DESIGNING LINGUISTIC SUPPORT FOR RISK MANAGEMENT COMMUNICATION

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Science of language, in particular cognitive semantics and performative pragmatics, offer an interesting access to risk management, by analyzing and modeling its intellectual and practical activities in information and communication processes, in particular on disaster reduction issues. Concepts like "situational awareness", "co-ordination" and "command" have become integral part of an integrated communication model that combines semantic and pragmatic aspects.

The analysis of risk management terms and collocations allows detecting these complex interactions that only integrated models are able to explain. Computational linguistics provides methods to increase both, the quantity and the quality, of a large body of authentic corpus material.

Our approach to terminological lexicography is constantly being adapted to the needs of risk management communication processes, where experts from different domains as well as laypersons have to be able to efficiently communicate across cultural and linguistic borders. Risk communication methods must not add "linguistic risks" to a critical situation; on the contrary, they must help communication partners in disambiguating any linguistic utterance.

Risk terms being concepts, their structure becomes a categorization of the underlying events, properties and relations. The resulting risk ontology is a formal, machine-processable model of risk management knowledge. This knowledge model is expressed in a precise terminological representation in many different languages.

The results of this research project are meant to contribute to the democratic diffusion of expert competence, which in the field of risk means aid, rescue, response, protection, safety and disaster reduction in real life.

1 From Philosophy to Linguistics and Ontology

The complexity of *disaster events* as seen from the physical point of view, of *disaster aid* as described from a technological perspective, and of *disaster risk* explained by psychology and logic, is a convincing, trans-disciplinary appeal to integrated models for *assessment* and *response*. Science of language offers an interesting access, by analyzing and modelling the intellectual and practical activities like information, exchange, and intervention processes as they appear in discourse. Therefore the collection and analysis of linguistic data have become of great interest for designing risk communication processes on a trans-disciplinary level.

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Starting with the evidence of the reciprocal inter-dependence and inference between *disaster risk* and *emergency*, an efficient *management* has to combine both in an integrated model. This is the challenge addressed by the application of linguistic positions and propositions for the benefit of the risk domain as currently carried out in a work package on "Human Language Interoperability" (HLI) within the Integrated Project WIN (Wide Area Information Network – Improving Risk Management). The approach developed for this work packages is called MULTH (Multilingual Terminology & Hypertext) and includes a combination of different methods from lexicography, linguistic discourse analysis, terminology analysis, and user-oriented hypertext design. The multilingual dimension of this work has so far focused on English, French and German and is being extended to other languages at the moment. The results of this work include a tri-lingual glossary, an online terminology database, a large corpus collection in the three languages including reliable domain-specific texts from risk management discourse and many different glossaries covering different domains related to risk management and risk communication.

Up to date linguistic theories and methodologies, especially validated by cognitive semantics (Bever, Bierwisch) and performative pragmatics (Grice, Searle) have revealed to be perfectly appropriate to model the concept of *disaster reduction* on the levels of information, communication and action. As far as the present topics are concerned, two directions become evident, from

- Semantics via **information** to "*situational awareness*", and from
- Pragmatics via **communication** and **action** to "*coordination*" and "*command*".

Risk language fluctuates between the most abstract and the most concrete nouns as mono-lexemes (= one word terms): *assessment, awareness* vs. *fire, water* and collocations as poly-lexemes (= nominal and verbal multi-word terms): *public risk awareness, to enhance, improve, increase risk awareness*. Collocations are fixed by user preferences, because, linguistically speaking, they organize knowledge by linking new to existent information, and by creating frames and scenarios among the instances involved.

"*Risk science*", the term that first appeared in Covello/Mumpower in 1985, has undeniably a philosophical background. *Risk* and *hazard* are characterized not by "assertion of existence" but by "modalities of existence" such as "uncertainty and probability", and "avoidance of existence", that defines *precaution, prevention* and *safety*. The constant reference to an entity whose existence is not wanted, reminds of Greek and scholastic views, but Enlightenment introduced pragmatic and technical views. Thus ***risk management*** illustrates the scientific conversion of the "probability of the existence of a disaster" into its "non-existence". "Modalities of existence" more than "existence" are particularly welcome for *risk* components: ***disaster*** as object, ***safety*** as objective, ***chance, catastrophe*** as evaluations, ***protection*** as obligation and desire. Habermas (1991), who was interested very much in public thinking and philosophical discourse, takes the example of risk, and develops the notion of connectivity (Konnektivität) among disciplines in order to make scientific progress.

These theoretical positions fortify the symbiosis of human and technical sciences, between semantics and pragmatics, between ordinary and special language, etc. as a strong conceptual foundation for *risk management*. The analysis of these terms, expressions, and sentences focuses on their use in context and allows detecting profound interactions that only the advanced method of "human language interoperability" is able to explain. Linguistics is interdisciplinary in nature. In cooperation with information technology, the quantity and quality of most authentic and idiomatic corpus material increases and becomes the warrant of the most efficient *risk communication*, where *knowledge of the domain*, comprehension within and between linguistic communities become priorities. With risks being transboundary, cross lingual research and products become a priority. The new challenges we address here are harmonized *risk information*, *risk communication* and *risk action* between experts, decision-

makers and citizens being required for the greatest possible number of linguistic communities, the respect of natural language diversity, and *multi-linguality*.

2 Semantic Support for Risk Information

For risk discourse in English, French and German, the multilingual risk terminology developed in the WIN-MULTH project is a great contribution to enhancing risk comprehension in diverse target communities. Currently there are only few risk term collections and glossaries, while special risk dictionaries in the classical sense of lexicography don't exist yet. At best, they are generated semi-automatically by extraction from special risk purpose texts in scientific, administrative and press publications. Most of the rare one-word terms come from general language, their meaning is settled down in the speaker community and in monolingual dictionaries of general language: *rain/pluie/Regen, emergency/crises/Notfall* with possible intercultural differences that have to be explained in order to avoid grave misunderstandings. Multi-word terms are fixed and standardized terminological collocations (Mel'cuk 1995), phraseological terms (Arntz/Picht 1981); they are very frequent in language of special purpose, they are idiomatic and result from the combinatory potential between basic head terms and members that quantify and qualify: *emergency response, to devise an emergency plan, to improve planning and response to crisis situations.*

Definitions coming from scientific and institutional authorities, able to identify and to regulate, are the resource to understand, explain, and communicate meanings of domain-specific terms. They focus on the distinctive semantic features of the abstract and concrete states, processes and actions concerned, they reduce linguistic ambiguity and vagueness, which constitutes a crucial imperative for risk management. Circularity and contradiction are frequent mistakes of ancient definitions that terminography is determined to avoid and to eliminate. In spite of the great number of risk glossaries (usually in the form of simple word lists), cross-lingual difficulties arise: entries and definitions in most international institutional glossaries (OECD-ISDR, Geneva 2001) are monolingual and always in English; national institutions, universities and research centers create their own glossaries in their national language (SKKK, Köln 2003) and rarely add English equivalents (CEDIM, Karlsruhe 2005). Mono-lingual glossaries combine terms with their definitions (TESEC-EUROPA Strasbourg / Tchernobyl, 2001), but bi-lingual ones offer only term correspondences without definitions (BfG, Hydrologie). For these reasons, multilingual risk glossaries with definitions specific to each language become the first necessity for international *risk cooperation*.

The following example shows an interesting comparison of cross-lingual definitions taken from the entry on *public awareness, risk communication / communication sur les risques / Bewusstseinsbildung der Öffentlichkeit, Risikokommunikation* (WIN-MULTH Glossary 2006):

English: *Interactive exchange of information and opinions throughout the risk analysis process as regards hazards and risks, risk-related factors and risk perceptions, among risk assessors, risk managers, consumers, feed and food businesses, the academic community and other interested parties, including the explanation of risk assessment findings and the basis of risk management decisions (EUD).*
The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. This is particularly important for public officials in fulfilling their responsibilities to save lives and property in the event of a disaster.
Public awareness activities foster changes in behavior leading towards a culture of risk reduction. This involves public information, dissemination, education, radio or television broadcasts, use of printed media, as well as, the establishment of information centers and networks and community and participation actions. (ISDR)

French: *échange interactif, tout au long du processus d'analyse des risques, d'informations et d'avis sur les dangers et les risques, les facteurs liés aux risques et les perceptions des risques, entre les responsables de l'évaluation des risques et de la gestion des risques, les consommateurs, les entreprises*

du secteur alimentaire et du secteur de l'alimentation animale, les milieux universitaires et les autres parties intéressées, et notamment l'explication des résultats de l'évaluation des risques et des fondements des décisions prises en matière de gestion des risques (EUD)

German: *Die Prozesse, die allgemeine Bevölkerung zu informieren, um die Wahrnehmung von Risiken sowie das Wissen, wie Menschen handeln können, um ihre Anfälligkeit gegenüber Gefahren zu reduzieren, zu steigern. Dies ist besonders wichtig für Einsatzkräfte und zuständige Personen, um ihre Verantwortungen, Leben und Sachwerte im Katastrophenfall zu schützen, zu erfüllen. Kampagnen zur Bewusstseinsbildung unterstützen Verhaltensänderungen in Richtung einer Präventionskultur. Dies schließt öffentlich zugänglich Informationen, Informationsverbreitung, Bildung, Radio- und Fernsehsendungen und den Gebrauch von Printmedien ebenso ein wie die Errichtung von Informationszentren und Netzwerken. (BDR)*

The sources quoted in these three languages show different conceptual characteristics in their definitions of the terms in the respective language. Still, there is sufficient conceptual overlap to establish an equivalence relationship between the multi-word terms in the three languages.

According to Pawlowski (1980), human sciences work with fuzzy terms, where definitions need to be completed in order to reach unambiguous communicaiton. *Risk* and *risk reduction* are concepts belonging to the humanities and to science, with "family resemblances" with and among related terms and expressions revealed as particularly important; they function as synonyms, partial definitions, user illustrations, standards of use; they develop a rich and differentiated potential of meaning and use. Intra- as well as interlingually, related terms and expressions compensate for the lack of complete semantic descriptions in discourse. When using the results of this terminographical work in real-life discourse, ambiguities and uncertainties in discourse can be reduced and avoided. *Public risk awareness* is a good example: *public information* and *risk communication*, being the most frequent synonyms, and 27 related expressions around *information* and *communication* illustrate the same conceptual field (WIN-MULTH Glossary 2006, B1-B2).

The most evident semantic support comes from the onomasiological network of risk terms. Traditional lexicography orders words and terms according to either formal aspects (semasiology) i.e. alphabetically, or semantic aspects (onomasiology), i.e. conceptually. According to experts of the domain (and this is a common position among the three projects within the 6th EU framework: ORCHESTRA, OASIS, WIN), the chronological cycle of risk events offers a user-friendly access to the conceptual categorization used in the risk management model. This model is used by our new approach to lexicography (Greciano 1989, 1990, 2001, 2005, 2006) as the macrostructure of dictionaries and glossaries. This conceptual approach is the pre-requisite to develop a risk ontology. An ontology as defined by information science is a formal classification system and a tool to structure *concepts* and *knowledge of the domain* (www.teledetection.fr, Gruber 1993, Corrazon 2005). Figure 1 shows a circular graphic that visualizes the initial observation about the inferential relation between the intellectual upper risk activities (A. *Risk assessment* and B. *Public awareness*) and the concrete concepts in the lower part of the model, i.e. *disaster events, rescue and protection equipments and operations* (C). Conceptual ordering is chosen as the principal method for collecting linguistic material and for building terminological glossaries. The resulting conceptual knowledge organization becomes a so-called macrostructure within each category, where interesting observations can empirically be confirmed; so the essential impact of *technology* within A. *risk assessment* and B. *public awareness*, with, for instance, (*geographic) information system, data processing, satellite, remote sensing, earth observation, precision farming for* A; *civil protection, water management, emergency planning, climate monitoring, forecast, warning system, (applied) monitoring* for B. and further within the *rescue and protection equipments and operations* of the *disaster events* (C): *extinguisher, ventilation, hydrograph, stage gauge, oil platform, skimmer*, are realities that make transboundary technical, economic as well as terminological international cooperation and assistance necessary for many risk-exposed countries.

Figure 1: The Risk Management Cycle used for organizing the structure of the Risk Management Glossary

Semantic support for risk information thus means the semantic organization of information in such a way that users of specific information tools such as terminology databases and glossaries are able to refer to such information resources either when preparing for their daily professional work in risk management and related activities, or for using such information in learning situations for acquiring knowledge about risk and risk management. Semantic tools of this nature are also a pre-requisite for successful discourse. All types of communication require a sufficient level of semantic congruence among the cognitive knowledge structures of all communication partners involved. Terminologies as displayed in conceptual glossaries are used by communication partners to refer to the same definition of terms that otherwise may be misunderstood due to their inherent polysemy. This is of particular importance in multi-domain discourse situations when terms that developed separately in different subject fields suddenly collide in a trans-disciplinary discourse situation.

The following chapter focuses on the pragmatic level of the actual use of semantic information in discourse:

3 Pragmatic Support for Risk Communication

The theories of pragmatics convinced linguists of the efficiency of authentic corpora, of using genuine idiosyncratic language in order to improve *communication* by the speakers' use.

Linguists are far from being surprised that specialists of law (e.g. a national transportation safety board) and physics (Rubise, Gautier 1995, 39 and 81) attribute *accidents* and *major hazards* to *communication* problems, e.g.,

- The great fire of the ferry 'Scandinavian Star' in 1990: language difference between mechanics, board officers and passengers was made responsible for the tragic event;
- The Boeing crash in Tenerife was attributed to the confusion, if not mistranslation, of instructions: « *vous pouvez vous aligner* » was misunderstood as « *vous pouvez décoller* » and thus caused the passengers' death.

Conceptually, *awareness* implies *knowledge*, *perception*, *assessment* a well as *reliability*, necessary for *coordination* and *command*. A holistic pragma-semantic network can thus be drawn around the concept of *awareness*, as figure 2 shows:

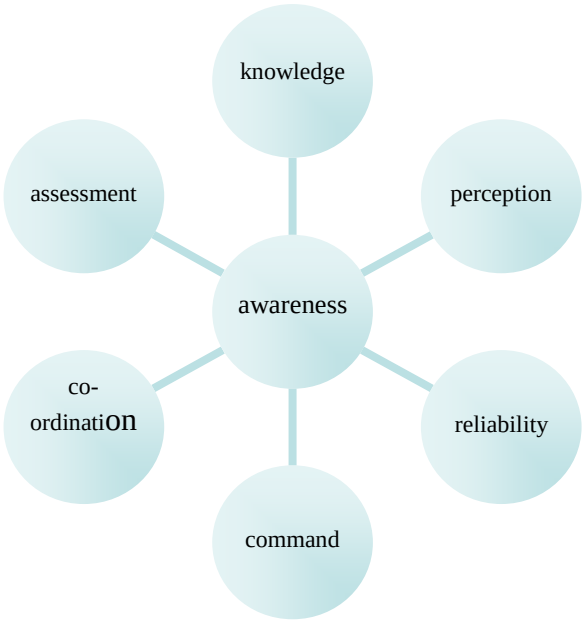

Figure 2: A pragma-semantic network of concepts organized around the key concept of *awareness*

Located at the illocution-perlocution level, the concept of *reliability*, a semantically more and more important ethic feature of risk management (SSR2006) in civil society, is pragmatically fundamental for the concept of *command*.

The tradition of ordinary language philosophy (Wittgenstein 1953, Austin 1962, Searle 1969) has demonstrated "how we do things with words" and has made speech acts to become the basic elements of human communication. Illocution and perlocution express the communicative functions of *forecasting* and *warning* and great attention is paid to the different linguistic, lexical and grammatical markers. There is no doubt about the action orientation of risk language:

- the high frequency of predicative nouns expressing action and processes: *acceptance, aid, assessment, awareness, management, coordination, mapping, planning, reduction, response, command;*

- the verb phrases*: a disaster occurs, to cause a disaster, to establish emergency services, to exert influence on the hazard, to improve risk awareness, risk detection, risk management, to reduce vulnerability ;*
- but above all, the fixed sentences themselves: formulas, routines, patterns, functioning as speech-acts, as pragmatic rules and normalized instructions in all three languages (i.e. English, French, and German), that require immediate *response* and therefore prohibit lexical and syntactic transformations and do not leave time for lexicon consulting. Here, fixity becomes overwhelming, it is extended from language to situation and becomes an important user constraint; efficient *emergency rescue* depends on the standardized expression in the precise moment; Affinities develop between context and text; and interlingual correspondences are necessary to save goods and human lives: *Imminent danger! Inform the fire brigade! Inform the police! Stay at home! Listen for warnings on the radio! Turn on radio and television! Find out what protective measures to take! Get off the street! Find shelter! Take protective measures! All-clear! Danger has passed! Listen out for TV and radio announcements!* From the pragmatic point of view, these speech acts of risk language are more than assertives (information), they become directives (warnings) and develop to declaratives (instructions).

In a globalized world with many societal processes taking place in cross-cultural and cross-lingual modes, risk communication has become a cross-cultural event in itself. *Risk situation awareness, risk coordination, and risk command* are increasingly processes taking place in multi-lingual communication situations. This fact requires parallel text research for all languages involved. Language professionals such as translators, technical writers, communication designers, linguists, language teachers, etc. are using special methods of multilingual terminology management (Wright/Budin 1997/2001), designed as a method of information and knowledge management fully embedded and contextualized in complex workflows and thus fully integrated in real-world situations at the levels of semantics **and** pragmatics.

It takes a long time to prepare oneself for complex communicative tasks such as risk communication, where the challenge is to assess a situation from the perspective of possible dangers to objects or living beings and to communicate to persons directly or possibly involved in such situations and making them aware of a risk situation and instructing them to behave in a specific way to reduce their personal risk. General language as acquired as a mother tongue must be further developed by students into a special language of the domain they study. By acquiring the domain knowledge of the field of study, students acquire the terminology of the field in this language, and vice-versa – studying the terminology of the field is a key to understand the complexity of a domain. Nowadays such domain-related language acquisition methods are supported by eLearning-methods. By a combination of 3 methods, CALL (computer-assisted language learning), CLIL (content and language integrated learning), and eLearning, it is now possible to design specific learning environments that enable students to acquire specific language skills and cross-cultural skills that enable them to communicate in risk situations focusing on natural hazards when members of different language communities are involved (Budin 2004a, 2004b): in a co-operative project between several universities, domain students of ecology with different mother tongues acquire foreign language skills in order to communicate with each other, while in the same learning group students of translation studies acquire content knowledge in several languages in order to enhance their competence to mediate between participants in cross-lingual communication situations. Domain terminologies in each language involved become the point of departure for students of translation and terminology who gradually learn to assess the quality of terminology data bases and high-quality glossaries, to use them adequately in specific communicative situations, and to prepare such glossaries themselves. The WIN-MULTH project has become an ideal learning situation for many students at the Center for Translation Studies at the University of Vienna during their studies: in a collaborative work process in multiple languages, students prepare small glossaries in different bi- and tri-lingual language

combinations in a terminology database that is available in an online eLearning environment. Multilingual terminology management has become a crucial part of translation management. Translation management refers to a comprehensive procedure covering all procedures of the computational management of translation processes by using a broad spectrum of computer tools (including machine translation systems, translation memory systems, term bases, etc.), modelling these processes into operational work flow models, and including economic and human resource management aspects (Budin 2005).

In this context it is important to differentiate clearly between two concepts discussed above, i.e. *terminology* and *ontology*:

- a terminology: an (organized) set of concepts and their designations (including the relations among them) in a domain and its special language (Budin 1996)
- on ontology: an explicit and formal specification of a conceptualization of a domain (Gruber 1993)

So the question arises: What do they have in common and where are the differences between the two concepts? The common root is classical logic, with Aristotelian categories and conceptual hierarchies. They share purposes and functions: organization of data, information, knowledge, content; support for machine translation and machine assisted human translation. Both aim at reaching a common understanding of a domain, they are supposed to help people sharing knowledge within an organization or in distributed professional communities who work on reaching common goals, and both help in expressing and explicitating knowledge. So where are the differences? An important difference is found in the different degrees of formalization and explicitation. From an operational point of view, this gradual difference has important implications, since a lot of intellectual effort is usually necessary to make implicit knowledge explicit and to formalize this explicit knowledge, as is necessary in ontology building. Full ontologies include logical reasoning rules (first order logic, frame logic, description logic, etc.) and constraints on the use of these rules. This is due to the fact that ontologies are used only for computer applications, while terminologies are also prepared for human consumption. Terminologies are limited to domain-specific concepts and designations (ontologies are not) and usually focus more on their linguistic and communicative functions and they capture much more cross-cultural relativity and many of the asymmetries between culture-specific conceptualizations and their lexicalizations on the cross-lingual level (Budin 2005). The current work in the WIN-MULTH project is now to build multilingual domain ontologies bottom-up from existing domain terminologies. Figure 3 shows a small extract of a formal ontology currently built in the framework of the WIN-MULTH project: terminological data as produced during the previous phase of terminological analysis and documentation are now being formalized and “ontologized” in an ontology editor tool. This ontology is still monolingual, the next step is then to align each monolingual ontology to each other according to the multilingual glossary that forms the pre-requisite and basis for this phase in the work process.

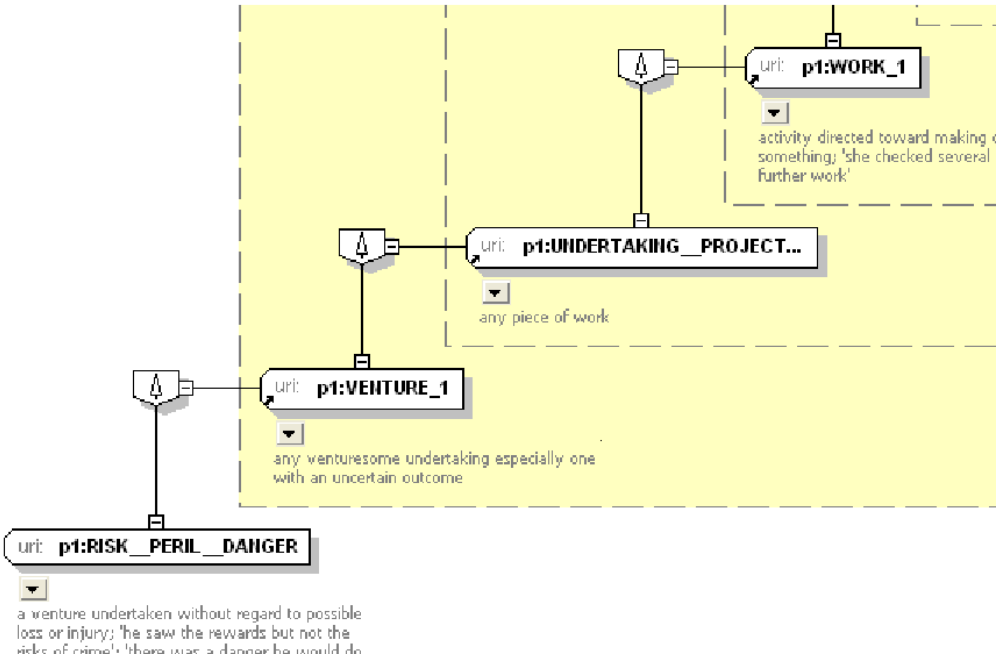

Figure 3: A small extract from a terminological concept system is transformed into a formal ontology by converting data from the terminology database into ontological data in a specific ontology editor

In summing up it has become evident that philosophical, linguistic and domain-specific semantic and pragmatic knowledge and discourse structures are the theoretical and methodological basis for building mono- and multi-lingual glossaries and databases and for using them in domain-specific discourse situations. The area of risk communication needs such a solid, trans-disciplinary basis in order to be successful in communication, due to the many challenges we are facing in real-time risk situations. Much more work still needs to be done to close the gap between the technological needs in multi-risk, real-time, multi-lingual, and multi-site situations that require immediate, reliable, and unambiguous communication in order to save lives, reduce damage to property and persons, and to motive society and decision makers to take the necessary measures to avoid future risks. This will only be possible with a comprehensive risk communication strategy based on solid pragma-semantic methods.

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