

Dealing with terminologies in collaborative systems for crisis management

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ABSTRACT

This paper presents approaches on how to deal with terminological ambiguities (different understandings of terms in heterogeneous groups of actors) in collaborative systems. First we will give some insight on the conceptual and theoretical foundation surrounding the ‘triangle of reference’, a model of how linguistic symbols are related to the objects they represent. Then we will describe the results of our exploratory empirical study, which was conducted in Germany, and dealt with inter-organisational crisis communication. Based on this, we will then deduce requirements necessary for supporting and dealing with terminologies, and propose technical approaches for collaborative systems.

Keywords

Terminology, Communication, Collaboration

INTRODUCTION: CONCEPTUAL AND THEORETICAL FOUNDATIONS

‘Communication’ literally means ‘conversation’ or ‘notification’, and is understood as a process of exchanging signs with the aim of transporting thoughts of existing objects via symbols. A model of how linguistic symbols are related to the objects they represent, is the ‘triangle of reference’ or the ‘semiotic triangle’ (Ogden & Richards 1923, Figure 1). It illustrates how *symbols* (words) symbolize *thoughts* (concepts) that refer to *referents* (objects). A symbol, like a word, does not directly refer to an object, but to the concept of that object.

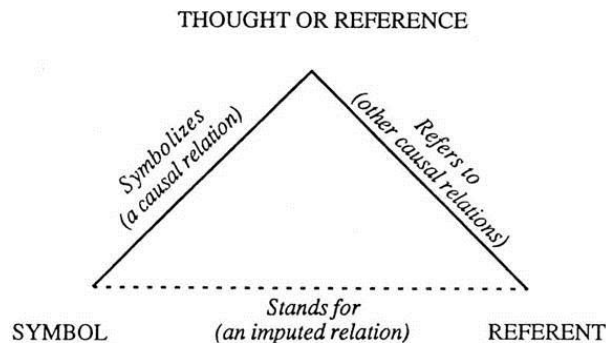


Figure 1: Triangle of reference or semiotic triangle (Ogden & Richards 1923, p. 11)

Communication problems are a common occurrence, even more so in a collaborative software, where actors communicate across organizational boundaries. One reason for these problems is that different actors have a different idea of the same ‘symbol’. This means that the same symbol, the word ‘injured’ for example, is interpreted differently by different actors. Terminology plays an important role here: ‘terminology’ is the total number of concepts and their names in a field. Terms are words and compound words that are used in specific contexts. Terminology is an important part of a technical language that in contrast to common language includes expanded, and for the subject area specialized, vocabulary. In communication, outside of the boundaries of this subject area, the use of terminology leads to comprehension problems, because different terminologies use the same symbols in different ways. In computer-mediated communication, they cannot be negotiated directly.

One way to deal with these problems is ‘Terminology management’, which includes the targeted use of terminological information (Wright & Budin 1997). It consists of the configuration and the analysis of language resources, including critical comparisons between different languages and disciplines, as well as the acquisition of terminologies in databases and the use of terminology management systems (Budin 2006). The aim is to create automatic links between references in different fields and to propose translations. Thesauri can connect items of vocabulary to each other to allow automatic adjustments. Ontologies can represent terms formally as

well as the relationships between terms. Fuzzy ontologies are more suitable to describe uncertainties. Never the less in practice not all terms are or can be transformed.

METHOD: DOCUMENT ANALYSIS AND EXPLORATIVE EMPIRICAL STUDY

In this paper we will analyse communication problems and how collaborative software can support this. The overarching goal of our study (Ley et al. 2012) is to obtain a set of requirements for a collaborative software for crisis management, such as collaborative situation maps (Wiedenhoefer et al. 2012), the use of citizen-generated content (Reuter et al. 2011) or computer supported crisis trainings (Reuter et al. 2009). The empirical study was conducted in two regions of Germany ('Siegen-Wittgenstein' and 'Rhein-Erft') and members of the police, fire department, aid organizations and electricity network operator were involved. They operate on a strategic level in a crisis management team, an operational command centre of the police and a centre for emergency services. Each operational command is led by a representative of the organization, who is responsible for the transmission of information. In addition to these official structures for unusual events an ad-hoc, cross-organizational communication without institutional framework takes place.

Qualitative methods (Randall et al, 2007), such as document analyses, interviews, observations and focus groups, were used. The goal of the *document analysis* was to obtain official information about relevant terminologies. 19 documents were analysed that represented the work of crisis management (laws, decrees, regulations, directives, and course materials) for the used terms. The *group discussions* made it possible to understand the communicative practice of inter-organizational communication. Four inter-organizational group discussions (lasting about four hours) were conducted with key players. The *observations* were used to obtain knowledge about the practical work in inter-organizational crisis management and were conducted in the district control room during a normal working day (observation time: nine hours), in the task force and in the operational control, during a crisis communication training, (four hours) as well as on a major event (six hours).

RESULTS: DEALING WITH TERMINOLOGIES IN CRISIS MANAGEMENT

In our document analysis we had already found terminological vagueness in legislative texts for important terms: In the legislation of the state of Hessen (HBKG 1998, §24, literally translated by the authors) a catastrophe is mentioned as a *'risk event, which measures or impairs the life, health or the vital supplies of the population, of animals, substantial property or the natural foundations of life in such an unusual way that the central management of all units and institutions of civil protection is required'*. This is not the case in the state of North Rhine-Westphalia. North Rhine-Westphalia (FSHG 1998, §1) does not describe the term catastrophe itself, but it defines the tasks of the fire services in situations which generally could be understood as catastrophe: *'to fight fire and to provide aid in accidents and to provide assistance to such public emergencies caused by natural disasters, explosions or similar events'*. In addition to the general legal differences, each organization has its own terminology. The technical terms are defined on an organizational level and predetermined by the police service provision (PDV100, 1995) and fire service regulation (FwDV 100, 1999).

Tactical signs, as a visual representation of the situation, also leave room for interpretation. The German armed forces have military signs that represent the different types of weapons they use. The Agency for Technical Relief has signs that representing their vehicles and tools. Although the individual organizations have a common pool of signs, the signs may differ in detail: Only in the fire services, the sign for squadron (German: 'Staffel') is two overlapping points ':' (FwDV 100, 1999) as the sign consists of four adjacent points '· · · ·' in the German armed forces (BdV 1990). A soldier (without prior knowledge) would interpret the fire services sign as a group and assume that they are not as many helpers available. In this case the interpretations would differ. A possible solution for this problem is a communal pool of signs. The 'Permanent Conference on Disaster Risk Reduction and Disaster Protection' presented an inter-organizational regulation 102 (DV 102, 2003) as a possible approach to solving this problem, which, however, has not been implemented yet.

The organization of the leaders of professional fire brigades (Arbeitsgemeinschaft der Leiter der Berufsfeuerwehren, 2005) is also aware of the problem of different terminologies: *'civil protection needs a uniform terminology: [...] This requires a county-and organization-wide agreement on definitions in the field of civil protection, to a uniform definition of 'disaster' and 'civil protection'*. Of course some organizational obstacles exist: many terms have evolved over years and decades and are needed in a different way in different organizations. Scoring systems like the "NACA-score", 'Injury-Severity-Score', 'Revised-Trauma-Score' or the 'Abbreviated Injury Scale' use different criteria for insurance and are used by different organizations. UNISDR (2009) developed basic definitions on disaster risk reduction to promote a common understanding

Further practical challenges were highlighted in our group discussions. It was emphasized that ‘each organization [...] has its own way of working’ - and these require that different terms are used. This can lead to communication problems, in which the seriousness of a situation is understood as being more dramatic than it actually is: “There is someone who has injured his finger and a member of the Agency for Technical Relief reports the accident. That message was almost understood as a fatality”. Because of the different focus, it is “very, very difficult to get an alignment of terminology. Even when police talks to the firefighters, there is a very large communication gap between them”. These problems can even occur within the same organization, in different communities. As an example, neighbouring fire departments were mentioned in which “completely different rules, totally different philosophies” existed. When communicating with other organizations or companies different uses of the same terms occur even more often. This becomes apparent in an example of a fire in an industrial building. In this case, 19 people in a factory were reported to have been injured, but what was actually meant was “injured as defined by the company, meaning 19 people who only had to be seen by a doctor. They do not have to be hurt”. This differs significantly from the use of the term in the public rescue service: “If the emergency service speaks of people having been injured, this means they have to be cared for and brought to a hospital”. There, too „different terminologies lead to different results“. In fact, in the understanding of the emergency service, “two people were hurt; others only had to be examined by the company doctor”. In this case the existence of terminological differences was not aware by everyone.

In addition, during the observation of work practices in the task forces, it was underlined that when communicating with citizens during an emergency call, it was noticed that the language consisted of colloquial terms and their meaning strongly differs. Hence, there is a need of structured interviews, which means that structured check backs are required for rating the situation.

CONCEPTS: DEALING WITH TERMINOLOGIES IN COLLABORATIVE SOFTWARE

In many parts of the inter-organizational crisis management we observed good communication. But while some “communities use ‘incident’, others use ‘event’ or ‘crisis’, in public alerting, ‘alert’, ‘warning’, and ‘notification’ are used interchangeably” (Dwarkanath & Gusty 2010). Of course not all problems are caused by communication problems, but by conflicting characters or different mind-sets. Our requirements for how to deal with terminological differences in inter-organizational collaboration systems arose from both the theory in this work, as well as from empirically tested practice. From our findings, we have derived these needs and have mapped and turned them into a technical solution (table 1): (1) The basis for a sensible handling of terminological differences is an awareness of their existence. This allows for the useful rating of information and the identification of possible misunderstandings. (2) To reduce the scope of potential misunderstandings in cooperative systems, it seems useful to distinguish between relevant information to execute a specific task and information that is not needed and therefore should not be displayed. (3) If information is relevant, it should be checked which terminologies can be automatically transformed. (4) Other information may be enriched with additional meta-data, which is usually presumed implicitly by the sender of a message. (5) Unclear information is often negotiated through direct check backs. Cooperative systems should also support this.

No.	Finding	Requirement	Possible technical solutions
R1	Heterogeneous awareness about different terms	Awareness and transparency of the terminological ambiguities	display of meta-data of terms and messages
R2	Not all terminologies must be understood	Flexibilisation and customization of the application system	customizable adaptive interfaces, target-group-specific display of information
R3	Different meanings of the same tactical signs	Automatic transformation of terms and tactical signs	transformation and display of tactical signs depending on users role
R4	Assumed but not existing tacit knowledge	Communication processes that query the implicit information	Forms with required fields, transmission of meta-data
R5	Negotiation instead of automatically transformation	Facilitation of negotiation routines	Chat and messaging, synchronous check backs, contact information

Table 1: Findings, derived requirements and possible technical solutions.

Requirement 1: Awareness about terminological ambiguities: Users must be aware of the existence of different meanings of the same term to create transparency of terminological ambiguity. Unclear terms and phrases can

be looked up in the database or by using thesauri, which can be accessed through a search function. Also, it seems reasonable that the role of the sender of a message or a document is displayed, thus the receiver allows for the interpretation of the terms. Also, tooltips, which list possible meanings of terminologies that are identified for this term in the base and of the author, are plausible.

Requirement 2: Flexibilization and customization of information: A customization of information display which can be adapted to the task by the user, can also be helpful in avoiding misunderstandings, because each organization requires different information. From a repository of services, the user can choose the right ones for him and put them together in his personal screen (Doerner et al. 2009). It is also possible to adjust the text information of an item. The interest of a power company in a power plant is, e.g. the performance data; however, the police is only interested in possible actions regarding security. Through the targeted presentation of selected information that is relevant to the organization and targeted services, not only terminological confusions can be bypassed (by non-representation), but also a more efficient work with the system is possible.

Requirement 3: Automatic transformation of signs and terms: Dymon (2003) points out, that the lack of “standardized symbols in emergency maps hinders information sharing during crucial emergency situations by emergency managers and people responding to disasters”. Robinson (2010) write that understanding map symbology is one mechanism to ensure that geospatial information is interpretable, but creating an effective map symbol standard is a complex and evolving task. Tactical signs play a crucial role in crisis management. As long as the uniform tactical signs (DV 102, 2003), have not been implemented, transformation based on the users role and profile with the help of ontologies (Wuchelt et al. 2011) could solve this problem as a classical use of terminology management (Budin 2006). If no corresponding sign of another organization exists, it should be examined whether this signs is relevant or whether stating the organization and description can be helpful.

Requirement 4: Structuring of communication: Presupposed implicit knowledge can lead to communication problems. Standard forms can support written communication by offering the user preference options for the input. Through the systematization of news, the used cooperative system is able to handle the forms for the recipient and adapt texts for him, so that there is no room left for interpretation. The terminology database could identify and replace key words or abbreviations. The conceptual differences have more influence in a freely written text, but they can be embanked. This would be particularly relevant in the integration of citizen-generated content. Submission of temporal, spatial and other contextual information should be appropriate.

Requirement 5: Check back routines and negotiation processes: Communication, whether through signs or language, should be supported. In cooperation systems the option of matching any questions about the gaps in understanding communication should always be given. This requires an awareness about the activities of other key players in order to reduce the lack of implicit negotiation through synchronous communication tools. It is more difficult to support verbal communication. Conceptual differences have to be negotiable, especially in critical, non-routine processes, so that a misinterpretation is not followed by a wrong action. These negotiation processes are also important because of the specifics of the field, that include dynamic and unforeseeable events, informal processes and ad-hoc structures. These events lead to the need to initiate the process of shifting systems from data-centric to activity/actor-centric.

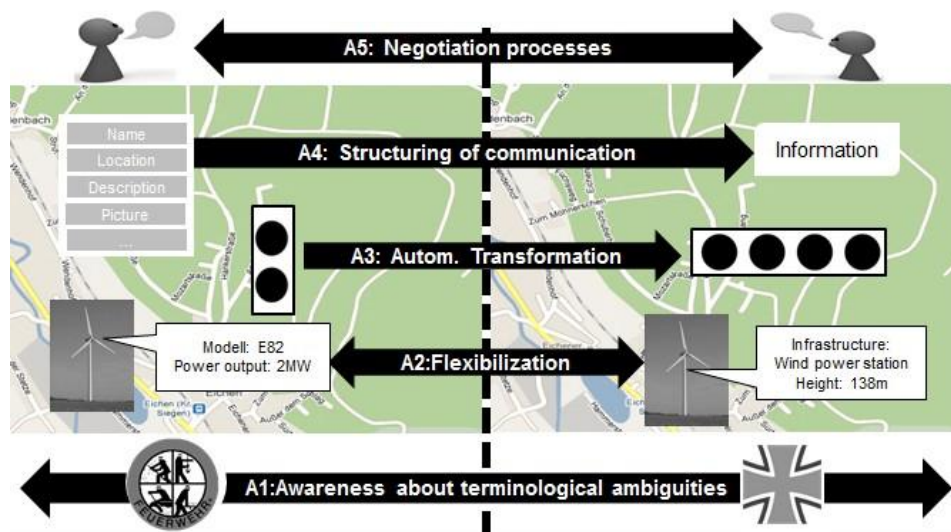


Figure 1: Approach to dealing with terminology in crisis management (Own illustration)

CONCLUSION

The aim of this study was to present approaches on how to deal with terminological ambiguities in collaborative systems. Based on the findings in our exploratory empirical study, we derived requirements for dealing with terminologies, and presented technical approaches for collaborative systems. They include (1) the creation of an awareness towards terminological differences, (2) flexibilization of information representation, (3) automatic transformation processes (where appropriate), (4) the structuring of communication and (5) manual processes of negotiation. Our current software prototype supports selected aspects and will be elaborated and evaluated so that more detailed recommendations can be deduced from our findings and to validate them.

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REFERENCES

1. Arbeitsgemeinschaft der Leiter der Berufsfeuerwehren [Working group of the leaders of the fire brigade] (2005): Führung und Leitung im Katastrophenschutz in Deutschland. <http://www.dgkm.org/>
2. Budin, G. (2006): Kommunikation in Netzwerken – Terminologiemanagement. In: Pellegrini, T. & Blumauer, A. (Eds.): *Semantic Web – Wege zur Vernetzten Wissensgesellschaft*. Springer: Berlin.
3. Bundesministerium der Verteidigung (1990): ZDV 1/11 "Taktisches Zeichen", Kapitel V. "Größenordnungszeichen", Nr. 225, Bonn.
4. Doerner, C., Draxler, S., Pipek, V. and Wulf, V. (2009): End Users at the Bazaar: Designing Next-Generation Enterprise-Resource-Planning Systems. *IEEE Software* 26(5), 45-45.
5. Dwarkanath, S. and Gusty, D. (2010): Information Sharing: A Strategic Approach, *Proc. ISCRAM*, Seattle.
6. DV 102 (2003): Ständige Konferenz für Katastrophenvorsorge und Katastrophenschutz. *Vorschlag einer Dienstvorschrift: DV 102 - Taktische Zeichen*. Köln.
7. Dymon, U. (2003): An analysis of emergency map symbology. *IJ of Emergency Management*, 1(3).
8. FSHG (1998): *Gesetz über den Feuerschutz und die Hilfeleistung (FSHG)*
9. FwDV 100 (1999): *Feuerwehr-Dienstvorschrift 100*. Führung und Leitung im Einsatz, NRW
10. HBKG (1998): *Hessische Gesetz über den Brandschutz, die Allgemeine Hilfe und den Katastrophenschutz*.
11. Ley, B., Pipek, V., Reuter, C. and Wiedenhofer, T. (2012): Supporting Improvisation Work in inter-organizational Crisis Management. In: *Proc. CHI 2012*, Austin, USA: ACM-Press.
12. Ogden C. K. and Richards, I. A. (1923): *The Meaning of Meaning*. New York, Harcourt, Brace & World
13. PDV 100 (1995). *Polizeidienstvorschrift 100*. Landesteil Nordrhein-Westfalen zur PDV 100 „Führung und Einsatz der Polizei“ Teile A-G, RdErl d. Innenministeriums IV C 2 – 1591 vom 31.3.1995.
14. Randall, D.W., Harper, R.H.R. and Rouncefield, M. (2007): *Fieldwork for Design: Theory and Practice*, London: Springer.
15. Reuter, C., Marx, A. and Pipek, V. (2011): Social Software as an Infrastructure for Crisis Management – a Case Study about Current Practice and Potential Usage. *Proc. ISCRAM*. Lisbon, Portugal.
16. Reuter, C., Pipek, V. and Mueller, C. (2009): Computer Supported Collaborative Training in Crisis Communication Management, *Proc. ISCRAM*, Gothenburg.
17. Robinson, A., Roth, R., MacEachren, A. (2010): Challenges for Map Symbol Standardization in Crisis Management. *Proc. ISCRAM*, Seattle.
18. United Nations International Strategy for Disaster Reduction (2009): *Terminology on Disaster Risk Reduction*. <http://www.unisdr.org/we/inform/terminology>
19. Wiedenhofer, T., Reuter, C., Ley, B. and Pipek, V. (2012): Supporting Improvisation in Inter-organizational Situation Assessment. *Proc. ISCRAM*. Vancouver, Canada.
20. Wright, S. E. & Budin, G. (1997): *Handbook of Terminology Management*. Amsterdam: Benjamins.
21. Wucholt, F., Yildirim-Krannig, Y., Mähler, M., Krüger, U. and Beckstein, C. (2011): Cultural Analysis and Formal Standardised Language – a Mass Casualty Incident Perspective. *Proc. ISCRAM*. Lisbon, Portugal.