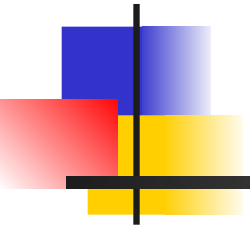
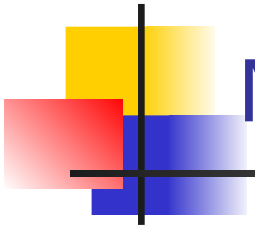


Research in the field of artificial intelligence conducted by lab 4.2 ISDCT SB RAS

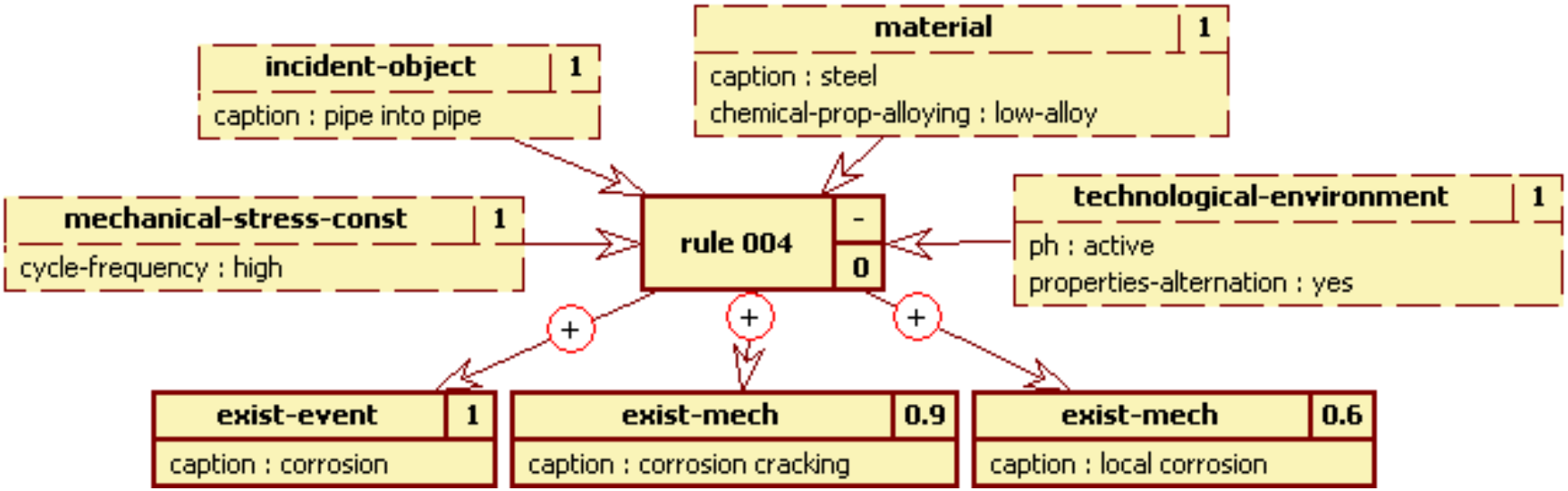
Yurin A.Yu.



Main areas of research

- Knowledge representation, acquisition and processing;
- Development of tools for AI methods and systems;
- Development of knowledge-based systems (ES, DSS);
- Agent-based simulation.

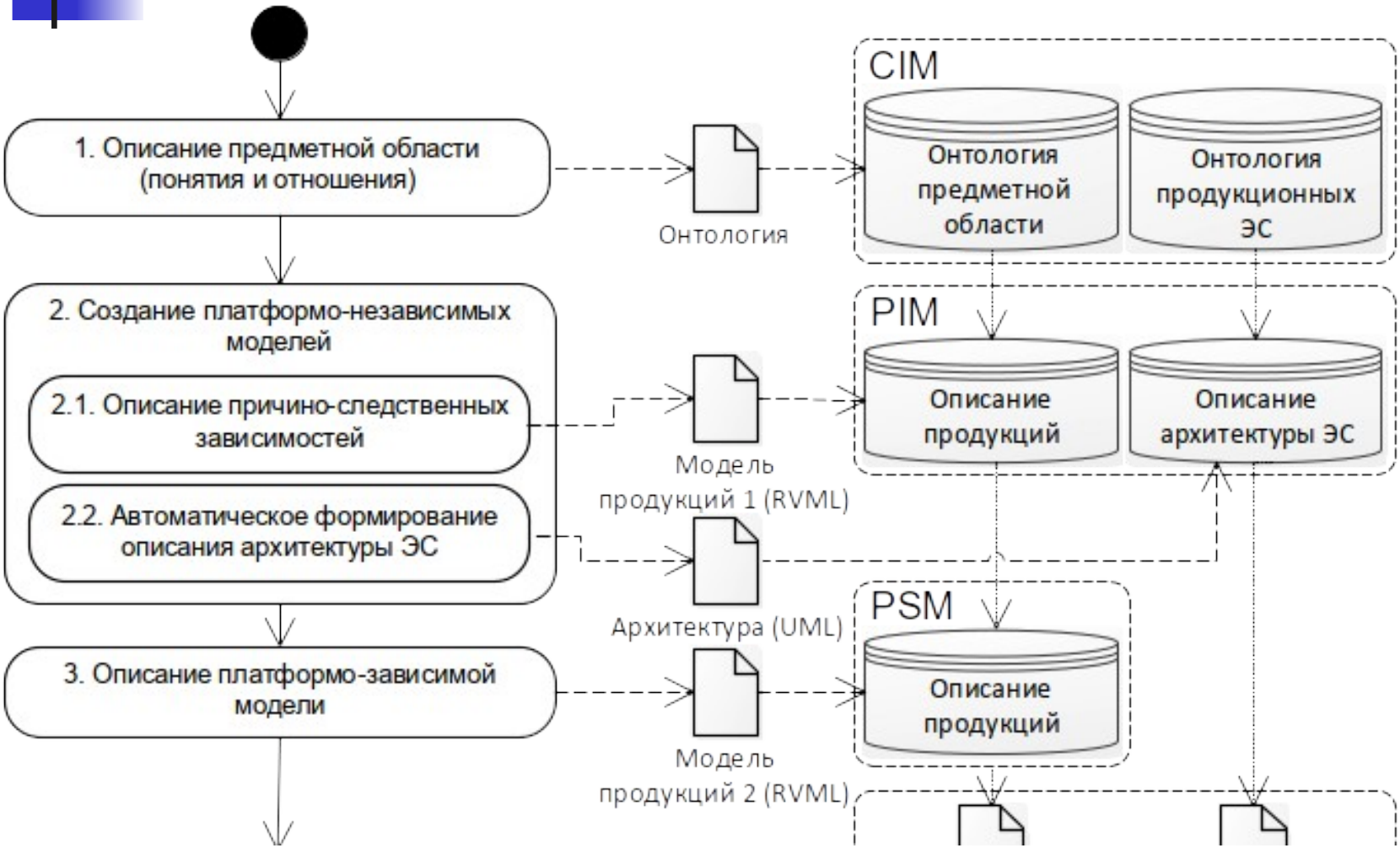
Rule Visual Modeling Language



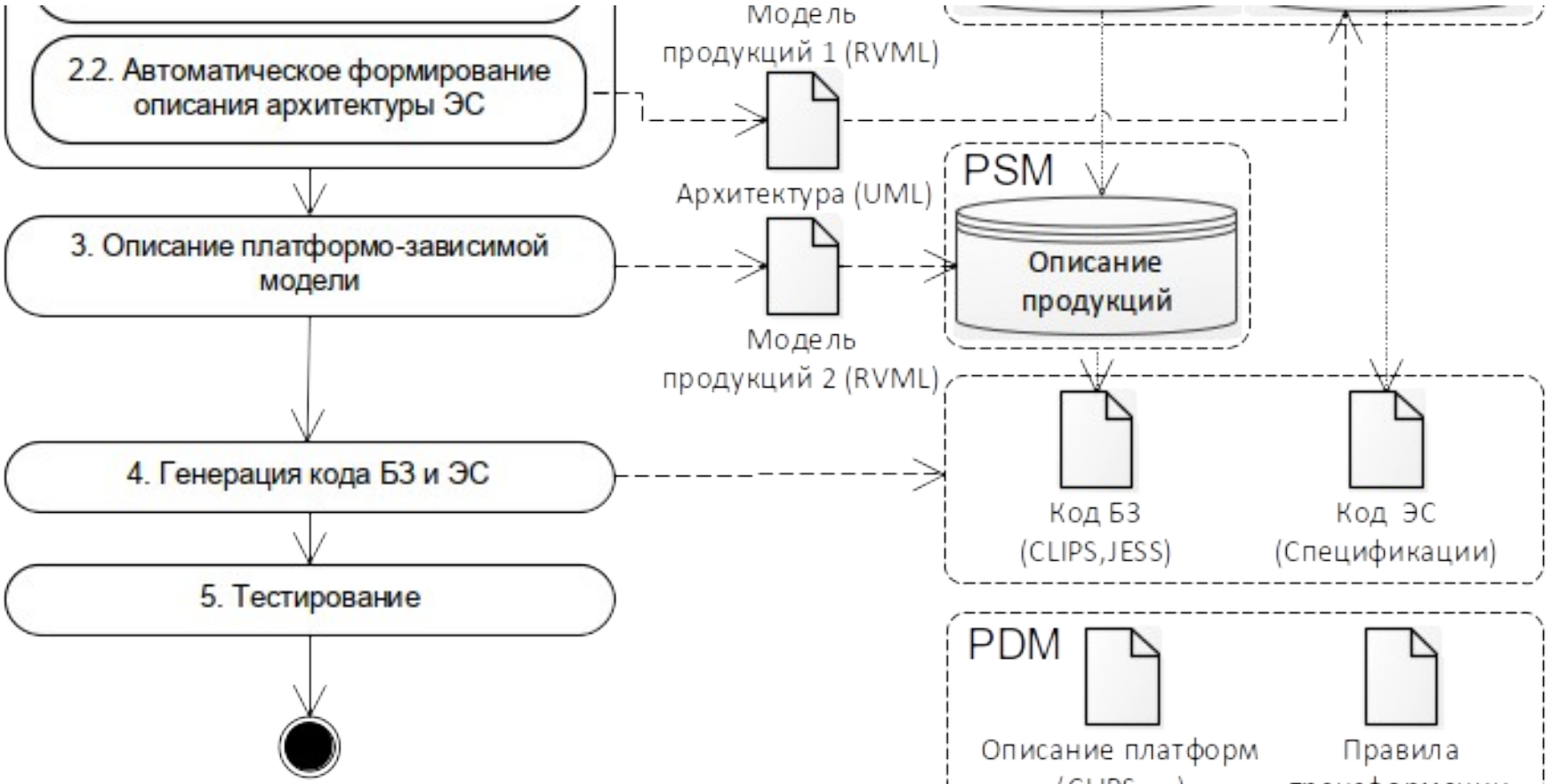

```
(defrule rule_004 ""
(mechanical-stress-const (cycle-frequency "HIGH") (cf "1") )
(technological-environment (ph "ACTIVE") (properties-alternation "YES")
(cf "1")
) ...
```

Yurin A.Yu., Dorodnykh N.O., Nikolaychuk O.A., Grishenko M.A. Designing rule-based expert systems with the aid of the model-driven development approach // Expert Systems, 2018, Vol. 35, No. 5, P. 1-23.

An approach for prototyping expert systems



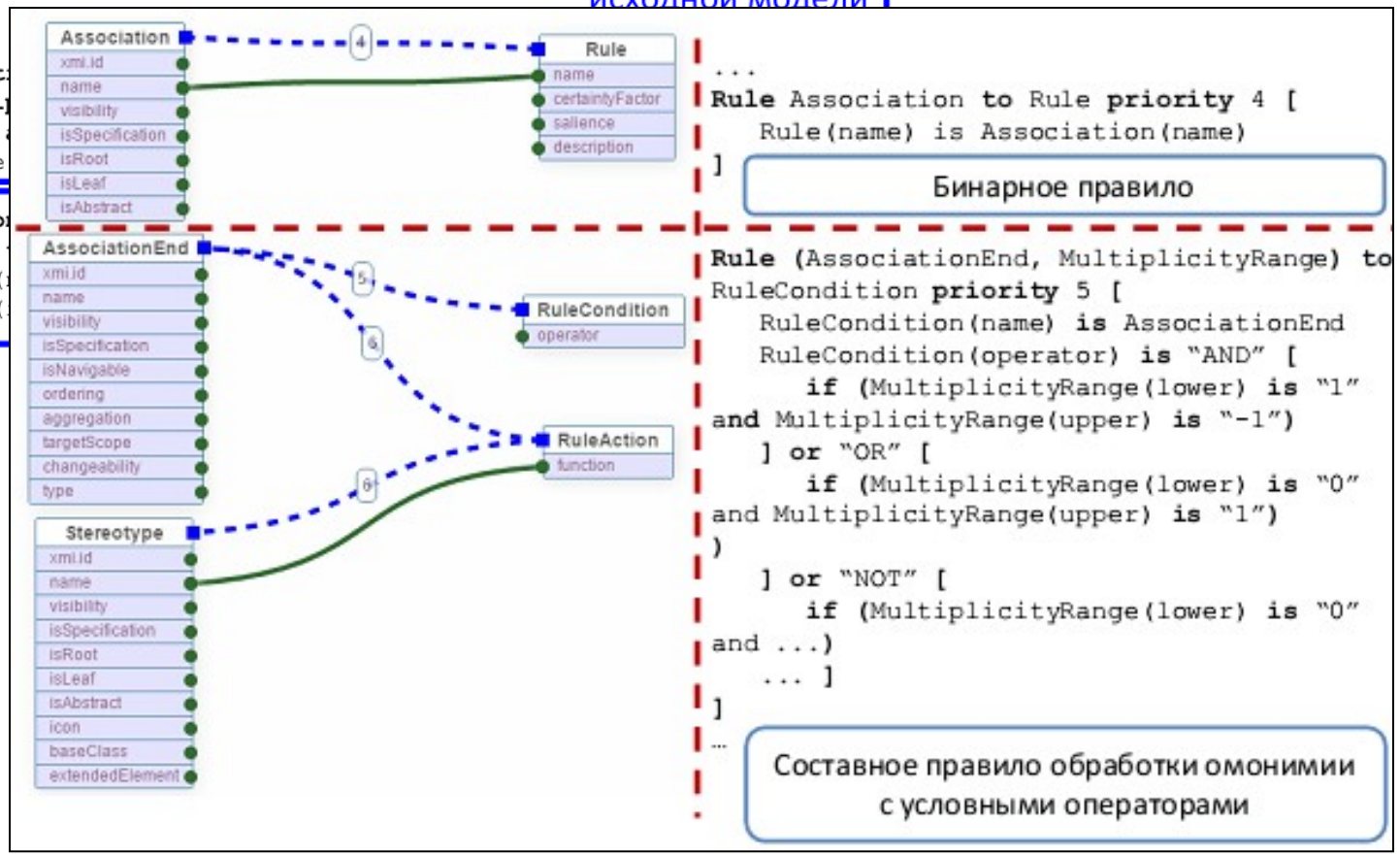
An approach for prototyping expert systems



Transformation Model Representation Language

Описание исходной модели

```
Source Meta-Model UML-diagram-class {
  Elements [
    Model,
    Class att
  Relationshi
    Model is
    Namespace
...
Transformatio
  Rule Model
    Ontology(
    Ontology(
```




```
...
Rule Association to Rule priority 4 [
    Rule(name) is Association(name)
]
...
Rule (AssociationEnd, MultiplicityRange) to
RuleCondition priority 5 [
    RuleCondition(name) is AssociationEnd
    RuleCondition(operator) is "AND" [
        if (MultiplicityRange(lower) is "1"
and MultiplicityRange(upper) is "-1")
    ] or "OR" [
        if (MultiplicityRange(lower) is "0"
and MultiplicityRange(upper) is "1")
)
    ] or "NOT" [
        if (MultiplicityRange(lower) is "0"
and ...)
    ... ]
]
...
```

Бинарное правило

Составное правило обработки омонимии с условными операторами

Main results: software tools

- Software tool for prototyping knowledge bases of rule-based expert systems – Personal Knowledge base designer (PKBD).
- Web-based tool for knowledge base creation on the basis of conceptual model transformation - Knowledge Base Development System (KBDS).
- A multi-component tool for building knowledge-based systems.
- Tool prototyping systems for agent-based simulation.

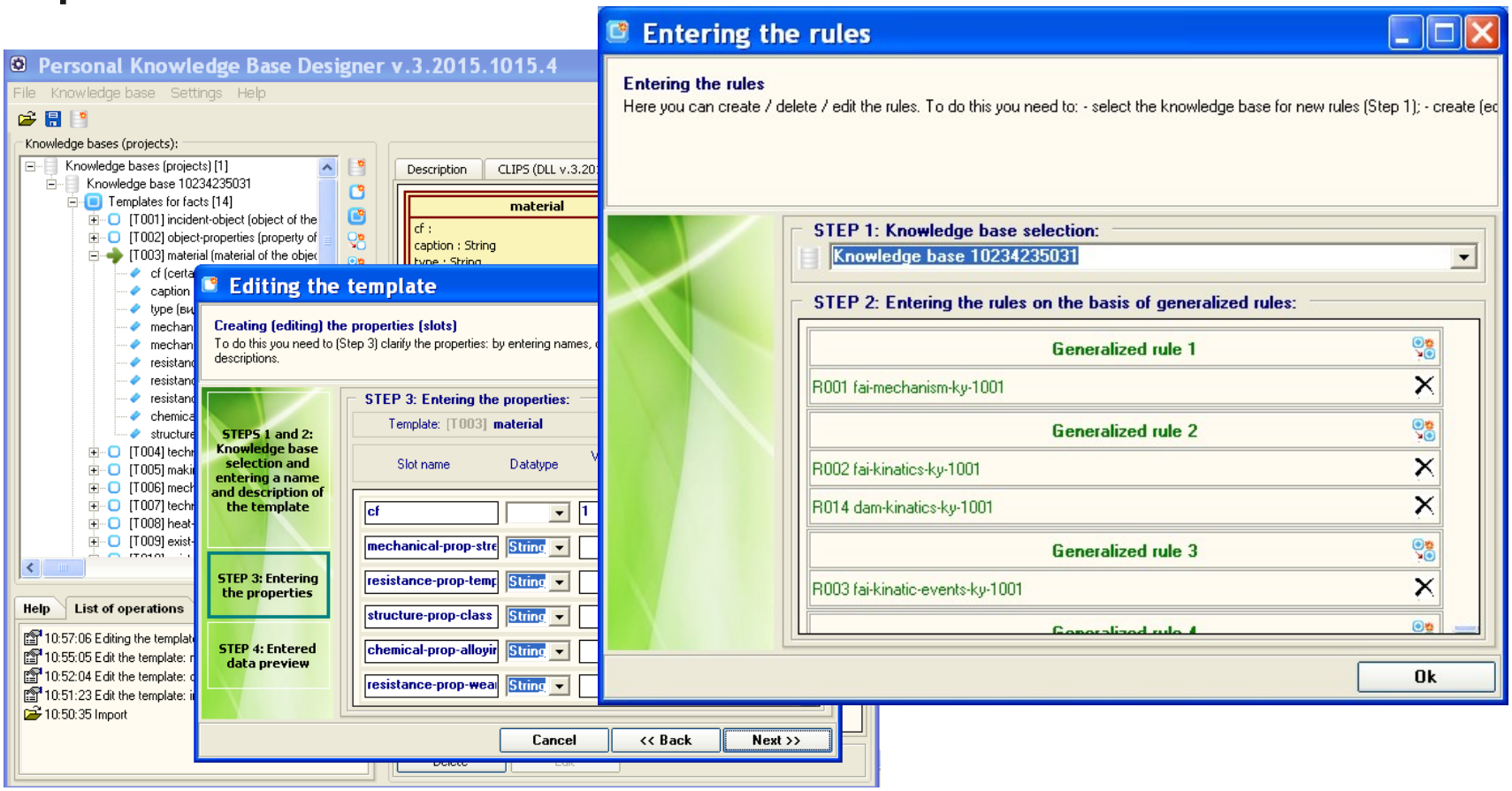
Personal Knowledge Base Designer

Main functions:

- knowledge base management;
- logical inference;
- support of “domain-specific editor" mode;
- support of RVML.

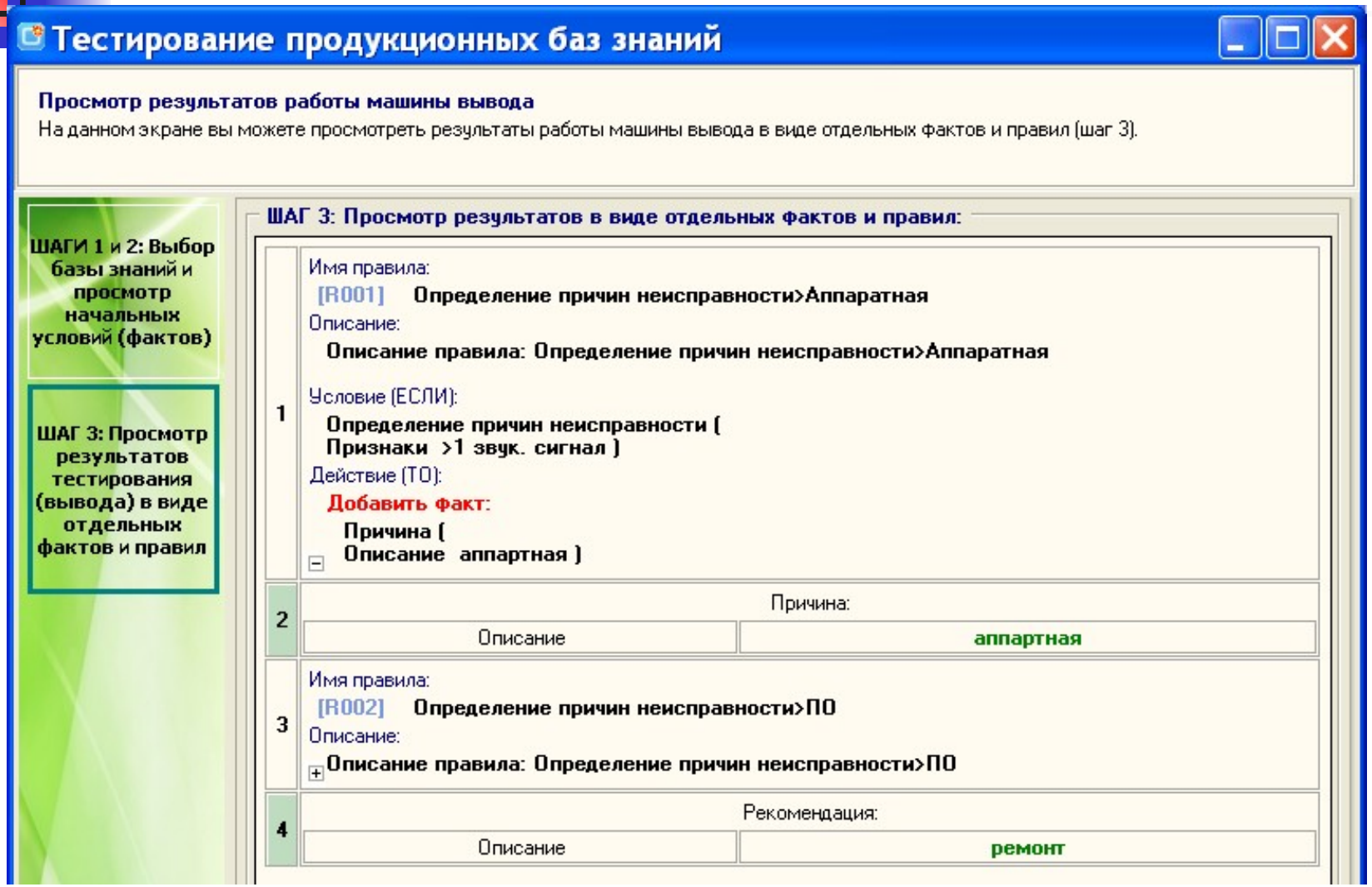
Yurin A.Yu., Dorodnykh N.O., Nikolaychuk O.A., Grishenko M.A. Designing rule-based expert systems with the aid of the model-driven development approach // Expert Systems, 2018, Vol. 35, No. 5, P. 1-23.

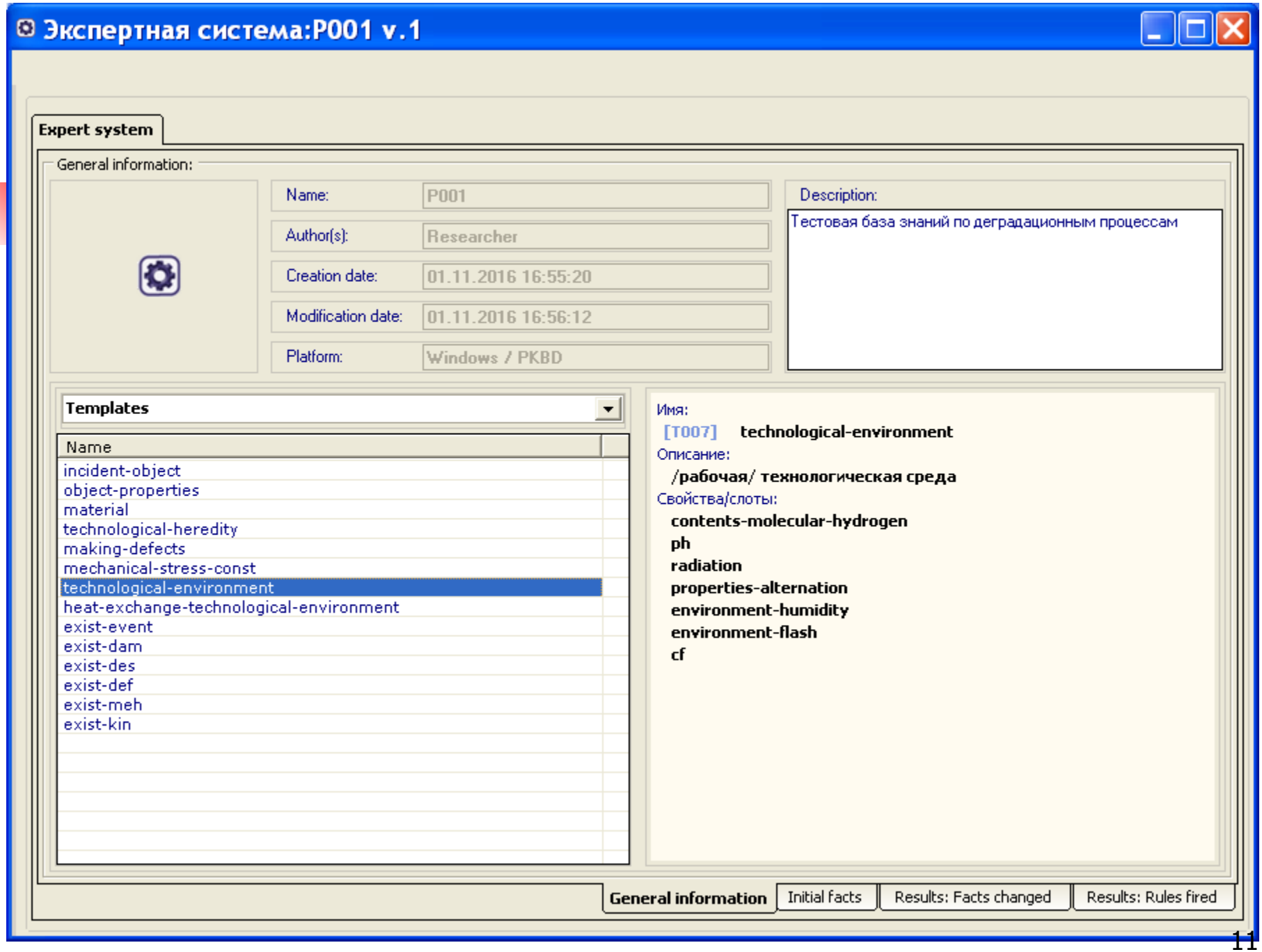
Personal Knowledge Base Designer

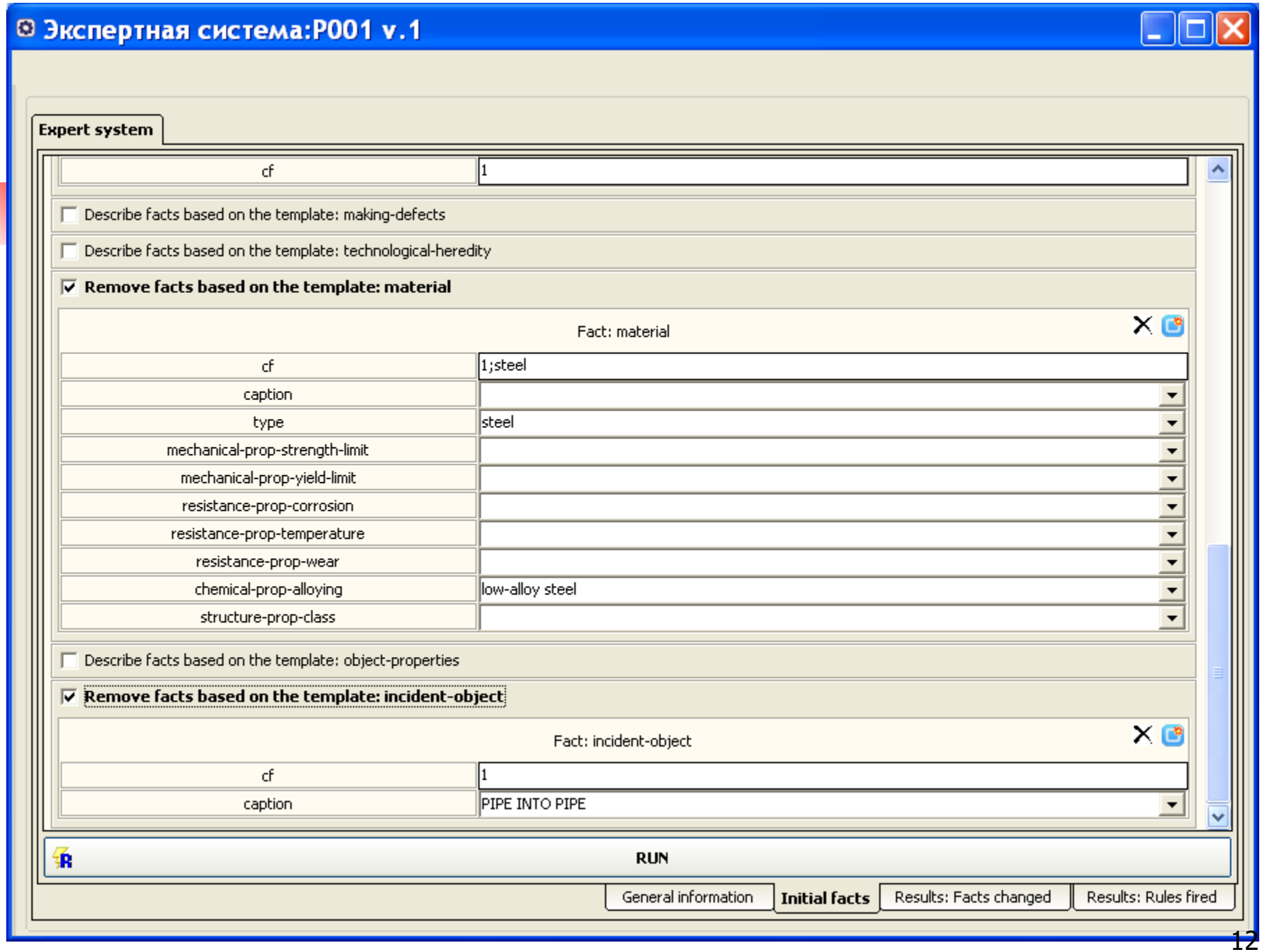


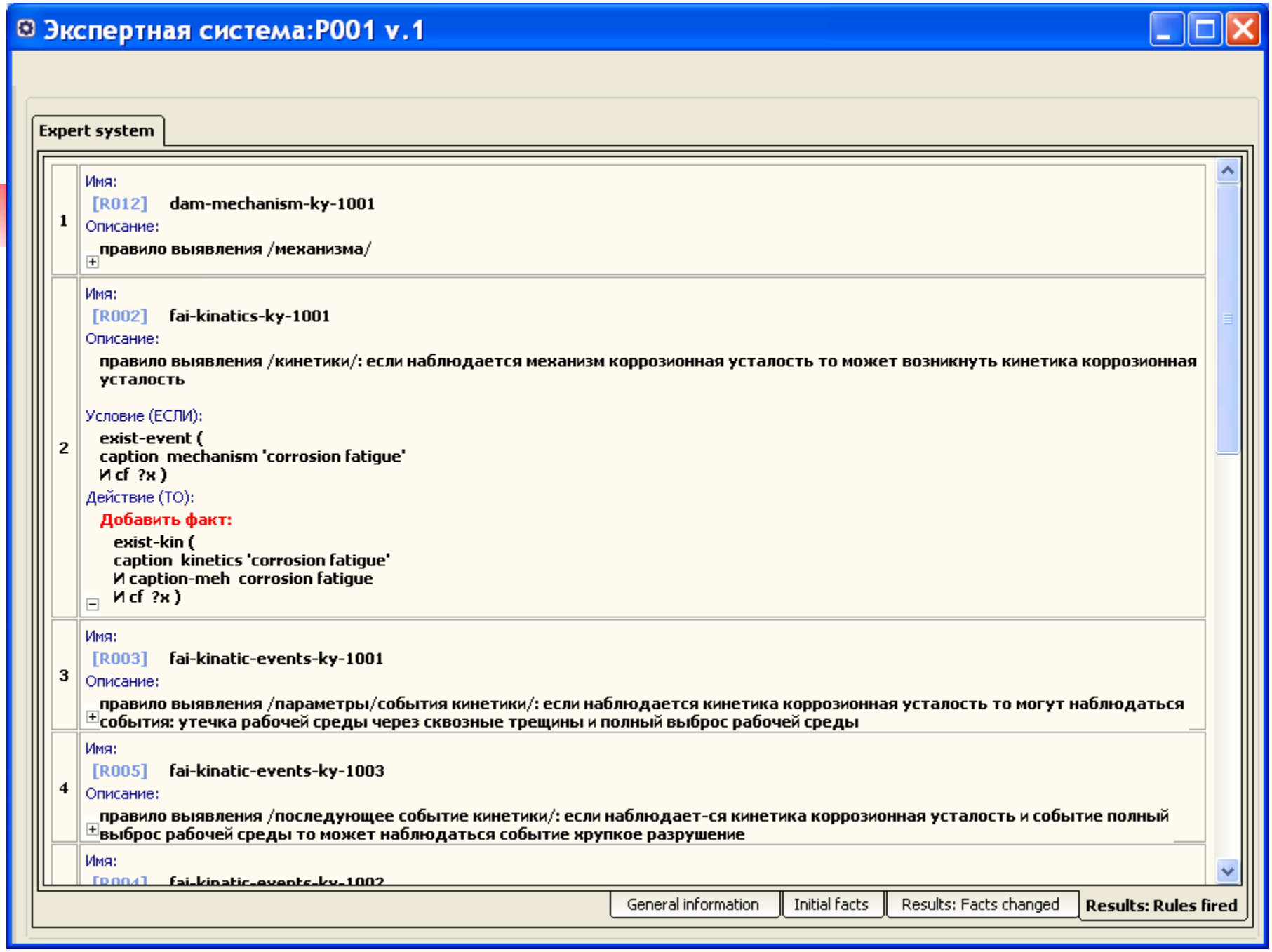
АС №№ 2016617733, 2012614093, 2007613714

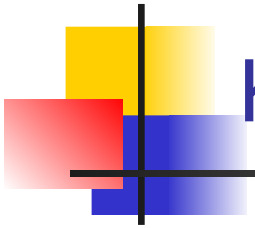
Personal Knowledge Base Designer




Экспертная система:P001 v.1
Expert system
General information:
Name:
P001
Author(s):
Researcher
Creation date:
01.11.2016 16:55:20
Modification date:
01.11.2016 16:56:12
Platform:
Windows / PKBD
Description:
Тестовая база знаний по деградационным процессам
Templates
Name
incident-object
object-properties
material
technological-heredity
making-defects
mechanical-stress-const
technological-environment
heat-exchange-technological-environment
exist-event
exist-dam
exist-des
exist-def
exist-meh
exist-kin
Имя:
[T007] technological-environment
Описание:
/рабочая/ технологическая среда
Свойства/слоты:
contents-molecular-hydrogen
ph
radiation
properties-alternation
environment-humidity
environment-flash
cf
General information
Initial facts
Results: Facts changed
Results: Rules fired


Экспертная система:P001 v.1
Expert system
cf
1
Describe facts based on the template: making-defects
Describe facts based on the template: technological-heredity
Remove facts based on the template: material
Fact: material
cf
1;steel
caption
type
steel
mechanical-prop-strength-limit
mechanical-prop-yield-limit
resistance-prop-corrosion
resistance-prop-temperature
resistance-prop-wear
chemical-prop-alloying
low-alloy steel
structure-prop-class
Describe facts based on the template: object-properties
Remove facts based on the template: incident-object
Fact: incident-object
cf
1
caption
PIPE INTO PIPE
RUN
General information
Initial facts
Results: Facts changed
Results: Rules fired


Экспертная система:P001 v.1
Expert system
1
Имя:
[R012] dam-mechanism-ky-1001
Описание:
правило выявления /механизма/
2
Имя:
[R002] fai-kinatics-ky-1001
Описание:
правило выявления /кинетики/: если наблюдается механизм коррозионная усталость то может возникнуть кинетика коррозионная усталость
Условие (ЕСЛИ):
exist-event (
caption mechanism 'corrosion fatigue'
И cf ?x)
Действие (ТО):
Добавить факт:
exist-kin (
caption kinetics 'corrosion fatigue'
И caption-meh corrosion fatigue
И cf ?x)
3
Имя:
[R003] fai-kinatic-events-ky-1001
Описание:
правило выявления /параметры/события кинетики/: если наблюдается кинетика коррозионная усталость то могут наблюдаться события: утечка рабочей среды через сквозные трещины и полный выброс рабочей среды
4
Имя:
[R005] fai-kinatic-events-ky-1003
Описание:
правило выявления /последующее событие кинетики/: если наблюдает-ся кинетика коррозионная усталость и событие полный выброс рабочей среды то может наблюдаться событие хрупкое разрушение
Имя:
[R004] fai-kinatic-events-ky-1002
General information
Initial facts
Results: Facts changed
Results: Rules fired

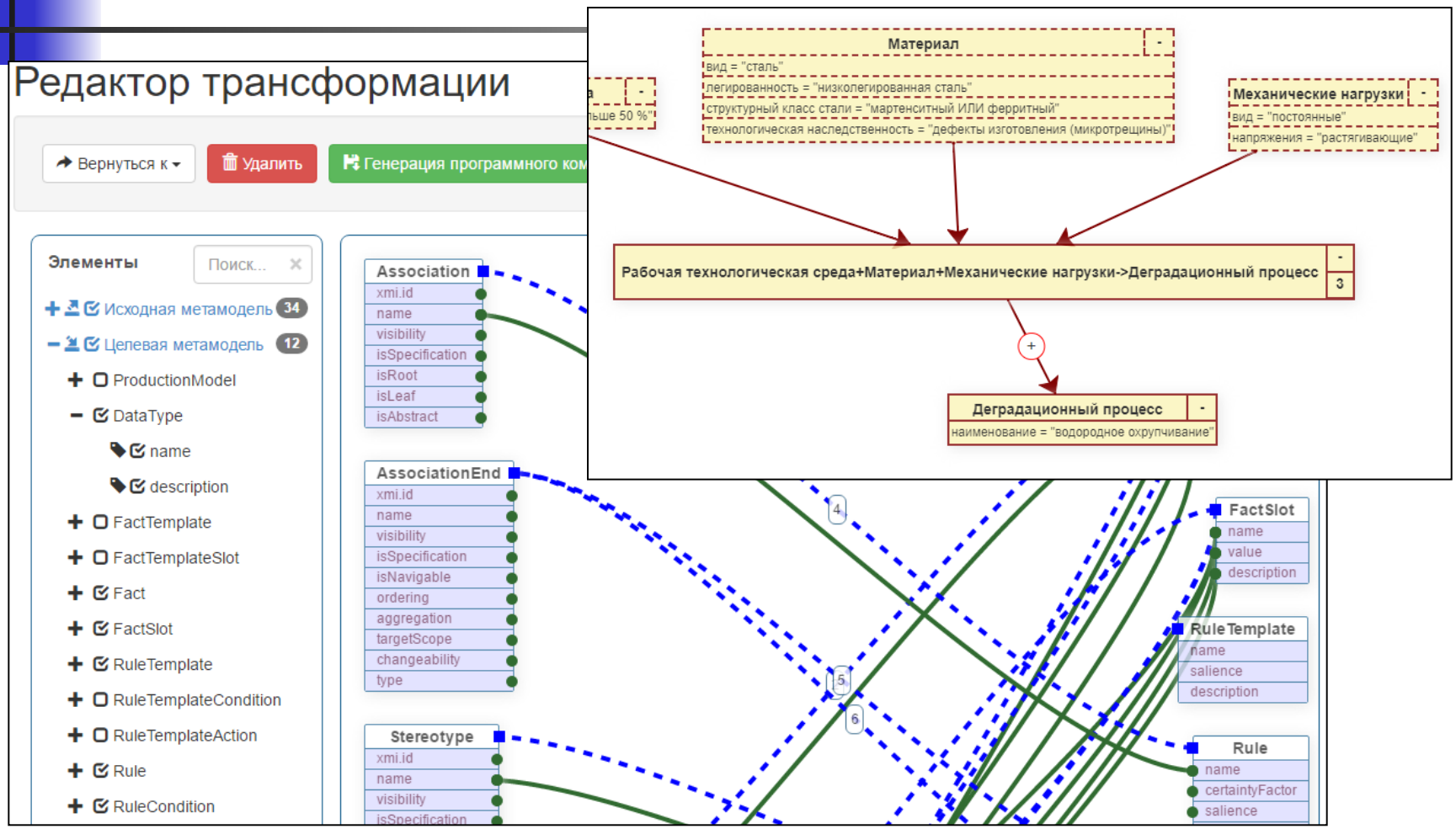


Knowledge Base Development System

Main functions:

- visual construction of transformation models (rules of elements correspondence);
- support of TMRL;
- CLIPS codes generation;
- support of RVML;

Knowledge Base Development System



АС №№ 2018660815, 2017618430 , 2017618446

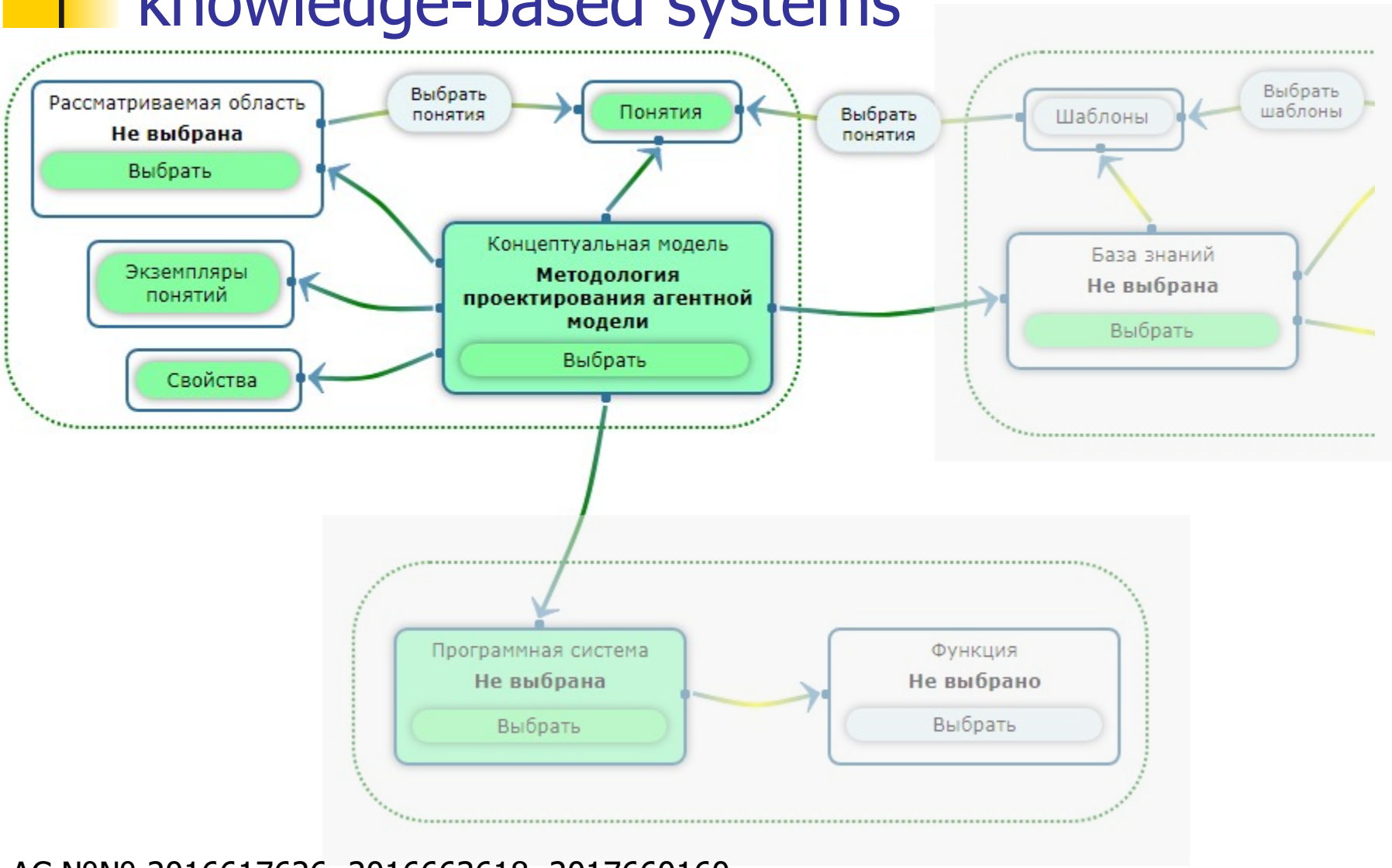
A multi-component tool for building knowledge-based systems

Main functions:

- conceptual modeling;
- rule-bases modeling;
- DROOLS code generation;
- testing obtained codes;
- generation of GUI.

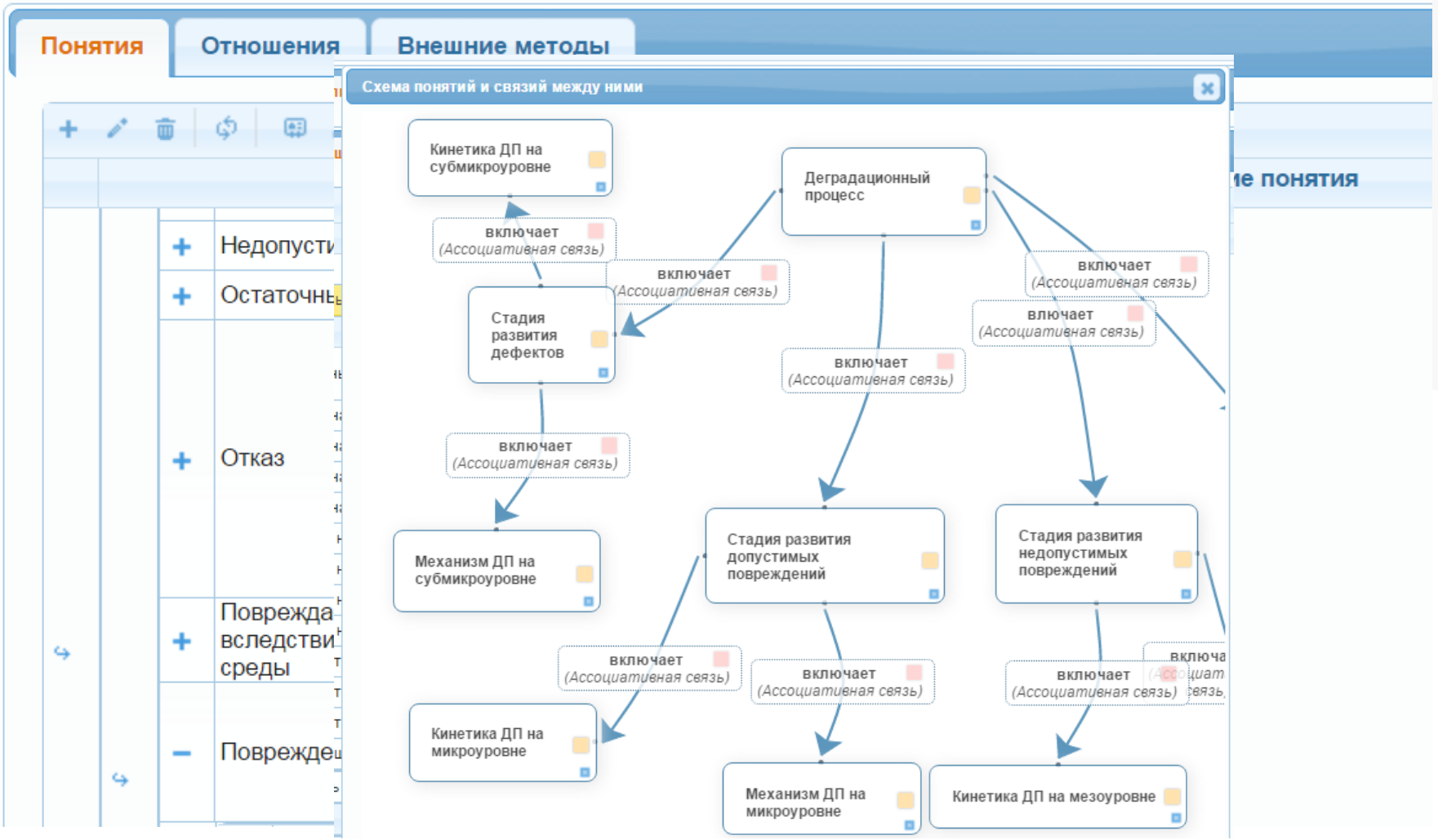
Nikolaychuk O.A., Pavlov A.I., Stolbov A.B. The software platform architecture for the component-oriented development of knowledge-based systems // MIPRO 2018. pp. 1064-1069.

A multi-component tool for building knowledge-based systems

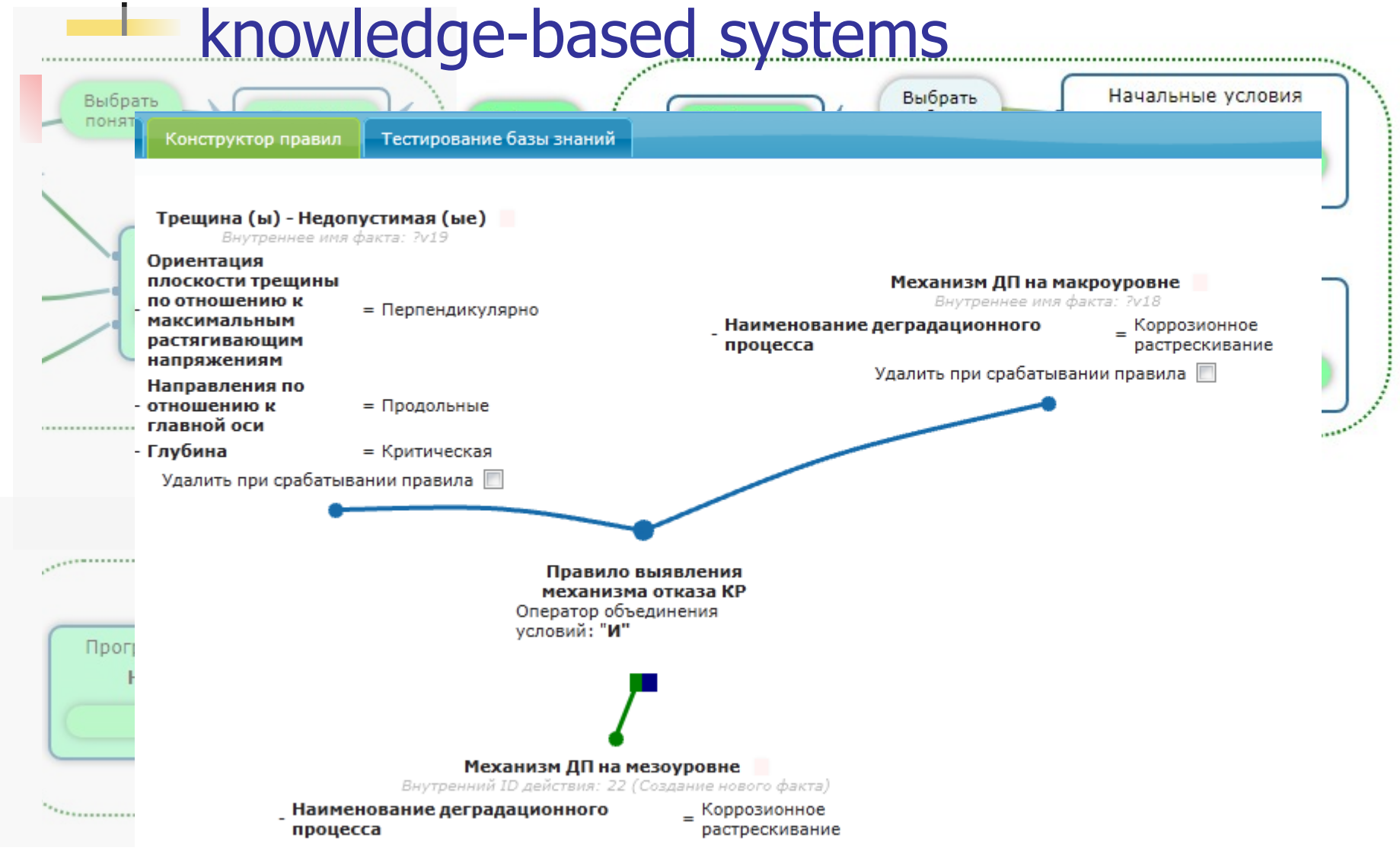
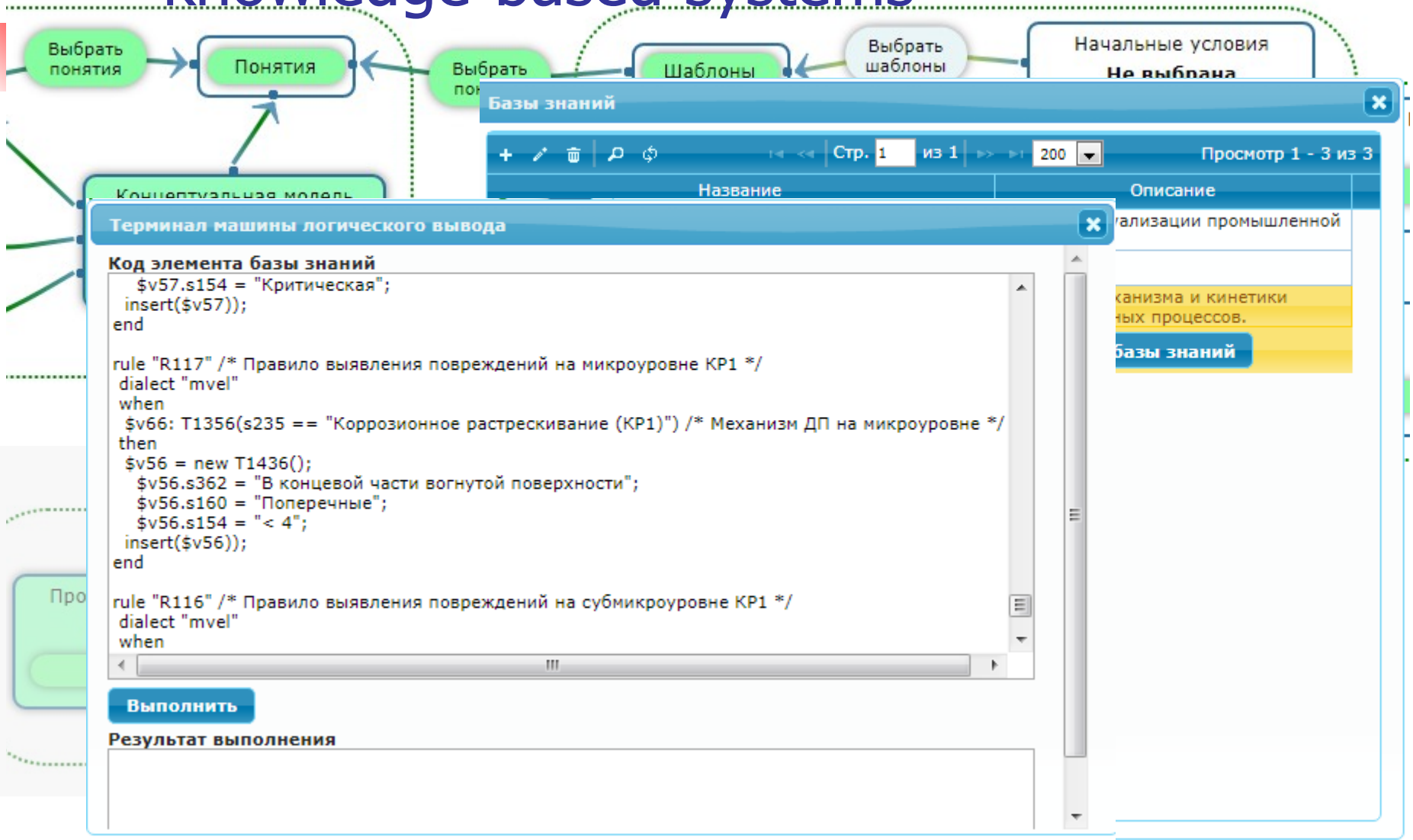


АС №№ 2016617626, 2016663618, 2017660160

A multi-component tool for building knowledge-based systems



A multi-component tool for building knowledge-based systems



A multi-component tool for building knowledge-based systems