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STUDY OF THE RELIABILITY OF THE INTEGRATED QUALITY MANAGEMENT SYSTEM WITHIN THE ORGANISATION

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Abstract:
In this paper, the authors aim to conduct a study on the development and implementation of a model for calculating the performance of the integrated management system within an organization in the field of civil engineering. The first part describes the integrated management system and how to monitor its performance. The methodology involved conducting an internal audit and a comparative analysis of each component based on the basic (internationally recognized) benchmarks of this integrated system, in order to assess the performance of the integrated management system.

Key words: management; system model; organisation.

1. Introduction

A system is an interconnection of different components - organisation, resources and processes - that aim to meet the objectives initially set. An integrated management system gathers all internal management practices in a single system, but not as individual elements. These subsystems integrated into company's management system interconnect, so that the boundaries between the processes are not visible. An organisation can itself develop its own management system at all its levels to meet a certain goal [1].

An integrated management system standardized by ISO incorporates all the structures and processes into a complete framework, allowing the organisation to operate as a single unified company. The integrated ISO system helps the organisation to become a whole entity, each of its functions subordinated to a single goal: to improve the performance of the entire organisation. Instead of a multidimensional system, the organisation uses a single more developed system through which it can obtain more benefits and in the future, the organisation can implement new systems much easier [2].

The management system is integrated (IMS) when at least two of the following components are included: quality, emergency management, environment, social responsibility, safety and health at work, etc. [3]. The most used references in Romania are the ISO 9001 standards for quality, ISO 14001 for the environment, SA 8000 for social responsibility, OHSAS 18001 and more recently ISO 45001 for occupational safety and health, etc. [4].

In order to ensure the performance of a management system, the following steps are required:

- Implementation of monitoring and measurement processes;
- Carrying out audits in all its forms;
- Management analysis;
- Achieving continuous improvement.

Monitoring is a continuous process that collects relevant information about how a particular activity performs, ensures the collection of information or statistical data and uses relevant and measurable indicators to follow the implementation process. The measurement is a process that uses the information obtained in monitoring time to analyse how the activity achieved its objective and was effective [5].

The concept of auditing comes from the Latin audio, which translates to listening, and has had over time various meanings: listening to the parties involved in a process, checking the accounts by experts, balance sheet or audit. In the field of quality management, the term audit means to examine the quality of processes, products and services or the quality system as a whole [6].

The analysis performed by the management leads to the evaluation of the opportunities regarding the improvement and the establishment of the necessary changes in order to ensure the management at the highest level that the adopted system is adequate and effective [7].

The continuous improvement of the management system is possible only by the continuous improvement of the company's processes, implicitly improving the products/ services offered by the company, from each stage of the product life cycle, starting with marketing studies to identify customer requirements and up to ensuring the proper use of the products. In this respect, the employees, who constantly focus on improving their activities, play the main role [8]. This process must be one of the permanent objectives of the company.

2. The integrated management system within the organisational framework

The organisation that is the subject of this case study is a company from Sibiu that operates successfully on the construction and assembly works market, performing large-scale works in civil, industrial and residential constructions, bridges and roads, and restoration of historic buildings. All production processes, execution stages and, implicitly, finished products, construction works meet the requirements in accordance with international ISO standards.

The analysed company had implemented, at the time of the study, an integrated management system on quality - environment - occupational health and safety - social responsibility, which meets the requirements of reference standards SR EN ISO 9001: 2015, SR EN ISO 14001: 2015, SR OHSAS 18001: 2008 and SA 8000: 2014. Currently the company's representatives are working to make successfully the transition from SR OHSAS 18001: 2008 to the new benchmark in the field of occupational health and safety, namely the SR ISO 45001 standard. The Integrated Management System runs in the organisational structure, in the processes/sub-processes, in the organisation's policy and objectives on quality, environment, health and safety at work and social responsibility, in accordance with the requirements for the areas of activity. The company has broad range of activities in various areas such as: execution of public works, civil works, bridges, roads, sewerage networks, hydro-technical constructions, industrial, rural constructions, restoration works, concrete manufacture and sale, ballast mining, aggregate mining and sorting, grade II laboratory activities, freight and oversized transport, services provided with the help of cranes of different tonnages. The organisation also had established a documented system based on procedural approach and risk-based

thinking, applying specific activities, documented information on the nature of the procedure, specific work instructions and other documents relevant to the organisation.

The organisation keeps documented information in process and sub-process records as follows:

- Management processes to support the planning, monitoring and improvement of production processes, assigning an internal value to the company;
- Production processes that serve the purpose of the company and include the main skills, customer requirements and ensure a high value of the company and the customer;
- Support processes to serve the production processes and to ensure their proper functioning found in the departments of transport, smithery, PVC joinery, grade II laboratory, etc.

In order to evaluate the adopted IMS performance the authors analysed the following existing procedures:

- General monitoring and measurement procedure for the environment, health and safety at work, social responsibility:
- The procedure for monitoring and measuring processes;
- The procedure for monitoring and measuring products;
- The procedure for performing the internal audit;
- The procedure for continuous improvement of the integrated management system;
- The procedure for executing of the management analysis.

3. Reliability and performance of the Integrated Management System (IMS)

Internal audit helps the reliability of the Integrated Management System. An IMS is reliable and efficient if there are no major lack of compliances following the audit. At the time of IMS development, the company's management set among the main objectives the threshold above the system is reliable. This threshold has been set at 0.98. This threshold was set at 0.98 by the statement of the general manager regarding the implementation of the integrated management system (quality-environment-security and occupational health-social responsibility) where the general manager drew as among the specific objectives - the objective related to IMS performance. Thus, it established as the threshold of an efficient functioning of the IMS the percentage of maximum 2% of non-conformities allowed. The condition is that they are not.

Taking into account the reliability function, we calculated the level of reliability resulting from the internal system audit performed, as follows:

$$R(t)=N(t)/N_0=436/498=0,88 \quad (1)$$

Where:

- 436 represents the number of requirements identified as compliant following the audit;
- 498 represents the total number of requirements audited.

According to this threshold, following the application of the system audit, it emerged that the company does not reach the established reliability level, because the reliability level is 0.88 and the established threshold is 0.98. The non-compliance percentage of 12.45% highlights the same fact.

Table 1 presents the audited requirements of the standards and their related non-conformities.

Compartment / process	Process manager	Chapter from the standard				AR	NR	NR/ AR* 100 (%)
		ISO 9001	ISO 14001	OHSAS 18001	SA 8000			
Management	CEO CFO Economic manager IMS Manager	4.1; 4.2; 4.3; 4.4; 5.1; 5.2; 5.3; 6.1; 6.2; 6.3; 7.1; 7.2; 7.3; 7.4; 7.5; 8.1; 8.2; 8.4; 8.5; missing 8.5.3; 8.6; 8.7; 9.1; 9.2; 9.3; 10.1; 10.2; 10.3	4.1; 4.2; 4.3; 4.4; 5.1; 5.2; 5.3; 6.1; 6.2; 7.1; 7.2; 7.3; 7.4; 7.5; 8.1; 9.1; 9.2; 9.3; 10.1; 10.2; 10.3	4.1; 4.2; 4.3.1; 4.3.3; 4.4.1; 4.4.2; 4.4.3; 4.4.4; 4.4.5; 4.4.6; 4.4.7; 4.5.1; 4.5.2; 4.5.3; 4.5.4; 4.5.5; 4.6	IV.1; IV.2; IV.3; IV.4; IV.5; IV.6; IV.7; IV.8; IV.9				
Total audited requirements (AR)		**27**	**21**	**17**	**9**			
Total non- conformities requirements (NR)		**1**	**1**	**2**	**1**	**74**	**5**	**6,76**
Human Resources	Human Resources Director	4.4; 6.3; 7.1; 7.2; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5.6; 8.7; 9.1; 9.3; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.2.2; 7.2; 7.3; 7.5; 9.1; 9.3; 10.1; 10.2; 10.3	4.3.2; 4.3.3; 4.4.1; 4.4.2; 4.4.3; 4.4.4; 4.4.5; 4.4.6; 4.5.1; 4.5.3; 4.5.4; 4.6	IV.1; IV.2; IV.3; IV.4; IV.5; IV.6; IV.7; IV.8; IV.9			
Total (AR)		**15**	**11**	**12**	**9**			
Total (NR)		**0**	**0**	**3**	**2**	**47**	**5**	**10,64**
Legal Office	Solicitor	7.2; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 7.2; 7.4; 7.5; 10.1; 10.2; 10.3	4.3.2; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.2; 4.5.4	IV.1; IV.2; IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
Total (AR)		**10**	**8**	**7**	**8**			
Total (NR)		**0**	**1**	**1**	**0**	**33**	**2**	**1,65**
Supply	Head of Procurement Service	6.3; 7.1; 7.3; 7.4; 7.5; 8.1; 8.4; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 7.1; 7.3; 7.5; 10.1; 10.2; 10.3	4.4.1; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.3; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8; IV.9			
Total (AR)		**11**	**8**	**7**	**7**			
Total (NR)		**1**	**0**	**0**	**0**	**33**	**1**	**3,30**

Compartment / process	Process manager	Chapter from the standard				AR	NR	NR/ AR* 100 (%)
		ISO 9001	ISO 14001	OHSAS 18001	SA 8000			
Technical office, bidding, settlement	Technical Director Head of technical service	4.4; 6.3; 7.1; 7.2; 7.3; 7.4; 7.5; 8.1; 8.2; 8.4; 8.5; 8.5.3; 8.5.5; 8.6; 8.7;9.1; 9.3; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.1.4; 6.2.2; 7.2; 7.3; 7.4; 7.5; 8.1; 8.2; 9.1; 9.3; 10.1; 10.2; 10.3	4.3.1; 4.4.2; 4.4.3; 4.4.4; 4.4.5; 4.4.6; 4.4.7; 4.5.1; 4.5.3; 4.5.4; 4.6	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8; IV.9			
	Total (AR)	**19**	**15**	**11**	**7**			
Total (NR)		**1**	**0**	**0**	**1**	**52**	**2**	**3,85**
Mechanization - transport	Head of mechanization - transport service	6.3; 7.1; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5; missing 8.5.3; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.1.4; 7.3; 7.5; 8.1; 8.2; 10.1; 10.2; 10.3	4.3.3; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
	Total (AR)	**13**	**10**	**6**	**6**			
Total (NR)		**1**	**1**	**1**	**0**	**35**	**3**	**8,57**
Laboratory	Laboratory Head	6.3; 7.1; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5; missing 8.5.3; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.1; 6.1.2; 6.1.3; 6.1.4; 7.3; 7.5; 8.2; 10.1; 10.2; 10.3	4.3.1; 4.3.3; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
	Total (AR)	**13**	**10**	**7**	**6**			
Total (NR)		**0**	**2**	**3**	**2**	**36**	**7**	**19,44**
Civil construction sites	Project manager	6.3; 7.1; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5; missing 8.5.3; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.1.4; 7.3; 7.5; 8.2; 9.1; 10.1; 10.2; 10.3	4.3.1; 4.3.2; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.1; 4.5.2; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
	Total (AR)	**13**	**10**	**9**	**6**			
Total (NR)		**0**	**2**	**5**	**1**	**38**	**8**	**21,05**
Hydro-urban construction sites	Project manager	6.3; 7.1; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5; missing 8.5.3; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.1.4; 7.3; 7.5; 8.2; 9.1; 10.1; 10.2; 10.3	4.3.1; 4.3.2; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.1; 4.5.2; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
	Total (AR)	**13**	**10**	**9**	**6**			
Total (NR)		**0**	**1**	**5**	**1**	**38**	**7**	**18,42**
Road and bridge construction sites	Project manager	6.3; 7.1; 7.3; 7.4; 7.5; 8.1; 8.4; 8.5; missing 8.5.3; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.1.4; 7.3; 7.5; 8.2; 9.1; 10.1; 10.2; 10.3	4.3.1; 4.3.2; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.1; 4.5.2; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			

Compartment / process	Process manager	Chapter from the standard				AR	NR	NR/ AR* 100 (%)
		ISO 9001	ISO 14001	OHSAS 18001	SA 8000			
Total (AR)		**13**	**10**	**9**	**6**			
Total (NR)		**0**	**1**	**5**	**1**	**38**	**7**	**18,42**
Concrete station	Concrete station manager	6.1; 6.3; 7.1; 7.3; 7.4; 7.5; 7.5.3; 8.1; 8.4; 8.5; missing 8.5.3; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 6.1.4; 7.3; 7.5; 8.2; 10.1; 10.2; 10.3	4.3.1; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
Total (AR)		**15**	**9**	**6**	**6**			
Total (NR)		**2**	**1**	**1**	**1**	**36**	**5**	**13,89**
Warehouse Management	Chief Manager	6.1; 6.3; 7.1; 7.3; 7.4; 7.5; 7.5.3; 8.1; 8.4; missing 8.5.6; 8.6; 8.7; 10.1; 10.2; 10.3	6.1.2; 6.1.3; 7.3; 7.5; 7.5.3; 9.1; 10.1; 10.2; 10.3	4.3.1; 4.4.2; 4.4.4; 4.4.5; 4.4.6; 4.5.1; 4.5.2; 4.5.3; 4.5.4	IV.3; IV.4; IV.5; IV.6; IV.7; IV.8			
Total (AR)		**14**	**9**	**9**	**6**			
Total (NR)		**2**	**3**	**4**	**1**	**38**	**10**	**26,32**

Table 1. Audited requirements from standards and identified non-conformities

The following graphs and diagrams help of the data presented in table 1. Figure 1 presents the comparative analysis between total audited requirements and total non-conformities requirements for each department. The graph highlights, that the department with the most audited requirements is the Management Department, and the department with the most non-conformities is the Warehouse Management Department.

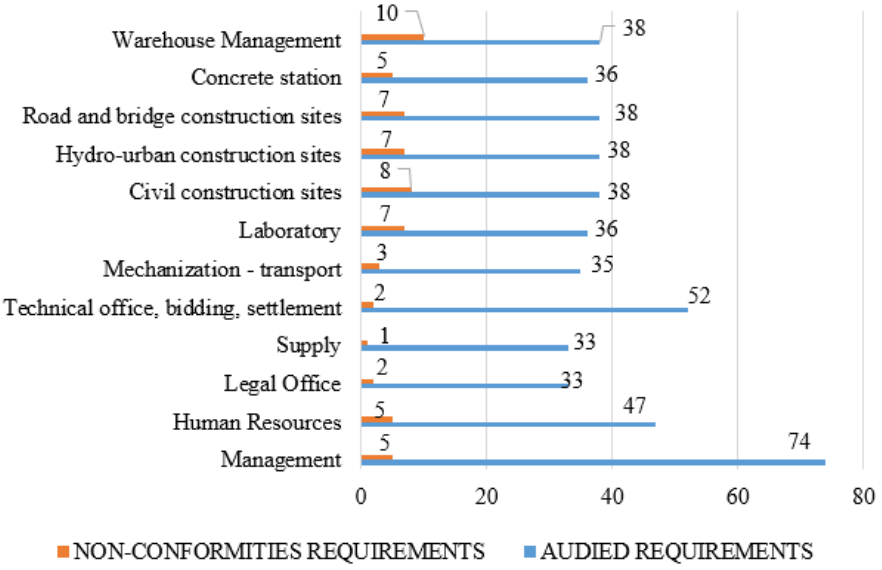

Fig. 1 Comparative analysis between total audited requirements and total non-conformities requirements

Figure 2 shows the comparative analysis between total audited requirements and total non-conform requirements for each management system. The graph below shows that the management system with the most audited requirements and the least non-conform requirements is the quality ISO 9001, followed by the environmental one, ISO 14001. The management system with the fewest audited requirements is that of social responsibility, SA 8000.

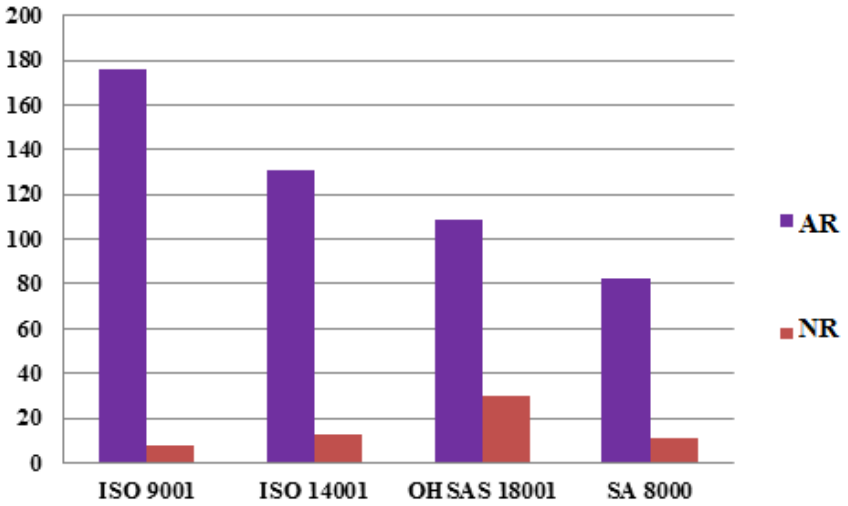

Fig. 2 Comparative analysis between total audited requirements and total non-conformities requirements for each management system

Figure 3 presents the analysis of the weights of non-conformities for each management system. From this diagram, it observed that the management system with the most non-conformities is of occupational health and safety, OHSAS 18001, and the management system with the least non-conformities is the quality one, ISO 9001.

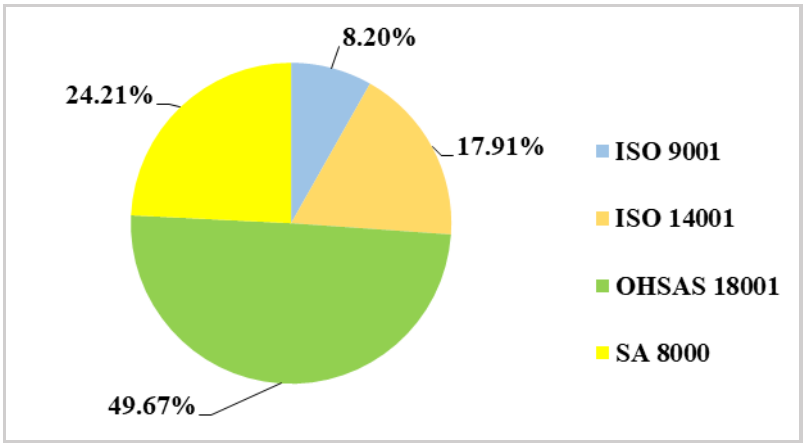

Fig. 3 Analysis of non-compliance weights for each management system.

The figure 4 presents the comparative analysis between the share of non-conformities for each department and total non-conformities requirements for the integrated management system. The graph from figure 4 shows that six departments are below the level of non-conformities / IMS, these being those of Management, Human Resources, Legal Office, Procurement, Technical Office,

bidding, settlement and Mechanization-transport, they have a percentage of non-conformities below 12.45%. The next 6 departments are above the level of non-conformities / IMS, these being those of laboratory, civil construction sites, hydro-urban construction sites, roads and bridges sites, concrete station and warehouse management.

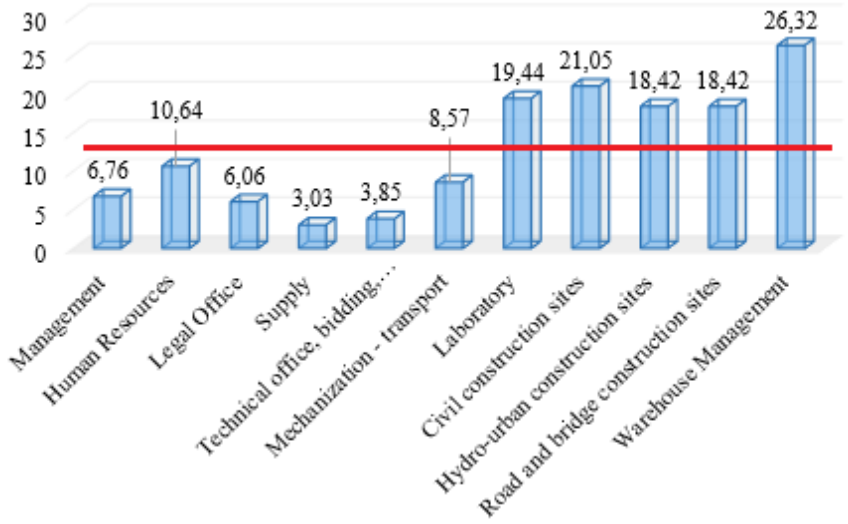

Fig. 4 Comparative analysis between the share of non-conformities for each department and total non-conformities requirements for the integrated management system

The figure 5 presents the comparative analysis between the share of non-conformities for each management system and total non-conformities requirements for the integrated management system. The graph from figure 5 shows that two management systems, ISO 9001 and ISO 14001, are below the level of non-conformities / IMS, they have a percentage of non-conformities below 12.45%, and the next two management systems, OHSAS 18001 and SA 800, are above the level of non-conformities / IMS.

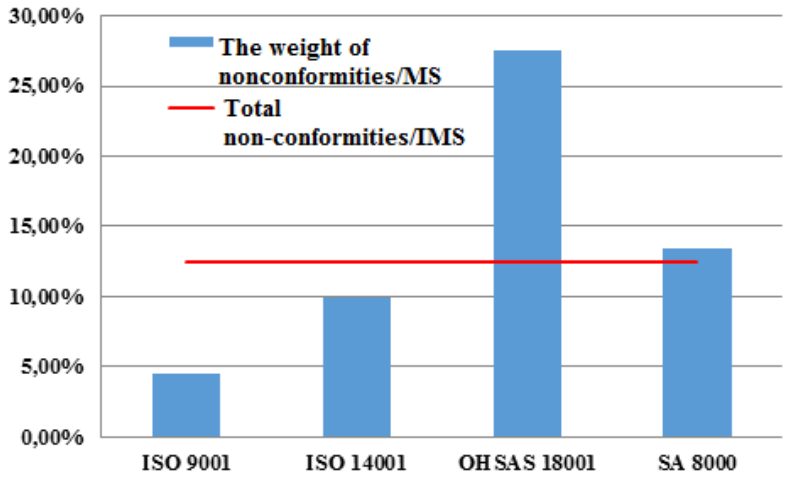

Fig. 5 Comparative analysis between the share of non-conformities for each management system and total non-conformities requirements for the integrated management system

The figure 6 presents the analysis of the weights of non-conformities for the integrated management system. The diagram from figure 6 shows that out of the total audited requirements, these being 498, 436 (87.55%) comply with the requirements of the standard, and 62 (12.45%) are non-conform audited requirements, which do not meet the requirements of the standard.

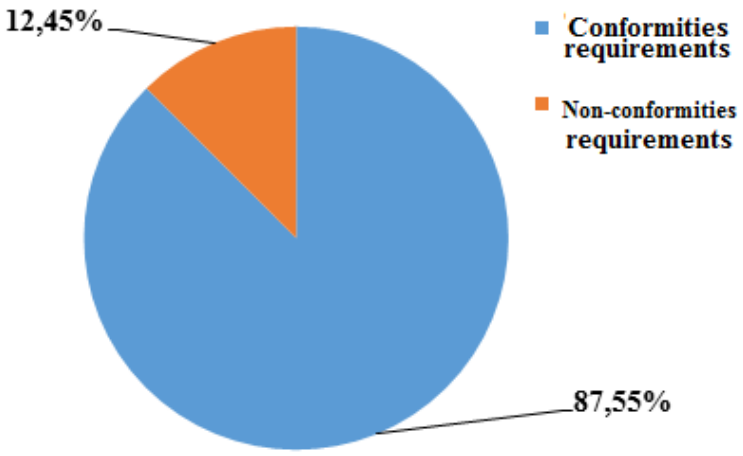

Fig. 6 Analysis of the weights of non-conformities identified following the integrated management system audit

Following the analysis of the audit report, a ranking was made of the reliability levels related to each component of the IMS. Figure 7 presents this analysis.

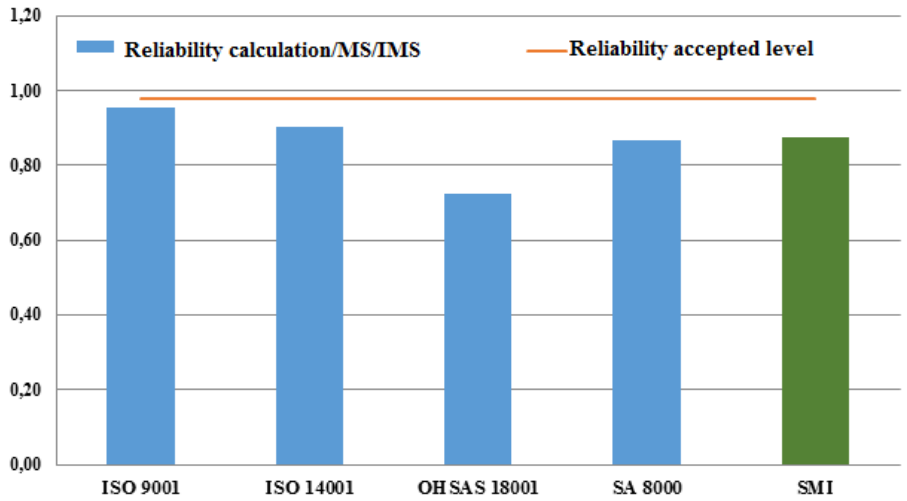

Fig. 7 Comparative analysis of the reliability levels related to each component of the IMS

3.1 Results analysis

The system audit showed that the management system integrated in the analysed organisation is not reliable, because it does not fall within the acceptance margin of reliability, which is 2%, which represent the non-conform requirements accepted and assumed. However, the identified non-conformities are not major therefore amendable in a short time, so the chances of recertification of the Integrated Management System are quite high. For this reason, the organisation has established

the strategy for ameliorating the non-conformities identified following the internal audits of the organisation, that involves:

- Organizing focus groups in all departments of the company, which will generate a number of solutions for each type of non-conformities;
- Those solutions will be evaluated using an alternative selection matrix;
- Planning the chosen alternatives
- Implementation of planned alternatives;
- Monitoring and control of the implemented alternatives;
- System adjustment;
- Recalculating the level of reliability;
- Comparative analysis with the previous level of reliability and establishment of the new level of reliability;
- If the level of reliability does not fall within the set threshold, the process will resume.

In conclusion, one can say that the Integrated Management System is workable but not reliable at this moment.

This model of calculation based on adapting the reliability equation (as an element of originality) can be successfully applied in any organization (regardless of field of activity) that has implemented a management system in accordance with a benchmark adopted or required by the market or imposed by legal regulations. It should be mentioned that, in addition to the standards already mentioned, it must be taken into account other international, European, national or even domestic standards such as: ISO 22000, EMAS, ISO 45001, VDA, ISO / IEC 27001, ISO / IEC 17025, ISO 15189 etc. or the Code of internal managerial control of public entities.

4. Conclusions

An Integrated Management System (IMS) is a management system that integrates the company's activities into a coherent whole, in order to fulfil the mission and objectives of that company. Instead of a multidimensional system, the organisation uses a single, more developed system that generates several benefits. Following the system audit, it turned out that the integrated management system in a construction company is not reliable, because it does not fall within the margin of acceptance of non-conformities established by the organisation's management. This result requires the company to identify opportunities to improve the system in the future.

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