Fourth Workshop on Controlled Natural Language

CNL 2014

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RuleCNL: a Controlled Natural Language for Business Rule Specifications

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Maximize the Business Value of Enterprise Data

Geneva, Switzerland

Outline

- Introduction
- Underpinning Concepts (Business rule, CNLs)
- Related Work
- *RuleCNL:* our CNL for Business Rule Specifications
  (Vocabulary, Grammar, Tool and Evaluation)
- Conclusion and Future Work

Introduction-Context

Business Agility

Information Systems (IS)

Business Changes

Ideal vehicle to capture the business logic

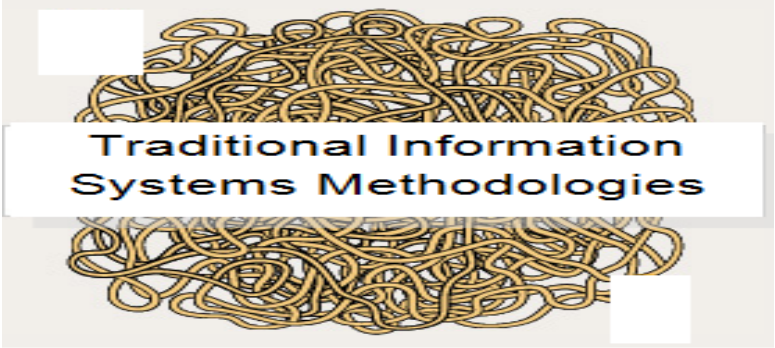
Ability to make IS flexible and amenable to change

Business rules

"Business rules are the ultimate levers with which business management is able to guide and control the business. In fact, the business's rules are the means by which an organization implements competitive strategy, promotes policy, and complies with legal obligations",

(Von Halle, 2006)

Introduction-Problematic

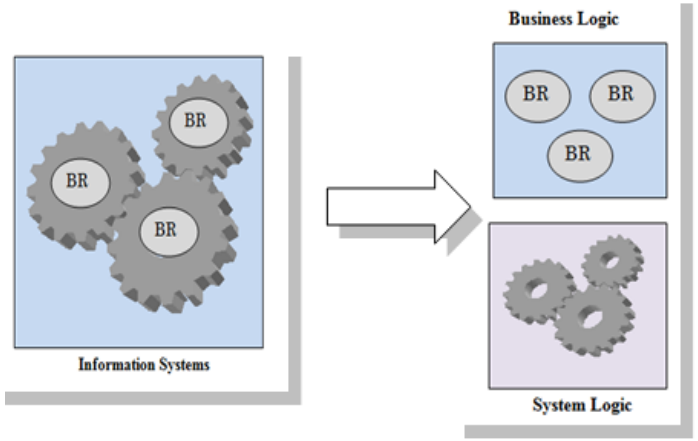


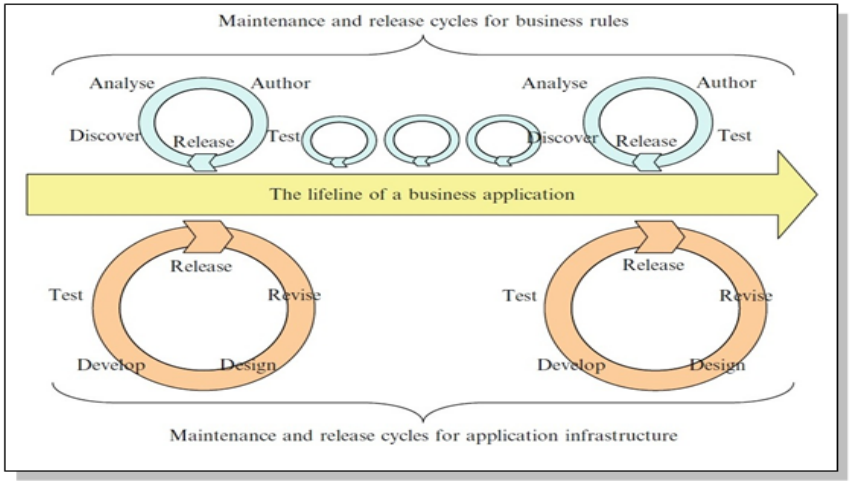
Issue 1: Business experts need to know which business rules they are using, and whether they are using them consistently.

Issue 2: Business rules that are embodied in IS need to be described in a language that all stakeholders can understand, and need a way of ensuring traceability between those rule descriptions and the actual implementations

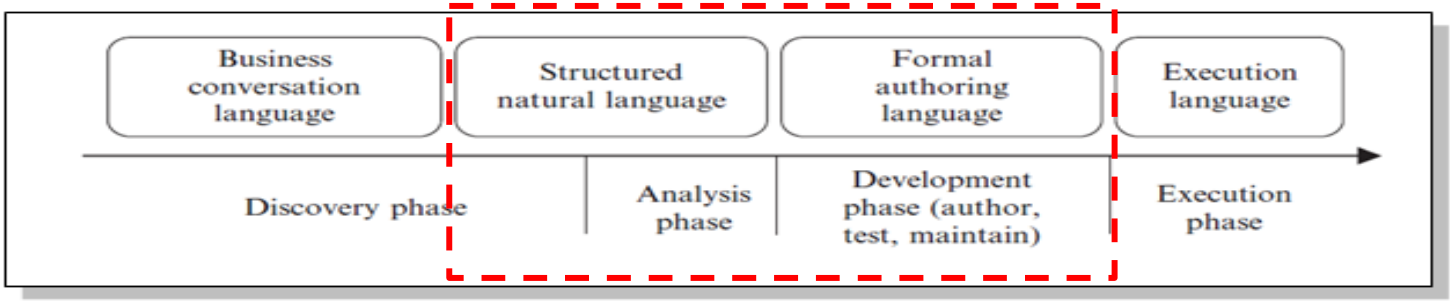
Issue 3: Business experts need an agile development infrastructure/paradigm that enables them to react to the changing environment in a timely manner.

Introduction-Problematic (1)



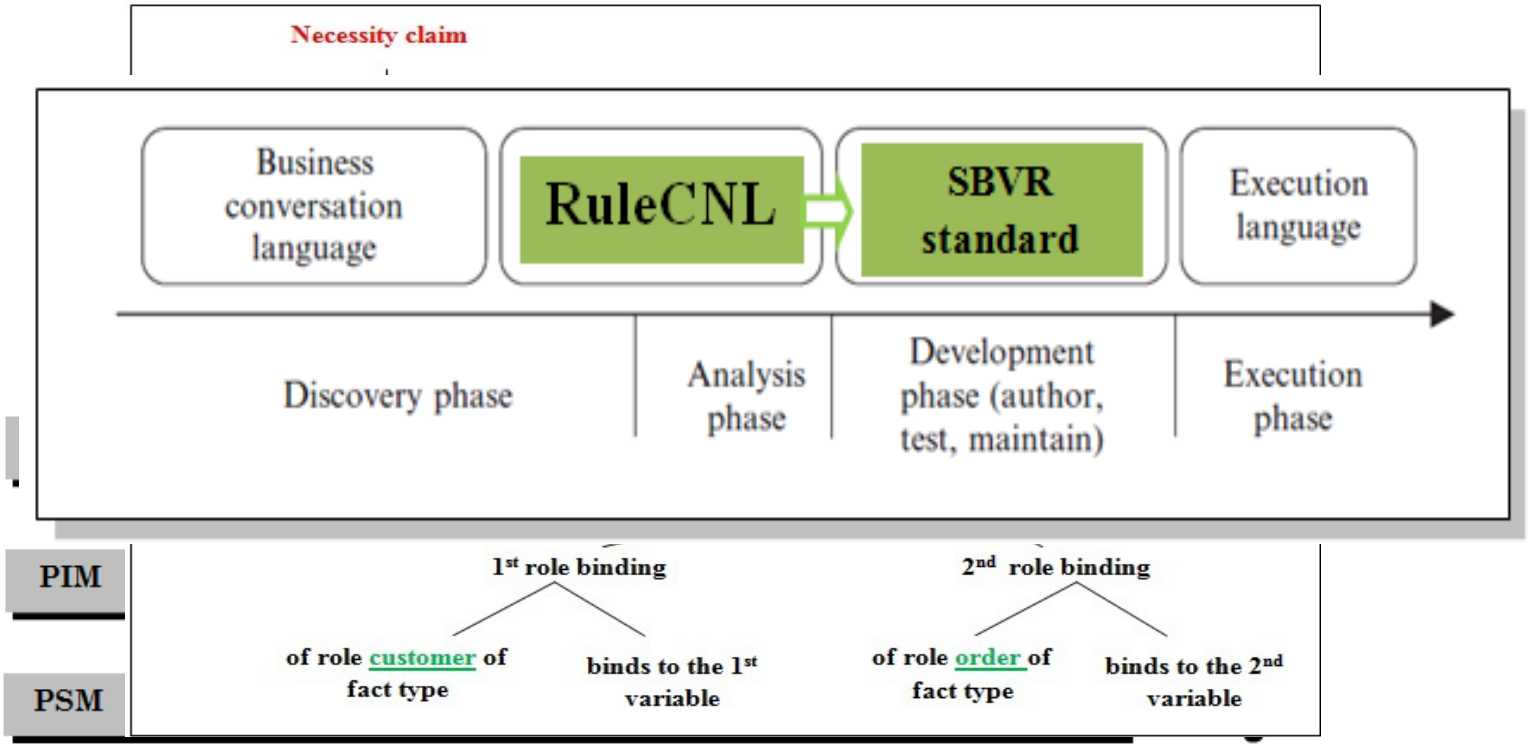


Business Rule Approach (BRA): business rules should be collected and explicitly represented in a centralized application called BRMS (BR



Introduction-Contributions

- Overview of RuleCNL within the Model Driven Architecture (MDA) multi-layered Framework



Business Rule

- **Definition:** *"Statement that defines or constrains some aspect of the business. It is intended to assert business structure, or to control or influence the behavior of the business"* (BRG, 2000)

- E.g. *The insurance does not reimburse medical expenses incurred abroad if the claim is presented more than one year after the expenses had been incurred, or if the claimant has spent more than 100 days abroad within the past year.*

- *A good business rule must be at least: atomic, declarative, business related, consistent, unambiguous, etc.*

- *IF the date of creation of the claim is more than one year after the date of treatment of the medical expense THEN reject the medical expense.*

- *IF the claimant spend more than 100 days abroad within the past year THEN reject the claim.*

Controlled Natural Language (CNL)

- *"A CNL is a constructed language that is based on a certain natural language, being more restrictive concerning lexicon, syntax and/or semantics while preserving most of its natural properties"*

  (Kuhn, 2014)

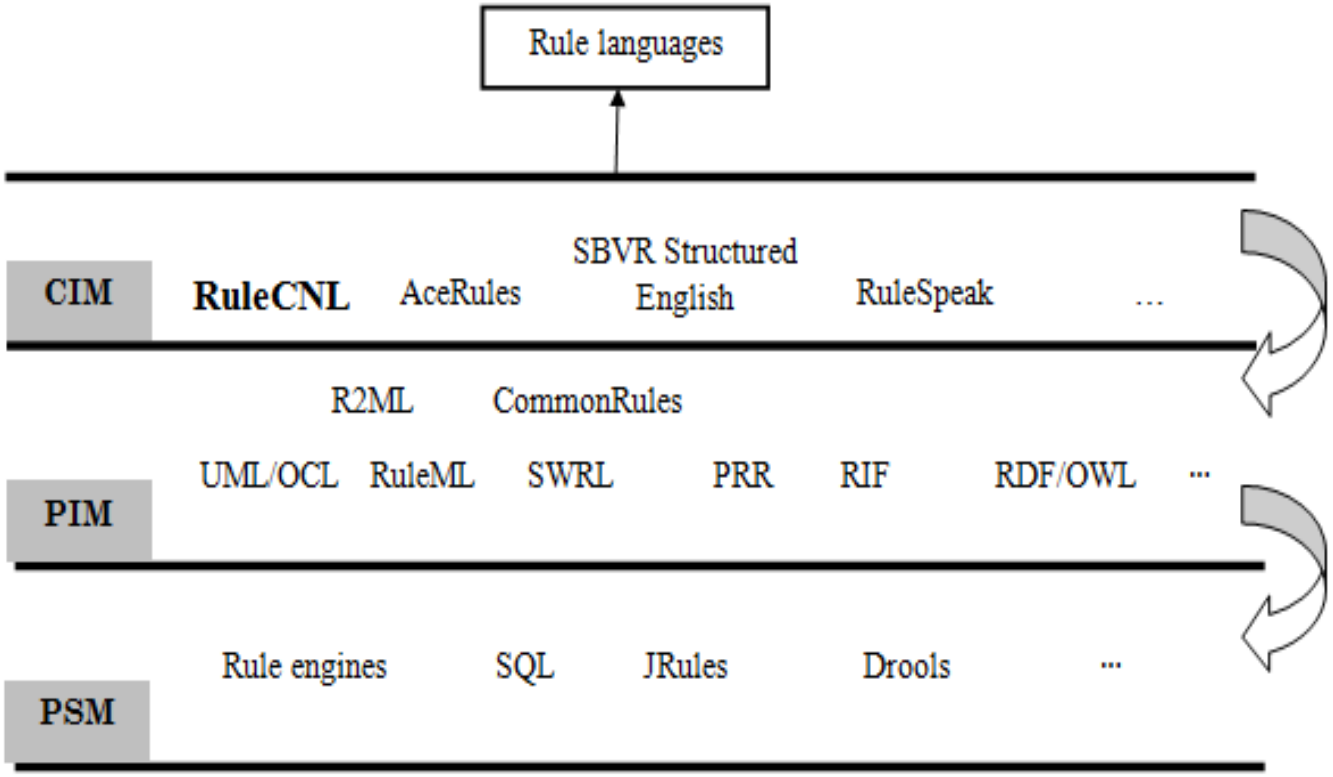
- Human-oriented CNLs are intended to improve the communication among people for specific purposes and the readability, comprehensibility of technical documentations.

  E.g. *Basic English, Caterpillar Fundamental English*, etc.

- Machine-oriented CNLs are designed to improve the communication between humans and computers.

  E.g. *ACE, PENG*, *Rabbit*, CLOUT, Lise, etc.

Related Work



Rule languages at different abstraction levels of the MDA Framework

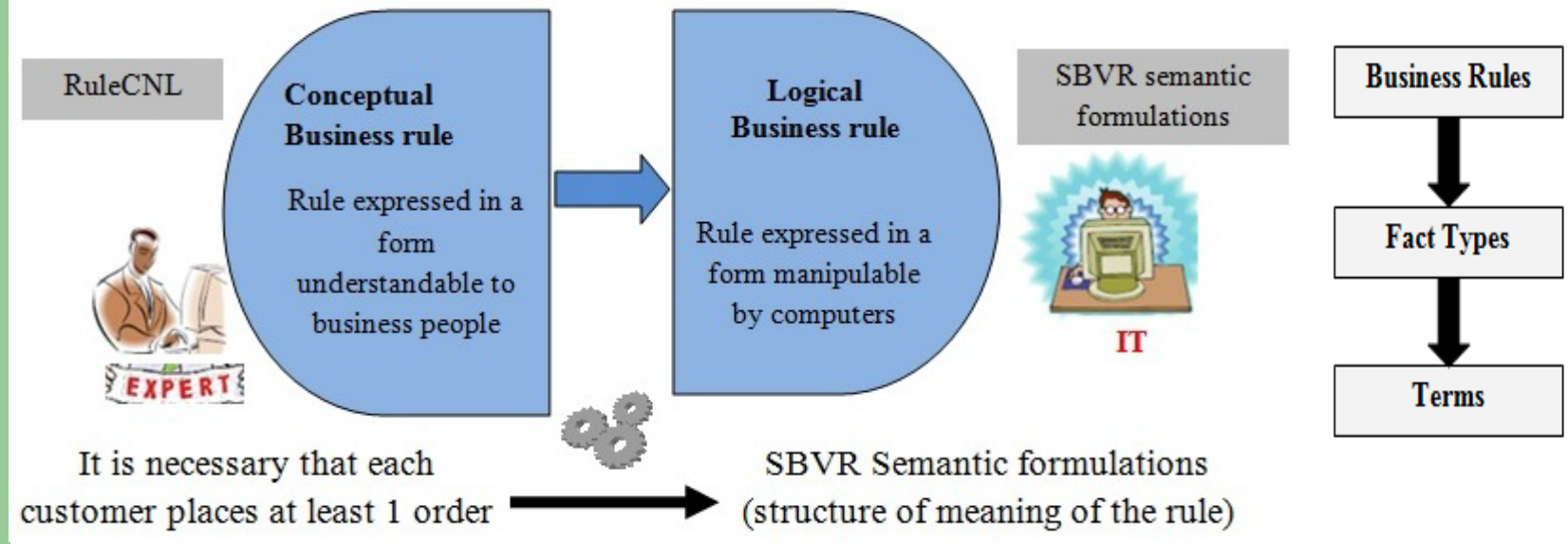
Related Work (1)

IF the customer is underage THEN apply 20% of discount

All customers must have at least 18 years old

```
<rule name "UnderageCustomer">
  <c
        context customer                    r();
              inv: self.cAge >= 18
  </
  <a
    customer.setDiscount(20);
  </action>
</rule>
```

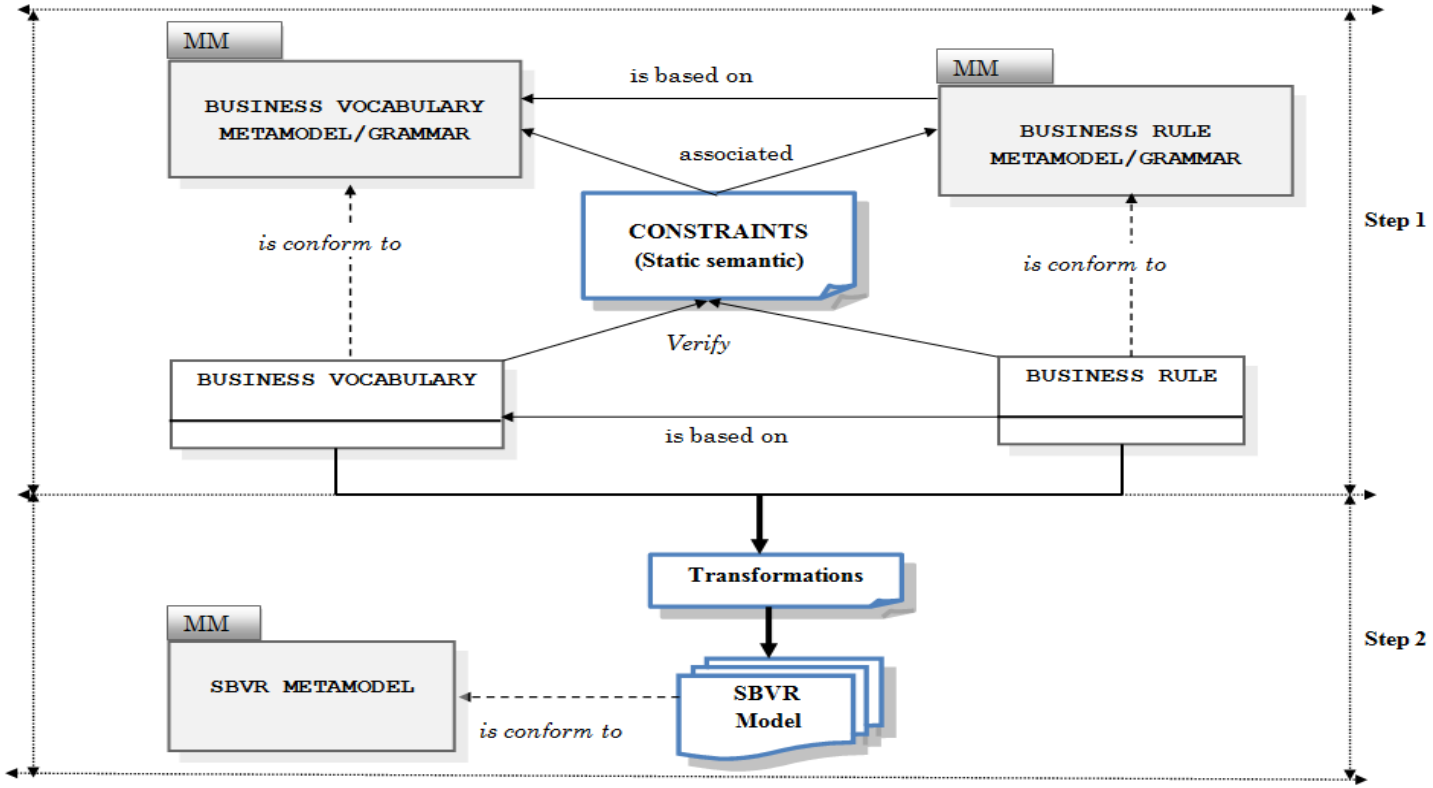
RuleCNL: OVERVIEW



- RuleCNL Syntax (Vocabulary and Grammar)
- RuleCNL Semantics (Translational)

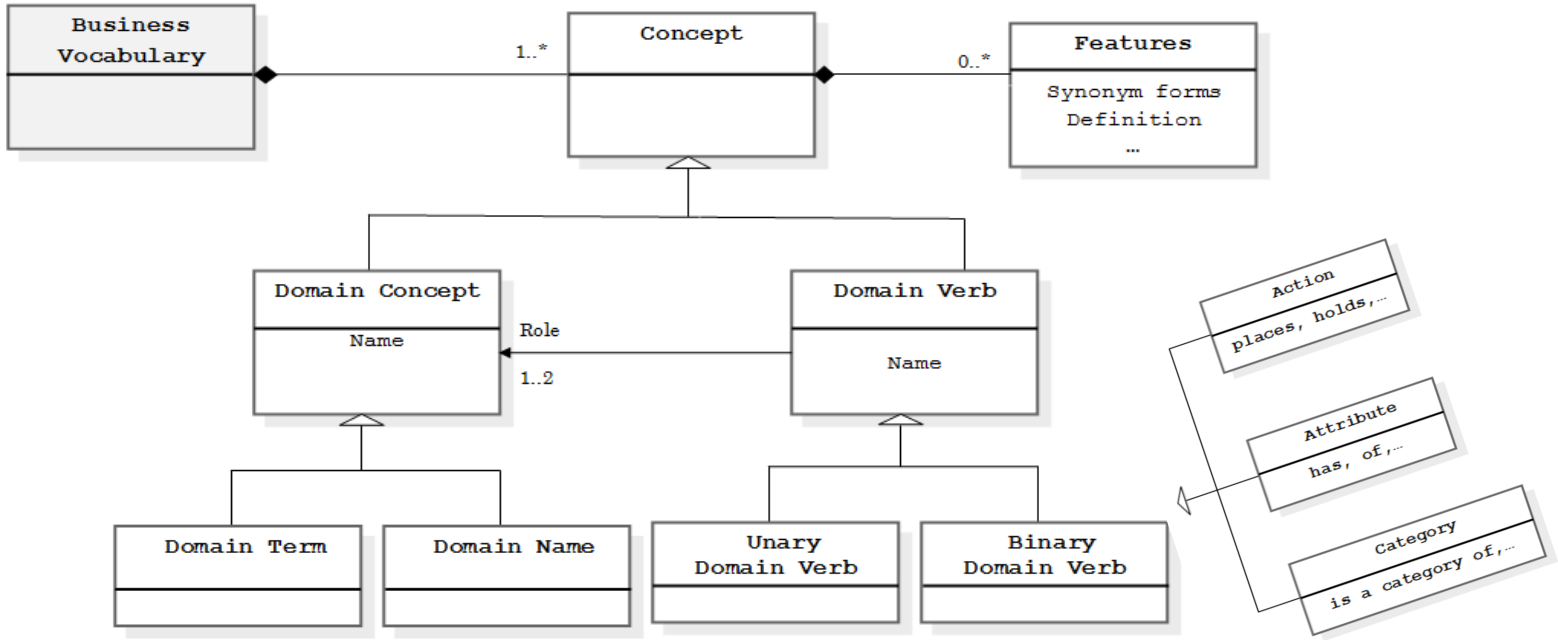
- RuleCNL Tool

RuleCNL: DESIGN PRINCIPLES



MDA principles based on metamodelling and model transformations

RuleCNL Vocabulary



customer

gold customer

bank account

France, Euro, USA,, etc

Subject + U_Domain Verb (customer *smokes)*

Subject + B_Domain Verb + Object

(customer *places* order or order *is placed by* customer)

customer holds bank account

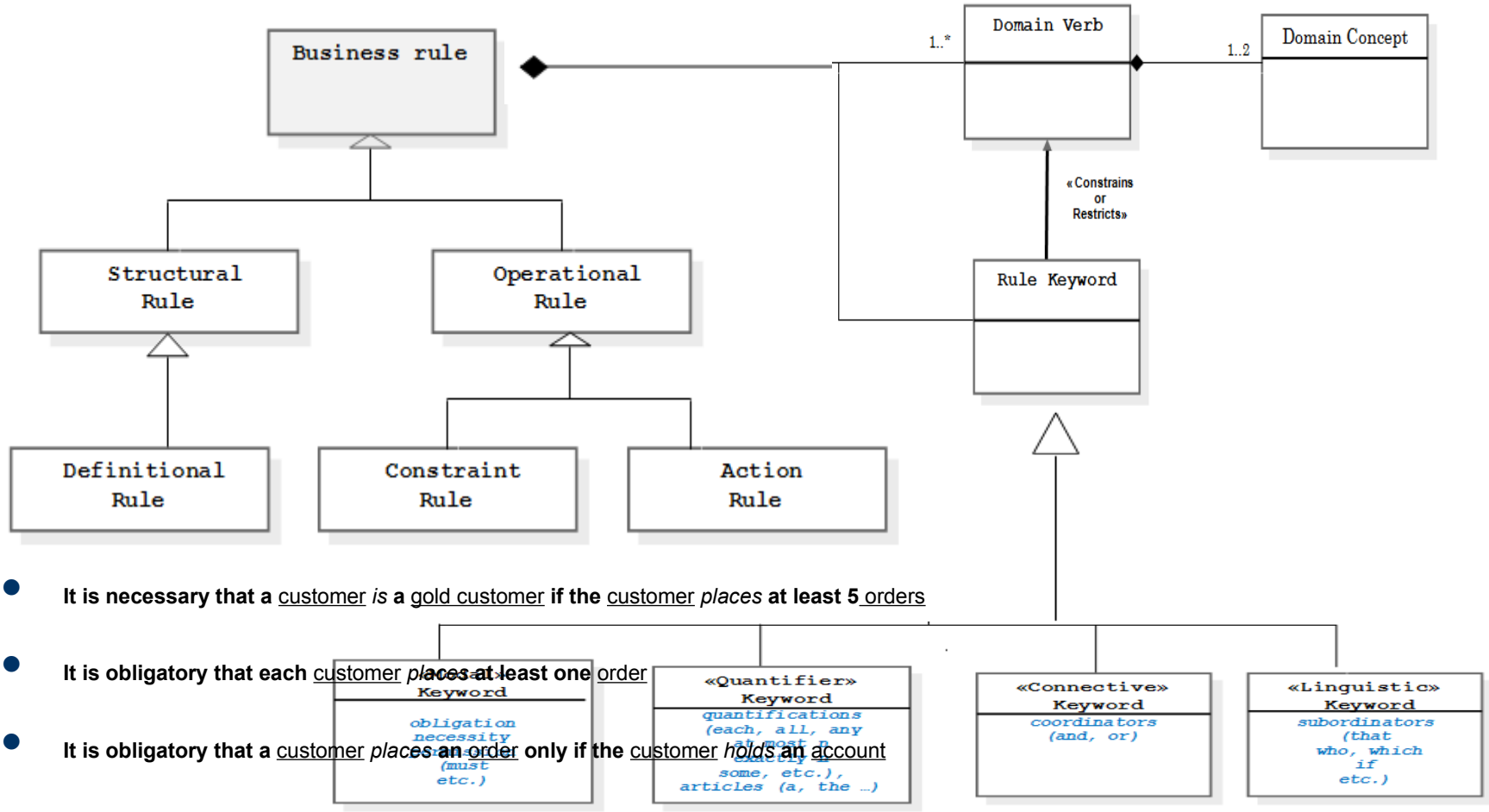
RuleCNL Vocabulary (1)

- *Domain Verb* has no meaning in isolation, but only within the relationship.

manager ***runs*** company; horse ***runs*** race; computer ***runs*** program

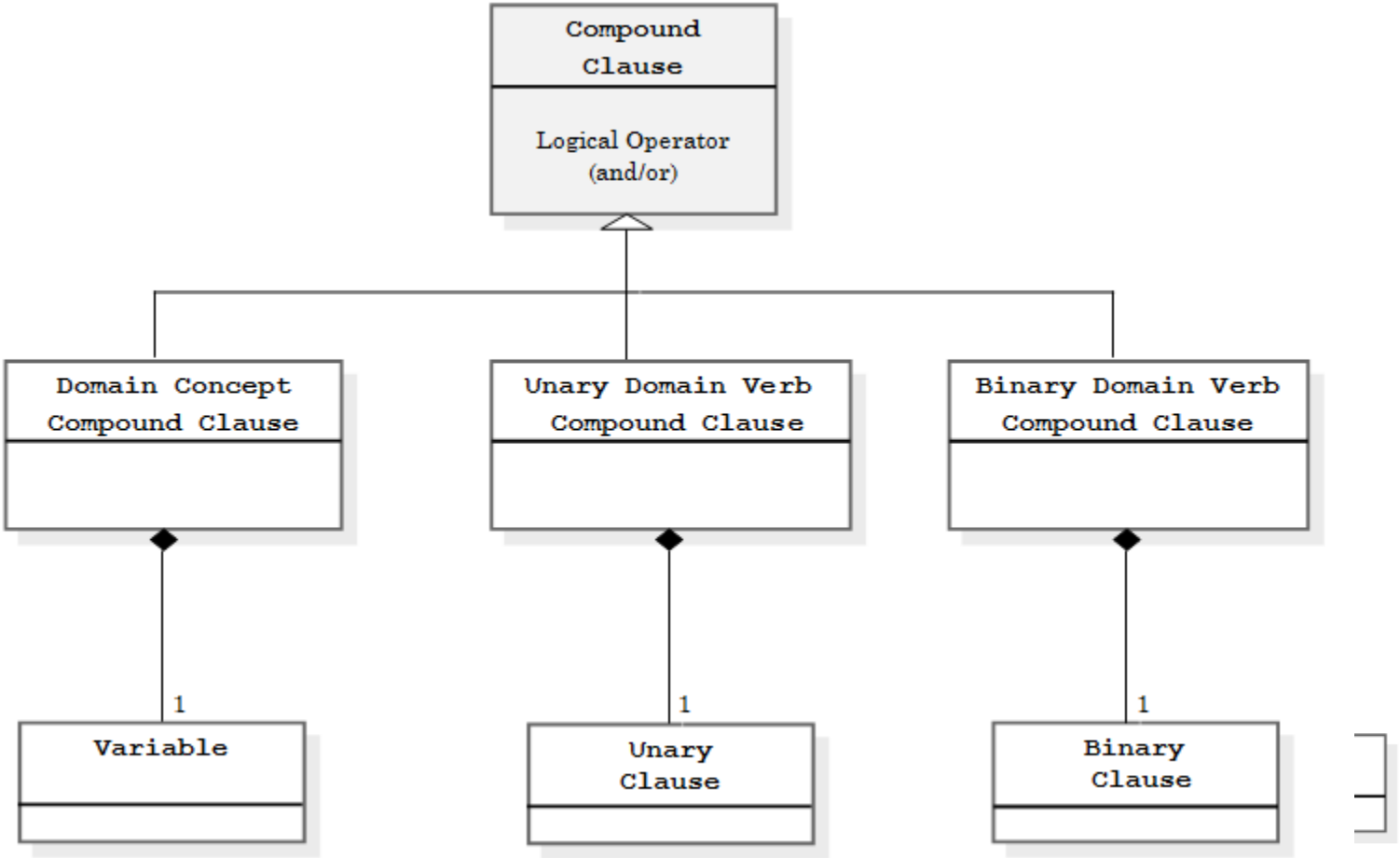
- No additional words or functional words in the relationship. Any constraints or restrictions are added when defining business rules.
- The RuleCNL vocabulary includes some built-in relationships as comparison verbs (equality/inequality) which are not defined by domain users.
- Domain users define or import their vocabulary with the help of the vocabulary editor.

RuleCNL Metamodel: Taxonomy and Rule Concepts



- **It is necessary that a** customer *is* **a** gold customer **if the** customer *places* **at least 5** orders
- **It is obligatory that each** customer *places* **at least one** order
- **It is obligatory that a** customer *places* **an** order **only if the** customer *holds* **an** account

RuleCNL Metamodel: Abstract Syntax

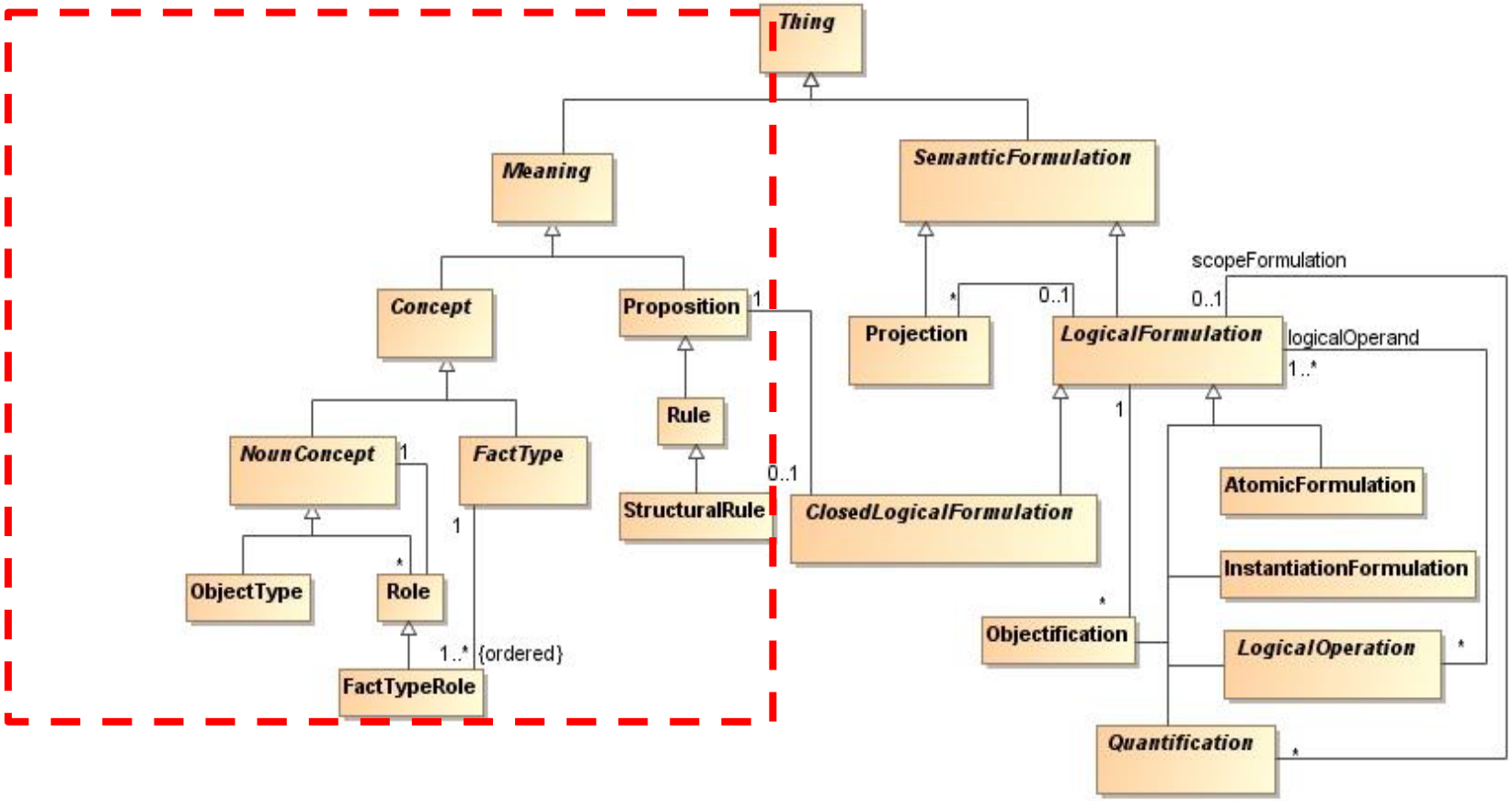


RuleCNL Grammar: Concrete Syntax

```
AuxilaryCompoundVerbConcept :  (Auxiliaire)?, Variable ;
BinaryFactQualifier:  ActionBinaryFactQualifier |AttributeBinaryFactQualifier|CategoryBinaryFactQualifier ;
ActionBinaryFactQualifier: Introducer, (Auxiliaire)?, (ref::BinaryVerb), (Quantifier)?, (ref::NounConcept);
AttributeBinaryFactQualifier: Introducer, Auxiliaire,  OperatorVerb,  Preposition, (Quantifier)?, NounConceptORValue;
CategoryBinaryFactQualifier: Introducer, Auxiliaire, CategoryVerb, (Quantifier)?, (ref::NounConcept) ;
NounConceptORValue : (ref::NounConcept) | ValueAttribute;
UnaryFactQualifier:  Introducer, Auxiliaire, (adverb = STRING)?, (ref::UnaryVerb),(qualifier = STRING)?;
InstantiationQualifier : STRING;
Auxiliaire : ListAuxiliaire ;
Quantifier :  UniversalQuantifier | ExistentialQuantifier ;
UniversalQuantifier : ListUniversalQuantifier;
ExistentialQuantifier :  ListExistentialQuantifier, INT ;
Preposition : ListPreposition];
Introducer : ListIntroducer ;
Attribute:    VariableAttribute | ConceptAttribute | ValueAttribute ;
ConceptAttribute:   Variable, Prep, Variable;
VariableAttribute:   Variable;
ValueAttribute :  INT,(STRING)?) | STRING ;
Prep : ListPrep;
OperatorVerb :PositiveOperatorVerb | NegativeOperatorVerb ;
PositiveOperatorVerb : ListPositiveOperatorVerb ;
NegativeOperatorVerb : ListNegativeOperatorVerb ;;
CategoryVerb : ListCategoryVerb;
Point : ".";
STRING :   ('a'..'z'|'A'..'Z'|'_'|'é'|'è'|'ê'|'ç'|'à'|'ë')('a'..'z'|'A'..'Z'|'_'|'-'|'0'..'9'|'é'|'è'|'ê'|'ç'|'à'|'ë')*;
```

RuleCNL Semantics

- Overview of SBVR Metamodel



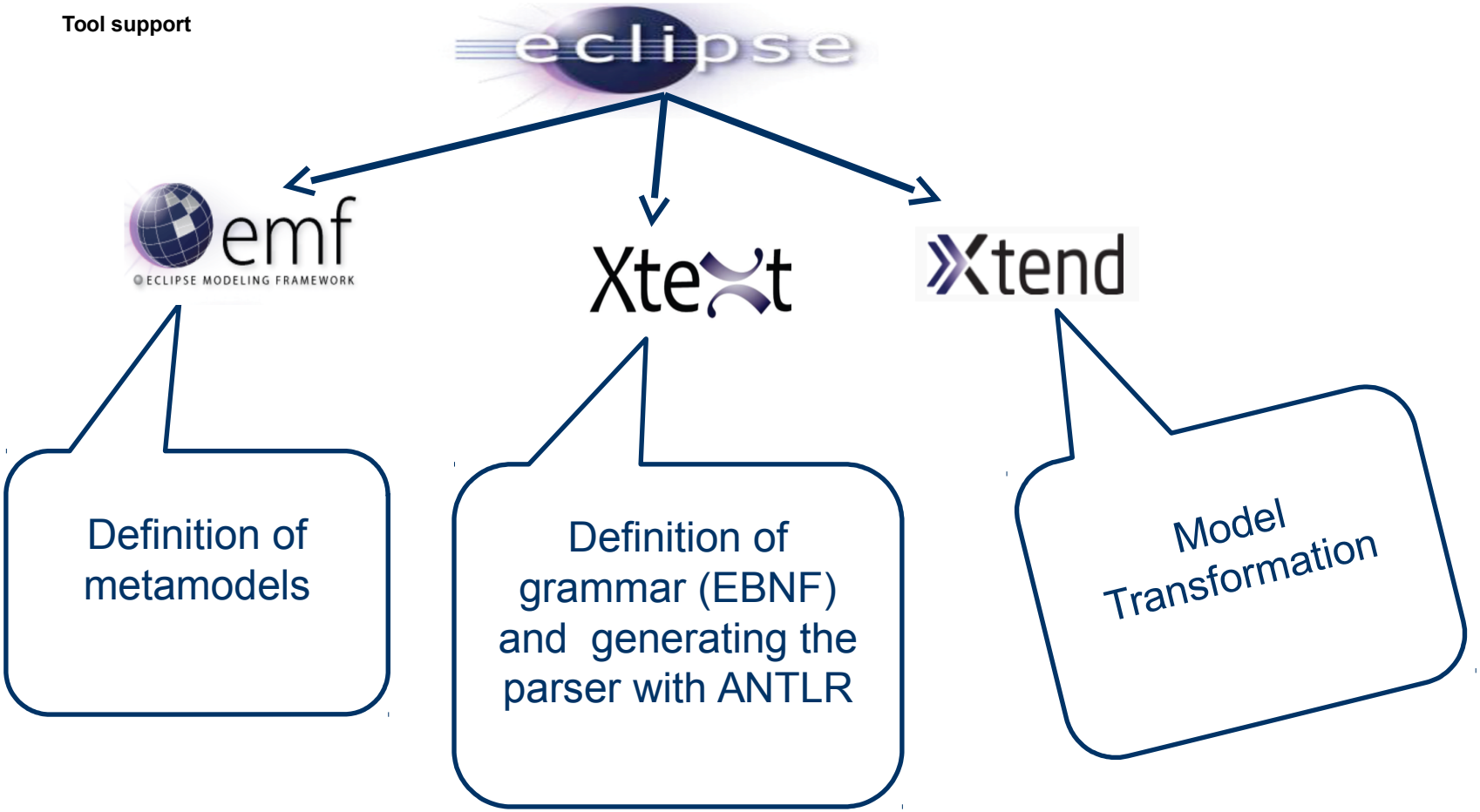
RuleCNL Semantics (1)

Rule 1: It is obligatory that the customer "John" places at least one order

```
<sbvr:rule  ruleID = "Rule1"/>
<sbvr:guidanceStatement xmi:id="stmt-formal" expression="stmt-formal-t" meaning="stmt-formal-p"/>
<sbvr:obligationFormulation xmi:id="obligation"/>
<sbvr:universalQuantification formulationEmbedsuniversalQuantification "the"/>
<sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:customer"/>
<sbvr:projectionIsOnVariable variable ="ref= xmi:customer/>
<sbvr:closedProjectionDefinesInstanceofNounConcept "John"/>
<sbvr:QuantificationScopesOverAtomicFormulation/>
<sbvr:atomicFormulation  atomicFormulationIsBasedOnBinaryFactType " ref= xmi:places"/>
 <sbvr:existentialQuantification formulationEmbedsexistentialQuantification "at_least" cardinality ="1"/>
<sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:order"/>
```

RuleCNL Tool: IMPLEMENTATION

Tool support



RuleCNL Tool: Vocabulary Editor

Resource - CNL2014Examples/Example.vocab - RuleCNL

File Edit Window Help

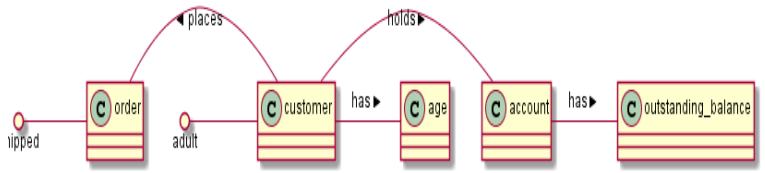
Project Ex... | Example.vocab | GeneratedVoc_Exam... | GeneratedRule_Exa... | Outline | PlantUML

CNL2014Examples
Test

```
Term: customer
Term: order
Term: account
Term: age
Term: outstanding_balance

Fact Type: customer places order
Fact Type: account has outstanding_balance
Fact Type: customer holds account
Fact Type: customer has age

Fact Type: order shipped
Fact Type: customer adult
```



RuleCNL Tool: Rule Editor

Resource - CNL2014Examples/Example.rule - RuleCNL

File Edit Window Help

Example.vocab | Example.rule | GeneratedVoc_Example.xml | GeneratedRule_Example.xml

CNL2014Ex
Test

```
ID Rule : Rule1
Description : It is necessary that each customer places at_least 1 order.

ID Rule : Rule2
Description : It is obligatory that each customer places an order if
                                    the age of the customer is greater than 18.

ID Rule : Rule3
Description : It is obligatory that an order is shipped if the customer who places the order
              is adult and holds an account that has a outstanding_balance that is greater than 0.

ID Rule : RUle4
Description :It is obligatory that each customer places at_least 1 account .
```

No consistency in the rule:
The binary fact (customer places account)
is not defined in the vocabulary

Example

RuleCNL Tool: Generated Vocabulary

Resource - CNL2014Examples/Generated Files/GeneratedVoc_Example.xml - RuleCNL

File Edit Window Help

Example.vocab | Example.rule | GeneratedVoc_Example.xml | GeneratedRule_Example.xml

CNL2014Ex
Test

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <!-- @generated. Author: Paul Brillant FEUTO-->
  <xmi:XMI xmi:version="2.1" xmlns:xmi="http://schema.omg.org/spec/XMI/2.1"
  xmlns:sbvr="http://www.omg.org/spec/SBVR/20070901/SBVR.xml">


<sbvr:term xmi:id="customer" signifier="customer-t" meaning="customer-c"/>
<sbvr:objectType xmi:id="customer-c"/>
<sbvr:text xmi:id="customer-t" value="customer"/>

<sbvr:term xmi:id="order" signifier="order-t" meaning="order-c"/>
<sbvr:objectType xmi:id="order-c"/>
<sbvr:text xmi:id="order-t" value="order"/>

<sbvr:term xmi:id="account" signifier="account-t" meaning="account-c"/>
<sbvr:objectType xmi:id="account-c"/>
<sbvr:text xmi:id="account-t" value="account"/>

<sbvr:term xmi:id="age" signifier="age-t" meaning="age-c"/>
<sbvr:objectType xmi:id="age-c"/>
<sbvr:text xmi:id="age-t" value="age"/>

<sbvr:term xmi:id="outstanding_balance" signifier="outstanding_balance-t" meaning="outstanding_balance-c"/>
<sbvr:objectType xmi:id="outstanding_balance-c"/>
<sbvr:text xmi:id="outstanding_balance-t" value="outstanding_balance"/>

<sbvr:sententialForm xmi:id="customer-places-order" expression="cpo-t" meaning="cpo-c" placeholder="cpo-p1 cpo-p2"/>
<sbvr:binaryFactType xmi:id="cpo-c" role="cpo-r1 cpo-r2"/>
<sbvr:designation xmi:id="places" signifier="places-t" meaning="cpo-c"/>
<sbvr:text xmi:id="cpo-t" customer places order"/>
<sbvr:text xmi:id="places-t" value="places"/>
<sbvr:placeholder xmi:id="cpo-p1" expression="customer-t"  meaning="cpo-r1"/>
<sbvr:placeholderUsesDesignation placeholder="cpo-p1" designation="customer"/>
<sbvr:factTypeRole xmi:id="cpo-r1"/>
<sbvr:placeholder xmi:id="cpo-p2" expression="order-t"  meaning="cpo-r2"/>
```

An outline is not available.

RuleCNL Tool: Generated Rules

Resource - CNL2014Examples/Generated Files/GeneratedRule_Example.xml - RuleCNL

File Edit Window Help

Example.vocab | Example.rule | GeneratedVoc_Example.xml | GeneratedRule_Example.xml

CNL2014Ex
Test

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- @generated. Author: Paul Brillant FEUTO-->
<xmi:XMI xmi:version="2.1" xmlns:xmi="http://schema.omg.org/spec/XMI/2.1"
xmlns:sbvr="http://www.omg.org/spec/SBVR/20070901/SBVR.xml">

<!-- SBVR Model expressed in XML based on the SBVR XML Schema-->


<sbvr:rule  ruleID = "Rule1"/>
<sbvr:guidanceStatement xmi:id="stmt-formal" expression="stmt-formal-t" meaning="stmt-formal-p"/>
<sbvr:necessityFormulation xmi:id="necessity" />
<sbvr:universalQuantification formulationEmbedsuniversalQuantification "each"/>
<sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:customer"/>
<sbvr:QuantificationScopesOverAtomicFormulation/>
<sbvr:atomicFormulation  atomicFormulationIsBasedOnBinaryFactType " ref= xmi:places"/>
 <sbvr:existentialQuantification formulationEmbedsexistentialQuantification "at_least" cardinality ="1"/>
<sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:order"/>
Statement of the structured rule: " It is necessary that each customer places at_least 1 order"

<sbvr:rule  ruleID = "Rule2"/>
<sbvr:guidanceStatement xmi:id="stmt-formal" expression="stmt-formal-t" meaning="stmt-formal-p"/>
<sbvr:obligationFormulation xmi:id="obligation"/>
<sbvr:universalQuantification formulationEmbedsuniversalQuantification "each"/>
<sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:customer"/>
<sbvr:QuantificationScopesOverAtomicFormulation/>
<sbvr:atomicFormulation  atomicFormulationIsBasedOnBinaryFactType " ref= xmi:places"/>
<sbvr:universalQuantification formulationEmbedsuniversalQuantification "an"/>
<sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:order"/>
 <sbvr:implication quantificationScopesOverLogicalImplication "if"/>
 <sbvr:implicationHasAntecedent/>
     <sbvr:universalQuantification formulationEmbedsuniversalQuantification "the"/>
     <sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:age"/>
     <sbvr:QuantificationScopesOverPropertyFormulation  attribute="of"/>
     <sbvr:universalQuantification formulationEmbedsuniversalQuantification "the"/>
     <sbvr:QuantificationIntroducesVariable  variableRangesOverConcept " ref= xmi:customer"/>
     <sbvr:QuantificationScopesOverAtomicFormulation/>
     <sbvr:atomicFormulation  atomicFormulationIsBasedOnOperatorFactType "is greater than"/>
```

An outline is not available.

RuleCNL Evaluation

Global Data Excellence
Maximize the Business Value of Enterprise Data

Geneva, Switzerland

operates in the field of Data Governance

- **ONP** (*Opérateur national de paye*): French parastatal company which handles the salary and pay slips of about 2.5 millions of ministry's employees

- Corpus: 50 Business rules from real-life case studies
- Users:

Group 1: Business experts with no background on IS

Group 2: Business experts with a background on IS

RuleCNL Evaluation (1)

Measures / Users	Group 1	Group 2
Expressiveness	84%	84%
Comprehensibility	90%	100%

Conclusion

.**Summary:**

- Categorize business rules regarding their syntax structures
- Define metamodels for business rules and business vocabulary
- Define constrains or static semantics for the alignment of the definition of the business rule with the business vocabulary
- Define a grammar (context free) for defining concrete syntax rules
- Automatic transformations of RuleCNL rules to SBVR SF
- Tool support

Future Work

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- Extend the evaluation
- Extend the RuleCNL metamodel
- Generate formal rules for rule engines and database systems from SBVR models
- Look for other grammar frameworks more suitable for natural languages

End

THANK YOU FOR YOUR KIND ATTENTIO