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Understanding Critical Delay Causative Factors and Their Mitigation Measures in Burundi Communal Construction Projects: A Factor Analysis and Structural Equation Modeling Approach

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Abstract: The execution of a construction project faces many potentials challenges, and delays are one of them. Communal construction projects in Burundi (CCP-Burundi projects) were considered as one field that could generate a Burundi government development plan. However, according to the frequency of delays encountered by these projects, at a rate of 70% on average every year, the government's target seems far from being achieved. As no scientific study exists on how to avoid CCP delays, this paper aims to identify and analyze factors that cause delays in CCP-Burundi and provide related measures to overcome them. Based on a list of fifty delay factors gathered from the National Communal Investment Fund institution FONIC (Fond National d'Investissement Communal), communal annual reports, and the literature, a questionnaire survey was developed and dispersed to CCP stakeholders to collect data about critical factors. The top fifteen factors were identified using a relative importance index and a factor analysis was performed. "Weather conditions" was the top-ranked factor, while "Claims" was the lowest ranked. A structural equation modeling approach was adopted to evaluate influences at the relationship level among delay factor groups. A standardized calculation revealed that Factors During Awarding of Bid (FDABs) positively influence Factors After the Award of Bid (FAABs). The findings were implemented in case studies to assess their efficacy. This paper's findings could assist upcoming construction practitioners and future researchers aiming to explore construction-related project delays, providing a fundamental understanding of the significant delays encountered in the Burundi construction industry.

Keywords: relative importance index; factor analysis; structural equation modeling; causes of delay; communal construction projects; fond national d'investissement communal (FONIC)

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1. Introduction

The success of project management is indicated by its achievement on time, budget, and quality corresponding to those agreed upon in the relevant contract [1]. Across the globe, one of the most significant challenges faced by construction projects is the issue of delays, which often emerge as the primary obstacle hindering their successful completion [2]. The literature has assigned different meanings to the term "delay". Therefore, "delay" generally defines the time that often runs over the one specified in a contract [3]. A "delay" is a condition related to a project that fails to be completed within the planned schedule [4]. The literature reveals two types of delays: excusable delays (compensable and non-compensable) and non-excusable delays, which are non-compensable [5,6]. On the other hand, four main categories of delays have been identified: excusable or non-excusable, critical or non-critical, concurrent or non-concurrent, and compensable or non-compensable [7].

The construction industry considers delays to be a significant global challenge. Among the key issues affecting Saudi Arabia's road construction projects, delay-related issues represented an average of 70% [8], with land acquisition as the top cause. Delays in Brazil's power plant construction projects have emerged as a leading issue, representing 64% of general challenges faced during project execution [9]. Time overrun in Malaysian construction projects represented almost 80% of the issues encountered in traditionally acquired projects in this industry [10]. The Egyptian construction industry has registered delay as a critical issue during project management. Therefore, great attention to this subject has been raised by Egyptian scholars and academics for decades, such as in Aziz, 2013a, etc. Hence, the literature reveals that delay is a common cause of complications in project management, particularly in developing countries [11–13]. When a delay occurs, all critical success parts of a construction project, like quality and budget, are subjected to be affected [14]. This leads to numerous adverse effects, such as cost overruns, stakeholder disputes, litigation, etc. Exceeding the contractual duration of projects also results in an extension of work time beyond the projects' planned completion date [15]. Conversely, when a project is accelerated to meet deadlines, some tasks may become susceptible to errors committed by workers, which may lead to reconstruction. This could result in financial losses for the involved parties, a lack of product quality, and mistrust between stakeholders [16,17].

Delays that have globally characterized the construction industry have also affected communal construction projects (CCPs) in Burundi at an average of 70%, as shown from communal reports. This has caused disturbance to the achievement of targeted government developmental objectives. Thus, it is relevant to research factors causing delays in CCP-Burundi, as no such study has been conducted since their inception. This research will identify the common and critical factors contributing to schedule overruns in CCP-Burundi. The findings will benefit practitioners by helping them understand the necessary measures to prevent or mitigate delays, as preventing delays is more effective than managing them after they occur. After this introduction (Section 1) comes Section 2, which introduces the problem statement for CCP-Burundi. Section 3 presents the literature review; Section 4 presents the research objectives and methodology; Section 5 presents the results and their interpretation and presents and analyses the case study; Section 6 includes a discussion of the results; Section 7 provides recommendations; and Section 8 concludes this research.

2. Statement About CCP-Burundi

CCP-Burundi has made significant financial and social contributions to the development of the country in general and one commune in particular. However, it has not escaped the issue of delay that haunts the construction industry in the world. Since 2016, the government of Burundi has decided to invest BIF 500 million in each of the 119 communes of the country. This fund intends to promote the construction of public infrastructures such as markets, schools, health and youth centers, power, and water supply to the population.

The government department monitoring and coordinating the above fund and related communal funded projects is the FONIC "Fond National d'Investissement Communal" based in the Ministry of Communal Development.

Unfortunately, as found in communal annual reports, about 451 projects were executed, and only 159 were delivered within the scheduled time. At the same time, 256 projects were delayed, and 36 projects were abandoned. It is deplorable that no specific scientific studies have been carried out to identify the factors causing CCP-Burundi's delays, as this challenge keeps growing each year. Therefore, the present research intends to identify the most significant factors causing delays in CCP-Burundi and rank them relatively according to their importance level and means as perceived by the parts involved. The following are the detailed key objectives for this research: (1) The primary objective is to identify and analyze the critical delay causative factors in communal construction projects in Burundi. (2) Understanding their interrelationships is also one of the primary goals. Through this, we aim to understand the underlying reasons for delays, which can range from environmental condition and financial, technical, and managerial conditions. (3) Secondarily, this study' objective is conducting a case study analysis for practically ensuring the implications of the results, which will be further composed on this study' objectives. (4) Finally, this study seeks to evaluate and propose effective mitigation measures to address these delays, ultimately improving the efficiency and timely delivery of CCP-Burundi projects. The findings of this paper will be more beneficial for Burundi's public and private construction practitioners interested in construction project schedule management.

3. Literature Review

Over the past decades, delays in construction projects have been a global challenge hampering project delivery within the quality, time, and budget specified in a contract [18], and this was considered the most common problem resulting in the increase in cost, loss of productivity, work disruption, disputes, third party claims, and even the abandonment or termination of contracts that affect both public and private projects [19,20]. For this context, research on civil construction delay has emerged, aiming to identify critical delay causes to provide the best practical measures for avoiding delays and/or mitigating their impacts. Time overruns in construction projects have been known in comprehensive studies from different civil engineering fields. For evidence of the field of road construction projects, we can cite the research of Singh et al. [21], who analyzed the cause of delays in forty-six municipal road projects that were executed as part of the Municipal Development Program; Baig et al. [22] who investigated the delay percentage in urban road construction projects; etc. The pipeline construction field is also one of the fields that faced delays; an example of this is presented by Khatib et al. [23], etc. The building field has numerous related types of research too; this is the case of Tikote et al. [24] in Thailand, Arantes and Ferreira [25] in Indonesia, etc. Figure 1 presents some existing research on construction project delay with the number of explored factors, type of project, and the study area.

The research on time overruns in construction projects has attracted scholars and practitioners worldwide due to the significant impact of delays on the construction industry and overall development. Consequently, the literature includes several studies conducted in different countries. Various methodologies have been applied to explore and analyze delay factors, leading to the identification of key contributing factors. Table 1 presents a selection of existing studies, the methodological approaches used, and a summary of their findings.

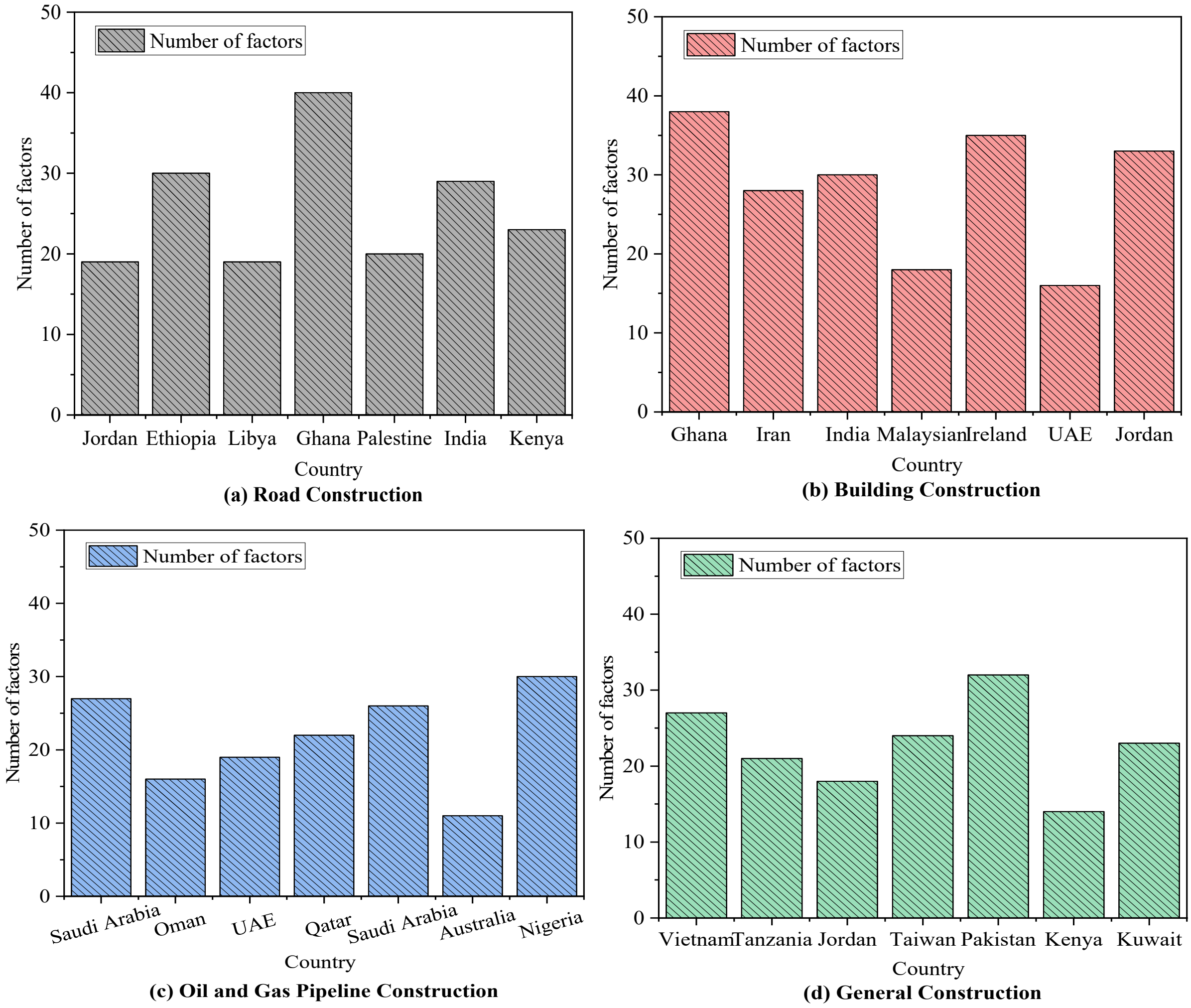

Figure 1. Some of the literature about the delay topic from different fields of the construction industry.

Table 1. Most identified causes of delay by some of the existing works.

Area	Methods	Major Delay Factors	Ref.
Egypt	Survey approach with F.I. analysis (F.I.: Frequency Index).	(1) Inadequate project planning, (2) changes in project scope, (3) poor communication and coordination, (4) lack of skilled labor, (5) payment delays, and (6) insufficient budget allocation are the top six factors causing delay in Egyptian mega construction projects.	[7]
Oman	Semi-structured interviews and RII.	(1) Contractual issues, (2) lack of construction materials, (3) workforce, (4) poor coordination between construction parties, and (5) external factors are the main factors delaying construction projects in Oman.	[26]
Malaysia	Survey and mean score (M.S.) analysis.	(1) Penury-related materials/manpower and equipment, (2) slow decision-making, and (3) delays caused by owner for contractor's payment are significant factors of delay in Malaysia.	[27]
Bangladesh	A questionnaire survey and RII analysis (RII: Relative Importance Index).	(1) Lack of a manager experienced in construction management, (2) lowest bidder selection, (3) lack of proper management, (4) owner shortage of funding, (5) improper planning and scheduling, (6) site constraints, (7) lack of experienced and skilled workers, (8) problems related to cash flow from contractor during construction, (9) excessive workload of contractor, and (10) escalation of resource price constitute the ten most important causes of delay from a list of 30 identified different causes.	[28]
Kuwait	Survey questionnaire for data collection and ANOVA for analysis.	(1) Contractor site management incompetence, (2) design quality deficiencies, (3) subcontractor-related challenges, (4) problems arising from the used contract, and (5) supply chain disruptions affecting the availability of labor and construction materials represent the top five causes of delays.	[29]

Table 1. *Cont.*

Area	Methods	Major Delay Factors	Ref.
Khyber Pakhtunkhwa (KPK), Pakistan	Questionnaire survey+ FI, SI, and RII for analysis method.	The most important causes of delay are (1) lack of political will, (2) delays from the government to release the funds, (3) delay in civil work, (4) ignorance with regard to properly visiting the site before the start of a project, (5) bad order and law situation, and (6) poor project time management.	[30]
Malaysia	Survey approach+ F.I. and S.I. (S.I.: Severity Index).	The causes leading to delay are (1) inadequate management and supervision by the contractor, (2) inadequate control and planning by the contractor, (3) design modifications by the client, (4) use of the lowest bid that results in poor performance, (5) changes to project scope, (6) errors in design and contract documents.	[31]
Ghana	Questionnaire survey + RII.	(1) Shortage of construction materials, (2) poor supervision, and (3) poor practices of site management are the top three out of the most critical ten factors causing delays in construction project delivery in Ghana.	[32]
Morocco	A questionnaire Survey+ Relative Importance Index RII.	The ten most important factors causing delays are (1) progressive late payment, (2) lack of employee training, (3) lack of waste management strategy, (4) rework due to construction errors, (5) unrealistic contract duration imposed by clients, (6) excessive subcontracting, (7) ineffective planning and scheduling, (8) delay in obtaining permits from government agencies, (9) unskilled labor, and (10) lack of collective planning.	[33]
Singapore	Interview and questionnaire method severity index for analysis.	The results revealed that (1) gradual late payment by the owner, (2) financial problems from the main contractor, (3) adverse weather conditions, (4) acts of god, and (5) evaluation of completed works are common factors causing delays in construction projects in Singapore.	[34]

Different solutions to avoid delay are provided in the literature. Thus, Riveros et al. ref. [16] suggested that to enable clients to be aware of any "change of design and scope of the project" during construction, clients should invest enough time and funds to select the appropriate consultants, and once the adequate consultant has been employed, they have to ensure consultants understand their design. Haslinda et al. [17] added that to avoid "poor project design" causing delay, a detailed design review for completeness and compliance within the owner's scope and interdisciplinary coordination before construction should be conducted seriously. To prevent the cause of "underestimation project schedule" from occurring, Wang et al. [18] recommended adopting an alternative bidding system instead of the lowest bidder selecting system. This alternative bidding can be, for instance, a performance of a detailed analysis of contractors who would otherwise be disqualified by the lowest bidder system, to name just one example.

Although the literature has provided practical and remedial measures to avoid and mitigate delay causes and their impacts on the construction industry, much attention is still needed regarding this critical challenge that the construction industry keeps facing. As revealed by the literature, every project is unique [19–21]. So, the type of contract, the type of project, the area of study, the budget allocated to it, the rules, the policy, and the execution circumstances of each project influence the type of delay causal factors [14]. Even if some delay factors are common to all project management, such as weather conditions and those related to acts of God, the uniqueness of the project management process, especially delay mitigation management, is still revealed in the literature. Consequently, CCP-Burundi delay factors need to be worthily identified and analyzed as they critically affect the planned schedule to a high level and lead to severe effects such as cost overrun, disputes, ligation, and even abandonment. The second reason is that no study has been conducted on CCP-Burundi since it has existed.

Most existing works identified causal factors of delays. They categorized them according to their corresponding project stakeholders' parties, such as client-related factors, consultant-related factors, contractor-related factors, subcontract-related factors, and sources like external-related factors, internal- and project-related factors, etc. [35–41]. Some past studies classified factors depending on project types, such as in De Carvalho and Chima and Tarka [42,43]. Few related researchers classified factors according to the time of project processes; they often occur. Furthermore, fewer existing ones are limited to weighting delay factors, such as Owolabi et al. [44] and Sambasivan et al. [45]. The purpose of the present research is then to identify those factors related to CCP-Burundi delays and classify and analyze them not only from the respective occurrence period of a construction project but also from the evaluation of the influence degree of the relationship existing between their groups (classified categories/occurrence periods) known as latent variables.

4. Methodology

In order to achieve the following objectives to (1) identify causal factors that affect CCP-Burundi delays, (2) classify delay factors according to the period of the project process when they often occur, (3) quantitively analyze delay factors and rank them according to their mean score and relative importance index, (4) evaluate how greatly their respective group variables influence each other, (5) recommend strategic measures to follow to effectively avoid these delay causes occurring in the future, and (6) provide a framework for CCP-Burundi's delay management, this paper first conducted a deep literature review to identify the causes of delay together with a systematic review made using yearly FONIC and communal reports gathering the most critical causes of delay in CCP-Burundi. Secondly, a semi-structured questionnaire survey to collect data was designed, administrated, and distributed face to face to the involved stakeholders including clients (these were from both FONIC and Communal staff), contractors, consultants, and engineers/architects. The targeted questionnaire respondents were selected based on the condition that they have been involved in CCP-Burundi for at least last 5 years. The questionnaire asked every participant to provide their opinion first from the listed 50 causes of delay based on the 5-point Likert scale: (1) very low, (2) low, (3) medium, (4) high, and (5) very high with regard to contributing to delay and secondly to add any other missing factor on the list according to his/her experience and opinion. To ensure responses were informed by practical knowledge and experience, respondents should have participated in at least 10 projects located in different provinces and districts as the execution conditions varied according to the region in which the project was executed. Data were gathered within the period of 4 months and saved for further use.

The third step consists of analyzing data. This most important step of the research utilized the RII to rank factors as the first data analysis approach. The research further utilized factor analysis (F.A.) as the next methodological approach, enabling authors to rank factors according to their mean score and obtain components. These two first analysis methods are also intended to verify the confidence status existing between their factors' ranking. The research used IBM SPSS V.24 support software to apply the factor analysis method. After the two analyses, 15 top delay causes in CCP-Burundi were identified. Furthermore, this methodology (F.A.) helps to extract the components that load the top 15 factors. Based on the obtained components of factors loading, we created related groups (latent variables) and proposed a hypothetical influential model/diagram to assess the relationship between them. The process is called structural equation modeling (S.E.M.) and is usually supported by IBMSPSS AMOS Software V24. Figure 2 Presents the general methodology route adopted by this research.

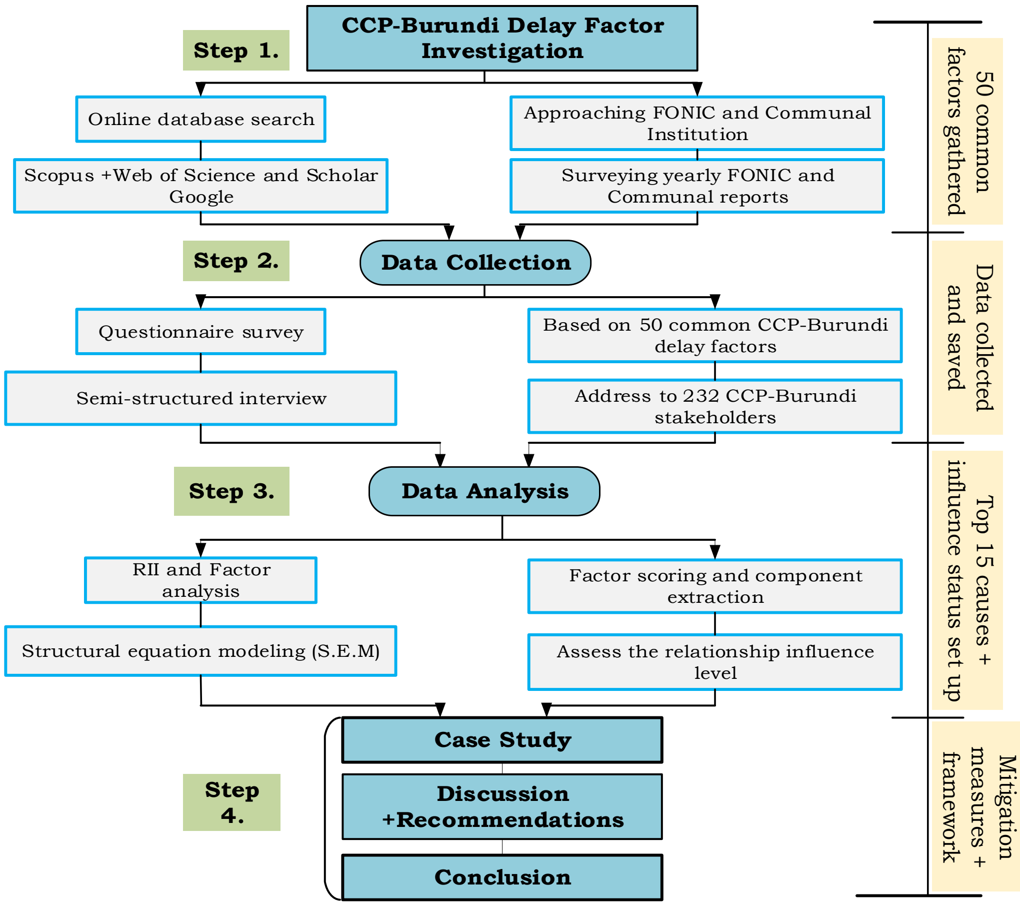

Figure 2. Research methodology approach flowchart.

4.1. Common Identified Delay Factors in CCP-Burundi

Some research indicated that the main phases of the construction project lifecycle are the Conception phase, design phase, construction phase and operation phase [46]. The construction project is composed of the pre-bidding stage, planning stage, design stage, execution stage, implementation stage, and handing-over stage [47]. Other research considered the execution, planning, design, operation/maintenance, and demolition phases as the main phases of a construction project lifecycle [48]. According to CCP-Burundi and FONIC organizational management processes, this paper followed the idea of Alshihri et al. [11] and estimated that the CCP-Burundi lifecycle management was in the following three main stages: (1) Factors Before Awarding of Bid (this includes planning and design stage); (2) Factors During Awarding of Bid; and (3) Factors After the Award of Bid (execution/construction stage). FDABs refer to the various considerations during the bidding process, such as contractor selection, cost evaluation, and legal requirements. FAABs, on the other hand, involve factors that affect the project after the contract is awarded, such as payment delays, project scope changes, and logistical challenges. These three stages are the main ones the CCP manager follows to monitor the projects and correspond with project cost payment steps. Thus, delay factors were gathered and classified according to the stages in which they often occur. Subsequently, 50 delay factors were identified and summarized in Table 2.

Table 2. Common factors influencing delays in CCP-Burundi.

No.	Phases	Causes of Delay	Id	Ref.
1	Factors Before Awarding of Bid (FBABs)	Disputes related to site ownership	$FBAB_1$	Independent audits, consulting the community [45,49]
2		Unqualified communal awarding members	$FBAB_2$	Communal and FONIC reports
3		Delay caused by awarding team when selecting prior projects	$FBAB_3$	Communal and FONIC reports, independent audits
4		Delay by owner (commune) to submit prior projects for finance	$FBAB_4$	Communal and FONIC reports, independent audits
5		Delay caused by owner for pre-project study	$FBAB_5$	Communal and FONIC reports, independent audits [45]
6		Unqualified designers and engineers	$FBAB_6$	Direct observations [16,45]
7		Inaccurate project technical specifications by owner	$FBAB_7$	Communal and FONIC reports, direct observations [45]
8		Underestimation of project schedule time and cost	$FBAB_8$	Communal and FONIC reports, independent audits [45]
9		Stand-alone national department for financing hundreds of projects in 119 communes (only the FONIC)	$FBAB_9$	Communal and FONIC reports, direct observations
10		Stand-alone national department in charge of reanalysis of hundreds of projects (DNCMP)	$FBAB_{10}$	Communal and FONIC reports, direct observations
11		Lack of finance of project's first stage management	$FBAB_{11}$	Communal and FONIC reports
12		Lack of geotechnical-related studies and analysis	$FBAB_{12}$	Communal and FONIC reports, direct observations [50]
13		Short time for project plan, design, and quantification	$FBAB_{13}$	Communal and FONIC reports [45,49]
14		Delay caused by the FONIC to provide a financial agreement (grant) to communes	$FBAB_{14}$	Communal and FONIC reports [49,51]
15	Factors During Awarding of Bid (FDABs)	Ignorance of a contractor with regard to visiting the site during bidding submission	$FDAB_1$	Communal and FONIC reports, independent audits [16,45]
16		Contractor's incompetence when reviewing project quantities	$FDAB_2$	Independent audits [16]
17		Ignorance of a contractor with regard to considering the variability of materials when preparing the tender	$FDAB_3$	Communal and FONIC reports [45,51]
18		Unqualified communal team in charge of tender analysis and project awarding	$FDAB_4$	Communal and FONIC reports, direct observations
19		Corruption	$FDAB_5$	Communal and FONIC reports, independent audits [45]
20		Some contractors present fraudulent documents	$FDAB_6$	Direct observations [16,45]
21		Owner ignoring checking tender documents' authenticity	$FDAB_7$	Communal and FONIC reports [45]
22		Focusing on the financial tender and awarding the lowest bidder	$FDAB_8$	Communal and FONIC reports [16,49]
23		Owner's delays in analyzing tenders	$FDAB_9$	Communal and FONIC reports, independent audits [45]
24		Lack of FONIC engineers responsible for monitoring communal teams during every scheduled meeting	$FDAB_{10}$	Communal and FONIC reports, Alsuliman (2019b) [52]
25		Awarded to a contractor whose projects exceed their financial potential	$FDAB_{11}$	Communal and FONIC reports [16,45]
26		Inadequacy of drawings and quantities to be executed	$FDAB_{12}$	Communal and FONIC reports, direct observations [50]
27		Bid audit team is fixed and without changes	$FDAB_{13}$	Communal and FONIC reports, direct observations [45]
28		Claims about the results from awarding	$FDAB_{14}$	Independent audits [16,45]
29		Awarding defaulter contractor	$FDAB_{15}$	Communal and FONIC reports, independent audits

Table 2. *Cont.*

No.	Phases	Causes of Delay	Id	Ref.
30	Factors After the Award of Bid (FAABs)	Weather conditions	$FAAB_1$	Communal and FONIC reports, directs observations, consulting the community [16,45,50]
31		Remote construction sites from the communal cities	$FAAB_2$	Communal and FONIC reports, direct observations
32		Difficulty in material supply	$FAAB_3$	Communal and FONIC reports [16,45]
33		Delay caused by the owner during the payment process	$FAAB_4$	Independent audits [16,45]
34		No roads to access the construction site	$FAAB_5$	Communal and FONIC reports, direct observations [16,45,50]
35		Poor site supervision	$FAAB_6$	Independent audits [16,50,51]
36		Indifference of engineers and laborers due to low salary	$FAAB_7$	Communal and FONIC reports [45,49,50]
37		Poor communication between stakeholders	$FAAB_8$	Communal and FONIC reports [16,50]
38		Disputes arising between stakeholders during the execution	$FAAB_9$	Communal and FONIC reports, independent audits [16,49]
39		Changes in project design during the time of execution	$FAAB_{10}$	Independent audits [16,49,53]
40		Increased material price during construction time	$FAAB_{11}$	Communal and FONIC reports [45], consulting the community
41		Lack of local construction materials	$FAAB_{12}$	Communal and FONIC reports, direct observations [50]
42		Incompetence in finance and skills for some contractors	$FAAB_{13}$	Communal and FONIC reports [16,49]
43		Unclear/unspecific project schedule	$FAAB_{14}$	Communal and FONIC reports, direct observations
44		Poor management/disorientation of finances by contractor after being paid	$FAAB_{15}$	Communal and FONIC reports [16,49], independent audits [50]
45		Lack of regular meetings during execution	$FAAB_{16}$	Communal and FONIC reports, independent audits
46		Recruitment of graduate engineers without experience	$FAAB_{17}$	Communal and FONIC reports [45], consulting the community
47		Poor project task time estimation	$FAAB_{18}$	Communal and FONIC reports, independent audits [50]
48		Lack of communal project management offices (PMOs)	$FAAB_{19}$	Communal and FONIC reports, direct observations
49		Unupdated project schedule	$FAAB_{20}$	Communal and FONIC reports [45]
50		Rework due to errors usually made by unqualified laborers and engineers	$FAAB_{21}$	Communal and FONIC reports, independent audits [16,51]

4.2. Relative Important Index (RII)

An important index method has been considered a relevant tool used by the literature to quantify any kind of factors/variables from different research fields. In construction projects related to delay factors, the relative importance index approach has known a wide range of uses, such as in [6,22–25], etc. This paper follows the same method of evaluating the importance of indices of factors causing a delay in CCP-Burundi by ranking them. Factors were arranged in descending order, from the highest to the lowest. The factor with maximum impact will be ranked 1, while the least is undermost. The analysis included ranking delay factors with their Relative Importance Index (RII) for each phase separately and ranking factors in the overall phases to derive the top 15 delay causes. The formula used to calculate the importance level of CCP-Burundi factors is the following [54]:

$$\mathrm{RII} = \frac{\sum_{i=1}^{5} WiXi}{A \times N}$$

where RII indicates Relative Importance Index, $Wi \rightarrow$ weighting given to each factor respondent and ranges from 1 to 5, $Wi \rightarrow$ frequency of the ith response for each factor that causes delay, $A \rightarrow$ highest weight (i.e., here this is 5), while $N \rightarrow$ total number of respondents.

4.3. Factor Analysis

Factor analysis is a statistical surveying technique used to identify the factors underlying the variables through clubbing-related variables in the same factor [26–28]. The key reasons for using the factor analysis method in this paper are that factor analysis could help us reduce the complexity of data as it enables underlying factors that explain the observed correlations among them, the method helps interpret complex data by assembling related factors for the easier estimation of their relationship, and it contributes to a visualization of data in a very interpretable way like through loadings and scorings. By using factor analysis, we can accurately enhance model prediction. As mentioned by Hamouda [29] and Ayat et al. [30], some conditions have to be considered in deciding on the suitable use of the factor analysis (F.A.) method for a given set of data. The two main conditions that must be verified are as follows: (1) Sample size, whereby the sample size towards factor analysis (F.A.) should be larger; however, the common guideline accepts the sample size of 100–200 participants for the instance of 20 factors/variables [31]. (2) The strength of the relations that exist between variables, and for this second condition, different indices should have been tested, such as the correlation matrix that must be $\geq$0.3 [32], Bartlett's test with Sphericity $p < 0.05$ [33], and the Kaiser–Mayer–Olkin index K.M.O. $\geq$ 0.7 [34].

A reliability analysis of the five-point Likert scale in this research was conducted using Cronbach's alpha coefficient, which ranged from 0 to 1. Cronbach's alpha coefficient must be at least 0.7 for a scale to be reliable [35,36]. To determine the optimal number of factors, this research uses a sequential latent root criterion (eigenvalues > 1.0). Present research verified the communalities of variables. For this case, variables whose extraction communality is less than 0.50 are removed, while those extraction communalities greater than 0.50 are retained, as Viles et al. [2] stated. The factors' mean score and standard deviation were calculated to make confidence on the similarity results between the RII and the mean score related to the ranking of delay factors.

4.4. Structural Equation Modeling (S.E.M.)

Structural equation modeling (S.E.M.) is defined as a multivariate data analysis technique used for analyzing the statistically complex structure relationships between constructs (latent variables) and their indicators (measured variables) [37,38]. This method has obtained a more accurate measurement of interesting theoretical concepts because the concepts considered are generally unobservable and measured indirectly by several indicators. Furthermore, structural equation modeling accounts for measurement error in the observed variables when estimating relationships [39]. By considering a factor causing a delay in CCP-Burundi as an independent variable that can be easily measured and its occurrence period of a construction project processes as a latent variable, this paper employs the S.E.M. method to evaluate the influence relationship level between latent variables. The importance of using the S.E.M. approach in this paper is that it can help examine the linear causal relationship among factors more powerful than another analysis method we could use, such as regression analysis, path analysis, etc., to complete the factor analysis result method. Only 15 critical factors entered the structural equation modeling due to the great impact of delay [40,41].

Even if the structural equation modeling (S.E.M.) method has attracted researchers from different fields, using this method is not random. Thus, different conditions must be completed to verify whether the method suits a certain data set. As evidence, a Confirmatory Factor Analysis (C.F.A.) must first be conducted to ensure whether the model completes the minimum conditions of its fitness. For this case, indices like the identifiability of a model (degree of freedom *df* shall be positive) and the chi-square (χ^2) shall be significant, and the probability level *p* must be less than 0.05 ($p \leq 0.05$) for the goodness of a model (G.O.F.) [42]. Secondly, indices such as chi-square normality (χ^2/df) < 3, a comparative fit index (*CFI*), the Tucker–Lewis Index (*TLI*) > 0.9, and the root-mean-square error of approximately (*RMSEA*) > 0.9 [43,44] are considered.

5. Results

This section highlights and discusses the results obtained from analyzing the data collected. The questionnaire results of sections one and two including the demographics of the respondents' profile and the general information of construction projects such as project location, delay magnitude, and state are presented. The results of section three of the questionnaire are first presented, while results from the factor analysis method are presented furtherly. This section also presents the results of a structural equation modeling (S.E.M.) approach and the implication of the results in the case study.

5.1. Questionnaire Survey Results

Previous research offers guidance on determining the appropriate sample sizes for questionnaire surveys, especially in construction project delay studies. Sambasivan and Soon [45] used 150 respondents to study delay causes in Malaysia, while Zarei et al. [19] analyzed time performance in construction project execution with 120 respondents, emphasizing the need for sufficient representation. Typical sample sizes range from 50 to 300, depending on research scope and resources [23]. After distributing 232 questionnaires to the stakeholders involved in CCP-Burundi, some 183 well-completed questionnaire responses were returned. This is estimated to be a rate of 79% and is considered as a more acceptable and reliable result [45]. Larsen et al. [20] further concluded that around the 20% to 30% response rate range, the sample size can be considered consistent according to the standard sample size rate in construction industry questionnaire surveys [46]. Despite several reminders, some of the 49 questionnaire forms have not been responded to or been responded to with errors that have not been considered during the analysis. Participants were owners, contractors, engineers/designers, consultants, and Subcontractors experienced in CCP-Burundi.

Staff from the FONIC have leveraged and facilitated this exploration, highlighting the number of projects executed during the last five years. The explored 451 CCP-Burundi projects executed over the years revealed that (1) some were in towns, some in villages, and others were remote (according to the location of these projects); (2) according to the delivery state of projects, few of them (159 projects = 35.2%) were delivered within the planned schedule, many (256 projects = 56.8%) were delayed, and some (36 projects = 8%) were abandoned; and (3) projects with delays encountered different delay magnitudes. Thus, some projects' delays are rated as 1–25%, 26–50%, 51–75%, and 76–100%, while others are delayed up to 100% based on their planned time. Figure 3 presents the distribution of respondents' profiles, project locations, project delivery state, and projects' delay magnitude.

As shown in Figure 3a, respondents from government (clients) and contractor sectors are presented to highly participate in this survey constituting around 35% and 40% of participation, respectively. Some and fewer participants are from subcontracting, designer, and consultant fields and represent in total about 25% of participation. Even if the experience of participants has not designed, owners and contactors are highly influenced by the success or failure of CCP-Burundi projects. Accordingly, we can ensure, according to the above participation, that survey responses truly reflect reality and that the results will, with reasonable confidence, meet the research purpose by comprehensively addressing the research gaps.

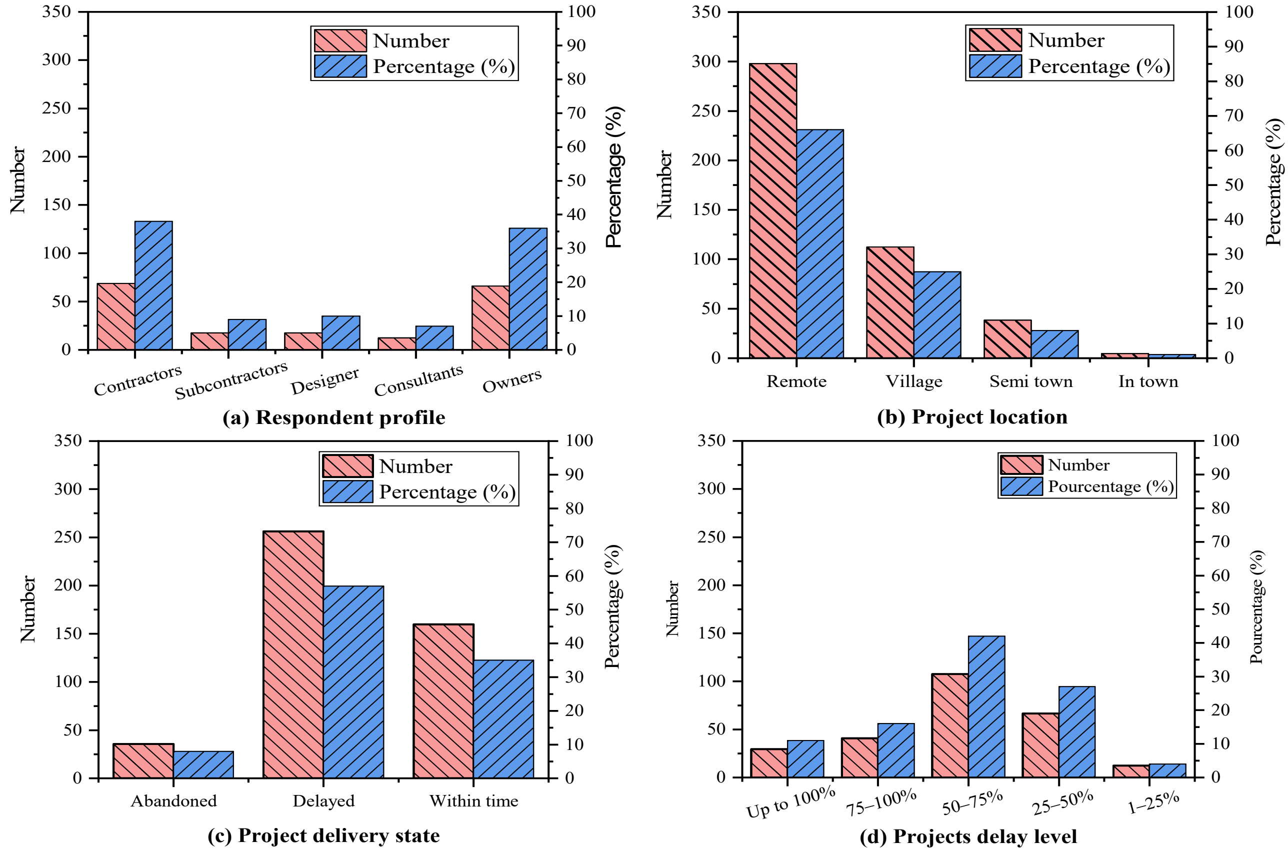

Figure 3. Distribution of respondent profile, project location, delivery state, and delay rate.

5.2. Results of Relative Importance Index

The top 15 factors causing CCP-Burundi's delays were extracted and ranked based on their relative importance index. Therefore, the causal factor "weather conditions" was found to have a high importance level of RII = 0.850. Consequently, the factor is ranked number one, while the causal factor "Claims about the results from awarding" has the lowest importance index of RII = 0.798 and is ranked the last (fifteenth). Furthermore, among the 15 most influential causes of delay, 5 often occurred after the awarding of the bid phase, 6 of them appeared during the bidding stage of CCP-Burundi projects, and 4 causal factors occurred before the awarding of bid phase. Table 3 ranks the top 15 causal factors of delay according to the period of a construction project and their respective relative importance index.

While this research identified 15 critical factors causing delays in CCP-Burundi, among the common 50 factors gathered, different numbers of factors causing delays were highlighted from different research in the literature. Owolabi et al. [44] identified and ranked the top five most important delay factors among twenty-seven factors explored in Burkina Faso's construction industry. Fashina et al. [47] highlighted only the top ten major delay factors that affected the Somaliland construction sector. In contrast to identifying and analyzing factors to find the more critical factors, some studies used to categorize factors and evaluate which category has much influence on delay. This is the case of Tavassolirizi et al. [48], who explored factors and classified them into four main categories, with the management factor category on top, causing delays in rail transportation projects in Iran.

Table 3. Top 15 causes of delay in CCP-Burundi.

Stage	Factor Name	Id	RII	Rank
Factors Before the Awarding of Bid (FBABs)	Disputes related to site ownership	$FBAB_1$	0.811	6
	Underestimation of project schedule time and cost	$FBAB_8$	0.810	7
	Unqualified designers and engineers	$FBAB_6$	0.802	10
	Short time for project plan, design, and quantification	$FBAB_{13}$	0.798	14
Factors During the Awarding of Bid (FDABs)	Focusing on the financial tender and awarding the lowest bidder	$FDAB_8$	0.820	4
	Awarded to a contractor whose projects exceed their financial potential	$FDAB_{11}$	0.813	5
	Ignorance of a contractor with regard to visiting a site during bidding submission	$FDAB_3$	0.808	8
	Inadequacy of drawings and quantities to be executed	$FDAB_{12}$	0.807	9
	Awarding defaulter contractor	$FDAB_{15}$	0.800	13
	Claims about the results from awarding	$FDAB_{14}$	0.798	15
Factors After the Awarding of Bid (FAABs)	Weather conditions	$FAAB_1$	0.850	1
	Delay caused by owner during payment process	$FAAB_4$	0.840	2
	Rework due to errors usually made by unqualified labors or engineers	$FAAB_{21}$	0.828	3
	Difficulty in material supply	$FAAB_3$	0.801	11
	Recruitment of graduate engineers without experience	$FAAB_{17}$	0.800	12

5.3. Factor Analysis Results

5.3.1. Goodness Test

To ensure the suitability of the factor analysis method, this paper first conducted a Kaiser–Meyer–Olkin assessment and Bartlett's Test of Sphericity, as these are the two required tests for the analysis method's fitness to a given data set. The results are presented in Table 4.

Table 4. Assessment of data suitability for factor analysis.

	Key Assessment	Test Items	Test Results	Recommended	Observation	Ref.
1	Kaiser–Meyer–Olkin (KMO)	Measure of sampling adequacy	0.830	$0.8 \leq \text{KMO} < 0.9$	Great	[34]
2	Bartlett's Test of Sphericity	Significance *p*-value	0.001	$p < 0.05$	Significant	[33]
		Degree of freedom *df*	105	No universal accepted value	Larger degrees of freedom are generally better	[33]
		Approximate chi-square χ^2	3533.476	No fixed accepted value	High chi-square value and low *p*-value confirm a significant relationship among variables, indicating the data's suitability for analysis	[33]

Given the results of tests in Table 4, K.M.O., which is 0.830 (KMO = 0.830 > 0.7), is greater than 0.7; the probability level found to be significant is equal to 0.001 ($p \leq 0.001 < 0.05$) and less than 0.05; the degree of freedom is positive df = 105; and the approximate chi-square χ^2 is significant (χ^2 = 3533.476). In addition, the values of the variables in the correlation matrix are larger than 0.3, which enables us to conclude that using the factor analysis method for data analysis in this research is applicable.

5.3.2. Exploratory Analysis Results

The application of factor analysis on the top 15 factors causing a delay in CCP-Burundi triggered the summarized results in Table 5. Accordingly, the mean score of all the 15 factors is significant and ranged from $FAAB_1$ = 4.23 to $FDAB_6$ = 3.99. The standard deviation (S.D.) corresponds to the top 15 delay causes that are all likely positive after being found (greater than zero). This indicates great variability among factors [49]. The same results reveal a similar ranking of factors according to their relative importance level and mean score. Thus, there is confidence between the two analysis methods.

Table 5. Exploratory factor analysis results.

						Components Extracted		
Factors ID	**Mean**	**SD**	***p*-Value**	**Rank**	**Communalities**	**1**	**2**	**3**
$FBAB_1$	4.10	1.149	0.001	4	0.933	0.894		
$FBAB_8$	4.07	1.182	0.002	5	0.645	0.814		
$FBAB_6$	4.04	1.197	0.004	8	0.912	0.768		
$FBAB_{13}$	4.02	1.200	0.004	9	0.664	0.699		
$FDAB_8$	4.00	1.254	0.006	13	0.831	0.802		
$FDAB_{11}$	3.99	1.275	0.008	15	0.895	0.721		
$FDAB_3$	4.23	1.061	0.000	1	0.769		0.768	
$FDAB_{12}$	4.20	1.098	0.000	2	0.794		0.865	
$FDAB_{15}$	4.14	1.182	0.001	3	0.912		0.839	
$FDAB_{14}$	4.01	1.288	0.004	11	0.777		0.703	
$FAAB_1$	4.00	1.305	0.005	12	0.875		0.792	
$FAAB_4$	4.05	1.203	0.003	6	0.919			0.703
$FAAB_{21}$	4.05	1.187	0.003	7	0.823			0.608
$FAAB_3$	4.01	1.240	0.004	10	0.771			0.812
$FAAB_{17}$	3.99	1.268	0.007	14	0.628			0.677
Cronbach's Alpha						0.783	0.722	0.713
Eigenvalues						8.002	2.942	1.201
Variance %						53.350	19.615	8.009
Cumulative %						53.350	72.965	80.974
Significant						0.001		

Factor analysis extracts the communalities level of the top 15 factors and is found to be greater than 0.50. Hence, all 15 factors have to be retained for further analysis. The Cronbach's alpha of extracted components equals 0.783 for component 1, 0.722 for component 2, and 0.713 for component 3. All these values are greater than 0.7, ranging between 0 and 1. Thus, the five-point Likert scales are verified as reliable. The results also reveal the eigenvalues of the components, which were found to be greater than 1.0. This indicates that the number of causal factors considered for this research is optimal.

The method is processed using a cumulative calculation of the extracted three components. Studies indicated that the normal guideline is reliable when it corresponds to 60% according to the latent root criteria [44]. Table 4 shows that a cumulative normality is more significant than 60%, which is 80.974%. The next discussions consist of renaming components. As the accurate sense of a component is produced by combining the variables that had relatively significant factor loads, the underlying three extracted components during factors analysis are labeled according to their occurrence period that composes a construction project life. Therefore, component 1 included those identified factors that occur during the award of a bid (FDABs), and component 2 included causal factors that were mainly observed after the period of awarding bid (FAABs). In contrast, component 3 is named an FBAB, which comprises factors often occurring before bidding.

5.3.3. Proportional Ranking of Causal Factors of Delay

Sole reliance on either the RII or mean score might overemphasize certain factors, potentially overlooking others that are still significant [50]. The RII emphasizes relative importance based on a weighted ranking system, while the mean score reflects raw average ratings [51]. Comparing both provides a broader understanding of the factors' roles and relative standings. Using both the Relative Importance Index and mean score to compare the proportionality ranking of delay factors ensures a more robust, validated, and nuanced understanding of their impacts on construction projects [52]. This dual approach leads to more accurate prioritization and informed decision-making in addressing delays. By analyzing both the RII and mean score rankings, we can cross-validate the importance of each factor. If the rankings align, it strengthens confidence in the findings. Understanding which factors have higher relative importance and are also supported by their mean scores allows for more informed decision-making about where to allocate resources [51].

Thus, the results in Tables 3 and 5 found a proportional (similar) ranking of the causal factors of delay, considering their relative importance index and the average score. This proportionality is presented in Figure 4a–c.

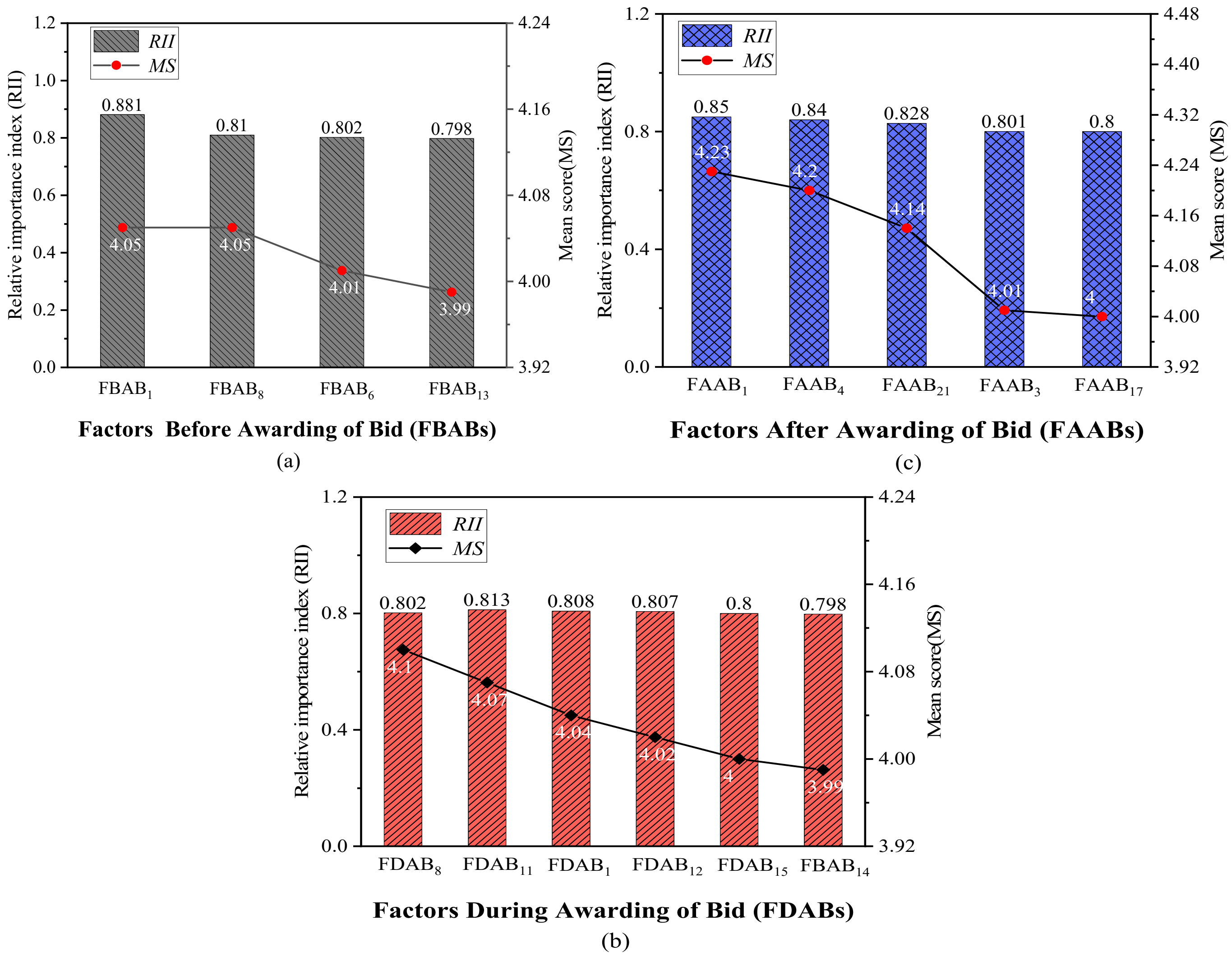

Figure 4. Relation ranking of RII and M.S. for the top 15 factors causing delay (**a**–**c**).

According to Arantes and Ferreira [24], construction delay factors are mainly categorized into four relevant dimensions including technical, financial, managerial, and environmental ones. For the comprehensiveness of our results, these 15 identified factors are organized in the same manner, with the aim to provide a holistic understanding of the causes of delays while ensuring that no significant aspect was overlooked, ultimately contributing to more effective and sustainable project management. Then, factors like weather conditions are highly classified as an environmental factor. CCP-Burundi delays encounter more technical-, financial-, and managerial-related factors. Thus, underestimation of project schedule time and cost; short time for project plan, design, and quantification; inadequacy of drawings and quantities to be executed; rework due to errors usually made by unqualified labors or engineers; unqualified designers and engineers; and difficulty in materials supply are identified factors related to the technical aspect. Meanwhile, delay caused by the owner during the payment process, focusing on the financial tender and awarding the lowest bidder, and awarded to a contractor whose projects exceed their financial potential will be classified as financial-related factors. The category of management-related factors includes factors such as disputes related to site ownership, ignorance of a contractor with regard to visiting the site during bidding submission, awarding a defaulter contractor, claims about the results from awarding, and recruitment of graduate engineers without experience are classified as managerial-related factors. Emphasizing these classifications can enhance CCP-Burundi's management so that mitigating delays causes impacts.

5.4. SEM Results

5.4.1. Hypothetical Model Formulation Theory

A hypothetical path model was constructed based on the extracted three components, resulting in the factor analysis method. During this process, this research utilizes a group of Factors Before Awarding of a Bid (FBABs), groups of the period of causal Factors During Awarding of Bidding (FDABs), and the group of Factors After Awarding of Bidding (FAABs) as latent/unobserved variables while their corresponding causal factors are considered as observed/measured variables. The goal is to evaluate to what level these groups influence each other and how significant they influence delays related to CCP-Burundi. The proposed hypothesis model is designed according to the start–finish construction project "lifecycle", and Factors Before Awarding of Bid are trusted to positively influence both Factors During Awarding of Bid and Factors After Awarding of Bid. Factors During the Award of Bid are believed to positively influence Factors After Awarding of Bidding. All groups of factors are considered to positively influence delays in CCP-Burundi. Therefore, Figure 5 presents the hypothetical model designed to present interrelations existing between latent variables based on the following six hypotheses:

H1: *FBABs positively influence FDABs to cause delays in CCP-Burundi.*

H2: *FBABs positively influence FAABs to cause delays in CCP-Burundi.*

H3: *FDABs positively influence FAABs to cause delays in CCP-Burundi.*

H4: *FBABs positively influence CCP-Burundi's delays.*

H5: *FDABs positively influence CCP-Burundi's delays.*

H6: *FAABs positively influence CCP-Burundi's delays.*

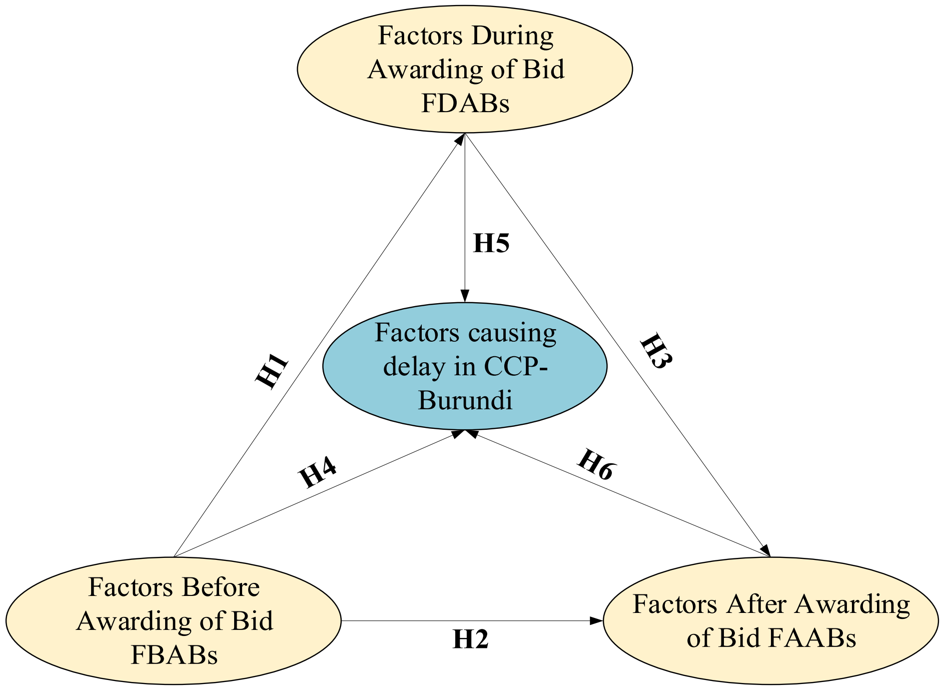

Figure 5. Hypothetical model.

5.4.2. Fitness Test

Before adopting S.E.M. hypothetical analysis, the research analyses first use the model goodness of fit by evaluating differently composed indices of a Confirmatory Factor Analysis (C.F.A.). The underlying indices used to test S.E.M. suitability usage are the comparative fit index (CFI), Tucker–Lewis Index (TLI), the Root-Mean Square Error of Approximation (RMSEA), the degree of freedom *df*, the significant probability level *p*, and normality chi-square χ^2/df such as that used by [53–55]. These indices that are used to evaluate the fitness of S.E.M. for this research have some recommended threshold values that must be completed. Table 6 shows the model goodness-of-fit assessment results and their recommended value to be followed. According to Table 6, the values obtained for all the used indices were within the standard range. Thus, S.E.M. analysis is applicable to our research data analysis.

Table 6. Model fitness assessment for SEM data analysis.

Key Indices	Recommended Value	Test Results	Observation	Ref.
Significance *p*-value	<0.05	0.001	Significant	[53]
Degree of freedom *df*	No universal accepted value	87	Larger degrees of freedom are generally better.	[55]
Approximate chi-square $(\chi)^2$	No fixed accepted value	183.119	High chi-square value and low *p*-value confirm a significant relationship among variables, indicating the data's suitability for analysis.	[53]
Normality chi-square χ^2/df	Ideal range: 1.0 to 3.0	2.105	Values closer to 1 indicate a perfect fit between the model and the data.	[54]
Comparative fit index (CFI)	Acceptable value: ≥0.90	0.999	Reasonable fit	[54]
Tucker–Lewis Index (TLI)	Acceptable value: ≥0.90	0.915	Reasonable fit	[55]
RMSEA	Acceptable value: ≤0.08	0.028	Reasonable fit	[53]

5.4.3. Measured Model

The formulated hypothetical model was further evaluated with observed variables that compose every latent variable. The findings indicated that the results do not confirm two hypotheses (H1 and H2), while the rest are positively verified. Thus, FBABs did not influence FAABs and FDABs to cause a delay in CCP-Burundi, while FDABs influenced FAABs positively to cause delays in CCP-Burundi. At the same time, FBABs positively influence CCP-Burundi's delays, FDABs positively influence CCP-Burundi's delays, and FAABs positively influence CCP-Burundi's delays. Table 7 illustrates the influence status and level resulting from the interrelationship analysis between the latent variables according to the proposed hypothesis.

Table 7. Influence status and level between proposed hypotheses.

Hypothesis	Latent Variables	Influence Status	Influence Level
H1	*FBABs* → *FDABs*	Negative (−)	1.10
H2	*FBABs* → *FAABs*	Negative (−)	0.33
H3	*FDABs* → *FAABs*	Positive (+)	0.73
H4	*FBABs* → CCP-Burundi's delays	Positive (+)	0.84
H5	*FDABs* → CCP-Burundi's delays	Positive (+)	0.78
H6	*FAABs* → CCP-Burundi's delays	Positive (+)	0.96

Figure 6 provides the measured model after a standardized estimate calculation towards S.E.M. analysis and a hypothesis related to the degree of influence between latent variables. The figure includes both latent variables with their related measured variables. Furthermore, the figure has errors resulting from standardized analysis.

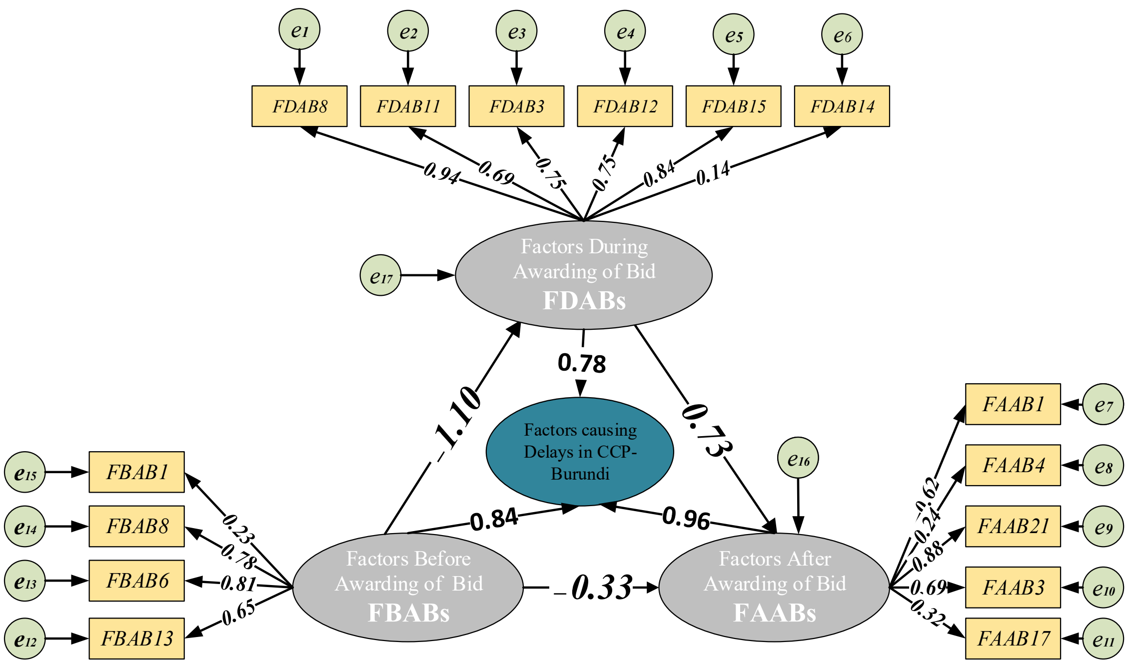

Figure 6. Measurement model.

As shown in the measured model (Figure 6), the standardized estimate results supported four hypotheses (H3, H4, H5, and H6) among the proposed six. Thus, Factors During the Awarding of Bid positively influence Factors After Awarding of Bid. As evidenced, the ignorance of a contractor with regard to visiting the site before bidding submission, the incompetence of the contractor to review project quantities, and the contractor's ignorance to consider the variability of materials when preparing the tender positively resulted in difficulty in the material supply process, arising from probable disputes between stakeholders during execution, and the increased material price during construction time. Furthermore, when the project is awarded by focusing on the financial tender of the lowest bidder only or awarded to a contractor whose projects exceed their financial potential, it can lead the contractor (winner) to recruit graduate engineers without experience for the fact that they will be paid less and this can consequently generate the indifference of those recruited. Factors Before the Award of Bid, Factors During Awarding of Bid, and Factors After Awarding of Bid significantly and positively influence CCP-Burundi's delays.

However, the results revealed that Factors During Awarding of Bid and Factors After the Award of Bid were negatively influenced by the Factors Before Awarding of Bid. Therefore, underestimating the project's time and cost does not warrant the later payment observed to the owner during construction. Moreover, late payment from the owner to their contractor may not have originated from the underestimation of the project cost of the owner but probably from the contractor's reasons. Surprisingly, the inadequacy between drawings and quantities to be executed is not influenced by the fact that there are unqualified and inexperienced design engineers. Further research has to be conducted for this to be verified and validated. The analysis of the relationships between delay factor groups is crucial for understanding how delays propagate throughout a project. A positive influence of Factors Before Awarding of Bid on Factors During Awarding of Bid indicates that early-stage preparations, such as thorough planning and clear criteria, contribute to smoother processes during the awarding phase. Similarly, the positive influence of Factors During Awarding of Bid on Factors After Awarding of Bid suggests that effective decision-making and transparency during the awarding phase ensure a more efficient post-award execution. However, the negative influence of Factors Before Awarding of Bid on Factors After Awarding of Bid highlights that poor planning or unclear requirements at the bidding stage can lead to delays during project execution. This relationship analysis is vital for identifying key intervention points to improve overall project timelines and mitigate delays.

5.5. Practical Implementation of CCP-Burundi Delay Factors Within the Case Study

5.5.1. Location of CCP-Burundi and Weather Condition on the Map

Burundi construction projects are often subjected to execution delays of more than 70%. Among the most critical factors that cause delay, weather conditions were found to be on top. Then, a commune's location in the country influences project schedule management more. For example, communes in prone and coastal areas have many delayed projects. This section points to two communal projects that were delayed due to weather conditions and issues related to the delivery of materials to the construction site due to weather, the low bid condition of a contractor, and critical road infrastructure.

According to Figure 7, most of the southwestern and northeastern communes of the country have the highest number of delayed projects, with an average of five and four in the southwestern and northeastern parts, respectively. The highest delay in those regions can be explained by the fact that the southwest part of the country is known as the highest annual rainfall region, and the coastal area of Lake Tanganyika is surrounded by mountains that usually slide during rainfall; then, there is a land-blocked roadway, and this affects traffic. Due to these reasons, the material supply will be delayed, and spare time will increase. Furthermore, construction activities will be suspended during heavy rain. Figure 7 shows the general location of CCP-Burundi delayed projects on the map of Burundi's communes.

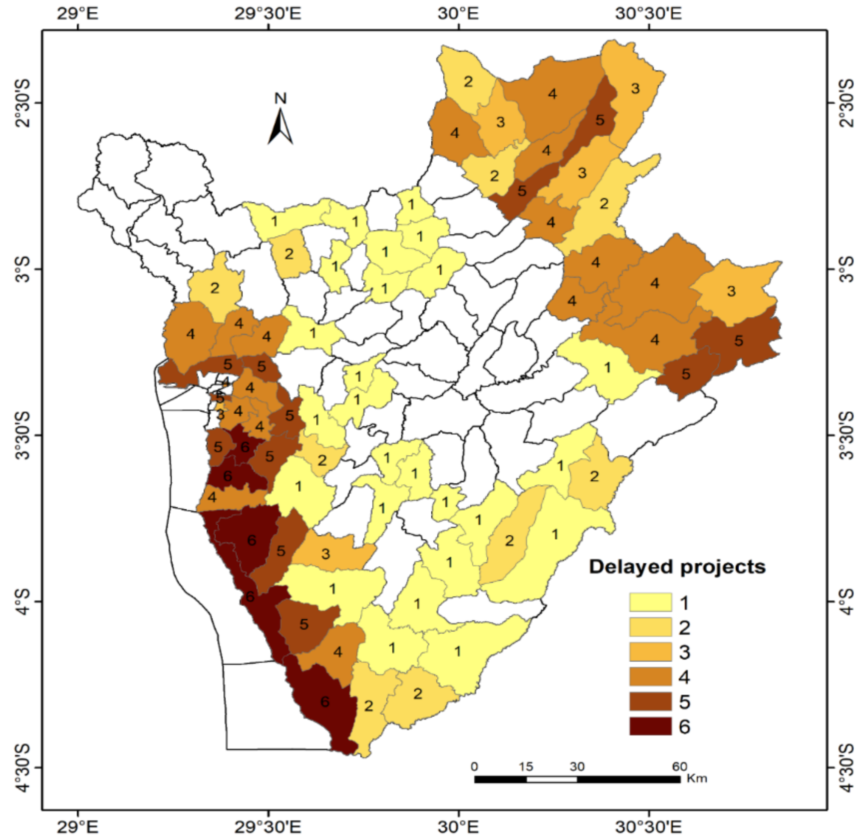

Figure 7. Location of CCPs delayed projects on the map of Burundi's communes.

The northeastern region is known as the part of the country with a lack of local construction materials. Thus, it will take hours or even days to reach materials such as gravel and sand from far away, whether in the country or from abroad to the site, which will negatively affect the project process. Figure 8a,b show, respectively, the project that was delayed due to a delay in material delivery caused by weather conditions and the project that was abandoned due to late delivery of equipment caused by a low bid of a contractor who was further disqualified for extra finance endorsement. Note that the first was a "Construction of school project" while the second was a "Construction of administrative office building project".

(**a**) (**b**)

Figure 8. Typical example of a delayed project due to delayed material delivery caused by weather conditions (**a**) and abandoned project due to late delivery of materials caused by weather, low bid price of a contactor, and ineffective road infrastructure (**b**).

5.5.2. Case Study Validation

Even though the theoretical analysis provides a foundational statement for the cases to validate the theoretical analysis of these case studies, interviews were conducted to quantitatively assess whether the theoretical constructs hold up in reality. Six participants during the planning and execution of the first case (delay in material delivery caused by weather conditions) and eleven participants were interviewed regarding the project case that was abandoned due to the late delivery of materials caused by weather. A sessional discussion was held with all participants from various organizational backgrounds, including Communal Technical Advisors, site engineers, a FONIC Technical representative, a Community representative, a Provincial Technical Advisor, a Government representative, and members of the private sector. The following Figure 9 represents the distribution of participant profiles.

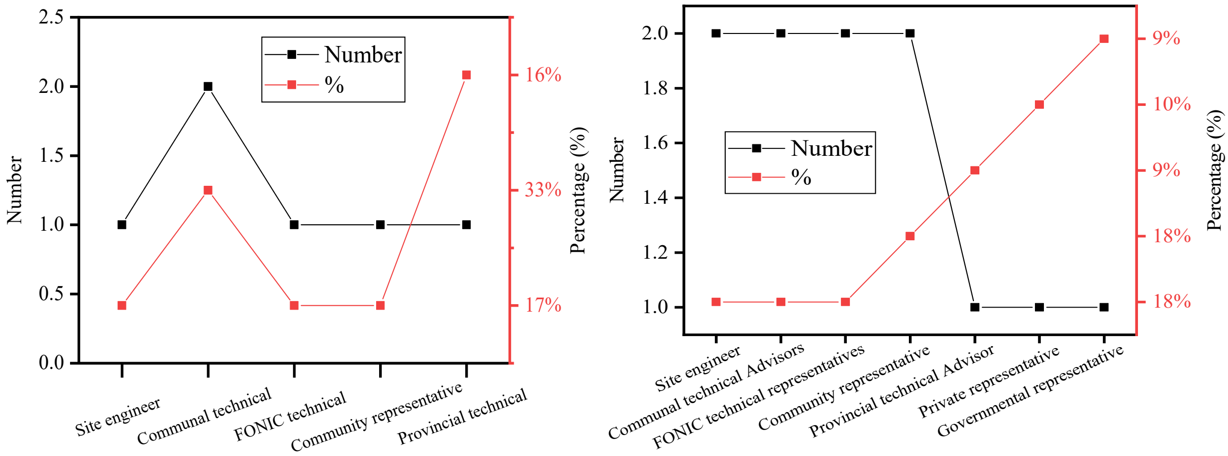

Figure 9. Distribution of participant profiles for the cases study analysis.

Participants were asked to truly tag what is the main causal reason that leads to challenges in material delivery for each case. A list of the identified four top causal factors for the case studies' material supply issue were presented including: environmental condition mainly/weather condition, Freight Availability, financial condition, and Transportation Infrastructure condition, as identified by Hirsch and Kunstman [56]. The 5 Likert scale points range from 1 (very causal) to 5 (least causal); they were used and the importance relative level was employed to identify the main causal condition that was a reason for the delay of the selected case studies. The following Table 8 shows the results of the main causal condition that led to a delay for each case.

Table 8. Case studies' empirical results on the top causal factors of delay.

Case 1			Case 2		
Delay Causative Reason	**RII**	**Rank**	**Delay Causative Reason**	**RII**	**Rank**
Environmental condition mainly/weather condition	0.914	1	Environmental condition mainly/weather condition	0.896	1
Financial condition	0.865	2	Freight Availability	0.864	2
Transportation Infrastructure	0.832	3	Financial condition	0.827	3
Freight Availability	0.820	4	Transportation Infrastructure	0.812	4

As shown in Table 8, even if financial, Freight Availability and Transportation Infrastructure factors have significantly resulted with a great importance level, environmental condition, especially weather condition, comes out as the top one causal reason of CCP-

Burundi's material supply challenges for all the considered cases. Weather condition in Burundi is characterized by continuous and heavy rainfall that has been observed most of the time during CCP-Burundi project execution.

6. Discussion

The lack of clear standards regarding land ownership often results in disputes between communal authorities and pretended landowners when providing land to contractors. Consequently, a project planned to start during favorable weather conditions will be delayed and affect the project's schedule management, as a solution to this matter can take several months. Omopariola et al. [57] indicate that poor land management often leads to disputes over land ownership, unclear boundaries, or illegal encroachments, which can delay project initiation and result in costly legal battles. These disputes can escalate into litigation, halting construction activities and prolonging completion timelines. Furthermore, insufficient land management can erode community trust and create resistance from local stakeholders. Failure to consider local cultural and social factors or to fairly compensate displaced individuals can spark opposition, damaging the reputation of the developers and hampering long-term project success [58].

As found from the annual reports, most construction companies are new, so their attention during tender preparation and submission is mainly reserved for being awarded instead of considering their capacity to execute the project. So, they usually lower their tender by ignoring the resulting consequences. This has a tremendous negative impact on the execution of the project as there is price fluctuation in construction materials in the country. Studies have confirmed that the introduction of new firms can lead to challenges, especially when they lack experience in managing the changes inherent in construction projects. For evidence, Musa et al. [59] assessed the change management practices in Bauchi State, Nigeria, and revealed that inadequate change management often results in time and cost overruns, adversely affecting project performance. At the same time, the CCP-Burundi law specifies that no amendment or upward revision is given to the initial bid price if needed during the project execution process.

Some contractors had several projects beyond their financing capacity, not because they are competent but simply because they have relationships with certain members of the project awarding committee and/or certain government leaders. Rarely do these contractors effectively manage the way to carry out the projects assigned to them within the time specified in the contracts as the payment process of government funds is always delayed. Others influence some delay factors. Thus, the latest supply of construction materials is honestly influenced not only by the weather condition factor but also by awarding a contractor many projects beyond their finances, the low bidder and default contractor, and the late payment of the owner. If both the project owner and contractor could organize a visit to the land planned for construction, they could know the condition of the land before deciding to plan a construction project there. Ahmed et al. [60] point out that inadequate site analysis may lead to unforeseen challenges, such as delays due to restricted access or additional costs for site preparation and remediation. Furthermore, construction activities can have significant environmental and social effects, including noise pollution, habitat disruption, and traffic congestion, which often require mitigation measures being factored into the bid. Accordingly, effective evaluation of site impacts ensures a more accurate and competitive bidding process while minimizing potential disputes during execution [61]. Thus, if there are conflicts related to land possession or any other challenge related to an environmental site during CCP-Burundi execution, these could have been resolved beforehand to avoid quarrels and time overrun during the execution of the project.

However, their ignorance with regard to visiting the land often leads to conflicts that extend a project's expected and planned duration.

Financial factors play a critical role in the successful completion of construction projects, influencing both the allocation of resources and the timely execution of tasks. In the context of communal construction projects in Burundi, the financing is typically planned and allocated by the government, with funds earmarked and voted for the projects before the start of the construction season. However, despite the availability of funds, delays often occur due to inefficiencies in the administrative processes managed by the FONIC (National Fund for Communal Infrastructure) and local commune departments. These administrative bottlenecks, particularly in the processing and disbursement of payments, are a significant contributor to project delays.

7. Recommendations

Effective mitigation measures are essential to manage and reduce these delays. A government plan can be achieved if CCP-Burundi can successfully be managed in quality, cost, and time. Thus, good management, proper coordination, and efficient management are key ways to mitigate the causal factors of delay in CCP-Burundi. Research by Wahab et al. [62] highlights that one critical strategy to manage delay in construction project execution is the implementation of robust contract management practices. Accordingly, efficient contract management plays an essential role in the timely completion of projects. It is, therefore, more essential to come up with the following recommendations that stakeholders can adopt for effective CCP-Burundi management:

1. The awarding should be based on several critical indices such as considering the contractors' technical experience and the number of project contracts they have already signed instead of only their lowest bid. For this purpose, a higher financial contractor's bid can be suitable for being awarded if their corresponding technical and experience bid are outstanding. The evidence is that of Alkhateeb et al. [63] who indicated that while cost considerations are critical, the selection of a contractor should balance financial, technical, and experiential factors. Awarding contracts to higher financial bidders with superior technical and experience credentials is an investment in the project's overall success, reducing risks and delivering long-term value.
2. The government should provide a training program for new graduate engineers before employing them. In fact, experienced engineers must guide fresh engineers during the construction project execution process. A comprehensive training program for new engineers is vital to prepare engineers to handle the technical, managerial, and interpersonal challenges of the construction industry, resulting in efficient project execution, improved safety, and long-term organizational benefits [64]. The continuous supervision of a construction site and the employment of experienced and skilled labor are among the key solutions that a contractor should implement. Babaeian Jelodar et al. [65] indicate that continuous supervision and the employment of skilled labor are indispensable components of effective construction project management. Together, they ensure that projects are completed on time, within budget, and to the highest quality and safety standards, ultimately leading to successful outcomes and satisfied stakeholders.
3. If there were a group of experts in project management employed by the government and in charge of supervising and coordinating the projects from the planning stage to the handover, causal delay factors should be predicted and voided in the earlier stage, and even if they occur their impacts on the project process should be mitigated/occur with low impact. This group may include experts from different fields involved in project management, such as engineers, architects, project managers, economists,

lawyers, etc. According to Bredin and Söderlund [66], experts bring specialized knowledge, extensive experience, and problem-solving skills that can significantly reduce the occurrence and consequences of delays. Their expertise in planning, monitoring, problem-solving, and resource management helps minimize delays, reduce costs, and ensure overall project success. By leveraging the skills and experience of experts during CCP-Burundi delay mitigation, construction teams can navigate challenges efficiently and deliver high-quality projects that meet client expectations.

4. A court specifically dedicated to managing disputes and claims in construction project delays plays a critical role in keeping construction projects on track. Nazzini and Godhe [67] show that providing an impartial, efficient, and legally sound framework for resolving disputes through tribunals reduce the risk of prolonged delays, financial losses, and damaged stakeholder relationships. Their ability to enforce contracts, resolve claims quickly, and maintain compliance ensures that construction projects can proceed smoothly, even in the face of challenges. Ultimately, the tribunal helps minimize disruptions, protect stakeholder interests, and contribute to the successful completion of construction projects. Establishing a special committee or tribunal solely for managing CCP-Burundi's claims and disputes will be important as long as the post-awarding period seems to recognize increased claims that last once they are oriented in ordinary courts. Furthermore, the criteria for selecting an appropriate contractor should be available and clearly understood by all parties involved. The special court should intervene further when there are disputes between the government (commune) and the landowners to provide quick and efficient solutions.
5. As the weather condition factor was identified as both a delay factor and causal reason for CCP-Burundi delays, following measures like scheduling construction activities around known seasonal weather patterns and such as focusing on critical tasks during dry months and developing contingency plans that allocate buffer time and resources to account for potential weather-related disruptions, etc., could be applied to successfully mitigate weather impacts during execution.
6. In addressing delays in public procurement, it is critical to consider global practices that have successfully mitigated such challenges. For example, the integrated procurement model recently adopted in Italy assigns the responsibilities of both executive project design and work implementation to a single contractor, often in collaboration with technical designers, as shown by Chiappinelli [68]. This approach aims to streamline the procurement process, reduce offer development time, and ensure alignment in material selection. Such innovations highlight the potential benefits of reforming procurement frameworks to minimize delays. While Burundi currently operates under a traditional procurement system, studying the procurement codes of other countries, such as Italy, may reveal practical strategies to address the delay causative factors identified in this study.
7. As most of the projects are located in rural areas, where it is difficult to have on-site access, the government, through the National Road Agency (N.R.A.), should at least construct unpaved roads or repair the existing damaged ones before the construction starts to enable easier material procurement. In addition, if the road is damaged, the N.R.A. needs to dispose of the necessary resources to repair it rapidly. The mentioned recommendations that must be undertaken for CCP-Burundi's delay management are summarized in the proposed framework, as shown in Figure 10.

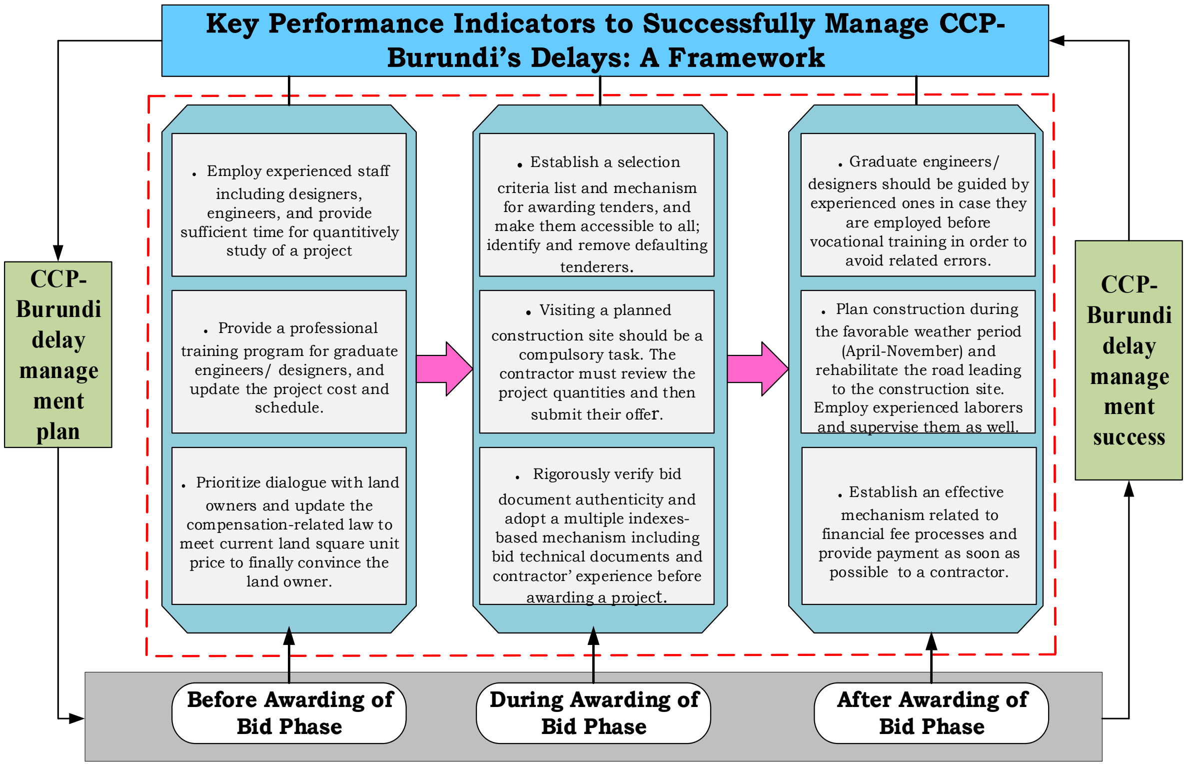

Figure 10. CCP-Burundi's delay management framework.

8. Conclusions

This paper explored common factors causing delays in communal construction projects in Burundi, called CCP-Burundi projects. These projects are financed by the government of Burundi through the "Fond National d'Investissement Communal (FONIC)" to achieve some of its key targeted development plans. This paper has initially identified 50 causes classified according to the often-occurring period of project lifecycle. The identified 50 causal factors were gathered from the literature and communal and FONIC annual reports. Thus, from the views of practitioners involved in CCP-Burundi, 15 have been found to make a significant contribution after a relative importance analysis and mean score. The 15 causes, grouped into three components, were analyzed using a structural equation modeling approach to identify the relationships between them and assess their impact on CCP-Burundi's delays. After a standardized calculation, Factors During the awarding of Bid have been found to positively influence Factors After Awarding of Bid. In contrast, the same results revealed no positive influence between Factors Before the awarding of Bid and Factors During and After the Award of Bid. The standardized results confirmed the significant influence of all the extracted groups of factors that caused CCP-Burundi's delays.

To perform CCP-Burundi projects within a successful schedule, a framework for CCP-Burundi's delay management has been provided from this research and could be undertaken by stakeholders. However, since successful construction project management is evaluated based on time, cost, and quality, further research on CCP-Burundi's management should focus on budget and quality aspects, as failures in these areas have negatively impacted time management. CCP-Burundi has known a great amount of delays since the start of its existence. This has caused the government's development plan to fail in achieving its target. Since no scientific research was conducted in CCP-Burundi to assess the critical causes of delay, these findings will help practitioners and researchers interested in project delay study as a fundamental set of references.

This research is limited to CCP-Burundi. So, the research's results and recommendations can only be referenced but not generalized to Burundi's overall construction projects as their management conditions have somehow been different regarding legal and technical specifications. Moreover, the proposed CCP-Burundi management framework and the overall proposed managerial strategies can only be validated after having been tested during future research by collecting data from ongoing projects, evaluating their impacts, and conducting an in-depth analysis. Future research can also focus on Burundi's general construction industry by not only being limited to a single type of project. Additionally, future research could involve comparative studies across different regions of East Africa or Sub-Saharan Africa to determine whether the delay factors identified in Burundi are applicable in similar contexts or if regional variations exist. Furthermore, investigating the impact of policy interventions, such as changes in government regulations or payment mechanisms, could help assess how effectively these measures mitigate delays in communal construction projects. Another potential avenue for future research is the role of technology adoption in improving project management and reducing delays. These areas of inquiry would further contribute to the development of best practices in construction management, particularly in developing countries.

Building on the findings of this study, future research could moreover explore how regulatory frameworks in Burundi and other similar contexts can be adjusted to better address the critical delay factors identified. For instance, studies could examine the impact of policy reforms or the introduction of more efficient procurement practices on reducing delays in communal construction projects. This would not only contribute to the body of knowledge but also potentially lead to the development of new regulatory measures that could enhance the effectiveness and timeliness of public construction projects in resource-constrained environments.

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