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 include: (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.

| 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 |

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.

| 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             |
| Aisinu 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 |

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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 effects 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 meritulously, 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 Sambasiv and Soong [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

| Study          | Country | Effects of Project Delay and Disruption |
|----------------|---------|----------------------------------------|
| 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. Shortage of skilled labour |
| Baloyi and Bekker [22] | 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 |
| Nkobane [23]     | SA      | 1. Design changes 2. Delays in payment to contractors 3. Information delays 4. Funding problems 5. Shortages of materials |
| Kikwasi [8]      | Tanzania| 1. Design changes 2. Delays in payment to contractors 3. Information delays 4. Funding problems 5. Poor project management |
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](image)

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 cause?
- What is the degree of severity of this cause on project 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?

| No. | Group               | Causes of delay and disruption                                                                 |
|-----|---------------------|-------------------------------------------------------------------------------------------------|
| 1   | Project contract    | Type of construction contract                                                                 |
| 2   | Client related      | Delay in decision making process by client                                                     |
| 3   | Contractor related  | Difficulties in financing project by contractor                                                |
| 4   | Consultant related  | Delay in reviewing and approving design documents                                              |
| 5   | Design-team related | Delays in issuing working drawings                                                               |
| 6   | Material related    | Delay in material delivery                                                                      |

| No. | Group               | Causes of delay and disruption                                                                 |
|-----|---------------------|-------------------------------------------------------------------------------------------------|
| 7   | Labour and equipment related | Original contract duration is too short                                                         |
| 8   | Contract            | Change orders by client during construction                                                     |
| 9   | Contractual relationship | Late in revising and approving design document                                                  |
| 10  | External            | Suspension of work by client                                                                   |

| No. | Group               | Causes of delay and disruption                                                                 |
|-----|---------------------|-------------------------------------------------------------------------------------------------|
| 1   | Project contract    | Type of construction contract                                                                 |
| 2   | Client related      | Change orders by client during construction                                                     |
| 3   | Contractor related  | Difficulties in financing project by contractor                                                |
| 4   | Consultant related  | Delay in reviewing and approving design documents                                              |
| 5   | Design-team related | Delays in issuing working drawings                                                               |
| 6   | Material related    | Delay in material delivery                                                                      |

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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?

| No. | Effects of delay and disruption |
|-----|--------------------------------|
| 1   | Cost overrun                   |

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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: Cα > 0.8 implies excellent, 0.8 > Cα > 0.7 as good, 0.7 > Cα > 0.5 as satisfactory, and Cα < 0.5 as poor [32].

2) Frequency Index (F.I)

The frequency index is depicted by Eqn. 1 as stated in Assaf and Al-Hejjii [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.

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

(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-Hejjii [10]. This is used to rank the causes and effects of delay and disruption based on the degree of severity as identified by the participants.

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

(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.

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

(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.

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.
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 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

| 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   | 96.25(1) | 87.83(6) | 77.8(19) | 92.5(12) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 2   | 93.75(12) | 90.23(2) | 76.75(3) | 83.75(21) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 3   | 95(3) | 75(40) | 71.25(29) | 92.5(12) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 4   | 93.75(4) | 90.23(1) | 79.5(1) | 60.8(40) | 48.3(30) | 79.25(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 5   | 93.75(5) | 90(23) | 84.3(10) | 77.8(19) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 6   | 93.75(6) | 93.75(8) | 82.09(14) | 79.5(1) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 7   | 93.75(7) | 83.75(35) | 78.52(17) | 79.25(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 61(44) | 43.77(42) | 71.25(20) | 91.75(1) | 89.25(1) | 69.39(1) |
| 8   | 93.75(8) | 93.75(13) | 82.09(14) | 79.5(1) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 9   | 93.75(9) | 93.75(13) | 82.09(14) | 79.5(1) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 10  | 93.75(10) | 83.75(35) | 78.52(17) | 79.25(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 61(44) | 43.77(42) | 71.25(20) | 91.75(1) | 89.25(1) | 69.39(1) |
| 11  | 93.75(11) | 83.75(35) | 82.09(14) | 79.5(1) | 8.5(9) | 73.7(11) | 79.2(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 91.25(18) | 65.5(15) | 64.55(5) |
| 12  | 93.75(12) | 83.75(35) | 78.52(17) | 79.25(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 61(44) | 43.77(42) | 71.25(20) | 91.75(1) | 89.25(1) | 69.39(1) |
| 13  | 93.75(13) | 83.75(35) | 78.52(17) | 79.25(2) | 84.25(7) | 67.9(3) | 83.75(1) | 79.25(7) | 61(44) | 43.77(42) | 71.25(20) | 91.75(1) | 89.25(1) | 69.39(1) |
| Rank | Cause/Issue                                                                 | Percentage |
|------|----------------------------------------------------------------------------|------------|
| 1    | Inadequate communication methods                                           | 88.75(26)  |
| 2    | Unclear and inadequate details in drawings                                  | 78.25(29)  |
| 3    | Weather conditions                                                          | 76.75(21)  |
| 4    | Unforeseen ground conditions                                                | 75(27)     |
| 5    | Low level of management payment by client during construction                | 74.38(23)  |
| 6    | Inadequate design documents                                                  | 74(24)     |
| 7    | Disputes and negotiations                                                   | 73(27)     |
| 8    | Delays in producing design documents                                        | 72.5(30)   |
| 9    | Shortage of materials in market                                             | 72.25(27)  |
| 10   | Unacceptable drawing revisions                                              | 72(31)     |
| 11   | Change order by client during construction                                   | 71.5(24)   |
| 12   | Delays in approving changes in the scope of work                            | 71(25)     |
| 13   | Late in reviewing and approving design documents                             | 70(26)     |
| 14   | Delays in performing inspection and testing                                  | 69.5(21)   |
| 15   | Poor site management and supervision                                        | 69.25(27)  |
| 16   | Delay in material delivery                                                   | 68.75(21)  |
| 17   | Delay in progress payments by client                                        | 68.25(29)  |
| 18   | Original contract duration is too short                                      | 68.25(29)  |
| 19   | Low productivity level of labour                                             | 68(30)     |
| 20   | Inadequate contractor’s experience                                          | 67.75(18)  |
| 21   | Complexity of project design                                                | 67.5(19)   |
| 22   | Late in revising and approving design document                              | 67.25(14)  |
| 23   | Unacceptable quality of material                                            | 67(22)     |
| 24   | Low level of equipment-operator’s skill                                      | 66.75(26)  |
| 25   | Inadequate communication of consultant                                       | 66.25(25)  |
| 26   | Inadequate design team experience                                           | 66(30)     |
| 27   | Major disputes and negotiations                                              | 65.5(13)   |
| 28   | Unavailability in financing project by the contractor                        | 65(26)     |
| 29   | Inadequate experience of consultant                                         | 64.75(18)  |
| 30   | Inadequate design team experience                                           | 64.5(11)   |
| 31   | Inadequate communication of consultant                                       | 64(23)     |
| 32   | Change of scope of work                                                      | 63.5(17)   |
| 33   | Inadequate communications                                                   | 63(26)     |
| 34   | Inability to communicate                                                    | 62.5(30)   |
| 35   | Late in revising and approving design document                              | 62(29)     |
| 36   | Change in design of project                                                 | 61.5(12)   |
| 37   | Inability to communicate                                                    | 61(24)     |

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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.1%    | S.1%       | IMP.1%      | F.1%    | S.1%       | IMP.1%      | F.1%    | S.1%       | IMP.1%      |
| 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(8) | 78.33(7) | 54.8(6) |
| 3    | Contractor related factors | 88.33(3) | 90.4(4)  | 79.5(3)    | 68.64(8) | 81.92(2) | 56.2(2)    | 57.87(8) | 85.65(1) | 49.6(4)    | 70.5(9) | 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)    | 53.88(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)    | 36.7(9)  | 53.19(10) | 30.8(10)   | 61.34(5) | 59.43(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) | 43.5(3)    | 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) | 72.0(5) | 49.6(3)    | 72.56(3) | 78.56(5) | 57(4) |
| 10   | External factors | 80.63(10) | 72.7(10) | 58.7(10)   | 53.57(10) | 65.18(9) | 34.9(9)    | 50.7(1) | 60.37(9) | 30.6(1)    | 59.7(10) | 65.47(9) | 39.3(10) |

() Rank

TABLE VIII

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

| S/ N | Effects | Clients | Consultants | Contractors | Overall |
|------|---------|---------|------------|-------------|---------|
|      |         | F.1%    | S.1%       | IMP.1%      | F.1%    | S.1%       | IMP.1%      | F.1%    | S.1%       | IMP.1%      |
| 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)   | 85.79(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)  | 86.25(10) | 78.25(4) | 51.84(8) |
| 3    | Poor quality of work due to rush | 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)    | 70.5(3) |
| 4    | Create stress on contractors | 91.5(3) | 90.5(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) | 61.6(4) |
| 5    | Disputes | 90(6)   | 82.5(9)   | 74.3(6)    | 72.25(4) | 59.75(2)   | 43.15(6)   | 78.75(7) | 68.3(10)   | 53.96(8)   | 79.75(5)  | 69(9)    | 54.6(5) |
| 6    | Idling resources | 70(11)  | 90.5(5)   | 61(11)     | 71.5(5)  | 61.67(7)   | 43.97(5)   | 70.25(9) | 77.75(5)   | 54.62(7)   | 70.75(8)  | 75(6)    | 53.0(6) |
| 7    | 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 abnormality | 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)    | 54.5(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-Ross [18] (Egypt) | Abd El-Razek et al. [19] (Egypt) | Ezekiel and Abdell-Ghany (20) (Egypt) | Kikwasi [8] (Tanzania) | Sunja and Jacob [1] (Nigeria) | Aibinu and Odeyinka [21] (Nigeria) | Akinsolu and Akinsola [16] (Nigeria) |
|------|----------------------------|----------------|---------------------------------|---------------------------------|---------------------------------------|-----------------------|-----------------------------|-----------------------------------|-----------------------------------|
| 1    | Strikes (employee strikes)  | Yes (7)        |                                 |                                 |                                       |                       |                             |                                   |                                   |
| 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 |               |                                 |                                 |                                       |                       |                             |                                   |                                   |

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6. Ineffective planning and scheduling of project
   - Current study
   - 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
   - Yes (3)

9. Shortage of labour and equipment
   - Yes (3)

10. Delay in decision making process by the client
    - Yes (8)

11. Unforeseen ground conditions
    - Yes (3)

12. Unclear and inadequate details in drawing
    - Yes (12)

13. Inadequate contractor’s experience
    - Yes (1)

14. Delay in approving changes in the scope of works
    - Yes (1)

15. Delay in material delivery
    - Yes (6)

16. Unacceptable quality of materials
    - Yes (6)

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

TABLE X

| 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 | Yes (2)                          | Yes (2)                       | Yes (2)                          | Yes (2)              |
| 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 | Yes (3)                       |                               |                                  |                      |
| 5    | Disputes                     | Yes (3)                          |                               |                                  |                      |

* 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 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 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 used in this research.

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