

Risk criteria in occupational environments: critical overview and discussion

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Abstract

The current work can be seen as a starting point for the discussion of the problematic on risk acceptance criteria in occupational environments. Some obstacles to the quantitative acceptance criteria formulation and use were analyzed. A look to the long tradition of major hazards accidents was also performed. This work shows that organizations can have several difficulties in acceptance criteria formulation and that the use of pre-defined acceptance criteria in risk assessment methodologies can be inadequate in some cases. It is urgent to define guidelines that can help organizations in the formulation of risk acceptance criteria for occupational environments.

Keywords: Acceptance, accident, decision, occupational, risk;

1. Introduction

Safety is nowadays one of the key items in the overall management process in any organization. Employers need to ensure low-risk levels at all workplaces, preventing the occurrence of occupational related accidents and diseases. Thus, each organization should reduce and manage their risks in order to provide adequate working conditions for all employees. However, safety has a cost and it is impossible for organizations to spend an unlimited budget to reduce risks to very low levels or even eliminate it, whenever possible. Consequently, a certain level of risk has to remain and be assumed. In this context, all organizations have to deal with a question linked to this issue, “What is the level of risk that can remain?” or paraphrasing the old question of Fischhoff *et al.* (1978), “How safe is safe enough?”

Companies need constantly to take decisions about risk, in order to decide if a certain risk level is low enough or if some risk reduction measures are need to be applied in order to take risk acceptable. In this respect, risk assessment can serve as a basis for a rational decision-making about risks, allowing as the evaluation and classification of a risk situation as acceptable or unacceptable. This presents itself as a complex process and needs to be developed rigorously. Consequently, and in order to facilitate its development, it is currently possible to verify

the availability of a broad range of supporting tools (Nunes, 2006). However, it is important to recognize that some issues can be a problem to the risk assessment process and are not only related with the objectivity of the analysis and the data used. Also the appropriateness of the criteria considered to support risk decisions is a problematic question.

Acceptance criteria are terms of reference by which the significance of risk is assessed (ISO 73:2002). In this context, the level of safety to be guaranteed by the companies can be dependent of the criteria used by them. Therefore, it is essential the integration of suitable acceptance criteria in the risk assessment process, avoiding the use of unsuitable criteria.

For major hazards, the problematic of acceptance criteria has been broadly discussed and some guidelines and recommendations are established (Ale, 2005; Hartford, 2009; Vinnem, 2010). However, for occupational settings these discussions are scarce, and there are no effective guidelines or recommendations given by authorities or other institutions that help companies in deciding which quantitative risk acceptance criteria they need to use. Therefore, it is not known how companies support their risk decisions, particularly how they define the acceptance criteria to be used, or even if they use them. The organization can formulate the acceptance criteria by themselves. However, the acceptance criteria formulation is not an easy task. Many factors need to be taken into account (Kjellén & Sklet, 1995; ISO 31000:2009) and can have influence on its formulation. Moreover, occupational risk decisions can also be supported on pre-defined criteria included on risk assessment methodologies. However, these criteria may not be suitable for all occupational realities. Other acceptance criteria can also be used, as the criteria proposed by some organizations but, for occupational settings, these types of criteria are scarce. This problematic is highlighted by the great diversity of occupational environments, due to its particularities, as well as, due to differences on safety culture, production processes and main risks. It seems to be not fair to require companies with different features to meet the same acceptance criteria. For example, the criteria applied to a construction company could not be the same criteria for a services company, or even use the criteria proposed for major hazards in a lower hazard manufacturing companies, where fatal accidents are not the major problem and its occurrence may be unacceptable regardless of their likelihood. Besides, at the same industrial sector, companies presents different characteristics, which can have influence on its safety performance, and consequently, on the decision-making process. Thus, it has been argued that risk acceptance criteria cannot be defined absolutely, i.e., they need to be dependent of the context where they will be used. For example, HSE (2001), referring to their own criteria, “these criteria are merely guidelines to be interpreted with common-sense and are not intended to be rigid benchmarks to be complied with in all circumstances”.

These issues make the acceptance criteria in occupational environments a critical question, frequently overlooked in the literature. Therefore, in order to improve the risk assessment process and optimize the risk decisions, it is essential to make such criteria as tangible as possible, in order to reduce the subjectivity inherent to the decision process, and appropriate to each occupational reality. In this context, and in order to give some further development to this issue, the current work presents a discussion on the problematic on risk acceptance criteria in occupational environments.

2. Risk decision in occupational environments

For occupational accidents, the risk decisions can be usually supported on different approaches. Decision-makers frequently can choose from different types of risk assessments, or directly classify each identified hazard (Harms-Ringdahl, 2001). In general, risk assessment processes can be classified in three different types: qualitative, semi-quantitative and quantitative. Each of these types presents a different precision of analysis and different data requirements. Consequently, the use of a different risk assessment type can result into different risk decisions, where in qualitative assessment decision-makers are looking for a decision that is good enough and in quantitative risk assessment for an optimal decision. Accordingly, the quantitative risk assessment is the more accurate analysis. However, in some cases, they are difficult to be applied, particularly in companies where the data available are not sufficient. For these companies the use of a semi-quantitative risk assessment may be sufficient (Woodruf, 2005). In this approach, instead of determine an absolute value of risk, it is established whether the risk is likely to fall within

an intolerable, tolerable or acceptable risk zone (Woodruff, 2005). The qualitative risk assessment can also be used, however, when used alone can provide insufficient data to support a risk decision (Pasman *et al.*, 2009), and decisions are based on personal judgments (Hughes & Ferret, 2007).

In addition to the type of assessment and its accuracy, the acceptance criteria used in the risk assessment process have also influence on the risk decisions. Here, different realities can be found in occupational environments. In qualitative risk assessment, the use of qualitative criteria is important because, given its qualitative nature, they require that the criteria for risk acceptance be also qualitative (Teixeira & Soares, 2007). They can be usually based on rules, laws, regulations or guidelines that provide a set of criteria that should be met (Harms-Ringdahl, 2001; Hopkins, 2011), but also qualitative risk matrices can be framed in this group and usually allows the risk classification as high, medium or low (Hughes & Ferret, 2007). In turn, semi-quantitative and quantitative risk assessments frequently require the use of quantitative acceptance criteria. For semi-quantitative risk assessments it is possible to find risk assessment methodologies that already include pre-defined acceptance criteria (see e.g. Woodruff, 2005). These criteria usually are the same in any different reality where these methodologies can be applied. However, organizations can also develop their risk matrix, with criteria defined by themselves (see e.g. Jacinto & Silva, 2010). On the other hand, for the quantitative risk assessment in occupational environments, the criteria are not usually defined by the methodologies applied and the legislation makes no mention about this issue. Organizations need to define their own acceptance criteria or use the criteria defined by other organizations/institutions.

3. Obstacles to the acceptance criteria formulation and use

As previously described, the acceptance criteria are an important issue to the risk assessment process in order to support risk decisions. These criteria are terms of reference by which the significance of risk is assessed (ISO 73:2002), often presented in terms of risk limits, being the basis for assessment on the need for risk reducing measures. However, companies are confronted with some problems associated with this issue, particularly related with quantitative acceptance criteria, which is the scope of this work.

Semi-quantitative risk assessment methodologies present frequently pre-defined acceptance criteria. However, the pre-defined criteria included in these methodologies may not be always the most appropriate to all situations, furthermore some methods of risk assessment may use unclear or ambiguous criteria (Marszal, 2001), jeopardizing their appropriateness. For example, Woodruff (2005) proposed a semi-quantitative risk estimation methodology to apply in lower hazard industrial and commercial sectors, where the acceptance criteria included for deaths are the proposed by HSE (2001) and for injuries defined by the author. This is an interesting work, where the criteria included are well explained. However, it is important to note that the criteria used for deaths in this method are frequently related with major hazards (see e.g. Ale, 2005; Hartford, 2009). For lower risk sectors, they may not be adequate. For example, the upper limit proposed by HSE (2001) and included in Woodruff's work for individual risks is 1 fatality in 1 000 persons per annum and the lower limit 1 in 1 000 000 per annum. Can these criteria be suitable to be applied in lower hazard sectors? Exemplifying with the case of the wood furniture sector in Portugal, which in 2010 employed approximately 32 000 persons (Eurostat, 2012), this would mean that, in this sector, it is tolerable less than 32 deaths per year and, it is broadly acceptable, less than 1 death in approximately 31 years. Is that so certain? Perhaps these criteria are not suitable for this sector and so more stringent criteria need to be applied.

Companies can also use the criteria defined by some organizations/institutions. However, specific criteria for the different occupational settings were not found. Thus, the same problem comes up, "Are the criteria defined by organizations/institutions suitable to be applied in different contexts?"

Finally, companies can define their own acceptance criteria. Considering the lack of any risk target for occupational accidents defined in the legislation and the scarcity of effective guidelines, companies should define the acceptance criteria. In this scenario, they have adopted internal standards, which are a performance-based rather than prescriptive-based approach (Cameron & Raman, 2005). Thus, the risk levels obtained are compared with the criteria previously defined. However, different issues need to be taking into account on its formulation: the nature, the likelihood and the consequences of risks, as well as the type of databases, the measures for risk analysis and the

available methods for risk assessment, the regulatory requirements, norms and the company's own experiences and the value systems (Kjellén & Sklet, 1995; ISO 31000:2009). However, it is also important to take in mind that some important factors can have influence on risk acceptance criteria definition, in particular factors related to the context and factors associated with stakeholders. Rodrigues *et al.* (2012) identify some factors that can have directly or indirectly influences on risk acceptance, particularly in the acceptance criteria formulation. These factors were grouped in organizational and individual factors. Individual factors, included risk perception, benefit perception, emotions, trust and, ethic, values and moral. Organizational factors comprised safety culture and work flexibility. These factors can lead to several discrepancies in the acceptance criteria defined among the different companies, and consequently to different decisions about risk.

Other problem related with acceptance criteria for occupational accidents is associated with the measures used to assess risk. The quantitative acceptance criteria are based on risk measures (metrics). Kjellén & Sklet (1995) discuss the application of risk assessments in conjunction with risk acceptance criteria based on measures of risk. According to the authors, the output of risk assessment and the acceptance criterion shall express the risk on the same scale of the measurement. However, different decision-makers can support their acceptance decisions on different risk assessment methodologies, which use different risk measures. Consequently, they need to use different acceptance criteria. Therefore, it is difficult for similar companies to use the same acceptance criteria.

4. Major hazard experience

Major hazards facilities present a long tradition in relation to the risk acceptance criteria. Legislation of different countries, as Norway, United Kingdom and The Netherlands, presents the risk decision process as being well established for some major hazardous facilities (Ale, 2005; Hartford, 2009; Vinnem, 2010). However, the legislation shows obvious differences among them, particularly in relation to the risk acceptance criteria. In this context, Ale (2005) discusses the difference between risk regulation in the UK and in The Netherlands. In both, authorities propose quantitative risk criteria. However, they differ in the numerical limits and in their interpretation. On the other hand, in Norway a different approach is used. In this country, the risk acceptance criteria are a responsibility of each company, with the absence of any guidelines given by the authorities to assist them in the risk acceptance criteria definition (Vinnem, 2010). Thus, in Norway it is the company itself that decides how the acceptance criteria should be defined, assuming the responsibility for the risk (Vatn, 1998).

The differences into European risk legislation related with major hazards has promoted a vast discussion concerned to the use of acceptance criteria, as well as, related to the different approaches used in distinct countries and interventions areas. Some works show that, while some authors argue for the use of quantitative acceptance criteria and its regulation in certain situations (Seiler, 2002; Vinnem, 2010), others do not, particularly in some specific areas (Aven & Kristensen, 2005; Aven & Vinnem, 2005; Aven *et al.*, 2006; Abrahamsen & Aven, 2008). According to Vinnem (2010), these differences in discussions and approaches about the use of risk acceptance criteria, particularly between the offshore and onshore Norwegian industries, are possibly related with the differences in the authority influence (authorities do not take a proactive approach to control the onshore companies), the legislation of the country and the maturity of companies. The same author verified that in some cases companies are not able to formulate the acceptance criteria by themselves, being its regulation important.

According to the major accidents experience, for sectors where companies present less maturity in the risk management process, the authority intervention in the acceptance criteria maybe important. However, when a large distance between the companies and the authority subsist, it is important to have the government intervention. In occupational settings, particularly in activity sectors that include a great number of small and medium size enterprises (SMEs) this can be a reality. So, some guidelines are important, which can provide some criteria or a framework that helps in the acceptance criteria formulation according the companies' needs.

5. Final remarks

This paper was really brought up to discuss the problematic of quantitative risk acceptance criteria in occupational settings. Notwithstanding to some actual obstacles to the acceptance criteria formulation, its use provides valuable insights for risk decisions, being its correct formulation and use important. In this context, this work was based on the premise that when a quantitative definition of risk is determined and then compared with the acceptance criteria, we are facing with an unambiguous way of making the decision.

In general, this work shows that risk acceptance criteria in occupational environments are a challenging issue. Companies are faced with a lack of guidelines defining the criteria or helping in the acceptance criteria for occupational accidents. Therefore, it seems that the responsibility for formulating these criteria falls into the companies. This situation, associated with the different measures that can be used and the variables that influence the risk acceptance, can lead to the use of unsuitable acceptance criteria, as well as, to a lack of a homogenization in relation to the measures and the criteria used among companies. This situation can conduct to different decisions about risk control and prevention, which in some cases can be inadequate, putting in question the companies' safety or leading them to spend resources improperly. So, it is urgent to define guidelines that help organizations in the risk acceptance criteria formulation for occupational environments, according to their needs and specificities. It seems also important to enhance the knowledge on the influence of some variables in risk acceptance, in order to improve the process and to help in the formulation of the guideline.

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