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The resilience engineering concept in enterprises with and without occupational safety and health management systems

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ABSTRACT

In this study, I examine whether the resilience engineering concept is related to the implementation of occupational safety and health management systems (OSH MSs) and to safety levels in Polish enterprises of different sizes and activities. A relative risk category was applied to the surveyed enterprises to allow for comparability among enterprises representing different hazards resulting from different types of activities and employment levels. The results showed that there is no relationship between the presence of OSH MSs and either the safety level or the level of the resilience concept. However, statistically significant differences were observed between enterprises in the extremely high-risk category and enterprises in the other risk categories.

1. Introduction

Despite the implementation of many occupational safety and health (OSH) management practices, accidents at work still occur. From one perspective, this seems natural, as accidents are inherent to any activity, and comprehensive control of all of the hazards that may exist in any given organisation is impossible. From another perspective, the ineffectiveness of OSH management programmes and practices, including OSH management systems (MSs) applied in these enterprises, may be to blame. Despite many years of research on OSH management performance, there is still no conclusive evidence of effectiveness of OSH management systems (e.g., Podgórski, 2015). There are, of course, reports on strong correlation of their implementation with OSH indicators (e.g., Yoon et al., 2013). On the other hand, such reports as presented by Robson et al. (2007) or Thomas (2012) show that whether there are no strong statistical proves of such correlation or, at least, there is no agreement which elements of systems really influence the safety level. Many practitioners find management systems to be ineffective due to their high level of formalisation and rigidity, which makes them unable to respond to emerging and unexpected challenges and risks. Moreover, traditional OSH management consists of a posteriori improvement activities based on accident analysis and occupational risk assessment. Corrective measures, which are often implemented on a small scale, usually result from an increasing trend in total or fatal accident rates. A traditional safety approach is therefore understood as freedom from unexpected events, whereas an accident is identified as a result of systemic dysfunction based on an analysis of work-related accident causes and circumstances (From Safety – I to Safety – II, 2013). Accordingly, the approach is reactive. There is no doubt that this approach has helped to reduce the number of accidents at work.

In light of the above, the concept of resilience engineering – which is understood as a process that encompasses organisational learning, adaptation to changing environments, improvement and risk anticipation – has been believed to be an efficient approach to organisational change management that ensures business continuity in changing and uncertain settings (e.g., Norris et al., 2008; Bahadur et al., 2010). The concept of resilience engineering assumes a perception of safety not only through system dysfunctions and their consequences but also through success factors that have contributed to avoiding accidents or other adverse events. Contrary to the traditional approach of focusing on "what went wrong", resilience engineering recognises that the "things that go right" are just as important as the "things that go wrong" and considers variability in performance as normal, not as a threat (Hollnagel, 2011a).

Such an approach allows for the identification of factors that contribute to system resilience. Business continuity constitutes the essence of the resilience engineering concept, which consists of organisational learning from both mistakes and successes,

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permanent monitoring of the OSH in an enterprise, and immediate responses to or even the anticipation of future events as a result of the enterprise's operations.

Within the concept of resilience engineering, there are numerous definitions of resilience. For example, Hollnagel defines resilience as the "ability of a system or an organisation to react and recover from disturbances at an early stage, with minimal effects on dynamic stability" (Hollnagel, 2006, p.16), whereas (Leveson et al. (2006), p.95) describe resilience as "the ability of systems to prevent or adapt to changing conditions in order to maintain (control over) system property." In general, the majority of the definitions describe resilience as "an ability" "to react/adapt" to address changes/obstacles. Lately, some efforts were made to make definitions of resilience more operationalised and societal. For example, Becker et al. (2014, p.7) define resilience as "emergent property determined by society's ability to anticipate, recognise, adapt and learn from variations, changes, disturbances, disruptions and disasters that may cause harm to what human beings value".

The fundamental idea behind resilience engineering is that resilience can be defined by so-called cornerstones, including responding (knowing what to do), monitoring (knowing what to look for), anticipating (knowing what to expect) and learning (knowing what has happened) (Hollnagel, 2011a). Responding requires preparedness, which is based on anticipation and includes both readiness to address actual problems and building and maintaining readiness itself. According to Paries, responding cannot be reduced to anticipation, as the important component of responding is that the events that happen cannot be anticipated in every detail; thus, "resilience implies a combination of readiness and creativity, and of anticipation and serendipity" (Pariès, 2011, p.6). Monitoring, which is understood as observing what is or what can become a threat through predefined indicators, should take into account the importance of proactivity and the anticipation of important changes in the environment (Podgórski, 2015; Zwetsloot, 2013). Such an approach implies a need for more information than can be garnered from just outputs (Wreathall, 2011). Anticipating is "knowing what to expect, that is, how to anticipate developments, threats, and opportunities further into the future, such as potential changes, disruptions, pressures, and their consequences" (Hollnagel, 2011a, p.xxxvii). Woods proposes six patterns of anticipation in resilient systems and states that resilient systems are able to recognise when adaptive capacity is falling and buffers or reserves are becoming exhausted. In addition, resilient systems must also be capable of recognising when to shift priorities across goal trade-offs, when to make perspective shifts and contrast diverse perspectives, when to navigate changing interdependencies across roles, activities, levels and goals and when to recognise the need to learn new methods of adaptation (Woods, 2011).

Learning in the resilience engineering concept is understood as learning from both failures and successes. Hollnagel (2011a) considers learning only from failures as ineffective because accidents and obviously catastrophes happen so rarely and are so different from each other that they do not provide good conditions for learning.

Resilience itself is generally considered to be difficult or impossible to measure directly. As resilience engineering theory is based on the four cornerstones, it implies that the cornerstones shall be measured and, as all four cornerstones are necessary for a system to be resilient, the level of overall resilience cannot be satisfactory without achieving satisfactory levels for every cornerstone. Some tools based on this concept have been prepared (e.g., the Resilience Analysis Grid by Hollnagel (2011b) and the Stress–Strain Model by Woods and Wreathall (2008)). However, they are references rather than ready-made tools for use in every organisation. There are numerous research on measuring the resilience. For example, Shirali et al. (2012, 2015) present methods of evaluating the resilience (and its deficiencies) with use of the list of predefined indicators measuring "potential for resilience" based on, but not limited to interviews with staff and analysing the existing documents. Dinh et al. (2012) proposed evaluating the resilience basing on six "resilience principles". Ferreira et al. (2011) presented a questionnaire based on concepts linked with resilience. Different approach was used by Saurin and Junior (2012), who focused on "sources of resilience" and corresponding "sources of brittleness".

The concept of resilience is sometimes considered to be a revolution in management, and resilience engineering is seen as a solution to the lack of effectiveness of traditional approaches to occupational health and safety. However, resilience has its critics. The first problem is its definition. The word "resilience" is used in a wide range of scientific fields with slightly different meanings, and there is no consensus on what exactly the word means, even within some fields. Clearly, some of the problems result from the widespread use of the term (Alexander, 2013, p.13) and a lack of consistency and scientific rigor in such use (Luthar et al., 2000).

In studies on organisation and management, the definitions of resilience are quite consistent and similar. However, they are very broad and leave a wide range of interpretation as to what they really mean. Even some specialists, including KPMG (2007) and TISN (2007) practitioners, admit that resilience is difficult to define. Among the important gaps and limitations, researchers list a lack of attention to the social context and to both the national and organisational culture (Lewis et al., 2011; Bracco et al., 2013) and the need for a multidimensional approach (Kamphuis and Delahaij, 2013; Luthar et al., 2000). The difficulty in measuring resilience also remains a weak point in resilience theory.

Resilience engineering itself has been criticised for its broad, unclear definitions and the use of metaphors as explanatory principles (McDonald, 2006). However, widely formulated definitions allow easy associations between both resilience and resilience engineering to other approaches and OSH concepts such as, e.g., high-reliability organisations (Gallis and Zwetsloot, 2014). Thus, the concept of resilience engineering is flexible and easily translatable to other concepts. This easy association with other concepts raises the question of whether and to what extent resilience engineering is a new, revolutionary idea or is simply the previous concepts stated in new words. According to Eric Hollnagel, "resilience engineering differs more in the perspective it provides on safety than in the methods and practical approaches that are used to address real-life problems" (Hollnagel et al., 2008, p.9).

In the light of the above there is a question of whether the resilience engineering concept is a new approach to OSH management or rather its novelty consists only in new nomenclature relating to the OSH management systems that are already functioning in enterprises. In addressing this question, research was conducted in which it was assumed that enterprises with an implemented OSH management system had a significantly high level of characteristics favourable to the idea of the implementation of the resilience engineering concept into the set of the enterprises' practices.

2. Methods

2.1. Survey questionnaire

The survey questionnaire developed for this study consisted of two main parts. The first part was directed towards the employees involved in OSH functions; its purpose was to collect objective information on the OSH levels in the enterprise for three consecutive years, from 2011 to 2013. Respondents were particularly asked to provide the following information:

- total number of accidents at work (including all injury incidents despite they result in absenteeism or not);