

Towards a Linguistic Analysis and Representation of Business Rules

Pieter Joubert

Department of Informatics, University of Pretoria, Lynnwood, Pretoria, South Africa

Abstract. The paper explores linguistics as a basis for analyzing and representing business rules. The actual business rules are seen as the text to be analyzed. A very simple, straightforward methodology is explained and illustrated with part of a bigger case study. In essence every business rule is analyzed to determine nouns, verbs, adjectives, adverbs, prepositions and other lexical categories. The business rules are then structured into sentences which basically have the structure of conjunctions, subject, predicate, and direct object/adjunct.

1 Introduction

Business rules have gained prominence over the last few years. They are seen as important assets of organisations that should be managed carefully [3]. Business rules can also be seen as an important (maybe the most important) link between business and IS. [4]

Business rules:

- Are constraints or tests designed to maintain integrity of data (Ross, 1997 in [2]).
- Are statements that aim to influence or guide behaviour and information in an organisation [5]
- Define how the business is actually run [2].
- Define or constrain some aspect of a business [6].
- Determine business structure [6]
- Influence the behaviour of an organisation [6].
- Are statements that influences business behaviour towards desired objective (Plotkin in [2])
- Are assertions that constrain patterns of the enterprise behaviour. (Morabito, et al, 2001 in [4])

Some characteristics of business rules are [4]:

- They exist in various forms, from simple to very complex and dynamic.
- They can originate internally, mostly derived from strategic processes, or externally, from government, industry or a specific profession.
- They can be based on explicit or tacit knowledge.

- They can be found in documents, procedures, policies, regulations, user manuals, information systems, etc.
- They are normally expressed in the form of principles, procedures, facts, figures, rules, formulas, etc.
- Explicit business rules are a manifestation of a richer underlying knowledge.

The purpose of this paper is to show that that a “guided” linguistic analysis can help to analyse and represent business rules. The methodology does not require the modellers to have a deep understanding of linguistics. A straight-forward, common-sense approach to linguistic analysis will be followed, so that this methodology is usable by non-linguists.

To show this the following will be done: Firstly, a very basic linguistic analysis methodology will be proposed and illustrated by analysing and representing a number of business rules from various sources. Secondly, the linguistic representations of the business rules will be discussed to indicate how this analysis contributes to better understanding the business rules.

2 A Basic Linguistic Analysis Methodology

2.1 Introduction

The methodology suggested in this section combines a morphological and syntactical analysis. A semantic and pragmatic analysis can also be included but has been excluded from this study because of space restrictions.

Every business rule can be seen as linguistic text to be analysed. In essence the methodology takes every business rule and breaks it up in the following fixed parts:

- A **conjunction** linking related clauses.
- A **subject** indicating the person or thing which the clause is about.
- A **predicate** describing what the subject did, what action was done to the subject or what state of existence the subject is in.
- A **direct object/adjunct** indicating persons or things affected by the action of the verb.

For instance the business rule “*each policy must have an expiry date*” can be represented in structured sentence format as:

Conjunction	Subject	Predicate	Object/Adjunct
	(Each) Policy	(Must) have	Expiry date

Or diagrammatically

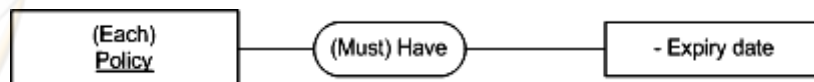


Fig. 1. Diagrammatical representation of a business rule.

2.2 The Steps in more Detail

The steps involved are listed below and business rule “*IF acceptance of renewal notice from insured is not received within 14 days THEN send reminder*” will be used to illustrate the process:

1. **Identify verbs:** Take each business rule and identify the verbs or verb phrases. Look for both action and existence verbs. (**Action verbs** portray actions, e.g. *He walked slowly forward*; while **existence verbs** indicate states of existence, e.g. *He is a man*.) There will normally be one row in the resulting table for each verb identified in the business rule. Make verbs infinitive, present tense where possible, for instance *walked* and *walks* become *walk*. Place auxiliary parts of a verb phrase in brackets. Place one verb only in the **Predicate** column.

Two verb phrases can be identified in the example business rule: *is not received* and *send*. Place these two verb phrases in the Predicate column of two subsequent rows. Make verbs infinitive, present tense, i.e. *is not received* becomes *(Not) receive*.

Conjunction	Subject	Predicate	Direct Object /Adjunct
		(Not) Receive	
		Send	

2. **Identify nouns:** Place one noun only in the second **Subject, Direct Object/Adjunct** column as applicable. (A **noun** denotes persons, places or things that we can either perceive by our senses or conceive in our minds.) Make all nouns singular and show the plural parts in brackets. There does not always have to be an explicit subject (although there is always an implicit one). These are nouns that are directly or indirectly the agent or doer of an action. Most human nouns are. There must be a direct object or adjunct or both. If there is more than one adjunct they must follow on subsequent rows. Simplify clumsy noun phrases, for instance, *courses that can be offered* should rather be *offered course*; and *courses that can be scheduled* should rather be *scheduled course*. Note that the two examples in the previous sentence implies that out of all possible courses, only some will be offered and only some will be scheduled.

In the example business rule neither verbs have subjects specified. For the first verb *receive* place the direct object *acceptance* in the second Direct Object/Adjunct column. For the second verb phrase *send* the direct object is a genitive case noun pair that needs to be resolved as shown in the next step.

3. **Identify all direct and indirect genitive case noun pairs.** Genitive case nouns can be identified by the following means: (1) the proximity of nouns, for instance, *room equipment* implies the *room's equipment*; (2) special words like *their* and *for*, for instance, *rooms and their equipment* and *equipment for rooms* also implies *room's equipment*; and (3) nouns with an apostrophe *s*, for instance, the *room's equipment*. Translate all these genitive case noun pairs into the basic genitive format, *noun of noun*, for instance, *equipment of room*.

In the example business rule *acceptance of renewal notice* becomes *acceptance (of) renewal notice*. At this stage the table looks as follows:

Conjunction	Subject	Predicate	Adjunct	
		(Not) Receive		Acceptance (of) Renewal Notice
		Send		Reminder

4. Identify adjectives: All adjectives must be placed within brackets together with their referent nouns. (**Adjectives** specify the attributes of a noun or pronoun e.g. *The tall girl danced.*)

In the example business rule the *14* in *14 days* is an adjective describing the noun *days*.

5. Identify prepositions: If a preposition is followed by a noun or a noun phrase it is part of the Adjunct (and placed in the first column of the **Direct Object/Adjunct** section), however, if it is followed by a verb or verb phrase it becomes a new row and the preposition (or its conjunction equivalent) is placed in the **Conjunction** column. (**Prepositions** indicate a semantic relationship between entities, for instance: (1) location of one entity in relation to another, e.g. *the book is on / under / above / below / near the bookshelf*; (2) direction, e.g. *he travelled from his house to work*; and (3) accompaniment, e.g. *with/without salt*.)

In the example business rule, related to the first verb are two prepositions: *from* and *within*. Specify on the next line in the first direct object/adjunct column the prepositions and in the second column the nouns on subsequent lines. At this stage the table looks as follows:

Conjunction	Subject	Predicate	Adjunct	
		(Not) Receive		Acceptance (of) Renewal notice
			From	Insured
			Within	(14) days
		Send		Reminder

6. Identify conjunctions: If you have more than one predicate per business rule, the resulting clauses are many times linked to each other. The **conjunction** column is used to link the various rows together.

In the example business rule the conjunctions *IF* and *THEN* are both followed by sentences and are therefore placed in the Conjunction column.

Conjunction	Subject	Predicate	Adjunct	
If		(Not) Receive		Acceptance (of) Renewal notice
			From	Insured
			Within	(14) days
Then		Send		Reminder

7. Identify adverbs. All adverbs must be adjusted so that they can be placed into the adjunct. For instance, for the phrase *double booked* place *book* in the **Predicate**

column and *double* in the **Adjunct** column. (**Adverbs** modify verbs (*he sang loudly*), adjectives (*a very tall building*), other adverbs (*unbelievably quickly*) and sentences (*sadly, he died*.)

There are no adverbs in the example business rule.

8. **Identify pronouns:** For the lexical analysis ignore pronouns and replace them with the nouns or noun phrases that they take the place of (their referents). For instance, in the phrase *instructors, and their availability*, the pronoun *their* refers to *instructors* and should be replaced by that. (**Pronouns** are words that are usually used in place of nouns or noun phrases, e.g. *she looked him in the eye*. The noun or noun phrase that is replaced by a pronoun is called the referent (or antecedent) of the pronoun.)
9. **Handle lists:** A list separated by commas implies that everything applying to the first item in the list also applies to the rest of the items.
10. **All other lexical categories:** Ignore all other lexical categories.

The final representation of the business rule is:

Conjunction	Subject	Predicate	Object/Adjunct	
If		(Not) Receive		Acceptance (Of) Renewal notice
			From	Insured
			Within	(14) day(s)
Then		Send		Reminder

This structured sentence can also be represented diagrammatically as follows (All noun phrases are placed in rectangles, verb phrases in ellipses, conjunctions in diamonds, prepositions are on the lines linking it):

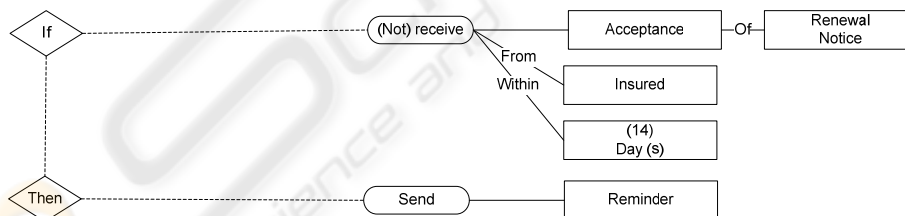


Fig. 2. Diagrammatical representation of example.

Specifying the business rule in this way clearly shows the structure of the business rule, missing information and the key components of the business rule:

- This business rule in essence is an action condition which, if not true, is followed by another action. It can be stated as follows: IF (NOT) ACTION THEN ACTION.

- Both actions lack a subject, which can lead to questions by the analyst like “who receives the acceptance” and “who must send the reminder”, ensuring more complete business rules.
- The fact that the business rule is involved in 4 objects (Acceptance of renewal notice, insured, days and reminder) is also very clear. It is possible to group business rules by object, for instance, by reminder.
- A basic logical check on the verb can help to ensure a more complete business rule. For instance, the verb receive, leads to the following questions (based on the Zachman questions plus other questions), what is received, who receives it, from whom do we receive, when must it received, where must it be received, why is it received. In this example, what = *acceptance*, when = *within 14 days*, from whom = *insured*. These questions can be asked for any action.

2.3 A more Extended Example

The following example (adapted from [6]) will be used as a more extended example:

EU-Rent has 1000 branches in towns in several countries. At each branch cars, classified by car group, are available for rental. Each branch has a manager and booking clerks who handle rentals.

Most rentals are by advance reservation; the rental period and the car group are specified at the time of reservation. EU-Rent will also accept immediate ('walk-in') rentals, if cars are available.

At the end of each day cars are assigned to reservations for the following day. If more cars have been requested than are available in a group at a branch, the branch manager may ask other branches if they have cars they can transfer to him/her.

Diagrammatically this example can be represented as follows:



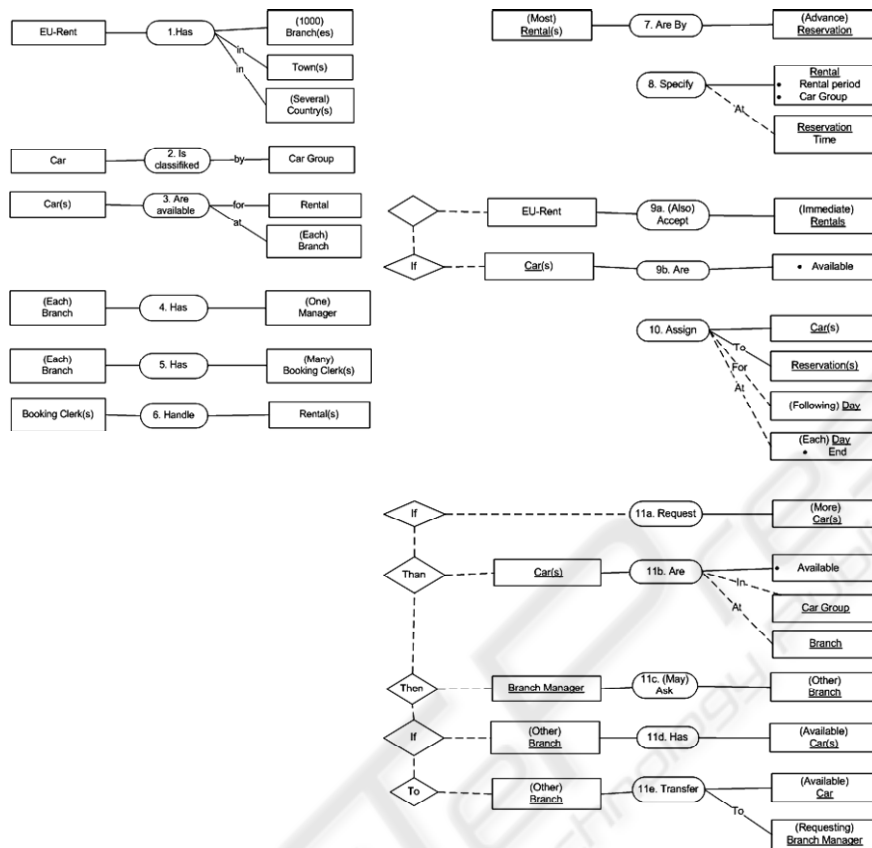


Fig. 3. Diagrammatic representation of EU-Rent example.

2.4 A Discussion of the Resulting Analysis and Representation

The above analysis and representation provides the following results fairly straight-forward:

- Existence verbs can indicate static relationships between objects. For instance, the *has* in business rules 1, 2 4 and 5, can be represented in an ERD as follows:

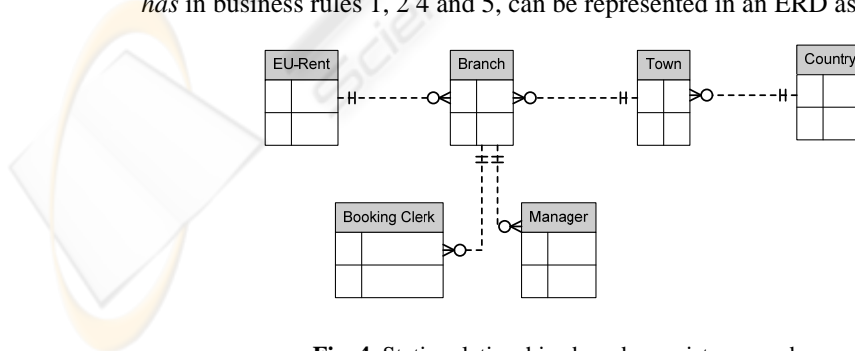


Fig. 4. Static relationships based on existence verbs.

- Existence verbs can also indicate static relationships between objects and their attributes. For instance, the *are* in business rules 9b and 11b, can be represented in an ERD as follows:

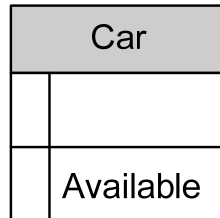


Fig. 5. Object attribute relationships based on existence verbs.

- By just listing all of the objects (as represented in blocks) a quick overview of the entities involved in the business rules can be identified.
- All subjects where the predicate is an action verb provide a list of all potential actors (in for instance, use case modelling). In the example business rules 6, 9a, 11c, 11e gives the list *Booking Clerk*, *EU-Rent*, *Branch Manager* and *Branch* can be deduced. Business rules 8, 10 and 11a are action predicates without subjects which then will logically lead to asking questions to determine the corresponding actors.

3 Conclusions

This paper shows that even a very basic linguistic analysis can help towards firstly understanding and analysing a business rule better; and secondly, representing it better. Based on this initial analysis further more advanced analysis can be done much easier.

This paper gives only an indication of what is possible with linguistic analysis and does not constitute completed research. Furthermore, at this stage the methodology only considers morphological and lexical analysis. Semantic and pragmatic analysis can be addressed in further research and will expand the richness of analysis even further.

References

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