

Improving the Relationship between the Main Contractor and the Subcontractor: Case Study in Egypt

Dalia A.kshaf¹, Mohamed A. Mohamed², Karim M. El-Dash³

¹ Civil Engineering Department, Faculty of engineering at Shoubra , Benha Univerisity, Egypt.

² Civil Engineering Department, Faculty of engineering at Shoubra , Benha Univerisity, Egypt.

³ Civil Engineering Department, Faculty of engineering at Shoubra , Benha Univerisity, Egypt.

Abstract:

The construction industry plays a vital role in the Egyptian economy. The main contractor depends on the subcontractors in the execution of the project. However, lack of planning, poor management, and contracting lead to many problems such as delays that cause claims and conflicts among the parties of the project. A model based on visual studio, C programming language, problems and solutions have been applied to solve problems facing projects. This research helps to choose a subcontractor in a project and improve the Egyptian subcontracting environment. A case study has been studied in the Egyptian construction industry about the relationship between the main contractor and the subcontractors. To avoid some of the problems that face relationship between the contractor and subcontractors in execution and due to delay in the project and claims between parties such as Compliance with the terms of the contract, choose contractors specialized in the required works, contract progress payment is done on time, and efficiency and lack of consideration favoritism.

Keywords: Main contractor; Subcontractor; Disputes; Contracting; Egyptian Construction Industries.

Date of Submission: 14-02-2022

Date of Acceptance: 28-02-2022

I. Introduction:

Subcontracting is an essential aspect of construction projects and its growing importance and role in recent years [1]. The subcontractor can be defined as a party cooperating with the main contractor based on skill and competence in implementing the construction project section. Among the reasons that the main contractor executes the project with other parties' help are the various specializations, escaping from the financial burden, and reducing the dispensable costs [2]. Subcontracting rose to top importance because projects became more difficult due to technological advances and the need for good resource management for a competitive edge [3]. Working with a subcontractor reduces the contractor's workload and the exposure thereof to risks [4]. Subcontracting also helps to improve quality and finishes work on time [5]. It is also seen that subcontracting is a risk to construction projects in the event of increased problems and disputes arising out of poor selection [6]. The subcontracting problems lead to poor project results [1]. There are methods for selecting the subcontractor correctly, but problems arise later in the project when used incorrectly. It is important to present a model capable of solving both parties' issues to view the project as a whole package and not separately because both the main contractor and the subcontractor share the benefit and loss together.

II. Problem statement and study objectives:

Delays in construction projects are common in the construction industry. The problems caused by the relationship between the main contractor and the subcontractor are responsible for converting the winning projects into losers in terms of the delay in the time allocated to complete the project and the required cost. Verification must be performed to identify problems for each party and find solutions to them.

III. Literature Review:

3.1 Problems facing the partnership:

The factors and causes of the problem must be determined before taking any action. The problems faced relation between the main contractor and subcontractor as lack of communication, adversarial culture [7]. Tesha and Luvara [8] said that the problems facing main contractors in managing subcontracted works are their cash flow management and poor management practices. The most important factor that causes the problem was the issue of delayed payments to subcontractors [9]. El-khalek et al. [19] mentioned that the main contractor's financial problems, non-adherence to the terms and conditions of the contract, delay in contract progress payments, and delay of the works behind the schedule are the most important problems that affect the

relationship between contractors and subcontractors. Othman and Risyawati [11] defined that poor communication, lack of information on the site, poor supervision, and the lack of management systems are the main reasons behind project delivery delays and having an inadequate relationship between the main contractor and the subcontractor.

3.2 Solving problems facing the partnership:

Othman and Risyawati [11] said that disputes could be avoided by a better understanding between the main contractor and subcontractors of their responsibilities and obligations and guidelines that promote a general expectation of fairness. Also, they suggested that many disputes could be avoided if each party tried, during contract negotiation and execution were the positions reversed. Contractors and subcontractors should arrange coordinated and proactive problem solving and regular meetings to review progress and joint site inspections to check the quality of completed works and work in progress. The clear written contracts with no ambiguities, proper contract processes, signing after clarifying details, using standard contracts were identified as the most effective preventing mechanisms of disputes related to contract incompleteness [12]. Good site management and proactive coordination by the main contractor are key to solve project issues and complete the project on time [3]. The main regarded face-to-face communications get to know the subcontractor before the subcontract is let as a crucial factor for a successful outcome. The subcontractors suggested that the main contractor's site team's good management and coordination was a key factor for the project's success [13]. Enshassi et al. [10] said that to avoid problems, the contractors should issue the subcontractor's financial payments on the due time. This would help develop the contractor's good reputation and enable the subcontractors to cover their expenses, purchase the required materials, and pay for their labor on time. The contractors should discuss the scope of the works with the subcontractors to set the plans and identify responsibilities before starting the work. The contractors should use written contracts that identify responsibilities and keep the rights of all parties. The subcontractors are recommended to employ a sufficient number of qualified technical staff with appropriate experience and to arrange all required materials and equipment to be able to adhere to subcontract requirements and schedule.

3.3 Subcontractor selection criteria:

Previous studies have been done to discuss several ways how to choose subcontractors . They improved ways to solve and avoid problems between the main contractor and the sub-contractor that affect the project. Yin et al. [14] referred to the correct selection of the sub-contractor increases the main contractor's success in projects. One of the subcontractor's selection criteria is that they demonstrate a positive attitude, commitment, and rapid response to the main contractor's needs [16]. Enshassi et al. [10] said that selecting the subcontractor according to their previous experience, reputation, and capabilities in terms of labor, equipment, and machinery since these items ensure the commitment of the subcontractor to the contract terms and conditions and ability to complete the work according to the schedule and to achieve the best quality. Issuing the subcontractor's payments on time helps in developing good reputation of the contractor and enables the subcontractors to cover their expenses, purchase the required materials, and pay for their labor on time. The subcontractor selection criteria in international construction projects were past experience is the most important criterion and the negotiation stage was found to contain the most important criteria where knowledge of project and reliability are the most significant two criteria[18]. El-khalek et al. [19] referred to the selection of the subcontractor are Time, Reputation, Quality, Cost, and Technical Capability. Biketi et al. [20] recommended that the skills and past experience of the subcontractor are the factor to be considered during their selection. The main contractor should also consider the capabilities and reputation of the subcontractor to make sure that the subcontractor selected is capable of completing the work and achieve the best quality.

IV. Model to improve solution of problems between the main contractor and the subcontractor:

4.1 Introduction:

The problems and solutions were collected from the literature. The most important factors that influence the interaction between main contractors and subcontractors in Egypt were deduced from literature. To addresses the relationship problems adduced in this research, a problems and solutions (PS) model was developed by using visual studio- C++ language. The PS model was designed to solve the problems between the main contractor and subcontractor to improve project success. The PS model is particularly appropriate for helping to solve complex decisions. It is based on the assumption that when faced with a complex decision the human reaction is to group the decision elements according to their common characteristics. Decision support systems can be meant as "computer-aided systems prepared to assist decision-makers to make better, faster, cheaper decisions less time- and effort-consuming. This model puts solutions to problems in any project related to parties of the project to improve the interface between the main contractor and subcontractor. The problems are divided into three groups (main contractor, subcontractor, and other) illustrated in Table 1. The main

contractors and subcontractors in domestic projects mostly have accumulated experience of working together on previous (and potentially on future) projects. During the project, several of the problems were appeared between parties lead to disputes. The problems that have a high probability of turning into disputes illustrated in Table 1 are related to the main contractor, the subcontractor, and the others. Table 2 shows the solutions categorized into five groups (communication, financial, performance, contract, and other sources) related to the project .Each factor group was analyzed in detail, according to about what actually contributes to disputes and what are the effective prevention mechanisms.

Table 1. Conflicts between contractors and subcontractors

Main Group	Problems
Main contractors	<ul style="list-style-type: none"> ▪ Delay in contract progress payment. ▪ Interruption and termination of the subcontractor work. ▪ Delay in providing necessary materials to the subcontractors. ▪ Failure to provide necessary clarifications to subcontractors. ▪ Providing low-quality materials to the subcontractor. ▪ Assigning the work to new subcontractors without informing the original subcontractor. ▪ Not providing the subcontractor with the essential services such as water and electricity. ▪ Non-adherence to the construction schedule. ▪ Lack of trust. ▪ Failure to provide security <i>in situ</i>. ▪ Disclosing subcontractors bid price to third parties to obtain a lower bid price. ▪ Absence of the main contractor from the site. ▪ Failure to provide health and safety measures <i>in situ</i>. ▪ Delay in certifying the work. ▪ Failure to make the final payment for an as long time as possible.
Subcontractors	<ul style="list-style-type: none"> ▪ Work delays. ▪ Not following main contractors' instructions. ▪ Subcontractor's absence from the site. ▪ Partnering the work with another subcontractor without getting the approval of the main contractor. ▪ Lack of proper equipment, the subcontractor insolvency. ▪ Poor health and safety compliance by subcontractors. ▪ The subcontractor not communicating regularly with the main contractor. ▪ The subcontractor not informing the main contractor when there is a problem. ▪ The subcontractor not adhering to the terms and conditions of contract. ▪ Lack of construction quality work. ▪ The subcontractor is involved in more than one project at a time. ▪ Shortage of skilled labor. ▪ Poor management of cash flow. ▪ Failure to preserve and take care of the material.
Other Sources	<ul style="list-style-type: none"> ▪ Change of governmental regulations and laws. ▪ Extreme weather conditions, price increments of material and labor. ▪ Geological condition of the site is not as expected. ▪ Political interference.

Table 2. Conflicts resolution between the contractors and the subcontractors .

Main Group	Solutions
Communication	<ul style="list-style-type: none"> ▪ Communicating regularly ▪ Communicating when there is a problem. ▪ Information communicated in time.
Financial	<ul style="list-style-type: none"> ▪ Complete and clear contract documents. ▪ Timely progress payment to the subcontractor. ▪ The accuracy of the project cost estimate. ▪ Subcontractor/main contractor financial stability.
Work performance	<ul style="list-style-type: none"> ▪ Subcontractors possessing enough skilled labor. ▪ The subcontractor possesses adequate machinery. ▪ Health and safety performance. ▪ Good construction work quality. ▪ Adherence to the construction schedule. ▪ Removing stereotypical thinking.

Contract	<ul style="list-style-type: none"> ▪ Fair contract. ▪ Adherence to the terms and conditions of the contract.
Other	<ul style="list-style-type: none"> ▪ Early involvement of the subcontractor in a project. ▪ Involvement of the subcontractor in the decision-making process. ▪ Mutual objectives. ▪ Trust between the parties.

4.2 The structure of the program model:

In order to efficiently program and run PS programs, the computational system was created using Visual Basic for Application, which is Windows-standard computing software. It is also an important advantage that the PS program does not occupy a space in the hard disc. The release package for the system was designed so that it can be easily installed to a Windows system and can run independently without the need for additional configurations. The main contractor needs to collect the problems facing relations with the subcontractor. Appendix 1 shows the most critical step which is coding all problems and solutions. According to their characteristics, the solutions will be linked to the problems using its code in the program. The solutions will be a variety and more than one. The PS program can be searched about the problem by name. Figure 1 shows the program steps that were followed to achieve the goals set for this study. The steps started by defining all problems as shown in Table 1, then defining all solutions related to all problems, as shown in Table 2. As an example: the problem of assigning of work to new subcontractors without informing the original subcontractor. This problem is related to the main contractor; its coding is 3-2(Appendix 1). According to its characteristics, the solution to this problem is communicating regularly, communicating when there is a problem, information communicated in time complete, and clear contract documents, involvement of subcontractor in decision making process, and trust between the parties. These solutions are linked with codes of the problems in the program. Just search by the name of the problem the solutions will appear automatically. Another example: Work delays. This problem is related to the subcontractor; its coding is 4-1. According to its characteristics, the solution to this problem is subcontractor posses enough skilled labor, subcontractor possess adequate machinery and early involvement of subcontractor in a project.

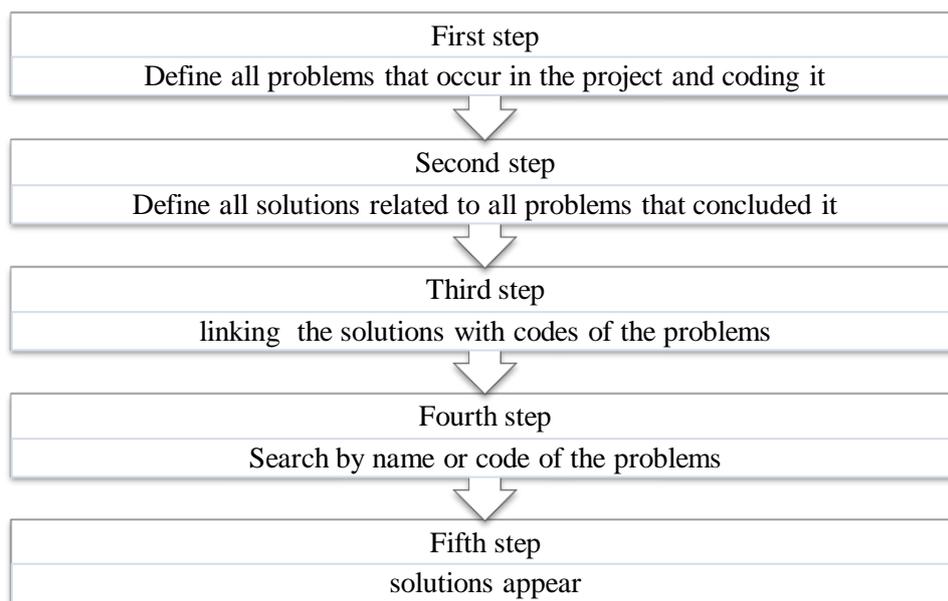


Figure 1: Steps of the PS program

V. Verification:

The data relating to the case study was collected from the interviews with its managers and engineers. The case study is a project in Egypt. The project name is October Plaza. The owner, main contractor, and consultant of the project are Six of October Development and Investment company(SODIC), Solid constructions, and EHAF, respectively. The location of the project in the Six of October City- Giza. The commencement and finish dates are November 2017 and January 2018, respectively. The contents of the project are Ten buildings (six Blocks). The contract price is Seventy-Eight Million, Two Hundred and Three Thousand, Two Hundred Fifty-Six Egyptian Pounds. Finally, the main contractor's contents are earthworks, concrete

works, masonry works, metal works, paint works, thermal and moisture protection works, marble works, mechanical works, electrical and low voltage works, and common area, entrances, and external finishes.

Table 3 shows the items included in the agreement and the number of subcontractors who execute items. The project was divided into 11 items. The main contractor determines the number of subcontractors who are specialized to perform the project.

Table 3. Numbers of subcontractors execute the item of project

Items	No. of subcontractors
Earthworks	1
Concrete works	3
Masonry works	6
Metal works	7
Paints works	6
Thermal and moisture protection works	2
Marble works	6
Mechanical works	1
Electrical and low voltage works	1
Common area, entrances	1
External finishes	1

5.1 Problems related to the main contractors:

The most important problems related to the main contractor were revealed and classified into seven problems from the interviews conducted. This project was delayed because many problems had happened during execution, more than problems that can occur or expected for any project. Table 4 shows the project's problems and a description of the problem that causes delay in the project. By applying the model used on the factors related to the main contractor, effective solutions are found to implement the project in the nearest time period from the date of completion of the project. As well as finding cash flow solutions that the main contractor faces with the subcontractor. Also to enhance confidence between the parties that lead to effective performance in the project.

Table 4. Problems of project related to the main contractor

Item	Problem	Problem description
1	Payment progress from the main contractor	<ul style="list-style-type: none"> ▪ Regarding the signed agreement, payment terms will be done within 30 days from the invoice submitting date. ▪ It doesn't happen. ▪ Period extend to 60-90 days ,so the subcontractor decreases the execution work rate or stop working on site until getting his payment. <p>- Example (1): The subcontractor used 10 resources; due to payment delay, the subcontractor decreased the resources to 2 resources. -Example (2): In the Finishing Works item, the agreement was 60% advanced payment, but in reality, 15% only was paid. So, the subcontractors refused to start work which affects the project schedule.</p>
2	Termination of the subcontractor	<ul style="list-style-type: none"> ▪ Not happen. ▪ The subcontractor's scope of the work was reduced. <p>-Example (1): In the Concrete Works item, one subcontractor has executed 2/3 of the project, then it decreased to 1/3 of the project for not adhering to the delivery dates regarding the financial issues.</p>
3	Late delivery of the necessary material to the subcontractor	<ul style="list-style-type: none"> ▪ Items (Concrete Works, Masonry Works, Marble Works, and Entrances Works) ▪ As a result of late payment, Suppliers were late in supplying material and late in work of the subcontractor and subcontractor back to send claims. <p>- Example (1): In the Concrete Works item, the concrete and steel were late in supply, and the subcontractor sent a claim regarding the payment of labor.</p>
4	Failure to provide necessary clarifications to subcontractors	<ul style="list-style-type: none"> ▪ Concrete works item change in drawings causes additional financial fees for what will be implementing.
5	Assigning work to new subcontractors without informing the original subcontractor	<ul style="list-style-type: none"> ▪ Two blocks were withdrawn without informing the original subcontractor of an alternative implementation for the concrete works item.
6	Not adhering to the construction schedule	<ul style="list-style-type: none"> ▪ As a result of the payment delay, the project schedule was delayed.
7	Lack of trust	<ul style="list-style-type: none"> ▪ The finishing item, the result of the late payment, was a bad reputation in the market, so the subcontractors are afraid to work with the main contractor and raise the price to indemnity result of late.

5.2 Problems related to the subcontractors:

The critical problems related to the subcontractor were classified into five problems from the interviews conducted. Table 5 shows the problems and describes their effects on items of the project. Implementing the most of the project's items on the subcontractor. The program provides effective solutions to the subcontractor to implement the project and avoid the problems with the main contractor, avoid disputes and improve performance.

Table 5. Problems of project related to subcontractor

Item	Problem	Problem description
1	Late in work for the subcontractor	<ul style="list-style-type: none"> ▪ Due to delays in the payments or the dates of supply of raw materials, the project schedule was delayed.
2	Lack of proper equipment	<ul style="list-style-type: none"> ▪ For the concrete works item, the equipment of the subcontractor was not enough, which decreased the scope - For the Concrete Works item, the subcontractor needs to implement buildings in parallel. During the execution, the subcontractor's equipment not enough to execute. The main contractor bought material and equipment and then deducted them from the subcontractor to solve the problem.
3	Lack in Quality	<ul style="list-style-type: none"> ▪ Masonry works item, the consultant refused delivery of work because of lack of quality on the part of the subcontractor due to poor possibilities.
4	Poor management of cash flow	<ul style="list-style-type: none"> ▪ Bad management in cash flow will affect the project scope and schedule.
5	Failure to preserve and take care of material	<ul style="list-style-type: none"> ▪ For the masonry works item, supply cement was responsible from the main contractor. The subcontractor not responsible for withdrawing specific quantities and not mention for any penalty in the contract in the case of not preserving or withdrawing more amounts of cement

5.3 Problems related to Others:

The project is affected by other factors. The most important problems related to the other sources were categorized into three problems from the interviews conducted. Table 6 shows the problems of the project and the problem description. The problems are out of control of the main contractor and the subcontractor, such as government regulations, global effects, or weather conditions. The solutions provided by the model in this part are cooperative between the two parties to prevent the problems that occur from the beginning or quickly solve it at the time it occurs.

Table 6. Problems of project related to others

Item	Problem	Problem description
1	Change of governmental regulations and laws	<ul style="list-style-type: none"> ▪ Licensing delay due to owner.
2	Extreme weather condition	<ul style="list-style-type: none"> ▪ For the concrete works and masonry works items, the materials cement and steel were damaged as a result of rains and bad storage.
3	Price increment of material and labor	<ul style="list-style-type: none"> ▪ It had happened in all items (financial claims have occurred, and item prices have been adjusted according to what had happened by a subcontractor, and approval has been made at rates less than required)

5.4 Applying the approach of the program :

The PS model was developed to enhance project performance by resolving conflicts between the main contractor and subcontractors. The result of the used model appeared in some of the examples applied. The idea of the program is to link the problem related to the project with their solutions according to their common characteristics.

- Example (1): Figure 2 illustrated the problem price increment of material and labor. The program solved it by three factors: fair contract, adherence to the contract's terms and conditions, and main contractor financial stability . Suppose during the performance of the contract , the price of the material significantly increases through no fault of the sub-contractor. In that case, the price shall be equitably adjusted by an amount reasonably necessary to cover any such significant price increases, therefore it was the goal of fair contract.

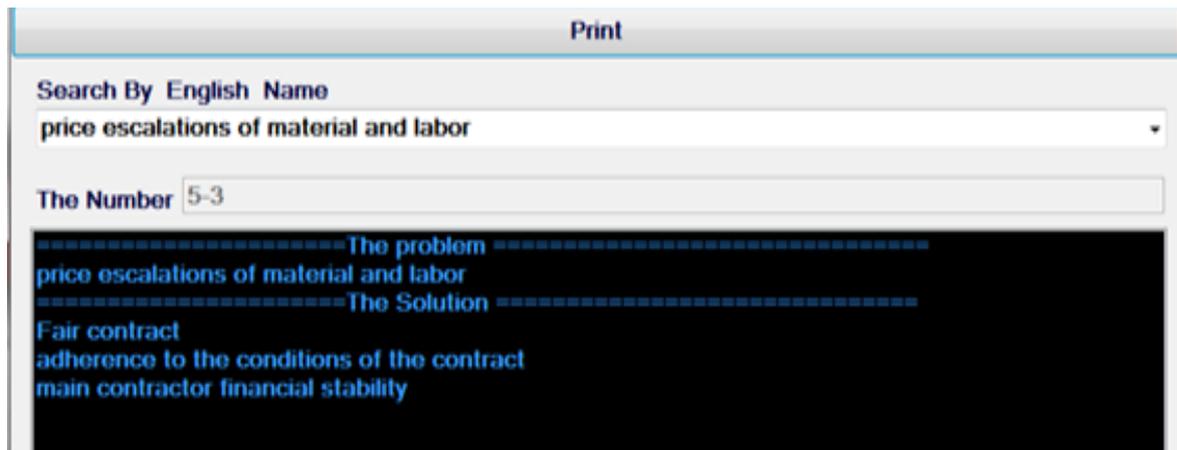


Figure (2): Price increment of material and labor problem.

VI. Improvement of the Egyptian subcontracting environment:

The interviews clarified the suggestions for improving Egyptian subcontracting to avoid projects' problems. This suggestion such as:

- Compliance with the terms of the contract.
- Choose contractors specialized in the required works.
- Contract progress payment is done on time.
- Efficiency and lack of consideration favoritism.
- Fair tender.
- Increased trust between the main contractor and subcontractor.
- Credibility in dealing.
- Previous experience.
- Financial stability-Business quality.
- The comparison between contractors technically and financially.
- Follow the FIDIC contracts system.
- Partnering the consultant in selection to ensure the ability of the subcontractor to perform the work-
- Specific regulations in the contract between the owner and the main contractor.
- Adherence to the penal terms.
- Increasing the number of contractors and increasing competition between them.
- Determine the conditions necessary to amend the contract whether for site conditions or change prices by a certain percentage.

VII. Conclusions:

With the advanced owners' requirements it has become hard for the contracting firms to undertake a project alone, due to the limited number of resources. Therefore, subcontracting has become a significant practice on construction projects. It is important to have a suitable understanding about strategies and prevention mechanisms to avoid any dispute between them. This paper presents a model to find the solutions for many projects' problems called PS (Problems and Solutions). If a dispute occurs between project parties, it will be un-useful to the execution of the project and failure to achieve their goals. Hence the study was conducted to assist in the improvement of this relationship. A case study has been studied in the Egyptian construction industry about the relationship between the main contractor and the subcontractors. A model based on visual studio, C programming language, problems and solutions have been applied to solve problems facing the project .This model contributes to the improvement of the performance, enhances confidence between parties, completes project in the date , and avoids the problems before occur. The project's suggestions were determined to choose a subcontractor and improve the Egyptian subcontracting environment to avoid problems that face partnership in execution, causing delay and generating conflicts in the project.

Reference:

- [1]. A. O. Ujene, E. Achuen, and O. Eta, "The Nature and Effects of Subcontracting on the Performance of Building Projects in South-South Zone of Nigeria," *J. Archit. Plan. Constr. Manag.*, vol. 1, no. 2, pp. 1–20, 2011.
- [2]. J. Mbachu, "Conceptual framework for the assessment of subcontractors' eligibility and performance in the construction industry," *Constr. Manag. Econ.*, vol. 26, no. 5, pp. 471–484, 2008, DOI: 10.1080/01446190801918730.
- [3]. H. White and R. Marasini, " Management of Interface between Main Contractor and Subcontractors for Successful Project Outcomes," *J. Eng. Proj. Prod. Manag.*, vol. 4, no. 1, pp. 36–50, 2014, DOI: 10.32738/jepm.201401.0005.
- [4]. L. Yoke-Lian, S. Hassim, R. Muniandy, and L. Teik-Hua, "Review of subcontracting practice in the construction industry," *WCSE*

- 2012 - *Int. Work. Comput. Sci. Eng.*, vol. 4, no. 4, pp. 442–445, 2012, doi: 10.7763/ijet.2012.v4.406.
- [5]. P. E. Eriksson and M. Westerberg, "Effects of cooperative procurement procedures on construction project performance: A conceptual framework," *Int. J. Proj. Manag.*, vol. 29, no. 2, pp. 197–208, 2011, DOI: 10.1016/j.ijproman.2010.01.003.
- [6]. L. Yoke-Lian, S. Hassim, R. Muniandy, and L. Teik-Hua, "Review of subcontracting practice in the construction industry," *WCSE 2012 - Int. Work. Comput. Sci. Eng.*, vol. 6, no. 1, pp. 442–445, 2012, DOI: 10.7763/ijet.2012.v4.406.
- [7]. S. Dahmas, Z. Li, and S. Liu, "Solving the difficulties and challenges facing construction based on concurrent engineering in Yemen," *Sustain.*, vol. 11, no. 11, 2019, DOI: 10.3390/su11113146.
- [8]. D. N. G. A. K. Tesha and V. G. M. Luvara, "Main Contractors' Strategies in Managing Construction Quality of Sub Contracted Works in Tanzania," *Int. Res. J. Eng. Technol.*, vol. 4, no. 6, 2017.
- [9]. O. A. Akintan and R. Morledge, "Improving the Collaboration between Main Contractors and Subcontractors within Traditional Construction Procurement," *J. Constr. Eng.*, vol. 2013, pp. 1–11, 2013, DOI: 10.1155/2013/281236.
- [10]. A. Enshassi, F. Arain, and B. Tayeh, "Major causes of problems between contractors and subcontractors in the Gaza Strip," *J. Financ. Manag. Prop. Constr.*, vol. 17, no. 1, pp. 92–112, 2012, DOI: 10.1108/13664381211211064.
- [11]. N. A. Mirawati, S. N. Othman, and M. I. Risyawati, "Supplier-Contractor Partnering Impact on Construction Performance: A Study on Malaysian Construction Industry," no. August 2015, DOI: 10.7763/JOEBM.2015.V3.150.
- [12]. B. K. C. Shivanthi, K. A. K. Devapriya, and T. P. W. S. I. Pandithawatta, "Disputes between the main contractor and subcontractor: causes and preventions," no. November, pp. 286–296, 2019, DOI: 10.31705/wcs.2019.29.
- [13]. B. A. M. Elazouni, A. Member, and F. G. Metwally, "D-sub: d," no. June, pp. 191–200, 2000.
- [14]. H. Yin, Z. Wang, J. Yu, Z. Ji, and H. Ni, "Application of DEA cross-evaluation model in project dynamic alliance subcontractors selection," *2009 Int. Work. Intell. Syst. Appl. ISA 2009*, pp. 1–4, 2009, DOI: 10.1109/IWISA.2009.5072743.
- [15]. D. Greenwood, "Subcontract procurement: are relationships changing?," *Constr. Manag. Econ.*, vol. 19, no. 1, pp. 5–7, 2001, DOI: 10.1080/01446190010003380.
- [16]. M. F. Dulaimi and H. G. Shan, "The factors influencing bid mark-up decisions of large- and medium-size contractors in Singapore," *Constr. Manag. Econ.*, vol. 20, no. 7, pp. 601–610, 2002, DOI: 10.1080/01446190210159890.
- [17]. G. Arslan, S. Kivrak, M. T. Birgonul, and I. Dikmen, "Improving sub-contractor selection process in construction projects: Web-based sub-contractor evaluation system (WEBSES)," *Autom. Constr.*, vol. 17, no. 4, pp. 480–488, 2008, DOI: 10.1016/j.autcon.2007.08.004.
- [18]. V. Arslan, S. Ulubeyli, and A. Kazaz, "Site-specific working conditions of occupational safety experts: the perspective of construction professionals," *Int. Conf. Civ. Environ. Eng.*, no. May 2017.
- [19]. H. A. El-khalek, R. F. Aziz, and E. S. Morgan, "Identification of construction subcontractor prequalification evaluation criteria and their impact on project success," *Alexandria Eng. J.*, vol. 58, no. 1, pp. 217–223, 2019, DOI: 10.1016/j.aej.2018.11.010.
- [20]. F. Q. Biketi, Tituskivaa, and G. Munala, "Factors for Efficient Relationship between Contractors and Subcontractors in Project Implementation in Nairobi Kenya," *Int. J. Eng. Sci.*, vol. 6, no. 8, pp. 70–91, 2017, DOI: 10.9790/1813-0608027091.

Appendix:

```

new ClsSection() {Index = "4-0", Name = "subcontractor insolvency"},
new ClsSection() {Index = "4-7", Name = "poor health and safety compliance by subcontractors"},
new ClsSection() {Index = "4-8", Name = "subcontractor not communicating regularly with main contractor"},
new ClsSection() {Index = "4-9", Name = "subcontractor not informing the main contractor when there is a problem"},
new ClsSection() {Index = "4-10", Name = "subcontractor not adhering to the condition of contract"},
new ClsSection() {Index = "4-11", Name = "lack of construction quality work"},
new ClsSection() {Index = "4-12", Name = "subcontractor involved in more than one project at a time"},
new ClsSection() {Index = "4-13", Name = "shortage of skilled labor"},
new ClsSection() {Index = "4-14", Name = "poor management of cash flow"},
new ClsSection() {Index = "4-15", Name = "failure to preserve and take care of material"},
//*****
new ClsSection() {Index = "5-1", Name = "change of governmental regulations and laws"},
new ClsSection() {Index = "5-2", Name = "extreme weather conditions"},
new ClsSection() {Index = "5-3", Name = "price escalations of material and labor"},
new ClsSection() {Index = "5-4", Name = "geological condition of site not as expected"},
new ClsSection() {Index = "5-5", Name = "political interference"},

// solutions
new ClsSection() {Index = "3-1", Name = "timely progress payment to subcontractor"},
new ClsSection() {Index = "3-1", Name = "main contractor financial stability"},
new ClsSection() {Index = "3-1", Name = "Fair contract"},
new ClsSection() {Index = "3-1", Name = "adherence to the conditions of the contract"},

new ClsSection() {Index = "3-2", Name = "Fair contract"},
new ClsSection() {Index = "3-2", Name = "adherence to the conditions of the contract"},

new ClsSection() {Index = "3-3", Name = "main contractor financial stability"},
new ClsSection() {Index = "3-3", Name = "Fair contract"},
new ClsSection() {Index = "3-3", Name = "adherence to the conditions of the contract"},

new ClsSection() {Index = "3-4", Name = "communicating regularly"},
new ClsSection() {Index = "3-4", Name = "communicating when there is a problem"},
new ClsSection() {Index = "3-4", Name = "information communicated in time"},

```

Appendix 1 : coding the problems and solutions

Dalia A.kshaf. "Improving the Relationship between the Main Contractor and the Subcontractor: Case Study in Egypt". *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, 19(1), 2022, pp. 42-49.