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CASE STUDY

Evaluating the Impact of Workshop Management on the Progress of Road Construction Projects (Case Study: Road Construction Projects of Tehran Province)

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ABSTRACT

Construction projects, including road construction, are very important. Therefore, a lot of money is spent on these projects every year. So, the lack of proper planning will increase the cost and cause irreparable damage to the country. The role of workshop management is one of the most important factors in increasing the cost of these types of projects. Generally, workshop management plays a very important role in improving the quality and quantity of projects and has an important place in the project implementation process. Therefore, this study evaluated the impact of workshop management on the progress of road construction projects on a case-by-case basis in road construction projects in Tehran province. According to the purpose of the research, this study was a descriptive-survey type. In addition, the tool used in this research was a questionnaire. The statistical population of this research included all experts and specialists in road construction projects, among whom 65 people were selected by snowball method. Then the collected data were analyzed using SPSS software. The results of this study showed that the management of the workshop and its role in the control and implementation of projects is a complex process, which can be implemented at high levels and effectively by combining scientific and experimental training. And a very important point in the discussion of workshop management is applying scientific management to the use of valuable experiences from others. Because management knowledge not only does not negate the use of these experiences, but also emphasizes the necessity of using them. In other words, improving the knowledge of workshop management is one of the requirements for the implementation of value engineering in construction projects, especially road construction, and it is very important.

Keywords: Construction projects; Workshop management; Snowball; Road construction

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ARTICLE INFO
Received: 8 March 2023 | Revised: 17 March 2023 | Accepted: 24 March 2023 | Published Online: 30 March 2023
DOI: https://doi.org/10.30564/jmser.v6i1.5520

CITATION
Modarresi, M., Mousavi, F., 2023. Evaluating the Impact of Workshop Management on the Progress of Road Construction Projects (Case Study: Road Construction Projects of Tehran Province). Journal of Management Science & Engineering Research. 6(1): 49-59. DOI: https://doi.org/10.30564/jmser.v6i1.5520

1. Introduction

Generally, no society without an advanced and planned management system will not be able to witness progress in various fields and will not be able to compete with other societies. On the other hand, construction projects are one of the most important economic sectors in the countries of the world, and the success of these projects largely depends on the definition and implementation of the project management system and its effectiveness. And the characteristic of the economic development of every country is construction projects, especially road-building and bridge-building, which are considered as a major criterion and index in the economic prosperity of that country [1]. Therefore, the progress and prosperity of a nation depend on the success of its country's construction projects, and success in the implementation of construction projects requires mechanisms and factors to end the cycle of affairs in a favorable way with the least cost and the most profit. Therefore, the ultimate goal of implementing any project is to create beneficial change and transformation [2]. In general, the amount of investment that has been made in the construction of large construction projects such as road and bridge construction is very large and significant [3]. Therefore, regardless of scientific issues and correct planning, the return of these funds is insignificant due to defects, excessive time wasting, loss of project efficiency in a period much shorter than the useful life, and causes loss of public property [4]. Different models have been presented to define the elements of a project. The commonality between all of them is the formation of a project organization that deals with managing the important limitations of the project including time, quality and cost. Therefore, in each project, according to the type of work, the volume of work, the extent of work, and the power of permanent forces, a suitable organization should be predicted to carry out the work [5]. On the other hand, the lack of proper management without a plan and the lack of continuity of proper management will prolong the duration of the operation and, as a result, increase the costs. The results and statistics from the studies conducted in American road construction operations also show that at least 45% of the total duration of the operation is lost due to various factors and if the management is not done properly, the figure of wastage will reach 80%. In other words, in correct management, the amount of useful work is 55% and in incorrect management, the amount of useful work is 20% of the total work, and these statistics also show the importance of correct management [6]. Therefore, according to the statistics and studies, the lack of proper management without a plan and the lack of continuity of proper management causes the duration of the operation to increase and as a result the costs increase. On the other hand, the ultimate goal of implementing a project is to create useful and beneficial changes and transformations, and various models have been presented to define the elements of a project. The common denominator of all of them, with minor differences, is the formation of a project organization that manages the important limitations of the project, including time, quality, and cost [7,8]. In order to carry out project activities, project resources such as machines, manpower, materials and a sufficient budget are needed.

Generally, civil infrastructures are undeniable in order to realize the economic and social development plans of the country, and the continuation and growth of constructions and the economic and social development of the country requires the creation and development of infrastructure facilities, including roads and bridges [6]. On the other hand, roads and bridges are one of the main criteria for the development of any country [9,10]. Today, in IRAN, many construction projects, including road construction, are being implemented, the credit of these projects is billions of Rials, and many human resources are working on these projects [11]. Road construction projects are among the country's infrastructure projects, which usually require spending heavy budgets and a long period of time [12]. In many road and bridge construction projects, the lack of proper planning in the implementation of the projects causes additional costs. These costs are due to the idleness of part of the machines during the project implementation period and the waste of useful time of human labor. This

causes the prices to increase due to the lengthening of the project implementation period and ultimately the increase without the logic of investments [1,13]. Therefore, proper and efficient planning and management in road and bridge construction projects is very necessary so that they can be put into operation in the estimated time, expected cost and appropriate quality [10,13]. But unfortunately, the lack of proper planning in the implementation of these projects causes additional costs in many of these projects. These costs are due to the idleness of part of the machines during the project implementation period and the waste of useful time of human labor. This causes the prices to increase due to the lengthening of the project implementation period and ultimately the increase without the logic of investments [2].

Basically, road construction projects are implemented with a delay in the schedule, and finally, with the delay in the start of operation of the road construction projects, in Iran, Sometimes the economic justification of the projects is lost [12]. So that in the last decade, some freeways have been invested by banks, but due to the significant increase in the implementation time and the delay in exploitation, irreparable losses have been inflicted on the investor. Currently, banks are no longer willing to invest in road construction projects. Therefore, it is necessary to find the root of these problems [2]. In examining the causes of delays in construction projects such as road and bridge construction, most of the mentioned cases are related to credit problems. In the second stage, it is caused by the weakness of the executive bodies in performing the tasks of the site, and in the third place, these delays are attributed to the weakness of the contractor [5].

Therefore, according to the mentioned contents, the success of a project depends to a great extent on the definition and implementation of its management and its effectiveness [13,14]. Management is a combination of science, experience, talent and art, and by combining these elements, it is possible to guide the desired collections in the best way in order to achieve the set goals. Many studies have shown that management is responsible for most delays and inefficiencies in the workplace [8]. Workshop management and equipment is an activity that is performed before the start of any project and has a very important role in the cost, safety and quality of the project [13,14]. Meanwhile, the role of workshop management is very important in order to achieve the goals of the project, and workshop management plays a very important role in the amount of cost, safety and quality of the project. The role of workshop management in order to create a logical interaction with the important limitations of the project and their components. improving the quality and quantity of the project is very unique in order to achieve the predetermined goals of the project [15]. On the other hand, the role of workshop management in shaping the project organization as well as the strategic orientation of the project management processes is very clear and decisive, and the weakness of workshop management will ultimately cause the failure of the project [16,17]. Therefore, considering the very high importance of the role of workshop management in the control and implementation of road and bridge construction projects in order to improve project quality and reduce costs and considering that no study has been done in Iran in this field. So, in this research, for the first time, the role of workshop management in the control and implementation of road construction projects located in Tehran province will be evaluated.

2. Materials and method

2.1 Case study

Road construction projects of Tehran province are a case study of this research. Tehran city is the center of Tehran province and the capital of Iran. This city is between the cities of Tehran, Ray and Shemiran. It is connected to the Alborz mountain range from the north and the desert from the south. The height of Tehran city starts from about 900 meters above sea level in the south and reaches about 1800 meters in the north. Geographically, in 51 degrees and 17 minutes to 51 degrees and 33 minutes of east longitude and 35 degrees and 36 minutes to 35 degrees and 44 minutes north latitude. The area of Tehran is an

area with approximate area of 615 square kilometers with 22 municipal districts and it has been done to meet the needs of urban services of the resident and working population (daily population), based on a population equivalent to 9.1 million people. Housing capacity, based on about 20 percent excess of the above population forecast and in order to develop construction and prevent housing market stagnation, for about 10.5 million people have been prepared up to the horizon of the plan. (Tehran Comprehensive Plan, 2016). According to the comprehensive plan document of the spatial organization of the city of Tehran, the "grid structure of the city of Tehran" is coordinated with the natural and historical structures and movement, performance and activity systems, consisting of five north-south axes and three east-west axes, which facilitates the possibility of movement. And better movement at the city level and reduction of travel demand, organizing large-scale elements with urban and extra-urban functions of Tehran provides. Also, the first comprehensive plan of this city was prepared in 1970 and until today this plan has been prepared only once for Tehran which corresponds to December 2016 with a horizon of 20 years, the spatial organization of Tehran is shown in the map below.

Figure 1. Tehran province map.

2.2 Scope of research

The subject area of this research is the impact of workshop management in the implementation of road construction projects. The spatial territory of Tehran province and the temporal territory is 1401.

2.3 Population and statistical sample

Since the criteria presented in this research include a wide range of variables in the field of examining the role of workshop management in the implementation and control of the project. Therefore, the selected statistical population includes employers, consulting engineers and contractors in the field of road and transportation in Tehran province who have expertise, skills and work related to the research flow. In the selection of the statistical population, samples were asked who mostly have a history related to the implementation of various types of roads in Tehran province. Then, 65 people were selected as a statistical sample using the snowball method.

2.4 Type of research method

Considering that the purpose of this research is to collect information from road construction workshops in Tehran province, the survey method is used. Therefore, the current research method is descriptive-survey type.

2.5 Method of collecting information

Considering the survey-analytical research in the completion of this thesis, in order to provide the information needed to complete the research, survey methods and statistical methods have been used. And in order to collect research data, various methods such as the use of available information and documents, interviews with experts and experts, as well as face-to-face and electronic questionnaires have been used. For this purpose, at first, the data and information were collected using the library method, and then the selection criteria were evaluated based on interviews with specialized and experienced people in this field and finally, to check the importance and weights of each of the criteria, a survey is done through a questionnaire. Therefore, in general, the method of conducting this research is to collect data and information in the field and in the library. In

the library method, in addition to studying available sources and books as well as authentic articles, an effort was made to collect and categorize the required information related to the role of workshop management in controlling road construction projects. A questionnaire tool was used in the field method. The questionnaire is considered as one of the most common tools of data collection in survey research. In order to prepare the questions of the questionnaire, experts and experts in this field were asked for their opinions, and after considering the sum of their opinions, the final questionnaire was prepared and distributed among the sample people. It should be noted that the measurement scale of this research was a 5-point Likert scale, and Cronbach's alpha method was used for the reliability coefficient of the measurement tool and the validity of the questionnaire.

2.6 Information analysis method

After collecting the completed questionnaires, the information obtained from the answer sheets will be entered into the computer and then analyzed using SPSS software. In order to analyze the data, descriptive statistics such as arithmetic mean, median, standard deviation, significance level will be used first, and then it will be done in order to obtain demographic information from the statistical sample. Then correlation tests such as Pearson's correlation coefficient were used.

3. Results

Table 1 shows the frequency distribution of respondents according to education, work experience, specialized work experience in works related to road construction and service location. **Table 1** shows that most of the respondents have a bachelor's degree, which is a total of 27 participants in the research (42%). Also, this graph shows that the lowest frequency is related to people with doctorate degrees, who made up 7 of the participants (11%). Also, **Table 1** shows that most of the participants in the research have 6 to 10 years of work experience, which is a total of 25 respondents (38%) and the least number have more than 16 years of work experience, which is a total of 5 of the participants in the research (8%). In addition, **Table 1** shows that most of the participants in the research have specialized work experience in works related to road construction and bridge construction 1 to 5, which made up a total of 40 respondents (62%) and the least number have specialized work experience in road construction and bridge construction for more than 16 years, which constituted only 1 of the participants in the research (1%) and **Table 1** shows that most of the participants in the research are contractors, who made up a total of 28 respondents (43%) and the number of employers (18 people) and consultants (19 people) was almost equal.

Table 1. The frequency distribution of respondents according to education, work experience, specialized work experience in works related to road construction and service location.

Education	**Frequency**	**Percent (%)**
PhD	7	10.76923
Master	19	29.23077
Bachelor	27	41.53846
Associate	12	18.46154
Work experience (year)	Frequency	Percent (%)
1-5	22	33.84615
6-10	25	38.46154
11-16	13	20
>16	5	7.692308
Specialized work experience (year)	Frequency	Percent (%)
1-5	7	17.5
6-10	7	17.5
11-16	12	30
>16	14	35
Place of service	Frequency	Percent (%)
Employer	18	27.69231
Consultant	19	29.23077
Contractors	28	43.07692

Figure 2 shows the frequency chart, which shows the horizontal axis of the given answers (1-5) and the vertical axis shows the frequency of samples in each

answer. According to **Figure 2**, the highest frequency is related to index 5, which shows that 31 people strongly agree with this question. And after that, most response is related to index 4, which shows that 23 people agree with this question. In fact, according to **Figure 2**, 47.7% of the respondents agree very much and 7.7%, 9.2%, and 35.4% disagree, somewhat agree and agree respectively.

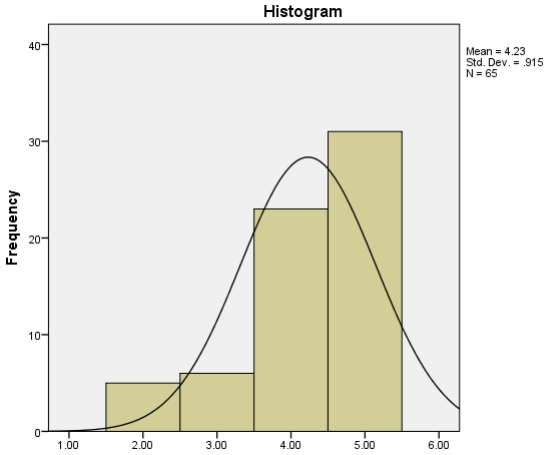

Figure 2. The graph of the frequency of respondents to hold periodic meetings and at different times in order to review the status of work.

Table 2 shows the results of the One-Sample Test related to the question of holding meetings alternately and at different times in order to review the status of the work, which the statistical test is in accordance with the null hypothesis and the opposite hypothesis that is mentioned in the section. The previous ones have been said and done. The test statistic value is 37.29 and the degree of freedom is 64. Due to the large probability value (p-value) displayed in SPSS with Sig and comparing it with the probability of arbitrary first-type error α (which is considered (0.05) It can be seen that the null hypothesis was rejected with 95% confidence because the value of 0.00 is less than 0.05. As a result, according to the positive value of the Mean Difference, holding intermittent meetings at different times in order to review the status of works has been recognized as one of the effective factors in the control and implementation of road and bridge construction projects.

Figure 3 shows the frequency chart related to the project plan update variable, which shows that the desired answers are normal. According to this figure, the highest frequency is related to index 4, which shows that 35 people agree with this question, and after that, the highest response is related to index 5, which shows that 20 people agree with this question. So, they agree with the question. In fact, according to this figure, 53.8 percent of respondents agree, and 4.6, 10.8, and 30.8 percent disagree, somewhat agree, and completely agree.

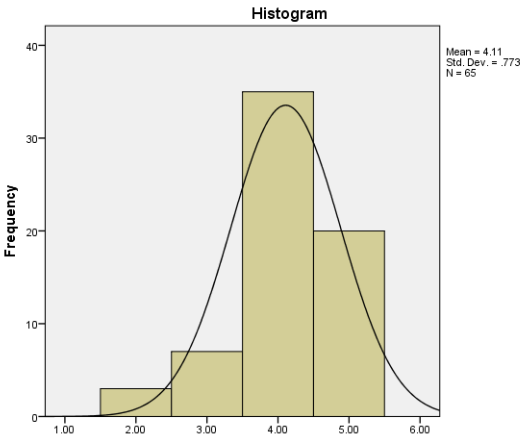

Figure 3. Frequency diagram related to the project plan update variable.

Table 3 shows the results of the One-Sample Test related to the variable of updating the project plan. The test statistic value is 11.55 and the degree of

Table 2. The results of the average test of a single sample related to the question of holding meetings alternately and at different times in order to review the state of affairs.

One-Sample Test						
	Test Value =3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
meetings	37.293	64	0.000	4.23077	4.0041	4.4574

Table 3. The results of the single sample mean test related to the variable of updating the project plan.

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
updating	11.552	64	0.000	1.10769	0.9161	1.2992

freedom is 64. Considering the large probability value (p-Value) and comparing it with the error probability of 0.05, we can conclude that the null hypothesis was rejected with 95% confidence, because the value of 0.00 is less than 0.05. As a result, according to the positive value of the Mean, updating the project plan has been recognized as one of the effective factors in the control and implementation of road construction projects.

Figure 4 shows the variable frequency table of corrective measures in technical specifications. According to this figure, the highest frequency is related to index 3, which shows that 36 people agree with this question to a certain extent, and after that, the highest response is related to index 2, which shows that 15 people agree with this question. They disagree with this question. Therefore, according to **Figure 4**, 55.4% agree to some extent.

Table 4 shows the results of the One-Sample Test related to the variable of corrective measures in technical specifications. The test statistic value is –3.76 and the degree of freedom is also 64. Considering the large probability value (p-value) and comparing it with the error probability of 0.05, it can be concluded that the null hypothesis was rejected with 95% confidence. Because the value of 0.00 is less than 0.05. As mentioned, in this case, the average value and the Mean Difference should be checked. Considering that the average score obtained by the respondents for the target index is less than 3. According to **Table 4**, the value of Mean Difference is negative, so it can be concluded that the average obtained for the variable of corrective measures in technical specifications is less than 3, and it can be concluded that the respondents disagree with this proposal or question, that is, in fact, the respondents have not recognized the variable corrective measures in technical specifications as one of the effective factors in the control and implementation of road and bridge construction projects.

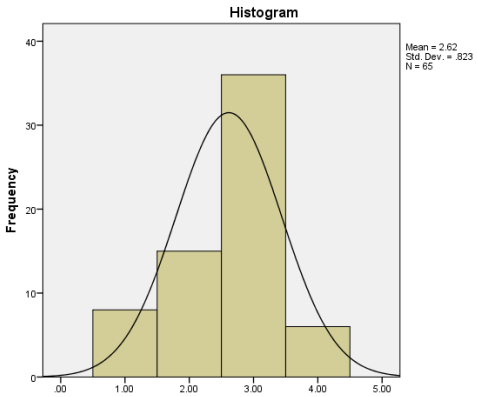

Figure 4. Frequency chart related to the variable of corrective actions in technical specifications.

Figure 5 shows the variable frequency table of documentation of learning in the project by the contractor, according to this figure, the highest frequency is related to indicators 2 and 3, which are equal to each other, and shows the number of 18 people. They disagree with this variable and 18 agree with

Table 4. The results of the average test of a single sample related to the variable of corrective measures in technical specifications.

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
measures	–3.766	64	0.000	–0.38462	–0.5886	–0.1806

this variable to some extent.

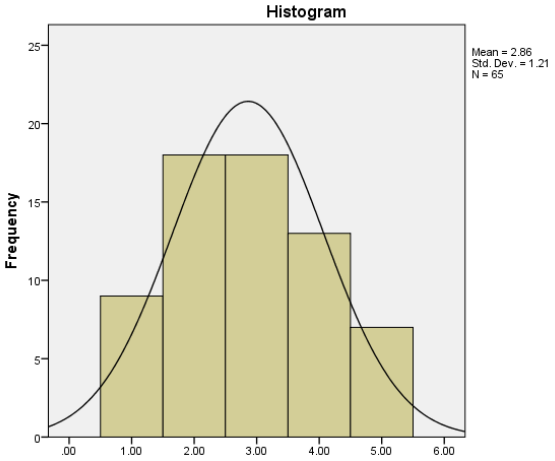

Figure 5. Frequency chart related to the variable of documenting the learnings in the project by the contractor.

Table 5 shows the results of the One-Sample Test related to the variable of documenting what has been learned in the project by the contractor. According to **Table 5**, the value of the test statistic is –0.92 and the degree of freedom is also 64. Considering the large probability value (p-value) and comparing it with the error probability of 0.05, it can be concluded that the null hypothesis is confirmed with 95% certainty. Because the value of 0.36 is higher than 0.05, as a result, the respondents to the variable of documenting the lessons learned in the project by the contractor did not recognize it as one of the effective factors in the control and implementation of road and bridge construction projects. And as a result, the null hypothesis cannot be rejected.

Figure 6 shows the frequency table of the speed of action variable in the appointment of the project manager or head. According to this figure, the highest frequency is related to index 4, which shows that 29 people, equal to 44.6%, agree with this variable.

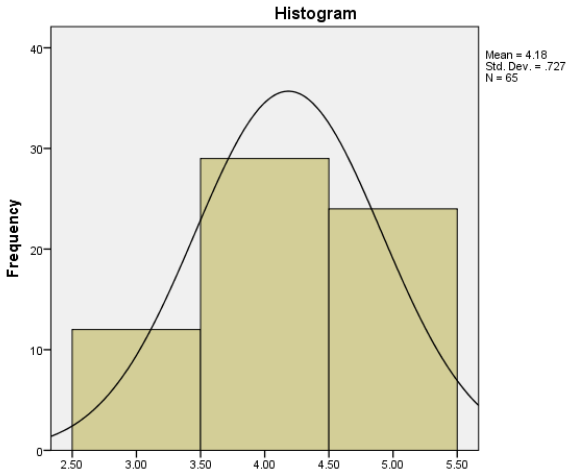

Figure 6. Frequency diagram related to the speed of action variable in the appointment of the project manager or head.

Table 6 shows the results of the One-Sample Test related to the variable of the speed of action in the appointment of the project manager or head. According to **Table 6**, the test statistic value is 13.14 and the degree of freedom is 4.6. Considering the smallness of the probability value (p-Value) and comparing it with the error probability of 0.05, it can be conclud-

Table 5. The results of the average test of the single sample related to the variable of documenting the learnings in the project by the contractor.

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
documenting	–0.922	64	0.360	–0.13846	–0.4384	0.1614

Table 6. The results of the single sample mean test related to the speed of action variable in the appointment of a project manager or president.

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
appointment	13.145	64	0.000	1.18462	1.0046	1.3646

ed that the null hypothesis is rejected with 95% certainty. Because the value of 0.00 is less than 0.05. As a result, the respondents have recognized the speed of action variable in the appointment of the project manager or chief as one of the effective factors in the control and implementation of road and bridge construction projects.

Figure 7 shows the frequency chart related to the variable of the contractor benefiting from sufficient knowledge and experience and doing things similar to the ongoing project. According to **Figure 7**, the highest frequency is related to index 5, which shows that 26 people completely agree with this question and after that, the most response is related to index 4, which shows that 25 people agree with this question. In fact, according to **Figure 7**, 40% of the respondents completely agree and 38.5% of the respondents agree.

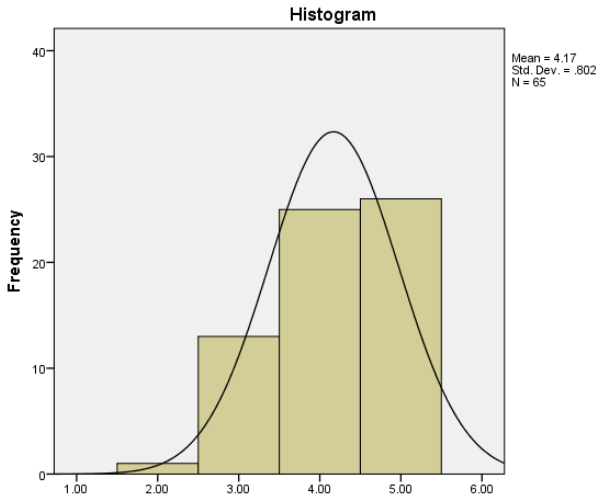

Figure 7. Frequency chart related to the variable of the contractor benefiting from sufficient knowledge and experience and performing similar tasks with the ongoing project.

Table 7 shows the results of the One-Sample Test related to the variable of the contractor benefiting from sufficient knowledge and experience and doing similar things with the ongoing project. The statistical test has been performed according to the null hypothesis and the opposite hypothesis that was mentioned in the previous sections. The test statistic value is 41.92 and the degree of freedom is 64. Due to the large probability value (p-value) displayed in SPSS with Sig and comparing it with the probability of arbitrary first type error α (which is considered 0.05). It can be seen that the null hypothesis was rejected with 95% confidence, because the value of 0.00 is less than 0.05. As a result, considering the positive value of Mean Difference, the variable of the extent of benefiting the contractor from sufficient knowledge and experience and doing similar things with the ongoing project has been identified as one of the effective factors in the control and implementation of road and bridge construction projects.

4. Discussion

According to the purpose of the research, a descriptive-survey method was used in this research, and in order to collect the necessary information in this research, online and face-to-face questionnaires were used. Therefore, at first, using the library method of collecting data and information, then the selection criteria were evaluated based on interviews with specialized and experienced people in this field, and to check the importance and weights of each of the criteria, a survey was done through a questionnaire. In the next step, after collecting the completed questionnaires, the information from the answer sheets was entered into the computer and analyzed using SPSS software. According to the obtained results, it can be said that workshop management plays a very important role in road construction projects and improves the quality of project implementation. On

Table 7. The results of the average test of a single sample related to the variable of the extent of the contractor benefiting from sufficient knowledge and experience and performing similar tasks with the ongoing project.

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
knowledge	41.926	64	0.000	4.16923	3.9706	4.3679

the other hand, the lack of optimal implementation of road construction projects in terms of resources, time and cost has an effective relationship with compliance and non-compliance with management standards in the implementation of such projects. According to the results obtained from this research and the opinions of the respondents and the conducted studies, it is necessary to pay attention to some points in playing the role of management as best as possible in the control and implementation of road construction projects. One of these variables is the processes related to project procurement management. These processes include issues related to the communication and interactions of the workshop management with subcontractors and the process of dealing with the status of subcontractors on behalf of the main contractor as well as the consultant and presentation to the employer, etc. According to the opinion of the respondents, the importance of this component was more than 79%, and in general, indirect communication between the contractor and the employer is foreseen in most types of contracts, but for some reason, it is recommended to communicate directly with the employer. One of the reasons for proposing direct contact between the contractor and the client is the possibility of making changes in the technical specifications and managing the integrity of the project. Sometimes, due to problems such as the expensiveness of the implementation method, the existence of more suitable alternatives and possible mistakes in the design, etc., there is a need to change the option and the implementation method according to the change applied. In case of no response from the consultant and interaction with the employer, it will not be possible to apply the desired change. Another factor to propose interactions is the possibility of changing contract items such as project cost management and corrective measures. These factors exist in most road construction projects that are ignored in the list of costs, in which it is easier to apply new figures and volumes through the employer, and considering that this responsibility is taken from the consultant, it is easier for the consultant to accept it. Another thing that emphasizes this proposal is the possibility of improving the situation review meetings and changing the control system. In this case, the possibility of things such as the necessity of helping the contractor, compensating part of the losses, facing unforeseen cases, etc. shows the necessity of the employer's intervention. Also, the interaction between the employer and the consultant improves project communication management and communication skills. In other words, the contractor may be harassed by the placement consultant while doing the work for some reason, and effective communication with the employer can be very useful.

5. Conclusions

Since one of the important causes of the increase in the implementation costs of road construction projects is the correct consideration of the role of workshop management. The lack of proper planning in terms of organizational structure and planning in road and bridge construction projects increases costs and reduces efficiency, and on the other hand creates differences among different executive units. Therefore, every workshop needs the correct role of workshop management. Therefore, in this research, the role of workshop management in the control and implementation of road construction projects was investigated, and the study scope of this research is road construction projects in Tehran province. In general, according to the obtained results, workshop management and its role in controlling and implementing projects is a complex process that can be implemented at high levels and efficiently by combining scientific and experimental teachings. A very important point in the discussion of workshop management is not to neglect the application of scientific management to the use of valuable experiences from others, because these experiences are not easily obtained and management knowledge not only does not negate the use of these experiences but also emphasizes the necessity of using them. In other words, improving the knowledge of workshop management is one of the requirements for the implementation of value engineering in construction projects and especially road construction, and in the meantime, the

existence of sufficient self-confidence of the head of the workshop due to mastering the knowledge of workshop management leads to quantitative and qualitative improvement.

Conflict of Interest

There is no conflict of interest.

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