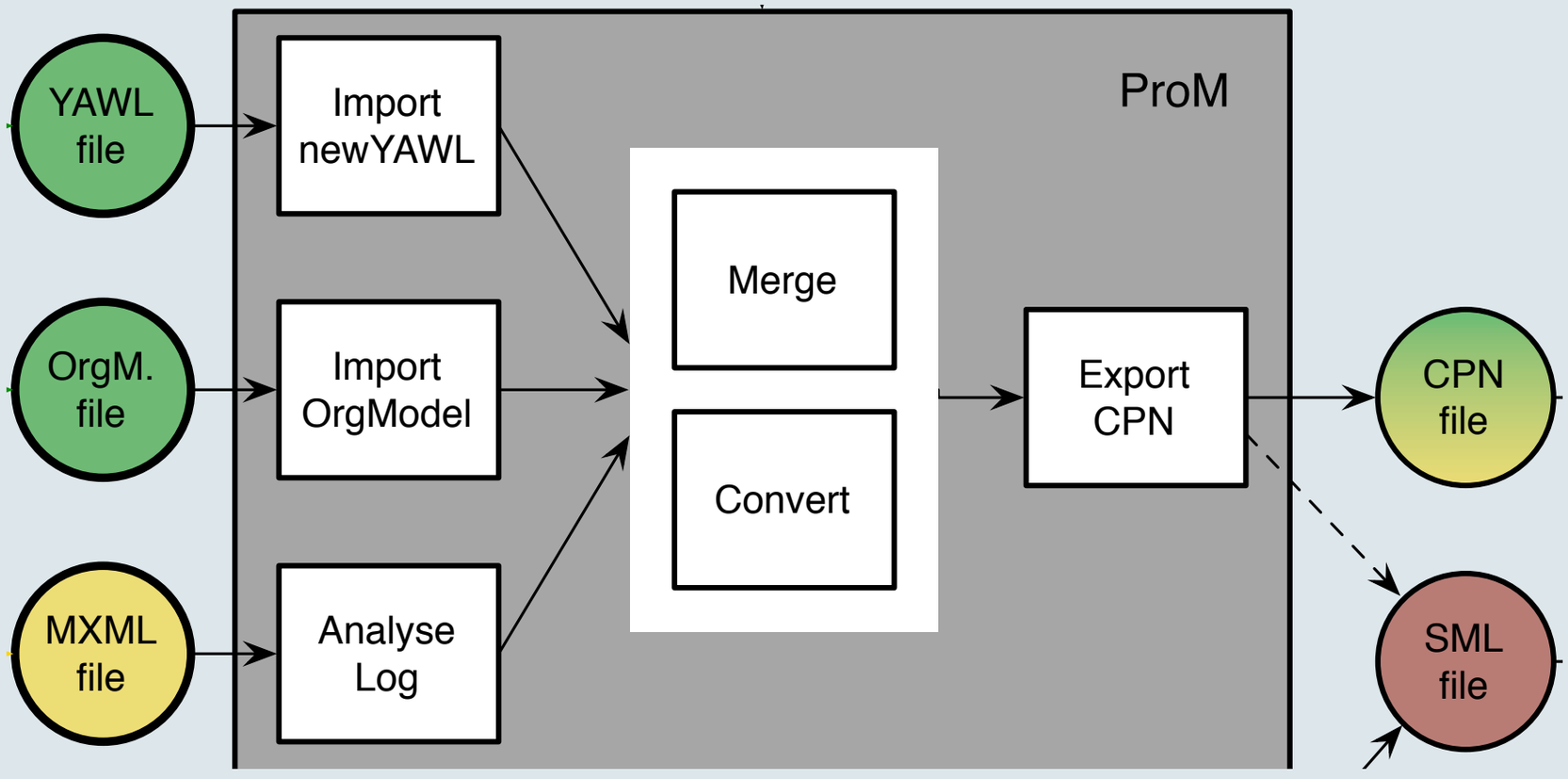

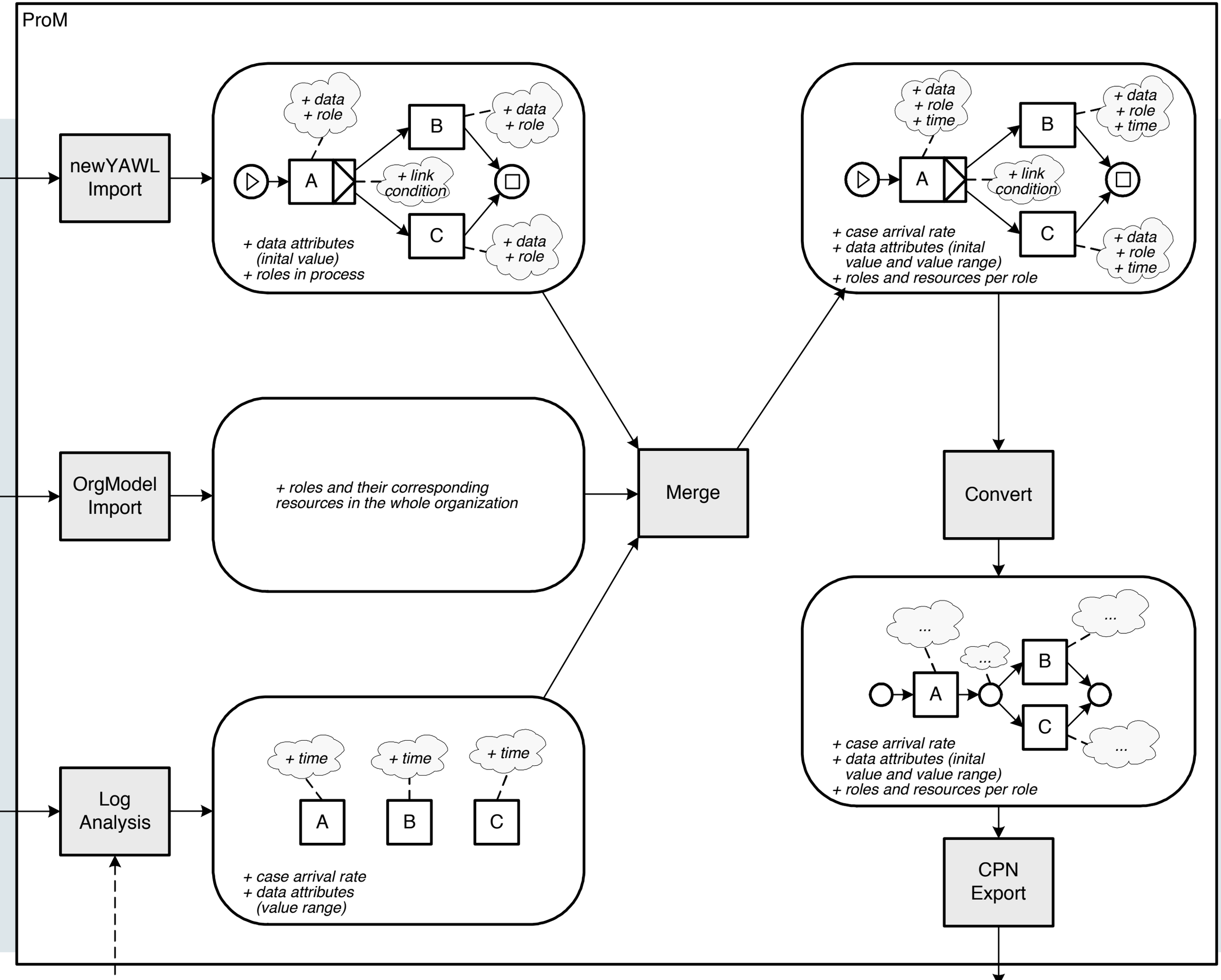
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+ link condition
+ data + role
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+ roles in process
OrgModel Import
+ roles and their corresponding resources in the whole organization
Log Analysis
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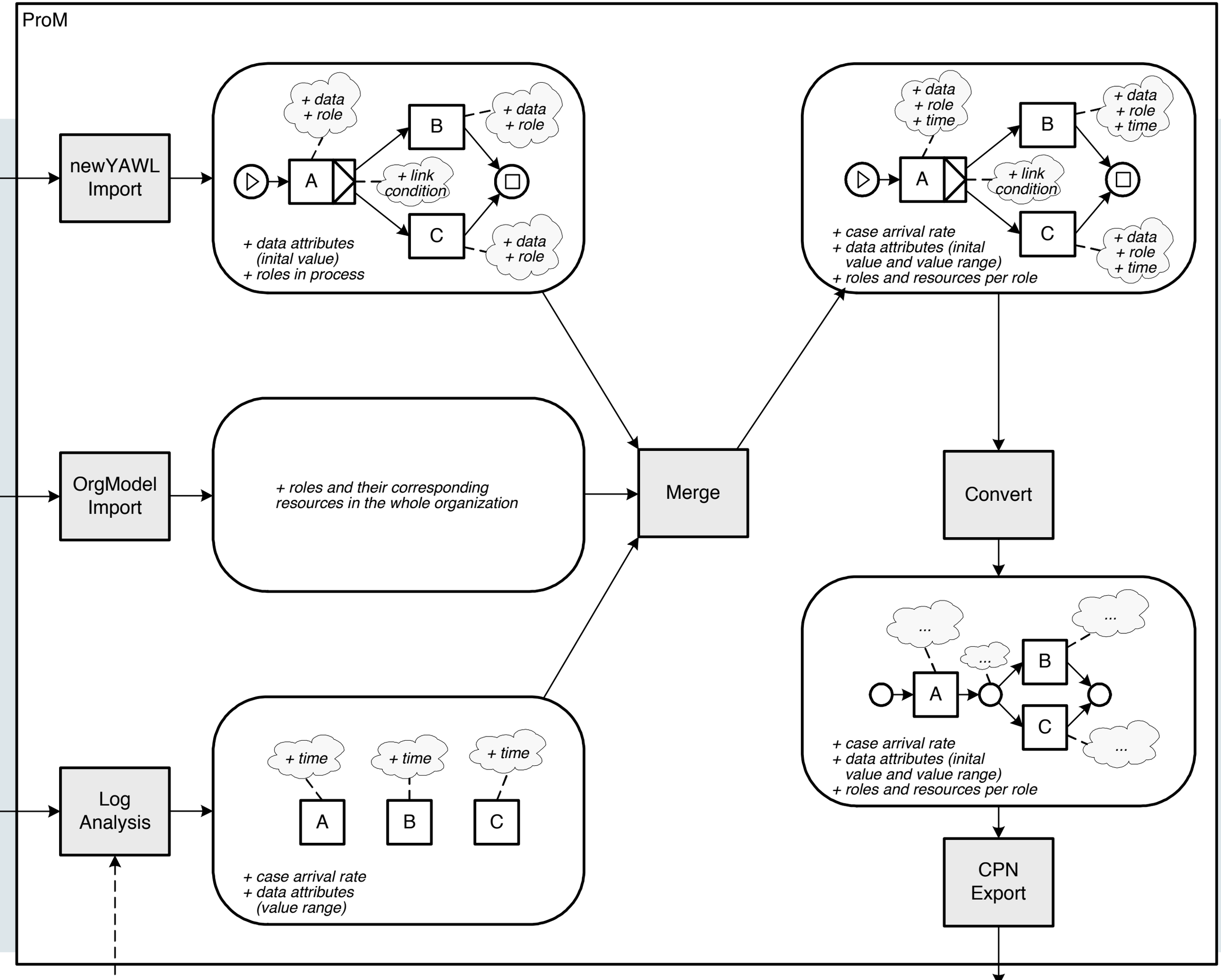
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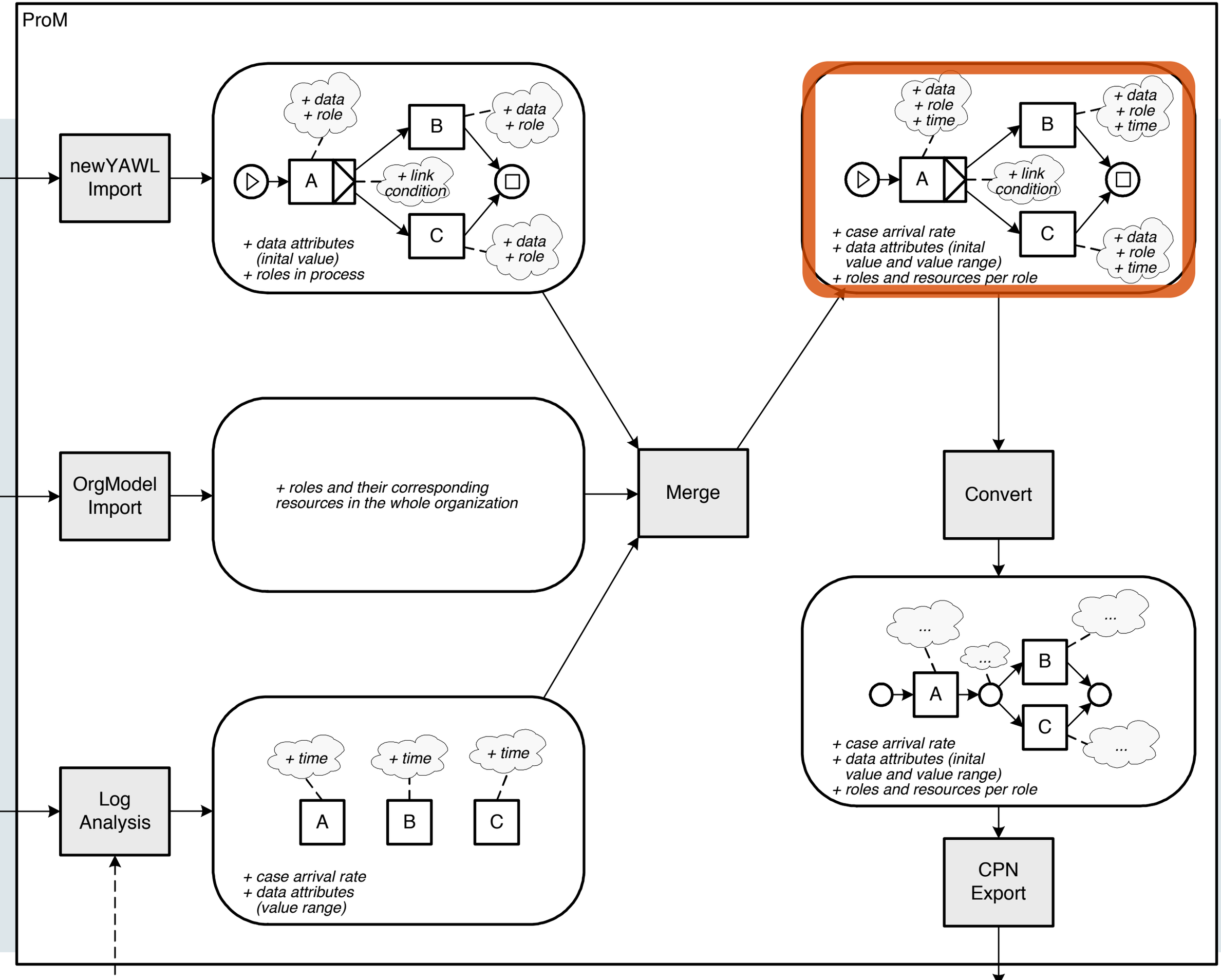
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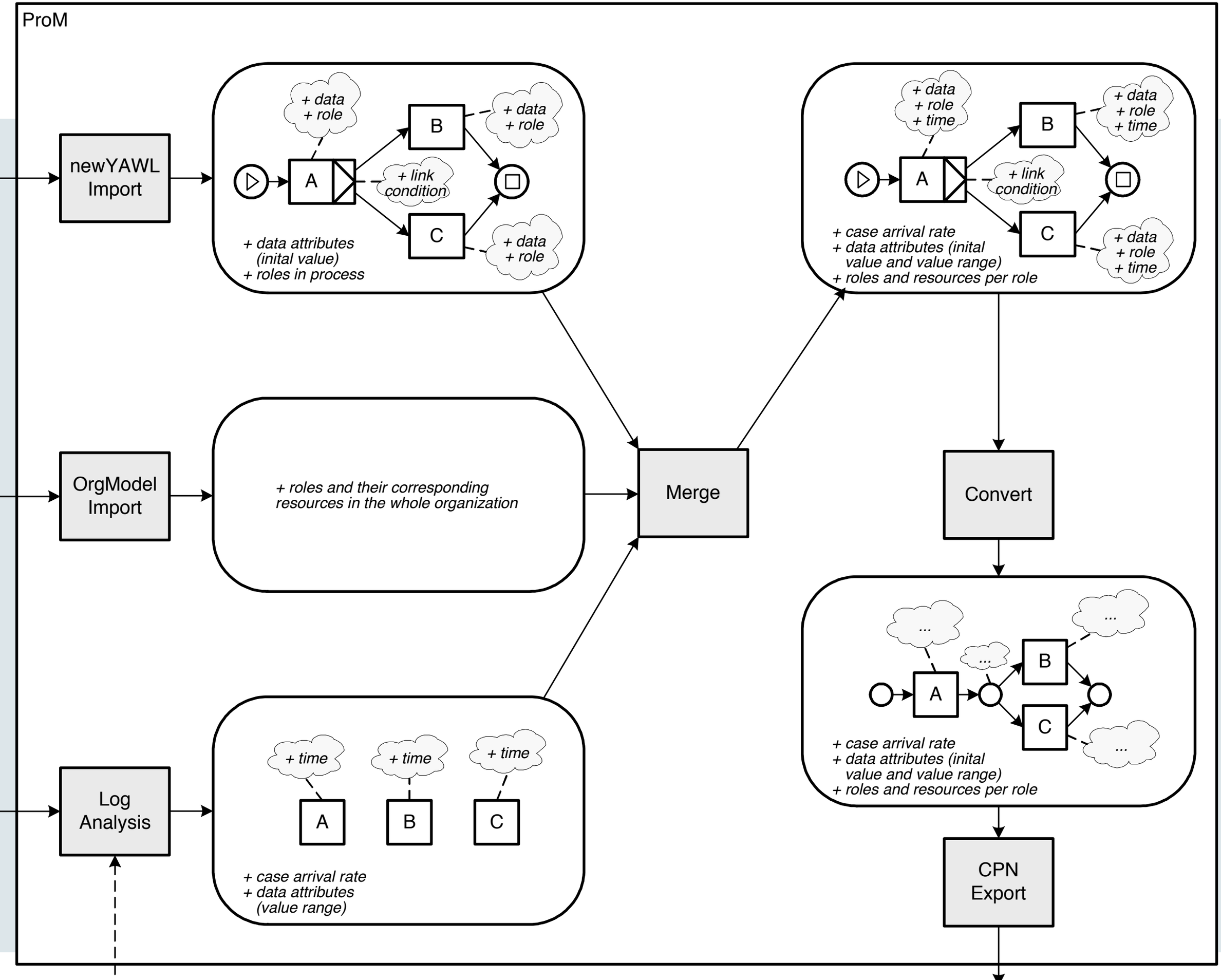
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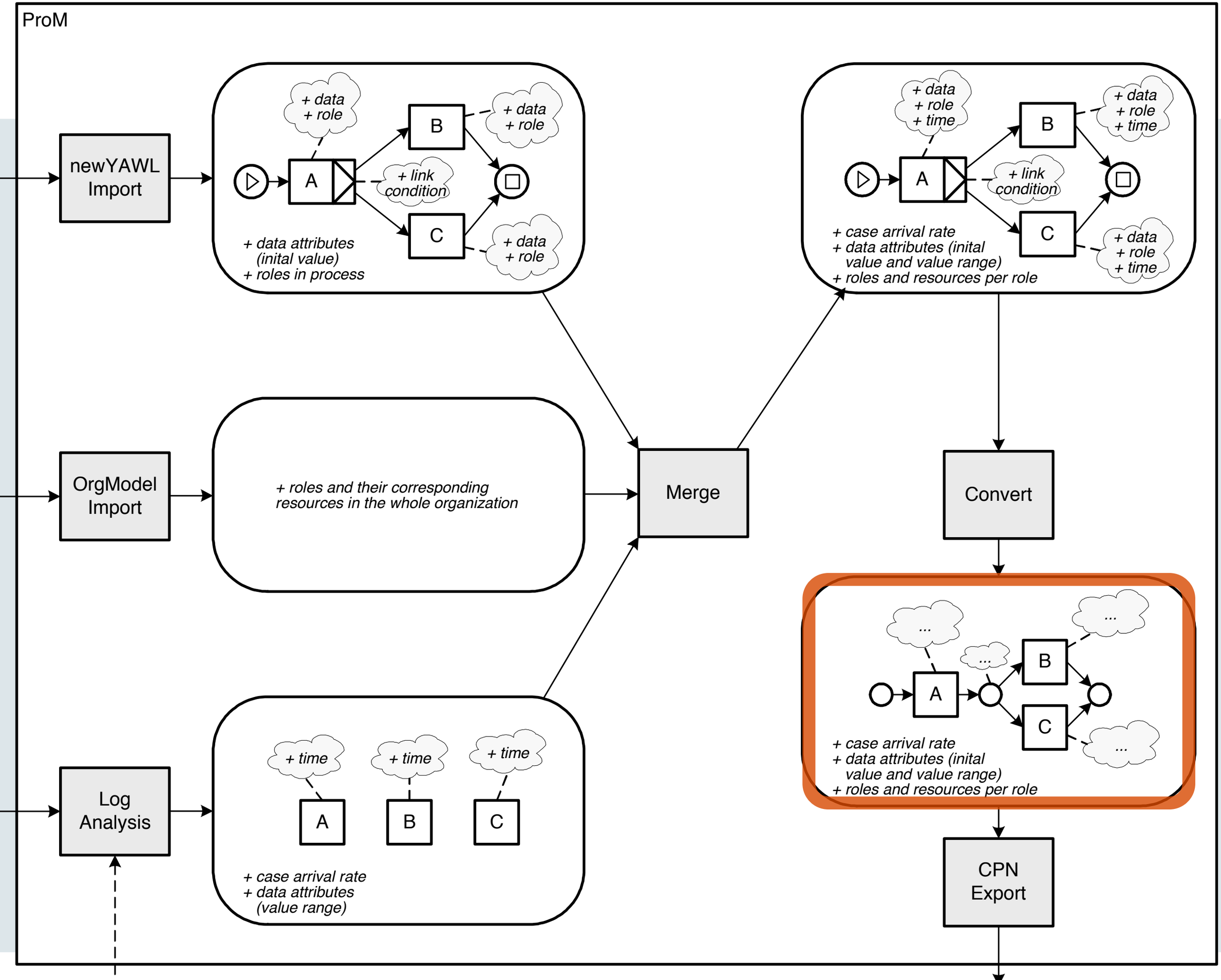
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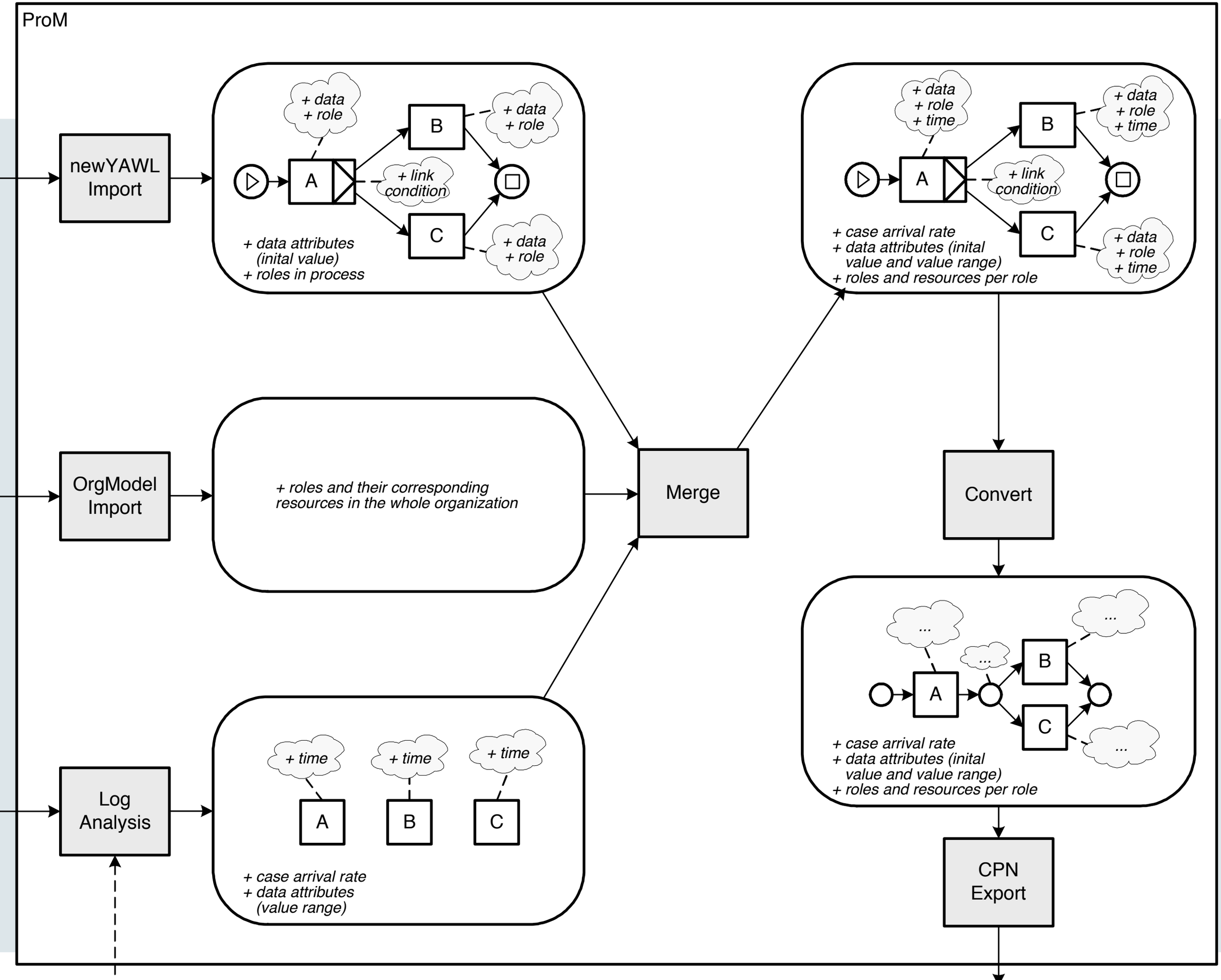
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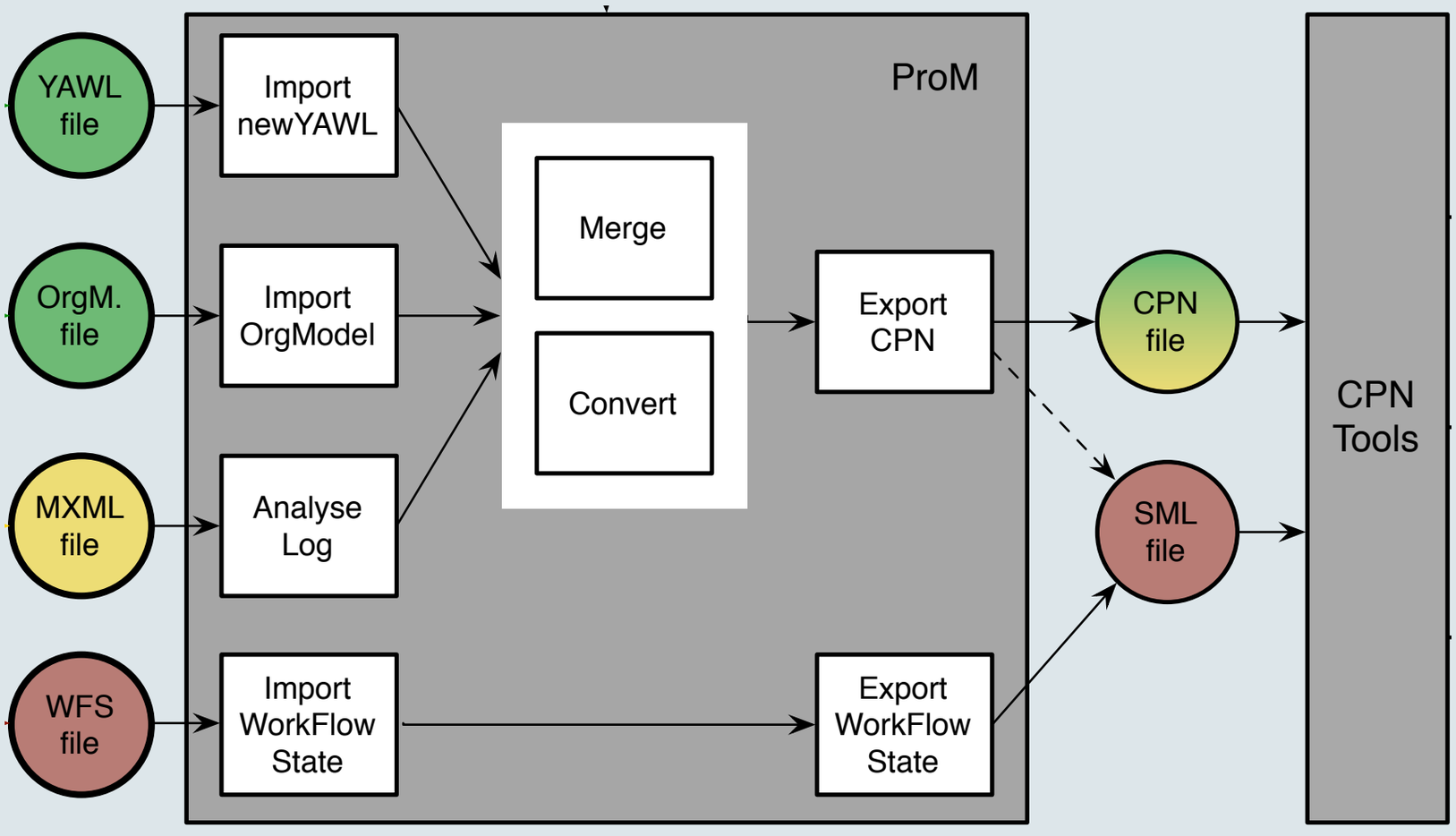
3.4 Loading the Current State

- Current state can be updated without changing the simulation model



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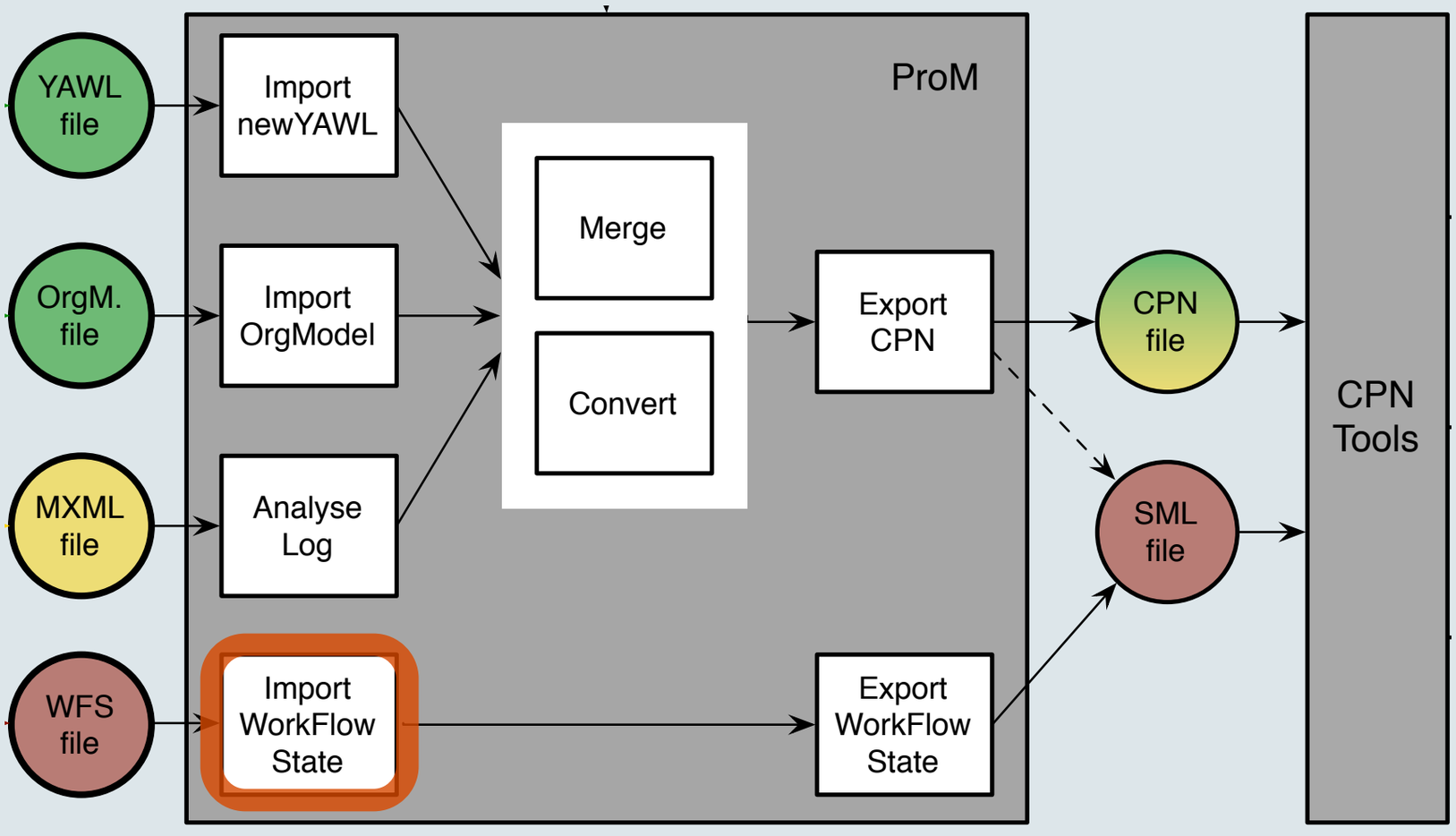

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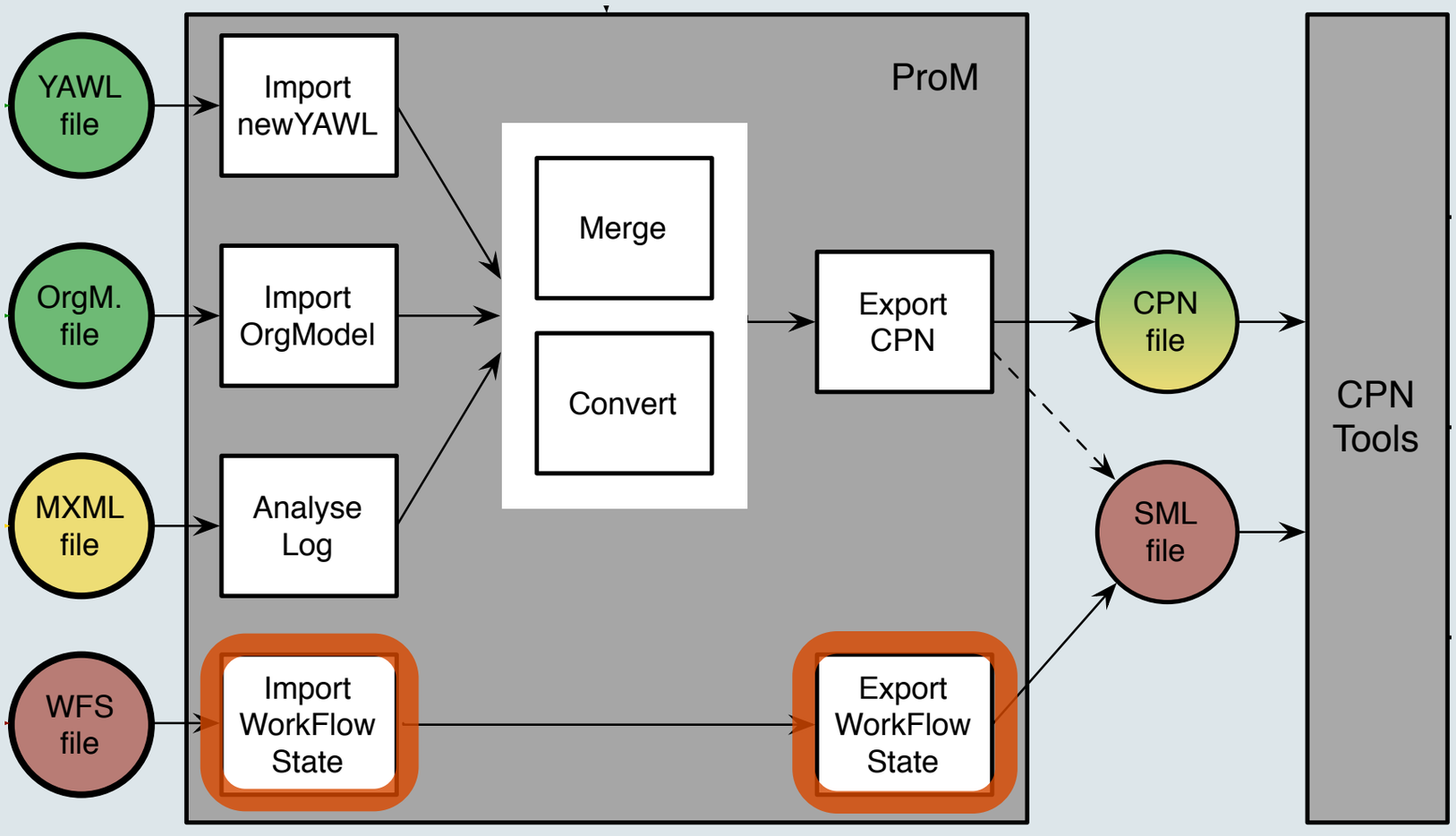

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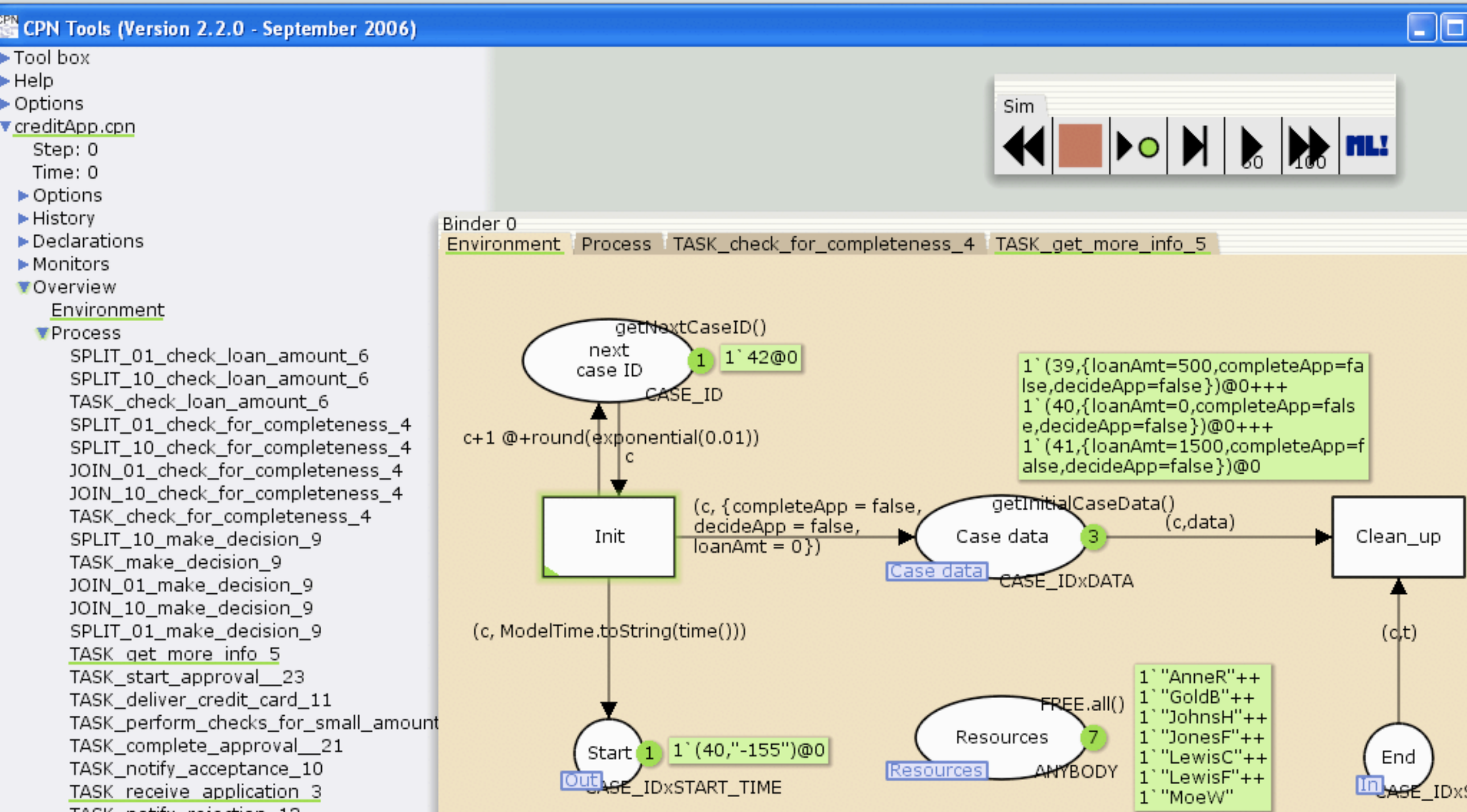

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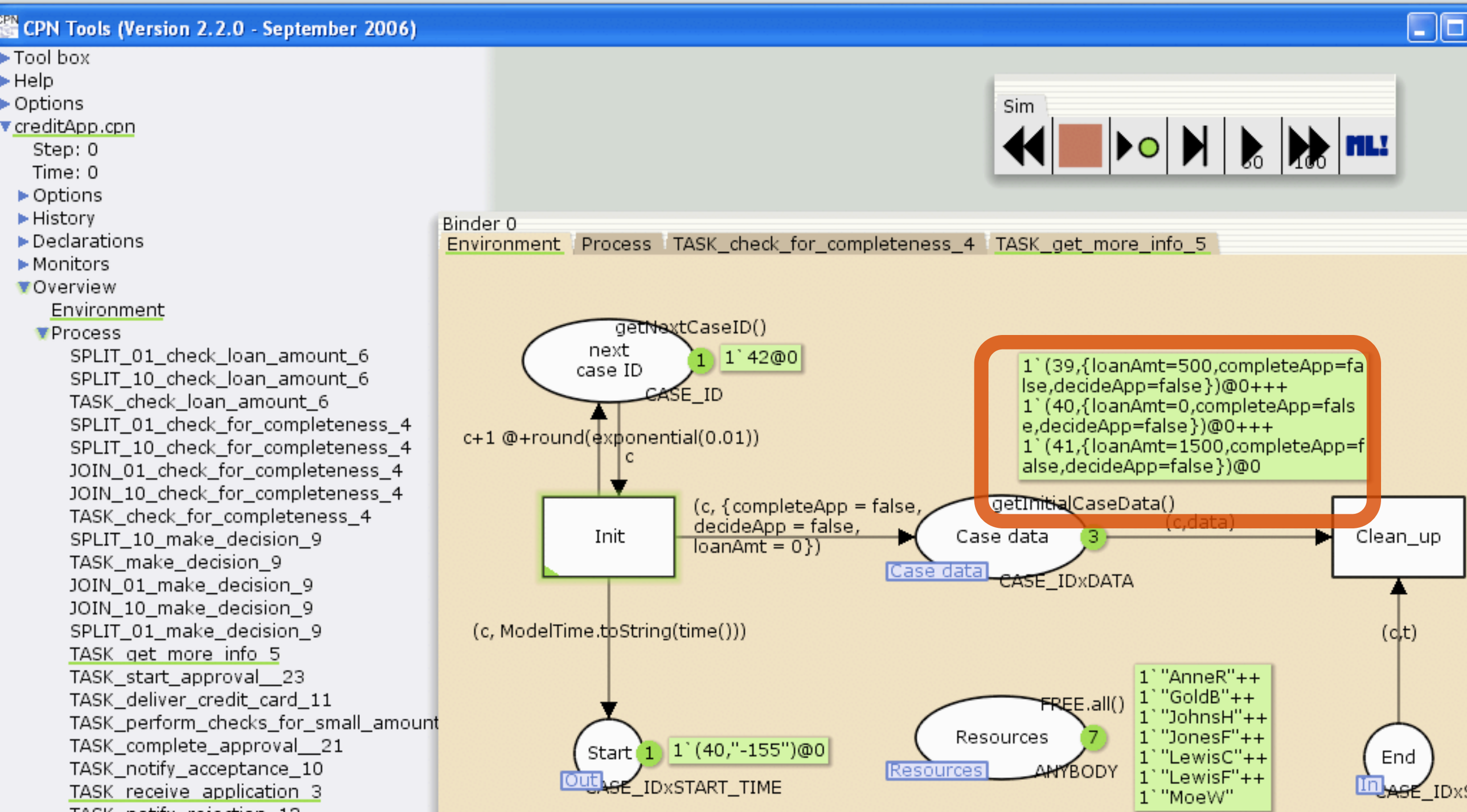

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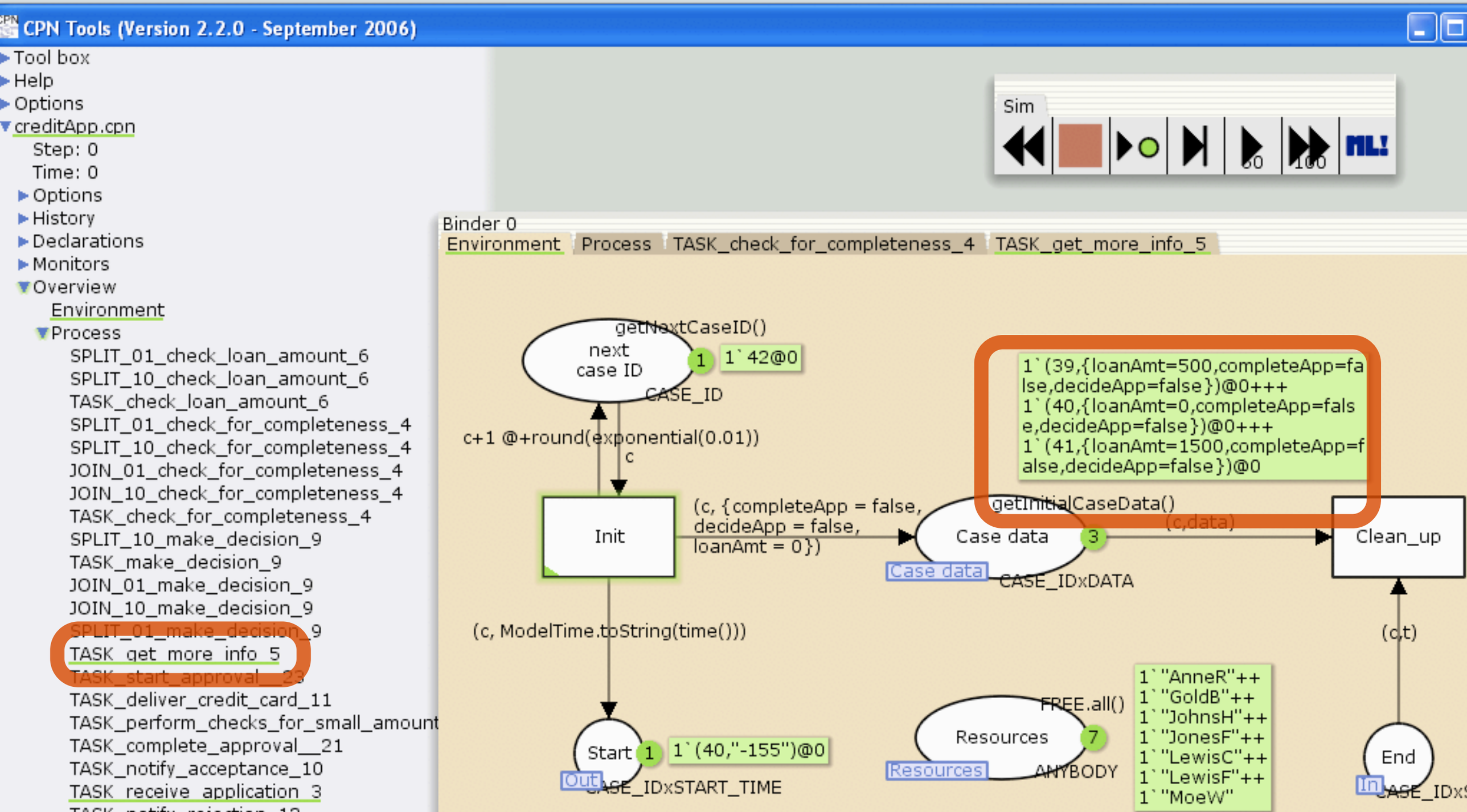
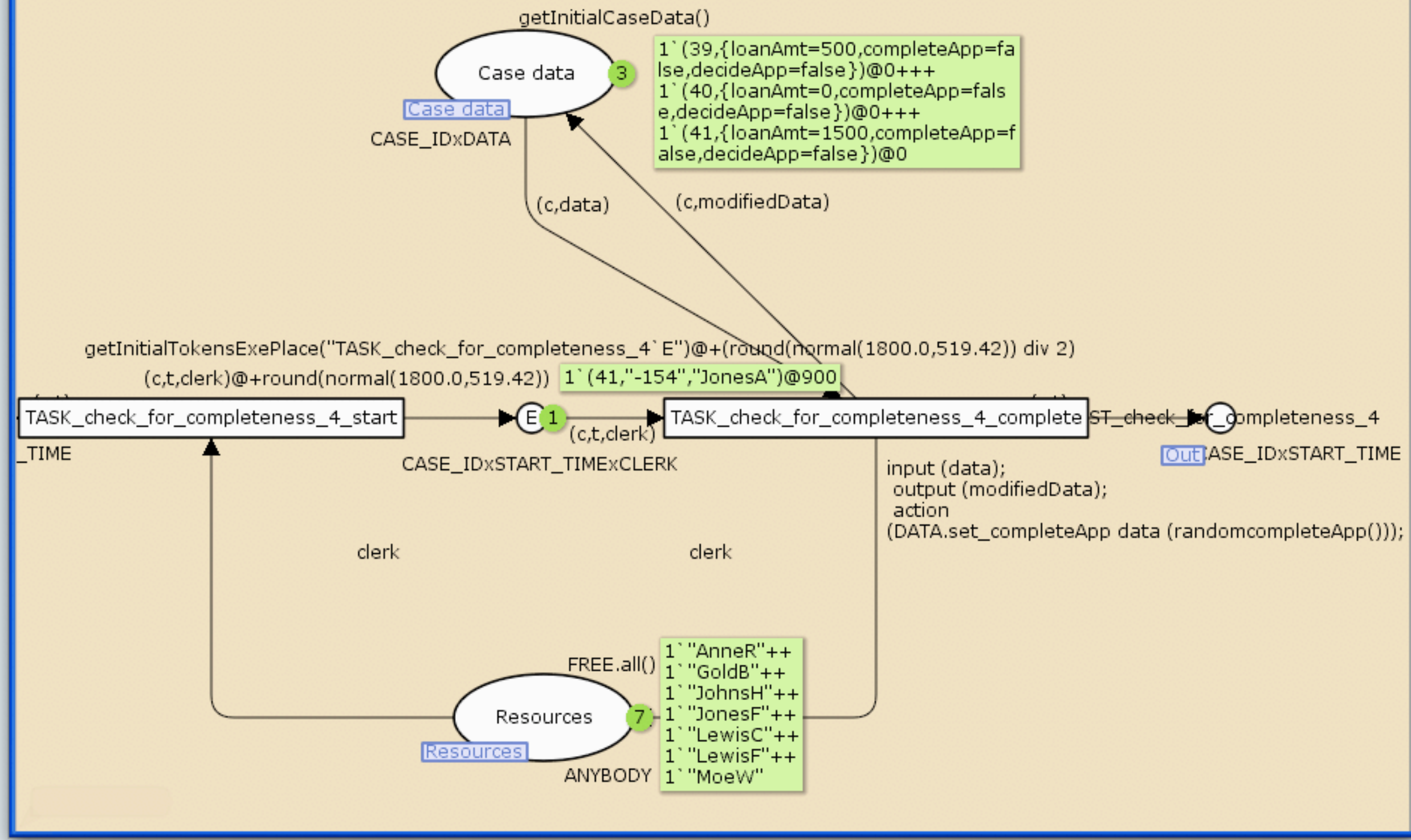


CPN Tools (Version 2.2.0 - September 2006)

Binder 0

Environment | Process | TASK_check_for_completeness_4 | TASK_get_more_info_5



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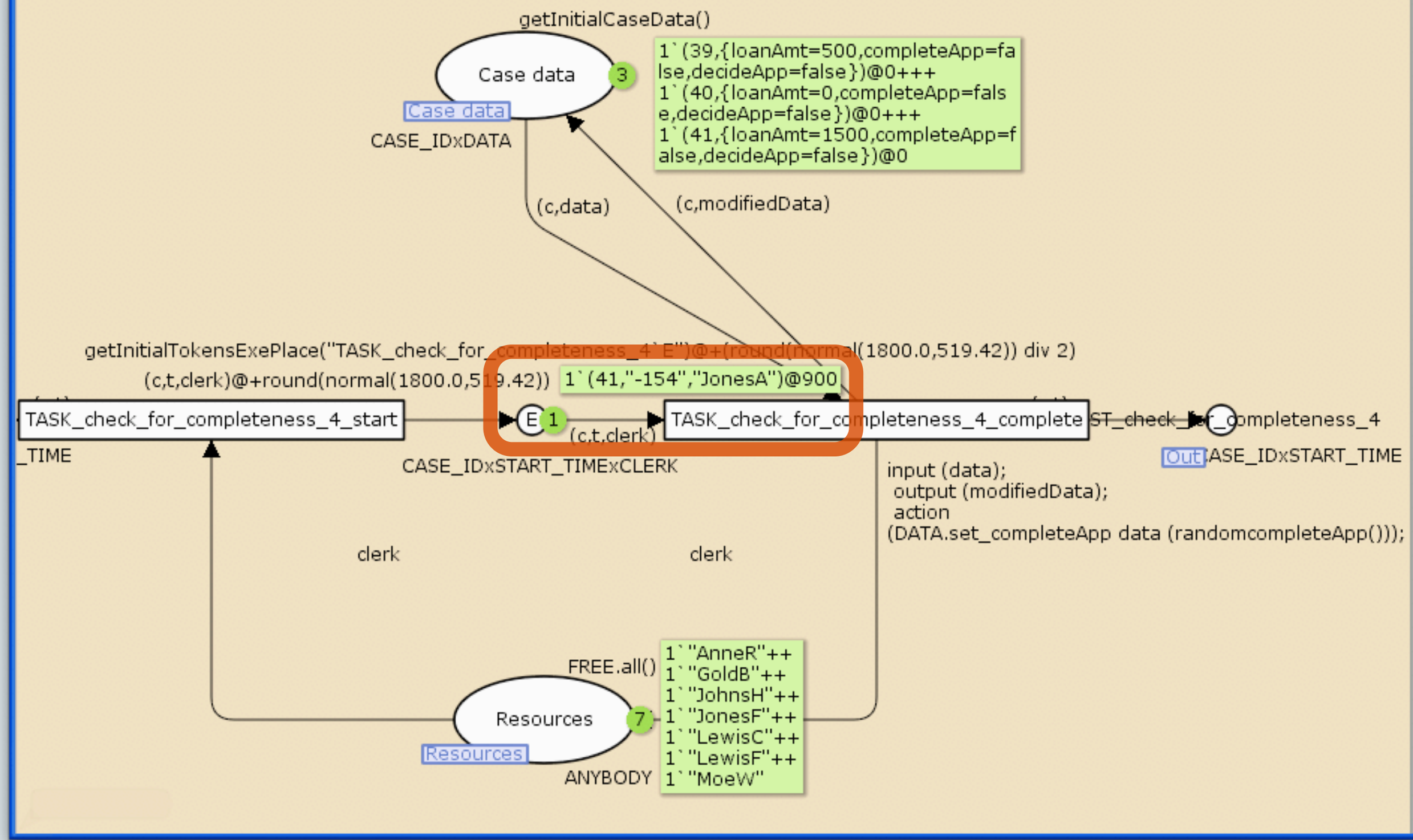

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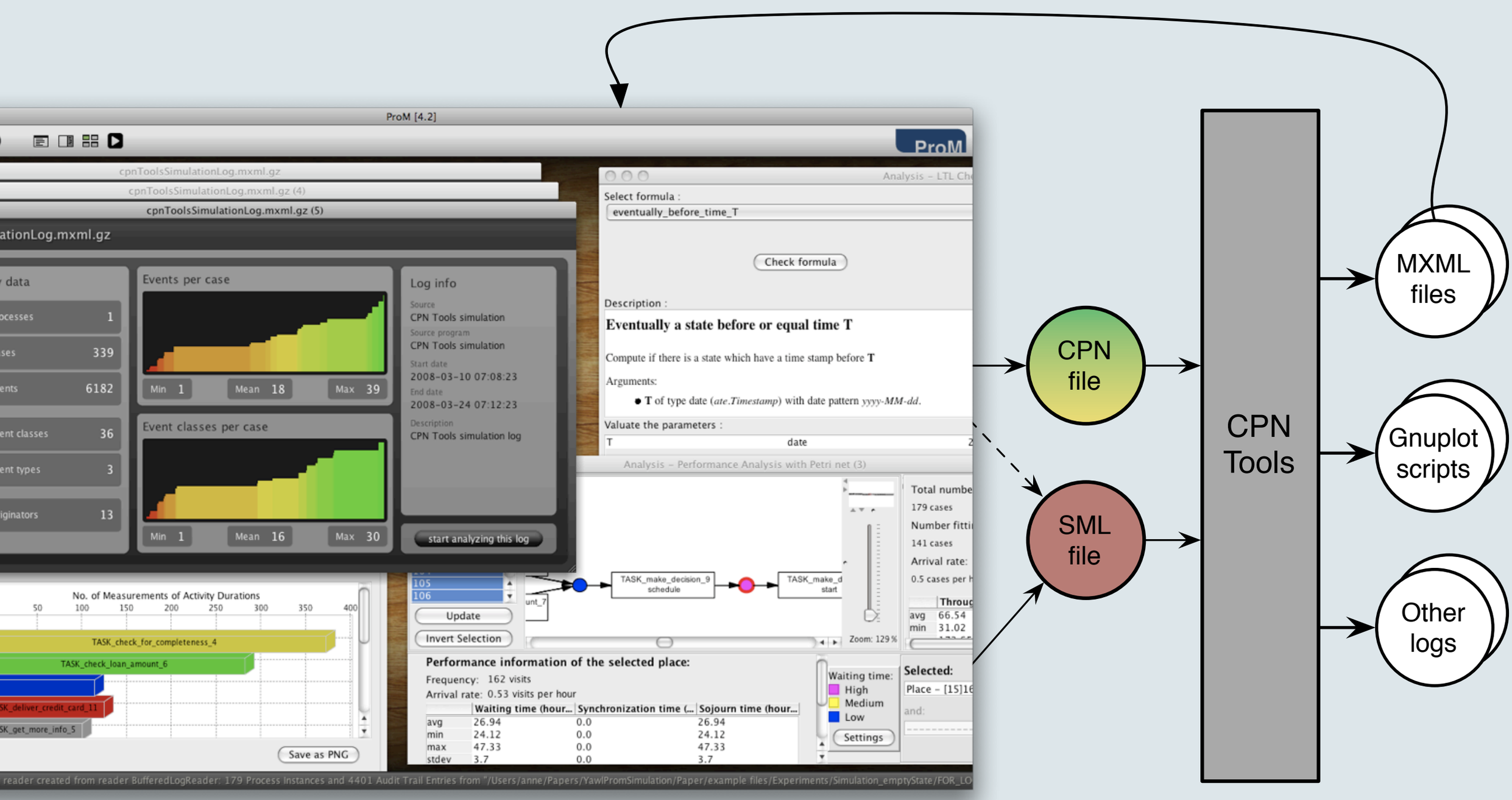
3.5 Analyzing Simulation Logs



3.5 Analyzing Simulation Logs

Example: 4 different simulation scenarios:

1. An **empty** initial state (‘empty’)
2. After loading the **current state** file with the 150 applications currently in the system (‘as is’)
3. After loading the current state file but adding **four extra resources** (‘to be A’)
4. After loading the current state file and adding **eight extra resources** (‘to be B’)

Number of applications that are in the system for four different scenarios

No. of applications in the system

Time horizon: two weeks (in seconds)

1)
2)
3)
4)

'as is'

'to be A'

'to be B'

'empty'

0
20
40
60
80
100
120
140
160
180

0
5000
10000
15000
20000
25000

95 % Confidence Intervals Average Throughput Time in Min
for the Four Simulation Scenarios (50 Replications each)

Confidence Intervals

'as is'
5.88 days

'to be A'
4.91 days

'to be B'
4.72 days

'empty'
3.86 days

Confidence Interval

9000
8500
8000
7500
7000
6500
6000
5500
5000

0
1
2
3
4
5

Simulation Scenarios

Outline

1. Three Common Pitfalls
2. Our Approach
3. Realization through YAWL and ProM
4. **Discussion**

5. Discussion

- Faithful simulation models
  - ★making use of existing artifacts (e.g., process history)
  - - But: modeling human behavior remains challenging

- Short-term simulation
  - ★operational decision making based on current state
  - - But: tool integration can be improved (feedback)

- Viewing real and simulated process in unified manner
  - ★simulation analysis results can be more easily related to initial properties of the process