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A COMPARATIVE STUDY OF CAUSES AND EFFECTS OF PROJECT DELAYS AND DISRUPTIONS IN CONSTRUCTION PROJECTS IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

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Abstract: ***Construction projects have been observed to have problems of project delays and disruptions and the South African construction industry is not an exception. This research identified causes and effects of project delay and disruption through a desktop study. Subsequently, a questionnaire was designed and used to conduct a survey to obtain the views of the three main construction project participants – clients, consultants, and contractors. The questionnaire contains 48 causes and 13 effects of project delay and disruption identified from the desktop study. This research identified sixteen most important causes of project delay and disruption and five most important effects of delay and disruption. Sixteen most important causes were: (1) strikes, (2) rework due to errors during construction, (3) shortage of materials in market, (4) suspension of work by the client, (5) poor communication between the parties, (6) ineffective planning and scheduling of project, (7) delays in issuing working drawings, (8) mistakes and discrepancies in design documents, (9) shortage of labours and equipment, (10) delay in decision making process by the client, (11) unforeseen ground conditions, (12) unclear and inadequate details in drawing, (13) inadequate contractor's experience, (14) delay in approving changes in the scope of works, (15) delay in material delivery and (16) unacceptable quality of materials. The five major effects include: (1) create stress on contractors, (2) cost overrun, (3) time overrun, (4) poor quality of work due to rush, and (5) disputes. Furthermore, the result of this research was compared with the result of previous studies conducted in other regions of Africa in terms of causes and effects of project delay and disruption. The research concludes that numerous causes and effects of delay and disruption are limited to South African construction projects based on the comparison. The causes limited to South African construction projects include: (1) strikes, (2) suspension of work by the client (3) mistakes and discrepancies in design documents (4) delay in approving changes in the scope of works and (5) unacceptable quality of materials, while the two major effects limited to South African construction projects includes: (1) create stress on contractors and (2) poor quality of work. In conclusion, some recommendations were made in order to minimise the causes of delay and disruption identified.***

Keywords: Construction project, Delay causes, Delay effects, Project delay and disruption, South African construction industry

I. INTRODUCTION

The construction industry of every country has its own distinctive and in some cases similar problems. The construction industry involves processes which are complex and dynamic [1]. The construction industry has a great impact on the economy of a nation [1]. This is so in view of the fact that at least 50% of the investments in a number of development policies are primarily in construction [2]. In South Africa (SA), construction contributed to about 35% of the Gross Domestic Fixed Investment in 1997 [3]. In 2013, construction contributed about 3.4% to the City of Johannesburg's (CoJs) economy growth which increased by 2.6% [4].

An indicator for an effective construction industry is the completion of a construction project on time [5]. The effective completion of construction project on time leads to creation of wealth, socio-economic growth and improved standards of living [1], [6]. Also, in project management, the completion of construction project on time can be seen as the main criterion of project success [5]. However, numerous construction projects experience extensive project delays and disruptions, and in so doing surpass initial time and cost budgets [6].

Delay as defined by Stumpf [7], is an act or occurrence that prolongs the time necessary for fulfilling a task under a contract. On the other hand, according to Kikwasi [8], disruption is an event which disturbs the programme of the construction project. Delays and disruptions in construction projects bring about dissatisfaction to all involved parties [9]. To the client, delay and disruption is regarded as loss of returns resulting from deficiency in the production facilities and rentable space or a dependence on existing facilities [10].The contractor on the other hand, delay and disruption is considered a greater overhead cost due to extended working period, increased cost of material as a

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result of price increment and also increase in labour cost [10].

The aim of this research is to do a comparative study on the causes and effects of project delay and disruption in construction project in the South African construction industry. The results of this research will be compared with the result of other research done in Africa, specifically Tanzania, Nigeria, and Egypt. The findings of this comparison will help to determine if the causes and effects of delays and disruptions in construction projects in SA is the same or not with other Africa countries.

The rest of this paper is structured as follows. Section II deals with the previous studies conducted on project delay and disruption in construction projects. In Section III, the methodology of the research is explained. The results and discussion are presented in Section IV. The study is summarized with concluding remarks in Section V. Finally, recommendations are highlighted in Section VI.

II. PREVIOUS STUDIES

A. Categories of Delay and Disruption

As stated by Bordoli and Baldwin [11], the category of delays and disruptions is at the mercy of the type of contract under which the project is being constructed.

TABLE I
CATEGORIES OF DELAY AND DISRUPTION

Categories of delay	Description	Sources
Critical	Delays that disturb the project completion time	Based on critical activities
Non-critical	Delays that do not disturb the project completion time	Based on critical activities
Non-Excusable	No reward is granted for either financial or extension of time (EOT)	Based on EOT and financial compensation
Excusable and compensable	Compensation is granted for both EOT and financial	Based on EOT and financial compensation
Excusable but non-compensable	EOT is granted but no financial compensation granted for delay	Based on EOT and financial compensation
Concurrent	Delays owing to effect of one activity to other	Based on time of activities
Non-concurrent	Delays owing to independent activities	Based on time of activities
Client's caused	Owning to Client and consultant activities	Based on participants activities
Contractor caused	Due to contractors activities	Based on participants activities
Neither-party caused	Due to other causes rather than project participants activities	Based on participants activities

However, in line with Wie [12], the category of delays and disruptions is hooked upon the type and degree of the effect that an activity will have on the project and who is accountable for the delay among the project participants. Several authors have categorised delay and disruption [11], [13], [14], [15], [16], [17] and are shown in Table I.

B. Causes of Delay and Disruption

Activities or factors that transpire before and during the construction phase which will disturb the completion of a project on time are referred to as causes of project delay and disruption [14]. Project delay and disruption can be caused by a number of unforeseen activities during the construction process, which result to either an increase in the required time for completing the project [17]. In addition, once the causes of delay and disruption are identified, then they can be minimized [16].

However, a number of studies have been conducted on the causes of delay and disruption in construction projects, both internationally and locally. These studies were critically reviewed so as to get the global and local views of causes of delay and disruption. Few studies have been conducted in SA as well as some other Africa countries such as Egypt, Nigeria, and Tanzania. These are highlighted in Table II.

TABLE II
MOST SIGNIFICANT CAUSES OF DELAY AND DISRUPTION

Scholars	Country	Most significant causes of delay
Aziz [9]	Egypt	1. Delay in progress payments 2. Different tactics patterns for bribes 3. Shortage of equipment 4. Ineffective project planning and scheduling 5. Poor site management and supervision
Marzouk and El-Rasas [18]	Egypt	1. Finance and payments of completed work by owner 2. Variation orders 3. Effects of subsurface conditions 4. Low productivity level of labours 5. Ineffective planning and scheduling of project
Abd El-Razek et al. [19]	Egypt	1. Financing by contractor during construction 2. Delays in contractors payment 3. Design changes by owner 4. Partial payments during construction 5. Non-utilization of professional construction
Ezeldin and Abdel-Ghany [20]	Egypt	1. Low speed of decision making by employer 2. Lack of construction coordination and supervision 3. Productivity 4. Economic problems 5. Lack of resources
Aibinu and Odeyinka [21]	Nigeria	1. Contractors financial difficulties 2. Clients cash flow problem 3. Architects incomplete drawing 4. Subcontractors slow mobilisation 5. Equipment breakdown and maintenance problems
Sunjka and Jacob [1]	Nigeria	1. Youth unrest, militancy and communal crises 2. Inadequate planning by the contractors

		3. Delay or non-payment of compensation to the communities 4. Wrong choice of consultants and contractors 5. Weather conditions
Akinsiku and Akinsulire [16]	Nigeria	1. Financial/cash flow difficulties 2. Financial difficulties faced by contractors and public agencies 3. Frequent change order 4. Failure to pay for completed works 5. Shortages of materials
Baloyi and Bekker [22]	SA	1. Incomplete drawing 2. Design changes 3. Clients slow decision making 4. Late issue of instructions 5. Shortage of skilled labour
Nkobane [23]	SA	1. Design changes 2. Poor communications and misunderstanding 3. Poor quality basic engineering leading to re-work 4. Lack of adherence to materials standards 5. Change of scope
Kikwasi [8]	Tanzania	1. Design changes 2. Delays in payment to contractors 3. Information delays 4. Funding problems 5. Poor project management

C. *Effects of Delay and Disruption*

Project delays and disruptions ensue either as a legal responsibility on the part of the contractor and his team, or the owner and his team, and third party – nature [16]. The effect of these project delay and disruption is at all times devastating in construction project performance [16]. The word 'effect of project delay and disruption' refers to the consequences or influence of delay and disruption in completion of a project [1]. Furthermore, when the causes of delays and disruption are not keyed out and worked on meritoriously, the consequences that will occur are referred to as effects of project delay and disruption [17]. Several studies have been conducted on the effects of project delay and disruption.

Kikwasi [8] conducted a study in Tanzania on causes and effect of delays and disruptions in construction projects. In his study, 14 effects of delays and disruptions were identified. These effects include time overrun, cost overrun, negative social impact, idling resources, disputes, arbitration, delaying by the client to return the loans, poor quality of work due to hurry, delaying in getting profit by clients, bankruptcy, litigation, create stress on contractors, total abandonment, and acceleration losses. He found that the first five effects were identified has the most important effects in Tanzania.

A study conducted by Semple et al. [24] revealed that claims, acceleration and disputes are the effects of delay in Canada.

Motaleb and Kishk [25] investigated the causes and effects of construction delays in United Arab Emirates (UAE). They identified 6 potential effects of delay – time overrun, cost overrun, dispute, arbitration, litigation and total abandonment. These potential effects of delay are the same with the ones identified by researchers such as Aibinu and Jagboro [26] and Sambasivan and Soon [27] in Nigeria and Malaysia respectively. Motaleb and Kishk [25] found that the most important effects in UAE are time and cost overrun. This finding is in agreement with research conducted by Aibinu and Jagboro [26] and Salunkhe and Patil [28] in Nigeria and India respectively.

In Nigeria, Sunjka and Jacob [1] conducted a study on significant causes and effects of project delays in the Niger Delta region. They added poor quality completed project, bad public relations, and claims to the 6 effects identified by Aibinu and Jagboro [26]. They found that the three most significant effects of project delays are time overrun, cost overrun, and disputes and claims. This also agrees with the finding of Aibinu and Jagboro [26] except for the addition of disputes and claims. In addition, Akinsiku and Akinsulire [16] identified 17 effects of delay. However, they discovered that the most important effects of project delays are the same with the findings of Aibinu and Jagboro [26] – cost and time overrun. Thus, there is a consensus among the studies conducted in Nigeria.

III. METHODOLOGY

A. *Area of Study*

This research is conducted in the economic hub of South Africa – Johannesburg. Johannesburg is a city in Gauteng Province of South Africa and has seven regions. City of Johannesburg (CoJ) is the provincial capital of Gauteng province (the wealthiest province in SA) and is the centre of a fast growing Gauteng Province in terms of urbanisation [4]. Also, CoJ is a top global city which provides services to over 4.4 million people – roughly 8% of the total population of SA [4]. Furthermore, in this region, there are a lot of construction firms, consultancy firms and a high concentration of different types of construction project ranging from building construction to civil engineering construction projects.

B. *Research Design*

This research was carried out by using a combination of data collection and analysis methods. In order to generate the necessary data and information needed for the analysis, the two major methods for generating data were used – primary and secondary data sources. The secondary data was obtained from the desktop study conducted and was used to design the questionnaire used for obtaining the primary data. The primary data were gathered through the questionnaire survey.

The data were analysed using Statistical Package for Social Sciences (SPSS) software with the frequency, severity, and importance indices taking in view of the participants. Furthermore, the Cronbach's Alpha Reliability test in the SPSS software was used to test the reliability of the questionnaire and the data.

C. *Questionnaire Design*

The objectives of the research were taken into consideration when designing the questionnaire so as to

be able to answer the research questions. Great effort was put into critically reviewing the literature so as to be able to identify the right questions for the questionnaire. Consultation was made with the Statistical Consultation Service (STATKON) unit of University of Johannesburg for fine-tuning of the questionnaire. This is to help present the questionnaire in an unambiguous format. Also, from the consultation with STATKON, the author was able to determine the sample size (135) to be used for the survey.

D. Contents of the Questionnaire

The questionnaire was divided into three major sections. The first section of the questionnaire contains general information about the participants and their organisation. The second section of the questionnaire addresses causes leading to project delays and disruption. A list of forty-eight (48) identified causes of project delay and disruption in construction project as acquired from the literature is presented. These causes are categories into ten (10) groups according to the sources of delay and disruption: Factors related to project contract, client, contractor, consultant, design-team, material, labour and equipment, contract, contractual relationships, and external factors (see Table III).

TABLE III
CAUSES OF DELAY AND DISRUPTION CATEGORISED INTO TEN GROUPS

No.	Group	Causes of delay and disruption
1	Project contract	Type of construction contract
		Type of project bidding and award
		Ineffective delay penalties
		Inadequate definition of substantial completion
		Original contract duration is too short
2	Client related	Delay in progress payments by client
		Change orders by client during construction
		Delay in decision making process by client
		Late in revising and approving design document
		Suspension of work by client
3	Contractor related	Difficulties in financing project by contractor
		Poor site management and supervision
		Ineffective planning and scheduling of project
		Rework due to errors during construction
		Improper construction methods
		Inadequate contractor's experience
4	Consultant related	Delay in performing inspection and testing
		Delay in approving changes in the scope of work
		Late in reviewing and approving design documents
		Conflicts between consultant and design engineer
		Inadequate experience of consultant
		Delays in issuing working drawings
5	Design-team related	Inadequate design-team experience
		Delays in producing design documents
		Complexity of project design
		Unclear and inadequate details in drawings
		Mistakes and discrepancies in design documents
6	Material related	Delay in material delivery
		Shortage of materials in market
		Changes in material types during construction
		Poor procurement programming of materials
		Unacceptable quality of materials
7	Labour and equipment related	Shortage of labours and equipment
		Equipment breakdowns
		Low level of equipment-operator's skill
		Low productivity and efficiency of equipment
		Low productivity level of labours
		Unavailability of equipment
8	Contract	Mistakes and discrepancies in contract document
		Change orders
9	Contractual relationship	Poor communication between the parties
		Major disputes and negotiations
10	External	Weather conditions
		Unforeseen ground conditions
		Changes in government regulations and laws
		Delay in obtaining permits from municipality
		Unavailability of utilities in site
		Strikes (employee strikes)

For each of the categories of factors of causes of project delay and disruption, the participants were asked two questions and required to use their experiences in answering the questions:

- What is the frequency of occurrence for this caus e?
- What is the degree of severity of this cause on pr oject delay and disruption?
-

Both frequency of occurrence and degree of severity were ranked on a four-point scale. Frequency of occurrence is ranked on a scale with the rating of '"1"' representing rarely, '"2"' sometimes, '"3"' often, and '"4"' always. In the same way, degree of severity is ranked on a scale with the rating of '"1"' representing little, '"2"' moderate, '"3"' great, and '"4"' extreme.

The third section of the questionnaire addresses the effect of the project delay and disruption on construction projects. A list of thirteen (13) identified effects of delay and disruption is presented (see Table IV) and the participants were asked two questions:

- What is the frequency of occurrence for this effect?
- What is the degree of severity of this effect on project delay and disruption?
- Both frequency of occurrence and degree of seve rity were ranked on a four-point scale just as the ones used in ranking the causes of project delay and disruption.

TABLE IV
EFFECTS OF DELAY AND DISRUPTION

No.	Effects of delay and disruption
1	Cost overrun

2	Time overrun
3	Disputes
4	Negative social impact (NSI)
5	Idling resources
6	Delaying by the client to return the loans
7	Arbitration
8	Poor quality of work due to rush
9	Delays in getting profit
10	Bankruptcy
11	Litigation
12	Total abandonment (TA)
13	Create stress on contractors

E. Data Collection

This research is centred on a survey designed to collect all necessary facts in an effective manner. The survey was carried using a simple random sampling method but judgemental. Simple random sampling is the wholesome form of probability sampling [29]. In simple random sampling, each participant of the population has a known and an equal chance of being selected [29]. On the other hand, judgemental sampling is a popular nonprobability method [29]. In Judgemental sampling, the samples are selected based on the researcher judgment [29]. For instances, a researcher may choose to get an entire sample from one representative city, despite the fact that the population includes all cities in the country [29]. The author's approach is judgemental in the sense that the survey is limited to COJ but the survey carried out is random.

Data was collected through a questionnaire process. Two approaches of collecting data were used – emailing the questionnaire and visits to several firms and sites with the questionnaire. Firstly, questionnaires were emailed to participants – Clients, Consultants and Contractors and the questionnaires were requested to be emailed back after completion to the researcher. However, the response rate for this approach was very poor and not encouraging. Thus, this prompted the researcher to opt for other approach of collecting data involving a subsequent visit to organisations and sites with the questionnaire.

This second approach involving visits to organisations and sites with the questionnaire, and follow-up telephone calls, yielded an encouraging response rate and the majority of the data were collected through this method. This method entails the questionnaire to be given to the participants physically to complete and also give the researcher the opportunity to interview participants. However, most of the participants were not available for an interview and the questionnaire were dropped to be completed and collected at a later date or returned by email.

F. Data Analysis

1) Reliability Analysis

This statistic is usually used to measure the internal consistency of responses to a set of questions that are combined as a scale to measure a particular concept [30]. It consists of an alpha coefficient (Cα) with a value ranging from 0 to 1, where a higher value indicates greater internal consistency and lower value illustrates lower consistency [30], [31], [32]. Values of 0.7 and above demonstrate that the questions combined in the scale are measuring the same thing [30]. However, in Sunjka and Jacob [1] and Nkobane [23], it stated that Cα values of 0.5 or above are considered acceptable while in Van et al. [33] it is said that values of Cronbach's alpha (Cα) of 0.6 and above are regarded to be acceptable.

In Albogamy et al. [32] and Doloi et al. [31], it was stated that there is no set standard as to what is an acceptable limit for the Cα value. Though, there is a rule of thumb for the interpretation of Cα values, which are: $C\alpha > 0.8$ implies excellent, $0.8 > C\alpha > 0.7$ as good, $0.7 > C\alpha > 0.5$ as satisfactory, and $C\alpha < 0.5$ as poor [32].

2) Frequency Index (F.I)

The frequency index is depicted by Eqn. 1 as stated in Assaf and Al-Hejji [10]. This is used to rank the causes and effects of delay and disruption based on frequency of occurrence taken in view of the participants.

$$(F.I)(\%) = \sum a\left(\frac{n}{N}\right) \times \frac{100}{4} \qquad (1)$$

Where, $\sum a\left(\frac{n}{N}\right)$ = Mean, from the descriptive statistics gotten from the SPSS

Where, a denotes the degree of frequency (ranges from 1 for rarely up to 4 for always), n is the number of participants who choose certain frequency, and N is the total number of participants.

3) Severity Index (S.I)

Eqn. 2 represents the formula for severity index according to Assaf and Al-Hejji [10]. This is used to rank the causes and effects of delay and disruption based of the degree of severity as identified by the participants.

$$(S.I)(\%) = \sum a\left(\frac{n}{N}\right) \times \frac{100}{4} \qquad (2)$$

Where, a means the degree of severity (ranges from 1 for little up to 4 for extreme), n is the number of participants who choose certain severity, and N is the total number of participants.

4) Importance Index (IMP.I)

The importance index of each cause and effect are calculated as a product of frequency index and severity index divided by 100. The equation is as shown in Eqn. 3.

$$(IMP.I)(\%) = \frac{[(F.I)(\%) \times (S.I)(\%)]}{100} \qquad (3)$$

Where, $(F.I)(\%)$ is the frequency index, and $(S.I)(\%)$ is the severity index

IV. RESULTS AND DISCUSSION

A. General information of participants

One hundred and thirty-five (135) questionnaires were sent out to the three main participants of construction project. The questionnaires were distributed to forty-five (45) of each of the main participants – clients, consultants, and contractors. A total of seventy-five (75) returned questionnaires were valid. This implies that the valid response rate is 55.6%, which is on the average and acceptable for the analysis. In Sunjka and Jacob [1], it stated that in a research questionnaire survey, a response rate of 30% - 40% is acceptable for data analysis. This implies that the response rate is more than acceptable. The demographic information of the 75 participants is shown in Table V.

B. Reliability analysis of the data

The overall Cα values from the result of the reliability analysis for frequency of occurrence and degree of severity for the factors of group causes of delay and disruption are 0.976 and 0.967 respectively. From the description of reliability analysis in Section III, it can be seen that Cα values that are greater than 0.8 are considered to be excellent. Thus, these Cα values (0.976 and 0.967) from the result of the reliability analysis are considered to be excellent. This implies that the data for both frequency of occurrence and degree of severity for factors of group causes of delay and disruption have greater internal consistency and are reliable.

Whereas, the overall Cα values from the result of the reliability analysis for frequency of occurrence and degree of severity for effects of delay and disruption are 0.864 and 0.907 respectively.

TABLE V
DEMOGRAPHIC INFORMATION OF PARTICIPANTS

Demographic information	No of Participants	Percentage%
Gender		
Female	26	34.7
Male	49	65.3
Age group		
20 - 30	12	16.0
31 - 40	35	46.7
41 - 50	22	29.3
51 and above	6	8.0
Sector		
Building	26	34.7
Civil Engineering	49	65.3
Years of experience		
Less than 2 years	4	5.3
2 - 5 years	10	13.3
6 - 10 years	38	50.7
More than 10 years	23	30.7
Employment category		
Client	20	26.7
Contractor	27	36.0
Consultant	28	37.3

These Cα values are regarded to be excellent. Therefore, this shows that the data for both frequency of occurrence and degree of severity for effects of delay and disruption have greater internal consistency and are reliable.

Ranking of causes of delay and disruption

There are 48 causes of delay and disruption identified from the desktop study conducted by the author. The result of the analysis conducted shows that out of these 48 causes identified, 16 of these causes were ranked as the most frequent, most severe, and most important causes of delay and disruption. Table VI shows the most frequent, most severe and most important causes of delay and disruption respectively according to the clients, consultants, and the overall combination of the participants with their respective percentage and ranking.

In Table VI, the combination of all the participants perspective, shows that the sixteen most important causes of delay and disruption consist of 3 contractors related, 3 materials related, 2 clients related, 2 consultants related, 2 external related, 1 design-team related, 1 labour and equipment related, 1 contract related, and 1 contractual relationship related factors.

Furthermore, from the same table, there are six causes of delay and disruption common to all the participants, which are strikes, rework due to errors during construction, shortage of materials in market, poor communication between the parties, ineffective planning and scheduling of project, and delays in issuing working drawings. However, there are many causes common between two parties.

Furthermore, causes of delay and disruption such as inadequate definition of substantial completion, changes in government regulations and laws, delay in obtaining permits from authorities, unavailability of utilities in site, and low productivity and efficiency of equipment were ranked as the least important causes of delay and disruption.

C. Ranking of group causes of delay and disruption

The 48 causes of delay and disruption identified were classified into 10 groups. Ranking of these group causes in relation to their frequency index, severity index, and importance index by the clients, consultants, contractors, and the overall combination of the participants are presented in Table VII.

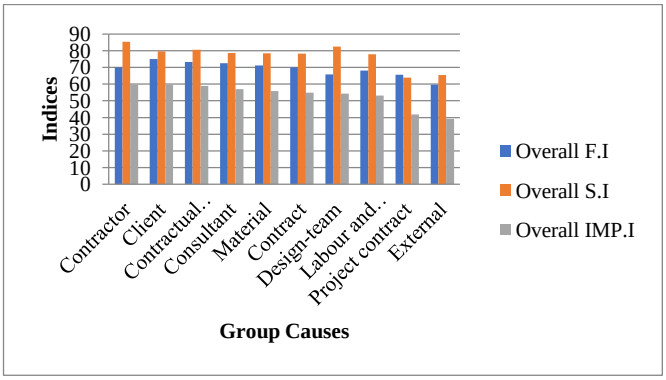

FIGURE I

Group causes of delay and disruption according to the overall indices

Tables VII indicates that the clients and consultants identified the contractual relationship related group factors as the most frequent and most important group causes of delay and disruption while the contractors point out that the client related group factors are the most frequent and most important group causes. In addition, all parties ranked the external related factors as the least frequent group causes of delay and disruption in Table VII. However, in Table VII, the clients and the contractors indicated that the external related factors are the least important group causes of delay and disruption while the consultants specified that the least important group causes are the project contract related factors.

Table VII shows that the clients and consultants specified that the most severe group causes of delay and disruption is the design-team related group causes whereas the contractors identified the contractor related factors as the most severe group causes.

Furthermore, the clients indicated that the external related factors are the least severe group causes while the consultants and the contractors specified that the project related factors are the least severe group causes of delay and disruption.

Fig. 1 shows the ranking of the group causes with respect to frequency index, severity index, and importance index by the overall combination of the parties. From the figure it can be seen that the contractor related factors are the highest ranked in terms of severity and importance index while the client related factor is the highest ranked in terms of frequency index. This indicates that the contractor related factors are the most severe and important group causes of delay and disruption while the client related factors are the most frequent group causes of delay and disruption.

D. Ranking of effects of delay and disruption

The result of the analysis conducted indicates that five out of the 13 effects of delay and disruption identified were ranked as the most frequent, most severe, and most important effects of delay and disruption.

TABLE VI
MOST FREQUENT, MOST SEVERE AND MOST IMPORTANT CAUSES OF DELAY AND DISRUPTION

S/N	Causes	Clients			Consultants			Contractors			Overall		
		F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%
1	Mistakes and discrepancies in contract document	96.25(1)	91.25(18)	87.83(6)	67(22)	77.8(19)	52.09(22)	61(26)	70.25(27)	42.85(29)	72.75(17)	78.75(22)	57.29(19)
2	Poor communication between the parties	96.25(2)	93.75(12)	90.23(2)	76.75(3)	76.8(22)	58.91(7)	65.75(17)	80.5(15)	52.93(14)	78(3)	82.75(15)	64.55(5)
3	Delay in decision making process by the client	95(3)	75(40)	71.25(29)	79.5(1)	60.8(40)	48.3(30)	79.75(2)	84.25(7)	67.19(3)	83.75(1)	73(37)	61.14(10)
4	Strikes (employee strikes)	93.75(4)	96.25(1)	90.23(1)	69.75(11)	82.3(9)	57.37(11)	74(5)	91.75(1)	67.9(2)	77.75(4)	89.25(1)	69.39(1)
5	Unavailability of equipment	93.75(5)	90(23)	84.38(10)	67(22)	77.8(19)	52.09(21)	71.25(11)	64(37)	45.6(26)	75.75(10)	76(30)	57.57(18)
6	Ineffective planning and scheduling of project	93.75(6)	93.75(8)	87.89(3)	70.5(9)	83(8)	58.52(10)	64.75(21)	84.25(8)	54.55(12)	74.75(12)	86.25(5)	64.47(6)
7	Type of project bidding and award	93.75(7)	83.75(35)	78.52(17)	62.5(32)	51(47)	31.88(43)	64.75(21)	54.75(46)	35.45(40)	71.75(20)	61(44)	43.77(42)
8	Delays in issuing working drawings	92.5(8)	93.75(13)	86.72(7)	72.25(8)	81.3(12)	58.7(9)	73.25(8)	73.25(23)	53.66(13)	78(2)	81.75(17)	63.77(7)
9	Suspension of work by the client	92.5(9)	95(7)	87.88(4)	69.75(12)	74(30)	51.62(23)	73.25(7)	87(5)	63.73(4)	77(6)	84.25(10)	64.87(4)
10	Conflicts between consultant and design engineer	92.5(10)	83.75(35)	77.47(21)	66(24)	70.5(36)	46.53(36)	68.5(14)	70.25(27)	48.12(21)	74(14)	74(35)	54.76(26)
11	Shortage of labours and equipment	92.5(11)	88.75(26)	82.09(14)	65.25(26)	80.3(15)	52.36(19)	65.75(17)	86(6)	56.55(9)	72.75(16)	84.75(9)	61.66(9)
12	Mistakes and discrepancies in design document	92.5(12)	95(5)	87.88(5)	70.5(10)	87.5(5)	61.69(2)	60.25(30)	76(18)	45.79(24)	72.75(17)	85.25(7)	62.02(8)
13	Rework due to errors during construction	91.25(13)	95(4)	86.69(8)	77.75(2)	82.3(10)	63.95(1)	63(23)	87(4)	54.81(11)	76(8)	87.25(3)	66.31(2)

14	Improper construction methods	91.25(14)	75(40)	68.44(32)	63.5(29)	81.3(13)	51.59(24)	50(42)	82.5(11)	41.25(32)	66(35)	80(19)	52.8(30)
15	Unclear and inadequate details in drawings	91.25(15)	93.75(10)	85.55(9)	67.75(19)	83(7)	56.23(14)	60.25(31)	76(18)	45.79(24)	71.25(21)	83.25(12)	59.32(12)
16	Delays in producing design documents	90(16)	83.75(35)	75.38(22)	54.5(43)	76(26)	41.42(37)	54.75(39)	57.5(43)	31.48(44)	64(38)	71.25(38)	45.6(39)
17	Weather conditions	68.75(45)	70(44)	48.13(47)	76.75(4)	76.8(22)	58.91(8)	73.25(9)	79.75(16)	58.42(6)	73.25(15)	76(30)	55.67(22)
18	Unforeseen ground conditions	87.5(22)	90(23)	78.75(16)	76(5)	80.3(17)	60.99(4)	71.25(10)	67.5(32)	48.09(22)	77.25(5)	78.25(23)	60.45(11)
19	Shortage of materials in market	88.75(17)	95(6)	84.31(11)	75(6)	80.3(14)	60.19(5)	69.5(12)	83.25(9)	57.86(7)	76.75(7)	85.25(8)	65.43(3)
20	Change order by client during construction	72.5(41)	83.75(35)	60.72(41)	75(7)	72.3(33)	54.19(17)	78.75(3)	75(21)	59.06(5)	75.75(9)	76.25(29)	57.76(17)
21	Delay in approving changes in the scope of work	73.75(38)	92.5(16)	68.22(33)	69.75(13)	76.8(22)	53.53(18)	78.75(4)	73.25(23)	57.68(8)	74(13)	79.75(21)	59.02(14)
22	Late in reviewing and approving design documents	73.75(38)	85(33)	62.69(38)	69.75(14)	71.5(35)	49.87(28)	74(6)	67.5(32)	49.95(18)	72.25(19)	73.75(36)	53.28(29)
23	Delay in performing inspection and testing	87.5(22)	88.75(26)	77.66(18)	69.75(15)	72.3(33)	50.39(26)	57.5(38)	81.5(13)	46.86(23)	70(25)	80(19)	56(21)
24	Poor site management and supervision	82.5(31)	71.25(43)	58.78(42)	69.75(16)	77.8(19)	54.23(16)	61(26)	62(39)	37.82(37)	70(26)	70.25(40)	49.18(36)
25	Delay in material delivery	87.5(22)	76.25(39)	66.72(35)	59(38)	69.8(37)	41.15(38)	81.5(1)	89(3)	72.54(1)	74.75(11)	78.25(23)	58.49(15)
26	Delay in progress payments by client	88.75(17)	87.5(29)	77.66(18)	60.75(36)	76.8(22)	46.63(34)	69.5(13)	71.25(25)	49.52(19)	71.25(21)	77.75(27)	55.4(23)
27	Original contract duration is too short	85(27)	86.25(31)	73.31(25)	59(38)	57.3(42)	33.78(41)	68.5(15)	55.5(45)	38.02(36)	69.25(27)	64.25(43)	44.49(40)
28	Low productivity level of labours	72.5(41)	91.25(18)	66.16(37)	65.25(26)	73.3(32)	47.8(32)	66.75(16)	82.5(12)	55.07(10)	67.75(30)	81.25(18)	55.05(25)
29	Inadequate contractor's experience	86.25(25)	96.25(2)	83.02(13)	62.5(32)	81.3(11)	50.78(25)	58.25(37)	89(2)	51.84(15)	67.25(32)	88(2)	59.18(13)
30	Complexity of project design	68.75(45)	96.25(3)	66.17(36)	63.5(29)	90.3(2)	57.31(12)	47.25(45)	76.75(17)	36.26(38)	59(45)	87(4)	51.33(34)
31	Late in revising and approving design document	77.5(36)	93.75(9)	72.66(28)	65.25(26)	80.3(16)	52.36(19)	63(23)	81.5(14)	51.35(16)	67.75(31)	84.25(11)	57.08(20)
32	Unacceptable quality of material	88.75(17)	93.75(11)	83.2(12)	66(24)	75(29)	49.5(29)	61(26)	83.25(10)	50.78(17)	70.25(23)	83(14)	58.31(16)
33	Low level of equipment-operator's skill	80(32)	92.5(14)	74(24)	55.25(42)	91(1)	50.28(27)	59.25(33)	67.5(32)	39.99(35)	63.25(39)	83(13)	52.5(32)
34	Inadequate experience of consultant	73.75(38)	92.5(15)	68.22(33)	67.75(19)	90.3(4)	61.14(3)	61(26)	66.75(36)	40.72(33)	67(34)	82.25(16)	55.11(24)
35	Inadequate design-team experience	80(33)	91.25(18)	73(27)	62.5(33)	90.3(3)	56.41(13)	47.25(45)	76(18)	35.91(39)	61.75(41)	85.25(6)	52.64(31)
36	Major disputes and negotiations	88.75(17)	88.75(26)	78.77(15)	68.75(17)	85.8(6)	58.95(6)	52.75(40)	63(38)	33.23(42)	68.25(29)	78.25(23)	53.41(28)
37	Difficulties in financing project by the contractor	85(27)	87.5(29)	74.38(23)	67.75(19)	80.3(17)	54.37(15)	50(42)	62(39)	31(45)	66(35)	75.75(32)	50(35)

( ) Rank

TABLE VII
GROUP CAUSES OF DELAY AND DISRUPTION RANKED ACCORDING TO FREQUENCY, SEVERITY AND IMPORTANCE INDEX

S/N	Group Causes	Clients			Consultants			Contractors			Overall		
		F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%
1	Contractual relationships factors	92.5(1)	91.25(2)	84.4(1)	72.77(1)	81.25(3)	59.1(1)	59.26(7)	71.76(6)	42.5(6)	73.17(2)	80.5(3)	58.9(3)
2	Contract related factors	90.63(2)	91.25(3)	82.7(2)	64.73(6)	76.79(6)	49.7(6)	60.19(6)	70.37(7)	42.4(7)	70(6)	78.33(7)	54.8(6)
3	Contractor related factors	88.33(3)	90(4)	79.5(3)	68.6(4)	81.92(2)	56.2(2)	57.87(8)	85.65(1)	49.6(4)	70(5)	85.42(1)	59.8(1)
4	Client related factors	85.25(4)	86.88(7)	74.1(5)	70(2)	71.88(8)	50.3(5)	72.78(1)	81.95(2)	59.6(1)	75.07(1)	79.5(4)	59.7(2)
5	Material related factors	85.25(5)	86(8)	73.3(7)	65.36(5)	72.5(7)	47.4(8)	66.67(3)	79.26(3)	52.8(2)	71.13(4)	78.53(6)	55.9(5)
6	Design-team related factors	84.5 (6)	92(1)	77.7(4)	63.75(7)	85.36(1)	54.4(3)	53.89(9)	72.41(4)	39(8)	65.73(8)	82.47(2)	54.2(7)
7	Project contract related factors	84.06(7)	84.25(9)	70.8(9)	56.7(9)	53.39(10)	30.3(10)	61.34(5)	59.45(10)	36.5(9)	65.67(9)	63.8(10)	41.9(9)
8	Labour and equipment related factors	82.71(8)	88.44(6)	73.1(8)	60.86(8)	79.69(4)	48.5(7)	64.82(4)	68.29(8)	44.3(5)	68.11(7)	77.92(8)	53.1(8)
9	Consultant related factors	82.29(9)	89.38(5)	73.5(6)	69.2(3)	77.08(5)	53.3(4)	68.83(2)	72.07(5)	49.6(3)	72.56(3)	78.56(5)	57(4)
10	External factors	80.63(10)	72.75(10)	58.7(10)	53.57(10)	65.18(9)	34.9(9)	50.7(10)	60.37(9)	30.6(10)	59.75(10)	65.47(9)	39.1(10)

( ) Rank

TABLE VIII
MOST FREQUENT, MOST SEVERE AND MOST IMPORTANT EFFECTS OF DELAY AND DISRUPTION

S/N	Effects	Clients			Consultants			Contractors			Overall		
		F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%	F.I%	S.I%	IMP.I%
1	Cost overrun	97.5(1)	97.5(1)	95.1(1)	76.75(3)	77.75(2)	59.67(3)	86(2)	87(2)	74.82(2)	85.75(2)	86.25(2)	73.96(2)
2	Bankruptcy	95(2)	92.5(4)	87.9(3)	49(13)	75(5)	36.75(8)	63(11)	71.25(8)	44.89(11)	66.25(10)	78.25(4)	51.84(8)
3	Time overrun	93.8(3)	93.8(3)	87.9(2)	81.25(2)	76.75(3)	62.36(2)	79.75(6)	84.25(3)	67.19(3)	84(3)	84(3)	70.56(3)
4	Poor quality of work due to rush	92.5(4)	90(5)	83.3(5)	69.75(6)	66(6)	46.04(4)	80.5(4)	79.75(4)	64.2(4)	79.75(4)	77.25(5)	61.61(4)
5	Create stress on contractors	91.3(5)	93.8(2)	85.5(4)	81.25(1)	84.75(1)	68.86(1)	87(1)	92.5(1)	80.48(1)	86(1)	90(1)	77.4(1)
6	Disputes	90(6)	82.5(9)	74.3(6)	72.25(4)	59.75(8)	43.17(6)	78.75(7)	68.5(10)	53.94(8)	79.25(5)	69(9)	54.68(5)
7	Idling resources	70(11)	90(5)	63(11)	71.5(5)	61.5(7)	43.97(5)	70.25(9)	77.75(5)	54.62(7)	70.75(8)	75(6)	53.06(7)
8	Negative social impact	86.3(8)	77.5(12)	66.8(9)	68.75(7)	50(13)	34.38(9)	83.25(3)	68.5(10)	57.03(6)	78.75(6)	64(12)	50.4(9)
9	Total abandonment	88.8(7)	77.5(12)	68.8(8)	53.5(12)	76(4)	40.66(7)	80.5(5)	72.25(6)	58.16(5)	72.75(7)	75(7)	54.56(6)

( ) Rank

TABLE IX
COMPARISON OF THE RESULTS OF THE CURRENT STUDY WITH RESULT OBTAINED IN OTHER REGIONS OF AFRICA IN TERMS OF MAJOR CAUSES OF DELAY AND DISRUPTION

Rank	Current study (South Africa)	Aziz [9] (Egypt)	Marzouk and El-Rasas [18] (Egypt)	Abd El-Razek et al. [19] (Egypt)	Ezeldin and Abdel-Ghany [20] (Egypt)	Kikwasi [8] (Tanzania)	Sunjka and Jacob [1] (Nigeria)	Aibinu and Odeyinka [21] (Nigeria)	Akinsiku and Akinsulire [16] (Nigeria)
1	Strikes (employee strikes)								
2	Rework due to errors during construction	Yes (7)							
3	Shortage of materials in market		Yes (8)						Yes (5)
4	Suspension of work by the client								
5	Poor communication between the parties					Yes (3)			

6	Ineffective planning and scheduling of project	Yes (4)	Yes (5)		Yes (10)		Yes (2)	Yes (8)	
7	Delays in issuing working drawings								Yes (9)
8	Mistakes and discrepancies in design documents								
9	Shortage of labours and equipment	Yes (3)			Yes (5)				
10	Delay in decision making process by the client			Yes (8)	Yes (1)				
11	Unforeseen ground conditions		Yes (3)		Yes (8)				
12	Unclear and inadequate details in drawing							Yes (3)	
13	Inadequate contractor's experience	Yes (12)							
14	Delay in approving changes in the scope of works								
15	Delay in material delivery			Yes (6)				Yes (6)	Yes (10)
16	Unacceptable quality of materials								

* Yes – Similar cause of delay and disruption, Number in bracket signifies the rank of the cause in their respective studies

TABLE X
COMPARISON OF THE RESULTS OF THE CURRENT STUDY WITH RESULT OBTAINED IN OTHER REGIONS OF AFRICA IN TERMS OF KEY EFFECTS OF DELAY AND DISRUPTION

Rank	Current study (South Africa)	Aibinu and Jagboro [26] (Nigeria)	Sunjka and Jacob [1] (Nigeria)	Akinsiku and Akinsulire [16] (Nigeria)	Kikwasi [8] (Tanzania)
1	Create stress on contractors				
2	Cost overrun	Yes (2)	Yes (2)	Yes (2)	Yes (2)
3	Time overrun	Yes (1)	Yes (1)	Yes (1)	Yes (1)
4	Poor quality of work due to rush				
5	Disputes		Yes (3)		Yes (5)

* Yes – Similar effect of delay and disruption, Number in bracket signifies the rank of the effect in their respective studies

The most frequent, most severe, and most important effects of delay and disruption as indicated by the clients, consultants, contractors, and the overall combination of all the parties are presented in Table VIII.

In Table VIII, the most important effects of delay and disruption identified include create stress on the contractors, cost overrun, time overrun, poor quality of work, and disputes. The four most important effects common to all the participants are create stress on the contractors, cost overrun, time overrun, and poor quality of work but not in the same order of importance.

The top effect of delay and disruption identified – create stress on the contractors is probably as a result of inadequate experience of contractors to handle delay and disruption, reason being that majority of these contractors are Small, Medium and Micro-sized Enterprises (SMMEs) and Broad-Based Black Economic Empowerment (BBBEE) contractors.

E. Comparison of previous studies conducted in other regions of Africa with current study on causes and effects of project delay and disruption

Table IX displays the comparison of the results of the current study with the result of the previous studies conducted in other regions of Africa with respect to major causes of delay and disruption. The table indicates that some major causes in South Africa are similar with other regions of Africa. However, it can be seen from the table that the majority of these key causes of delay and disruption are limited to SA. From Table IX, strikes, suspension of work by the client, mistakes and discrepancies in designs documents, delay in approving changes in the scope of works and unacceptable quality of materials have been identified as the major causes of delay and disruption limited to SA. The major causes of delay and disruption limited to SA are briefly discussed below:

1. Strikes: As a result of the history of Apartheid, the Government of SA creates job opportunities for the Historically Disadvantaged Individuals in different communities through Construction projects. However, during the construction period when a contractor is having a challenge with its financial cash-flow these individuals tend to go on strikes. In-addition, if a certain

ward in a community is not benefiting from the construction project in terms of employment, this also leads to strikes.

2. Suspension of work by the client: Budget constraints are the major reason for this cause of delay and disruption. For example, public construction projects are been planned for in every financial year. However, once these construction projects have exceeded its budget for a particular financial year and this particular project is not planned for in the following financial year, this leads to suspension of work by the client.
3. Mistakes and discrepancies in design documents: This is as a result of rush in preparation of design documents so as to meet up with the operational plan for a certain financial year. This often leads to the issue of addendum during the tendering process.
4. Delay in approving changes in the scope of works: this is as a result of lot of paper works. Before a change in the scope of work can be approved various committee are been involved. Example of such committees includes design committee, finance committee, etc. These committees take their time to examine the reason for the change in scope, as to if there is a need for the change in the scope. Also, the cost implication is also considered, as to if there is sufficient funds for the execution of the change in the scope of work. All these process takes time thereby leading to delay in approving change in the scope of works.
5. Unacceptable quality of materials: this occurs as a result of cutting cost by the contractor. In cases, whereby the contractor purchases an inferior material to be used for construction project and during the inspection by the consultant or an appointed agent by client such inferior material are discovered the contractor has to procure a standard material. Thus, leading to delay of the construction work to be executed.

The comparison of the results of the current study with the result of the previous studies conducted in other regions of Africa in terms of key effects of delay and disruption are presented in Table X. It can be seen from the table that two key effects of delay and disruption – create stress on contractors and poor quality of work are limited to SA while the other three key effects are similar with other regions of Africa. The two major effects limited to SA are briefly discussed:

1. Create stress on the contractors: this is probably a result of inadequate experience of contractors to handle delay and disruption, reason being that majority of these contractors are Small, Medium and Micro-sized Enterprises (SMMEs) and Broad-Based Black Economic Empowerment (BBBEE) contractors.
2. Poor quality of work: this is a result of rush from the part of the contractor due to time constraint. Contractors tend to rush the construction work due to time constraint thereby compromising the quality of the work. In-addition, poor quality of work maybe as a result of using unacceptable quality of material.

I. Conclusion

This research investigated the causes and effects of project delay and disruption in construction projects in South Africa through a desktop study. A questionnaire was designed and used to conduct a field survey to obtain the views of the three main construction project participants – client, consultants, and contractors. The questionnaire designed contained forty-eight causes and thirteen effects of delay and disruption identified from the desktop study. The forty-eight causes identified were classified into ten main groups – project contract related, contractor related, client related, consultant related, material related, design-team related, labour and equipment related, contractual relationship related, contract related, and external related delay and disruption factors.

The questionnaire survey involved 20 clients, 27 contractors, and 28 consultants. From the survey, it was found that majority of the participants which is about 65% of the participants are involved with civil engineering construction projects. Furthermore, it was revealed from the survey that majority of the participants have six to ten years of working experience in the field of construction. The data collected were analysed using SPSS and Indices.

The result of the analysis shows that the data collected are reliable through the Cronbach's alpha reliability test conducted. Furthermore, the result of the analysis indicates that the most important causes of delay and disruption include: (1) Strikes (employee strikes), (2) rework due to errors during construction, (3) shortage of materials in market, (4) suspension of work by the client, (5) poor communication between the parties, (6) ineffective planning and scheduling of project, (7) delays in issuing working drawings, (8) mistakes and discrepancies in design documents, (9) shortage of labours and equipment, (10) delay in decision making process by the client, (11) unforeseen ground conditions, (12) unclear and inadequate details in drawing, (13) inadequate contractor's experience, (14) delay in approving changes in the scope of works, (15) delay in material delivery and (16) unacceptable quality of materials. Similarly, from the result of the analysis, the most important effects of delay and disruption are: (1) create stress on contractors, (2) cost overrun, (3) time overrun, (4) poor quality of work due to rush, and (5) disputes.

Furthermore, this research compared the result of causes and effects of delay and disruption identified in this current research with other previous studies conducted in other regions of Africa.

The research thus concludes that there are numerous major causes and effects of delay and disruption which are

limited to South African construction projects and there are few causes and effects similar to other regions of Africa based on the comparison conducted. The causes of delays and disruptions identified to be limited to SA include strikes, suspension of work by the client, mistakes and discrepancies in designs documents, delay in approving changes in the scope of works and unacceptable quality of materials. While, the effects limited to SA are: (1) Create stress on contractors and (2) poor quality of work. Finally, recommendations were made in order to minimise the causes of delay and disruption identified.

V. RECOMMENDATIONS

Based on the findings of this research a number of recommendations can be made, which might help to reduce and control delays and disruptions in construction projects. The following points can be recommended:

- Contractors must make proper preparation for causes of delay and disruption such as strikes by motivating their employees. Negotiations can be used to reduce the duration of strikes in the advent of occurrence.
- Contractors must make sure proper work is done on site by making sure daily supervision and daily report of work carried out are submitted so as to avoid rework as a result of errors during construction.
- Contractors should give more attention to preparation of effective plan and schedule. The project can only be well executed only if a well-planned and scheduled work program is in place.
- Clients must make fast decisions in order not to hinder the flow of work whenever a problem arises during construction.
- Clients must make sure they have sufficient funding before embarking on a project, because insufficient finances might result in suspension of work.
- Consultants should prepare and issue working drawings on time.
- Consultants should prepare and approve changes in the scope of work on time.
- Effective and proper communication and coordination channels between the different parties should be established during each phase of construction projects.

A. Recommendations for future studies

Similar study can be conducted for specific projects like Eskom power plant projects. Another study can be conducted on risk matrix of causes of delay and disruption on construction projects in South Africa using the same approaches use in this research.

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