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Review of Management Comprehensiveness on Occupational Health and Safety for PPP Transportation Projects

Dimitrios Dimitriou [1,*] and Konstantinos Papakostas [2]

[1] Department of Economics, Democritus University of Thrace, 69100 Komotini, Greece
[2] Olympia Odos SA, 4 Rizareiou Str., Chalandri, 15233 Athens, Greece; kpapakostas@olympiaodos.gr
* Correspondence: ddimitri@econ.duth.gr

Abstract: Sustainability of large transport infrastructure projects is directly linked with the working conditions and procedures in construction and maintenance. Furthermore, safety is one of the most crucial performance indicators for transport infrastructure operators, dealing with management priorities, policies and measures closely related to Occupational Health and Safety (OHS). This issue is extremely important especially for public private partnerships (PPP), extensively adopted in transport sector in many regions, where detailed contacts and OHS provisions should be considered. By a systemic analysis, this research identifies the key management factors influence safety performance in the PPP/concession projects and the management comprehensives over those factors. The survey analysis framework for the evaluation of OHS management performance for large transport operators are breakdown, promoting the structure and the expected outcomes toward sustainable management of transport infrastructure. The application is the Greek motorways concessions projects that implemented in the last decade. The research outputs provide key messages to planners, managers, decision makers, and stakeholders over large transport infrastructure sustainable development, promoting OHS performance aspects should be taken into consideration in operation management contacts and highlighting the link between OHS, level of safety, and sustainability. The case study structure and outputs are valuable for comparisons with similar cases, provide the framework for using in other places and/or cases and stimulate the interest for further research.

Keywords: occupational health and safety; concession projects management; safety management; safety performance; sustainable management in transportation; transport infrastructure

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1. Introduction

It is a common practice that many countries seek new ways to manage and finance their transport infrastructure projects through the formation of Public Private Partnerships (PPPs) [1,2]. Large transport infrastructure projects constitute capital intensive projects where the pay-back period may extent from many years to some decades [3–5]. Therefore, PPPs agreement leverage capitals from the private sector and share the business risks between the involved parties, [6,7]. Identifying the reasons for PPP contracts in transport sector, three key factors can be highlighted: (a) the project financing conditions and the capitals availability and cost for implementing the projects; (b) the agreement on performance management, governance and productivity of the project; and (c) the sharing mechanism of business incentives and risks [8].

Possibly the most common practice to apply PPPs is the concession approach, according to which the concessionaire takes over the financing, design, construction, maintenance, operation and exploitation of the infrastructure project, [9]. Therefore, the concessionaire collects the fees/fares that the users of the infrastructure pay to meet its business plan where a bottom line regarding the debt/loans coverage is well illustrated in the contact, and in many cases caps in earnings and benefits are also included for a pre-defined, contractually agreed period of time [7,9,10].

The construction of the project is taken over by the concessionaire and executed usually by the construction sector of the shareholders. Therefore, the concessionaire does not construct itself, but gives the rights and obligations in a back-to-back scheme to its shareholders, [11]. Consequently, the shareholders are becoming subcontractors at the same time. In parallel, the concessionaire has the obligation to operate and maintain the project. Once again, the maintenance of the project is executed either by the concessionaire itself or the affiliated companies [9]. Therefore, the concessionaire has to manage its subcontractors in the maintenance of the project in terms of project management, price, quality, safety, whereas (at the same time) its subcontractors are directly related with its shareholders. The obstacles are obvious, since supervising or monitoring an entity with which there is a direct relationship cannot provide a framework of independent control, [9,10].

Sustainability of these projects is directly linked with the conditions facing the personnel working for their construction and maintenance, as part of the society pillar including in the objectives announced by the United Nations for sustainable development [12]. Prevention of accidents at work and occupational diseases ensure a better wellbeing for the personnel working on PPP/concession projects [13,14]. In addition, especially regarding transportation infrastructure projects, the smooth and better operation and construction of these projects depends on management comprehensiveness over safety issues [15,16].

2. Literature Review

The key objective of this research deals with the investigation of how the transport infrastructure operators are understanding and prioritize Occupational Health and Safety (OHS) in corporate environment and evaluate the importance of incentives and actions for improving the level of safety in operation of transport infrastructures [16,17]. The application is the concession projects/PPPs, referring to private sector management in public transport infrastructure, providing key messages to planners, managers, and researchers in the field of transportation and asset management [18,19].

By a systemic approach and by reviewing relevant literature, the key factors influencing OHS are presented thoroughly in this research. The prioritization of the key performance factors and the incentives towards efficiency and performance in the frame of OHS are reviewed by a questionnaire where the structure and the expectations in terms of outputs are analyzed. The numerical application is the Greek PPP projects that represent the 80% of the new infrastructure investments implemented in transportation sector in this state. It is noteworthy that the survey contacted to PPP project personnel that it is active in all responsibility levels of corporate hierarchy including top and operational management.

Management factors such as the customization of the contracts with the subcontractors, the analysis of the occupational health and safety conditions in the design phase of the project, the clear definition of roles and responsibilities on site, but also the commitment to occupational health and safety from the top management of the company are directly contributing aspects which support the achievement of a high safety performance level in a PPP/concession project. Furthermore, the creation of the safety climate in the worksite, a smooth, comprehensive and organized flow of information, in combination with the proper staff management and site organization, can provide an adequate environment for effective project in terms of occupational health and safety. Finally, the implementation of an occupational health and safety management system along with a field and live risk management scheme provide all of the technical tools to mitigate the occupational hazards and improve the working conditions. On the other, hand, it seems that the extended level of subcontracting as well as the conditions developed due to the COVID-19 pandemic cannot be an obstacle for achieving high safety performance in PPP/concession projects. Similarly, the implementation of a system for sanctions and rewards in the worksite of PPP/concession projects does not seem to have necessarily a positive effect for the enhancement of the safety performance.

The proposed survey structure and the presented statistical analysis approach addressed the correlation of OHS and management performance factors, such as learning,

performance monitoring, operative risk management, and safety climate. Particularities of the concession projects/PPPs are considered and the survey analysis outputs provide key messages in a worldwide scale. The survey is addressed to both top and middle management, providing feedback from all involved responsibility actors in managing OHS, identifying best practices and key areas may need to take additional actions and measures. Finally, good practices are highlighted and key findings for the liaison between safety performance and safety management constitute input for further research are highlighted.

Conventional wisdom is to present the structure for contacting a survey to evaluate the management comprehensiveness over OHS for large transport operators. The numerical application provides essential messages to compare with relevant cases in transportation, but also to other relevant industries such as energy and telecommunication. The survey results provide essential messages to planners, managers and decision makers in the transportation sector towards OHS comprehensiveness and highlight key actions towards effective safety performance.

3. Survey Structure and Results Evaluation

3.1. Assessment Concept and Variables

Management priorities and tools influencing OHS is critical over safety performance of developing transport infrastructure projects covering the whole project lifecycle, including the construction and the operation period [17,18]. In particular, factors such as commitment, project management, supervision and staff management have been introduced in the concessions/PPP sector and affect the safety performance in infrastructure projects [19,20]. Additionally, the new operational conditions due to COVID-19 affect the safety performance and, on the other hand, the application of sanctions and rewards as a tool to motivate personnel to improve the performance on site in terms of occupational safety [21,22].

By a systemic approach in activities, responsibilities, tasks and targets have to be addressed in PPP projects (i.e., the key issues linked the OHS perception in corporate environment) [23–26]. The review of above items is critical to evaluate the corporate climate, culture and attitudes on OHS that represent the management comprehensive over safety [27,28]. The adopted concept of OHS comprehensives deals with a proactive management orientation dealing with measures and actions that mitigate OHS risks to employees and improve safety to infrastructure users [29,30]. An analysis of key issues linked with OHS in transportation infrastructure projects is depicted in Figure 1.

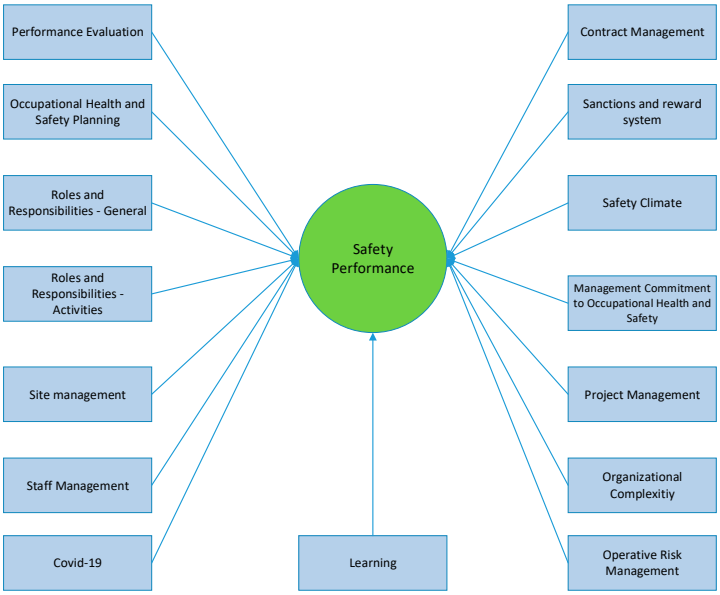

Figure 1. Depiction of conceptual assessment of the OHS management comprehensiveness for large transport infrastructure operation.

3.2. Questionnaire Structure

The analysis of OHS comprehensiveness driven by a questionnaire developed in the basis on the above concept. After the survey data collection, the data analysis method defined using the variables as derived from the literature review as presented above, but also occurred due to the current conditions such as COVID-19 conditions and presented below, along with details for each variable, as presented below (Table 1).

Table 1. Variables and Definitions.

Variables		Details
1	Contract management	Adjustments of safety requirements/specifications to the particularities of each construction project
2	Occupational Health and Safety planning	Analysis of the Occupational Health and Safety conditions of a construction project
3	Roles and responsibilities-General	Assignment of the tasks and responsibilities
4	Roles and responsibilities-Activities	Assignment of the tasks and responsibilities for specific activities
5	Organizational complexity	Extended subcontracting escalation (contractor uses subcontractor, who uses his subcontractor and so on)
6	Project management	Overall management of a construction/maintenance project
7	Management commitment to OHS	Management will to establish and implement safety measures
8	Safety climate	The perceived level (feeling) of safety
9	Sanctions and reward system	A system that provides sanctions to those not applying safety measures and rewards to those that do apply safety measures
10	Learning	The learning resulted after an investigation and generally the flow of information
11	Site management	General worksites organization
12	Staff management	Management of staff in terms of training, supervision, evaluation, appraisal, creation of environment of trust
13	Operative risk management	A scheme that includes activities during the execution of the project, such as identification of risks their evaluation, definition of mitigation measures, evaluation of remaining risk, reporting, etc.
14	Performance evaluation	Development of a safety management system according to International Standards (ISO 45001, etc.) to monitor and evaluate the safety performance
15	COVID-19	Working conditions developed due to COVID-19

The survey results analysis is delivered by using the SPSS statistical software. The analysis structure delas with the above variables including a series of sub-questions, focusing on creating reliable and reasonable explanations in the collected information. Therefore, the research participants, based on their general experience, provided their opinions on questions which were structured on the framework of the above variables, as presented below (Table 2).

Table 2. Questionnaire items and SPSS output.

Variables	Items	SPSS Output Variable Name
Contract management	Adjustments of safety requirements/specifications to the particularities of each construction project	Q5

Table 2. *Cont.*

Variables	Items		SPSS Output Variable Name
Occupational Health and Safety planning		Analysis of the Occupational Health and Safety conditions of a construction project	Q6
Roles and responsibilities-General		Assignment of the tasks and responsibilities	Q7
Roles and responsibilities-Activities	i.	Definition of measures by specific person(s)	Q8.1
	ii.	Performance of inspections by specific person(s)	Q8.2
	iii.	Identification of non-compliances by specific person(s)	Q8.3
	iv.	Definition of corrective actions by specific person(s)	Q8.4
	v.	Approval of corrective actions by specific person(s)	Q8.5
	vi.	Application of sanctions/rewards by specific person(s)	Q8.6
	vii.	Suspension of works by specific person(s)	Q8.7
Organizational complexity	i.	Ability to control and manage all subcontractors	Q9.1
	ii.	Flow of information (specifications, requirements, decisions, etc.) top down to all subcontractors	Q9.2
	iii.	Supervision of all subcontractors is time spending	Q9.3
	iv.	Limited control on the competency of the personnel of all subcontractors	Q9.4
	v.	Communication channels are complex when many entities participate	Q9.5
Project management	i.	Dedicated resources for health and safety	Q10.1
	ii.	Balanced coordination of construction activities,	Q10.2
	iii.	Smooth communication in the worksite between the involved entities	Q10.3
	iv.	Level of meeting the requirements	Q10.4
	v.	Sufficiency of time for the completion of the project	Q10.5
Management commitment to OHS	i.	Clear statement health and safety objectives	Q11.1
	ii.	Clear statement of the safety requirements	Q11.2
	iii.	Active participation to implementation of the safety guidelines	Q11.3
	iv.	Full participation in the training process	Q11.4
	v.	Enhanced participation in the incident/accident investigation	Q11.5
	vi.	Large participation in the safety inspection process	Q11.6

Table 2. *Cont.*

Variables	Items		SPSS Output Variable Name
Safety climate	i.	General labor environmental framework focusing on current personnel needs	Q12.1
	ii.	Proper staff management	Q12.2
	iii.	Management high commitment for achieving a high level of safety	Q12.3
	iv.	Personnel high level of involvement and enhancement of the learning process	Q12.4
	v.	Best project management	Q12.5
	vi.	Clear definition of roles and responsibilities	Q12.6
	vii.	Personnel feeling satisfied and dedicated to implement the safety system	Q12.7
	viii.	Depth of cooperation and interaction	Q12.8
	ix.	high empowerment conditions to support personnel	Q12.9
Sanctions and reward system	i.	Integrity of the evaluators	Q13.1
	ii.	Fairness of the system	Q13.2
	iii.	Definition of the terms from the very beginning	Q13.3
	iv.	Encouragement to continue reporting incidents	Q13.4
Learning	i.	Incidents (accidents as well as near misses) were reporting	Q14.1
	ii.	Detailed incident investigation and lessons learned diffusion	Q14.2
	iii.	Proper circulation of health and safety requirements to all personnel	Q14.3
	iv.	Proper circulation of health and safety instructions and measures to all personnel	Q14.4
Site management	i.	Clear definition of working zones	Q15.1
	ii.	Separation pedestrian areas from vehicle zones	Q15.2
	iii.	Securing danger zones storage areas	Q15.3
	iv.	Good housekeeping in general	Q15.4
Staff management	i.	Personnel sufficient training	Q16.1
	ii.	Personnel adequate skills and qualifications	Q16.2
	iii.	Manager's sufficient and contributing supervision	Q16.3
	iv.	Manager's active involvement in providing solutions in safety issues	Q16.4
	v.	creation of positive environment in the worksite as well as a safety climate	Q16.5
	vi.	good relationship between management workers	Q16.6

Table 2. *Cont.*

Variables	Items		SPSS Output Variable Name
Operative risk management		A scheme that includes activities during the execution of the project, such as identification of risks their evaluation, definition of mitigation measures, evaluation of remaining risk, reporting, etc.	Q17
Performance evaluation		Development of a safety management system according to International Standards (ISO 45001, etc.) to monitor end evaluate the safety performance.	Q18
COVID-19	i.	Personnel training only via teleconference	Q19.1
	ii.	Personnel limitations in mobility	Q19.2
	iii.	Discomfort due to application of personal protective measures (masks, etc.)	Q19.3
	iv.	Operational and production difficulties due to technical measures required (disinfection of tools, etc.)	Q19.4
	v.	General feeling of insecurity	Q19.5
	vi.	Stress	Q19.6
	vii.	mental health at risk	Q19.7

Moreover, there are demographic questions added to these variables and items, such as age, level of education, work position and sector of business currently working. Following the introductory demographic part, the questionnaire consisted of three additional parts. The types of these questions used in the questionnaire was structured as below:

- 5-scale Likert type direct questions with no sub-questions (questions 5–7, 17, 18);
- 5-scale Likert type direct questions with sub-questions (questions 8–16, 19).

Regarding the profile of the survey correspondence is adopted the following categories (Table 3):

Table 3. Key profile characteristics for the survey correspondence.

Profile of Survey Correspondence			
ID/Range	**Age**	**Education**	**Occupancy**
1	Up to 30	Middle school	Worker
2	31–40	High school	Production/Operation
3	41–50	Bachelor	Middle Management
4	51–60	Master	Executive
5	60+	PhD	Partner/Investor

4. Survey Results Analysis

4.1. Questionnaire Participants Profile

The invitees were invited to participate, via personal messaging indicating the focus of the research as well as the characteristics of the sample of the participants. All of the recipients of the questionnaire hold an engineering field of expertise and have an experience in concession projects, either as health and safety experts or as managers responsible to implement the necessary occupational health and safety measures, whereas most of them

are currently collaborating with a PPP/concession project. The questionnaire was shared, between 210 persons from 25 national and international organizations and 58 replies received which equals to a return rate of 27.6%. The sector of business of the participants' organizations is shown as below:

- PPP/concession infrastructure project in Greece: 44.8%
- International PPP/concession infrastructure project: 5.2%
- Occupational Health and Safety consultant: 15.5%
- Industrial (manufacturing, construction, etc.): 13.8%
- Energy, utilities: 6.9%
- Other: 13.8%

The values in the following statistics are related to the above value of each selection (Table 4). Therefore, for example, when the mean of the age is 3.16, this means that the average age of the participants was slightly over 41 years old.

Table 4. Demographic statistics.

		What Is Your Age?	What Is the Highest Degree or Level of Education You Have Completed?	What Is Your Current Work Position?	Sector of Current Business
N	Valid	58	58	58	58
	Missing	0	0	0	0
Mean		3.16	3.84	2.97	2.88
Std. Error of Mean		0.134	0.069	0.101	0.279
Median		3.00	4.00	3.00	2.50
Mode		3 [a]	4	3	1
Std. Deviation		1.023	0.523	0.772	2.128
Variance		1.046	0.274	0.595	4.529
Skewness		−0.016	−0.954	−0.890	0.819
Std. Error of Skewness		0.314	0.314	0.314	0.314
Kurtosis		−0.723	2.570	1.162	−0.574
Std. Error of Kurtosis		0.618	0.618	0.618	0.618
Minimum		1	2	1	1
Maximum		5	5	4	7
Sum		183	223	172	167

Multiple modes exist. The smallest value is shown.

Since sector of business is a nominal variable, we cannot interpret the descriptive statistics in the same way.

4.2. Grouping of Variables

All questions are treated as a separate value. As mentioned before, we have the Likert scale, according to which 1 corresponds to 'No, I don't think so' to 5 which corresponds to 'Yes, I definitely believe that'. Not only descriptive statistics but also reliability and normality are addressed and calculated through these values.

4.3. Reliability and Validity of Data

In order to find out the level of reliability and validity of the research, we have to calculate Cronbach's a and factor analysis. Initially, the Cronbach's a factor is calculated to 0.676. The research can be considered as reliable and valid, if we have a number over 7. Therefore, from Table 4 we can see that if we delete and not take into account Q4, then the

Cronbach's a is 0.840. Indeed, from Table 5 we see that we reach that number for Cronbach's a. We can still improve this factor and increase it again. However, we have really minor improvement for any item/variable deleted. Consequently, we can take the Table 6 and conclude that we have reliable and valid data.

Table 5. Reliability statistics.

Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**		
0.676	0.852	19		
	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Age	73.8071	28.340	0.216	0.672
Level of education	73.1174	32.284	−0.138	0.694
Work position	73.9967	30.188	0.113	0.679
Sector of current business	74.0830	33.290	−0.248	0.840
Contract Management	72.3588	29.363	0.317	0.660
Occupational Health and Safety Planning	72.6519	28.992	0.268	0.663
Roles and responsibilities-General	72.3761	29.575	0.355	0.659
Operative Risk Management	72.8243	26.979	0.551	0.632
Performance Evaluation	72.6864	27.807	0.619	0.636
Roles and Responsibilities-Activities	72.6815	28.392	0.621	0.642
Organizational Complexity	73.0898	29.840	0.209	0.669
Project Management	72.6071	29.140	0.546	0.650
Management Commitment	72.6893	27.305	0.740	0.627
Safety Climate	72.6960	27.590	0.818	0.629
Sanctions and reward system	72.6347	27.265	0.652	0.630
Learning	72.3717	28.270	0.681	0.639
Site management	72.5269	27.448	0.758	0.629
Staff Management	72.5169	27.965	0.695	0.636
COVID-19	73.6051	30.947	0.024	0.688

Table 6. Reliability statistics (after removing Q4).

Cronbach's Alpha.	**Cronbach's Alpha Based on Standardized Items**	**N of Items**		
0.840	0.872	18		
	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Age	70.9278	27.964	0.396	0.841
Level of education	70.2381	33.201	−0.031	0.851
Work position	71.1174	30.327	0.279	0.842

Table 6. *Cont.*

Cronbach's Alpha.	Cronbach's Alpha Based on Standardized Items	N of Items		
Contract Management	69.4795	30.185	0.425	0.832
Occupational Health and Safety Planning	69.7726	30.023	0.327	0.839
Roles and responsibilities-General	69.4967	31.024	0.365	0.835
Operative Risk Management	69.9450	28.214	0.580	0.824
Performance Evaluation	69.8071	29.285	0.615	0.824
Roles and Responsibilities-Activities	69.8022	29.957	0.602	0.826
Organizational Complexity	70.2105	30.988	0.261	0.841
Project Management	69.7278	30.596	0.554	0.829
Management Commitment	69.8100	28.766	0.737	0.819
Safety Climate	69.8167	29.094	0.806	0.819
Sanctions and reward system	69.7554	28.493	0.688	0.819
Learning	69.4924	29.467	0.740	0.822
Site management	69.6476	28.860	0.765	0.819
Staff Management	69.6375	29.304	0.719	0.821
COVID-19	70.7258	33.784	−0.121	0.864

4.4. Contract Management Data Analysis

We can notice that the development of a detailed and customized contract to the needs of the project with the subcontractors can lead to better results in safety performance on site. A high majority of the respondents, which is calculated to 95%, confirms that adjusting the contracts to the particularities of each project can lead to better safety performance, as presented in Figure 2.

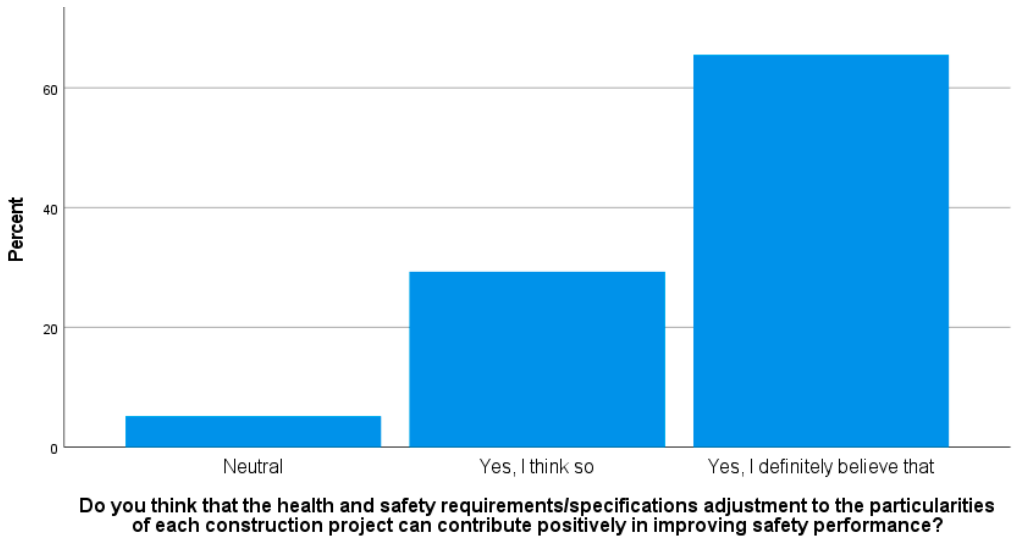

Figure 2. Contract management index.

4.5. Data Analysis for Occupational Health & Safety Planning

We can notice that the inclusion of the health and safety considerations in a project at its design phase is important for achieving high results in safety performance on site. We can notice that almost 90% of the respondents believe that safety performance is linked with the inclusion of the safety concept in the design phase of the project, as presented in Figure 3.

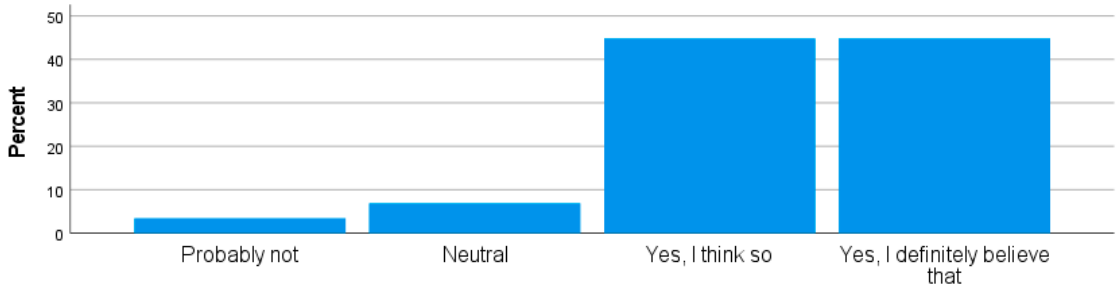

Figure 3. Occupational Health and Safety planning index.

4.6. Roles and Responsibilities Data Analysis

We can notice that all of the research participants believe that the construction sites of PPPs/concession projects need to have a clear status on who is doing what in terms of safety supervision, audits, providing instructions and generally on the role and responsibility of everyone. The assignment of tasks should be specific and realistic, so that everyone can easily make the correct decisions in the measures to comply with the safety requirements.

4.7. Data Analysis for Organizational Complexity-Subcontractors

There is no clear position of the respondents on whether the extended use of subcontractors negatively affects the safety performance on site, since we can even notice replies to around '2-probably' not and '3-neutral' about the factors that affect safety performance. This is also confirmed, since we can also see the standard deviation equals 0.647 and replies are found around mean 3.87, as presented in Figure 4.

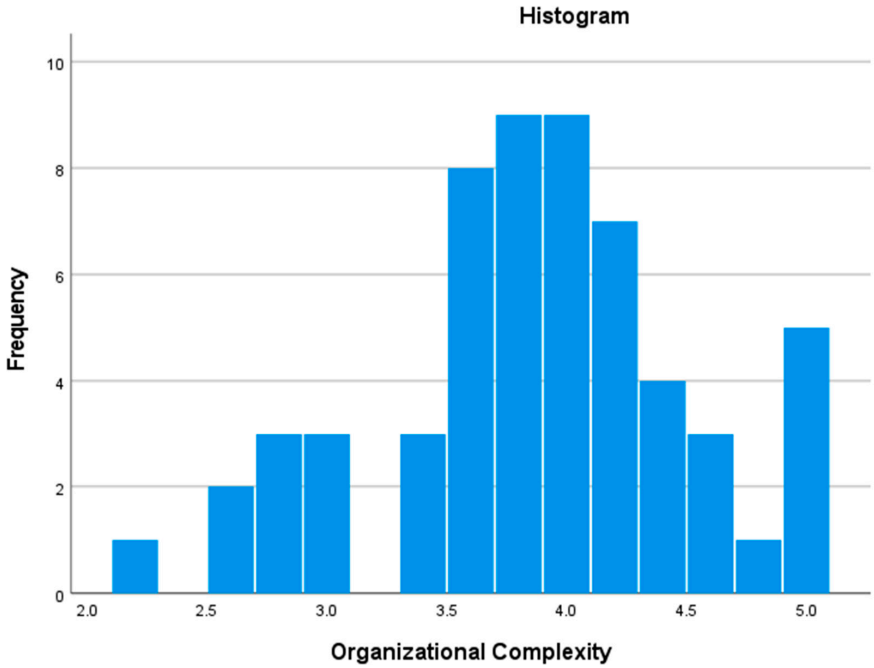

Figure 4. Index for organizational complexity-subcontractors.

4.8. Data Analysis for Management Commitment to Occupational Health & Safety

We can notice a strong belief that the top management commitment is critical for the enhancement of the safety performance in a construction site. Most respondents have replied that all different aspects of top management (as they are described in the sub-questions) are important to achieve high level of safety on site. Most replies are located around '4-yes I think so' and '5-yes I definitely believe that'. This is also confirmed, since we can also see the standard deviation equals 0.536 and replies are found around mean 4.27, as presented in Figure 5.

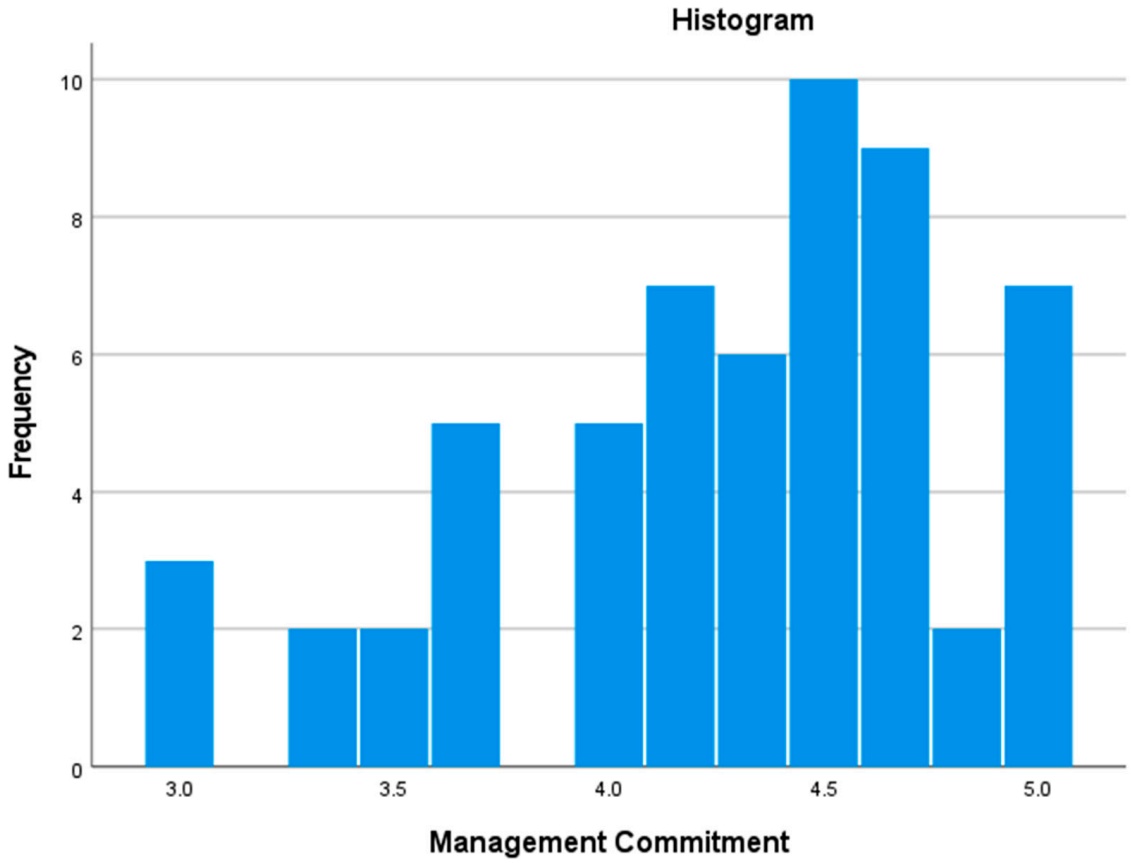

Figure 5. Index for management commitment to Occupational Health and Safety.

4.9. Safety Climate Data Analysis

It seems that the development of a safety climate in a construction/maintenance site of PPPs/concession projects is directly linked with the necessary applications of the safety measures and the safety performance, according to the participants of the research. All different aspects of safety climate (as they are described in the sub-questions) are important to achieve high level of safety on site. Most replies are located around' 4-yes I think so' and '5-yes I definitely believe that'. This is also confirmed, since we can also see the standard deviation equals 0.458 and replies are found around mean 4.27, as presented in Figure 6.

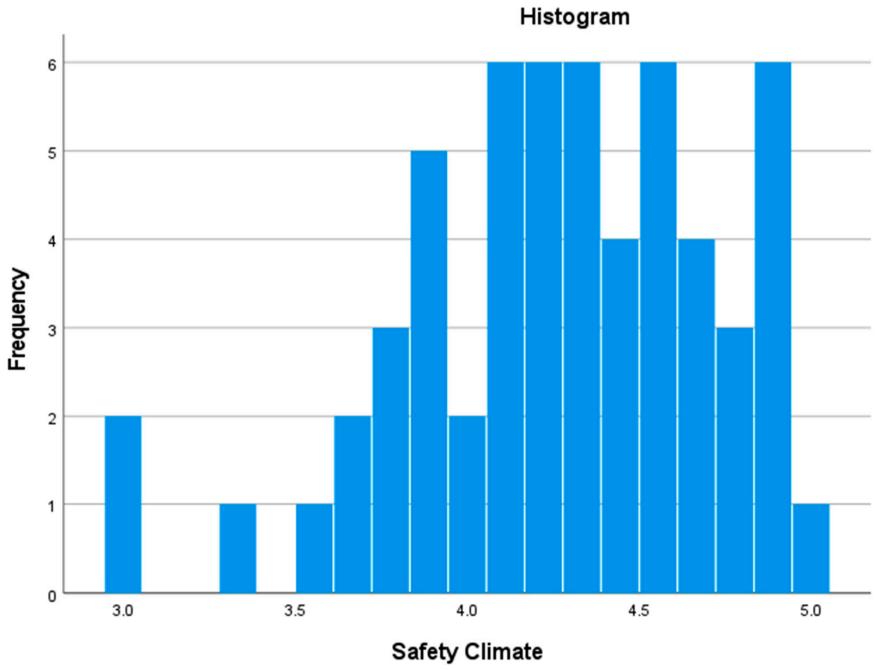

Figure 6. Safety climate index.

4.10. Data Analysis for Sanctions and Rewards System

There is no clear belief on whether a system, which provides sanctions in case of bad safety performance as well as rewards in case of good safety performance, can have that desired effectiveness in the improvement of the safety conditions on site. There are several answers close to 'Neutral'. Therefore, we can conclude that the involved personnel is hesitating in applying such a system. Although we can see the standard deviation equals 0.604 and replies are found around mean 4.33, there is no clear conclusion, since this curve seems to slightly deviate from a normal curve, as presented in Figure 7.

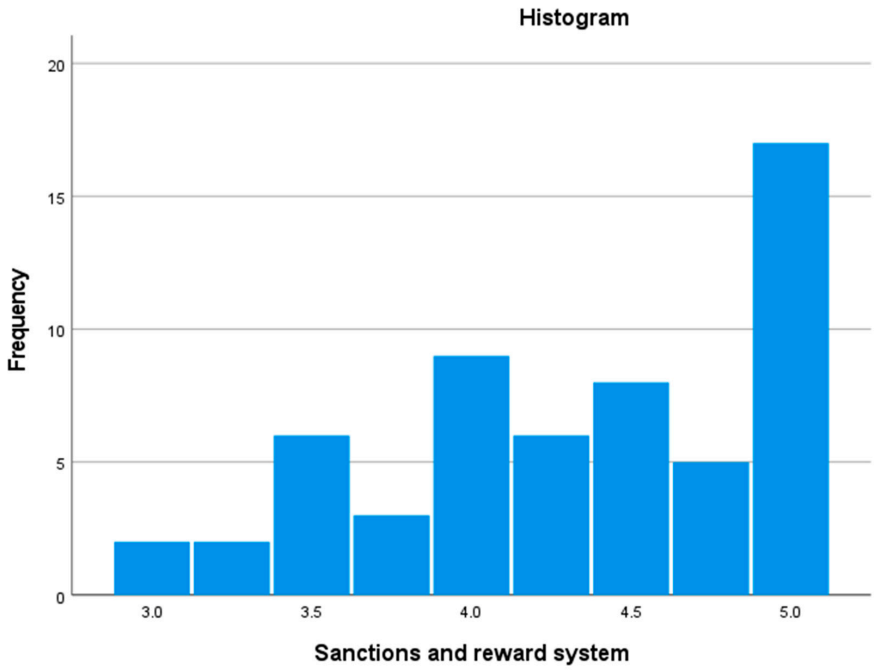

Figure 7. Index for sanctions and reward system.

4.11. Learning Data Analysis

In parallel, we can observe that most respondents consider as important that smooth flow of information as well as the functionality of the learning channels. When a new information, conclusion, instruction is developed for any reason (incident investigation, new assessment of risks, etc.), the construction site should have developed the communication and information diffusion channel, so that everyone on site is properly informed. Most replies are located around '4-yes I think so' and '5-yes I definitely believe that', as presented in Figure 8.

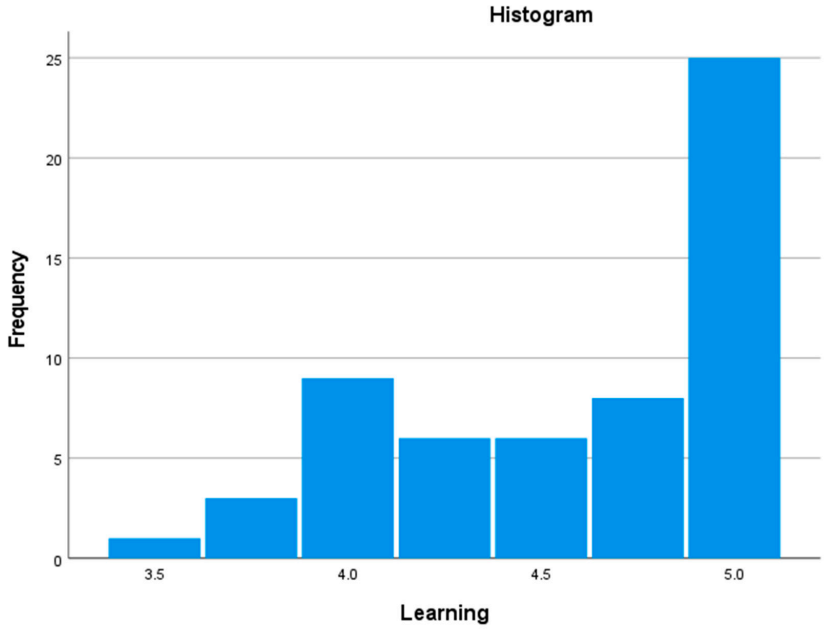

Figure 8. Learning index.

4.12. Site Management Data Analysis

In addition, we can notice that most correspondents agree with the important of the worksite organization and its factors (as they are presented in the sub-questions) and their effect in the achievement of safety performance. Most replies are located around '4-yes I think so' and '5-yes I definitely believe that', as presented in Figure 9.

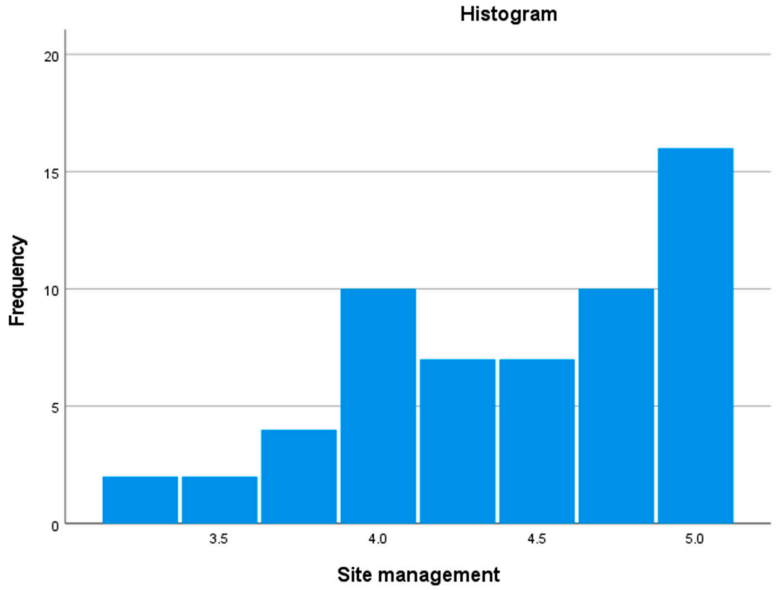

Figure 9. Site management index.

4.13. Staff Management Data Analysis

It is highly notable that most participants agree with the opinion that staff management has a contributing role in achieving a high level of the safety performance in a concession/PPP project. The staff management factors as they are presented in the sub-questions are crucial in affecting the safety behavior and consequently safety performance on site. Most replies are located around '4-yes I think so' and '5-yes I definitely believe that'. This is also confirmed, since we can also see the standard deviation equals 0.482 as well as replies are found around mean 4.45, as presented in Figure 10.

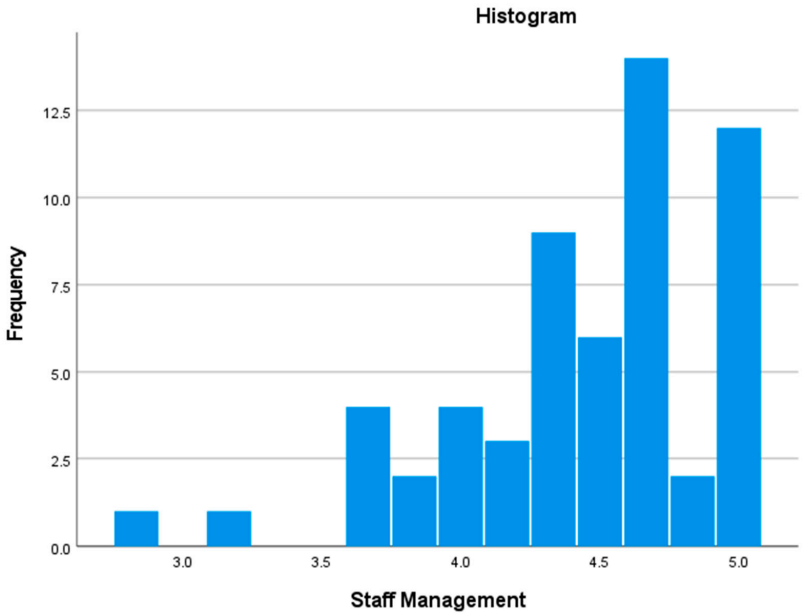

Figure 10. Staff management index.

4.14. Operative Risk Management Data Analysis

We can notice that the development of a methodology to identify, evaluate, and define measures to mitigate the risk, can support in the enhancement of safety performance on site. All of these steps as part of a holistic risk management system on site can lead to better results on safety. More than 80% of the respondents confirm that the proper management of the risks on site are positively influencing the safety performance in the construction site, as presented in Figure 11.

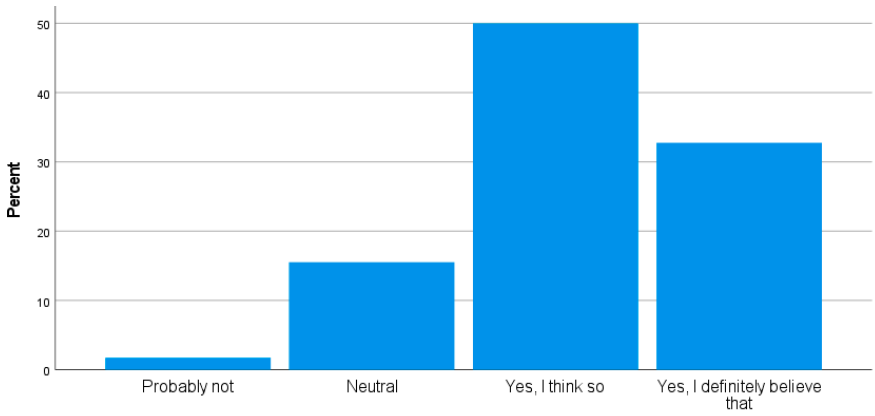

Figure 11. Operative risk management index.

4.15. Performance Evaluation Data Analysis

We can notice that the evaluation of safety performance as part of a comprehensive safety management system can provide the correct tools and opportunities for improving safety performance on site. Almost 95% of the research participants believe that the implementation of an occupational health and safety system actively contributes in achieving high safety performance results, as presented in Figure 12.

Figure 12. Performance evaluation index.

4.16. Data Analysis for COVID-19 and Implications in Occupational Health & Safety

On the other hand, it seems that COVID-19 and its implications in the daily works, but also the special working conditions developed during the pandemic, do not affect significantly the safety performance on site. This means that there is no clear position of the participants on whether COVID-19 implications have actually affected the safety performance on site, since we can even notice replies to around '2-probably not' and '3-neutral' about the factors that affect safety performance. This is also confirmed, since we can also see the standard deviation equals 0.766 as well as replies are found around mean 3.66, as presented in Figure 13.

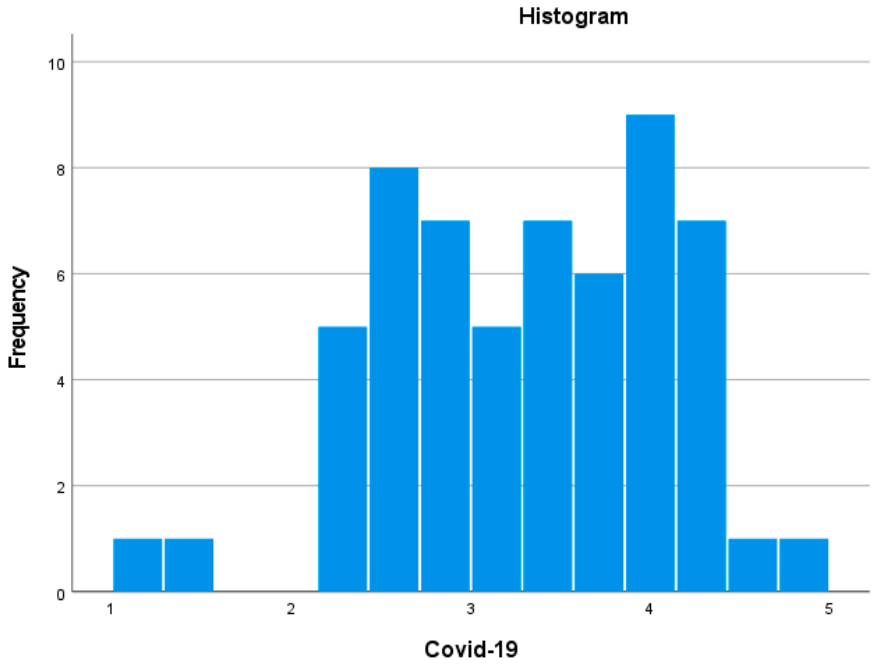

Figure 13. COVID-19 implications index.

4.17. Data Analysis for Project Management

Finally, the respondents believe that the general project management, not strongly but quite positively, affects the safety performance on site. The different aspects of the project management contribute in maintaining of enhancing lever of safety on site. Most replies are located around '4-yes I think so'. This is also confirmed, since we can also see the standard deviation equals 0.412 and replies are found around mean 4.36, as presented in Figure 14.

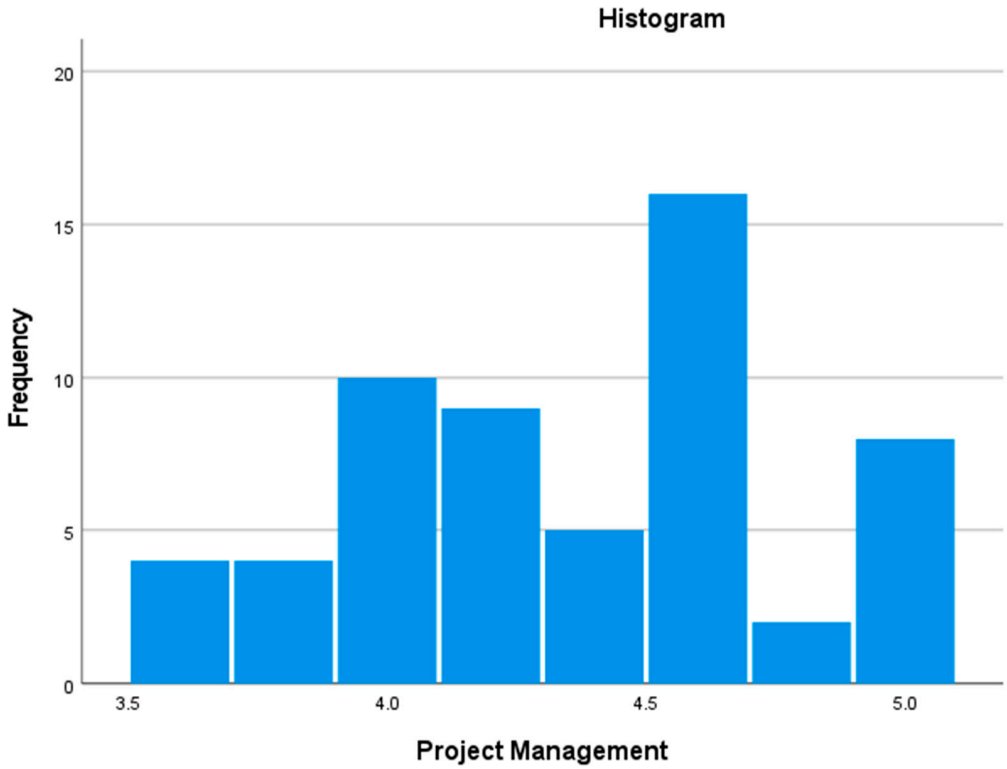

Figure 14. Index for project management.

4.18. Correlation between Variables

In order to examine the correlation between the variables, we used inferential statistics and more specifically Pearson test. For our research, there are two levels of significance in the correlation test: the 0.01 and the 0.05 *p*-value. So, if $p < p\ value$, then we can say that there is a correlation in that particular significant level. We can see in the Table 7 the Pearson test along with the correlation significance (above mentioned '*p*'). The extract of SPSS provides us with the opportunity to highlight the correlation between the variable, since there is a star (*), either double or single, depending on the level of significance, when there is a correlation between the variables. It seems interesting to identify the correlation between the demographic and the dependent variables. Therefore, and in addition, we have highlighted in yellow the Pearsons result where there is a correlation. Of course, we can omit the correlation between a demographic variable and another demographic variable. In parallel, the correlations of the sector of business are not considered important, since–as we saw from Crombach's a test-, our research is reliable only if we do not take into account this variable.

In general, Table 7 presents the value for the Pearson test between all demographic variables and dependent variables in two axes; vertical and horizontal. However, for visibility purposes we present and use only the horizontal axe, without omitting any information.

Table 7. Variables correlation.

		Age	Education	Work Position	Sector of Business	Contract Management	Occupational Health and Safety Planning	Roles and Responsibilities-General	Operative Risk Management	Performance Evaluation	Roles and Responsibilities-Activities	Organizational Complexity-Subcontractors	Project Management	Management Commitment	Safety Climate	Sanctions and Rewards	Learning	Site Management	Staff Management	COVID-19
Pearson Correlation	Age	1	−0.053	0.363 **	−0.443 **	0.162	0.346 **	0.163	0.297 *	0.325 *	0.230	0.009	0.208	0.263 *	0.318 *	0.399 **	0.473 **	0.341 **	0.302 *	−0.334 *
	Level of education	−0.053	1	0.073	−0.285 *	0.081	−0.054	0.221	−0.171	−0.212	−0.034	0.096	0.114	−0.003	0.037	0.025	−0.088	0.011	0.059	−0.222
	Work position	0.363 **	0.073	1	−0.430 **	0.162	0.320 *	0.008	0.194	0.104	−0.062	0.139	−0.038	0.186	0.214	0.128	0.312 *	0.375 **	0.239	−0.238
	Sector of current business	−0.443 **	−0.285 *	−0.430 **	1	−0.290 *	−0.162	−0.048	−0.101	−0.031	0.007	−0.146	−0.054	−0.040	−0.024	−0.126	−0.185	−0.064	−0.103	0.394 **

Single star (*) corresponds to 0.05 level of significance, whereas double star (**) corresponds to 0.01 level of significance.

4.19. Age Correlation

It is impressive that age is correlated –to any level of significance- with many variables. The value for the Pearson test between Age and Occupational Health and Safety Planning is calculated to 0.346 in a 0.01 level of significance, which means that these two variables are highly correlated. In addition, the value for the Pearson test between Age and Operative risk management is calculated to 0.297 in a 0.05 level of significance, which shows a strong correlation as well. Moreover, the value for the Pearson test between Age and Performance evaluation is calculated to 0.325 in a 0.05 level of significance, which –again- indicates a strong correlation. Furthermore, the value for the Pearson test between Age and Management Commitment is calculated to 0.263 in a 0.05 level of significance, which –again- indicates a strong correlation. The value for the Pearson test between Age and Safety Climate is calculated to 0.318 in a 0.05 level of significance, showing again a strong correlation. The value for the Pearson test between Age and Sanctions and reward system is calculated to 0.399 in a 0.01 level of significance, showing a really high correlation. Again, the value for the Pearson test between Age and Learning is calculated to 0.473 in a 0.01 level of significance, showing again really high correlation. Similarly, the value for the Pearson test between Age and Site management is calculated to 0.341 in a 0.01 level of significance, showing once again really high correlation. In parallel, the value for the Pearson test between Age and Staff Management, calculated to 0.302 in a 0.05 level of significance, showing strong correlation. Finally, the value for the Pearson test between Age and COVID-19 implications is calculated to -0.334 in a 0.05 level of significance, showing strong inverse correlation. This means that when someone is older and more experienced, believes that these variables affect more in the safety performance on site.

4.20. Work Position Correlation

In addition, there is a correlation between Work Position on the one side, and on the other the Occupational Health and Safety Planning, the Learning and the Site Management. The value for the Pearson test between Work Position and Occupational Health and Safety Planning is calculated to 0.320 in a 0.05 level of significance, showing strong correlation. In addition, the value for the Pearson test between Work Position and Learning is calculated to 0.312 in a 0.05 level of significance, showing –again- strong correlation. Finally, the value for the Pearson test between Work Position and Site Management is calculated to 0.375 in a 0.01 level of significance, showing a really high correlation. This means that the higher a position someone holds, the greater effect believes these variables have to the safety performance.

5. Discussions

In general, we can observe that most of the management aspects affecting the safety performance on site are also confirmed in PPP/Concession Projects. However, the research showed that there are specific particularities due to the nature of the PPP/concession projects, and therefore not all findings agree with the findings of the general construction framework.

Furthermore, it is generally accepted that the commitment to occupational health and safety from the top management of the company is an absolute necessity and an important prerequisite for the achievement of the safety performance. The strategy designing of the top executives inside a company should involve the safety attitude. The top management sets the target, provides the resources, supports the middle management in the decision-making process and asks for concrete results. These are the tools, with which a construction/maintenance site can organize itself and coordinate its activities, setting safety as a first priority.

Of course, we cannot ignore that this research has taken place in the era of COVID-19 influence. Therefore, every participant is highly affected personally and professionally from the special conditions developed due to the pandemic. However, it seems that COVID-19 and its implications in the daily works but also the special working conditions developed do not affect significantly the safety performance on site. The replies of the

research participants vary among the level of effect that the different conditions developed due to COVID-19 could have. There is no clear outcome whether the extra organizational measures applied or the extensive mental health risks negatively affect the implementation of the safety measures in the worksites of the PPP/concession projects.

Moreover, it seems that the general management of the project directly affects the safety performance on site. It is critical to dedicate resources for health and safety issues targeting not only to meet the legislative requirements, but also to reach a high level in terms of safety performance. In the framework of the proper organization of the project, the balanced coordination of construction activities ensures the sufficiency of time for the completion of the project. An important aspect is to clearly set the regulations on the communication between the involved entities in the worksite, so that it can be performed in a smooth basis. This is highly crucial, since the environment of a PPP/concession project includes many involved entities, partners, joint ventures, and subcontractors, all of which should have a clearly defined role, avoiding any conflict.

As expected, a highly critical factor, which affects the safety performance in the PPP/concession projects, is the staff itself and its management. The way that a worksite is treating its personnel in terms of safety, usually defines the compliance as well as the performance for these issues. The managers in the construction site should ensure that the personnel should be sufficiently trained for the safety rules and measures to be applied in the site, but also it should hold any necessary skills and qualifications related to their duties and responsibilities. Therefore, each task will be executed by personnel who are aware of the necessary safety measures for the specific works. In parallel, managers will practice a sufficient and contributing supervision, providing solutions for any occurring safety issues. Consequently, a good relationship between management and workers will be created along with a positive environment in the worksite.

Finally, the correlation between the variables showed that depending to the respondent's age the replies may vary. However without any significant change to the overall spirit of the reply. Age affects the reply to management factors such as Occupational Health and Safety planning, roles and responsibilities, operative risk management, performance evaluation, organizational complexity and subcontractors, project management, management commitment, safety climate, sanctions and reward system, learning, site management, staff management and COVID-19. In addition, work position and position in the decision-making process affects management aspects such as Occupational Health and Safety planning, learning, and site mmanagement. This means that the higher a position someone holds, there is a stronger belief that these variables affect the safety performance on site.

However, these working conditions occur since the project designs lack of a safety prospect. For example, many works at height could have been more easily and safely executed, if in the initial design of the construction, the designer have provisioned a clear and safe way to reach that height. Thus, it seems now that a global effort has commenced, focusing on including those issues early enough (i.e., in the design phase).

6. Conclusions

Conclusively, it is highly critical for companies, organization, but also states' authorities to acknowledge the safety management as part of the overall strategy, in order to ensure their sustainability and their positive impact to the society and the local communities. The key objective of this paper is to investigate how the PPP/Concession companies prioritize Occupational Health and Safety incentives that need to be introduced, in order to improve OHS in concession projects/PPPs, since sustainability of these projects is directly linked with the conditions facing the personnel working for their construction and maintenance. In that view, the authorities should increase the support to the organizations not only for the development of a safety structure as described above, but also for the development of the necessary tools to control the correct implementation of the safety measures. The management factors presented in the research can also be the compass for the organizations as per

their focus towards high safety performance results. Further research can indicate that the improvement of safety performance pays back not only for companies but for states as well. Therefore, a common effort by the involved parties on the axes described in this research and presented as safety management factors can positively contribute in the long-term improvement of the working conditions in a construction site. Consequently, occupational health and safety in the concession projects/PPP can contribute to the sustainability of the projects, in the framework of the workers/personnel and their personal environment wellbeing. Taking also into account the experience worldwide, where technical projects may be structured in a scheme different from concessions/PPPs, concrete knowledge is developed towards the creation of the necessary management tools to overpass obstacles and deviations from high safety standards.

The analysis presented in this paper provides a detailed structure of a survey to identify the level of comprehensives of OHS for PPPs transport infrastructure. However, the analysis could be extended to include the lower level of hierarchy (i.e., the workers in a construction/maintenance site). Their point of view could be very useful in the investigation of the causes of a bad safety performance. Moreover, further research could be interesting to investigate the specific topic under completely different legislative and attitude conditions. It would be interesting to see whether different safety attitudes correlate (or not) with a multicultural environment.

Furthermore, all of the management factors identified in the process of the current analysis can constitute a topic for specific analysis with regard to its liaison with the contribution or not in achieving a high level of occupation health and safety performance in Concession Projects/PPPs. Finally, the outcome of this research can be a contributing item in the safety management worldwide. The experience of the Concession Projects/PPPs can be incorporated in the best practices applied in other project structures worldwide, aiming to achieve a safer working environment. Global efforts for the improvement of the management tools efficiency can result in sustainable organizations.

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References

1. Dimitriou, D. Deterministic Modeling to Estimate Economic Impact from Implementation and Management of Large Infrastructure. *Int. J. Ind. Syst. Eng.* **2017**, *11*, 2754–2759. [CrossRef]
2. Adem, A.; Çakit, E.; Dağdeviren, M. Occupational health and safety risk assessment in the domain of Industry 4.0. *SN Appl. Sci.* **2020**, *2*, 977. [CrossRef]
3. Dimitriou, D. Quantitative evaluation taxonomy for transport infrastructure projects. *Int. J. Res. Sci. Manag.* **2017**, *4*, 34–40.
4. Dimitriou, D.; Poufinas, T. Quantitative financial analysis for the estimation of road accident costs. *Int. J. Decis. Support Syst.* **2017**, *2*, 260–277. [CrossRef]
5. Dimitriou, D.; Sartzetaki, M. Decision Framework for developing transport logistics hub. *Int. J. Eng. Sci. Res. Technol.* **2017**, *6*, 314–322.
6. Dimitriou, D.; Sartzetaki, M. Decision Framework for Cross-Border Railway Infrastructure Projects. *Int. J. Bus. Econ. Eng.* **2016**, *10*, 3648–3653.

7. Dimitriou, D.; Sartzetaki, M. Assessment framework to develop and manage regional intermodal transport networks. *Res. Transp. Bus. Manag.* **2020**, *35*, 100455. [CrossRef]
8. Dimitriou, D.; Sartzetaki, M. Evaluation framework for investments in rail infrastructure projects. *Int. J. Soc. Behav. Educ. Econ. Bus. Ind. Eng. Int. J. Eng. Technol.* **2017**, *11*, 1302–1306.
9. Dimitriou, D.J. The Evolution in Transport Operator's Corporate Structure: Ownership and Governance. In *Ouhttpsourcing and Offshoring*; InTechOpen: London, UK, 2021; ISBN 978-1-83968-471-5. [CrossRef]
10. Rangel, T.; Vassallo, J.M.; Arenas, B. Effectiveness of safety-based incentives in Public Private Partnerships: Evidence from the case of Spain. *Transp. Res. Part A Policy Pract.* **2012**, *46*, 1166–1176. [CrossRef]
11. Vassallo, J.M.; Gallego, J. Risk-sharing in the New Public Works Concession Law in Spain. *Transp. Res. Rec.* **2005**, *1932*, 1–8. [CrossRef]
12. Dimitriou, D.; Karagkouni, A. Assortment of Airports' Sustainability Strategy: A Comprehensiveness Analysis Framework. *Sustainability* **2022**, *14*, 4217. [CrossRef]
13. Dimitriou, D.; Sartzetaki, M. Sustainable development variables to assess transport infrastructure in remote destinations. *Int. J. Urban Civ. Eng.* **2017**, *10*, 1343–1350.
14. Dimitriou, D.; Poufinas, T. Cost of Road Accident Fatalities to the Economy. *Int. Adv. Econ. Res.* **2016**, *22*, 433–445. [CrossRef]
15. Nadhim, E.A.; Hon, C.K.; Xia, B.; Stewart, I.; Fang, D. Falls from Height in the Construction Industry: A Critical Review of the Scientific Literature. *Int. J. Environ. Res. Public Health* **2016**, *13*, 638. [CrossRef]
16. Haslam, R.; Hide, S.; Gibb, A.; Gyi, D.; Pavitt, T.; Atkinson, S.; Duff, A. Contributing factors in construction accidents. *Appl. Ergon.* **2005**, *36*, 401–415. [CrossRef]
17. Zhao, J.; Fu, X.; Zhang, Y. Research on Risk Assessment and Safety Management of Highway Maintenance Project. *Procedia Eng.* **2016**, *137*, 434–441. [CrossRef]
18. Winge, S.; Albrechtsen, E.; Arnesen, J. A comparative analysis of safety management and safety performance in twelve construction projects. *J. Saf. Res.* **2019**, *71*, 139–152. [CrossRef]
19. Törner, M.; Pousette, A. Safety in construction–A comprehensive description of the characteristics of high safety standards in construction work, from the combined perspective of supervisors and experienced workers. *J. Saf. Res.* **2009**, *40*, 399–409. [CrossRef]
20. Bolt, H.; Haslam, R.; Gibb, A.G.; Waterson, P. *Pre-Conditioning for Success: Characteristics and Factors Ensuring a Safe Build for the Olympic Park*; Research Report RR955; Health and Safety Executive: London, UK, 2012; Available online: https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/12247/2/RR955%202012.pdf (accessed on 20 March 2021).
21. Sartzetaki, M.; Koltsikoglou, I.; Konstantinidis, T.; Dimitriou, D. Interventions for occupational stress management in air traffic providers. *J. Soc. Political Sci.* **2019**, *2*, 917–925. [CrossRef]
22. Sartzetaki, M.; Asprouli, V.; Dimitriou, D.; Konstantinidis, T. Assessing health and safety risks in regional airport enterprises. *Int. J. Sci. Res.* **2019**, *8*, 544–547. Available online: https://www.ijsr.net/archive/v8i9/ART2020941.pdf (accessed on 20 March 2021).
23. Hallowell, M.R.; Calhoun, M.E. Interrelationships among Highly Effective Construction Injury Prevention Strategies. *J. Constr. Eng. Manag.* **2011**, *137*, 985–993. [CrossRef]
24. Hale, A.R.; Guldenmund, F.W.; van Loenhout, P.L.C.H.; Oh, J.I.H. Evaluating safety management and culture interventions to improve safety: Effective intervention strategies. *Saf. Sci.* **2010**, *48*, 1026–1035. [CrossRef]
25. Gibb, A.; Lingard, H.; Behm, M.; Cooke, T. Construction accident causality: Learning from different countries and differing consequences. *Constr. Manag. Econ.* **2014**, *32*, 446–459. [CrossRef]
26. Hallowell, M.R.; Hinze, J.W.; Baud, K.C.; Wehle, A. Proactive construction safety control: Measuring, monitoring, and responding to safety leading indicators. *J. Constr. Eng. Manag.* **2013**, *139*, 04013010. [CrossRef]
27. Mohammadi, A.; Tavakolan, M.; Khosravi, Y. Factors influencing safety performance on construction projects: A review. *Saf. Sci.* **2018**, *109*, 382–397. [CrossRef]
28. Behm, M.; Schneller, A. Application of the Loughborough Construction Accident Causation model: A framework for organizational learning. *Constr. Manag. Econ.* **2013**, *31*, 580–595. [CrossRef]
29. Kines, P.; Andersen, L.P.; Spangenberg, S.; Mikkelsen, K.L.; Dyreborg, J.; Zohar, D. Improving construction site safety through leader-based verbal safety communication. *J. Saf. Res.* **2010**, *41*, 399–406. [CrossRef]
30. Winge, S.; Albrechtsen, E.; Mostue, B.A. Causal factors and connections in construction accidents. *Saf. Sci.* **2019**, *112*, 130–141. [CrossRef]