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Original Research Article

MEASURES TO MITIGATE THE MAIN CAUSES OF SOCIAL HOUSING DELAYS IN ALGERIA

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A b s t r a c t

Social housing in Algeria is carried out with state budget funds in order to eliminate social inequalities and guarantee a decent life to the citizen. However, delays have been observed in the realization. This study aims to examine the main causes and develop guidelines to effectively mitigate delays. Through an in-depth analysis of the literature and formal interviews on the topic of potential risks with construction experts, a list of 67 delay factors was identified. Data was collected through an online questionnaire via Google Forms and semi-structured interviews of a sample professionals established in Algeria. A total of 59 valid responses were analyzed and classified by SPSS software. The results indicate that the 5 most critical causes are: "Delay in payment", "Slow change orders in extra works", "Ineffective planning and scheduling", "Slow change orders in extra quantities", and "Difficulties in financing the project by contractor". Though, the correct implementation of the measures suggested by this study allows government authorities and professionals to deal with the 10 most critical causes that have favored the occurrence of delays in order to successfully implement similar construction projects.

Keywords: Algeria, social housing, construction projects, delay causes, mitigation measures

1. INTRODUCTION

Providing large and robust social housing comes with substantial financial, administrative and political responsibilities for governments [26]. Projects are designed to meet strategic objectives or operational needs [2]. Nevertheless, delays are inevitable and are considered by the building industry to be costly, complicated and risky. Thus, delays must be resolved quickly by allocating responsibilities among stakeholders in a fair and appropriate manner [19]. a plethora of studies have addressed the issue of project delay and identified the main causes by country, region, type of project and procurement

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methods, as well as from the viewpoint of various stakeholders [9]. The delay factors are therefore specific, hence the difficulty of normalizing them [11]. It should be noted, however, that while some of the external challenges may not be mastered by the project, all of the internal challenges can be met with a commitment to excellence in project management [2]. The performance of the construction management team plays a critical role in determining construction time performance [29]. In most developing countries, the adoption of the traditional contract by the government leads to significant delays in major projects [22].

Social housing is defined as rental housing subsidized by the government and provided by local authorities to low-income households and rented well below market levels [26]. The involvement of the Algerian government in the provision of housing is a constitutional obligation [20]. Since 1999, having regained political and institutional stability and significant financial resources due to rising oil prices [23], and despite the considerable budgetary resources allocated to housing representing approximately 5% of total public spending and 15% of investment spending and the diversification of housing access options. However, the government's dominant role in land ownership and the housing market has resulted in delayed innovation in the financial sector, thereby depriving the government of effective potential partners, and has also led to a significant delay in delivery. In addition, the limited capacity of private and public construction companies, the difficulty in finding suitable land, and a cumbersome bureaucracy in terms of tendering, authorization and payment slow down the timely completion of projects. An investment of about DZD 2.45 trillion (USD 24 billion) was committed to build housing during the periods of 2010 and 2015, but only 362,100 units out of the 1,085,500 planned units for the Public Rental Housing Program (PRHP) were actually built and delivered [20].

This research aims to enrich previous works on risk events and develop recommendations to effectively mitigate delays in the construction projects of (PRHP) in Algeria. Thus, the authors' concern is to realize the points of view of the participants directly involved in the realization of this type of housing, namely, owners, consultants, designers and contractors.

2. LITERATURE REVIEW

Several researchers have conducted literature reviews to provide an up-to-date compilation of previous studies dealing with the ranking of delay causes.

2.1. Universal causes of delay

Durdyev and Hosseini [9] presented a systematic review of studies published between 1985 and 2018. A total of 149 causes of delay were identified through an extensive review of 97 selected studies. However, the results reveal that there are common causes that have been reported by the majority of researchers. Thus, only 10 most frequently cited causes were considered and discussed in depth, namely: "weather/climate conditions", "poor communication", "lack of coordination and conflicts between stakeholders", "ineffective or improper planning", "material shortages", "financial problems", "payment delays", "equipment/plant shortage", "lack of experience/qualification/competence among project stakeholders", "labor shortages", and "poor site management".

Viles et al. [28] reviewed 47 studies published between 1985 and 2017 worldwide. Indeed, they proved that statistical study is more appropriate to identify the most frequent and important causes of delay. Regardless of the study location, the results reveal that the "Execution", "Administrative Issues" and "Workforce" groups were the most highly ranked (77.3% of the causes reported in the examined literature were included in these three groups).

Sanchez-Cazorla et al. [24] developed a proposal for risk categorization based on a total of 9

homogeneous categories that encompass all types of risks identified in the 83 analyzed references, in particular: "design risks", "legal and/or political risks", "contractual risks", "construction risks", "operation and maintenance risks", "labor risks", customer/user/society risks", "financial and/or economic risks", and "force majeure risks".

Prasad and Vasugi [21] selected, reviewed and analyzed 53 research articles studied in different countries and evaluated during the period 1970-2016, on the causes of delay. They noted that two common causes appear in both types of economies and are classified as critical causes that absolutely must be mitigated: "delay in approvals of drawings, design changes and errors", and "change orders/increase in scope of work". Otherwise, in the case of developed countries, the causes of delay are mainly related to external factors. This shows that the subcontractor factor is ranked among the most important causes, while in the case of developing countries, project delays are governed by external factors in addition to client and contractor factors. This can be explained by the "financing difficulties", the "lack of project management competencies", and the "inadequate experience of contractors".

Based on an in-depth literature review of 103 articles reviewed for different types of projects and covering 45 countries worldwide, and then an analysis of the results of 202 questionnaires collected through semi-quantitative surveys conducted in Norway on road, railway and building construction projects as well as renovation of existing buildings, Zidane and Andersen [34] compared the top 10 delay factors identified in Norwegian major projects with the top 10 universal delay factors. It is worth noting that among the top 10 delay factors identified in the two above-mentioned studies, 5 causes are common, namely: "poor planning and scheduling", "resources shortage", "poor site management and supervision", "design changes during construction/change orders", and "late/slow/incomplete/improper design".

Ramanathan et al. [22] concluded that no study is comparable to another, and each study has a different ranking for the groups/categories/sources of delays and cost overruns. The most influential groups in the previous studies (in 1995) are no longer considered as high-risk factors (in 2010). It is highly unlikely that the possible variations in the ranking results are due to different respondents. It would appear that the groups and factors causing delays are specific to country, location and project and that there are no root causes that can be generalized.

2.2. Country-specific critical causes

Heravi and Mohammadian [13] evaluated the performance of small, medium and large urban construction projects in Iran, in terms of cost and time. 72 projects were studied by examining their documents and real performance. Moreover, different types (urban roads and buildings) and two natures (new and renovation) of construction projects are considered in this research. The main findings of this study are as follows: "only 7% of the studied projects were completed within budget", "only 8.5% of the studied projects were completed on time", "large urban construction projects were faced higher cost overruns and delays", "time and cost performance of new-build projects were generally better than those of renovation projects", and "the cost-performance ratio of urban road projects were better than that of building construction projects". These results allow a realistic estimation of time and cost in urban construction projects in developing countries.

Kog [17] analyzed time extensions for 78 project construction of 184 high-rise residential buildings completed before March 1987 in Singapore. The file review of these projects revealed that a total time extension of 854 months was required for 164 buildings (89%), ranging from a minimum of 1 month to a maximum of 18 months for a contract duration of 18 to 26 months. The identified eligible delay factors in this study are compared with the main delay factors reported by Hwang et al. [14] for Housing and Development Board (HDB) projects based on a self-administered questionnaire survey. A

comparison is also made with studies of countries where administrations are at a similar stage of economic development to Singapore: this included "Hong Kong", "South Korea" and "Taiwan". The results show that only three eligible delay factors are among the top delay factors affecting at least three Asian countries, namely: "late release of site", "variation orders", and "late delivery/shortage of construction materials".

Bajjou and Chafi [5] determined the critical causes of project delays in the Moroccan construction, namely: "delay of progress payment", "lack of employee training", "lack of a waste management strategy", "unrealistic contract duration", "rework due to construction errors", and "excessive subcontracting". These causes are similar to the most frequent causes affecting developing countries in Africa and Asia, particularly "delay of progress payment" and "subcontracting problems" with occurrences of 80% and 60% respectively.

Zemra et al. [32] identified the main causes of delay in the Algerian basic infrastructure and assessed their importance according to the main project stakeholders. The main causes of delay are: " slow change orders", "unrealistic contract duration", "slow variation orders", "delays in payment", and "inefficient planning and scheduling".

2.3. Specific causes for the housing sector

Durdyev et al. [10] studied the main causes of delays in the residential construction sector in Cambodia. The influencing factors most recognized by contractors and consultants are:"shortage of materials on site", "unrealistic project scheduling", "late delivery of materials", "shortage of skilled labor", and "project complexity".

Islam and Suhariadi [15] examined the causes of delay in major privately financed building construction projects in Bangladesh. The most important causes are: "lack of experienced construction managers", "lowest bidder selection", "lack of funds from owners", "lack of proper management by project owners", and "improper planning and scheduling". These causes are mainly related to management and financing problems, which are similar to the situation in some other developing countries, such as India, Pakistan, Vietnam, Egypt, Kuwait, Malaysia, Ghana, and Saudi Arabia. Taking these results into account allows project stakeholders to take upstream control measures to make their investments safe and sustainable.

Muhwezi et al. [18] assessed the delay factors in building construction projects in Uganda. The most important factors were identified as: "delay in assessing changes in the scope of work by the consultant", "financial indiscipline/dishonesty by the contractor", "inadequate contractor’s experience", "design errors made by designers", and "inadequate site investigation by the consultant". The study concluded that the category related to the consultant had the highest impact.

Fugar and Agyakwah-Baah [12] focused on the construction delay of building projects in Ghana. Clients, consultants, and contractors agreed on the following ranking of major delay factors: "delay in honoring payment certificates", "underestimation of project costs", "underestimation of project complexity", "difficulty in accessing bank credit", and "poor supervision". These causes are mainly related to problems of financing, materials, and scheduling and control.

2.4. Specific causes of a risk category

Shaikh et al. [27] explored the root causes of delay related to construction project financing in Pakistan. Examining the viewpoints of contractors, bankers, clients and consultants engaged in the construction sector immersed the main causes, which are: "weak cash flow management in the administration of a project", "inadequate financial resources", "delay in payment by the client", and "inconsistent stability of financial market". The most important underlying causes for each of the four major elements

highlighted above are indicated as: "difficulties in obtaining advances from investors", "customer's weak financial condition besides trade administration", "inconsistent monetary background of the contractor", and "price increases". Approximately 66% of participants pointed out that clients are responsible for the financial issues that impact project time extensions.

Based on real data from projects in Egypt, Saudi Arabia, the United Arab Emirates, and Qatar, Badawy et al. [4] concluded that the cost of late payments in residential buildings can be estimated as a function of the "total contract value", "the duration of late payments", and "the total project duration".

Yap and Skitmore [31] analyzed the survey data which revealed that construction projects in Malaysia experience cost and time overruns of 5 to 20% due to frequent design changes whose the most significant causes are: "lack of coordination among various professional consultants", "change of requirements/specifications", "addition or omission of scopes of application", "errors/discrepancies in design documents", and "unforeseen ground conditions".

Khanyile et al. [16] elucidated communication management practices informed by the local culture of Eswatini (Swaziland) and showed that there is a link between project performance and three practices, namely:"information technology", "communications management plan", and "clear channels within organization's structure".

Based on a survey of construction consulting organizations in the UK, Braimah and Ndekugri [6], emphasized the importance of the role of the owner's quantity surveyor in the evaluation and settlement of claims for the benefit of contractors, however the lack of adequate information on the project and the use of obsolete programs are the main obstacles to the use of more reliable methods.

Aiyetan and Dillip [1] reported that the shortage of skilled labor affects significantly the quality of work, leading to rework and low productivity, followed by delays in project construction in the Eastern Cape Province of South Africa.

Ariffin et al. [3] have shown that "poor management by the developer", and "financial crisis" are the main factors leading to abandonment of the housing project in Malaysia.

2.5. Mitigation measures

In addition to highlighting critical and high-influencing causes, many researchers and studies have provided significant and successful solutions to alleviate the problem.

Prasad and Vasugi [21] proposed to undertake a research approach integrating both methods, in which the causes identified from the statistical analysis of the responses to the questionnaire can be compared to the causes that emerge from the study of the documents of complaint, which will strengthen the objectivity of the data collected.

To reduce delays to acceptable risk levels, Viles, et al. [28] noted that forecasting techniques are appropriate for reducing causes related to "changes during construction," "poor construction management," and "construction errors" that arise during execution. A study of the typologies of project cash flows helps to prevent " poor financial and economic behavior" related to the "Administrative Issues" group, Finally, in the "Workforce group", consideration of human behavior significantly reduces the root causes of "Conflict/Relationships", "Lack of Experience" and "Low Productivity".

Braimah and Ndekugri [6] noted that particular attention should be given to improving current programming and record-keeping practices as well as supporting training in the use of the most sophisticated methods, promoting the use of more reliable methodologies which, in turn, will increase the chances of a speedy and amicable settlement of delay claims, particularly in the UK.

Zemra et al. [32] proposed to implement the following measures to reduce the similarity of risk factors: "Minimize change orders ", "Ensure that funds are available for projects before they are commissioned", "Develop effective communication ", "Schedules should be defined and negotiated

taking into consideration contractor capacity and resource availability", "Develop human resources through adequate training programs ".

To minimize the causes of delay, Bajjou and Chafi [5] suggested compliance with: "A clear and transparent payment schedule and procedure, from the planning stage, to ensure that companies will be paid regularly." "Implemented training programs for the benefit of workers to improve skills and techniques required in scheduling, cost and schedule control, building information modeling (BIM) technology, and risk analysis." "Define a realistic duration in the contract." " Simplify administrative procedures to reduce the time allocated to the permitting process."

Kog [17] proposed the following delay mitigation measures: "improving communication among the different departments acting as in-house consultants of the agency", "professionalizing contractors' project teams", and "increasing construction productivity while increasing levels of automation and adoption of precast technology".

To minimize and control delays, Muhwezi et al. [18] noted that consultants should: "Ensure clarity of project documentation", "point out ambiguities and correct design errors", "address any changes in project scope without compromising the desired outcome of the final project", "Ensure timely, accurate and adequate communication between all stakeholders during the project life cycle", and "Require attendance of a competent representative of the consultant on site to make binding decisions and ensure the preparation of interim payment certificates on time".

In order to prevent the problem of project abandonment, Ariffin et al. [3] recommended the developer to "have a good financial system" and an "effective system of risk management strategies". Yap and Skitmore [31] pointed out that "successful collaboration and effective communication between contracting parties" greatly improves project coordination.

Strategies for improving the availability of skilled labor have been suggested by Aiyetan and Dillip [1], namely: "improving investment in labor wages", "investing in talent management and staff development programs", and "ensuring a better working environment, with better health and safety". It should be noted that the majority of the studies reported in the literature reviewed adopted statistical analysis of questionnaire responses, however, the study of claim documents was also used. Thus, in order to focus resources on the most critical causes, only the ten most cited causes were considered and discussed in depth, for both types of economies (developed and developing countries), and for different types of projects. It would appear that the categories and factors causing delays are specific to country, location and project, hence the difficulty of normalizing them.

3. RESEARCH METHODOLOGY

Exploratory interviews and discussions were carried out with eight experts and twelve construction professionals, this allowed us to focus our research on a case study (PRHP), to delimit the field of research to the regions of Northern Algeria, to define a content of questions consistent and relevant with the object of the research and to choose the sample. The questionnaire was drafted on the basis of an in-depth literature review and feedback from professionals solicited from their organizations. Calling on the expertise of three professionals and three academics made it possible to make technical and methodological revisions and to check, as a result, *the apparent validity* of the questionnaire.

In the end, the resulting questionnaire is composed of three parts. The first is dedicated to the description of the respondent and his organization; it is about, his position in the project, his level of education, his experience in the construction industry and his estimate of the average percentage of the delay in past projects. The second part is devoted to the precise definition of each potential cause of the delay. A list of 67 causes of delay was constructed. The combination of the level of probability of an event occurring and the severity it would have on the project, is used to measure and judge the criticality

of an identified risk in relation to others. A five-level evaluation grid (Likert scale from 5 to 1 point) was used. Probability is assessed as: always, often, sometimes, rarely, and never (scale); Severity is rated as: critical, major, significant, minor and negligible. The third part is based on the past experience of the respondent to ask him to bring his suggestions and his recommendations in order to overcome the paradigmatic divide to develop a more useful vision and anchored in the context of the practice, essential to mitigate and provide a holistic understanding of what drives time overruns in (PRHP).

3.1 Data collection

Beforehand, a questionnaire accompanied by an explanatory letter was sent to the participants via Google Forms in order to allow them to learn about the subject of the study. Indeed, making contact, face to face or by telephone, with professionals is essential to direct and validate the work of the researcher. Out of 81 questionnaires administered, we were only able to carry out 20 interviews (face to face) and we were able to obtain 59 complete answers giving a response rate equal to 72.84%. These responses have been processed and validated accordingly. This investigation was implemented through a questionnaire undertaken between the months of November 2020 and February 2021.

3.2 Data analysis techniques

SPSS software was adopted to perform statistical analyses of the collected data:

Cronbach's alpha technique

The “Cronbach's alpha coefficient” was used to measure the internal reliability of the questionnaire. This is most popular for questions adopting the Likert scale. Its value varies from 0 to 1; the higher the value, the more reliable the adopted measurement scale will be [25].

The results of the test gave a value of 0.985 (> 0.7) for the entire questionnaire (i.e., 134 items) thus testifying to the high reliability of the scale and the internal consistency of the instrument used. (At the 5% level of significance) (Table 1)

Table 1. Coefficient « Cronbach’s alpha»

Variables	Number of items	Cronbach’salpha
Probability responses	67	0,975
Severity responses	67	0,973
Overall questionnaire	134	0,985

Means and standard deviation

Means are calculated using SPSS software to perform cause ranking. If the same average is obtained for two or more causes, the cause with the lowest standard deviation will be ranked higher.

The normalized values of the averages will be calculated to identify the most critical causes among the 67. The following calculation method has been adopted:

$$\text{Normalized value} = \frac{(\text{mean} - \text{minimum mean})}{(\text{maximum mean} - \text{minimum mean})} \quad (1)$$

The cause is considered critical for a value ≥ 0.5 [30, 33, 7]

Importance index ranking technique

To calculate the (RII) of each cause. The following formulas were used [32]

- Relative importance Index

$$R = [F\ (\%) \times S\ (\%)] \div 100(\%) \quad (2)$$

- Frequency index

$$\mathbf{F} = \frac{\mathbf{1}}{\mathbf{4}} \times \sum_{\mathbf{i=1}}^{\mathbf{5}} \mathbf{Wf_i} \times \left(\frac{\mathbf{n_i}}{\mathbf{N}}\right) \times \mathbf{100}(\%) \qquad (3)$$

- Severity index

$$S = \frac{1}{4} \times \sum_{i=1}^{5} Ws_i \times \left(\frac{n_i}{N}\right) \times 100(\%) (4)$$

Where: Wfi/Wsi, is the constant weight given to each response (1 to 5), n_i is the frequency of the ith response, and N is the total number of responses.

Kendall's test

The decision to use the Kendall test (Kendall's W) responds to the concern to be able to better interpret the existence of a significant agreement between the respondents in terms of ranking potential causes. The values of this test vary between 0 (No Agreement) and 1 (Perfect Agreement) and must be associated with a level of significance lower than 0.05.

Analysis of variance

The analysis of variance ANOVA test is used to verify the existence of significant differences in the points of view of the main actors directly involved in the (PRHP), namely: the Client/owner, the Contractor and the Consultant.

4. SURVEY RESULTS

4.1 Population characteristics

The general information of the respondents is summarized in the following table 2:

Table 2. Respondent Characteristics

Characteristics	Frequency	% of Total	Characteristics	Frequency	% of Total
Project function			**Education**		
Owner/Developer - Manager	11	18.64	Civil Engineer	27	45.76
Project manager - Manager	15	25.42	Architect	28	47.46
Project Chief	10	16.95	Magister	3	5.08
General Manager	6	10.17	Doctor	1	1.69
Project Director	4	6.78	Total	59	100
Consulting engineer	4	6.78	**Role**		
Design architect	6	10.17	Owner	21	35.59
Contractor - Manager	2	3.39	Project manager /Consultant	29	49.15
Urban planner	1	1.69	Contractor	9	15.25
Total	59	100	Total	59	100
Experience (housing)			**Experience (other projects)**		
0	0	-	0	5	8.47
1-5	6	10.17	1-5	13	22.03

6-10	3	5.08	6-10	7	11.86
11-15	14	23.73	11-15	11	18.64
16-20	11	18.64	16-20	7	11.86
21-25	6	10.17	21-25	6	10.17
26-30	7	11.86	26-30	6	10.17
> 30	12	20.34	> 30	4	6.78
Total	59	100	Total	59	100
Percentage of delays			**Projects Importance**		
0	1	1.69	250-500	22	37.29
0-10	3	5.08	500-750	10	16.95
10-20	5	8.47	750-1000	3	5.08
20-30	7	11.86	1000-1250	6	10.17
30-40	7	11.86	1250-1500	3	5.08
40-50	9	15.25	1750-2000	1	1.69
50-60	10	16.95	> 2000	14	23.73
60-70	4	6.78	Total	59	100
70-80	6	10.17	**Region**		
80-90	3	5.08	East	39	66.10
90-100	1	1.69	Center	13	22.03
> 100	3	5.08	West	7	11.86
Total	59	100	Total	59	100

The highest rates, as reported by respondents, have been summarized as follows: The results show that the respondents have a good professional experience in housing projects and in other types of projects, namely, 23.73% justify an experience varying from 11 to 15 years, while 20.34% have an experience that exceeds 30 years, moreover, 18.64% have an experience ranging from 16 to 20 years old. All respondents have a university degree, most of whom are Architects (47.46%) and Civil Engineers (45.76%) and who are mainly responsible for project management with the Project Manager (25.42%) and the Client/Promoter (18.64%). It was also found that nearly half of the respondents work on behalf of project managers, i.e., 49.15%, and 35.59% are hired by project owners. The projects studied are mainly located in the East of the country with a concentration of 66.10%. It was also noted that 37.29% of the projects belong to the importance interval of 250 to 500 dwellings. All told, it was noted that 16.95% of the respondents reported the highest rate of delay in the various completed projects estimated at 50-60% of the initial project duration, followed by a rate of 40-50% estimated by 15.25% of respondents.

The Chi-Square statistical test was carried out separately for the two parameters, the project function and respondents' experience in housing. Table 3 highlights the absence of a statistically significant relationship between the two parameters studied and the estimate of the percentage of delays communicated by the respondents (sig >0.05).

Table 3. Chi-Square Tests

Chi-Square Tests				
	Project function	Asymp. Sig. (2-sided)	Experience	Asymp. Sig. (2-sided)
Pearson Chi-Square	90,927[a]	0,394	58,616[a]	,140

4.2 Classification analysis

Initially, 67 potential causes of delay were identified by this study. The ascending hierarchical classification was carried out by the (RII) technique. This is how the Risk Breakdown Structure (RBS) developed by Derakhshanfar et al. [8] was adopted to group these causes into two broad categories and four levels (Table 4).

Table 4. Delay causes and categories

Level 1	Level 2		Level 3		Level 4		
	Category	**Mean RII**	**Category**	**Mean RII**	**ID and Designation**	**RII**	**Rank**
Project risk	Stakeholders	49,50	Client-Owner	52,43	R41 Lack of project management skills	52,10	16
					R19 Unclear description of requirements, poorly expressed priorities	39,68	52
					R2 Unrealistic contract duration	62,10	8
					R43 Delay in payment of performed work	68,86	1
					R44 Funding difficulties	53,82	13
					R38 Frequent changes in specifications during implementation	38,43	55
					R49 Slow change orders in extra quantities	65,90	3
					R50 Slow change orders in extra works	68,41	2
					R21 Slowness in reviewing and approving design documents	45,25	29
					R42 Inefficient flow information from owner's departments	43,46	34
					R47 Slow decision-making in Preliminary Detailed Design (PDD) changes	38,69	54
			Contractor	52,20	R51 Inadequate contractor qualification and experience	64,17	6
					R52 Difficulties in financing the project by contractor	65,76	5
					R53 Poor information exchanges between the contractor's departments	42,57	37
					R54 Poor site management and supervision	57,91	11
					R55 Ineffective planning and scheduling	65,90	3
					R56 Inadequate techniques and tools used in project planning	45,96	27
					R57 Obsolete technology used by contractor	51,64	17
					R64 Site accidents due to lack of safety measures	40,82	46
					R65 Inconsistency between the main contractor and subcontractors' schedules	47,58	25
					R66 Rework due to errors during construction	39,73	51
			Consultant	40,71	R33 Lack of technical control skills	43,15	35
					R35 Poor information exchanges between the consultant's departments	36,00	61

				R36 Slowness in reviewing and approving execution study documents	44,37	31
				R37 Conflicts between the consultant and the engineering office	42,40	38
				R39 Inflexibility (Rigidity) of consultant	37,64	56
		Government	52,65	R6 Bureaucracy in public administrations	61,58	9
				R3 Unpredictability of the authorization and land acquisition process	48,04	24
				R4 Delay in the provision of on-site public services (water, electricity…)	51,37	18
				R7 Delay in the provision of construction site by owner	49,60	20
Resources	45,39	Labor	51,81	R9 Shortage in skilled workers	63,73	7
				R63 Inappropriate schedules with labor regulations	45,50	28
				R10 Shortage of technical personnel	52,34	15
				R11 Lack of qualified professionals in project management	53,60	14
				R60 Low productivity level of labor	56,37	12
				R59 Low level of equipment operator's skills	39,33	53
		Material	38,67	R12 Shortage in local required quality construction materials	36,14	60
				R62 Delay in materials delivery	41,20	44
		Equipment	45,68	R58 Low productivity and efficiency of equipment	48,99	21
				R61 Late delivery of equipments	42,36	39
Processes	40,15	Design	37,07	R17 Complexity of project design	27,01	67
				R18. Insufficient competence and experience of the design team	37,16	57
				R20 Conflicts due to incomplete understanding of client's requirements	34,35	65
				R25 Delay in producing design document	41,91	42
				R26 Design errors and omissions	40,13	49
				R27 Unclear and inadequate plan details	42,36	39
				R28 Ambiguity in specifications and conflicting interpretation by parties	36,58	58
		Contract related	43,75	R1 Unclear definition of the specific scope of the project	34,78	64
				R14 Non-compliance of contract-award rules	35,05	63
				R15 Non-compliance of subcontractors' selection rules	42,80	36
				R16 Insufficient design completion during tender invitation	48,50	22
				R34 Work start before completion of the execution study	50,43	19
				R30 Project team instability	44,72	30
				R29 Lack of communication between project stakeholders	47,28	26
				R31 Limited negotiations between project stakeholders	41,05	45
				R32 Delay in resolving contractual disputes	58,69	10
				R40 Slow feedback on plans for contractual changes in specifications	39,95	50
				R46 Wasted time between the end of the PDD and the effective start of work	41,48	43
				R48 Disagreement problems due to decreased work	40,18	48

		R67 Contract termination and change of contractor	43,88	33
External	39,62	R8 Lack of knowledge about the socio-economic and technological environment	42,13	41
		R13 Uncertainties about regulatory and political issues	40,61	47
		R23 Uncertainties about weather and hydraulic conditions at the site	36,19	59
		R24 Uncertainties about the geotechnical and archaeological conditions of the site	44,05	32
		R22 Inadequate Building codes used in the design of the projects	30,49	66
		R5 Disagreement on compensation for the land and initiation of appeal procedures	35,59	62
		R45 Market inflation	48,25	23

Table 5 summarizes the Level 3 results, which show that the causes of delay are mainly related to internal factors. It emerges that the factor related to Government, Owner and Contractor is ranked among the most important categories, while external factors are among the less important categories. Therefore, the delays in projects are governed by internal factors, in fact the economy of Algeria joins that of developing countries [21].

Table 5. Categorization process

Level 3		
Category	**Moy RII**	**Rang**
Government	52,65	1
Client-Owner	52,43	2
Contractor	52,2	3
Labor	51,81	4
Equipment	45,68	5
Contract related	43,75	6
Consultant	40,71	7
External	39,62	8
Material	38,67	9
Design	37,07	10

4.3 Critical causes

In order to synthesize the number of potential causes in an optimal way, the most critical causes are generally retained.

Means technique and Standard deviation

A second ascending hierarchical classification was carried out using the technique of the averages of the responses obtained. By being limited (by convention) to causes with normalized values greater than 0.5, and which are therefore considered critical. In this case, table 6 produced by SPSS retained the first 24 causes on the basis of this criterion, and globally represent (35.82%). The standard deviation was used to refine the ranking of causes with an identical score.

Table 6. Normalized values of the means

ID. Causes	Mean	Standard deviation	Rank	Normalization [a]
R43	**3,539**	**1,32574**	**1**	**1[b]**
R50	**3,5186**	**1,27745**	**2**	**0,98984772[b]**
R55	**3,4508**	**1,38693**	**3**	**0,95600677[b]**
R49	**3,4102**	**1,26023**	**4**	**0,9357022[b]**
R52	**3,3797**	**1,19233**	**5**	**0,92047377[b]**
R9	**3,3153**	**1,42064**	**6**	**0,88832487[b]**
R51	**3,2881**	**1,15028**	**7**	**0,87478849[b]**
R6	**3,2475**	**1,41876**	**8**	**0,85448393[b]**
R2	**3,2305**	**1,2859**	**9**	**0,84602369[b]**
R32	**3,0508**	**1,20607**	**10**	**0,75634518[b]**
R54	3,0508	1,36184	11	0,75634518[b]
R60	2,9763	1,35854	12	0,71912014[b]
R44	2,8814	1,46081	13	0,67174281[b]
R11	2,8508	1,43387	14	0,65651438[b]
R57	2,8373	1,49319	15	0,64974619[b]
R41	2,7864	1,38358	16	0,62436548[b]
R4	2,7661	1,47492	17	0,6142132[b]
R10	2,7593	1,3441	18	0,6108291[b]
R34	2,7424	1,52589	19	0,60236887[b]
R7	2,6915	1,46467	20	0,57698816[b]
R58	2,6441	1,38268	21	0,55329949[b]
R65	2,6237	1,525	22	0,54314721[b]
R16	2,6169	1,53591	23	0,53976311[b]
R45	2,6	1,41908	24	0,53130288[b]

Note: a = Normalized value; b = A value ≥ 0.5 indicates that the cause is critical.

Top 10 ranked delay causes

After ranking the potential causes, it suffices to compare the most critical causes chosen from the first to the tenth rank. The main results, of the two classifications carried out by the technique of the means of the responses and that of the Relative Importance Index (see Table 4), are presented in Table 7. It can be seen that the causes identified are identical as well as their respective ranks, with the exception of slight permutations in the ranks of causes R9 and R51, and those of R6 and R2.

Table 7. Top 10 ranked delay causes

ID	Mean	Standard deviation	Rank	Relative Importance index	Rank
R43	3,539	1,32574	1	68,86	1
R50	3,5186	1,27745	2	68,41	2
R55	3,4508	1,38693	3	65,9	3
R49	3,4102	1,26023	4	65,9	3
R52	3,3797	1,19233	5	65,76	5
R9	**3,3153**	**1,42064**	**6**	**63,73**	**7**
R51	**3,2881**	**1,15028**	**7**	**64,17**	**6**
R6	**3,2475**	**1,41876**	**8**	**61,58**	**9**
R2	**3,2305**	**1,2859**	**9**	**62,1**	**8**
R32	3,0508	1,20607	10	58,69	10

Indeed, these causes are mainly related to "payment problems", "poor management", "excessive bureaucracy", and "a lack of qualified manpower". This can be explained by the "financing difficulties", "lack of skills in project management", and the "inadequacy of the qualification and experience of Contractors".

4.4 Differences in views

Kendall's test

A value of 0.180 was obtained for Kendall's coefficient associated with a significance level sig equal to 0.000 (Table 8). This last value explains the existence of a significant agreement between the respondents in terms of ranking the causes of delay.

Table 8. Kendall's Coefficient of Concordance

Kendall's Coefficient	
Kendall's W	0,180
Asymp. Sig. (2-sided test)	,000

ANOVA test

The one-way ANOVA test is significant (sig < 0.05) for 15 causes, which represents 22.39% of the total number of causes, thus confirming the existence of significant differences in the points of view of the three categories of respondents (Contractor, Owner, Consultant). Table 9 summarizes the results of the test.

Table 9. Dependent Variable

Dependent Variable	R2	R5	R6	R29	R34	R41	R42	R44	R48	R49	R50	R53	R57	R60	R66
Sig.	0,022	0,021	0,009	0,021	0,032	0,001	0,002	0,016	0,039	0,028	0,022	0,047	0,012	0,01	0,007

It should be recalled here that the ANOVA test considers the relationship as a whole, without specifying the levels of education that would be the most discriminating in terms of the divergence in the respondents' points of view. Thus, to locate these discrepancies, the Least Significant Difference (LSD) post-hoc test was performed. The most important results are presented in the table 10, which details the divergences of the categories of respondents, taken 2 by 2, for each variable:

Table 10. Divergence in respondents' views

ID	Dependent Variable	Divergence in respondents' views					
		Owner - Consultant	Sig.	Owner - Contractor	Sig.	Consultant - Contractor	Sig.
1	R2	√	0,025	√	0,015		
2	R5			√	0,006	√	0,033
3	R6	√	0,016	√	0,006		
4	R29	√	0,012				
5	R34	√	0,01				
6	R41	√	0				
7	R42	√	0				
8	R44	√	0,004				
9	R48	√	0,04				
10	R49			√	0,009		
11	R50			√	0,009		
12	R53	√	0,014				
13	R57					√	0,008
14	R60	√	0,003				
15	R66					√	0,002

The LSD post-hoc test therefore completes the interpretation of the results by specifying that it is mainly the divergence between the project owner and the project manager that shapes this relationship, with a total of 10 causes, which represents 66.67%. The table 2 emphasizes the influence of the statistical distribution of these 03 categories which specifies that the Consultant and Owner are the majority in our sample with respectively 49.15% and 35.59%.

5. DISCUSSION

The summary of recommendations from respondents to the open-ended question embedded in the questionnaire, combined with the guidelines highlighted in the literature review; suggest the adoption of the following strategies to ensure early monitoring and mitigation of the effects of the 10 most common and critical causes.

5.1 Delay in payment of performed work (R43)

In order to prevent "bad financial and economic behavior", the Algerian government is asked to instruct a supervisory body to effectively monitor the allocations of funds that had been decided to ensure the perfect completion of the project. Thus, a clear and transparent payment schedule and procedure should be explicitly stipulated in the contract to ensure that companies will be paid regularly as proposed by Bajjou and Chafi [5]. In addition, the presence of a competent representative of the consultant on site to make binding decisions and ensure the preparation of interim payment certificates on time would be of great importance [18]. It is also recommended that the promoter has an effective system of risk management strategies. In addition, implementation of monetary, banking and administrative reforms are than essential in view of the scarcity of resources.

5.2 Slow change orders in extra works (R50)

Prediction techniques are indicated to reduce the root causes related to "working change orders" [28], thus, it is necessary to:

- "Rationalize the choice of an instrument for evaluating the maturity of the execution study" in relation to a pair of objectives/results; With the aim of: "Setting up an adequate information system", "Involving the necessary skills", "Predicting provision tools and forecasting instruments" which systematically involve measuring the effectiveness of the results and applying sanctions in relation to the deviation observed from the objectives. Indeed, consultants must address any changes in the scope of the project, without compromising the desired outcome of the final project [18];
- "Stop empowering bureaucratic administrative staff to design and control projects, however a real project must be technically made, programmed and budgeted both financially and in time, this is why the study must be entrusted to a multidisciplinary team project management (Architects, Engineers and Economists) for better management of the client's needs and perfect control of the works";
- "Social pressure forces the administration to announce the start of a project before the implementation dossier has matured. On the other hand, the company will only agree to start the work after receipt and verification of the complete technical file".

5.3 Ineffective planning and scheduling of project by contractor (R55)

- "Schedules should be defined and negotiated taking into consideration the capacity of the companies and the availability of resources" [32];
- "Establish appropriate schedules for the project environment and hire a competent technical support team";
- "Include subcontractors in the different phases of the project in an official way, thus making it possible to integrate the schedules of specialized companies into the general schedule", and "Ensure good site organization with the use of innovative technologies and high-performance material resources".

5.4 Slow change orders in extra quantities (R49)

Work on a program that should be identified, evaluated in a precise manner and for which one should estimate the work of achieving the objectives in terms of improving the efficiency of public expenditure. Indeed, the consultants must:

- Develop complete, detailed and precise specifications meeting the requirements of the project that will be validated by mutual agreement by all the contracting parties;
- Ensure timely, accurate and adequate communication between all stakeholders during the project life cycle", and
- Ensure the clarity and conformity of project documents, in addition to pointing out ambiguities and correcting design errors [18].

5.5 Difficulties in financing the project by contractor (R52)

"Assessing contractors' financial resources before awarding projects allows precise measurement of the consequences that “works” decisions will have on the financial balance of the business". It is also necessary "to know the resources allocated to obtain a well-defined result", constitute the bases of the finance of the company. They are also useful for evaluating future performance and the risks incurred

in the development of the project.

5.6 Inadequate contractor qualification and experience (R51)

- Along with "the need to revise the status of building companies and the requirement of a qualification threshold for bidding companies" associated with "on-site support by an engineering office to ensure internal control", "objective criteria must be set of evaluation for the attribution of the category of qualification to the companies". It is also essential "to launch the work in batches" and "to include the subcontractors in the different phases of the project in an official manner", thus allowing specialized companies to integrate into the construction process in order to increase productivity and improve the quality of work.
- "Encourage and support the creation of large companies and the birth of mixed companies" by easing tax and para-fiscal procedure and expanding investment in heavy construction to improve construction performance while raising levels of automation and adoption of prefabrication technology.
- "Re-qualify companies on the digitization of design and monitoring of achievements" in order to be up to date on Building Information Modeling (BIM) technology and risk analysis.
- "Ensure compliance with the conditions of eligibility and selection of companies and avoid price caps (administered prices), in favor of the rules of supply and demand (free market)".

5.7 Shortage in skilled workers (R9)

The main measures attributable to "Labor" personnel are: "Improving the status of employees in the sector through investing in workforce wages" and "ensuring a better working environment, with better health and safety" in addition "to investing in the organization's staff training and development programs" [1]. It is also necessary "to establish a real qualifying training policy in this strategic sector by taking charge of the training of construction trades by the government" and "ensuring the support of young graduates by employment integration organizations".

5.8 Unrealistic contract duration (R2)

Successful collaboration and effective communication between the contracting parties greatly improves the coordination of the project and the choice of competent companies, this is how the contract will be discussed after the lifting of the constraints of land availability and the respect of urban plans in project planning. Indeed, the deadline will be negotiated accordingly in relation to the availability of financial resources, qualified personnel and material resources adequate to the project environment. Special regulatory measures should also be introduced to facilitate the rapid acquisition of land for the construction of collective housing.

5.9 Bureaucracy in public administrations (R6)

- The Algerian government should simplify the administrative procedures for construction companies in order to reduce the time allocated to the process of obtaining the various authorizations and to speed up the approval procedures. For this, it is recommended to: "Investing in the digitization of services for the benefit of business and public administration would reduce the incidence of bureaucracy and corruption, and save time, money and productivity. However, the improvement of the quality of the provision of services on the sites will be ensured thanks to the involvement of qualified personnel and the creation of integrated service centers for users also by taking into account the feedback of user experience to be able

to redefine administrative procedures";

- "Implementation of the legal text on the decriminalization of the act of management makes it possible to lift criminal liability and encourage the executives of public companies to take decisions generating risk-taking, which will result in greater efficiency of management in a public company. In addition, state clerks (decision makers) must be accountable for their actions";
- "Undertake a study in consultation with all stakeholders, in favor of an objective drafting of a new public procurement code that will meet the current and future needs of players involved in the building industry";
- "Foster a spirit of consultation between the technical, financial and legal departments of public administrations to resolve any problem encountered in real time".

5.10 Delay in resolving contractual disputes (R32)

Particular attention should be given to:

- "Rapid and amicable settlement of conflicts that arise during implementation through rigorous monitoring and release of decision-making power at the local level";
- "Rationalize the choice of land (topography and legal nature) and the choice of budgets allocated to the viability lot and creation of a pleasant living environment for the project";
- "Develop specifications appropriate to the project, thus, we must adapt to the environmental, social and economic specificities of the region and differentiate the projects to be built in the North, Highlands, South and Great South";
- "Reform the exchange rate to overcome the duality of the market and therefore the duality of prices (align the exchange rate with the official price)".

6. CONCLUSIONS AND RECOMMENDATIONS

The objective of this research was the in-depth examination of the main causes and the development of guidelines to an effective mitigation of delays. Indeed, if the literature has provided such a vast and substantial documentation of the risks associated with delays, however, it remains limited with regard to the context of construction in Algeria. Furthermore, the major objective of this research was to develop a more useful and practice-based view, essential to provide a holistic understanding of what provides upstream control and mitigation of the effects of the 10 most critical causes of delay in Public Rental Housing programs. The results indicate the 10 most critical causes of delay, which are: "Delay in payment ", "Slow change orders in extra works", "Ineffective planning and scheduling", "Slow change orders in extra quantities", "Difficulties in financing the project by contractor", "Inadequate contractor qualification and experience", "Shortage in skilled workers", "Unrealistic contract duration", "Bureaucracy in public administration", and "Delay in resolving contractual disputes". The results also underline that most of these causes are related mainly to "financing difficulties", "the lack of skills in project management" and "the inadequacy of the qualification and experience of contractors". It is to be noted that these causes are mainly due to internal factors. It shows that the Government, Owner and Contractor factor is ranked among the most important categories while external factors are among the least important categories, this means that internal factors are a priority that determines the project success.

In order to prevent "bad financial, economic and managerial behavior", the Algerian government is asked to implement monetary, banking and administrative reforms. "Investment in the digitization of services for the benefit of companies and public administration", "the decriminalization of the act of

management", "the establishment of a new public procurement code", "the rationalization of the choice of an instrument of evaluation of the maturity of the execution study", "consultation between the technical, financial and legal departments of public administrations", "the improvement of the status of employees in the sector", "the need to revise the status of construction companies and the requirement an accompaniment on site by an engineering office", "the obligation to rule out the adoption of administered prices", and "compliance with the conditions of eligibility and selection of contractors", are all measures to be put in place in order to ensure upstream control and mitigation of the effects of the 10 most critical causes.

7. PERSPECTIVES

A first way of research will be based on the review of documents and the actual performance of different types of projects, such as: (Public Infrastructure and Building). Eligible delay factors can be identified from this perspective. The major factors thus identified will be compared with the main delay factors reported for projects of the same nature on the basis of a self-administered questionnaire survey and which are located in regions with identical environmental and socio-cultural constraints. A comparison will also be made with studies of countries where the administrations are at a similar stage of economic development as the country under consideration.

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