RISKS IN INDUSTRIAL MANAGEMENT SYSTEMS

LUBOS KOTEK[1], ALES NOSEK[2], ALOIS FIALA[1], VOJTECH BARTOS[3]

[1]Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic

[2]Brno University of Technology, Quality Management Department, Brno, Czech Republic

[3]Brno University of Technology, Faculty of Business and Management, Brno, Czech Republic

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e-mail: kotek.l@fme.vutbr.cz

This paper focuses on the evaluation of the approach to risk management in management systems in technical industries. The underlying framework is the updated standard ISO 9001 which is compared to the requirements of specific standards for the automotive industry, the aviation industry, the railway industry and the chemical and processing industries that fall under major accident prevention (SEVESO). This article aims to compare the requirements of these management systems for individual areas from the perspective of systemic risk prevention.

KEYWORDS

management systems, risk management, system comparison

1 INTRODUCTION

Industrial production is an important element of economic growth but it is also accompanied by negative aspects in the form of threats to life and health of employees, customers, environmental damage as well as the consequences of serious accidents and incidents in which human life can be lost and property and the environment can be damaged. It is a sort of "tax for progress" which is inevitable today, but it is necessary to minimise the negative effects of industrial production through hazard identification, risk analysis and the introduction of various safety measures, e.g. technological, material and organisational. An important aspect is the implementation of management systems that ensure a systematic approach in this area. Some of these systems are mandatory and apply to all companies operating in the relevant industry and meeting the established criteria. Some are optional and their implementation and maintenance only provide a competitive advantage. [Ivanova 2014] This paper analyses four frequently used industrial management systems which are compared with the new standard ISO 9001:2015.

As understood by this article, a management system following a specific standard is reduced to a set of individual requirements which must be fulfilled in order to be able to declare the company system conforming to the requirements of the standard. Therefore, we compared the requirements of individual selected standards and analysed their topics according to the methodology that was used in the standard entitled Self-Audit Handbook for SMEs. [Kotek 2014]

2 DESCRIPTION OF SELECTED MANAGEMENT SYSTEMS

2.1 Quality Management System According to ISO 9001:2015

The ISO 9001 standard specifies requirements for a quality management system that organisations can use for internal application, certification or for contractual purposes with suppliers and customers. It is used in certification for an independent assessment of an organisation's ability to meet the requirements of ISO 9001, customers, regulatory requirements, their own requirements set for the effective functioning of all processes and continuous improvement of the quality management system. [Blecha 2006]

The international standard defines basic processes as a logically functional system that has the potential to ensure that the organisation has a high-quality management system and thus is economically successful. The standard includes good practice in terms of what needs to be ensured in the management system. It is nothing more than a logical framework which includes the logic of management (planning, organisation, management and control of organisational activities aimed at achieving organisational goals) with an emphasis on a system of functioning processes.

The standard defines the requirements for processes and it is basically a preventative tool which aims to successfully manage the organisation through its processes, a functioning management system. The ISO 9001 standard essentially gives a feedback perspective of the existing functioning of the organisation with the addition of a philosophy of the culture of behaviour of all individuals who make the organisation what it is. These requirements are generic and applicable to any organisation in which management takes place, i.e. a quality management system. [ISO 2015]

The origins of the management system standard ISO 9001 date back to the 1980s but the practice itself, when people began to think more about recurring and reproducible quality, appeared already in the 1920s with the expansion of serial production. The objective has been the same. To ensure that customer needs and expectations are satisfied, i.e. that the end products are of high quality and that they can be achieved in a planned and certain manner. The latest version of the ISO 9001:2015 standard took into account the requirements for risk management and incorporated them into the quality management system. For this reason, emphasis on this area in other management systems is expected to increase. No major change is expected in some systems because the area of risk management has been included in them. [Nemcova 2015]

2.2 Management System in the Automotive Industry ISO/TS 16949:2009

The automotive industry is among the top industries in terms of management system quality assurance. A global unified and integrated standard of requirements for management systems, which is ISO/TS 16949, exists to achieve this. It is an international standard developed by IATF (International Automotive Task Force) which is composed of European, American and Japanese organisations in the automotive industry. It was issued for the first time in 1999. The currently valid version is the 3rd version from 2009 which was supplemented by an amendment in 2013. A new version which is now being prepared should accept the requirements of ISO 9001:2015.

It contains requirements of several national standards for the automotive industry QS 9000 (US standard), EAQF94 (French standard), VDA 6.1 (German standard) and AVSQ (German standard). It is based on the framework of ISO 9001 and unifies the specific requirements of manufacturers in the automotive industry worldwide. These especially include requirements for

introducing new products, quality planning, customer approval, process qualification and continuous improvement. [Kartha 2004]

ISO/TS 16949 specifies the requirements for the organisation itself as well as all its suppliers. Compared to ISO 9001, this standard is more specific and detailed in some of its requirements as regards the specifications for the automotive industry. [ISO 2009] It can be said that if an organisation has a running management system in accordance with the principles of ISO 9001 and would need to demonstrate more confidence in its management system, including links to customers and the supply chain, ISO/TS 16949 is the clear choice for a standard for such demonstration. [Scrimshire 2002]

2.3 Quality Management System in Aviation AS/EN 9100:2016

Requirements for quality management in the aviation industry are applied through harmonised standards under the leadership of IAQG (International Aerospace Quality Group) with the participation of the largest and most prestigious manufacturers in the world, especially Airbus Industrie, The Boeing Company, General Electric, Pratt & Whitney, Rolls Royce, and others. [AS 2016] A new version of the AS/EN 9100 standard was issued in 2016 and it contains higher requirements towards risk management. Quality management is structured according to the process areas in which the company operates.

AS/EN 9100 - Requirements for quality assurance in the design, development, production, installation and servicing of civil/military aviation and aerospace industries. This standard is primarily designed for organisations engaged in the design, development and/or production of aviation, aerospace and defence products and providing follow-up support, including the provision of maintenance, spare parts or material for their own products.

AS/EN 9110 - Requirements for Aviation Maintenance Organizations. This standard is primarily designed for organisations that primarily perform maintenance, repairs and overhaul of aviation products manufactured by other manufacturers.

AS/EN 9120 - Requirements for Distributors for Aviation, Aerospace and Defence. This standard is primarily designed for organisations that purchase parts, materials and assemblies and then sell these products to customers in the aviation, aerospace and defence industries. [Solc 2014]

2.4 Quality Management System in the Railway Industry IRIS 2.1

IRIS, a standard created by the Union of the European Railway Industry, UNIFE and based on the quality management standard ISO 9001, to which it adds requirements specific to the railway industry. [UNIFE 2012] Obtaining IRIS certification is optional and only provides a competitive advantage. However, many companies are motivated to obtain the certification by a customer who makes further cooperation conditional upon obtaining the IRIS certification. Meeting the requirements of the IRIS standard demonstrates that the management system meets the standards of the rail industry. Apart from basic requirements, attention is focused on the area of reliability, maintenance, risk management, and configuration management. [Scrimshire 2006]

At present (June 2016), the second revision of the IRIS standard (version 02.1) has been issued and more than 1,300 businesses have been certified in this area worldwide.

2.5 Management System for Major Accident Prevention SEVESO III

The management system for major accident prevention originated in Europe in the 1990s following the Piper Alpha accident investigation. After 1996 (following Directive 96/82/EC), the idea of systematic management for major accident prevention was set as the basis for the management of facilities in which hazardous chemicals are placed.

After the adoption of Seveso III (2012/18/EU), the principles, on which this system should be built, were more precisely defined in Annex III. [EU 2012] The management system for major accident prevention must primarily be proportionate to the hazards, industrial activities and complexity of the organisation in the plant and must be based on risk assessment. It should also include part of the general management system which includes the organisational structure, responsibilities, common practices, procedures, processes and resources for determining and implementing the major accident prevention policy. [Pol 2014]

The management system for major accident prevention should primarily address the following areas:

- Organisation and employees: roles and responsibilities of employees involved in the management of major risks at all levels of the organisation, together with the measures taken to raise awareness about the need for continuous improvement;
- Identification and evaluation of sources of major risks: adoption and implementation of procedures for systematic identification of major risks arising from normal and abnormal operation;
- Operational control: adoption and implementation of procedures and instructions for safe operation, including maintenance of the plant, processes and equipment, and alarm management and temporary shutdowns;
- Change management: adoption and implementation of procedures for planning changes to existing or the construction of new equipment, processes or storage facilities;
- Planning for emergencies: adoption and implementation of procedures to identify foreseeable emergencies using systematic analysis and to prepare, test and evaluate emergency plans so that they correspond to such emergencies and to provide special training to the employees concerned;
- Monitoring of programme performance: adoption and implementation of procedures of ongoing evaluation of compliance with the objectives set by the operator's major accident prevention policy and safety management system, as well as the mechanisms for the investigation and implementation of corrective measures in the event that these objectives are not fulfilled;
- Monitoring and evaluation: adoption and implementation of procedures for periodic systematic evaluation of the major accident prevention policy and the effectiveness and suitability of the safety management system.

Every EU Member State approaches the creation of precise requirements for the management system for major accidents prevention individually, and they only share the obligation of regular audits of the implemented management system for major accident prevention. [Vallerotonda 1995]

In the following, we will therefore compare the approach that was used in the fulfilment of requirements of SEVESO III in the Czech Republic (Act No. 224/2015 Coll., and Government Regulation No. 227/2015 Coll.).

3 COMPARISON OF THE REQUIREMENTS OF INDIVIDUAL RISK MANAGEMENT SYSTEMS

For the purposes of further steps, the requirements of individual standards were first compared in detail. It was primarily verified whether each requirement in each standard has its equivalent in the content of the chapter according to the ISO 9001 standard, or whether the significance of the requirement corresponds to any of the requirements of the ISO 9001 standard.

The following figure, which was created according to ISO 31000:2009, contains the principles used for evaluation. [ISO2 2009]

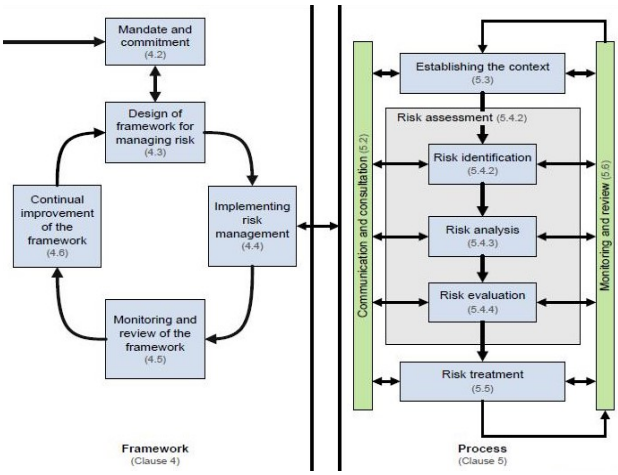

Figure 1. Principles of Risk Management

Because it cannot be clearly determined for some requirements of industrial standards whether they have been fulfilled (have been fulfilled partially), more detailed information is given for some answers. The entire comparison is given in Tab. 1.

Requirement	ISO 9001	ISO/TS 16949	AS/EN 9100	IRIS	Seveso III
Commitment	Yes	Yes	Yes	Yes	Yes
Design of Framework	Yes	In general	Yes	Yes	Yes
Implementing Risk Management	Yes	In general	Yes	Yes	Yes
Monitoring of Framework	Yes	In general	Yes	Yes	Yes
Continual Improvement	Yes	Yes	Yes	Yes	Yes
Communication of Risks	In general	In general	Yes	Yes	Yes
Establishing the Context	Yes	Yes	Yes	Yes	Yes
Risk Identification	Depending on the context	In FMEA process	Within the selected method	Depending on the context	Yes
Risk Analysis	Depending on the context	In FMEA process	Within the selected method	Depending on the context	Yes
Risk Evaluation	Depending on the context	In FMEA process	Within the selected method	Depending on the context	Yes
Risk Treatment	Depending on the context	In FMEA process	Within the selected method	Depending on the context	Yes
Monitoring of risks	Yes	Yes	Yes	Yes	Yes

Table 1. Comparison of the Requirements of Evaluated Standards

The approach contained in the Self-Audit Handbook for SMEs published by the European Union was used to evaluate the requirements. [European Commission 1995] The aim of this methodology was to assist in the improvement of the safety system, product quality and to enhance work performance. Area 1 of this methodology, which focuses on risk management, was used for the evaluation.

According to this methodology, the system itself is introduced if there is enough information available for risk management and its condition is evaluated (1), if the evaluation of the effectiveness of corrective measures is ensured (2), if the risk management system is based on current and controlled documentation (3), if periodical and constant risk assessment is conducted (4), if a change management system has been implemented (5), if information about the current state of knowledge in the evaluated area is available (6), if work is managed with respect to risk prevention (7), if the limitations of people are taken into account and the machines and processes are adapted to them (8), if measures to prevent the occurrence of risks (protection against risks) are used (9), if the employees are adequately trained for their work with regard to the risks to which they are exposed (10), if activities are well organised and responsibilities and powers properly delegated (11), and if employees have an opportunity to intervene with their insights into the risk management process and are involved in its improvement (12).

Questions may contain sub-questions that verify specific details in the area. Each question is evaluated by points (0-5) while the highest value means that the area is described in detail in the standard, the lowest value means that the area is not addressed in the standard. Subsequently, the average result was calculated for each of the described standards. The entire evaluation is given in Tab. 2.

Requirement	ISO 9001	ISO/TS 16949	AS/EN 9100	IRIS	Seveso III
1. Quality of information	5	5	5	5	5
2. Preventive measures	5	5	5	5	5
3. Documentation	4	5	5	5	3
4. Risk evaluation	3	4	5	3	5
5. Management of change	3	4	5	3	5
6. Keeping abreast of technology	3	3	5	3	5
7. Preventing risks	4	4	4	4	5
8. Adapting the work	2	2	2	2	5
9. Protection	4	5	5	5	5
10. Training	4	4	4	4	5
11. Organisation and delegation	5	5	5	5	3
12. Worker participation	5	5	5	5	5
Result	3.9	4.3	4.6	4.1	4.7

Table 2. Evaluation of requirements of individual standards according to the Self-Audit Handbook

In the next step, individual areas are assessed according to the methodology given in the Handbook by assessing four basic areas – personnel, equipment, organisation and environment according to the methodology of the Self-Audit Handbook. This evaluation is based on the principle that each of the sub-questions for evaluation in Tab. 2 is, according to the methodology of the Self-Audit Handbook, assigned to an evaluation area. The final score then indicates the strength of the standard in a particular area.

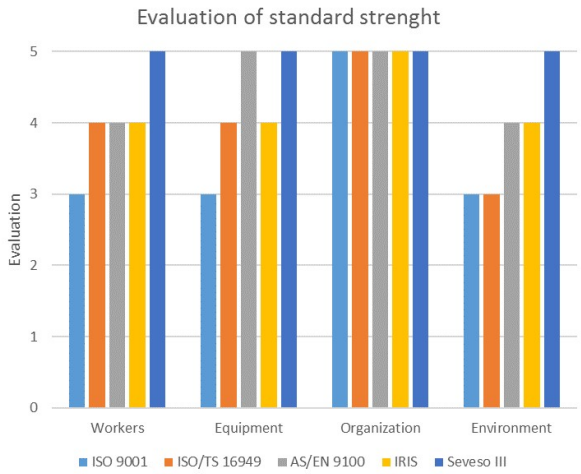

Figure 2. Evaluation of Individual Standards for Four Basic Areas

4 DISCUSSION

It is apparent from the comparison of the requirements of the individual standards according to the framework of ISO 31000 (Table 1) that the highest conformity of fulfilment of the requirements is in case of the SEVESO and AS/EN 9100 system. The weakness of ISO/TS 16949 lies in the prescription of compulsory use of the FMEA method (it is often much better to use a different method).

When evaluating the requirements of individual standards according to the Self Audit Handbook, it has been found that basic components of risk management are required most consistently in the SEVESO regulation, while ISO standards are very general, and these requirements do not guarantee a comprehensive risk management system.

The result of the evaluation of individual standards in four basic areas (Fig. 2) was that all the described industry standards are very strong in the area of organising the management system. In terms of the implementation of the requirements, risk management towards the environment inside and outside the company can be classified as the weakest areas.

5 CONCLUSIONS

In the last few years, considerable emphasis has been placed on risk management in industry standards affecting control management. The ISO 9001 standard, which is primarily focused on quality management, was fundamentally revised in 2015 and turned toward risk management which also caused changes in other fields that are adjusting to this trend. In this article, 4 major industry standards (compulsory and optional) were described which are used in the industrial sectors (automotive industry, aviation industry, railway industry and chemical and processing industry falling under the prevention of major accidents) in terms of risk management.

This paper compares individual requirements according to the framework of the ISO 31000 standard and evaluates the individual requirements according to the methodology of the Self Audit Handbook (area 1). It is apparent from the comparison that the requirements of the updated industry standards are more stringent than the requirements of ISO standards in all areas. Based on the evaluation of the 4 major areas (Fig. 2), it is apparent that all standards are very strong in the organisation of the management system, and in other areas the required level varies.

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CONTACTS

Ing. Lubos Kotek, Ph.D.
Brno University of Technology
Faculty of Mechanical Engineering
Institute of Production Machines, Systems and Robotics
Technicka 2896/2, 616 69 Brno, Czech Republic
e-mail: kotek.l@fme.vutbr.cz
Tel.: +420 541 142 391
http://www.fme.vutbr.cz/

Ing. Ales Nosek, Ph.D.
Brno University of Technology
Rector's Office Quality department
Antoninska 548/1, 601 90 Brno, Czech Republic
e-mail: nosek@ro.vutbr.cz
Tel.: +420 541 145 241
http://www.vutbr.cz/

doc. Ing. Alois Fiala, CSc.
Brno University of Technology
Faculty of Mechanical Engineering
Department of Quality, Reliability and Safety
Technicka 2896/2, 616 69 Brno, Czech Republic
e-mail: fiala@fme.vutbr.cz
Tel.: +420 541 142 209
http://www.fme.vutbr.cz/

doc. Ing. Vojtech Bartos, Ph.D.
Brno University of Technology
Faculty of Business and Management
Institute of Finances
Kolejni 2906/4, 612 00, Brno, Czech Republic
e-mail: bartos@fbm.vutbr.cz
Tel.: +420 541 142 679
https://www.fbm.vutbr.cz/