



## **SBUR's Approach to Controlled Natural Language**

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# PRESENTATOR

Drs. S. Spreeuwenberg has a background in artificial intelligence and many years of experience in business rules modeling and application development where business rules play an important role. She is the co-founder and director of LibRT. LibRT helps customers to assess and improve the quality of business rules. We believe that focus on quality is necessary to profit of all promises of the business rules approach.

Silvie is involved in the business rules work group of the OMG working on standardization of business rules and is editor of the European section of the Business Rules Community.

LibRT is co-organizer of the European Business Rules Conference.

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# ACKNOWLEDGMENTS

We would like to express our appreciation to all the members of the team who contributed to the SBVR specification.

It is their willingness to share knowledge and their individual dedication to quality work that is making this body of work a success.

In particular, we would like to thank those who have devoted their time and effort to reviewing, and improving, this paper.

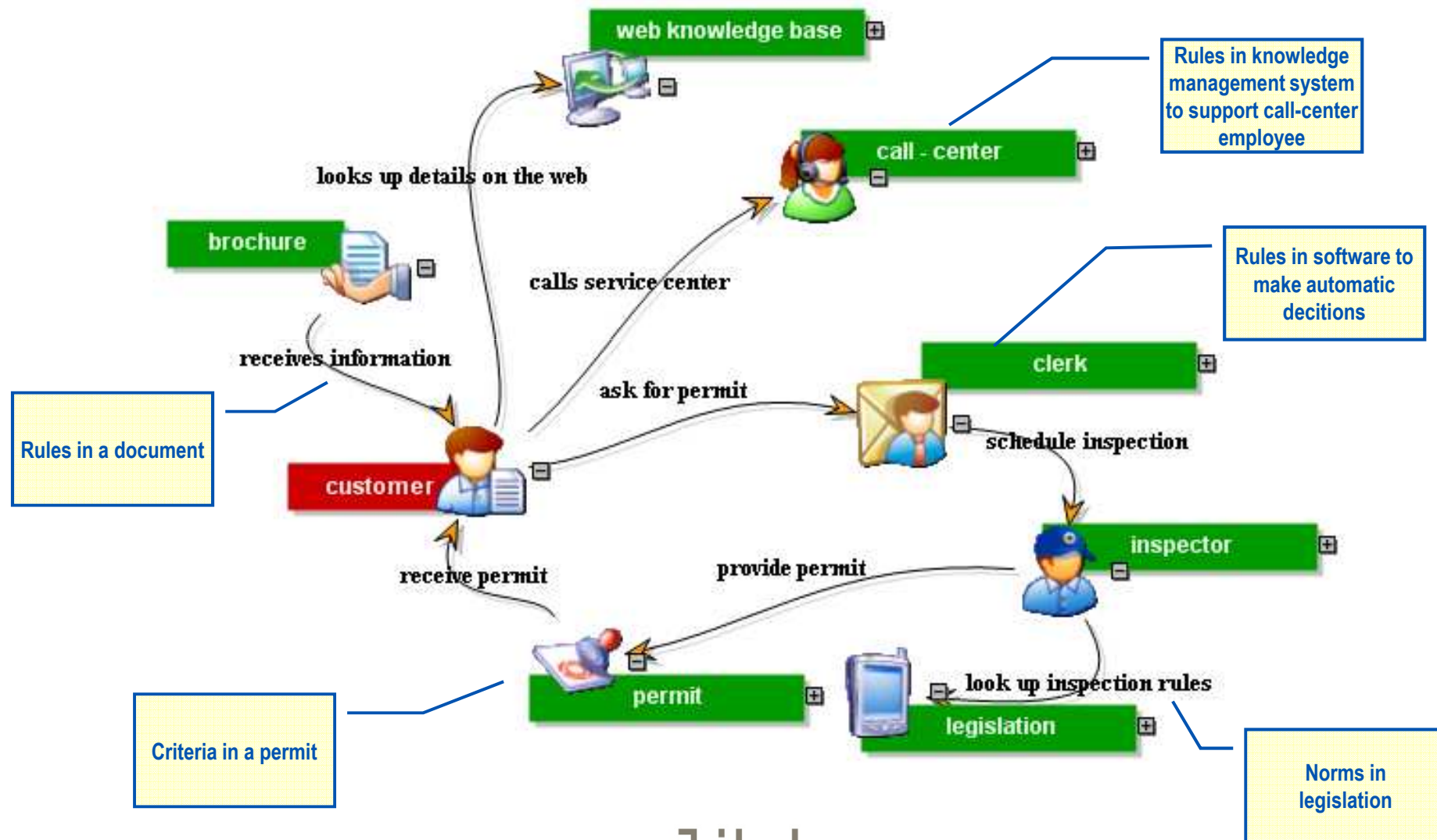
SBVR can be downloaded at : <http://www.omg.org/specs/sbvr/1.0/>

daily work

objectives

# MY BACKGROUND AND INTEREST IN SBUR & CNL

# RULES IN ADMINISTRATIVE ORGANIZATIONS



# EXAMPLE BUSINESS RULES



*Rules are made for people, not people made for the rules.*

*The term business should be interpreted in its broadest sense.*

*A gold customer must be allowed access to the waiting lounge.*

*A customer is always considered a gold customer if the customer has more than 12 rentals during a calendar year.*

*The total base charge of a rental is always computed as the car group rate times the number of rental time units, plus any additional charges, minus any customer discount.*

# NOT A BUSINESS RULE



*But not all “natural language” qualifies ...*

- *not “Legaldegook”*

No savings and loan holding company, directly or indirectly or through one or more transactions, shall acquire control of an uninsured institution or retain, for more than one year after other than an insured institution or holding company thereof, the date any insured institution subsidiary becomes uninsured, control of such institution.

**human readable sentence SWRL rule:**

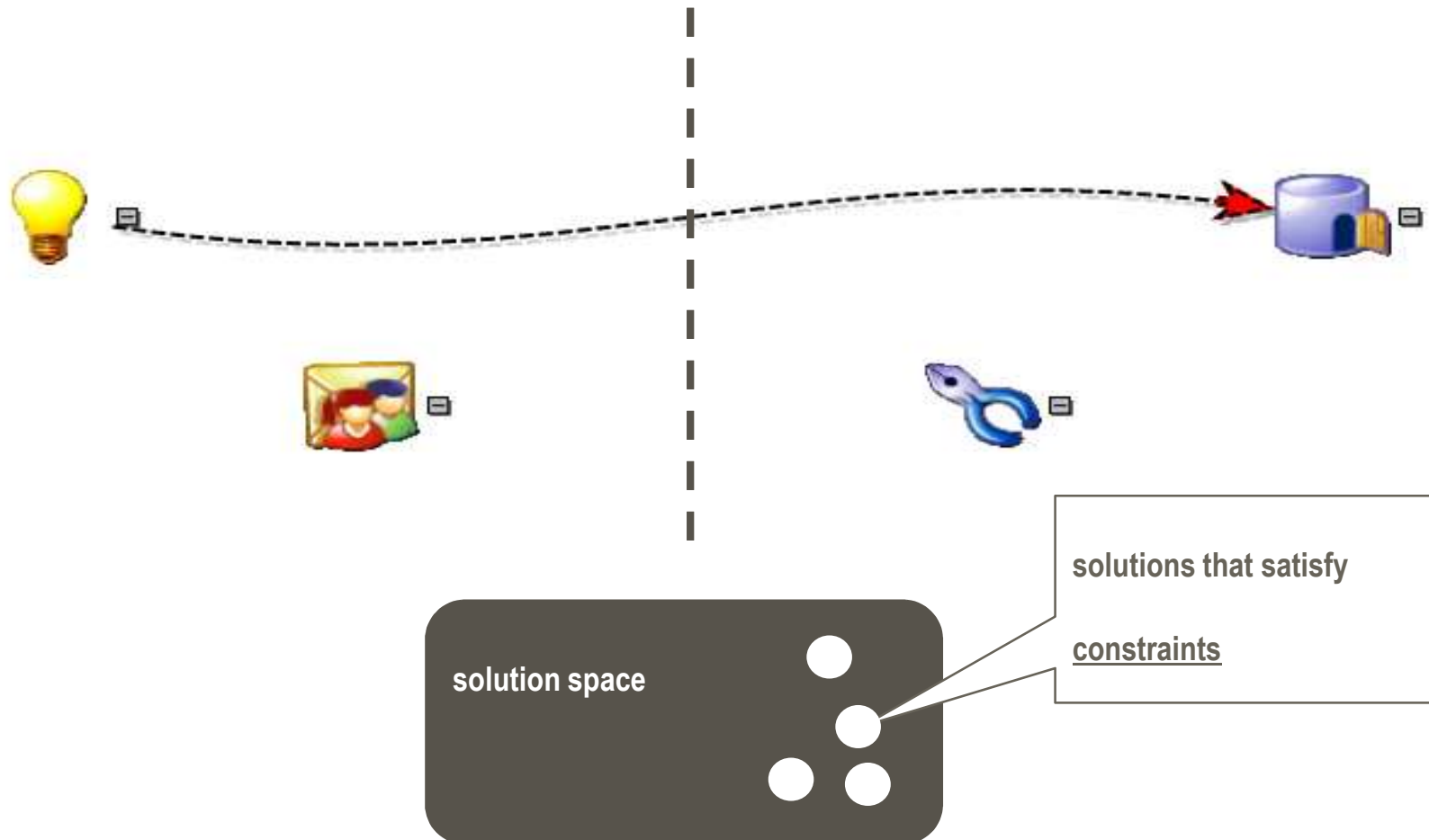
`hasParent(?x1,?x2) ∧ hasBrother(?x2,?x3) ⇒ hasUncle(?x1,?x3)`

“Business people don’t set variables  
and they don’t call functions.”

Don Baisley, Microsoft

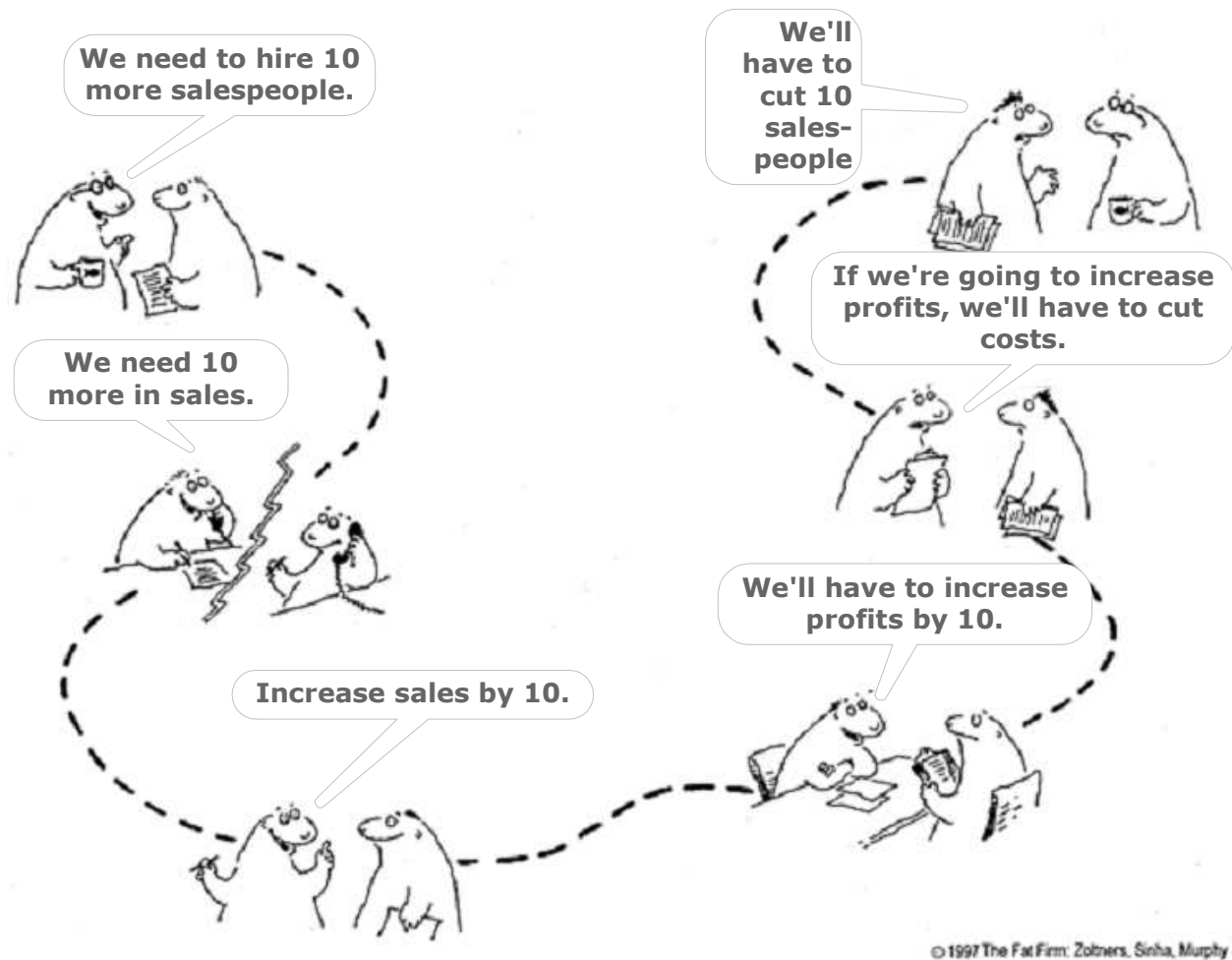
Architect of Rules Modeler while at Unisys

# THE BIG PICTURE





# CAN WE SOLVE THIS ISSUE ?



what is SBVR?

who was involved?

what where the sources of inspiration?

the SBVR document

**SBUR**

# WHAT IS SBVR ?

- a standard ... a product standard

a document .... available at <http://www.omg.org/specs/sbvr/1.0/>

- who is the OMG?



standards organization .... consortium of computer-industry companies

both large and small ... a range of membership plans

- SBVR timeline

June 2003: OMG issued RFP (Request for Proposal) as "*Business Semantics of Business Rules (BSBR)* "

July 2003: Business Rules Team (BRT) was formed

**Diverse mix: practitioners, methodologists, academics, vendors**

Jan. 2004: BRT drafted Initial Response

Sep. 2005: BRT's Final Response (SBVR) adopted by OMG

Sep. 2007: SBVR Finalization completed

Dec. 2007: SBVR approved

Jan. 2008: SBVR v1.0 published

# PARTICIPANT ORGANIZATIONS

Adaptive  
Automated Reasoning Corporation  
Business Rule Solutions, LLC  
Business Rules Group  
Business Semantics Ltd  
Fujitsu Ltd  
Hendryx & Associates  
Hewlett-Packard Company  
InConcept  
LibRT

KnowGravity Inc  
MEGA  
Model Systems  
Neumont University  
Perpetual Data Systems  
PNA Group  
Sandia National Laboratories  
The Rule Markup Initiative  
Unisys Corporation  
X-Change Technologies Group

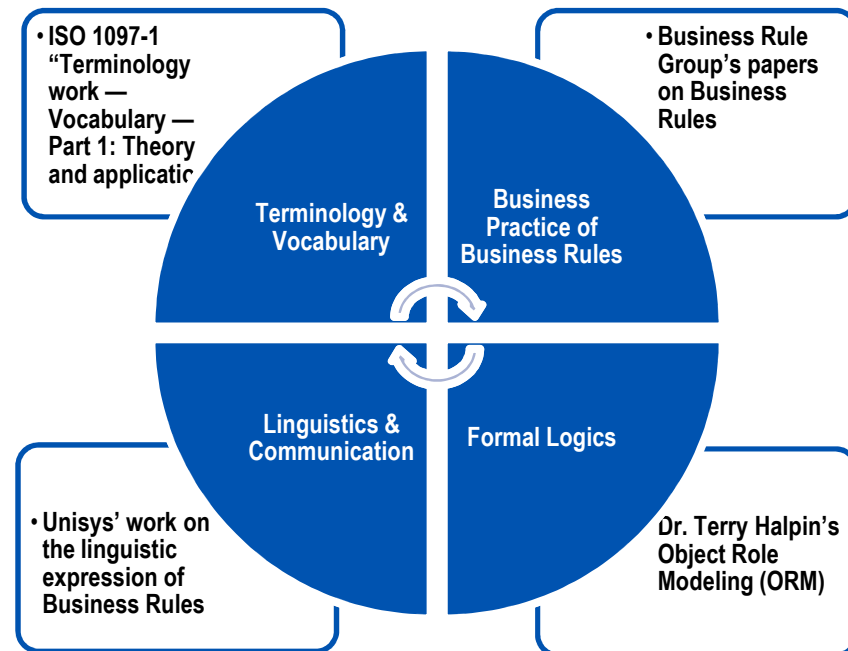
sizeable team: 20 organizations  
(Submitters & Supporters)

geographically-distributed: 7 countries across North  
America, Europe, Asia



# ABOUT SBUR

- supports the development/specification of  
**business vocabularies** (terms & definitions)  
**business rules** (and other kinds of elements of guidance)
- reflects a **business perspective**  
... not an IT systems perspective
- uses the **language of the business**  
... not the terminology of IT models
- independent of whether or not  
vocabulary/rules will be **automated**



**Unique synthesis of four disciplines**

# WHAT DOES SBVR STANDARDIZE

a **metamodel** for developing semantic models of business vocabularies and business rules

- a **vocabulary** for talking about meaning, vocabularies, and business rules
- a **model** (and XML format) for representing the semantics of vocabularies and business rules

the **Model** is derived from the **SBVR Vocabularies**

the **XML Schema** is derived from the **Model**

what does **SBVR NOT** standardize?

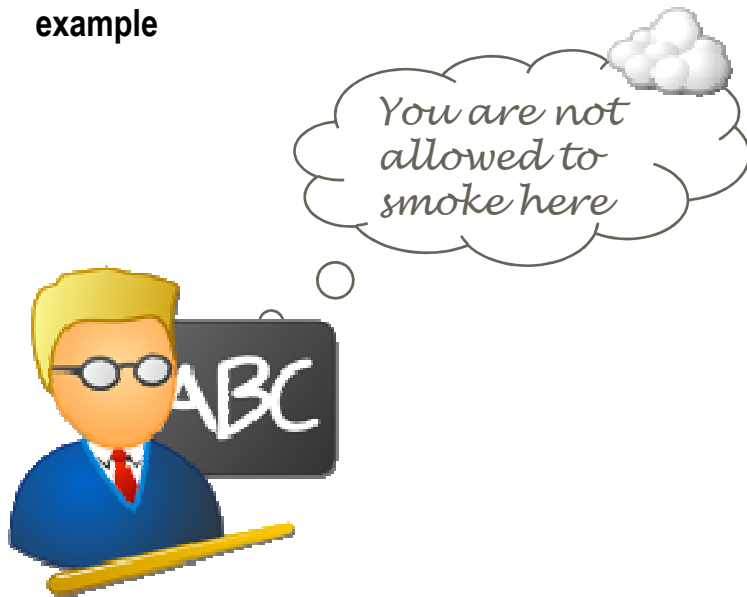
1. **NOT** language for stating rules
2. **NOT** diagramming conventions
3. **NOT** methodology
4. **NOT** how to map business vocabularies/rules to application systems/databases
5. **NOT** how to transform business rules into production rules for execution

# ESSENCE OF SBUR

## meaning

"... the meaning of what you say"

example



## representation

"... the form that represents the meaning"

example

*I say ....*

- *smoking prohibited*
- *no smoking*
- *no fumar*

*I see ...*



# MEANING OF ... general concept

Concept

Noun concept

General concept

**designated by** (one or more) term (s):

Word or word phrase that represents a general concept in singular form, plural form is assumed.

**general concept**

definition:

noun concept **that** classifies things on the basis of their common properties

Source:

based on ISO 1087-1 (3.2.3)

**currency**



**customer**



**gold customer**

**rental car**





# MEANING OF ... individual concept

Concept

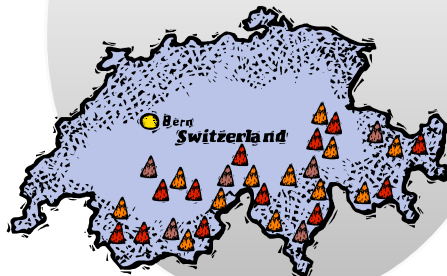
Noun concept

Individual concept

designated by name:

Word or word phrase that  
represents an individual concept.

Switzerland



individual concept

definition:

noun concept that corresponds to only one object [thing]

Source:  
based on ISO 1087-1 (3.2.2)

Lots of individual concepts  
never appear in fact models, like  
"John" or Car "XH-Ff-123"

Eiffel Tower

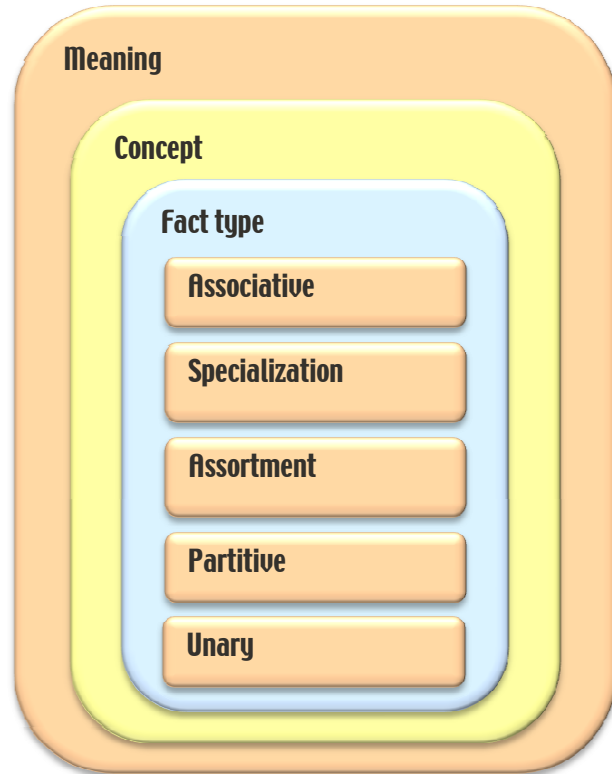


Libri

Obama



# MEANING OF .... verb concept

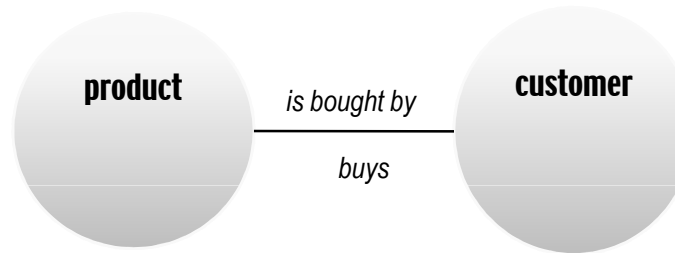


synonym: fact type

definition:

concept **that is** the meaning of a verb phrase that involves one or more noun concepts and whose instances are all actualities

Source:  
based on ISO 1087-1 (3.3.23)



product *is bought by* a customer

does not constrain possible facts in any way

*Two fact type definitions define the same fact type if they reveal the same incorporated characteristics and the same fact type roles.*

# MEANING OF .... associative fact type

associations with more than two roles are often called n-ary fact types

Source:  
based on ISO 1087-1 (3.3.23)

## Fact type

### Associative fact type

is-property-of fact type

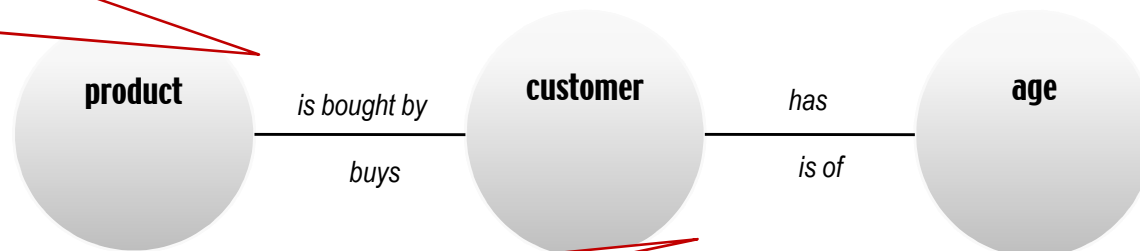
## associative fact type

definition:

fact type that has more than one role and that has a nonhierarchical subject-oriented connection drawn from experience, based on practical rather than theoretical considerations

... buys ....

- Associative fact-type
- Non-hierarchical
- Subject oriented
- Two roles

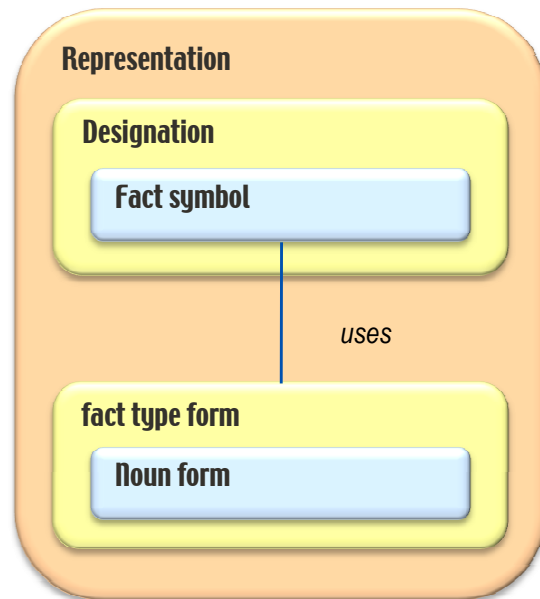


... has ....

- Is-property-of fact type
- Implies a structural rule :  
person always has age
- Introduces an essential quality

*One concept is something so important to the other concept's very nature that without it that thing would not be the same thing.*

# OBJECTIFICATION OF .... associative fact type



Example:

train arrives in city

**arrival**

arrival is at [arrival time] time

**fact types cannot have properties.**

- only things (concepts) can have properties

**objectification**

- give a name to a fact type
- this name represents a thing and can be used in other fact types.

*A propositional nominalization is similar to objectification. It is a kind of logical formulation that structures the meaning represented by a mention of a statement or proposition as opposed to a use of it.*

# TALKING ABOUT STATES AND EVENTS

rule :

A car assignment of a rental must occur before the pick-up date of the rental.

An objectification uses a propositional expression to identify a state of affairs or event.

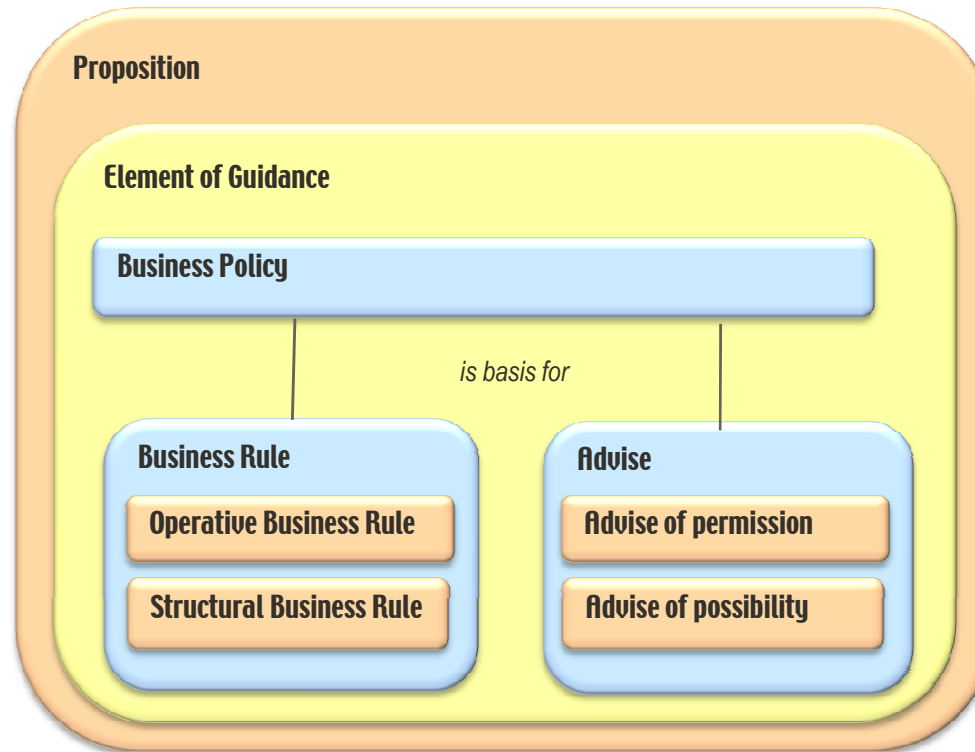
## use objectification to identify the state or event

- **Term:** car assignment
- **Concept type:** objectification
- **Definition:** state of affairs where a car is assigned to a rental.
- **Fact type:** car assignment objectifies the fact type :

'Car is assigned to rental

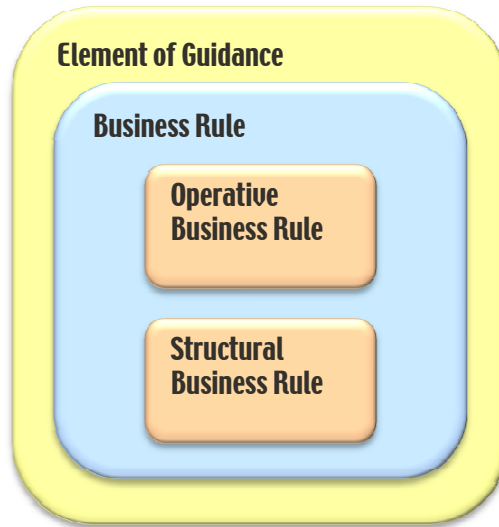
## define fact types that involve states and events:

- state of affairs *occurs before* point in time
- state of affairs1 *occurs before* state of affairs2 *occurs*



**ON THE MEANING SIDE ..... kinds of guidance**

# MEANING OF ... business rule



## Operative business rule

Removes freedom by telling:

- what is prohibited or
- what is obligated

- guide actions,
- intended for people,
- can be broken

**"A gold customer must be allowed access to the waiting lounge."**

## Structural business rule

Removes freedom by telling:

- what is necessarily true or
- what is impossible

- shape our understanding of concepts
- inferences and calculations
- true by definition

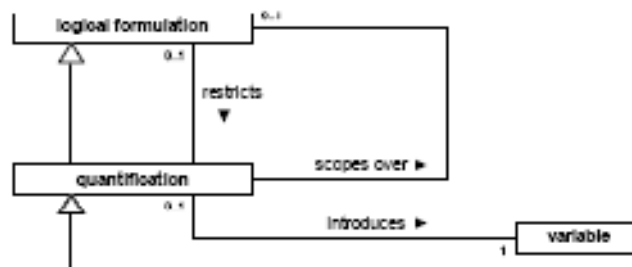
*"A branch is always located in exactly one country."*

# MORE ELEMENTS OF MEANING IN RULES

## quantifiers

### refer to a member of a set

- universal quantification  
each driver must be ....
- existential quantification  
at least one passenger must be ....
- at least n quantification  
at least two drivers must be ....
- at most n quantification  
at most three children must be ....
- exactly n quantification  
exactly one driver must be ....



### variations on a theme:

- between n and m  
numeric range quantification
- at least one  
existential quantification
- at most one  
at most one quantification

### scope of a quantifier

- Each man and his wife must be ....

Do we mean: "each man and each wife?"  
Do we mean: "each man and wife (the couple)"



# MORE ELEMENTS OF MEANING IN RULES

## logical operators

### express logic

- **conjunction**

... and ....

each driver must be qualified and the license of the driver must not be expired.

- **disjunction**

... or ....

each rental must be paid by cash or by approved credit card payment.

- **implication**

... if ....

a credit card payment is approved if the credit card company gives clearance.

- **logical negation**

not ....

a credit card payment is not approved if the credit card company does not give clearance.

### variations on a theme:

- **exclusive disjunction**

.... or .... but not both

- **nand formulation**

not both ... and ....

- **nor formulation**

neither ... nor ....

- **whether or not formulation**

whether ... or not ....

- **equivalence**

... if and only if ...

# LIMITS TO MEANING IN SBVR

**facts may be inferred, but sbvr does not standardize inference.**

- control over the order in which inferences are made is often used in automated systems ...  
... but not part of sbvr.

**no references to 'discourse'**

- it is a best practice to state a rule in one sentence  
... no free variables in a logical formula.

**attachment should be resolved within one sentence.**

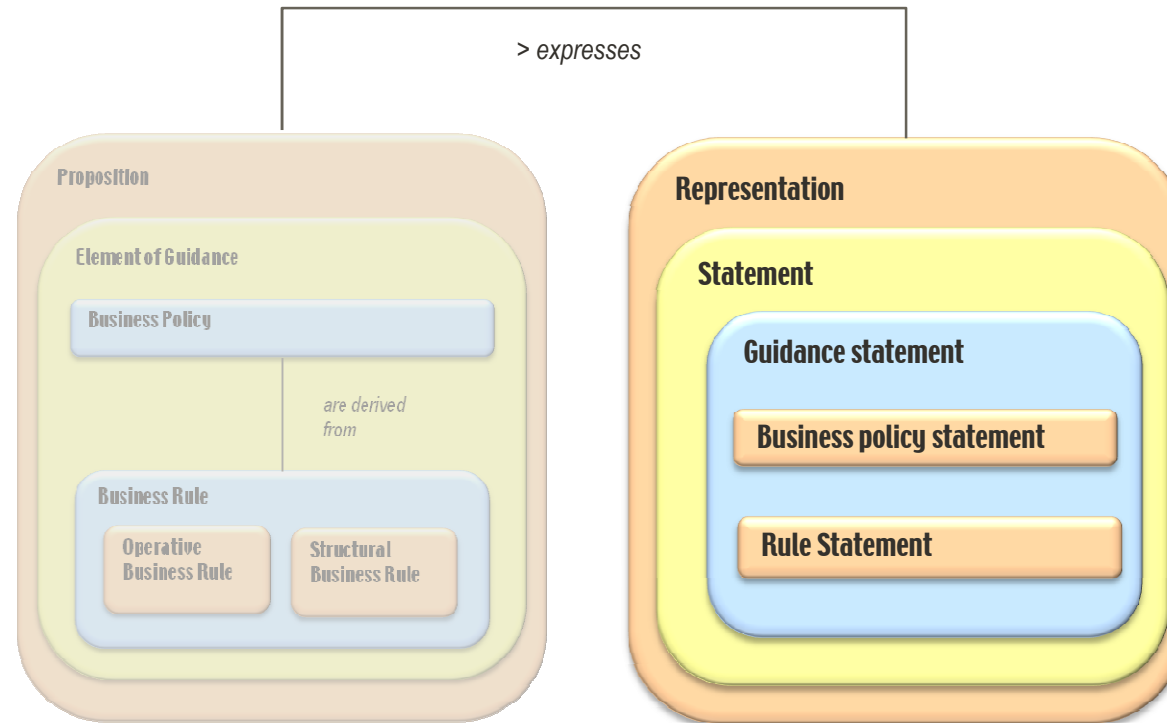
- we can refer to 'the person' if the concept 'person' has been introduced earlier in the sentence  
... or if you refer to the individual concept "The person John".

**no directives**

- the meaning of a directive like : "no smoking in this room" can not be expressed in SBVR

**no meaning for past tense or future tense**

- "person was ill"  
... but we can say that "person has been ill in the last year"



**ON THE EXPRESSION SIDE .....**

# EXPRESSION OF .... business rule



SBVR uses 'controlled natural language'

a subset of natural language, obtained by restricting the grammar and vocabulary in order to reduce or eliminate ambiguity and complexity

## One meaning ... many expressions

- different national languages
- different language choices
- different patterns
- non textual form
- understandable by the business
- understandable by machines



Controlled English Languages :

- Attempto Controlled English
- CLCE - Common Logic Controlled English
- PNL - Metalog's Pseudo Natural Language
- Ordnance Survey Rabbit
- PENG - Processable ENGLISH



$p$	$q$	$p \vee q$	$p \wedge q$	$p \rightarrow q$	$p \leftrightarrow q$
T	T	T	T	T	T
T	F	T	F	F	F
F	T	T	F	T	F
F	F	F	F	T	T

# EXPRESSION OF .... business rule



*There is no “SBVR Language” !!*

## *language choices for the SBVR practitioner*

### **SBVR Structured English**

- *one way of using English that maps mechanically to SBVR concepts and what SBVR uses to present its own vocabularies*  
documented in SBVR Annex C

### **RuleSpeak®**

- *a business rule notation developed by Business Rule Solutions, LLC (BRS) that has been used with business people in actual practice in large-scale projects since the second half of the 1990s*  
documented in SBVR Annex F

### **Object Role Modeling (ORM)**

- *a conceptual modeling approach that has been used in industry for over 30 years, as a graphical and textual language for specifying business rules*  
documented in SBVR Annexes I and J

# pattern of expression : operative rules



informal rule

Don't rent to a person who is drunk !

Every restricted permission statement can be restated as conditional prohibition:

it is prohibited that .. if ... = it is not permitted that ...if ...

An intoxicated person must not be a driver of an open rental.

It is prohibited that an intoxicated person is a driver of an open rental.

It is permitted that a rental be open only if no driver of the rental is intoxicated.

kind of formulation	SBUR structured english keywords
obligation	It is obligatory that .... ... must ...
prohibition	It is prohibited that .... ... must not ...
restricted permission	It is prohibited that ... only if .... ... may... only if

# pattern of expression : structural rules



## informal rule

A rental is considered open when the car is picked up !

Every restricted possibility statement can be restated as conditional impossibility:

it is impossible that ..if ... = it is not possible that ...if ...

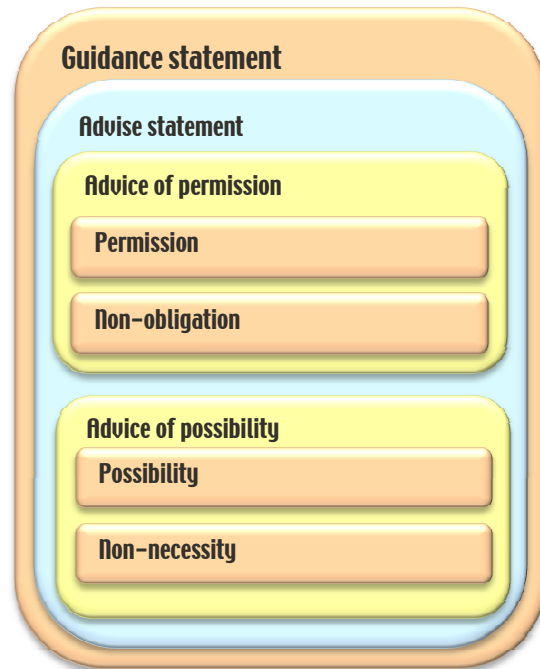
The rented car of an open rental has  
always been picked up.

It is impossible that the rented car of an  
open rental has not been picked  
up.

It is possible that a rental is an open  
rental only if the rented car of the  
rental has been picked up.

kind of formulation	SBUR structured english keywords
necessity	It is necessary that .... ... always ...
impossibility	It is impossible that .... ... never not ...
restricted possibility	It is possible that ... only if ....

# pattern of expression : advise



## Permission

1. A rental deposit may be paid in cash
2. A rental deposit need not be paid in cash

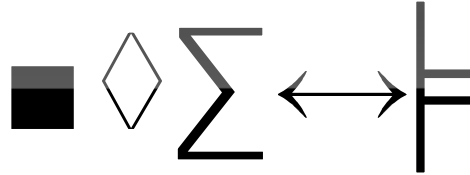
kind of formulation	SBUR structured english keywords
permission	It is permitted that that .... ... may ...
non-obligation	It is not obligatory that .... ... need not ...
possibility	It is possible that .... ... can ...
non-necessity	It is not necessary that ...

## Possibility

1. A rental can have more than one driver
2. It is not necessary that a rental has exactly one driver



# BACK TO MEANING ... grounded in formal logic



## SBVR – meaning is grounded in formal logic to :

- Everyone who reads the rule statement gives it the same interpretation
- Software can ‘understand’ it in the same way
- Different expression forms can be relied on to have the same meaning

# BACK TO MEANING ... grounded in formal logic

Modality		Modal Formula		applying modal negation rules ... = (Logically Equivalent) Modal Formula	
		Formula	Reading (Verbalized as):	Formula	Reading (Verbalized as):
alethic	necessity	$\Box p$	It is necessary that $p$	$\sim \Diamond \sim p$	It is not possible that not $p$ It is impossible that not $p$
	the negation of necessity: non-necessity	$\sim \Box p$	It is not necessary that $p$	$\Diamond \sim p$	It is possible that not $p$
	possibility	$\Diamond p$	It is possible that $p$	$\sim \Box \sim p$	It is not necessary that not $p$
	the negation of possibility: impossibility	$\sim \Diamond p$	It is not possible that $p$ It is impossible that $p$	$\Box \sim p$	It is necessary that not $p$

## Modal logic – two extra operators :

- Deontic — for Operative (Behavioral) Business Rules

Obligation

Permission ... and its negation, Prohibition (Forbidden)

“It is obligatory that ....”

“... must ....”

“It is permitted that ....”

“... may ....”

“... need not ....”

“It is necessary that ....”

“... always ....”

“It is possible that ....”

“... can ....”

- Alethic — for Structural (Definitional) Business Rules

Logical Necessity

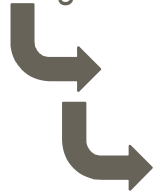
Logical Possibility ... and its negation, Impossibility

# BUILD RULES BASED ON MEANING

## meaning

### semantic formulation

obligation



at least two : 'ticket'

customer *buys* product (ticket)

### logical formulae

it is obligatory that

- ▶ for all customers K
  - ▶ there is a product Y
    - ▶ buys(K, Y) and
      - ▶ number (Y) => 2

## expression

### terms:

**drive** *is a* **person**

### names

**ticket**, the name of a **product**

### fact types

customer *buys* product

### rule:

**A customer must buy at least two tickets.**

It is obligatory that a customer must buy at least two tickets.

It is prohibited that a customer buys one ticket.

SBVR Structured English

RuleSpeak

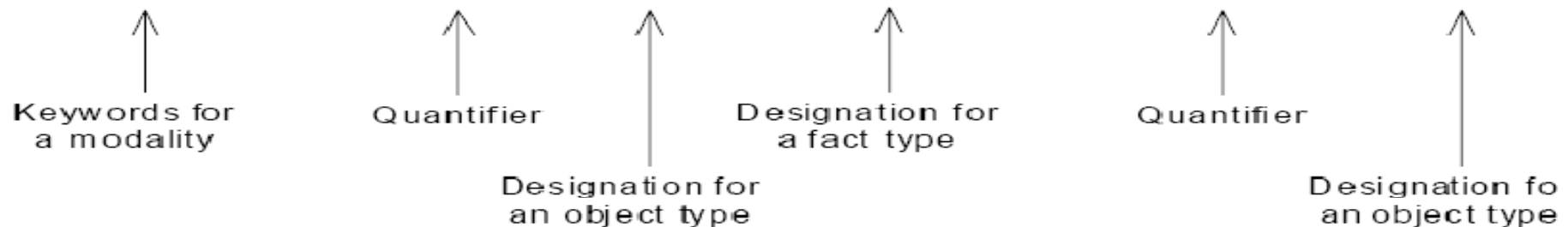
# CONTROLLED LANGUAGES

SVBR also allows for rules and definitions as informal text.

# SBUR STRUCTURED ENGLISH

## four formatting styles

It is obligatory that each rental car is owned by exactly one branch.



The role 'modality' of the fact type 'modal formulation *claims* modality'.

# SBUR STRUCTURED ENGLISH

## four formatting styles

... blue underlined in this training.

- **Term**

Green underlined.

Used for designations for noun concepts that are defined in the vocabulary.

Defined using lower case letters in singular form.

Plural forms are implicitly available.

- **Name**

Green double underlined

Used to reference to individual concepts that are defined in the vocabulary.

- **Meaning is un-interpreted text**

Ordinary font in black.

Reference to informal text.

- **Verb**

*Blue italic.*

Used for designations for fact types.

Such designation is defined in the context of a form of expression.

Forms of expressions are defined using singular active forms of verbs.

Infinitive, plural or gerund forms of verbs are implicitly available.

- **Key words**

**Red.**

Used for linguistic symbols to construct statements.

Quotation marks are in the keyword font

Single quotation is used to quote a designation or form of expression that is being mentioned:

# SBUR STRUCTURED ENGLISH

other keywords than the key word for qualifiers, logical operators and modal operators

## the

- a driver is qualified if the driver is licensed  
'the' can be used to reference to a previous use of the same designations.  
this is formally a binding to a variable of a quantification.
- the country 'Switzerland' has mountains.  
introduction to a name of an individual thing or a definite description.

## a, an

- if a car is assigned to a rental then the .....  
universal quantifier if used in the beginning of a sentence.  
existential qualifier depending on context  
based on English rules .

## another

- a person and another person constitute a couple.  
existential quantification plus a condition that the referent thing is not the same things as the referent of the previous use of the term.

## a given

- at a given date each ... always has ...  
universal quantification , 'a given' is used such that it represents one thing at a time.

this is used to avoid ambiguity where the 'a' by itself could otherwise be interpreted as an existential quantification.

# SBUR STRUCTURED ENGLISH

## other keywords

### that

- **that driver ....**  
when preceding a designation for a noun concept it is a binding to that noun concept.
- **a car that is qualified**  
when after a noun concept and before a fact type it introduces a restriction on the things referenced by the noun concept.
- **a car assignment that ....**  
introduction to a proposition being objectified or nominalized.

### what

- **the report must specify what car ....**  
used to introduce a variable in a projection.  
example is called 'answer nominalization'.

### who

- **a driver who is qualified**  
when after a noun concept and before a fact type it introduces a restriction on the things referenced by the noun concept that is a person, same as the second use for 'that'.

### of

- **the age <that is> of a person**  
'of' is used as a shorthand for 'that is of'.  
it is implicitly assumed that the statement 'person has age' has the inverse reading 'age that is of person'.



# SBUR STRUCTURED ENGLISH

## handling logical operators

### repeating logical operators

- Where a subject is repeated when using 'and' or 'or', the repeated subject can be elided.  
"An implication has an antecedent and the implication is embedded in a modal formulation,"  
→  
"An implication has an antecedent and is embedded in a modal formulation."

### not

- Use 'not' after the verb 'is' to introduce a logical negation.  
"A person is not ...."
- Use 'does not' before other verbs to introduce a logical negation.  
"A person does not have ...."

### repeating subjects and verbs

- A repeated subject and verb can be elided.  
"An implication has an antecedent and the implication has a consequent,"  
→  
"An implication has an antecedent and a consequent."

# RULESPEAK

## RuleSpeak

Sentence templates

Do's and Don'ts

SBVR is very flexible in supporting alternative practices with respect to rules and definitions.

This flexibility is enabled by the underlying logical formulations and their underpinning in formal logic.

## differences rulespeak - sbvr structured english

- sbvr structured English prefers prefixing rule keywords on propositions
- rulespeak uses a mix-fix notation; embedding equivalent rule keywords in propositions.
- rulespeak includes alternative wordings for better readability
- rulespeak is aimed at business workers to make operational business decisions on a day-in-and-day-out basis.

## different set of keywords for modality claims

includes a set of guidelines for writing rules and definitions

# EXAMPLES

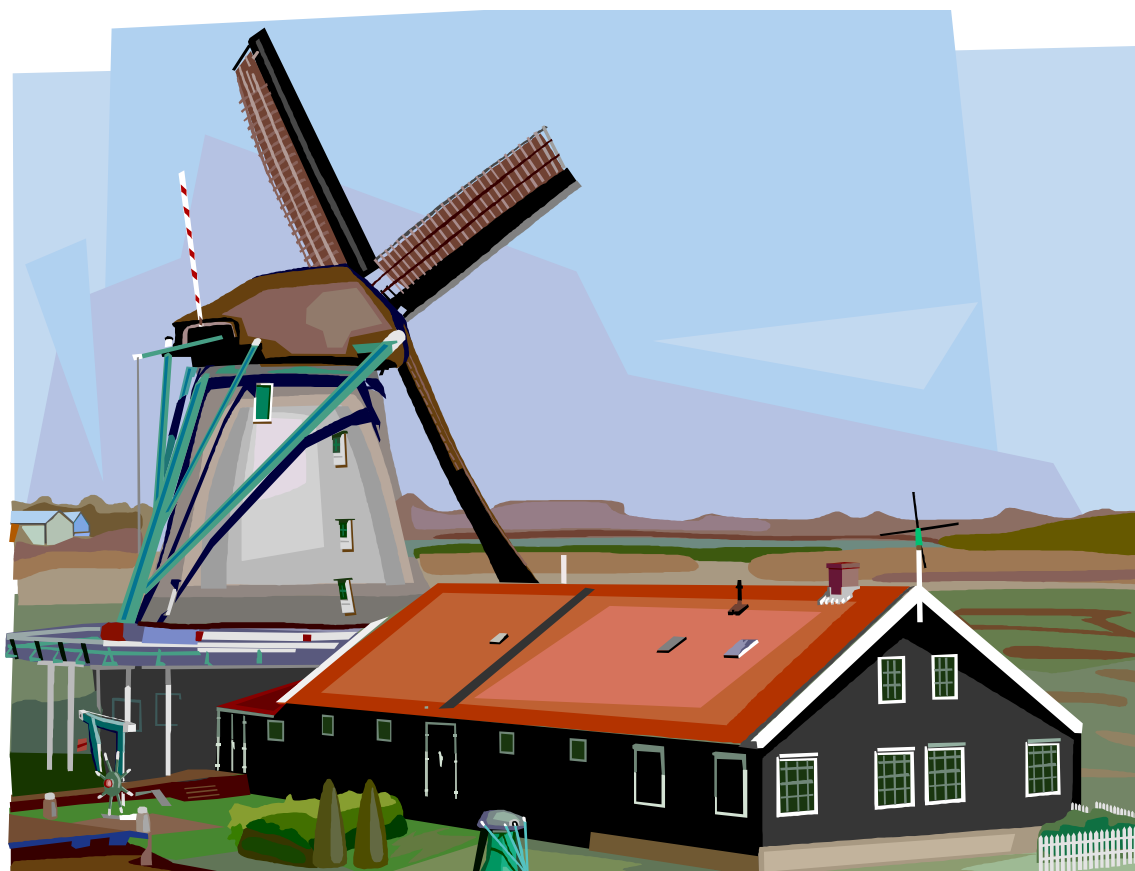
The rental duration of a rental **must** not be more than 90 rental days.

The rental charge of a rental is **always** *calculated* in the business currency of the rental.

**All of the following are always true** for an agency:

- It *has* a third-party location
- It *has* a minimal car storage capacity.
- Its operation mode *is* on-demand.

A location **is to be considered** a third-party location if *located* at an EU-Rent site that is *owned by* a third party.



## RULESPEAK IN MULTIPLE LANGUAGES



See [www.rulespeak.com](http://www.rulespeak.com) to download rulespeak in English, dutch, german or spanish

## what I want ...

remember that formal verification and execution only come in the picture once we have formal rules.

# HELP NEEDED

## 1. **support rule evolution**

tools that help me write natural language sentence that **can** be mapped to an SBVR semantic formulation (training on the job).

## 2. **support rule evaluation**

an evaluation technique to evaluate if the controlled language is good for a specific user group and how to improve it.

## 3. **support rule analytics**

ways to explain to the results of smart natural language analytics to an end-user with average understanding of a normal language.

## 4. **good performance**

on line analytics should be fast (10.000 domain terms, 5.000 rules)

# RULEXPRESS

**THE BUSINESS TOOL FOR EXPRESSING & COMMUNICATING BUSINESS RULES**

**[www.rulexpress.com](http://www.rulexpress.com)**

**[www.rulearts.com](http://www.rulearts.com)**

The screenshot displays the RuleXpress application window. On the left, a table lists various rules, with 'Article 03.3a' highlighted. The right pane shows the detailed view for 'Rule - Article 03.3a', including its rule statement and a vocabulary lookup section.

Rules	Terms	Facts	Wordings
Name	Rule statement	Status	
Show all	Show all	Show all	
Article 03.1a	An independent contribution to the thesis must be deemed suitable for PhD graduation	Approved	
Article 03.1b	A person may register as PhD student only if all of the following is true: - he/she has successfully graduated from a graduate institution...	Approved	
Article 03.2a	A person has successfully graduated must be taken to mean that the sum of the study-load of each passed examination he/she has passed is at least 168 points	Approved	
Article 03.2b	The Doctorate Board may register a person who do not meet the requirements in Article 3.1.	Approved	
Article 03.2b	A person may request to waiver the requirements in Article 3.1 in writing to the PhD director.	Approved	
Article 03.3a	each person wanting to register must apply for registration to the PhD Director at the start of the PhD research.	Approved	
Article 03.3b	The application for registration must include all of the following: - a application form that is complete - authenticated copies of diplomas - a curriculum vitae...	Approved	
Article 03.3c	An application form must be considered complete if all of the following is true: - the application form contains an indication of the theme of the PhD research. - the application form contains each name of each professor willing to act as supervisor. - the application form contains the signature of each professor willing to act as supervisor.	Approved	
Article 03.4	The Doctorate Board may interview the applicant before he/she registers.	Approved	
Article 03.5a	The Doctorate Board may approve the registration.	Approved	
Article 03.5b	The Doctorate Board must decide whether the applicant is allowed to start with the research	Approved	
Article 03.5c	The Doctorate Board may officially appoint each supervisor only after receiving the application.	Approved	

**Rule - Article 03.3a**

each person wanting to register must apply for registration to the PhD Director at the start of the PhD research.

**External Lookup**

**Vocabulary Lookup**

Defined	Not defined
person	each
register	wanting
registration	to
PhD Director	must
start	apply
PhD research	for
	to
	the
	at
	the
	of

**Expression analysis**

**Verification**

**Quality summary**

Lists Visuals Hierarchies Properties Expression Relationships Rule Groups Usage History

## sbvr structured english

It is obligatory that *at the* actual return date/time *of each* in-country rental *and each* international inward rental *the* local area *that includes the* return branch of the rental *owns the* rented car *of the* rental.

## rulespeak

The local area *that includes the* return branch *of an* in-country rental *or international inward rental* *must own the* rented car *of the* rental *at the* actual return date/time *of the* rental.