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The Information Systems Modeling Suite:
Modeling the Interplay between Information and Processes

Jan Martijn van der Werf
Artem Polyvyanyy

Information system: structure and process

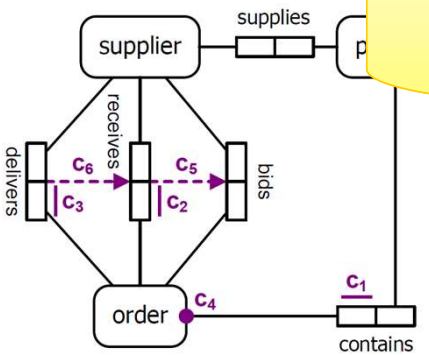
- Information modeling
  - **Structure of data**
  - **Data retrieval and querying**
  - **Data manipulation**
  - **…**

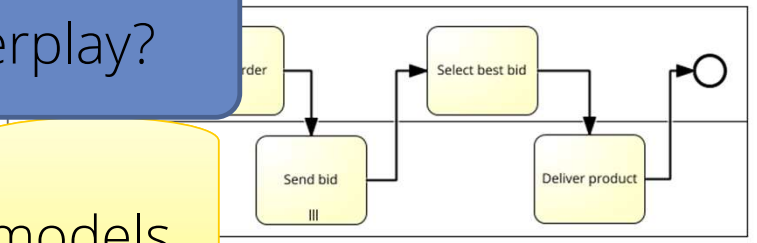
- Process modeling
  - **Flow of tasks**
  - **Who manipulates data, and when?**
  - **How is data transferred from A to B?**

How to model and simulate their interplay?

Data models

Process models





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A purchase process system

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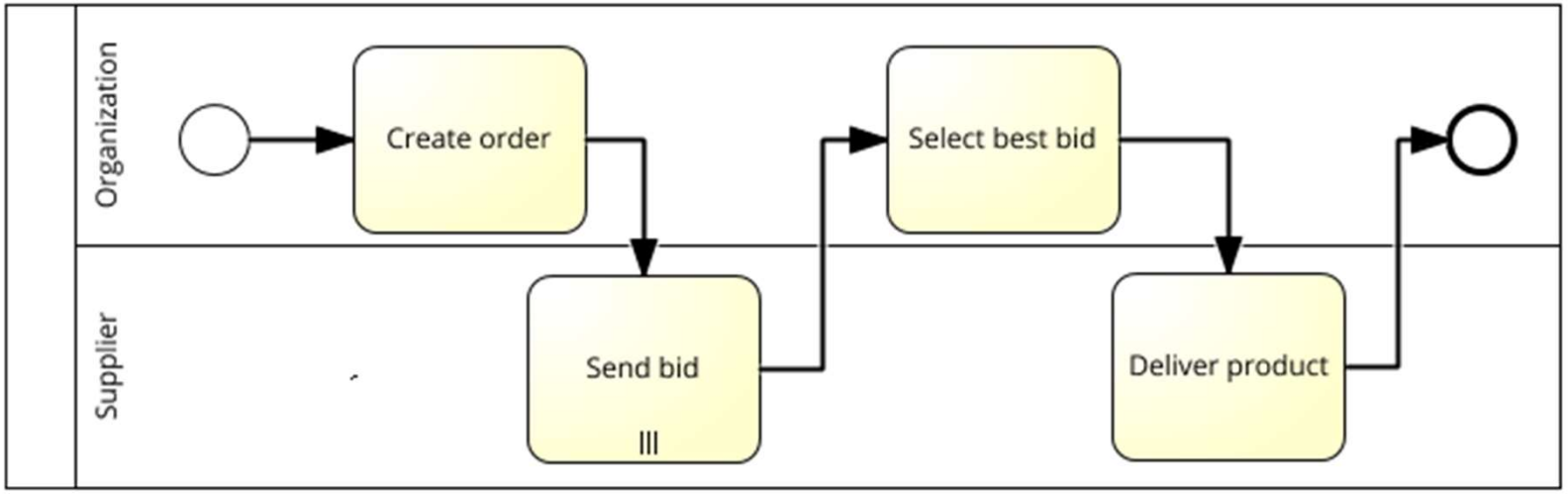
- For each product:

  create order, let suppliers bid, select the best offer
  Constraint: at least two different suppliers should bid!



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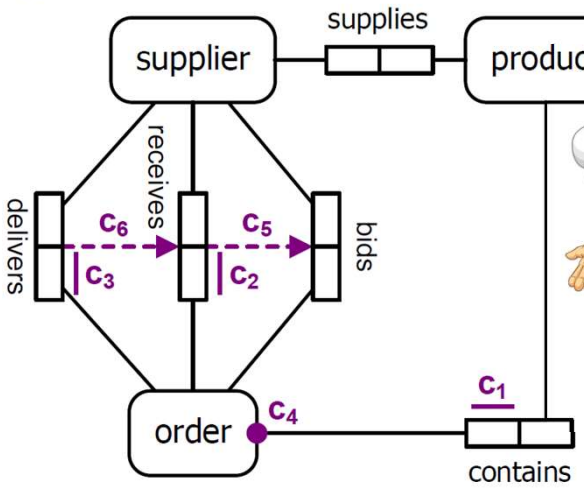

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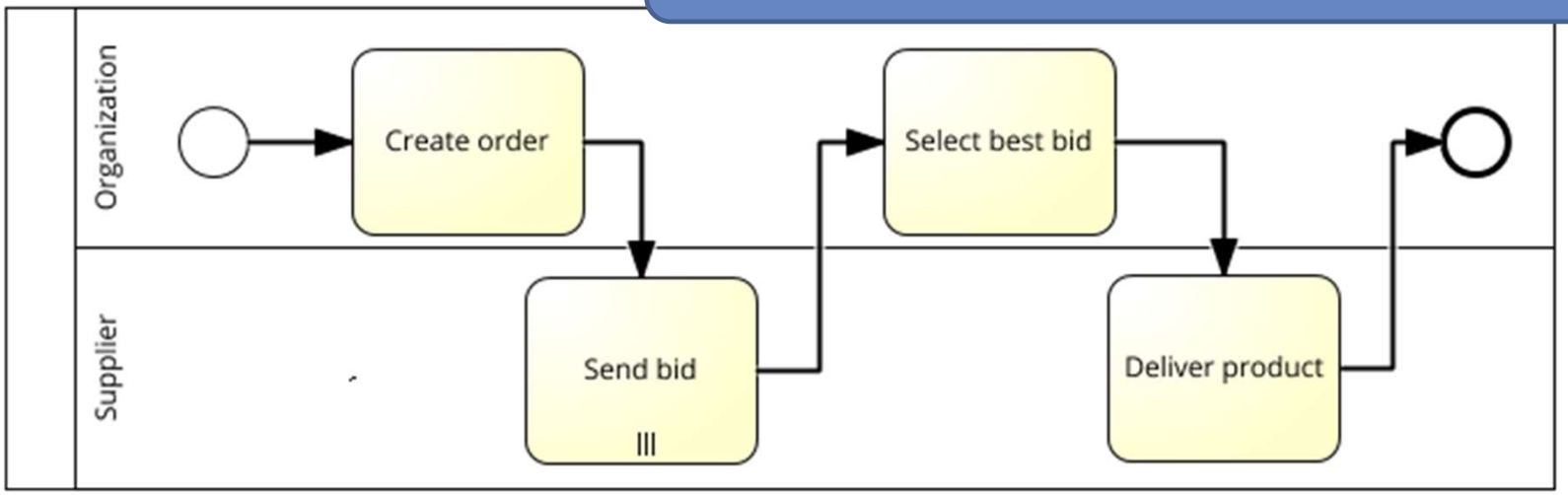

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Information Systems Modeling Language

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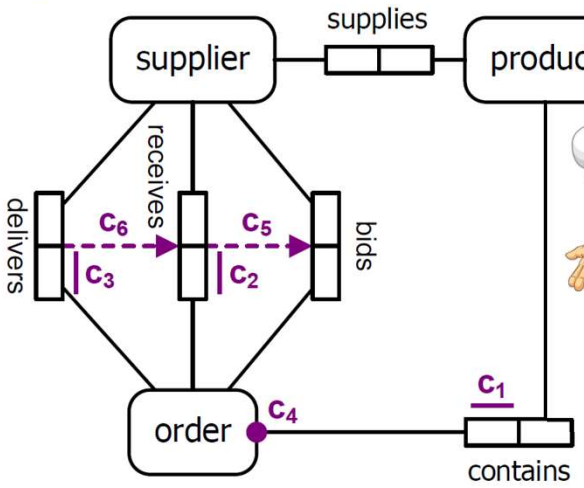
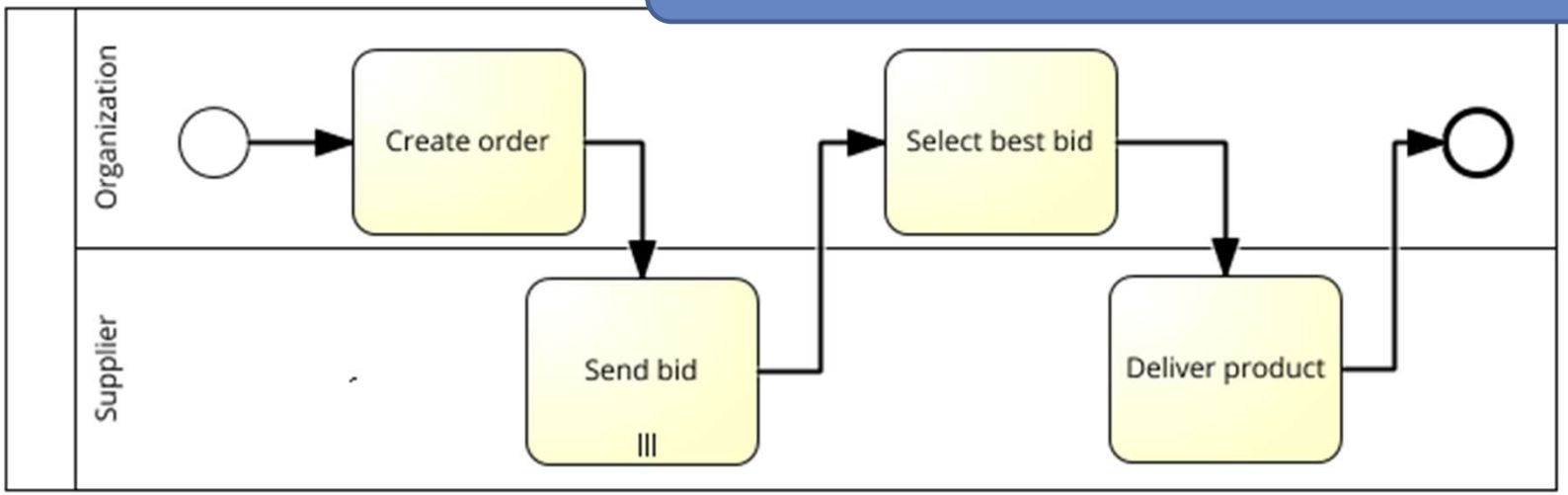


1. Information model
2. Process model: Petri nets with identifiers
3. Specification to define the manipulations

How to model and simulate their interplay?



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Information model

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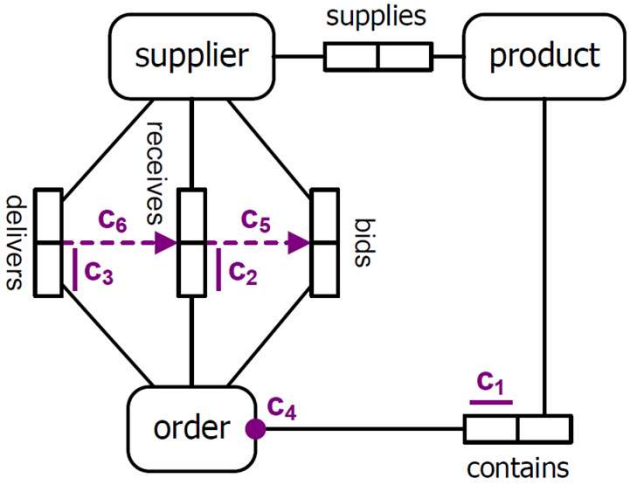
$$\forall o \in order, s_1 \in supplier : \left(receives(s_1, o) \Rightarrow \exists s_2 \in supplier : (bids(s_2, o) \wedge s_1 \neq s_2)\right)$$



- Information model
  - **Entity types**
  - **Relation types**
  - **Constraints**
    - Subtype
    - Uniqueness
    - Mandatory
- Population
  - **Sets for each entity & relation**
  - **Valid if all constraints hold**
- Transaction
  - **Add & remove entries from sets**
  - **Valid: if it results in a valid population**

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Petri nets with identifiers

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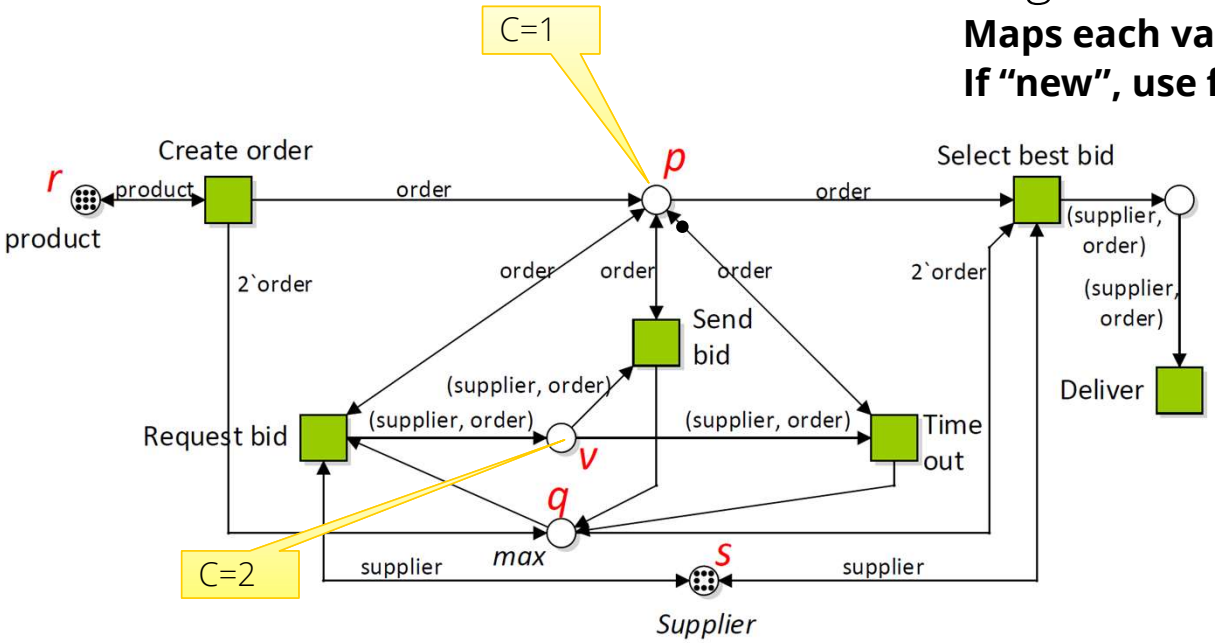
- Each place has a *length*, denoted by C(p)
  - **Implied by the vector of variables on the arcs**
- Variable vectors on arcs
  - **"Creator" variable: only on output**
- Binding:
  - **Maps each variable to ID**
  - **If "new", use fresh ID**



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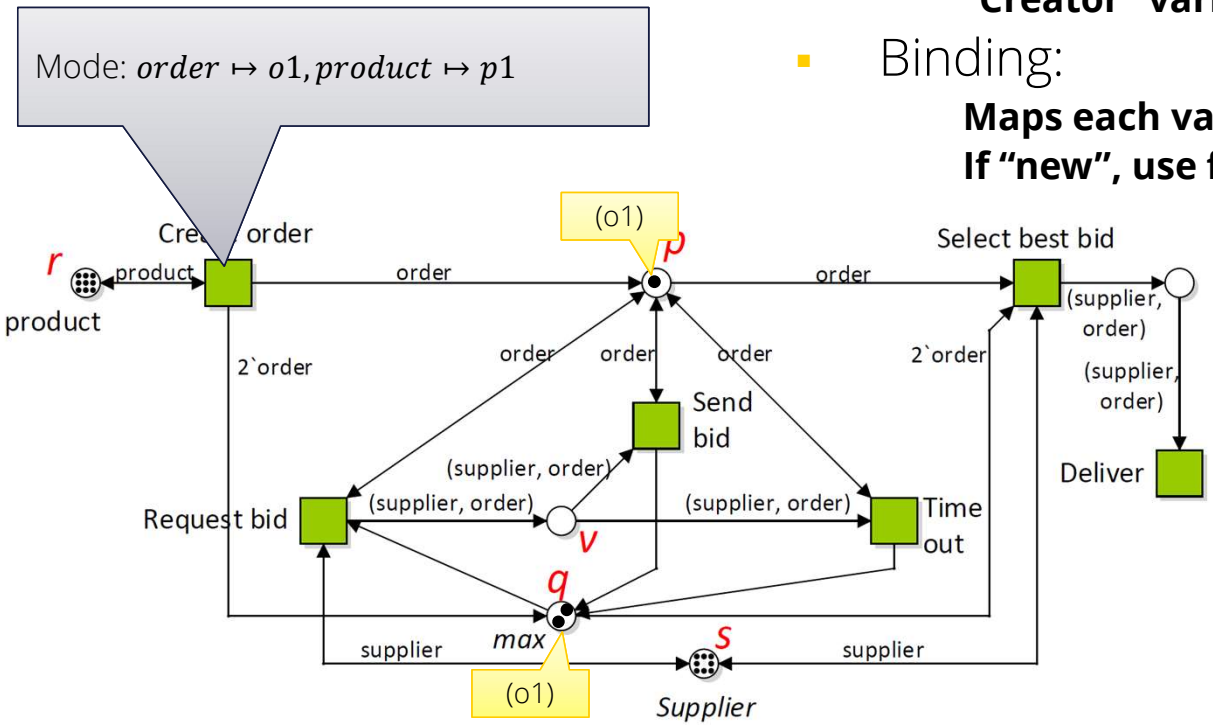

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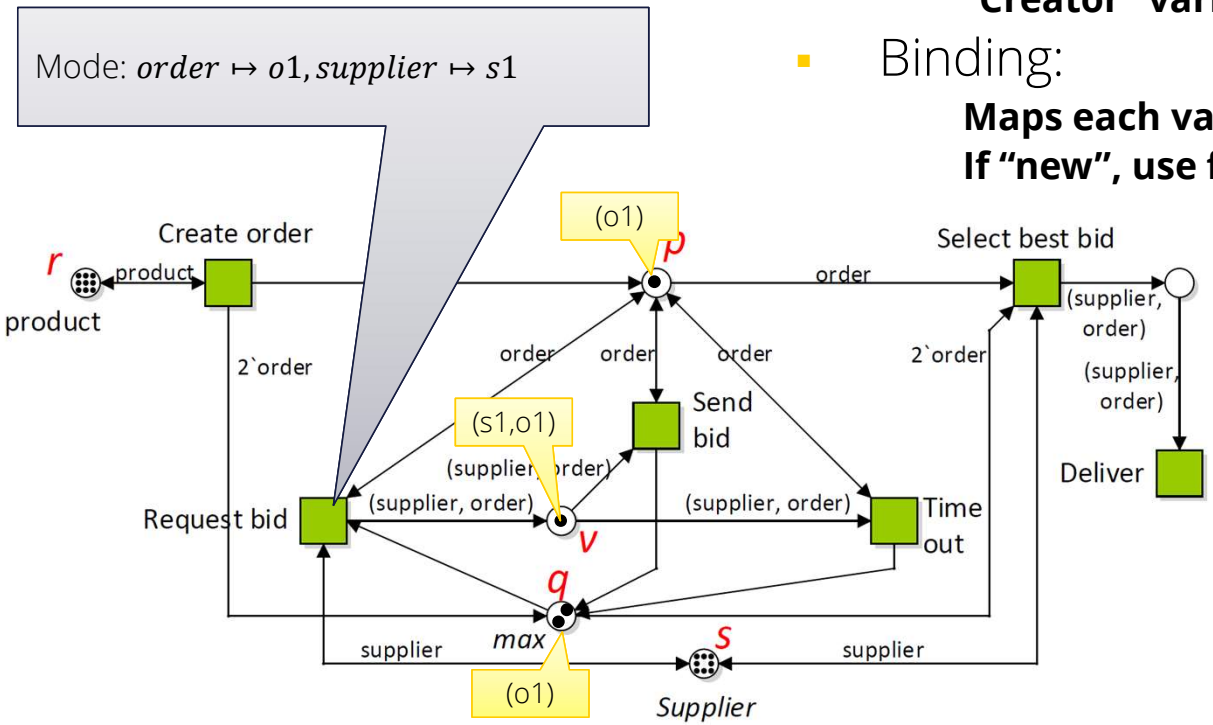
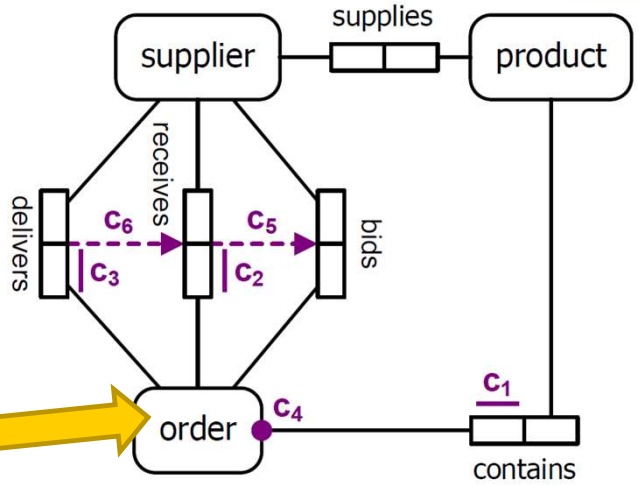
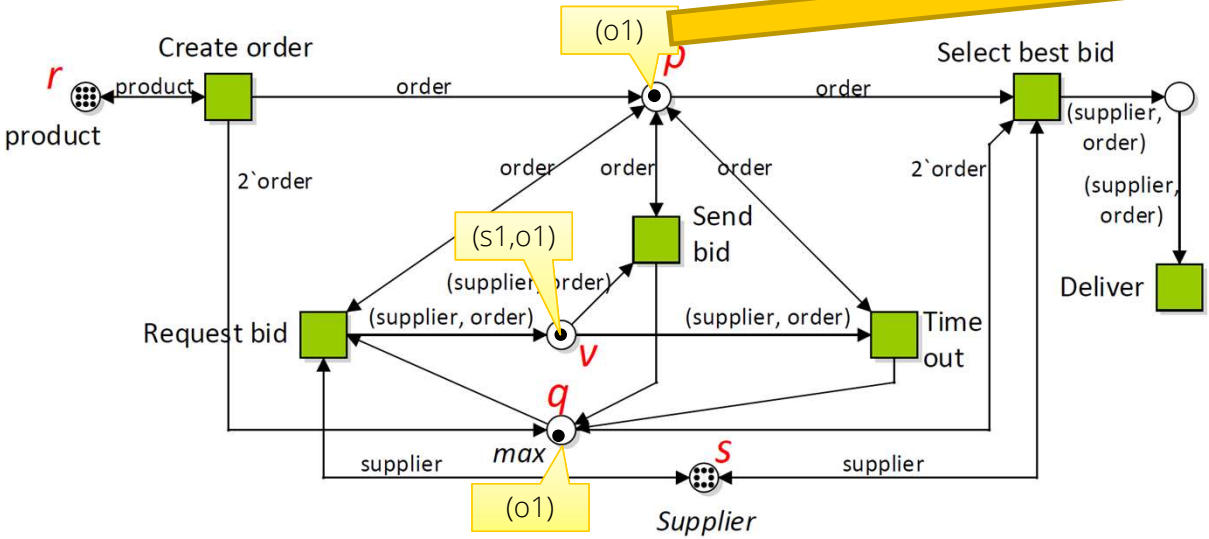


Combining information and process models

Identifiers point to entities





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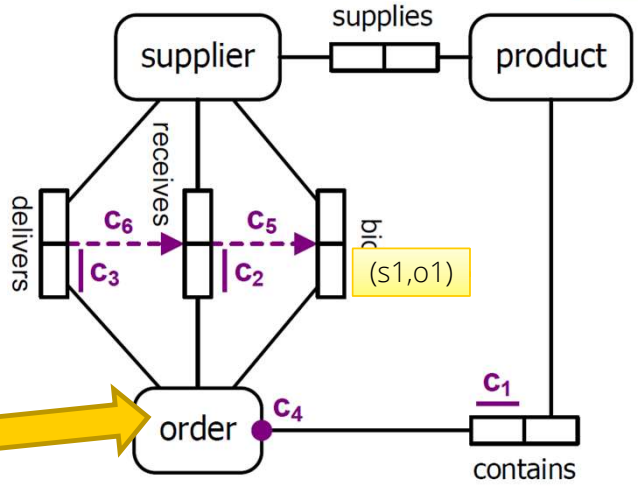

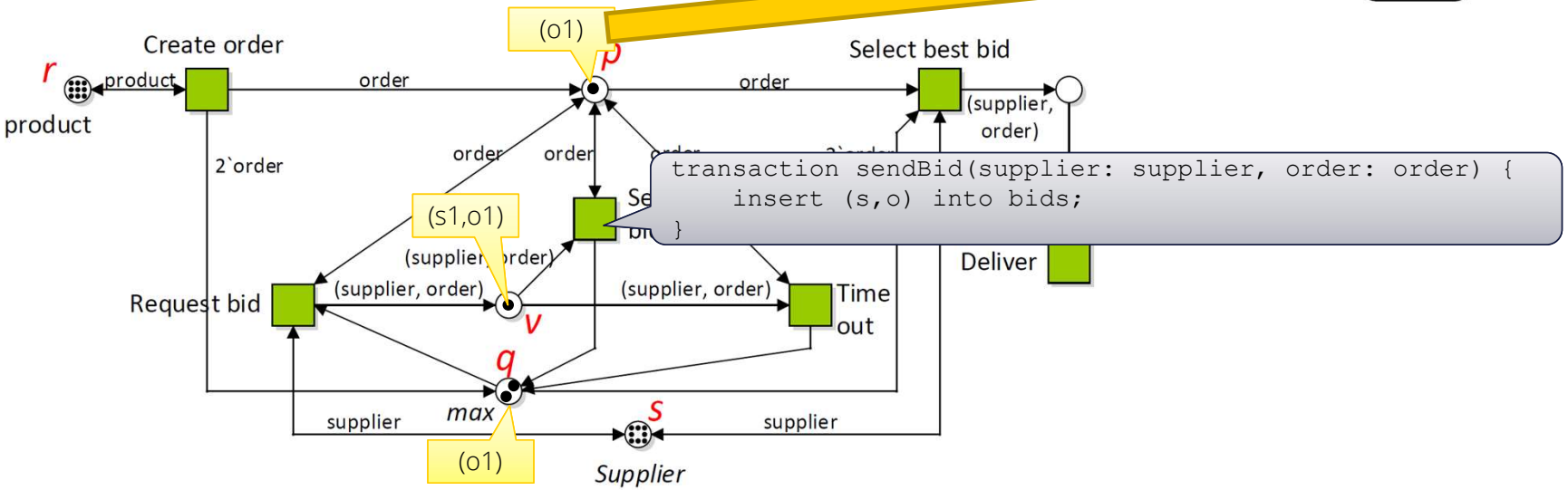

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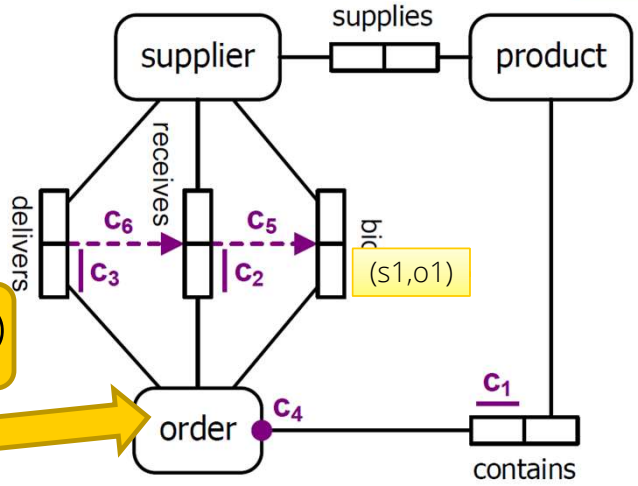

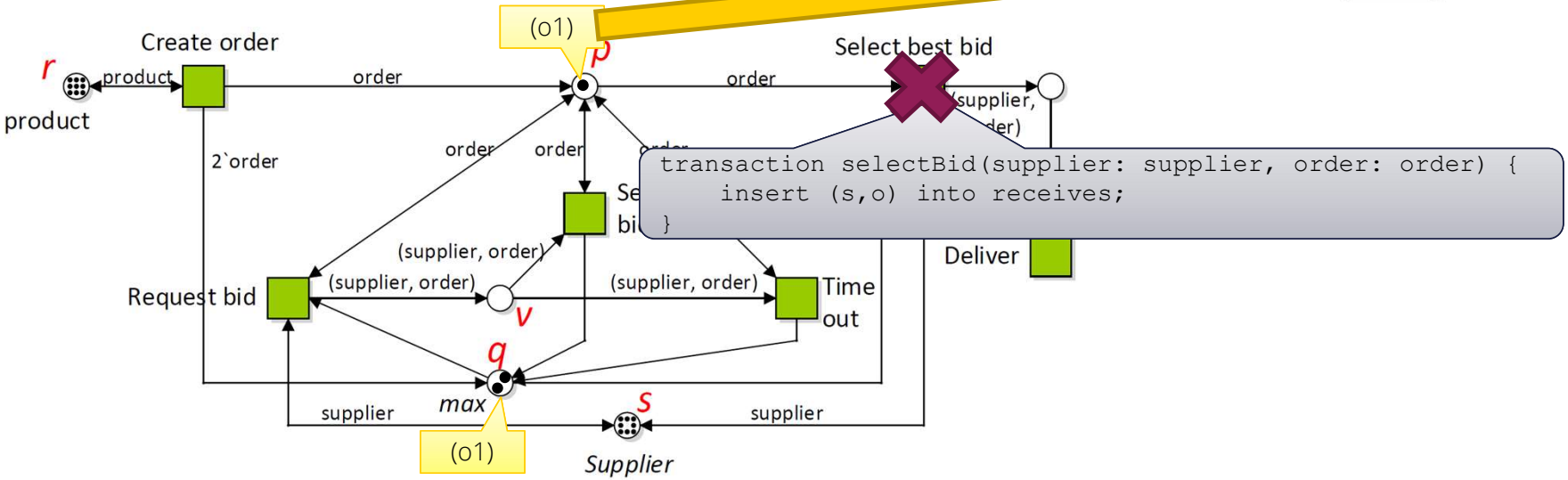


```
transaction selectBid(supplier: supplier, order: order) {
    insert (s,o) into receives;
}
```

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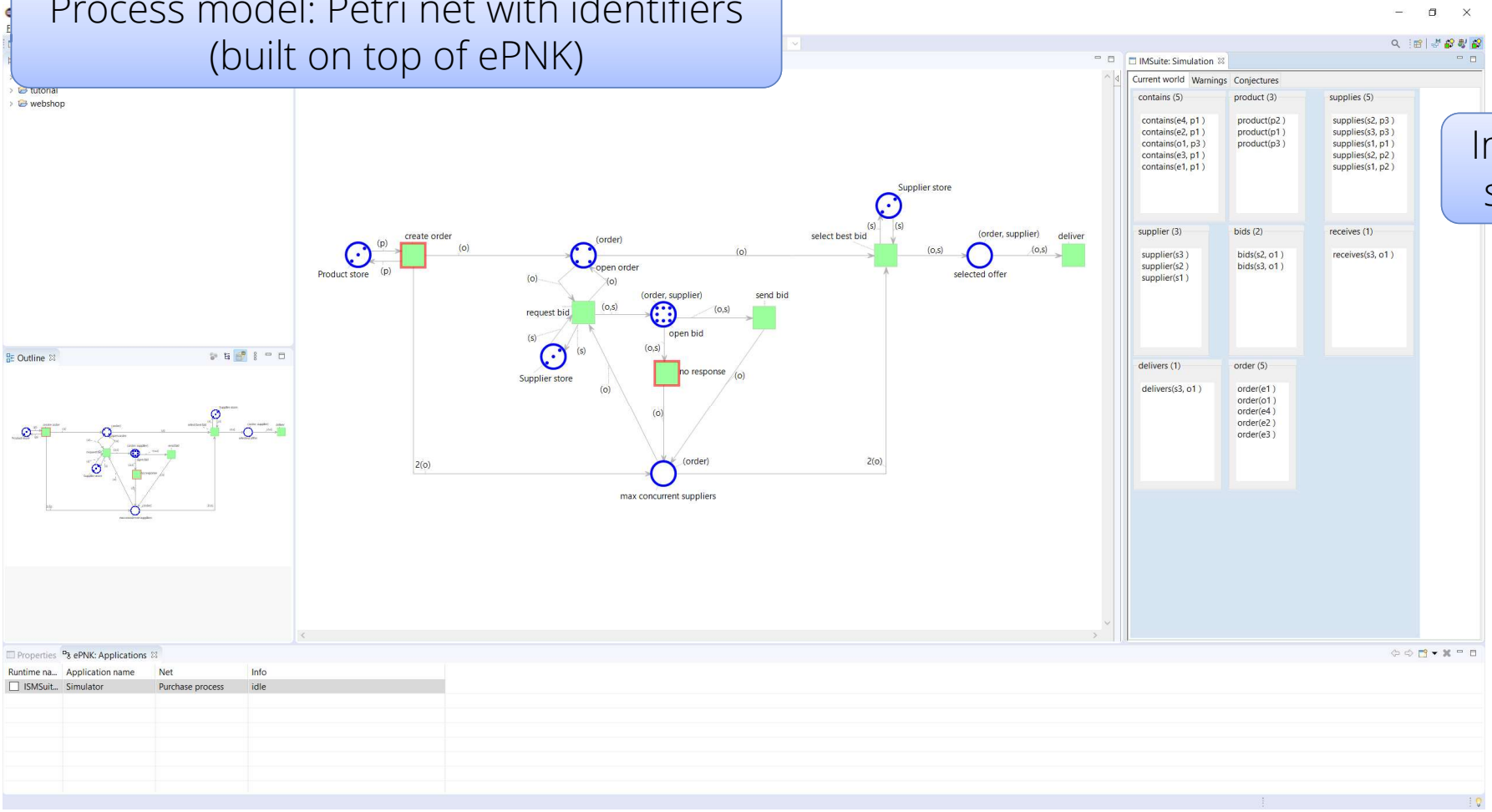
Process model: Petri net with identifiers (built on top of ePNK)



Information model: sets and relations

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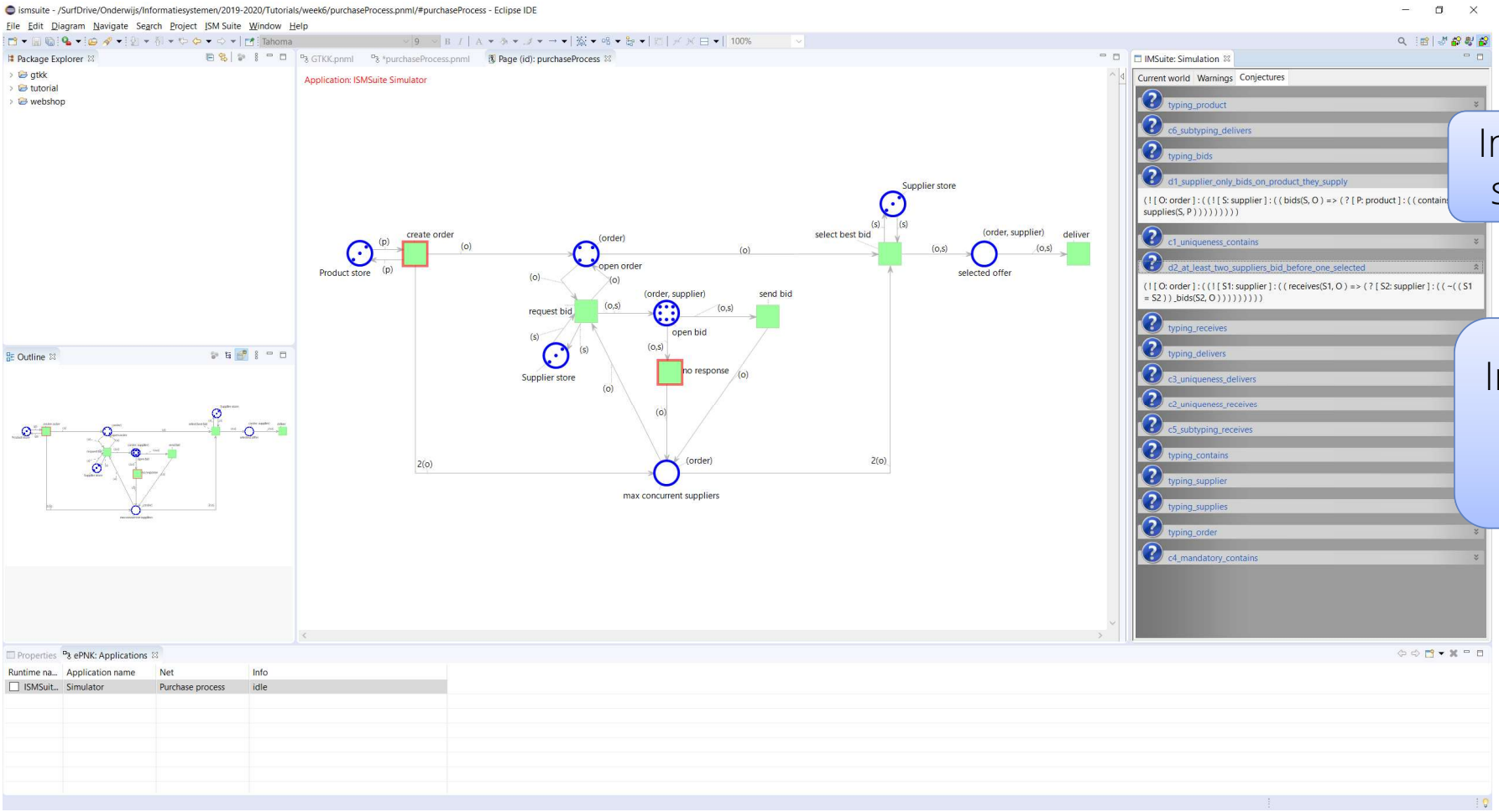

Information model: sets and relations

Information model: Constraints in First-Order Logic

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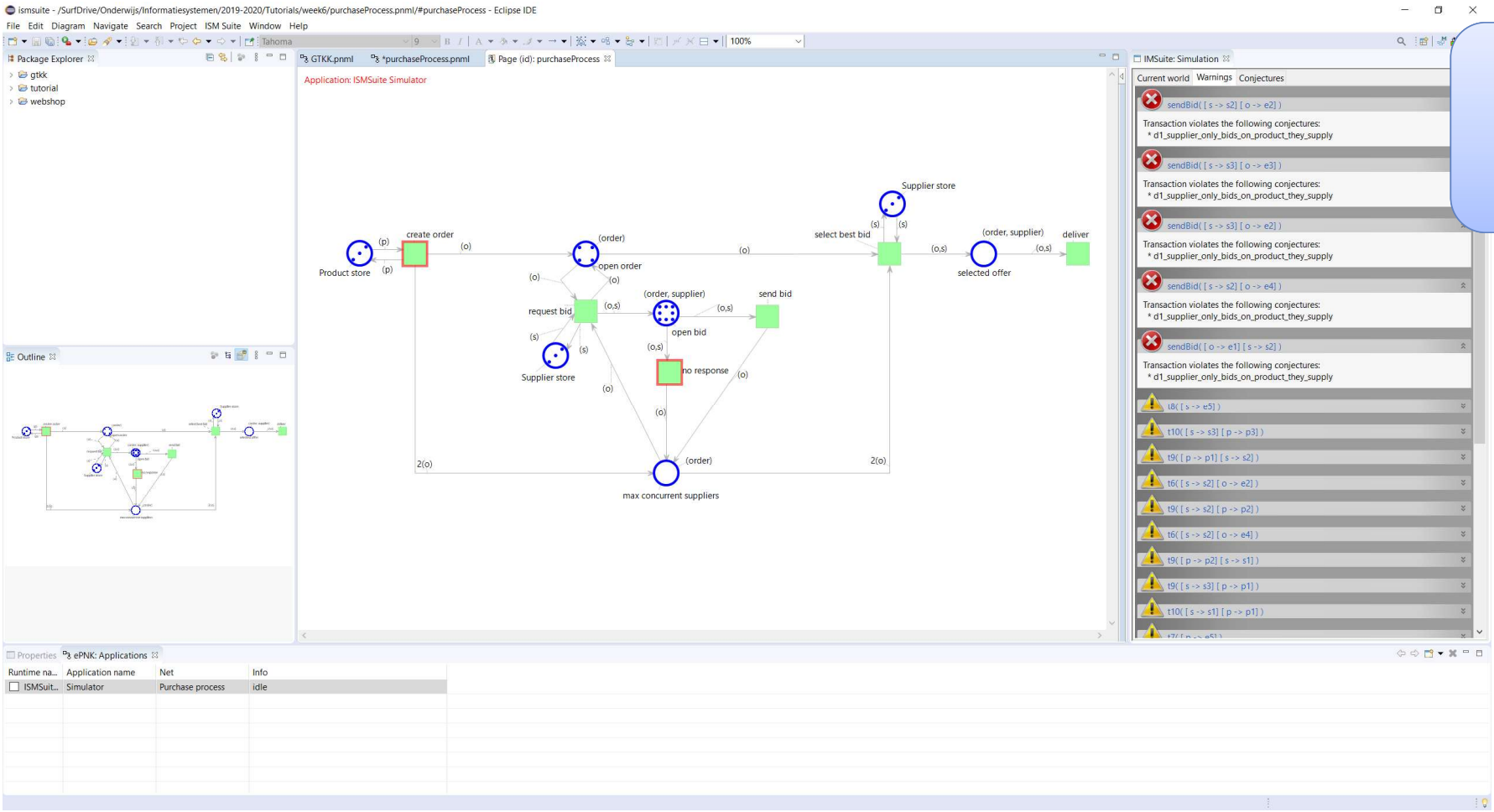

Transitions firings that will violate constraints

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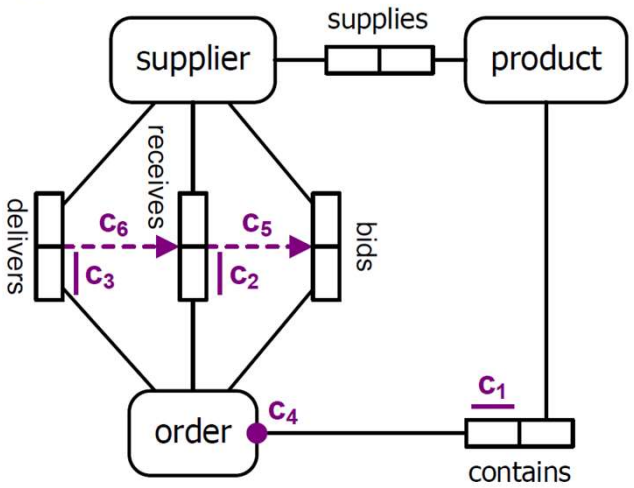
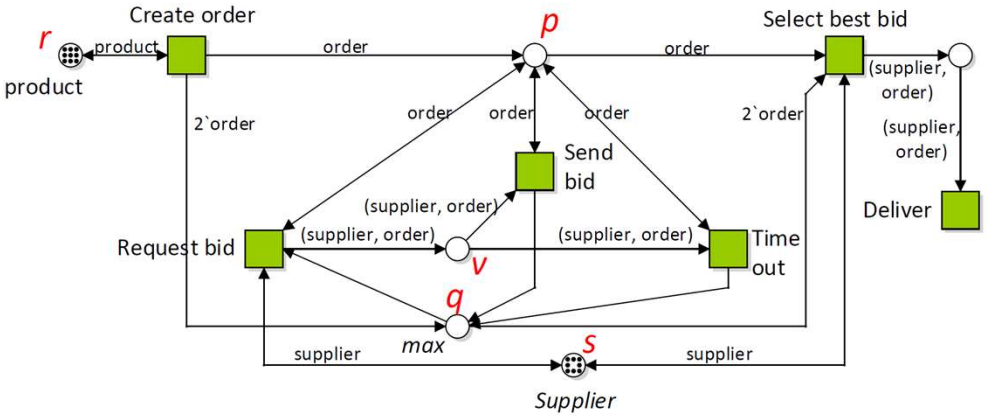


Conclusions

- Information Systems Modeling Suite
  - **Internal Petri net simulator**
  - **Internal automated prover on finite sets**
- Interplay between information and processes
- Future work
  - **Incorporate information modeling in the suite itself**
  - **Develop modeling & analysis strategies**
  - **Extensive experimentation with students**



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www.informationsystem.org/ismsuite/

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