

# **DELAY IN CONSTRUCTION INDUSTRY: CAUSES, EFFECTS AND MITIGATION MEASURES**

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The main objectives of this paper are to determine the main causes of delays that occur in construction projects in Cyprus and their effects, and suggest measures that can assist in their effective control and reduction. Seeing that no relevant work has been undertaken for the case of Cyprus, a detailed literature review was carried out to identify the most significant causes of delay at the international level. Based on the review, a survey questionnaire was distributed to members of the construction industry of Cyprus. The analysis of the results indicated variations requested by the client, mistakes and missing information from consultants' drawings, and low productivity and inadequate programming of works from the contractor's side to be the main causes of delay. By considering the delay causes analysis specific mitigation measures are proposed that are mainly related to the programming of the works, work progress and productivity monitoring, and the appointment process of the parties involved in a construction project.

*Keywords:* Disputes, Time, Completion, Disruption, Projects, Arbitration.

## **1 INTRODUCTION**

In the construction industry, the completion of projects within the agreed time constraints is considered an important contractual issue. In the case of delayed completion, all the main parties involved will potentially attempt to recover the financial losses they suffered because of the occurred delay by claiming the payment of financial losses by other parties of the project.

Depending on the size of the project and the agreement amount, the reimbursement sums, which are claimed for alleged delay or disruption, may be extremely high. Consequently, parties aim to avoid liability, which in turn result in frequent disputes (Vacanas *et al.* 2016a). Disputes, despite the various alternative dispute resolution methods available nowadays, will always cause further costs and losses to all parties. Additionally, delayed infrastructure projects (roads, hospitals, airports etc.) affect public's quality of life. For these reasons, researchers and institutions attempted to examine the causes of delay in construction projects.

Considering the above, the objectives of this paper are set to: (a) present an overview of the main causes delay in construction projects at the international level, (b) investigate the causes of delay in the Cypriot construction industry, and (c) examine measures that can aid the delay, and subsequently dispute, avoidance in the Cypriot construction industry.

## 2 CAUSES OF DISRUPTION AND DELAY IN CONSTRUCTION PROJECTS

### 2.1 Studies at the International Level

Studies regarding the causes of delay have been carried out by a number of researchers for various for various countries and geographical areas (Abd El-Razek *et al.* 2008, Ahmed *et al.* 2002, Chan and Kumaraswamy 1996, Chua *et al.* 1999, CIOB 2009, El-Sayegh 2008, Frimpong *et al.* 2003, Memon *et al.* 2010, Muhwezi *et al.* 2014, Odeh and Battaineh 2002, Orangi *et al.* 2011, Polat *et al.* 2014, Xiao and Proverbs 2003, Zou *et al.* 2007). The main causes of delay that were identified are summarized ranked from most frequently identified to the least frequently identifies in Table 1.

Table 1. Causes of delay in ranked from most to the least frequently mentioned in literature.

Cause of Delay
Changes and Variations by Consultants
Delay in payments to Contractor
Contractor's poor management ability
Intervention and changes to design by Client/ Owner
Inadequate contractor experience / poor technical performances
The financing by contractor during construction
Delay in issuing permits and approvals by government
Incomplete Documents/ design errors
Inadequate programme scheduling/ improper planning
Price inflation of construction materials
Suppliers' incompetency to deliver materials on time
Subcontractors' poor performance and management
Shop Drawings Approval/ delays in approvals
Design Development
Tight programme schedule
Shortage in manpower supply and availability/ shortage of site workers
Inadequate site investigation
Poor communication
Inspections
Changes in Laws and Regulations
Lack or departure of qualified staff
Weather conditions
Rework
Low speed of decision making involving all project teams
Labour productivity
Decision During Development stage/ slow decision making
Procurement delays

As it can be seed in Table 1, the ‘Changes and Variations by Consultants’, ‘Delay in payments to Contractor’, ‘Contractor's poor management ability’, ‘Intervention and changes to design by Owner’, ‘Inadequate contractor experience / poor technical performances’ and ‘The financing by contractor during construction’ are the most important causes of delay in construction projects identified at the international level.

### 2.2 Causes of Delay in Cyprus

In order to identify the most important causes of delay in construction projects in Cyprus we designed a questionnaire that was asking the participants to value the impact of twenty identified causes on a scale of 1 to 5; (1) corresponds to a very high level of impact, (2) to a high level, (3)

indicates an average level, (4) a low level and (5) shows a very low level of impact, respectively. The twenty causes of delay proposed by the experts, and their respective significance as experienced by the participants are illustrated in Table 2.

Table 2. Causes of delay in Cyprus construction industry in ranked order.

<b>Cause of Delay</b>
Changes by the Client
Mistakes and Missing Information from Consultants drawings
Low productivity by Contractor
Inadequate experience by Consultants on specialised projects
Delayed Instructions by Consultants
Difficulties in Financing of the works by the Contractor
Inadequate programming of works
The involvement of a large number of parties
Payments Delay
Problems between Contractor and his Subcontractors
Delay to responses by Consultants to requests of information
Delay to responses by Client to requests of information
Bad communication
Delay to material approval
Suspension of Works by Contractor
Problems between Contractor and his Suppliers
Works required by public authorities (Electricity, Water, etc.)
Delay to approval of final drawings
Bad weather
Accidents

Based on the survey results, it was concluded that delay causes that are identified as the ones with the highest impact on projects' completion are changes by client, mistakes and missing information from consultants drawings', low productivity by contractor, inadequate experience by Consultants on specialized projects', 'late instructions by consultants, difficulties in financing of the works by the contractor, and inadequate programming of works.

### 2.3 Effects of Delay in Cyprus

To identify the effects of delay in projects the participants were asked to identify the percentage of projects where delay occurred. The participants' replies are summarized in Table 3. Only 17% of the participants state that delay occurred up to 20% of the projects they worked on, where 30% of the participants experienced delay on more than 60% of the projects they worked on.

Table 3. Delay occurrence in projects.

<b>Delay Occurrence in Projects</b>	<b>%</b>
Delay occurred in 0-20% of projects	17%
Delay occurred in 21-40% of projects	28%
Delay occurred in 41-60% of projects	26%
Delay occurred in 61-80% of projects	17%
Delay occurred in 81-100% of projects	13%

With regards to the duration of the delay, 28% of the participants experienced delay of duration up to 10% of the original contract duration, and 80% of the participants experienced delay with duration up to 30% of the original contract duration (Table 4).

Table 4. Delay duration in projects.

<b>Delay Duration in projects</b>	<b>%</b>
0-10 % of original duration	28%
11-20 % of original duration	26%
21-30 % of original duration	26%
31-40 % of original duration	9%
41-50% of original duration	7%
> 50% of original duration	4%

Regarding the agreement on EOT award duration, 53% of the participants stated that always or usually there is an agreement until the delivery of the project; and 47% that rarely or never is there an agreement on EOT duration until the delivery of the project (Table 5).

Table 5. Agreement of EOT award duration until the delivery of a project.

<b>Answer</b>	<b>Percentage</b>
Always	7%
Usually	46%
Rarely	39%
Never	7%

Depending on the contract, disputes in construction contracts are resolved via arbitration or court proceedings. The standard form contracts for construction projects in Cyprus are based on JCT 63 (private building projects) or FIDIC 4 (public works). More than 60% of the participants replied the arbitration proceeding has duration up to 2 years, whereas most of the court proceedings last more than 2 years without taking into account time spent on appeals (Table 6).

Table 6. Duration of arbitration proceedings.

<b>Answer</b>	<b>Arbitration Proceedings</b>	<b>Court Proceedings</b>
1 - 12 months	28%	2%
13 - 24 months	33%	2%
25 - 36 months	15%	26%
more than 36 months	9%	41%
I do not know	15%	29%

The enforcement of an Arbitral Award is an issue that has not been investigated thorough so far. According to the participants' experience usually there is requirement for the Court's intervention for the enforcement of the Arbitrator's award (Table 7). This is possibly because the parties that have the obligation to pay the amounts of the award know that they can delay their payment without serious consequences. Therefore, it is preferable to retain the amounts in their accounts for as long as possible, taking into advantage the slow judiciary system of Cyprus.

Table 7. The Arbitrator's award requires the court's aid to be enforced.

<b>Answer</b>	<b>Percentage</b>
Always	9%
Usually	54%
Rarely	11%
Never	4%
I do not know	22%

### **3 DELAY AND DISPUTE MITIGATION MEASURES**

By considering the causes of delay and the effects of delay the following measures could be applied for mitigating delay and its effects including the generation of disputes:

#### **3.1 Programming of the Works Related Measures**

Programming is important in construction projects for organizing and scheduling the construction activities as well as controlling the various time constraints agreed. For this reason, there are various measures and practices related to programming that if applied could aid delay mitigation and avoidance:

- Preparation of realistic programme of works with critical path method
- Periodical (weekly, monthly) update of the works programme according to progress of works, with all changes highlighted to all parties
- When a disruption event occurs the programme to be updated and distributed

#### **3.2 Work Progress and Productivity Monitoring Measures**

Early warning for delays can make the parties act in a responsible way towards delay control and avoidance. Concordantly, there has to be frequent, clear and transparent updating of the parties on the works progress. The combined use of traditional methods (meetings, site reporting, frequent schedule updating etc.) and new technologies (e.g. use of BIM technology with UAV and Laser scanning for works progress recording and updating via 3D images) (Vacanas *et al.* 2016b) can provide clear updating of all the interested parties regarding the progress of works.

#### **3.3 Assessment of Consultants' Experience During Appointment Process**

One of the most important causes of delay is the changes and variations by Consultants and Clients. The reasons for these variations and changes are mainly the mistakes and missing information on consultants' drawings and the incomplete design because of restrictive timeframes and budgets. The appointment process of Consultants must include assessment of their ability to fulfill any special project requirements. Furthermore, there must be an audit methodology to ensure complete design preparation by the Consultants prior the tender period. Apparently, the Clients do not fully understand the end result of the design until they see it being constructed. BIM technology may be used to provide to Clients 3D visualization of the end project so that changes by the Clients during construction are avoided.

#### **3.4 Assessment of Contractor's Experience and Financial State During Tendering Process**

Every construction project is different but there are similarities between projects, which some contractors have experienced more than others. For this reason, the experience and ability of Contractors, especially for projects with certain particularities, have to be taken into consideration during tendering process. Difficulties in works financing by the Contractor and Late Payments are two major causes of delay and for this reason the financial state of the Contractors has to be investigated to avoid awarding the contract to a Contractor that will not be able to finance the works in the case there are late payments or any other payment issues.

### 3.5 Arbitration

Arbitration is clearly the dispute resolution method that offers fast resolution of disputes. However, this particular method for dispute resolution is not provided by all construction contracts. This is an issue that needs to be looked at. Nevertheless, the Arbitration Act of Cyprus was enacted around the middle of the previous century. The Cyprus Arbitration Act needs to be updated and certain disadvantages have to be improved.

## 4 CONCLUSIONS

Timely completion is one of the basic components that can set a construction project as successful. The main causes of delay have been analyzed at international and local level. Certain measures for delay mitigation have been suggested and discussed. The data acquired from the questionnaire research will be analyzed and the results presented in the future via journal papers.

### References

- Abd El-Razek, M. E., Bassioni, H. A., and Mobarak, A., Causes of Delay in Building Construction Projects in Egypt, *J. Constr. Eng. Mgmt.*, 134, 831–841. doi:10.1061/(ASCE)0733-9364, 134:11(831), 2008.
- Ahmed, S. M., Azhar, S., Castillo, M., and Kappagantula, P., Construction Delays in Florida: An Empirical Study, Final Report, Florida International University, 2002.
- Chan, D. W. M. and Kumaraswamy, M. M., An Evaluation of Construction Time Performance in The Building Industry, *Build. Environ.*, 31, 569–578. doi:10.1016/0360-1323(96)00031-5, 1996.
- Chua, D. K. H., Kog, Y. C., and Loh, P. K., Critical Success Factors for Different Project Objectives, *J. Constr. Eng. Manag.*, 125, 142–150, doi:10.1061/(ASCE)0733-9364(1999)125: 3(142), 1999.
- CIOB, Managing The Risk of Delayed Completion in the 21st Century, 2009.
- El-Sayegh, S. M., Risk Assessment and Allocation in the UAE Construction Industry, *Int. J. Proj. Manag.*, 26, 431–438, doi:10.1016/j.ijproman.2007.07.004, 2008.
- Frimpong, Y., Oluwoye, J., and Crawford, L., Causes of Delay and Cost Overruns in Construction of Groundwater Projects in A Developing Countries; Ghana as a Case Study, *Int. J. Proj. Manag.*, 21, 321–326, doi:10.1016/S0263-7863(02)00055-8, 2003.
- Memon, A. H., Abdul Rahman, I., Abdullah, M. R., and Abdu Azia, Ade, A., Factors Affecting Construction Cost in Mara Large Construction Project: Perspective of Project Management Consultant, *Int. J. Sustain. Constr. Eng. Technol.*, 1, 41–54, 2010.
- Muhwezi, L., Acai, J., and Otim, G., An Assessment of the Factors Causing Delays on Building Construction Projects in Uganda, *Intl. J. Constr. Eng. Mgmt.*, 3, 13–23, doi:10.5923/j.ijcem.20140301.02, 2014.
- Odeh, A. M. and Battaineh, H. T., Causes of Construction Delay: Traditional Contracts, *Int. J. Proj. Manag.*, 20, 67–73, doi:10.1016/S0263-7863(00)00037-5, 2002.
- Orangi, A., Palaneeswaran, E., and Wilson, J., Exploring Delays in Victoria-Based Australian Pipeline Projects, *Procedia Eng.*, 14, 874–881, doi:10.1016/j.proeng.2011.07.111, 2011.
- Polat, G., Okay, F., and Eray, E., Factors Affecting Cost Overruns in Micro-Scaled Construction Companies, *Procedia Eng.*, 85, 428–435, doi:10.1016/j.proeng.2014.10.569, 2014.
- Vacanas, Y., Themistocleous, K., Agapiou, A., and Danezis, C., Methodology for Infrastructure Project Management, Dispute Avoidance and Delay Analysis, *An. Edif.*, 2, 12–19, doi:10.20868/ade.2016.3193, 2016a.
- Vacanas, Y., Themistocleous, K., Agapiou, A., and Hadjimitsis, D., The Combined Use of Building Information Modelling (BIM) and Unmanned Aerial Vehicle (UAV) Technologies for the 3D Illustration of the Progress of Works in Infrastructure Construction Projects, *Proceedings of SPIE - The International Society for Optical Engineering*, doi:10.1117/12.2252605, 2016b.
- Xiao, H. and Proverbs, D., Factors Influencing Contractor Performance: An International Investigation, *Eng. Constr. Archit. Manag.*, 10, 322–332, doi:10.1108/09699980310502937, 2003.
- Zou, P. X. W., Zhang, G., and Wang, J., Understanding the Key Risks in Construction Projects in China, *Int. J. Proj. Manag.*, 25, 601–614, doi:10.1016/j.ijproman.2007.03.001, 2007.