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Standardization of English Navigation Terminology in Railway Traffic Domain

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Abstract: The technical progress and the globalization accelerate rapidly the development of new disciplines and sub-disciplines. Consequently, new and specific terminology is necessary. In addition, the interdisciplinarity contributes as well to the development of communication problems between non-professionals and experts of a special domain or between experts of different domains—as well at international level. Usually, technical terms are defined differently according to their domains. Therefore, a new terminological approach will avoid semantic vagueness as synonymy, antonymy, risk of confusion, hypernymy-hyponymy relations and polysemy, homonymy, etc.. For example, the terms "localization" and "positioning" are prototypes for this semantic vagueness. The objective of the *iglos* ("intelligent glossary") terminology work of the Institute of Traffic Safety and Automation Engineering of the Technische Universität Braunschweig is to clarify the multilingual and multidisciplinary misunderstanding between special languages of different domains by standardizing the definitions of technical terms. The focus of this paper lies on semantic problems of English navigation terminology in railway traffic domain and the clarification of the semantic vagueness between its terms with a modeling process and a linguistic method with different criteria. Finally, the result of these approaches should be a consistent navigation terminology in the railway domain.

Key words: Terminology, methodological approach, semantic vagueness, *iglos* work, consistent terminology, navigation, railway.

1. Introduction

Multilingual and multidisciplinary communication grows rapidly in importance. Especially, the number of special domains increased in the last decades so that each technical domain has its own terminology.

There are linguistic communication problems between experts within a domain, between experts of different domains, between non-professionals and experts of a domain but also in all these communication levels at international context.

According to the common language, "terminology" is the vocabulary of a special linguistic variety (technical language) [1]. The DIN (German Institute for Standardization) [2] standards define terminology as the entirety of terms and their designations in a special field. In addition to the standard DIN 2342 "Concepts of Terminology Theory" (German: "Begriffe der Terminologielehre"), there are also the standards DIN 2330 "Concepts and Denominations—General Principles" (German: "Begriffe und Benennungen—Allgemeine Grundsätze") and the ISO (International Standardization Organization) 1087 "Terminology Work—Concepts—Part 1: Terminology Theory and Its Application" (German: "Terminologiearbeit—Begriffe—Teil 1: Terminologielehre und ihre Anwendung") which describe the basic elements of the terminology theory such as denomination and the concept of a term. Whereas the denomination is the linguistic and non-linguistic designations of a term, the concept is the cognitive representation of a term [2-4].

In general, a terminology consists of terms which are the smallest meaningful linguistic units of a

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technical language system and are used within the communication of a particular domain of human activity.

In the linguistics, a term describes "a word with a meaning that is relatively precise and independent of the context, often subject to some special convention or regulation as, for example, with technical terms defined by standards associations" [5].

On the one hand, there is a terminology work which treats with the management and practice of terminology and terminological problems, and on the other hand, the terminology standardization which treats with the harmonization of terms in specific domains by authorized bodies (e.g., German Institute for Standardization, DIN, ISO (International Organization for Standardization)). The *iglos* terminology work of the Institute for Traffic Safety and Automation Engineering of the Technische Universität Braunschweig intends to optimize the scientific and commercial communication by creating a consistent and unambiguous terminology in different domains.

In our paper, we will present two methodological approaches for clarifying semantic vagueness (e.g., synonymy, ambiguity, risk of confusion, etc.) between navigation terms in railway traffic domain based on the *iglos* terminology work. Among these navigation terms, there are "position", "location", "positioning", "localization" and "navigation". Therefore, the main question is: "How are the five navigation terms related to each other?" and "Which method is efficient for solving the semantic vagueness between terms?".

Generally, the first methodological approach for clarifying the relations between navigation terms bases on a modeling process with three steps (definition of terms, relation of terms and visualization of relations between terms) whereas the second approach includes different linguistic criteria for clarifying the semantic vagueness between English navigation terms in railway domain with the aid of term definitions.

The contribution of this work will be enabling and facilitating the technical communication in English railway navigation domain by creating a consistent terminology.

2. The *Iglos* Terminology Work

Before explaining the methodological approaches for clarifying the semantic vagueness between English navigation terms in railway traffic domain, we will present the *iglos* terminology work with its goals and characteristics. In general, the terminology theory begins with Wüster's dissertation "Internationale Sprachnormung in der Technik, besonders in der Elektrotechnik" (English: "International Language Standardization in Engineering, especially in Electrical Engineering"). Wüster [6] describes the basic elements of terminology theory such as denomination, concept, term, definition, characteristic, etc.. The standards DIN 2330 and DIN 2342 mentioned above are developments following the work of Wüster.

2.1 Goals of the Iglos Terminology Work

Originally, the idea for the *iglos* project resulted from a cooperation of the Institute for Traffic Safety and Automation Engineering and the Department for German Linguistics (both of the Technische Universität Braunschweig). Predominantly, the interdisciplinary project includes the dialogue of different domains such as terminologists, linguists, computer scientists, engineers, translators and users, and different languages such as German, English, French, Chinese, Slovak, Turkish, etc.. Furthermore, the main goal of *iglos* is to develop a software platform on a linguistic basis. For optimizing the scientific and commercial communication, it is intended to accelerate and facilitate a consistent, multilingual and unambiguous development of technical terminology.

Finally, the foundation of the *iglos* terminology work consists in a further development of the

variety-based trilateral sign model.

2.2 The Iglos Sign Model

The variety-based trilateral *iglos* sign model describes linguistic signs, especially lexemes as abstract morphological units which are concretized by their grammatical word forms. A lexeme consists of three constituent sides, namely the lemma (designation), the definition which refers to the context of a lexeme and the variety (technical language) [7, 8]. In our contemplation, we have terms as special lexemes. Overall, there are three lexemes (Fig. 1). A relational lexeme which represents a certain relation type connects two lexemes. Some selected relation types with their predicates can be mentioned in this context, e.g.:

- risk of confusion (is "mixed up with");
- translation (has "translation");
- output (has "output", is "output of");
- input (has "input", is "input of");
- holonymy (has "part", is "part of");
- meronymy (is "part of", has "part");
- antonymy (has "antonym");
- synonymy (is "synonym of");
- polysemy (is "polysem of");
- homonymy (has "homonym").

Firstly, the *iglos* sign model enables the specification of terminologies by avoiding terminological vagueness and creating and visualizing concrete relations between terms in a systematic context (variety). These relations are unobstructedly typable. Secondly, the *iglos* sign model contributes to avoiding synonymy and ambiguity (disambiguation) of terms within the communication between different languages (multilingualism) and domains (multidisciplinarity).

By relating terms on the basis of attributes (property, characteristic, quantity, value) with each other, a terminology building can be constructed [9, 10]. Properties can be expressed in language by denominations and present terms in the sense of a previously presented metalinguistic model. Characteristics are basic elements for the recognition and description of objects and consequently a major for the order within a terminology building. Moreover, quantities describe a class of physical phenomena or which amounts a scale of numeric indicated value and which can be ascribed to concrete phenomena, which can be produced under well-defined experimental conditions. At last, values can be presented as a product of numerical value and scale unit. In this context, the scale unit is a defined real scalar value by international agreement which any other value of the quantity can be compared with. As numerical value, it can be expressed as relation of both quantity values (translated from) [11]. The terminology building with these attributes is presented in Fig. 2.

A terminology building (*iglos* graph) emerges by relating terms with each other. This can be explicitly

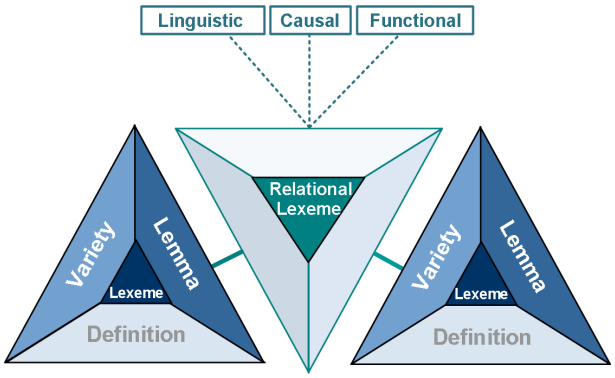

Fig. 1 The *iglos* sign model.

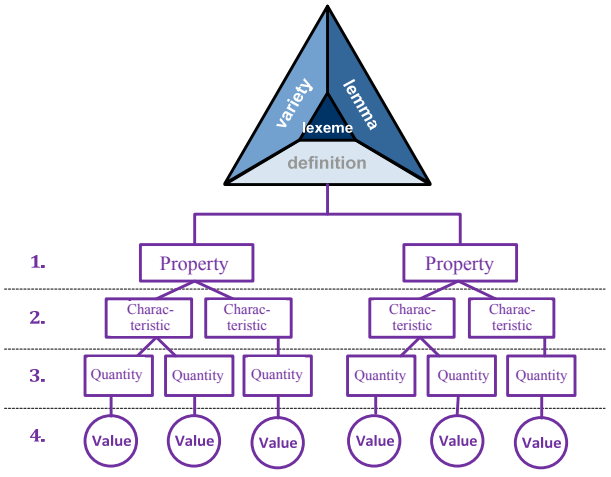

Fig. 2 Terminology building with the attribute hierarchy.

carried out by the consistent attribute hierarchy of properties, characteristics, quantities and values [12, 13].

3. Methodological Approaches for Clarifying Semantic Vagueness between English Navigation Terms

In the present paper, there are two approaches on the basis of the *iglos* terminology work for solving semantic vagueness between navigation terms in the domain of railway traffic. The first approach is the modeling process of railway navigation terms. On the basis of three steps (definition of terms, relation of terms and visualization of relations between terms), it is intended to clarify the semantic vagueness between these terms. In contrast to that, the second approach will include linguistic criteria for solving relation problems between terms. This approach is the innovative aspect of the complete terminological study.

The main goal of both approaches is to achieve a consistent and unambiguous railway navigation terminology by solving the semantic problems between terms.

Within the framework of *iglos*, there are several preliminary works about semantic vagueness between navigation terms in different languages.

3.1 Preliminary Iglos Terminology Works on Navigation Terminology in Railway Domain

The first study is about solving relation problems between multilingual problems in navigation terminology. In this study, English navigation terms were compared with German and Turkish navigation terms [14]. In contrast to that, the second analysis is about English navigation terms in railway domain [15] and the third about Turkish navigation terms in railway engineering [16].

The main goal of these studies is to analyze the relation between "positioning" and "localization", and "position" and "location" in three different languages. Especially, the main question is if there is a synonymy relation between navigation terms "position"/"location" and "positioning"/"localization" or if they are mixed up with each other.

A linguistic research method was chosen for the relation analysis of these terms in English, German and Turkish. This linguistic analysis contained the etymological, grammatical, semantical and relational aspects of the four terms in the study of English navigation terms [15]. In addition to these aspects, the studies of Turkish and multilingual navigation terms also included the translational aspect [14, 16].

Finally, the studies in these different languages provided the result that "positioning" and "localization", and "position" and "location" are no synonyms but that they are mixed up with each other. The linguistic criteria supported the differentiation between definitions and the relation of the navigation terms.

Furthermore, "position" is an output of "positioning" and "location" an output of "localization". The reason for this relation is that "positioning" and "localization" are functions or processes which obtain the states "position" and "location" [14].

Based on the basis of these preliminary works, we will analyze the relation between "position", "location", "positioning" and "localization" in a more extensive context and with the aid of a modeling process of the navigation terms.

3.2 Modeling Process of English Railway Navigation Terms

In this subsection, we show the modeling process of the five English railway navigation terms "position", "location", "positioning", "localization" and "navigation". In the traditional terminology work, a modeling process is important for determination of definitions between terms in a specific domain [17]. In contrast to the traditional terminology work, the *iglos* terminology modeling process includes also the creation of relations between terms and the

visualization of the created relation. The creation of term relations and visualization of term relations enable the construction of a consistent and unambiguous terminology.

Firstly, these five terms should be defined based on the basis of sources of the railway domain (e.g., in technical standards, glossaries or dictionaries). Therefore, the definitions for these five terms are presented in Table 1.

After defining the five navigation terms in railway domain, we have to relate these with the *iglos* relation types. With the aid of the definition of these terms (Table 1), the following relations can be recommended:

(1) Causal/functional relation between "position" and "positioning" and "location" and "localization":

- "Position" is output of "positioning";
- "Positioning" has output "position";
- "Location" is output of "localization";
- "Localization" has output "location";
- "Position" is input of "localization";
- "Localization" has input "position";
- "Location" is input of "positioning";
- "Positioning" has input "location";

(2) Risk of confusion between "position" and "location", and "positioning" and "localization":

- "Position" is mixed up with "location";
- "Positioning" is mixed up with "localization";

(3) "Positioning" and "localization" are hyponyms of "navigation":

- "Positioning" is hyponym of "navigation";
- "Positioning" has hypernym "navigation";
- "Localization" is hyponym of "navigation";
- "Localization" has hypernym "navigation";
- "Navigation" is hypernym of "positioning";
- "Navigation" has hyponym "positioning";
- "Navigation" is hypernym of "localization";
- "Navigation" has hyponym "localization".

In the last step of the modeling process of railway navigation terms, the created relations can be visualized as a node-edge model by the *iglos* tool (Fig. 3).

In conclusion, we have created the relations between the five navigation terms based on the basis of their definitions which also support the determination of their relations. The visualization enables to model the construct and hierarchy of the railway domain terms.

3.3 Linguistic Method for Solving Semantic Vagueness between English Railway Navigation Terms

The second possibility for clarifying the relations between English railway navigation terms is a linguistic analysis with different criteria. Among these linguistic criteria, there are etymological and grammatical aspects.

Etymologically, "local" is borrowed from the Latin word "locus" which describes a geographic point,

Table 1 Definition of English railway navigation terms.

Term	Definition in traffic engineering terminology	Source of definition (example) reference
Position	Given by a set of coordinates related to a well-defined coordinate reference frame	Ref. [19]
Location	A position in terms of topological relations	Ref. [19]
Positioning	Process of obtaining a position	Ref. [19]
Localisation	Process of obtaining a location	Ref. [19]
Navigation	Combination of routing, route traversal and tracking	Ref. [20]

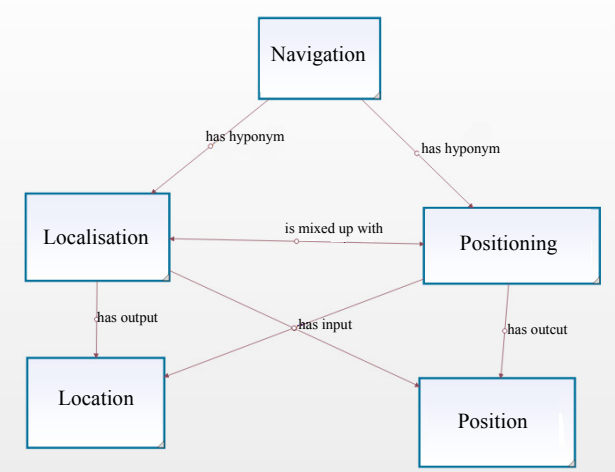

Fig. 3 Visualization of relations between English railway navigation terms.

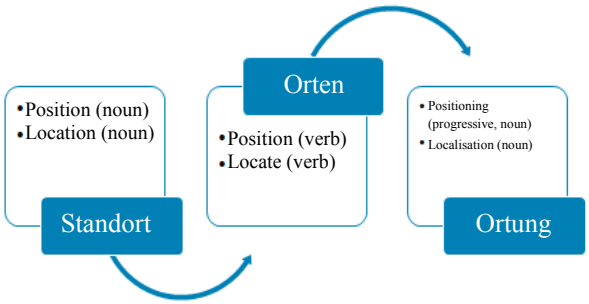

Fig. 4 Word forms of the English navigation terms.

place or area to relate rather topographically than topologically a certain object (Schnieder) or from the French word "local(e)" in the 18th century [18].

In contrast to "local", the term "position" defines the place of an object. It is borrowed from Latin "positio" (English: "place", "status") or "ponere" (English: "to put", "to set", "to lay") in the 16th century. The French influence on "position" as technical term in philosophy, economics, astronomy, nautics is primarily perceivable. In common language, "position" concerns an important status in an institution, in a firm or in a system [18].

In our contemplation, we differentiate between system states (location and position) and functions (localization and positioning). Therefore, "location" and "position" are states of the processes "localization" and "positioning". With the aid of the "localization" and "positioning", the "location" and "position" can be determined.

Finally, the grammatical aspect also contributes to solving the definition and relation problem between navigation terms.

The analysis of "positioning" and "localization" in relation to the grammatical aspect has shown that both distinguish by their own word forms which represent them (e.g., "positioning" has a noun "position" and a verb "to position" and "localization" has a noun "location" and a verb "to locate") (Fig. 4). The "positioning" and "localization" are parallel and different processes. They are represented with the different words of both terms.

4. Conclusions

With the aid of two methodological approaches, we could find out that there are semantic differences between the analyzed navigation terms other. The *iglos* sign model as an advanced ontology structure with single lexemes describes the relations between technical terms. Therefore, the relation types are the most important aspect for the methodological analysis of term definitions and support to clarify problems of semantic relations of terms, e.g., by creating a relation between at least two terms in a certain variety.

The variety also helps to classify the term definitions and the relations between terms. The *iglos* work distinguishes from the traditional terminology work by creating relation and by its variety concept. The definition of terms based on a specific variety. At last, a terminology building can be constructed by creating relations between terms.

The combination of the linguistic method with the terminology modeling process is a successful approach for clarifying semantic vagueness between terms. Whereas the modeling process helps to determine the definitions and relations of terms in a specific domain, the linguistic analysis with the etymological and grammatical aspect supports the verification of the relations determined by the modeling process. Thus, both approaches are relevant for the creation of a consistent and unambiguous terminology.

Principally, *iglos* as terminology and knowledge management system of the next generation uses several terminologies of different domains by denoting the definitions, properties and interrelationships of concepts. Therefore, *iglos* is a structural framework which collects, integrates, shares and relates terminologies of different national languages and different technical languages.

With the *iglos* semantic modeling process based on the variety-based sign model, a consistent and unambiguous terminology of English railway navigation terminology is enabled which is shown in Fig. 3. The figure shows that the relations between

navigation terms are visualized as an *iglos* node-edge model.

Based on the basis of further terminology projects, we will develop the linguistic method for solving semantic vagueness between technical terms. In this case, we will study a new method for determination of preferred and rejected denominations for solving the synonymy and ambiguity problem between terms.

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