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THE IMPACT OF LOAD SHEDDING ON THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

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Abstract
Eskom generates about 95% of electricity used in SA (Conradie & Messerschmidt, 2000). In 2008 (January) ESKOM introduced load shedding or planned rolling blackouts based on a pre-determined rotating schedule, in phases where short supply threatens the integrity of the grid. Demand-side management has concentrated on encouraging consumers with the aim to conserve power during peak periods in order to reduce the incidence of load shedding. The purpose of this paper is to establish the impact that load shedding has on a construction project specifically on the time and cost elements during construction. The methodology followed was to acquire usable support for the hypothesis through an in depth review of the literature that interprets and discusses the current knowledge on the subject matter, followed by structured interviews and two case studies. The findings of this study indicate that load shedding has a financial effect on a construction project and also influence the time. Therefore resulting in time and cost overruns on the project. Time and cost are therefore influence by the application of load shedding during a construction project. The value of this review reflects the impact of load shedding not only on a single construction project but on the construction industry as a whole. It is suggested that provision such as a specific clause in the contract or provision in the Preliminaries and General section of the construction contract should be made in future construction projects for load shedding to minimise and manage the impact of load shedding on the time and cost elements of the project.

Keywords: Load shedding, ESKOM, Construction industry, Cost overruns, Time overruns

1 Introduction

ESKOM is a South African (SA) electricity public company, established in 1923 as the Electricity Supply Commission (ESKOM) by the government of SA in terms of the Electricity Act (1922). The company is divided into Generation, Transmission and Distribution divisions. Eskom generates about 95% of electricity used in SA (Conradie & Messerschmidt, 2000). In 2008 (January) ESKOM introduced "load shedding", "planned rolling blackouts" based on a pre-determined rotating schedule, in phases where short supply threatens the integrity of the grid. Demand-side management has concentrated on encouraging consumers with the aim to conserve power during peak periods in order to reduce the incidence of "load shedding". However, it well known that load shedding is becoming more frequent in South Africa due to the low supply and high demand of electricity. ESKOM even apologised to the public of South Africa for the inconvenience due to load shedding. They also admitted that while the reserve margin being low, they do not have sufficient capacity to meet demand. This necessitating planned, controlled and rotational "load shedding", to protect the power system

from a total country-wide blackout. Alarmingly, a country-wide blackout is a strong probability. The first steps include requesting large consumers to reduce load voluntarily. However, if numerous power station units trip unexpectedly, ESKOM has to skip these steps and implement load shedding, this is to prevent the system from becoming unstable. Scheduled load shedding is measured by way of sharing the available electricity energy among all its customers.

By switching off parts of the network in a controlled manner, the system remains stable throughout the day, and the impact is spread over a broader base of consumers (Conradie & Messerschmidt, 2000).

There are three dimensions to the electricity problem faced in South Africa. First of all, capacity - According to Altman (2008:12) this capacity problem is initiated mainly by the difference between the connected (or operational) generating capacity and the peak demand of South Africa. One main solution is recommended, and that is on the supply side, to increase the capacity by new investment, and ESKOM's capacity resources, while on the demand side, to reduce the peak demand of consumers.

Secondly, supply - Altman (2008:12) also stated that the supply problem of electricity is caused mainly by a difference between consumption levels by the consumers and the ability to supply power from ESKOM. Unfortunately, a combination of operational capacity has to be increased and also the ability to run it over sustained periods by increasing the supply of power. It depends also upon technical requirements for maintenance which must be done regularly, and the availability of complementary inputs, as well as primarily coal that has to be increased. It also seems that in South Africa is there a constraint on production caused by the quantity and quality of coal supplies to ESKOM.

Lastly, the reserve Margin - Newberry (2007: 0nline) and Altman (2008:13) shows that the reserve margin problem in South Africa has been caused by the high demand for electricity which is faster than operational capacity of ESKOM. Therefore, less time for maintenance is available, and the equipment lifespan is shorter, which results in parts that have to be replaced and the electricity price increase. This also reduces the shield for unplanned down time of the electrical equipment, which leads to disruptions of supplies. However, all these problems can be solved in the future by increasing the capacity. The capacity problem, and the ability to meet unanticipated increases in demand of electricity, depends on the availability of coal for the output of electrical energy. When stocks of coal are exhausted, they can only be rebuilt if coal purchases exceed usage. This can only be achieved in part by reducing the electricity consumption from the consumers.

The purpose of this study is therefore to:

1. Explore the impact of load shedding on the construction industry with regards to time lost and cost when load shedding occurs.
2. Identifying the impact load shedding has on the building work but also lack of performance by the construction industry during load shedding.

Time and cost might be the "overruns" that influence the critical path of a project. Load shedding has become a recognized problem, thus by identifying the impact load shedding has on the industry; provisions can be made to address the current problem.

2 Literature Review

When the electricity crisis first arose late in 2007, ESKOM informed all municipal supply authorities and consumers that it required a 10% saving in electricity consumption. This was in order to maintain the stability of the national electricity grid while still allowing for a 4% growth in consumption annually. ESKOM placed a six month moratorium on the approval of

all power applications for new construction projects, which was supposed to have ended on 31 May (Greager, 2008). This moratorium by ESKOM applies to all new projects requiring an electricity supply exceeding 100 kVA.

As reported in the May issue of Vector, an Electricity Crisis Forum was established by Master Builders South Africa (MBSA), which includes all role players in the construction industry, including the Electrical Contractors Association of South Africa (ECASA). They appointed a smaller task team to allow role players to discuss and debate with ESKOM appropriate reactions to the electricity supply issues as they unfolded (Greager, 2008). Alarmingly, at the first meeting ESKOM representatives reminded the other delegates that ESKOM was formulating criteria and guidelines that would be used when considering applications for the provision of electricity supplies to new developments when the moratorium ended. However, it had now been decided that the moratorium would continue, and the quotations issued would merely reflect the cost of providing the new supply, and the time frames within which new supply could be provided. The South African construction industry was hard hit by the infrastructure development highs leading up to the 2010 FIFA World Cup, followed by a global recession and/or depressed growth. Detail statistics of the decline of the construction industry over the last three years have been well publicised (PWC, 2013). However, in 2013 the construction industry was also in the headlines for all the wrong reasons. The most notable headlines have been the finalisation of the Competition Commission enquiries as well as the significant delays at ESKOM power plant projects. All these negative headlines have highlighted the importance of the industry, not only for the country's development, but also the challenges of the environment in which it operates (PWC, 2013). According to PWC (2013) large capital projects are inherently risky as well as their multi-year timelines, changing requirements and complex procurement issues. All these require diligent oversight from the construction industries common concern for budget overruns and the effect on financial health.

Kerzner (2001:5) emphasizes that project success includes "completion within the allocated time period, within the budgeted cost, with acceptance by the user/customer, at the proper performance and with minimum or mutually agreed upon scope changes". This paper will firstly identify the effect of load shedding on time in the construction industry, followed by the impact time has on the building process due to load shedding. The impact of time on the construction industry leads to multiple effects on the cost of the project. Secondly the researcher introduces the effect of cost in the construction industry, and the cost implication when time is influenced such as: Penalties for late completion: Late acquirement due to late completion of the building thus lost in income.

It is well known that "cost overruns and delays" have always been serious issues, but companies have recently become increasingly concerned about these elements since the recent economic uncertainty. PWC (2013: online), stated that even by correcting the course of capital projects, is the reality that mega-projects frequently exceed their budgets by 50% or more.

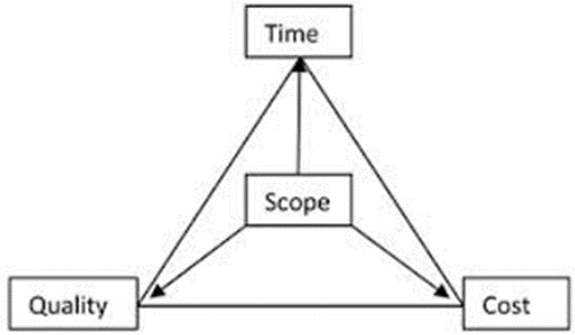

Figure 1. Four critical elements in Project Management (Source: Knipe, van der Waldt, van Niekerk, Burger and Nell, 2002: 18)

Figure 1 show that time is interlinked with cost, thus time lost during the construction equals loss of cost. When the time of construction is lengthened more resources should be allocated to the project to stay within the given time and budget. As seen in the figure quality are also affected.

3 Research Methodology

The methodology that follow is to acquire usable support for the hypotheses through an in depth review of the literature that interprets and discusses current knowledge on the subject matter, followed by qualitative research to test these theories on the effect of load shedding on time and cost in the construction industry. The research method that was applied is qualitative case study research approach. The case study was chosen because the growing problem of load shedding in South Africa, and to identify if this might have an impact on the construction industry. This is also an explanatory study and this has not been studied before in the Bloemfontein area. The case study is based on two construction sites (Project 1 and 2) in Bloemfontein, Free State Province, South-Africa.

The following inclusion and exclusion criteria for the research study were followed: The study is on the impact of load shedding on the construction industry (two commercial projects) in Bloemfontein, South-Africa. Yin (cited in Maree, 2007: 75) explained that a case study as a research method can be viewed as an empirical question that explores a modern phenomenon in a real-life context. The aim of this study and the structure of the research problem are as follows, with the research problem consisting of 'what is the impact of load shedding on the construction industry in South Africa, with the following four research questions:

- What is the cause of load shedding in South Africa?
- What is the effect of load shedding on time during a construction project?
- What is the effect of load shedding on cost during a construction project?
- If load shedding becomes more frequent; what does this mean for the construction industry?

The views of relevant groups of role players are considered in case study research to obtain a deeper understanding of the dynamics of the situation (Maree, 2007: 75). In the qualitative research the authors makes use of purposeful/purposive sampling to gather information (Patton, 2002: 230). The author therefore conducted interviews with two experienced contractors (more than 10 years in the construction industry) in the Bloemfontein area. Friedmann (2011:18) explained that a contractor is exposed to the different elements during construction. This is why the focus group only consisted of two contractors in the Bloemfontein area. Established businesses and residential groups in the area were not interviewed, for the author believed that these groups would not make useful contributions to the research which focused on the impact of load shedding on the construction industry.

The researcher made use of a semi-structured interview protocol consisting of subjective open-ended and close-ended questions. The semi-structured interviews consisting of subjective open-ended questions were found to be effective in testing the propped objectives set in the study. Merriam (2009) explained that in semi-structured interviews all questions can be used flexibly, with specific data required from all the respondents. The largest part of the interview is guided by a list of questions or issues that needs to be explored. Coding the data also formed part of the data analysis and the interpretation of the results of the research. Coding is done to reduce the amount of data to manageable and understandable text, therefore enabling analysis and making sense of the data (Welman, 2005: 211-314). A pilot study with 1 contractor was conducted one month prior to the interview.

4 Findings and Discussion

Project 1

Project 1 is a commercial building consisting of multiple shops surrounding an anchor shop, including basement for parking purposes. The cost of the project is between R 40 000 000 – R 45 000 000 and the size is approximately 9000 m². The penalties amount is R 12 000 per day (Late completion) and the time of load shedding per week was about 2 hours (approx.) The scheduled amount of load shedding per week, 7.5hours (Assuming Stage 1). The contract period was 10 months but only finished after 23 months due to non-payment. A total of 690 hours of load shedding will occur according to the load shedding schedule.

Project 2

Project 2 is a commercial building consisting of luxury finishes with multiple buildings surrounding an anchor shop with high-suspended ceilings. The cost of the project is between R 42 000 000 – R 47 000 000 and the size is approximately 7000m².The penalties amount is R 5 000 per day (Late completion) and the time of load shedding per week was about 2 hours (approx.) The scheduled amount of load shedding per week, 7.5 hours (Assuming Stage 1). The contract period was 9 months. A total of 270 hours of load shedding will occur according to the load shedding schedule.

The following questions in respect of load shedding were asked to the contractors involved in these two projects. The purpose of these questions are to establish the effect of load shedding on critical elements (time and cost) of a construction project. Also to determine if there can be any provisions made for future projects in respect of the effect of load shedding.

4.1 Are you aware of the load shedding schedule?

Both respondents pointed out that they are aware of the load shedding schedule and were given a load shedding schedule for the project. They also added that there are numerous sources from where load shedding schedules can be obtained. The acquiring of a schedule was presented in a meeting in the first encounter when load shedding started becoming more frequent. It was obvious that both contractors were fully informed about load shedding schedules.

4.2 Is load shedding applied according to the schedule?

Both respondents stated that load shedding was not always applied according to the schedule. Therefore, the load shedding schedule was not always checked during the projects due to the unreliability of the schedule. However, both contractors were always aware of the possibility of load shedding. McDonald (2008:4) in an earlier study found that most of the companies reported that they had little or no warning of outages and even when ESKOM had distributed the load shedding schedules, they were infrequently adhered to. A number of companies recommended that they would prefer to have one full-day deprived of electricity once a week rather than random outages. In this way they could accommodate their working hours in discussion with their employees. It is interesting to note that both respondents indicated that they had not bought generators for emergency, or were planning to do so, because of the generator costs ranging between R100 000 and R500 000. Respondents to the survey by McDonald (2008: 4) also indicated that a waiting time from generator suppliers of between two to four weeks. Those answering towards the end of the survey period reported that the waiting period had increased to between eight and twelve weeks. It is understood that the waiting period is considerably longer now.

4.3 What is the average time of load shedding experienced per week?

The respondents indicated that the estimated amount of load shedding per week was two to three hours. The respondents also indicated that the load shedding schedule was unreliable and that load shedding occurred without warning or according to the schedule.

Confirming the results in a previous study that illustrates 85% of the BDO Company respondents stated the average period of load shedding is two to four hours. ESKOM (2015: Online) stated that most customers (those in two hour blocks) might therefore be without electricity for up to 2.5 hours at a time. Also depending on the stage implemented that week.

However, ESKOM (2015: Online) also stated that if more load needs to be shed than has been scheduled in Stages 1, 2, 3 and 4, the National Control will instruct additional, unscheduled load shedding. This means you may be shed outside of your scheduled times. However, both contractors indicated that they have an inexpensive generator on site for emergency, but they also mentioned that they do not plan to buy generators for back-up during load shedding periods. It seems that the cost factor and running cost of a generator outweighs the benefit of a generator.

4.4 Is there made use of generator on site for when load shedding occurs?

Both respondents stated that if you are a contractor in the construction industry, a high-quality, dependable generator is a vital asset to your business. Portable generators are the most commonly used generators at work site that can withstand the harshest of conditions and demands. However, they also mentioned that often times in larger, more difficult projects, a standard generator may not be your best option, especially if space is limited or the conditions can present a challenge. Both respondents confirmed that they do make use of generators on site but not for the purpose of load shedding alone, due to the high hire and operating cost. However, for one project (Project 1) the contractor relayed on a direct line of electricity and was vulnerable to the effect of load shedding. The contractor confirmed that this was an issue they had to deal with. Respondent two use a generator, but highlight again the extra cost involved. To conclude, it seems that for projects that are more heavy duty, you will need a generator that not only has a higher power output, but is built specifically for more demanding construction work. However, the cost of a "custom made generator" which fits construction operation needs exactly and the operating cost of a generator are currently just too high to compensate for the influence of load shedding on productivity as reported by the respondents.

4.5 Effect of load shedding on the project production process

One respondent detailed that due to the nature of the project (Project 1), of having a basement, load shedding delayed production to proceed as there was a health and safety risk of working in the dark. Respondent two mentioned that the load shedding have influenced the work significantly during high-suspended ceilings and multiple shop front installation. Olatunji (2010:15) in an earlier study concluded that time control concerns, and the effort made to the initial specified time of project are under serious constrains to finished the project in time. There are also various aspects of projects to be controlled human resources, health and safety, materials, machine control and maintenance (Olatunji, 2010:15). Both respondents highlight the importance of "health and safety" in their projects, and that load shedding plays a significant role even in the health and safety of the workers when they try to work in the dark.

4.6 Problem experienced when load shedding is applied

Respondent of project 1 has again highlighted all the problems they experienced when working in a basement of the building, stated that load shedding delayed production severely, and the health and safety risk of working in the dark. The respondent also elaborated that at their in-house manufacturing of construction equipment, a delay on the site arises due to load shedding,

and this equipment and material is dependable of electrical consumption. Both contractors also mentioned that the unprofessional conduct of time could have an adverse effect on the outcome of the project with respect to cost and quality if load shedding is not taken into account. The time taken to execute the project tasks from inception of site to delivery of the project is known as project duration (Olatunji, 2010:15). To concluded, the "project duration" is a vital variable in the cost of a project. The contractors mentioned that they are always under severe pressure because of these "deadlines" which they have to meet. Both contractors also highlight that it is not always possible to do "other" work during the time when load shedding is effected therefore load shedding influences the productivity of construction work.

4.7 Is the project on schedule?

Both respondents indicated that their projects is still on schedule, but if it exceeds the deadline the penalties amount will be between R5 000 (project 2) to R12 000 (Project1) respectively per day. They also highlight the fact, that for every minute they lost working time, they lose money. Ramabodu (2014:1) also mentioned that time is interlinked with cost, thus as the time of a project exceeds the estimated deadline this influences the cost of a project.

4.8 Provisions made for load shedding?

Interestingly, both respondents indicated that there was no provision made for the continuous load shedding on their construction projects. They mentioned again that the cost involved for a "custom generator" will be over R300 000, and the running cost of these generators is just too high.

Altman (2008:19) stated in this regard that the size of any impact that will shock the construction industry will depend on the time, over which it is measured, for numerous obvious reasons. Firstly, any increasing impact in time will be bigger if the periods become longer, to put it simply because it is cumulative. Secondly, and importantly for the construction industry the impact will be greater the more time there is for it to have knock-on effects (for the shock waves of load shedding to be felt through the construction industry).

One respondent also added that the construction teams do not take the relatively fast growing problem of load shedding into account. He highlighted the seriousness of the problem and his concerns "*If this problem of load shedding increases, provisions will have to be made not only on the time line but claims for time as well*."

These results are aligned to the findings of a previous study by Von Ketelhodt and Wöcke, (2008:8) who indicate that 25.2% of manufacturing respondents strongly agree that load shedding influences the manufacturing process, the work process, and therefore the process duration. It is a fact that load shedding will increase, and provisions must be made not only for time lines, but also for claims if deadlines are not met.

5 Conclusion, Recommendations and Further Research

Based on the literature review it is acknowledged that one of the most common factor that contributes to load shedding is, historical bad assessments made by ESKOM. It is also expected that the reserve margin in electricity will continue to go on a downward trend for the next few years until there is a substantial power plant that can accommodate the demand of this new age. ESKOM admitted that with the reserve margin being low, they do not have enough capacity to meet demand, necessitating planned, controlled and rotational load shedding, to protect the power system from a total country-wide blackout.

Time and cost overruns in projects are problems that are almost always experienced in construction projects. However, while there is almost no clear way of avoiding time and cost overruns, there should always be proper planning to decrease the chances of these overruns occurring. As with load shedding, there is an element of probability in the occurrence of time and cost overruns. Load shedding may cause delays in time overruns and these can affect not only current projects, but will also affect future projects, as time constraints and adjusted deadlines affect their execution. Time is interlinked with cost, thus as the time of a project exceeds the estimated deadline due to load shedding, this might influence the cost of a project.

The aim of this study is to investigate the impact of load shedding on the construction industry in South Africa. In conclusion it is recommended that the construction industry considers the implementation of the recommendations mentioned in this paper. This might result in cost saving for the construction industry. The study revealed several limitations in various areas, which could be overcome in future research. The limitations include the following:

- To the researcher's knowledge, no studies relating to the influence of load shedding in the construction industry was done before, which made it really difficult to draw comparisons.
- The results of this study were based on data obtain from the Bloemfontein metropolitan only; therefore the results cannot be generalized to the other provinces in South Africa, as certain discrepancies may occur. It is recommended that future studies should be conducted to incorporate all the provinces of South Africa.
- This paper includes only case studies on commercial projects, which will be limited to commercial projects completed in the Free State province of South Africa. It is recommended that future studies should be conducted to incorporate all the other sectors in the construction industry in the different provinces of South Africa to establish the total impact load shedding might have.
- This paper is a "pilot" study, with a limited questionnaire. A comprehensive questionnaire must be developed to explore all the sectors in the construction industry which could be influenced by load shedding.
- Lastly, the research only explores what the effect of load shedding is on time and cost during a construction project. All the other project performance elements could be explored and the real time lost as well as cost could be determined as basis of a future study.

Further research can also concentrated on contributions to delay in the delivery of projects by professionals in the industry.

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