Lecture Notes in Civil Engineering

Bashar S. Mohammed · Nasir Shafiq · Shamsul Rahman M. Kutty · Hisham Mohamad · Abdul-Lateef Balogun *Editors*

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Preface

This book contains papers presented in the 6th International Conference on Civil, Offshore and Environmental Engineering (ICCOEE2020) under the banner of World Engineering, Science and Technology Congress (ESTCON2020) held on 13–15 July 2021 at Borneo Convention Centre, Kuching, Malaysia. The ICCOEE series of conferences started in Kuala Lumpur, Malaysia, in 2012.

The main objective of the ICCOEE is to provide a platform for academia and industry to showcase their latest advancements and findings in the broad disciplines of civil, offshore and environmental engineering with an emphasis on the looming Industrial Revolution 4.0. The conference also provides great opportunities for participants to exchange new ideas and experience as well as to forge research and business relations with global partners for future collaborations.

The articles in this book were accepted after a rigorous review process. All accepted papers are categorized based on the following themes and areas of research:

- Green Environment and Smart Water Resource Management Systems
- Advanced Coastal and Offshore Engineering
- Resilient Structures and Smart Materials
- Advanced Construction and Building Information Modelling
- Smart and Sustainable Infrastructure

We would like to express our gratitude to the Technical Programme Committee and Advisory Committee who undertook the biggest responsibility in the paper reviewing process. We are also grateful to the additional reviewers who helped the authors deliver better papers by providing them with constructive comments. We hope that this process contributed to a consistently good level of the papers that are included in the book.

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Contents

Dominant Success Factors of Managing Subcontractors by Main Contractors in Sustainable Development Project

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Abstract. Challenges faced by businesses, including a construction service sector, are involved. The complexity in a construction business stimulates construction project practitioners to cooperate and apply POAC (Planning, Organizing, Actuating, Controlling) management function well. However, there always problems during the construction process, like problems between contractor-subcontractor. A contractor plays roles as one who executes the plan, and a subcontractor works under the contactor's commands—the contractor-subcontractor relationship based on a legal contract. There is no research on the problems conducted on the base of POAC management perspectives yet. The samples of this research are contractor-subcontractor who was working on a skyscraper project in Jakarta. The research instrument conducted four dependent variables and 40 independent variables. Data analyzed with confirmatory factor analysis in 2 stages; each stage results in dominant numbers derived from the respondents' perception. The research finds that the most commonly occurring problem between them is actuating

Keywords: Management function · Sustainable development · Contractor · Subcontractor

1 Introduction

The activities of construction project implementation are considered unique and complex. The main contractors as executors of these construction projects attempt to provide the best services to the employers or project owners in compliance with the given quality standards, within a period and on an agreed budget. Although the work on the field is assigned to the main contractors, most of the work is often assigned to specific specialist subcontractors, especially building projects, it is found for 80–90% of the work to be performed by subcontractors [1].

The main contractor is obliged to be able to manage all the subcontractors involved in the implementation of construction projects to achieve specific project goals; grade quality based on specifications, on time as planned, and minimum cost as much as possible have become the responsibilities of the main contractor to the project owner. The accurate of shared information between contractor and subcontractor is slightly weak and often failed [2] they make subcontractors' dejection with main contractors due to unresponsiveness of their need for timely and correct information. Many

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problems often occur during the implementation of construction projects, such as the lack of trust, delay, and lack of communication [3].

Various studies on contractor and subcontractor management have been conducted, but the studies that focus on subcontractor management's dominant success factors are less to be found especially in sustainable development project. According to [4] researched factors that influence a construction project manager's performance but have not managed to include subcontractor management topics. [5] studied the measurement instruments of innovative performances of contracting companies but is yet to include correlations with subcontractor management. [6] researched contractor risks, but still have not included relations to subcontractor management risks. Thus, studies need to be continued regarding subcontractor management by the main contractor. [7] studied the factors that influence the main contractor's selection of specialist subcontractors but still has to focus on the dominant success factors of subcontractor management by the main contractor. [8] have studied subcontractor selection criteria by the main contractor and have not focused on the dominant success factors of subcontractor management by the main contractor. [9] has studied the behaviors of the main contractor in arranging a construction project subcontract but is yet to focus on the dominant success factors of subcontractor management by the main contractor. [10] has studied risks of subcontractors' work on a construction project but has put relations to dominant success factors of subcontractor management by the main contractor. According to [11] did study on the critical success factors of work relations between the main contractor and subcontractor but is not considered quite assertive to be used as dominant success factors of subcontractor management by the main contractor.

Based on the studies of past researches, therefore raises a question, ``What are the dominant success factors of subcontractor management by the main contractor in sustainable development project?".

2 Method of Study

This study uses questioners as the primary method to collect data from projects. The targeted respondents are project managers (PM), site managers (SM), and site engineers (SE) from leading contracting companies of multiple-story building projects who have experience in sustainable development project in academia in Jakarta. The questioner includes variables that are part of the dominant success factors of subcontractor management by the main contractor. The measurement scale used is the Likert scale (whereas 1 = uninfluential to 5 = very influential). The original data set of 46 samples. The samples was split into two subsamples: Sample 1 (6) and Sample 2 (40). Subsequently, factor analysis was performed on Sample 1 using principal component analysis and The principal component analysis revealed 1 factors unvalid. Next, confirmatory factor analysis (CFA) was performed on Sample 2 to confirm the factor structure.

Table 1. Variables and Sub-Variables

No	Sub-Variables	Variables	Code
1	Planning and Scheduling Factors	Arranged materials and equipment schedules by provided by each subcontractor in accordance to the master schedule by the main contractor	X1
2		Distribution of site plans to every subcontractor both at offices and warehouses that are to be used	X2
3		Subcontractors are able to carry out short project implementation times	X3
4		Submission of sample materials by subcontractor at least 1 month prior to installation	X4
5		Subcontractors making mockups for repetitive work	X5
1	Budget and Contract Factors	The value of work subcontracted by the main contractor to the subcontractors	X6
2		Obligations and rights of the subcontractor in relations with the main contractor must be regulated in the contract	X7
3		The role of the main contracting that is very dominant to the subcontractors and is not supported with adequate subcontract design* planning	X8
4		The main contractor provides subcontractors with detailed and clear specifications and drawings at the time of submission of prices	X9
1	Resource Factors	The length of work/experience of an individual in the relevant subcontracting company	X10
2		On-time mobilization of subcontractor resources (materials, tools, labor)	X11
3		Expertise and skills as well as high work motivation for direct workers subcontractors in the field	X12
4		Sufficient number of workers / in accordance with existing work activities by subcontractors	X13
5		The availability of sufficient materials / as needed by subcontractors	X14
6		Availability of working tools / equipment that are sufficient / in accordance with needs by subcontractors	X15
1	Managerial Factors	Support from top management of the main contractor to parties involved in the project both human resources, budget, methods, and implementation time	X16
2		Mutual trust between subcontractors and main contractors	X17
3		The long-term commitment between subcontractors and main contractors is not just one project	X18
4		Effective communication between subcontractors and main contractors	X19

(*continued*)

Table 1. (*continued*)

No	Sub-Variables	Variables	Code
5		Productive conflict resolutions from the main contractor to its subcontractors	X20
6		Giving power* to the main contractor project manager in carrying out the management of its subcontractors because it is still controlled by the head office	X21
7		The efficient coordination system in the project from the main contractor to its subcontractors	X22
8		Regular control of the work of subcontractors by a team appointed by the main contractor	X23
9		Need of special markings on each subcontractor equipment	X24
10		The documentation system in the project is neat by the main contractor for the subcontractors from the beginning to the end of the project	X25
11		Supervision of work from subcontractors	X26
12		Placement of supervision / supervisor of the main contractor in accordance with their abilities	X27
13		Services and responsibilities during the maintenance period of the subcontractor	X28
14		Proper construction implementation method according the plain of the subcontractor	X29
15		Reports and regular meetings between the main contractors with the subcontractors	X30
1	Technical Factors	The experience of subcontracting companies handling the same type of work and project size	X31
2		There is initial explanation before the subcontractor joins both the contract and project implementation	X32
3		The subcontractor must provide the main contractor with detailed and clear specifications and drawings before implementation	X33
4		Competent technical and managerial quality of personnel in the main contracting work organization	X34
1	Work Safety Factor	Procedure for handling work accidents by subcontractors	X35
2		The safety policy of the main contractor to its subcontractor	X36
3		Participation in subcontractor labor insurance	X37
4		Periodic safety talk by the main contractor to the subcontractors	X38

Sources: [4, 6, 12–19]

The stages of this study are as follows:

a. **First stage**
Conduct interviews and give questionnaires to experts to validate variables from previous studies and bibliography and other references that have been compiled. Categories as experts are people who have expertise in academia and practitioners with at least ten years of work experience in the field of construction. The Variables of library research for studying the main contractor success factors in the subcontractor's management in the implementation of construction were 39 (thirty-nine), whereas after being validated by experts who had long been involved in the main contractor at the time of the pilot survey as many as 38 (thirty-eight) are shown in Table 1 (one).

b. **Second stage**
Distribution of questionnaires to respondents. Respondents are project managers (PM), site managers (SM), and site engineers (SE) of the leading contracting company building projects in Jakarta who have experince in sustainable development project. Namely PT. MULTIKON, PT. TOTAL BANGUN PERSADA Tbk, PT. PP (PERSERO) Tbk, PT. NUSA RAYA CIPTA, PT. TOTALINDO EKA PERSADA, PT. TATA MULIA NUSANTARA INDAH, PT. PULAU INTAN, PT. WASKITA KARYA (PERSERO) Tbk, PT. JATIKARYA MEGAH LAKSANA. Of the 50 questionnaires send out, 40 were returned with varying degress of completeness.

c. **Third stage**
Validating the results of the second stage to be included in the SPSS program, then create analysis and conclusion. The steps are as follows:

1. Tabulate results of questioner data to verify which sub-variables have been fulfilled and then can be processed.
2. Validation and reliability tests to identify factors that fulfill the sub-variables or not. If the data does not fulfill, therefore, the sub-variable is to be excluded. Fulfilling data are continued in the process.
3. Correlation analysis aims to identify the pattern and closeness relationship between two or more variables. The value of r is judged. The value of r is to be tested with a probability value of < 0,05 and value of t that is if the counted value of t < t of the table, therefore the decision is the value of correlation analysis r is not significant, and if the counted value of t, then the value of correlation analysis r is significant
4. Analysis factors with calculations: Calculate the value of Kaiser-Meyer-Olikin (KMO test) and Barlet test and probability (sig. = p). İf KMO > 0,5 and probability < 0,05, then the sub-variables can be factored, take anti-image correlation, or Loading Faktor (λ) test. if $\lambda > 0,5$, then the sub-variables are considered valid to be factored; if initial eigenvalue > 1, then the sub-variables is considered valid to be factored, the next step is Communalities.

5. Conclusion Includes results from dominant success factors of subcontractor management by the main contractor in the implementation of construction projects with the confirmatory analysis factor retrieved from the roles of its variables.

3 Results and Discussions

3.1 Validity and Reliability

From the validation test, we can conclude that Corrected item-total Correlations are higher than the value of 0.3. Thus, the independent variable, x, can be considered valid, and if the value is less than 0.3, then invalid. Data of x that are not valid are X3, X5, X7, and X20. Those, as mentioned earlier, will not be included in the next process. From the reliability test, it is shown that the value of Cronbach's Alpha is 0.922, Cronbach's Alpha Based on Standardized Items is 0.927 with N of items is 38. Which describes the level of reliability of being very reliable, 0.80 to 1.00.

3.2 Correlation Analysis Results

From the validation and reliability tests, as many as 34 variables were used. The correlation analysis results showed that 12 variables have significant relationships with the main contractor's success in managing subcontractors in the implementation of construction.

Those were (1) X2 Distribution of site plans to every subcontractor both at offices and warehouses that were to be used (Correlation value = 0.689); (2) X16 Support from top management of the main contractor to parties involved in the project both human resources, budget, methods, and implementation time (Correlation value = 0.622); (3) X17 Mutual trust between subcontractors and main contractors (Correlation value = 0.685); (4) X23 Regular control of the work of subcontractors by a team appointed by the main contractor (Correlation value = 0.668); (5) X25 The documentation system in the project was neat by the main contractor for the subcontractors from the beginning to the end of the project (Correlation value = 0.622); (6) X27 Placement of supervision / supervisor of the main contractor in accordance with their abilities (Correlation value = 0.413); (7) X29 Proper construction implementation method according the plain of the subcontractor (Correlation value = 0.605); (8) X30 Reports and regular meetings between the main contractors with the subcontractors (Correlation value = 0.658); (9) X32 There is initial explanation before the subcontractor joins both the contract and project implementation (Correlation value = 0.616); (10) X36 The safety policy of the main contractor to its subcontractor (Correlation value = 0,659) (11) X37 Participation in subcontractor labor insurance (Correlation value = 0.643); (12) X38 Periodic safety talk by the main contractor to the subcontractors (Correlation value = 0,675).

3.3 Factors Analysis Results

From the results of the correlations analysis, the variables were tested with confirmatory factors analysis. The results obtained were sorted from high to low, which are as follows: (1) There was a preliminary explanation to the subcontractor before the contract or project implementation process with a contribution of 73.9% (2) Routine meetings and reports between the main contractor and subcontractors with a contribution of 59.9% (3) Work safety policy provided to the subcontractors by the main contractor with a contribution of 54,9% (4) Regular control of subcontractors' work results that were conducted by a team assigned by the main with a contribution of 52.9% (5) Appropriate implementation methods for subcontractors with a contribution of 52.2% (6) Placement of supervisors or supervision of the main contractor in accordance to their abilities with a contribution of 29.6%.

4 Discussion

Based on the results of the analysis of data processing with statistic method (correlation analysis and confirmatory factor analysis), the top six ranked factors that require extra attention from the main contractor in managing subcontractors on construction projects implementation in Jakarta as follows:

1. There is an initial explanation before the subcontractor joins both the contract and project implementation. Explanation of the contract at the beginning must have clear and detailed contract clauses, and the method of implementation needs to be explained at the beginning to get a description of the method of work to be carried out both the availability of materials and tools to be used to minimize the risks that will occur and to facilitate monitoring of work.
2. Periodic reports and meetings between the main contractor and subcontractors. Hopefully, these periodic reports and meetings will be able to decide on existing issues and provide a positive solution or impact on the project's progress.
3. The safety policy of the main contractor to the subcontractor. The management team of the main contractor must support and work on programs that can guarantee that no accidents occur or minimize work accidents or work accident prevention measures to the subcontractors.
4. Control the work of subcontractors regularly by a team appointed by the main contractor. The designated team must understand and understand the work of their subcontractors, to minimize the delays in the work of their subcontractors and minimize complaints from project owners.
5. Proper construction implementation method according to the plan of the subcontractor is an essential factor for the main contractor to assess its subcontractors' performance and commitment in helping accelerate the implementation of work on the project.
6. Placement of supervision/supervisor of the main contractor following their abilities. Supervision/supervisor to coordinate and control all subcontractors.

5 Conclusion

The topic is needed to be restudied by adding other variables that is yet to be included in this research paper, such as the need of the main contractor to draw sequence from the steps of work that has to be done including the critical path, Design coordination for every work should be discussed earlier and more detailed, subcontractors are obliged to provide its organizational structure that is clear and only focuses on the assigned work in the related projects, Due to the fact that subcontractors vary from one another, future researches and studies should be more specific on certain subcontractors for their work assigned such as substructure, structure, architecture and MEP (Mechanical, Electrical and Plumbing).

6 Suggestion

Recommendations for this particular subject of field would be the urgent need of further and more researches, respons and reviews from participating subcontractors to the main contractor that makes sure the subcontractors succeed at maintaining good relationship with main contractors in a construction project, therefore future researches can provide more depth in the study.

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Dominant Success Factors of Managing Subcontractors by Main Contractors in Sustainable Development Project

by Teknik Sipil 11

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problems often occur during the implementation of construction projects, such as the lack of trust, delay, and lack of communication [3].

Various studies on contractor and subcontractor management have been conducted, but the studies that focus on subcontractor management's dominant success factors are less to be found especially in sustainable development project. According to [4] researched factors that influence a construction project manager's performance but have not managed to include subcontractor management topics. [5] studied the measurement instruments of innovative performances of contracting companies but is yet to include correlations with subcontractor management. [6] researched contractor risks, but still have not included relations to subcontractor management risks. Thus, studies need to be continued regarding subcontractor management by the main contractor. [7] studied the factors that influence the main contractor's selection of specialist subcontractors but still has to focus on the dominant success factors of subcontractor management by the main contractor. [8] have studied subcontractor selection criteria by the main contractor and have not focused on the dominant success factors of subcontractor management by the main contractor. [9] has studied the behaviors of the main contractor in arranging a construction project subcontract but is yet to focus on the dominant success factors of subcontractor management by the main contractor. [10] has studied risks of subcontractors' work on a construction project but has put relations to dominant success factors of subcontractor management by the main contractor. According to [11] did study on the critical success factors of work relations between the main contractor and subcontractor but is not considered quite assertive to be used as dominant success factors of subcontractor management by the main contractor.

Based on the studies of past researches, therefore raises a question, ``What are the dominant success factors of subcontractor management by the main contractor in sustainable development project?''.

2 Method of Study

This study uses questioners as the primary method to collect data from projects. The targeted respondents are project managers (PM), site managers (SM), and site engineers (SE) from leading contracting companies of multiple-story building projects who have experience in sustainable development project in academia in Jakarta. The questioner includes variables that are part of the dominant success factors of subcontractor management by the main contractor. The measurement scale used is the Likert scale (whereas 1 = uninfluential to 5 = very influential). The original data set of 46 samples. The samples was split into two subsamples: Sample 1 (6) and Sample 2 (40). Subsequently, factor analysis was performed on Sample 1 using principal component analysis and The principal component analysis revealed 1 factors unvalid. Next, confirmatory factor analysis (CFA) was performed on Sample 2 to confirm the factor structure.

Table 1. Variables and Sub-Variables

No	Sub-Variables	Variables	Code
1	Planning and Scheduling Factors	Arranged materials and equipment schedules by provided by each subcontractor in accordance to the master schedule by the main contractor	X1
2		Distribution of site plans to every subcontractor both at offices and warehouses that are to be used	X2
3		Subcontractors are able to carry out short project implementation times	X3
4		Submission of sample materials by subcontractor at least 1 month prior to installation	X4
5		Subcontractors making mockups for repetitive work	X5
1	Budget and Contract Factors	The value of work subcontracted by the main contractor to the subcontractors	X6
2		Obligations and rights of the subcontractor in relations with the main contractor must be regulated in the contract	X7
3		The role of the main contracting that is very dominant to the subcontractors and is not supported with adequate subcontract design* planning	X8
4		The main contractor provides subcontractors with detailed and clear specifications and drawings at the time of submission of prices	X9
1	Resource Factors	The length of work/experience of an individual in the relevant subcontracting company	X10
2		On-time mobilization of subcontractor resources (materials, tools, labor)	X11
3		Expertise and skills as well as high work motivation for direct workers subcontractors in the field	X12
4		Sufficient number of workers / in accordance with existing work activities by subcontractors	X13
5		The availability of sufficient materials / as needed by subcontractors	X14
6		Availability of working tools / equipment that are sufficient / in accordance with needs by subcontractors	X15
1	Managerial Factors	Support from top management of the main contractor to parties involved in the project both human resources, budget, methods, and implementation time	X16
2		Mutual trust between subcontractors and main contractors	X17
3		The long-term commitment between subcontractors and main contractors is not just one project	X18
4		Effective communication between subcontractors and main contractors	X19

(*continued*)

Table 1. (*continued*)

No	Sub-Variables	Variables	Code
5		Productive conflict resolutions from the main contractor to its subcontractors	X20
6		Giving power* to the main contractor project manager in carrying out the management of its subcontractors because it is still controlled by the head office	X21
7		The efficient coordination system in the project from the main contractor to its subcontractors	X22
8		Regular control of the work of subcontractors by a team appointed by the main contractor	X23
9		Need of special markings on each subcontractor equipment	X24
10		The documentation system in the project is neat by the main contractor for the subcontractors from the beginning to the end of the project	X25
11		Supervision of work from subcontractors	X26
12		Placement of supervision / supervisor of the main contractor in accordance with their abilities	X27
13		Services and responsibilities during the maintenance period of the subcontractor	X28
14		Proper construction implementation method according the plain of the subcontractor	X29
15		Reports and regular meetings between the main contractors with the subcontractors	X30
1	Technical Factors	The experience of subcontracting companies handling the same type of work and project size	X31
2		There is initial explanation before the subcontractor joins both the contract and project implementation	X32
3		The subcontractor must provide the main contractor with detailed and clear specifications and drawings before implementation	X33
4		Competent technical and managerial quality of personnel in the main contracting work organization	X34
1	Work Safety Factor	Procedure for handling work accidents by subcontractors	X35
2		The safety policy of the main contractor to its subcontractor	X36
3		Participation in subcontractor labor insurance	X37
4		Periodic safety talk by the main contractor to the subcontractors	X38

Sources: [4, 6, 12–19]

The stages of this study are as follows:

a. **First stage**
Conduct interviews and give questionnaires to experts to validate variables from previous studies and bibliography and other references that have been compiled. Categories as experts are people who have expertise in academia and practitioners with at least ten years of work experience in the field of construction. The Variables of library research for studying the main contractor success factors in the subcontractor's management in the implementation of construction were 39 (thirty-nine), whereas after being validated by experts who had long been involved in the main contractor at the time of the pilot survey as many as 38 (thirty-eight) are shown in Table 1 (one).

b. **Second stage**
Distribution of questionnaires to respondents. Respondents are project managers (PM), site managers (SM), and site engineers (SE) of the leading contracting company building projects in Jakarta who have experince in sustainable development project. Namely PT. MULTIKON, PT. TOTAL BANGUN PERSADA Tbk, PT. PP (PERSERO) Tbk, PT. NUSA RAYA CIPTA, PT. TOTALINDO EKA PERSADA, PT. TATA MULIA NUSANTARA INDAH, PT. PULAU INTAN, PT. WASKITA KARYA (PERSERO) Tbk, PT. JATIKARYA MEGAH LAKSANA. Of the 50 questionnaires send out, 40 were returned with varying degress of completeness.

c. **Third stage**
Validating the results of the second stage to be included in the SPSS program, then create analysis and conclusion. The steps are as follows:

1. Tabulate results of questioner data to verify which sub-variables have been fulfilled and then can be processed.
2. Validation and reliability tests to identify factors that fulfill the sub-variables or not. If the data does not fulfill, therefore, the sub-variable is to be excluded. Fulfilling data are continued in the process.
3. Correlation analysis aims to identify the pattern and closeness relationship between two or more variables. The value of r is judged. The value of r is to be tested with a probability value of $< 0{,}05$ and value of t that is if the counted value of $t < t$ of the table, therefore the decision is the value of correlation analysis r is not significant, and if the counted value of t, then the value of correlation analysis r is significant
4. Analysis factors with calculations: Calculate the value of Kaiser-Meyer-Olikin (KMO test) and Barlet test and probability (sig. = p). İf KMO $> 0{,}5$ and probability $< 0{,}05$, then the sub-variables can be factored, take anti-image correlation, or Loading Faktor (λ) test. if $\lambda > 0{,}5$, then the sub-variables are considered valid to be factored; if initial eigenvalue > 1, then the sub-variables is considered valid to be factored, the next step is Communalities.

5. Conclusion Includes results from dominant success factors of subcontractor management by the main contractor in the implementation of construction projects with the confirmatory analysis factor retrieved from the roles of its variables.

3 Results and Discussions

3.1 Validity and Reliability

From the validation test, we can conclude that Corrected item-total Correlations are higher than the value of 0.3. Thus, the independent variable, x, can be considered valid, and if the value is less than 0.3, then invalid. Data of x that are not valid are X3, X5, X7, and X20. Those, as mentioned earlier, will not be included in the next process. From the reliability test, it is shown that the value of Cronbach's Alpha is 0.922, Cronbach's Alpha Based on Standardized Items is 0.927 with N of items is 38. Which describes the level of reliability of being very reliable, 0.80 to 1.00.

3.2 Correlation Analysis Results

From the validation and reliability tests, as many as 34 variables were used. The correlation analysis results showed that 12 variables have significant relationships with the main contractor's success in managing subcontractors in the implementation of construction.

Those were (1) X2 Distribution of site plans to every subcontractor both at offices and warehouses that were to be used (Correlation value = 0.689); (2) X16 Support from top management of the main contractor to parties involved in the project both human resources, budget, methods, and implementation time (Correlation value = 0.622); (3) X17 Mutual trust between subcontractors and main contractors (Correlation value = 0.685); (4) X23 Regular control of the work of subcontractors by a team appointed by the main contractor (Correlation value = 0.668); (5) X25 The documentation system in the project was neat by the main contractor for the subcontractors from the beginning to the end of the project (Correlation value = 0.622); (6) X27 Placement of supervision / supervisor of the main contractor in accordance with their abilities (Correlation value = 0.413); (7) X29 Proper construction implementation method according the plain of the subcontractor (Correlation value = 0.605); (8) X30 Reports and regular meetings between the main contractors with the subcontractors (Correlation value = 0.658); (9) X32 There is initial explanation before the subcontractor joins both the contract and project implementation (Correlation value = 0.616); (10) X36 The safety policy of the main contractor to its subcontractor (Correlation value = 0,659) (11) X37 Participation in subcontractor labor insurance (Correlation value = 0.643); (12) X38 Periodic safety talk by the main contractor to the subcontractors (Correlation value = 0,675).

3.3 Factors Analysis Results

From the results of the correlations analysis, the variables were tested with confirmatory factors analysis. The results obtained were sorted from high to low, which are as follows: (1) There was a preliminary explanation to the subcontractor before the contract or project implementation process with a contribution of 73.9% (2) Routine meetings and reports between the main contractor and subcontractors with a contribution of 59.9% (3) Work safety policy provided to the subcontractors by the main contractor with a contribution of 54,9% (4) Regular control of subcontractors' work results that were conducted by a team assigned by the main with a contribution of 52.9% (5) Appropriate implementation methods for subcontractors with a contribution of 52.2% (6) Placement of supervisors or supervision of the main contractor in accordance to their abilities with a contribution of 29.6%.

4 Discussion

Based on the results of the analysis of data processing with statistic method (correlation analysis and confirmatory factor analysis), the top six ranked factors that require extra attention from the main contractor in managing subcontractors on construction projects implementation in Jakarta as follows:

1. There is an initial explanation before the subcontractor joins both the contract and project implementation. Explanation of the contract at the beginning must have clear and detailed contract clauses, and the method of implementation needs to be explained at the beginning to get a description of the method of work to be carried out both the availability of materials and tools to be used to minimize the risks that will occur and to facilitate monitoring of work.
2. Periodic reports and meetings between the main contractor and subcontractors. Hopefully, these periodic reports and meetings will be able to decide on existing issues and provide a positive solution or impact on the project's progress.
3. The safety policy of the main contractor to the subcontractor. The management team of the main contractor must support and work on programs that can guarantee that no accidents occur or minimize work accidents or work accident prevention measures to the subcontractors.
4. Control the work of subcontractors regularly by a team appointed by the main contractor. The designated team must understand and understand the work of their subcontractors, to minimize the delays in the work of their subcontractors and minimize complaints from project owners.
5. Proper construction implementation method according to the plan of the subcontractor is an essential factor for the main contractor to assess its subcontractors' performance and commitment in helping accelerate the implementation of work on the project.
6. Placement of supervision/supervisor of the main contractor following their abilities. Supervision/supervisor to coordinate and control all subcontractors.

5 Conclusion

The topic is needed to be restudied by adding other variables that is yet to be included in this research paper, such as the need of the main contractor to draw sequence from the steps of work that has to be done including the critical path, Design coordination for every work should be discussed earlier and more detailed, subcontractors are obliged to provide its organizational structure that is clear and only focuses on the assigned work in the related projects, Due to the fact that subcontractors vary from one another, future researches and studies should be more specific on certain subcontractors for their work assigned such as substructure, structure, architecture and MEP (Mechanical, Electrical and Plumbing).

6 Suggestion

Recommendations for this particular subject of field would be the urgent need of further and more researches, respons and reviews from participating subcontractors to the main contractor that makes sure the subcontractors succeed at maintaining good relationship with main contractors in a construction project, therefore future researches can provide more depth in the study.

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