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Risky language – or a common language for risk communication and process safety?

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Abstract
Risk communication and process safety are fundamental elements of operational safety. Inaccurate communication in these areas can quickly lead to serious safety problems or increased effort in the area of documentation. An established terminology management system and the use of controlled language helps to strengthen safety and keep the effort of documenting and translations to a minimum. In the field of process safety techniques, controlled language helps to formulate states more precisely and to exclude confusion or ambiguity. Many variants of a controlled language like the radio communication in aviation have been established for decades.

Introduction
Risk communication and the correct transfer of the message as well as its understanding is an indispensable component of risk assessment and risk management and is therefore crucial for resulting process safety. [1, p. 1] Communication and the transmission of unambiguous risk and hazard information is an important key element in the safety life cycle. [2]
Although the meanings of hazard communication, risk communication and crisis communication are different in terms of timing and stakeholders, the basic elements and requirements for successful implementation are the same and are not specifically separated herein.
Work safety, food safety, pharmaceutical applications and the process industry are some fields where risk communication is inherently implemented in different ways, but with the same process safety goals.
While the normal working life is mostly influenced but little burdened with discussions between stakeholders, there are special industries such as production or process plants with environmental impact assessments or even the nuclear industry with which there can be a great need for discussion with stakeholders. Clear and unambiguous information and its transfer is an indispensable part for communication and the finding of a consensus.

This communication requires trust and understanding of the other parties involved, in normal operation as well as in the event of deviations from the daily routine. [3] A clear language includes both scientific statements with the comprehensibility of everyday life. Incomprehension of information ends in a lack of trust and consequently in rejection of the communicated demands or measures. [4]–[6]

The different kinds of communication concerning process safety and risk management can be simplified separated in three parts. Care communication, consensus communication and crisis communication. [1, pp. 3–4]

Care communication is the communication about hazards and risks and the management and mitigation of them through science, technology and understanding. Care communication is widely accepted by the stakeholders and applied. Examples are work instruction, standard operation procedures, safety data sheets, maintenance instructions or mandatory given precautions per law. Risk communication of generally accepted risks like smoking, eating too fat foods or too much sweets are special cases of this communication.

Consensus communication is risk communication through groups and different stakeholders. The intent is to inform and encourage stakeholders to work together and find solutions. This is the case, for example, in industrial plant law, where one stakeholder (a company) has a request but another has an objection. The law on industrial plant and equipment and environmental protection with public participation are examples of communication with stakeholders from various professional and educational backgrounds. Preventive accident measures are also integrated here. [1, p. 5]

Crisis communication occurs in the face of imminent danger and requires precise, fast and prudent actions by all those involved without much room for misinterpretations. Instructions must be kept unambiguous and short, but must also be understood. Without an understanding of the measures, they are often disregarded within panic or rejected. [7], [8]

Within this framework risk and hazard communication as well as consensus communication refers to preventive measures. Crisis communication includes corrective measures for affected stakeholders. The legal backgrounds to this are e.g. the Ordinance on Hazardous Incident Information or Emergency Plans.

But regulated communication is not only helpful between stakeholders. It is also a necessity in the definition and description of operational concepts. Data that is generated from a team in one phase in the safety life cycle at one location at a time passes through many intermediaries, for example process safety techniques, and generates further measures from it, which in turn have an iterative effect in system changes, redefinitions, and within different life cycle phases.

A controlled language and clear terminology within companies and between stakeholders can help to strengthen process safety and consensus.

Controlled Language
In the area of conflict between applications and process safety, there is always communication between the parties involved. Clear terminology is a necessary prerequisite for making the design of systems, applications and maintenance safer. Communication between the stakeholders requires a clear, precise "controlled language" and an unambiguous symbolism.

Different fields of activities in science and technology like mathematics, informatics and engineering have this similarity. See following examples.

Example 1: "3+3=6", is a generally understandable mathematical formalism.

Example 2: "if...then...else",
gives a clear instruction in IT.

Example 3: Pump (English), Pumpe (German),
 (Language independent engineering-symbolism).

Language problems and prevented tragedies

Within history, several incidents and disasters were caused by wrong understanding or the misuse of a language. [9], [10] This caused several branches to use kinds of a controlled language for decades.
A controlled language means a simplified language with a controlled vocabulary and rules for building sentences. [11]–[13] An advance is the use of non-ambiguous words. This means one word has one meaning. This is useful for a better understanding and for more efficient and secure machine translation.
Well known examples are the military and civil radio two-way communication. Strict rules enable a purposeful communication.
Like "Roger" which means "Received Order Given, Expect Results" or "Over", when someone stops transmitting.

Methods

This paper is based on extensive literature search of journals, article and books on process safety, risk perception and risk communication, written by renowned scholars on process safety, risk management techniques, crisis and hazard communication. In general about 500 journal articles and books (425:75) were reviewed, whereas about 50 made statements which are incorporated in this article. The selection for this study within this documents was guided by the search for the use of a controlled language or the use of terminology.

The selection was led by the central questions:

- What are the crucial key elements of successful risk communication?
- How can risk assessment and management be made more efficient through better communication?
- Has terminology management and controlled language a positive influence on process safety?
- How to make translations for non-native speakers more efficient and secure?

Results and Discussion - Controlled Language

Instructions, manuals and maintenance manuals often were the source of misinterpretations and mistakes in different branches of our daily and the industrial life, partly with fatal consequences.
Starting in the 1970ies, the use of a controlled language for this and other purposes in relevant, dangerous and safety critical applications was suggested. [14] The first approaches were within the military and aviation fields. Later the automotive industry, the medicine and the pharmaceutical industry as the food processing industry joined the use of a controlled language.

Today, many companies and organisations like Airbus [15], Scania [16], Microsoft [17], Volkswagen [18], Caterpillar [19], Nortel, Bull, etc. [20, p. 23] use a controlled language.

Especially the ASD-STE 100 should be highlighted. [21] It is a controlled language, developed in the 1970ies by the Association of European Airlines to investigate the readability and understandability of maintenance documentation and find a solution to simplify the language used in these documents. [21, p. i]

Although English is worldwide one of the most important languages, controlled languages or easy languages are available in different languages.

- Leichte Sprache (Easy Language in German) [22], [23]
- Spell Checkers for „easy languages“ in different languages. [24]

Understanding = the first step to safety!

A controlled language can also be found within other safety relevant branches or areas like machine safety, where a clear wording indicates a clear and increasing level of danger to health and life like the controlled words: "Caution < Warning < Danger". [25]

In chemistry, the P & H statements are in common use. They are part of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The P - Precautionary statements give advice about the correct handling of chemical substances and mixtures. The H - Hazard statements form a set of standardized phrases about the hazards. The code like e.g. "H320" stands for "Causes eye irritation". With the help of the P & H statements, safety instructions can be attached briefly and without language barriers. The code can be decoded with the help of standardized tables in various languages.

Controlled Language in Risk Assessment

Risk identification, assessment and mitigation often are the last frontiers against incidents or accidents. So why don't we use a controlled language for this purpose yet?
Risk management needs a clear definition of a system, a process or an application to describe possible problems, deviations and barriers! [26]–[29]
Defining parts and systems for safety or safety related functions need clear definitions for functionality. [30] And a controlled language provides this.
The HAZOP (Hazard and Operability Analysis) as an example, aims in the direction of a limited controlled language by providing a set vocabulary for possible deviations within a process. [31]
With a controlled language and clear terminology, it is also easier, safer and more efficient to manage the iterative feedback loop of changes in the documentation, which is shown in figure 1. Clear descriptions help to implement changes clearly. This has an effect on all levels of the documentation that finally promote process safety, if correct understood and applied. On the one hand through clarity, on the other hand, for example, by saving work with regard to inquiries in case of ambiguities.

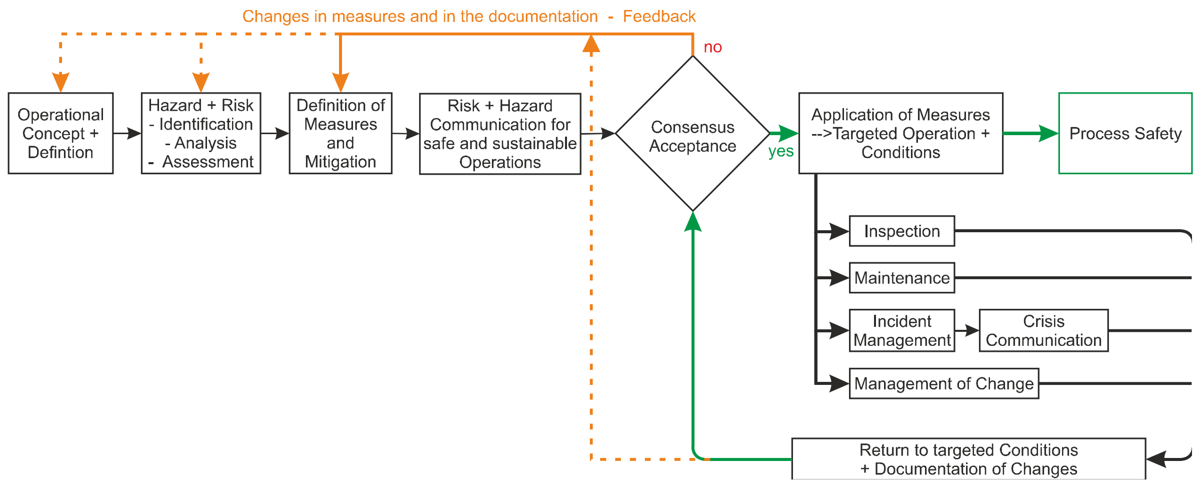

Figure 1: Risk and Hazard Communication and Documentation - Feedback Loop

Rules for a controlled language

After studying a set of well-known and proven rules, Crabbe summed up some rules and proposed them as the structured basis for a controlled language. [20, pp. 91–92]

Some examples on the rules are:

- *Use only words that are part of the controlled language.*
- *Use only the approved spellings.*
- *Do not add new words to the controlled vocabulary unnecessarily.*
- *Avoid using abbreviations and contractions unless they are part of the controlled language.*
- *Limit word strings to no more than three nouns or adjectives.*
- *Use the active voice wherever possible.*
- *Use the imperative mood in sentences containing instructions.*
- *Use positively worded sentences wherever possible.*
- *Use negatively worded sentences wherever possible in cautions and warnings to draw attention to their content.*
- *Limit each sentence to one instruction.*
- … [20, pp. 91–92]

Examples for the use are:

- Bad: The cables must not be kinked.
  Good: Do not make kinks in the cables.

- Bad: Mark the component with a code that will ensure its correct assembly.
  Good: Identify the component with a code to help you to install it again correctly.

Conclusion

Within literature and the industry, there is a strong agreement, that controlled languages and terminology management help us to make information more understandable and that language barriers will decrease. Experiences from industries show that controlled languages make work safer and translations into other languages more simple, secure and cost effective. [19], [32], [33]

The use of a controlled language is a win-win situation for all involved native and non-native speaking users and stakeholders. It improves communication and understanding between the parties involved. [34]

Nevertheless it should be said, that the implementation could lead to more costs within the first phase, because the controlled dictionary, and the terminology have to be established and further people have to be trained and the rules and restrictions have to be applied. Like in all applications, a proper training and repetition is an indispensable part in the implementation of terminology and a controlled language for more safety. [35], [36]

In existing documents a lot of work has to be done, before it leads to quality improvement and better understanding. The change process in the documentation starts from top and multiplies in effort to the bottom. But this argument is not generally accepted. Some argue it is not difficult to use controlled languages and the benefit is much higher than the effort. [37]

It should be suggested that the controlled language is increasingly used in the area of process safety and its risk-management techniques. The input of these techniques, which are often the last barriers in the safety or loss prevention structure, must not be ambiguous or incomprehensible. Process safety requires a precise terminological framework.

Dealing with external stakeholders requires clear language rules, which must be clear and trustworthy. Incomprehension fosters mistrust and furthermore a lack of a tendency towards acceptance and consensus. [1], [3]

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