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Safety regulations: Implications of the new risk perspectives

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ABSTRACT

The current safety regulations for industrial activities are to a large extent functionally oriented and risk-based (informed), expressing what to achieve rather than the means and solutions needed. They are founded on a probability-based perspective on risk, with the use of risk assessment, risk acceptance criteria and tolerability limits. In recent years several risk researchers have argued for the adoption of some new types of risk perspectives which highlight uncertainties rather than probabilities in the way risk is defined, the point being to better reflect the knowledge, and lack of knowledge, dimension of risk. The Norwegian Petroleum Safety Authority has recently implemented such a perspective. The new ISO standard 31000 is based on a similar thinking. In this paper we discuss the implications of these perspectives on safety regulation, using the oil & gas and nuclear industries as illustrations. Several suggestions for how to develop the current safety regulations in line with the ideas of the new risk perspectives are outlined, including some related to the use of risk acceptance criteria (tolerability limits). We also point to potential obstacles and incentives that the larger societal and institutional setting may impose on industry as regards the adoption of the new risk perspectives.

1. Introduction

To govern risk related to industrial activities there is a need for a balance between control/command on the one hand and self-regulation on the other. Studies on regulation have shown that over the last three decades there has been a gradual shift from a command and control type of regulation towards a co-regulation one that is based on industries' self-regulations that are supervised by the regulatory bodies [9]. The co-regulation entails blurring the boundaries between private and public regulation, which means that self-regulation may be more or less governmentally constrained [11,12]. In any case, co-regulation places a clear responsibility for the activities on the industry, and in this sense it stimulates the industry to find new and better solutions, seen from a cost-effectiveness perspective. At the same time, some safety functions are simply considered too critical to be subject to optimisation and analysis, and therefore some prescriptive detailed requirements for specific solutions still constitute an important pillar of the regulations.

The co-regulation approach relies strongly on risk-based thinking. The issue is to what extent the solutions and measures are meeting the overall goals and criteria specified, and how improvements can be most effectively obtained. Risk assessment and risk management are central tools for this purpose.

The foundation for the way these tools are used in industry today was to a large extent developed in the 70s and 80s. The risk assessment and management fields have developed considerably in recent years, but current industry practice, when it comes to for example the way to conduct and use risk assessments, has not changed much. Now, in the wake of the Macondo accident in the Gulf of Mexico in 2010 and the Fukushima Daiichi nuclear disaster in Japan in March 2011, we have seen a renewed interest in the foundation of these fields – there is an increasing understanding of the need to scrutinise and improve current thinking and methods.

Several researchers have called for such a development (see e.g. [8,14]). They have pointed to weaknesses in current practices and argued for the adoption of some new types of risk perspectives, providing alternative ideas about the risk concept, its measurement and how to manage risk. A key point in these perspectives is the stronger weight given to the knowledge and surprise dimensions compared to current thinking. The Petroleum Safety Authority Norway (PSA-N) has recently implemented such a perspective for the oil and gas industry in Norway. The new ISO standard 31000 is based on a similar thinking. These perspectives are explained in more detail in the Appendix A.

The natural and important questions then to ask are: what are the implications of these perspectives on safety regulation? What changes does the regulator need to implement to be in line with them, and how should the industry adapt to these? What could be

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possible obstacles or incentives to adopting these perspectives in practice?

The present paper discusses these questions, the aim being to provide improved insights about the main implications of the new risk perspectives on the risk regulations. Moreover, the purpose is to present some suggestions on how to best change current regulations to match these perspectives, as well as to reflect potential obstacles and incentives that the larger societal and institutional setting may impose on industry as regards adoption of the new risk perspectives. The oil & gas and nuclear industries are used as illustrations.

We build on a huge literature on risk management and risk regulation that have provided insights and clarity on issues relevant for the current discussion. We will draw attention to for example Paté [26] who highlights the difference between acceptable risk and acceptable decision processes, and Apostolakis [2] who stresses the importance of seeing the safety work being risk-informed rather than risk-based.

In the discussion we draw on risk assessment and management frameworks as well as the institutional perspective on safety regulation that provides insights into larger societal and organisational settings, which may contribute to or constrain the adoption of new thinking (see e.g. [13]). By *contributive* aspects or factors we mean for example major accidents and related public concern, which may increase the interest in learning; or successful organisations, which serve as good examples for others to imitate their strategies and structures; or proximity between industry and risk management expertise that provides adequate interaction, resources and knowledge for learning. *Constraining* factors entail lack of resources, or a situation where the company is located in several countries with their own specific laws and regulations that limit the adoption of similar perspectives; or existing expertise and strong understanding of right ways to deal with risk and safety that prevent the adoption of new ideas. Understanding these factors is important, because safety regulation is influenced both by risk perspectives and by larger organisational and societal conditions.

The paper is organised as follows. Firstly, we perform a brief overall review and discussion of the current status and development trends seen in the oil and gas industry (Section 2) and the nuclear industry (Section 3). Reflections are made on the implications of the new risk perspectives. Then in Section 4 we broaden out the discussion and address, on a more general basis, some of the key issues raised in Sections 2 and 3. This section also covers the announced suggestions for how to change the regulations. Finally, Section 5 provides some conclusions.

2. The oil and gas industry

Risk-based thinking, with a risk reduction focus (including As Low As Reasonably Practicable (ALARP) considerations), and the use of risk assessments and risk acceptance criteria, have been adopted for offshore activities on the Norwegian Continental Shelf for nearly 30 years. The overall principles are to a large extent in line with the standard principle of risk assessment and management as we find them described in, for example, ISO 31000 [18].

According to the regulations relating to management in the petroleum activities, the operator shall formulate acceptance criteria relating to major accidents and to the environment. The acceptance criteria shall be used for the evaluation of results from the various Quantitative Risk Assessments (QRAs) and shall be addressed for

1. personnel on the installation as a whole, and for personnel groups that are particularly exposed to risk
2. loss of main safety functions
3. pollution from the installation.

In order to fulfil the requirements and acceptance criteria for major accidents, the NORSOK Z-013 standard is recommended [24]. Some examples of typical risk acceptance criteria are:

1. The FAR value should be less than 10 for all personnel on the installation, where the FAR value is defined as the expected number of fatalities per 100 million exposed hours.
2. The probability that a specific safety function shall be impaired in a one-year period shall not exceed 1×10^{-4}.

The main characteristic of the Norwegian system, as we have seen in the last 20 years, has been a relatively 'mechanistic' approach to risk analysis and evaluation, implying that the focus is often limited to satisfying the risk acceptance limits, usually with no or small margins [4]. In this system the operator needs to demonstrate to the authorities that the limits have been met; this is often achieved by referencing the risk results, and the authority involvement is typically rather superficial.

Formally speaking, the Norwegian legislation has the required encouragement for further risk reduction; within the regulations there is also a requirement for an ALARP evaluation of risk, in addition to the use of risk acceptance criteria. For many years, however, this has been more a formality than reality. The ALARP evaluation has also usually been carried out with a mechanistic approach. Very often, this process implies that possible improvements are identified, but immediately disregarded, based on a cost-benefit (cost-effectiveness) analysis. This analysis has often been perfunctory or very coarse [4].

There has been some discussion about the suitability of the current practice and for example the use of risk acceptance criteria to assess and control risks (see e.g. [4,20]). The use of risk acceptance criteria is intuitively appealing, but a closer look reveals several problems, of which the following two are the most important:

1. The introduction of pre-determined criteria may give the wrong focus – meeting these criteria rather than obtaining overall good and cost-effective solutions and measures.
2. The risk analyses – the tools used to check whether the criteria are met – do not in general have a sufficient precision level for such a mechanical use of criteria.

Item 1 is clearly demonstrated for environmental risk. Risk acceptance criteria have been required by Norwegian authorities for many years, but such criteria have almost never led to improvement from an environmental point of view. Acceptability of operations with respect to environmental risk has been decided based upon a political process, and after this process, risk acceptance is not an issue and risk acceptance criteria do not have an important role to play [4].

The risk acceptance criteria are to be understood as minimum safety requirements. And there is no reason why the operators should define ambitious limits, as, if the limits are not met, measures need to be implemented regardless of costs. Suppose that the operator considers two alternatives: a weak limit, say, $1 \cdot 10^{-3}$, and a strong limit, say, $1 \cdot 10^{-4}$. What limit should it choose? The answer would be the weak limit, as the strong limit could mean lack of flexibility in choosing the overall best solution. If the benefits are sufficiently large, the level $1 \cdot 10^{-3}$ could be acceptable. Following this line of argument, the use of such limits leads to the formulation of weak limits, which are met in most situations. Risk analysis is then used to verify that the risk is acceptable