

Digital Platform for the Optimization of Occupational Health and Safety Systems Specific to the Industrial Area – Part II

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Abstract

Digital platforms are now increasingly used by the European economy, with a significant increase in their economic and social importance. The benefits of digitalization, mainly for the occupational health and safety system (OHS) are multiple. This paper continues the research carried out using our online application SSM.RO with the goal to analyse this application in terms of efficiency and accessibility. The most important tool was a questionnaire that was answered by 246 respondents. Fisher's exact test also helped us to conclude that the area in which the employees operate is related to the fact that the online training sessions with SSM.RO have a higher degree of efficiency than other instruction forms. One of the most important components of the application SSM.RO is the possibility to generate and send by phone message or by e-mail any type of training related to the legislation on occupational health and security systems or informative materials related to the rules of conduct and protection measures (the transmitted documents can have a pdf, audio, video or pps format).

Keywords

occupational health and safety, digital platform, optimization

1. Introduction

Optimization represents the expression of humans' endeavour to attain perfection. Optimization can be defined as the operation of studying a problem in order to obtain a result which, in comparison with other possible results, is the best, the most appropriate, the most indicated and based on which one can make a decision with economic and technical character. The optimization of industrial processes has been a permanent problem for the specialists in the field, which is also proven by the large number of research publications such as: oil production forecasting [1], chemical process [2], machining operations [3], energy saving strategies in industrial sector [4].

To this end, in order to reach an optimal allocation of resources that are specific to the industrial processes and in order to establish a relationship between technology and the multiple applications specific to different processes, digital industrial platforms have appeared. These are software applications which, by means of some algorithms process input data and transform them in final and favourable strategic choices.

The process of administration and management of the files in the framework of the occupational health and safety system (OHSS) could be optimized efficiently by referring to digital services and the electronic administration of documents.

2. Materials and Methods

2.1. The application SSM.RO

In the global context, one can see the benefits of the remote process of training of the employees. In this framework, the online platform SSM.RO (Figure 1) allows the companies to use the electronic signature for the files that are transmitted to their employees, in a digital format. As a consequence, any file, which is transmitted and signed electronically will obey the requirements of the legislation in force.

More precisely, they have the juridical effects imposed by the Law 319/2006, G.D 1425/2006, Law 208/2021 and the other normative acts in force, which set rules regarding the OHSS. Furthermore, the application uses certificates for remote electronic signature from a Romanian provider who is qualified for remote electronic signature, see detailed data in the paper [5].



Fig. 1. The structure of the application SSM.RO [5]

By using the application SSM.RO one can issue, transmit and sign any document in an electronic format. One of the most important components of the application SSM.RO is the possibility to generate and send by phone message or by e-mail any type of training related to the legislation on occupational health and security systems or informative materials related to the rules of conduct and protection measures (the transmitted documents can have a pdf, audio, video or pps format). Moreover, with the application SSM.RO, the employers can transmit work instructions, operating procedures, technical solutions, contracts and any other documents which are related to the activity and are fully consistent with the standards regarding the occupational health and security systems.

2.2. Questionnaire - validation from a practical point of view of the process of online SSM instruction of the workers

After conducting the online training of the employees in the context of the OHSS, we practically validated the data by using a case study that was detailed in [5]. The number of employees was 800 and they were selected from random companies.

The instruction was conducted both online and classical (in the training room). At the end, the workers were required to answer a questionnaire with 15 relevant questions (remark: seven of the questions (1-7) were presented and analysed [5], and the remaining eight questions (8-15) which are presented in this paper).

Below we present the remaining questions of the questionnaire.

8. In comparison with other training forms that you benefited from, do you think that the online training is more efficient and contributes to an increase in the level of knowledge acquisition?

- yes
- no

9. Does the online training offer you a friendlier and more relaxed environment?

- yes
- no

10. Does the diversity of forms of explanation or illustration of informative materials (be it texts, images, videos) contribute to a better understanding of the information that you receive?

- yes
- no

11. Within the company you are
 - a leader
 - a simple employee
12. Do you want to have the following trainings in the online environment?
 - yes
 - no
13. How do you evaluate, on a scale from 1 to 5, the level of accessibility of the application SSM.R0? (1 - very hard access, up to 5 - very easy access)
 - 1 - very hard access
 - 2 - hard access
 - 3 - medium access
 - 4 - easy access
 - 5 - very easy access
14. How do you evaluate the steps regarding the registration/ training/ testing (1 - very difficult, up to 5 - very easy)
 - 1 - very difficult
 - 2 - difficult
 - 3 - medium
 - 4 - easy
 - 5 - very easy
15. How do you evaluate the structure of the application? (1 - not intuitive, up to 5 - very intuitive)
 - 1 - not intuitive
 - 2 - little intuitive
 - 3 - medium
 - 4 - intuitive
 - 5 - very intuitive

2.3. Fisher's exact test

The statistical processing was performed in the same way as in paper [5]. The following is a reminder of the statistical processing method.

If we want to find out if there is a significant relationship between two categorical variables, we can perform independence test. Some important independence tests are the Chi-square test and the Fisher's exact test [6-8].

In order to use these tests, first we compute the contingency table. If there are cells in this table that contain expected values that are less than 5, then the Chi-square test may give wrong results. Another alternative is to use the Fisher's exact test.

The hypotheses are the same for both Fisher's exact test and the Chi-square test. If there is no relationship between the variables (i.e. they are independent), then we refer to H_0 . This also tells us that the value of one variable cannot be predicted if we know the value of the other variable. If there is a relationship between the variables (i.e. they are dependent), then we refer to H_1 . We also deduce that the value of one variable can be predicted if we know the value of the other variable.

One important statistical tool is the p-value, namely the probability that there are observations at least as extreme as the measured one if the null hypothesis were true. It shows the likelihood of the null hypothesis. In other words, it represents the lowest degree of significance for which the data show rejection of the null hypothesis. It is too unlikely that the observations happen just by chance if the null hypothesis were true in the case of a p-value below the level of 5%. As a consequence, we reject the null hypothesis. But if the p-value is higher than the level of 5%, then we cannot ignore the null hypothesis.

3. Results

3.1. The replies to the questions

The eighth item: in comparison with other training forms, the online training is/ is not more efficient, thus contributing/ or not to an increase in the level of acquisition of knowledge.

The aim of the question was to offer a general picture with regards to the degree of efficiency of online training in comparison with other training forms, for the workers.

In Figure 2 we depict the replies to the eighth question.

From the analysis of the results, we deduce that for 78.46% of the workers, the degree of efficiency of digital instruction in comparison with other training forms is perceived as high (yes), while only for 21.54% of them it is low (no).

Conclusion: for the majority of the respondents, the digital instruction of the workers presents a higher degree of efficiency than other forms of training.

The ninth question: online training offers/ or not a friendlier and more relaxed environment

The aim of the question was to analyse the perception of the employees regarding the environment of the online training.

In Figure 3 we depict the replies to the ninth question.

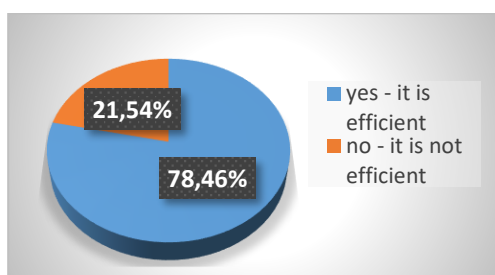


Fig. 2. The criterion regarding the efficiency of online training for an increase in the level of acquisition of knowledge

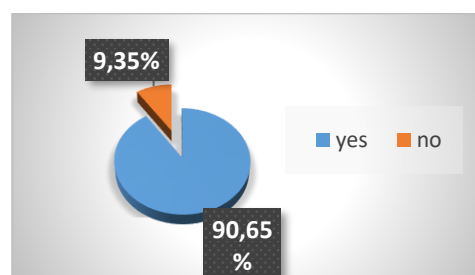


Fig. 3. The criterion regarding the efficiency of online training - friendlier and more relaxed environment for the training

From the analysis of the results, we infer that for 90.65% of the employees, the online training offers a friendlier and more relaxed environment (yes), while for only 9.35% of them we have the opposite (no).

Conclusion: for the majority of the respondents, the online training of the employees represents the training in a friendlier and more relaxed environment.

The tenth question: the diversity of the forms of explanation or illustration of the informative materials (which can be texts, images or videos) are/ or not able to contribute to a better understanding of the received information

The aim of this item was to obtain a general image of the perception of the employees regarding the contribution of the digital instruction sessions to a better understanding of the information.

In Figure 4 we represent the replies to the tenth question.

From the summary of the answers, we draw the conclusion that for 95.12% of the respondents the online training offers a better understanding of the received information (yes), while only for 4.88% of them we have the opposite (no).

Conclusion: for the majority of the respondents, the creation of a software for digital instruction of the workers would imply the training in a friendlier and more relaxed environment.

The eleventh questions: the position held by the respondents within the company

The goal of the question was to find out the position held by the respondents within the company.

In Figure 5 we depict the replies to the eleventh questions.

Conclusion: from the analysis of the results, we conclude that 85.37% of the workers are simple employees, while 14.63% of them hold leadership positions.

The twelfth question: the wish of the respondents to have the following trainings in a digital environment.

The aim of the question was to analyse the wish of the respondents to have the following instruction sessions in an online environment.

In Figure 6 we depict the replies to the twelfth question.

By analysing the results, we conclude that 91.06% of the respondents want to have the future trainings in the digital environment (yes), while 8.94% of them do not (no).

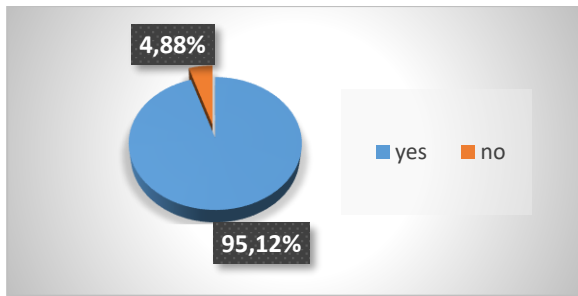


Fig. 4. The criterion regarding the efficiency of the digital instruction sessions - a better understanding of the received information

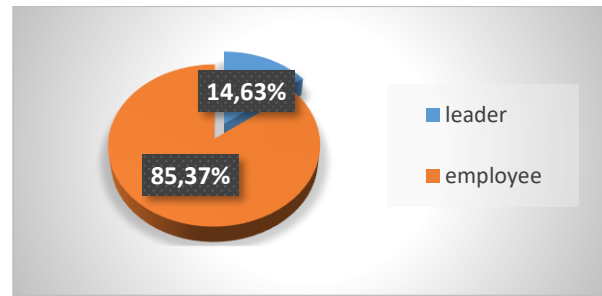


Fig. 5. The criterion regarding the position held by the respondents and the efficiency of the digital training

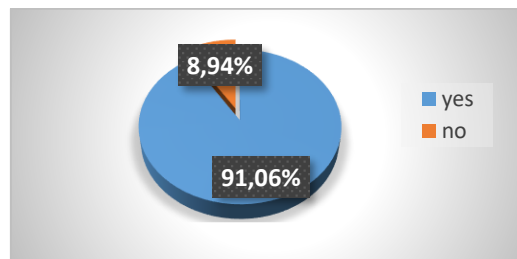


Fig. 6. The criterion regarding the future online training

Conclusion: the majority of the respondents want to be trained in the future in the online environment.

3.2. Fisher's exact test

In this section we analyse if there is a statistically significant association between the data below.

- The age of the employees and the level of difficulty in employing the application SSM.RO
- The position held by the respondents within the company and the fact that online training offers/ or not a friendlier and more relaxed environment
- The highest successfully completed level of education and the level of accessibility of the application SSM.RO

The data stems from 246 workers.

3.2.1. The age of the employees and the level of difficulty in employing the application SSM.RO

In the sequel, we study the relationship between the age of the employees and the degree of difficulty in using the application SSM.RO. The degree of difficulty in employing the application SSM.RO is grouped into 5 categories, namely 1-very difficult, 2-difficult, 3-medium, 4-easy, 5-very easy. We describe the data in a contingency table, which is depicted in Figure 8. The corresponding code appears in Figure 7.

```
ageDiff <- data.frame(
  "age_1" = c(0, 0, 1, 3, 36),
  "age_2" = c(0, 0, 5, 17, 69),
  "age_3" = c(0, 1, 6, 9, 63),
  "age_4" = c(0, 0, 1, 5, 22),
  "age_5" = c(0, 0, 2, 4, 2),
  row.names = c("1-very difficult", "2-difficult", "3-medium", "4-easy", "5-very easy"),
  stringsAsFactors = FALSE
)
colnames(ageDiff) <- c("18-24", "25-34", "35-44", "45-54", ">55")
ageDiff

fisher.test(ageDiff, workspace=2e7)
chisq.test(ageDiff)$expected
```

Fig. 7. The R code for the statistical analysis of the contingency table of the age groups and the degree of difficulty in employing the application SSM.RO

	18-24 <dbl>	25-34 <dbl>	35-44 <dbl>	45-54 <dbl>	>55 <dbl>
1-very difficult	0	0	0	0	0
2-difficult	0	0	1	0	0
3-medium	1	5	6	1	2
4-easy	3	17	9	5	4
5-very easy	36	69	63	22	2

5 rows

Fig. 8. The contingency table of the age groups and the degree of difficulty in using the website SSM.RO

We compute the expected frequencies for the table in Figure 8 and describe the results in Figure 9.

1-very difficult	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
2-difficult	0.1626016	0.3699187	0.3211382	0.1138211	0.03252033
3-medium	2.4390244	5.5487805	4.8170732	1.7073171	0.48780488
4-easy	6.1788618	14.0569106	12.2032520	4.3252033	1.23577236
5-very easy	31.2195122	71.0243902	61.6585366	21.8536585	6.24390244

Fig. 9. The expected frequencies for the table depicting the age groups and the degree of difficulty in using the website SSM.RO

We observe that more than 20% of the entries in the table from Figure 9 have values below 5, so we should again use a Fisher's exact test. By computing this test in R, we obtain a p-value of 0.02466. This value lies under the level of 5%, which implies that we reject the null hypothesis. So there is in fact a relationship between the age of the employees and the degree of difficulty in using the website SSM.RO.

3.2.2. The position held by the respondents within the company and the fact that online training offers/ or not a friendlier and more relaxed environment

First of all, we study the relationship between the position held by the respondents within the company and the fact that online training offers/ or not a friendlier and more relaxed environment. We have two categories, namely boss and employee. We also count the answers to a yes/no question. We describe the data in a contingency table, as follows from Figure 10.

	boss <dbl>	employee <dbl>
yes	30	193
no	6	17

Fig. 10. The contingency table representing the position held by the respondents within the company and their opinion about the online training

In the sequel, the expected frequencies are calculated, by the following R code: `chisq.test(fctFrd)$expected`. Note that in the contingency table there are many cells with values below five. As a consequence, the Chi-square test may be wrong, so we refer only to the Fisher's exact test. The relevant R code is `fisher.test(fctFrd, workspace=2e7)`.

Fisher's Exact Test for Count Data

```
data: fctFrd
p-value = 0.1197
alternative hypothesis: true odds ratio is not equal to 1
95 percent confidence interval:
 0.1506327 1.4805547
sample estimates:
odds ratio
 0.4422501
```

Fig. 11. The expected frequencies for the table representing the position held by the respondents within the company and their opinion about the online training

By performing Fisher's exact test in R, we obtain a p-value of 0.1197 (see Figure 11). Since the p-value is greater than the threshold of 5%, we do not reject the null hypothesis. As a consequence, we do not reject the independence of the variables. On the other hand, we do not accept the null hypothesis (the possibility of having no relationship between the position held by the respondents within the company and the fact that the online training offers a friendlier and more relaxed environment) because the p-value is very close to the threshold.

3.2.3. The highest successfully completed level of education and the level of accessibility of the application SSM.RO

In this section, we study whether there is an association between the highest successfully completed level of education (which can be university or high school) and the degree of accessibility of the application SSM.RO (which contains 5 categories). This can be seen in Figure 12.

	university <dbl>	highschool <dbl>
1-very hard access	0	0
2-hard access	1	1
3-medium access	9	2
4-easy access	37	22
5-very easy access	159	15

5 rows

Fig. 12. The contingency table of the highest successfully completed level of education and the degree of accessibility of the application SSM.RO

We calculate the expected frequencies in Figure 13. As an observation, we cannot use the Chi-square test of independence since there are several variables with values below 5.

1-very hard access	0.000000	0.000000
2-hard access	1.674797	0.3252033
3-medium access	9.211382	1.7886179
4-easy access	49.406504	9.5934959
5-very easy access	145.707317	28.2926829

Fig. 13. The expected frequencies for the table representing the highest successfully completed level of education and the level of accessibility of the application SSM.RO

We will use Fisher's exact test instead, as follows from Figure 14.

```
Fisher's Exact Test for Count Data
data: stdAccApp1
p-value = 3.023e-06
alternative hypothesis: two.sided
```

Fig. 14. Fisher's exact test for the table representing the highest successfully completed level of education and the level of accessibility of the application SSM.RO

Note that the p-value is very small, namely 3.023×10^{-6} . This shows that there is a very significant association between the variables in the columns and in the rows of the contingency table.

4. Conclusions

Fisher's exact test also helped us to draw the conclusion that the area in which the employees operate is related to the fact that the online training sessions with the application SSM.RO have a higher degree of efficiency than other instruction forms.

It is very important that more than 91% of the workers expressed their wish to have the future instruction sessions in an online environment because the application SSM.RO was evaluated as intuitive and easy to use.

The benefits of the digitalization of the activity of the occupational health and security systems are multiple. By using the application SSM.RO one can issue, transmit and sign any document in an electronic format. One of the most important components of the application SSM.RO is the possibility to generate and send by phone message or by e-mail any type of training related to the legislation on occupational health and security systems or informative materials related to the rules of conduct and protection measures (the transmitted documents can have a pdf, audio, video or pps format). Moreover, by means of the application SSM.RO, the employers can transmit work instructions, operating procedures, technical solutions, contracts and any other documents which are related to the activity and are fully consistent with the standards regarding the occupational health and security systems.

Another very important aspect related to the use of the online environment, especially in the process of remote training of the workers, is represented by the possibility to electronically sign the documents that are issued and transmitted in an electronic format. We mention that the certificates for the remote electronic signature that are used by the application SSM.RO are issued by a Romanian provider who is qualified for remote electronic signature.

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