



Utrecht University



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

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Information system: structure and process



- Information modeling

Structure of data

Data retrieval and querying

Data manipulation

...



- Process modeling

Flow of tasks

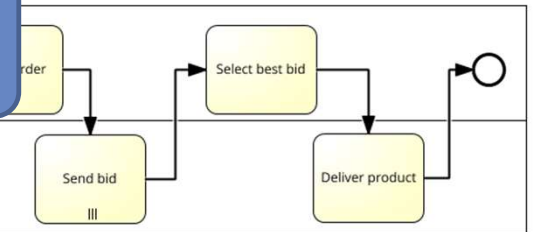
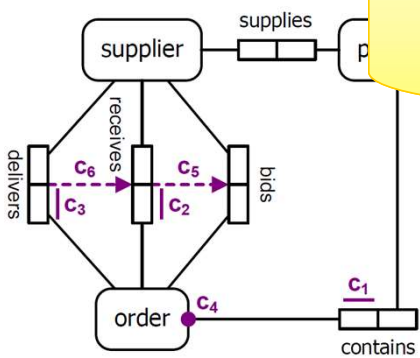
Who manipulates data, and when?

How is data transferred from A to B?

How to model and simulate their interplay?

Data models

Process models

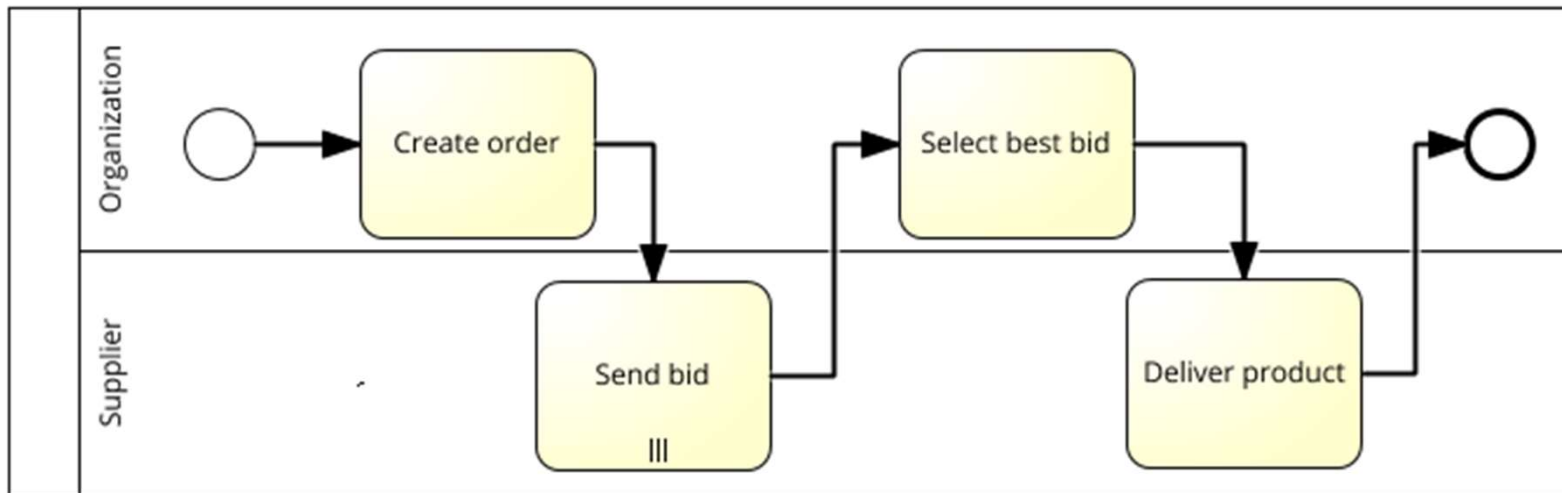




A purchase process system

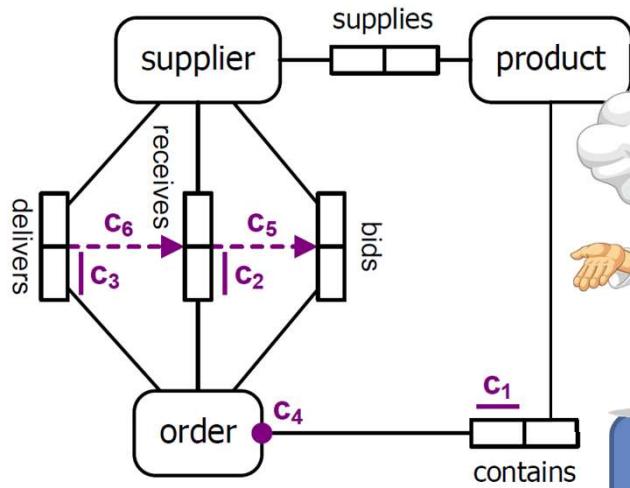


- For each product:
create order, let suppliers bid, select the best offer
Constraint: at least two different suppliers should bid!



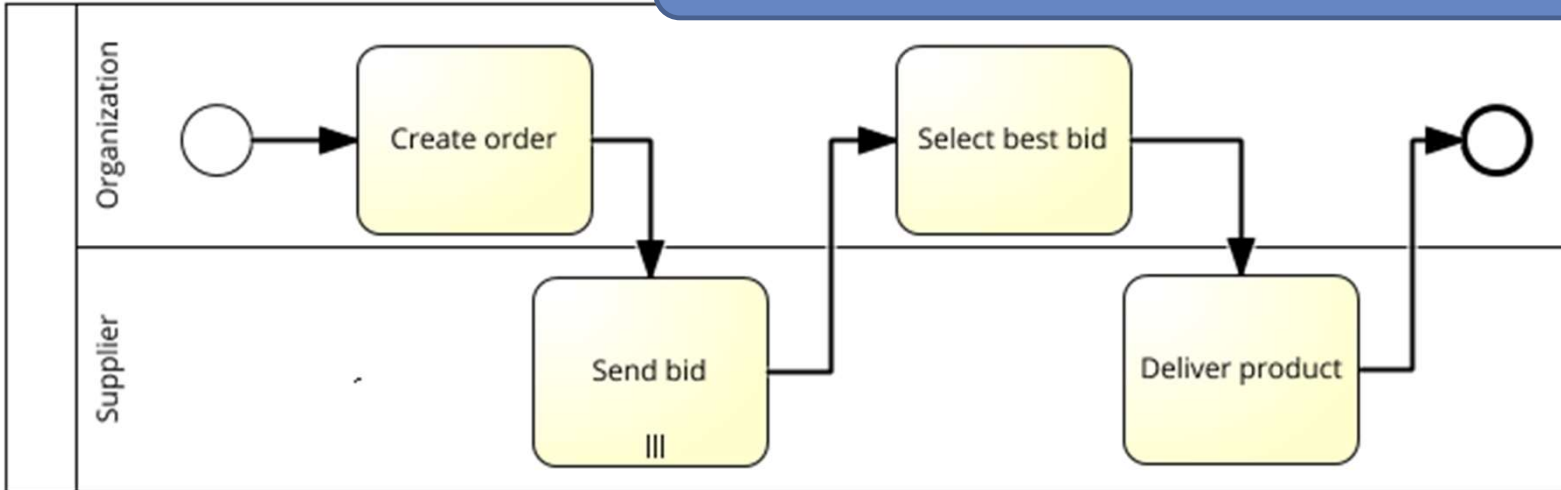


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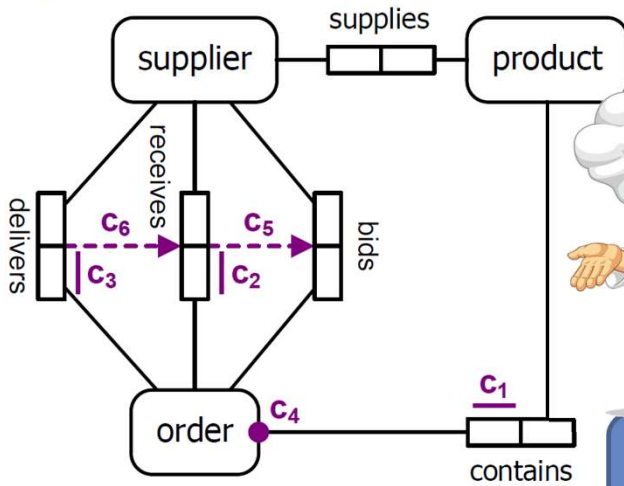
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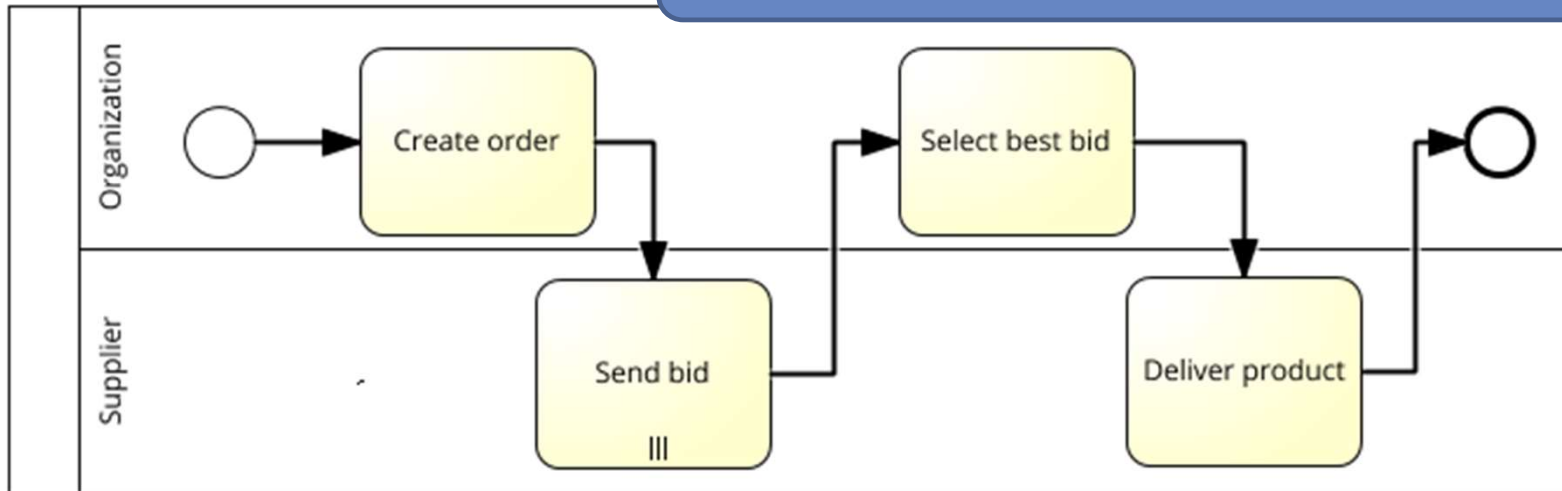


Information Systems Modeling Language



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

How to model and simulate their interplay?

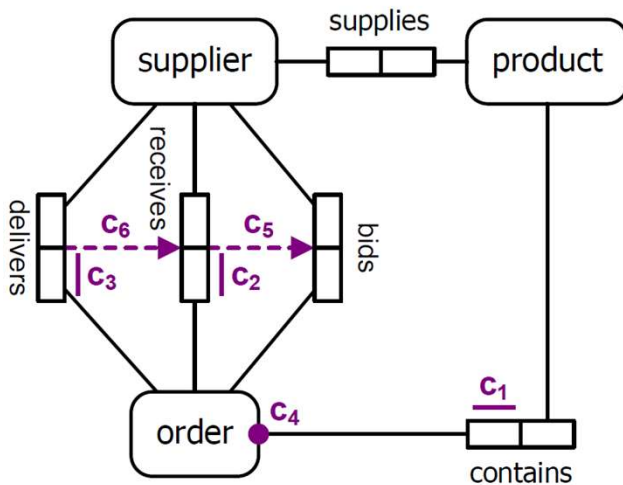




Information model



$$\forall o \in \text{order}, s_1 \in \text{supplier} : (\text{receives}(s_1, o) \Rightarrow \exists s_2 \in \text{supplier} : (\text{bids}(s_2, o) \wedge s_1 \neq s_2))$$

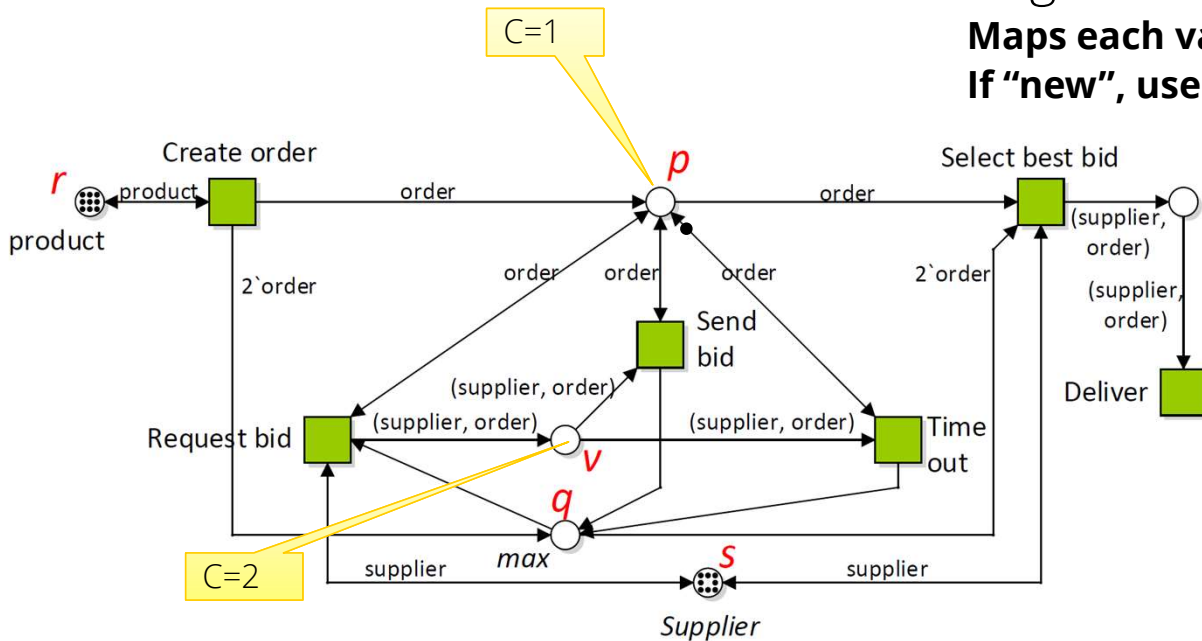


- Information model
 - Entity types**
 - Relation types**
 - Subtype
 - Uniqueness
 - Mandatory
 - Constraints**
- Population
 - Sets for each entity & relation**
 - Valid if all constraints hold**
- Transaction
 - Add & remove entries from sets**
 - Valid: if it results in a valid population**



Petri nets with identifiers

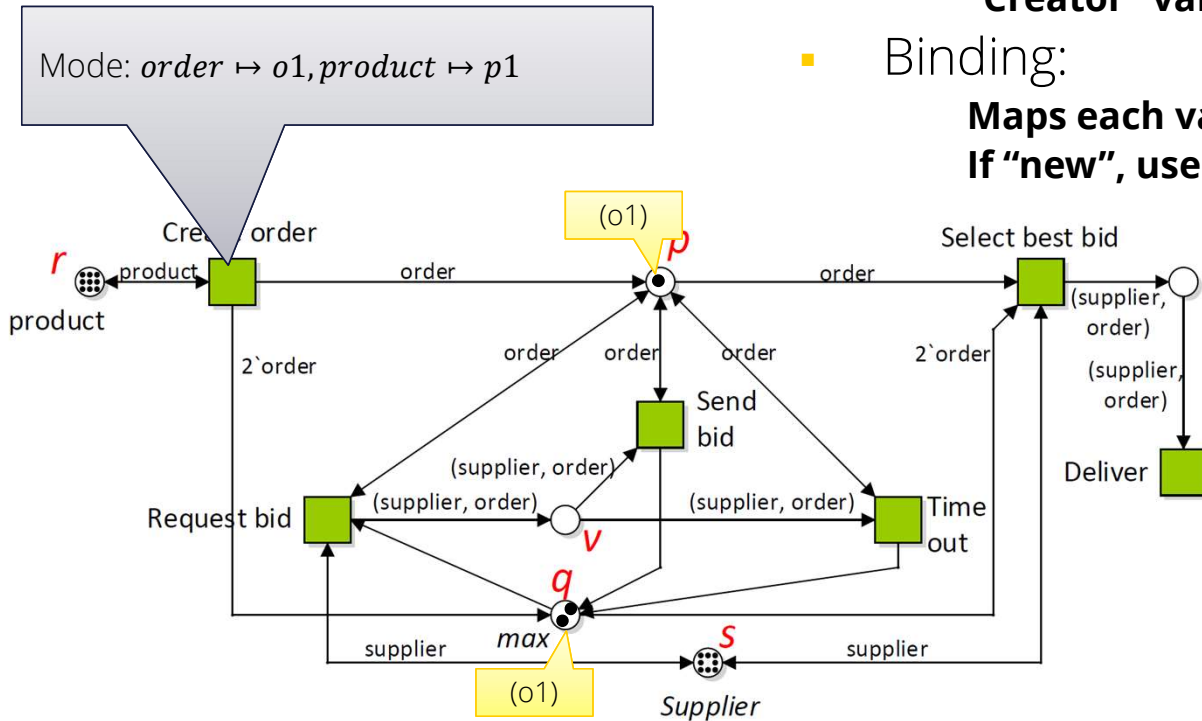
- Each place has a *length*, denoted by $C(p)$
Implied by the vector of variables on the arcs
- Variable vectors on arcs
"Creator" variable: only on output
- Binding:
Maps each variable to ID
If "new", use fresh ID





Petri nets with identifiers

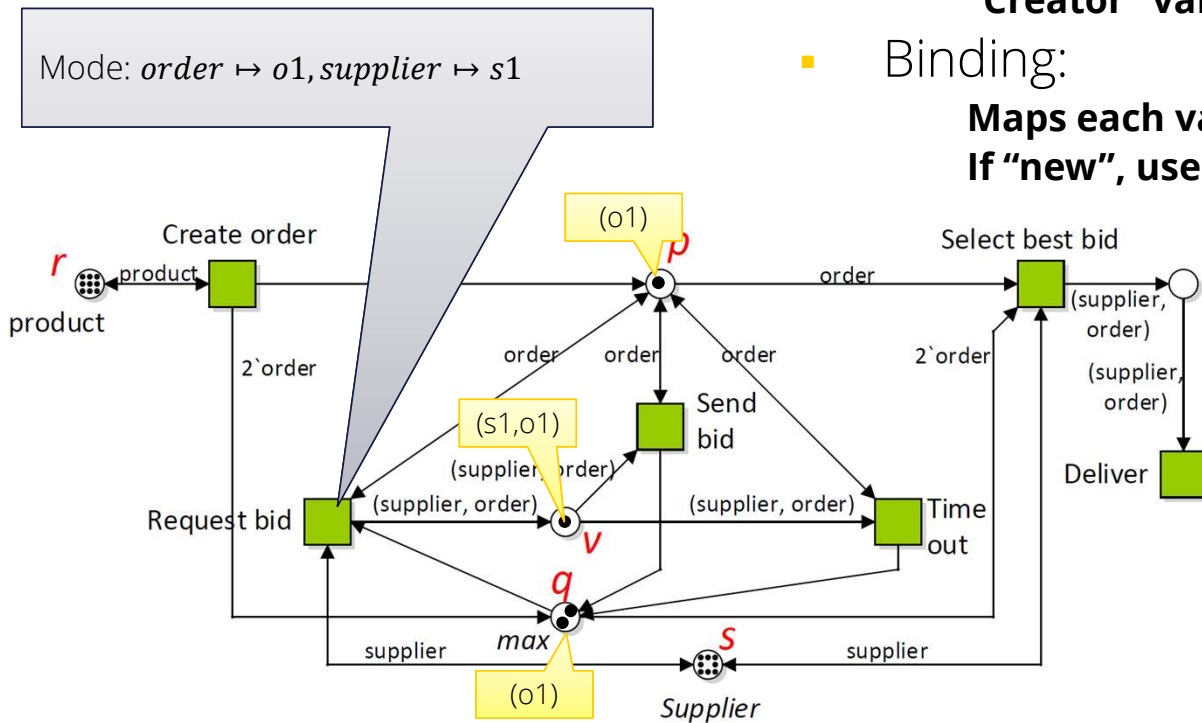
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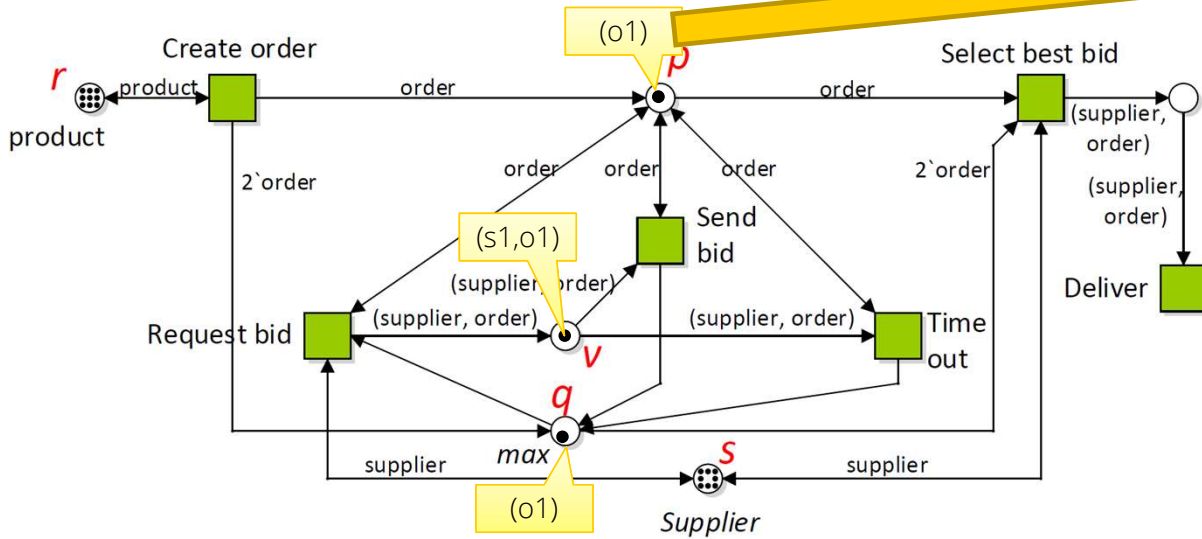
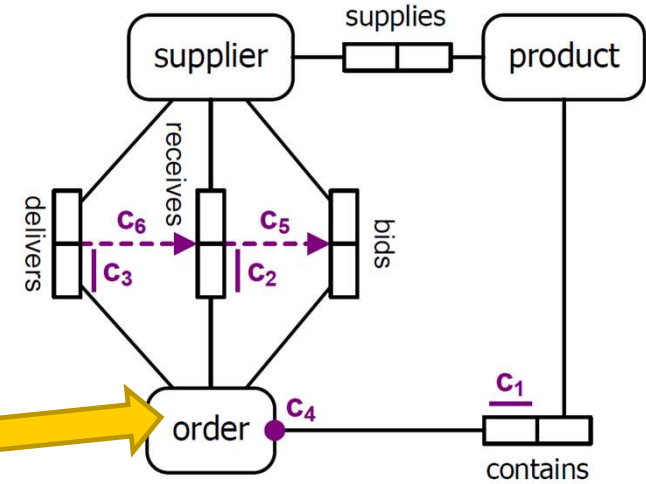




Combining information and process models



Identifiers point to entities

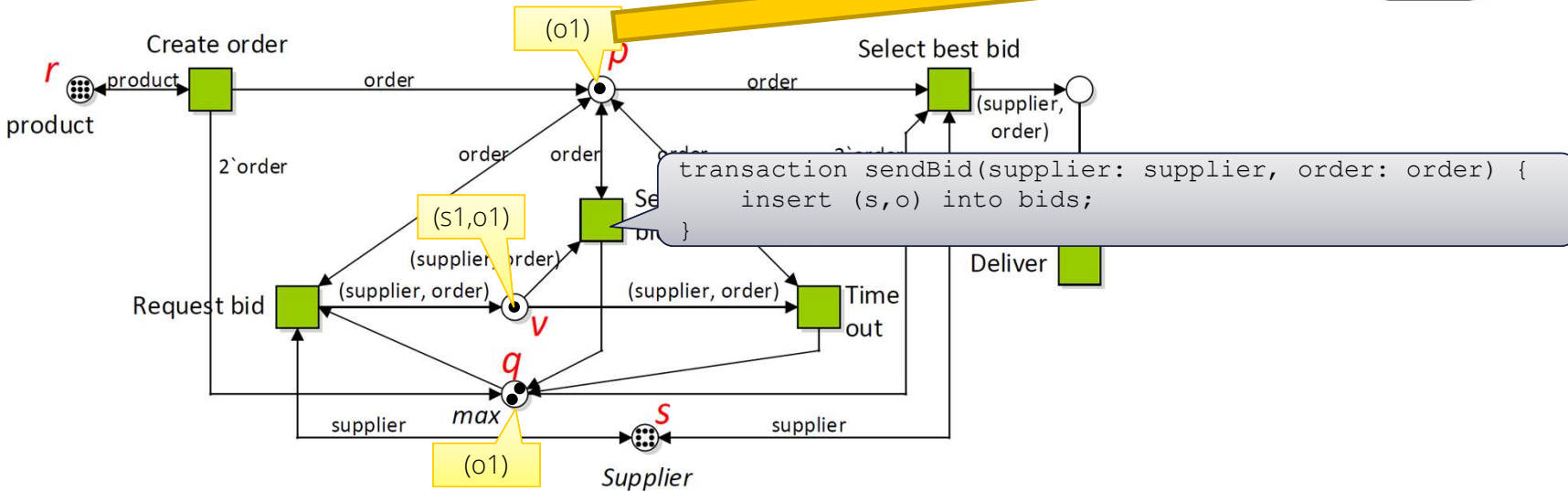
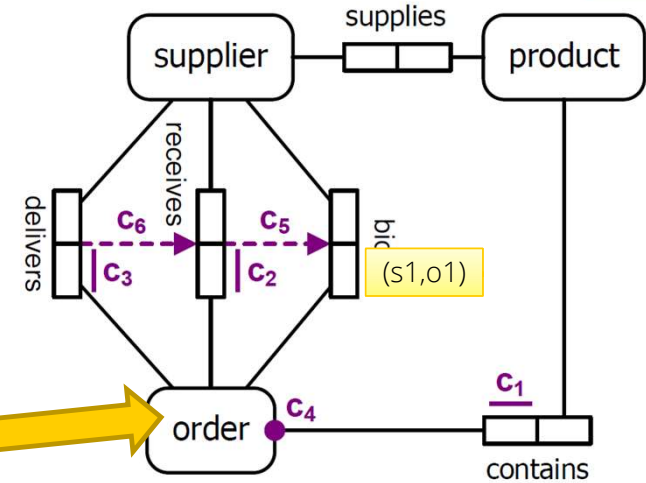




Combining information and process models



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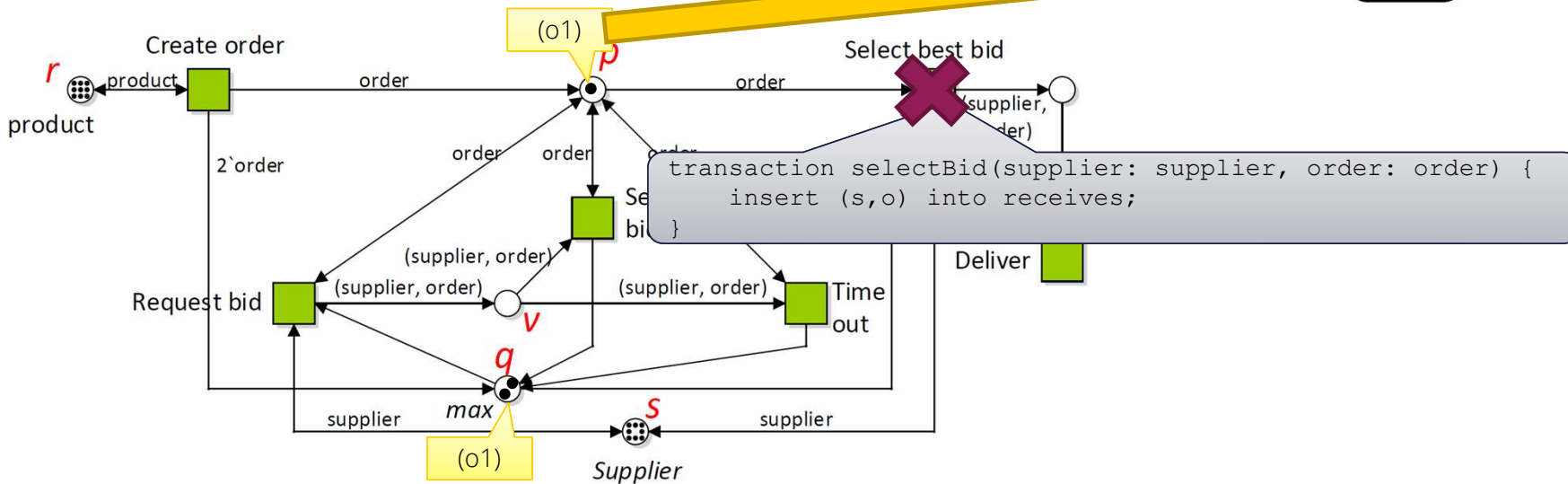
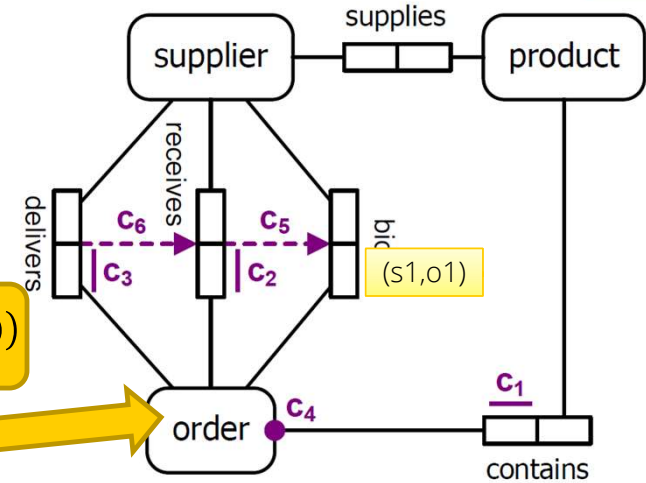




Combining information and process models



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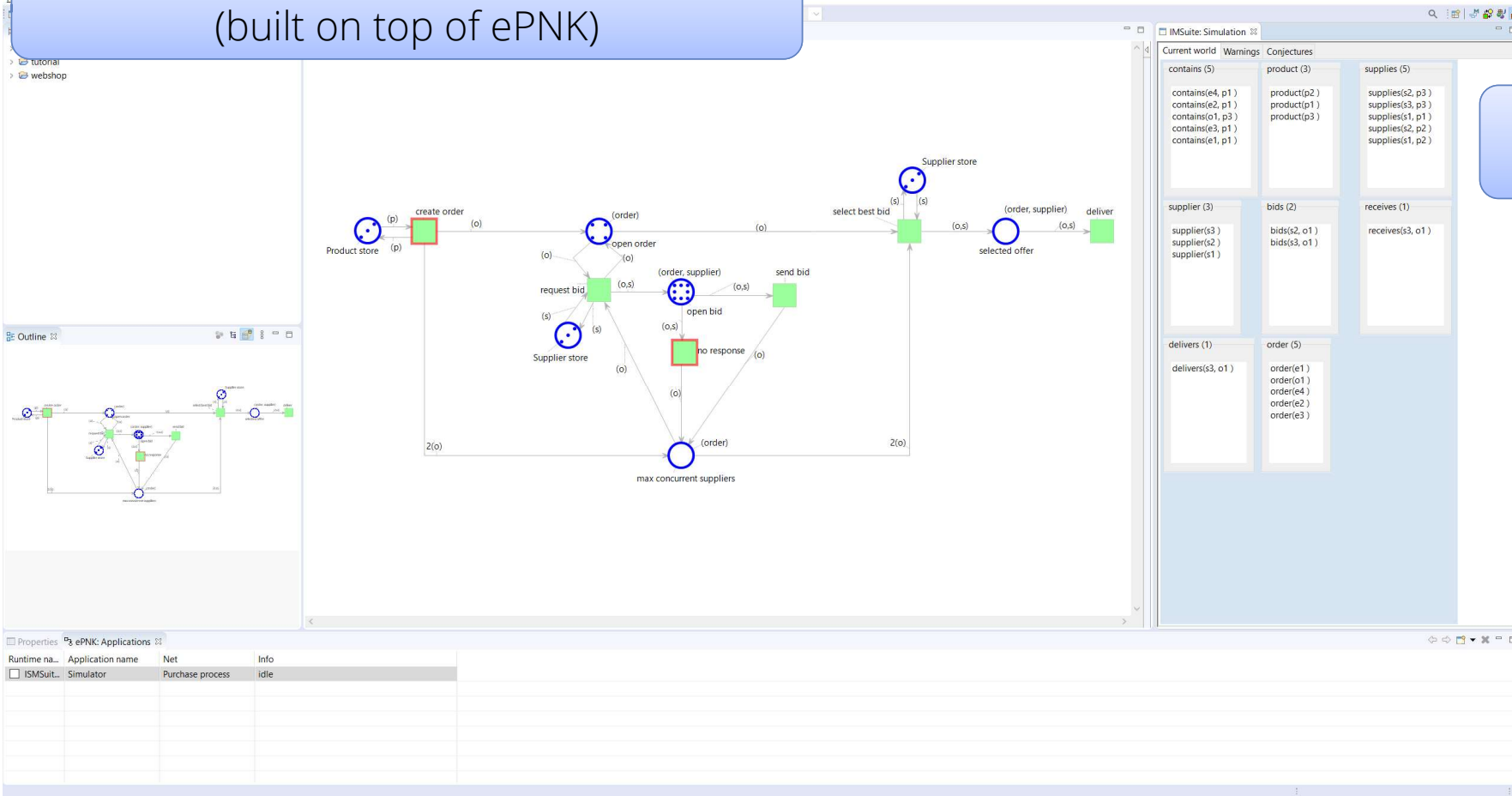




Information Systems Modeling Suite



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



Information model:
sets and relations

ISMSuite - /SurfDrive/Onderwijs/Informatiesystemen/2019-2020/Tutorials/week6/purchaseProcess.pnml/#purchaseProcess - Eclipse IDE

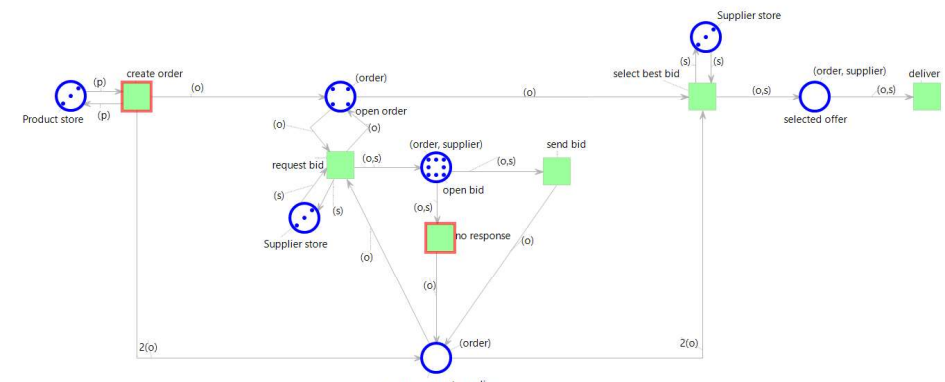
File Edit Diagram Navigate Search Project ISM Suite Window Help

Package Explorer

- gtkk
- tutorial
- webshop

Outline

Application: ISMSuite Simulator



ISMSuite: Simulation

Current world Warnings Conjectures

- typing_product
- c6_subtyping_delivers
- typing_bids
- d1_supplier_only_bids_on_product_they_supply
- c1_uniqueness_contains
- d2_at_least_two_suppliers_bid_before_one_selected
- typing_receives
- typing_delivers
- c3_uniqueness_delivers
- c2_uniqueness_receives
- c5_subtyping_receives
- typing_contains
- typing_supplier
- typing_supplies
- typing_order
- c4_mandatory_contains

Properties ePNK: Applications

Runtime na...	Application name	Net	Info
<input type="checkbox"/>	ISMSuit...	Simulator	Purchase process idle

Information model:
sets and relations

Information model:
Constraints in
First-Order Logic



Information Systems Modeling Suite



Transitions firings that will violate constraints

The screenshot displays the ISMSuite Simulator interface. The main window shows a Petri net diagram for a purchase process. The diagram includes places (circles) and transitions (squares) representing the system's state and actions. Key elements include:

- Product store** (place) with 2 tokens.
- Supplier store** (place) with 2 tokens.
- max concurrent suppliers** (place) with 2 tokens.
- Transitions:** create order, open order, request bid, open bid, send bid, select best bid, selected offer, deliver, and no response.

The simulation log on the right side of the interface shows the following entries:

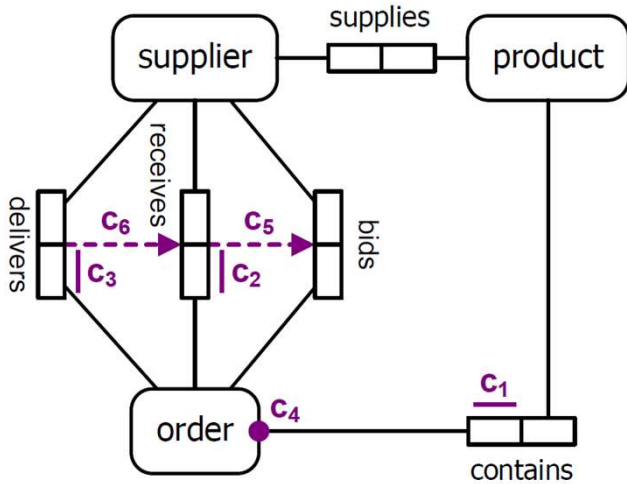
- Transaction violates the following conjuncts:
* d1_supplier_only_bids_on_product_they_supply
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Below the log, a table shows the runtime status of the simulation:

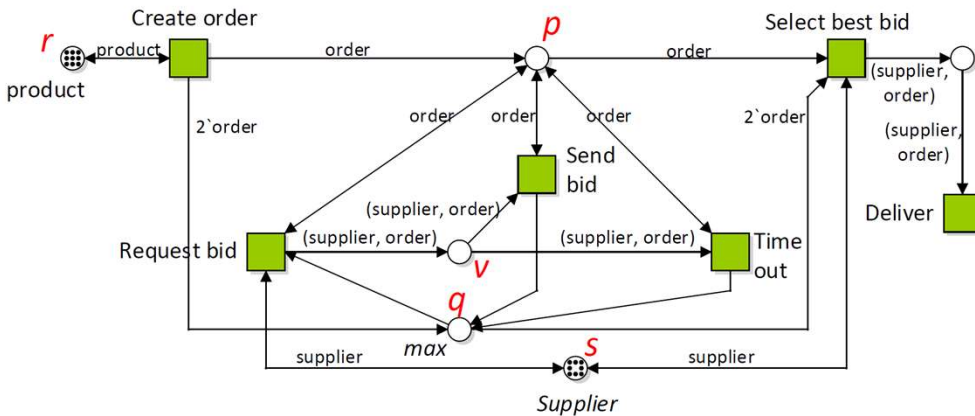
Runtime na...	Application name	Net	Info
ISMSuit...	Simulator	Purchase process	idle



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

www.informationssystem.org/ismsuite/

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