OPTIMISM BIAS, PATHOGENS AND COST OVERRUN: THE CASE OF AN RTS PROJECT IN SOUTH AFRICA

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The demand for electricity in South Africa is on the upward trend. To meet the demand, a state own enterprise embarked upon major infrastructure projects, which have been plagued with cost and schedule overrun. The overrun is particularly severe with return-to-service power projects. The aim of the study was to finds ways of understanding latent factors that promoted overrun in such projects. Thus, with the use of a case study, the paper presents the contributing factors to cost overruns, which were overlooked at project inception. Major stakeholders with planning and implementation responsibilities were interviewed on the case project. A clear trend that was observable by all the interviewees was the inability to address cost and time overrun that was encountered on the project due to the presence of 'optimism bias and pathogens' in the project environment. Rather, the urgent electricity demand provided a platform for the implantation of optimism bias and planning fallacy, which stimulated pathogens. The practice, industry, task and circumstance related pathogens thus influenced the scale of the cost overrun that has been reported on the case project. The notable insight provided by the exploratory study is that resident pathogens in a complex project environment can work in unison with optimism bias and planning fallacy to engender cost overrun.

Keywords: cost overrun, major projects, South Africa

INTRODUCTION

Cost overrun is a barrier to the proliferation of infrastructure projects in developing countries (Flyvbjerg *et al*., 2003). The literature has established that cost overrun is associated with major projects (Priemus *et al*., 2008). For instance, it has been reported that project cost estimates may be wrong when compared to actual development cost (Altshuler and Luberoff, 2003). Understanding cost overruns in infrastructure projects in the broader construction context requires an assessment of many factors such as competitive tendering, which shows causes, frequency and severity (Park and Papadopoulou, 2012). These factors and its dynamics give credence to the reported assertion that a positive correlation exists between contract value and cost overrun (Love, 2011). In this regard, the paper presents the preliminary findings of a study aimed at gaining additional understanding of cost overruns in South Africa. Although return-to-service (RTS) projects are done for socio-economic reasons, their cost should not constitute a burden to tax payers. Based on the South Africa experience, a major feature of RTS projects at completion is cost overruns, and a reason pertains to the competition for the resources, commodities and manufacturing

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capacity needed for the design and construction of power projects (Schlissel and Biewald, 2008). In other words, project complexity is a major factor for the occurrence of overrun (Flyvbjerg, 2011a). The objective of the study was to identify mitigation decisions by understanding latent factors that promote overruns in major infrastructure projects. The objective is underpinned by the premise that RTS projects suffer overruns due to planning and implementation mechanisms in South Africa.

AN EXPOSITION ON RTS PROJECTS IN SOUTH AFRICA

In response to high demand for electricity in South Africa, a State Owned Enterprise (SOE) embarked on new and RTS power projects. The reason for the RTS of the old mothballed stations is because it seems to be a quicker option to generate electricity. Some of these RTS stations were mothballed for almost 20 years. In RTS projects, most contracts are structured to allow escalation after a year. The longer the delay on the project, the higher inflation costs, especially contract price adjustment. As an illustration, in a case where items are manufactured and have not yet been installed due to delays in the plant, the items would have to be stored in a safe place. In the case of specialised equipment such as the Switchgear for a power plant, it can only be stored at the manufacturer's storage facilities and if the delays are for a long period, the cost commitments would rise. This explanation is crucial because most of the items manufactured outside South Africa come into the country by air or sea freight and could take 5 weeks to 18 months. As a result of the aforesaid, there is a need to pay attention to either overestimation or underestimation of deliverables of RTS projects.

In the case of lack of experience in contract works, the non-prevalence of RTS project is a factor. Project experience is scarce when it comes to RTS projects. The knowledge and experience element inform the broadness of project information, which are in relation to the strength of project team (Wang and Yuan, 2011). Having these required attributes could be the difference between failure and success in a typical major project. For instance, request for information that often delay activities would emanate from incomplete drawings due to a lack of knowledge of what needs to be done, or insufficient time to ensure the drawings are complete and checked thoroughly, or incompetence. In RTS projects, equipment is not purchased new - they are refurbished equipment. This makes it very difficult to estimate the cost to refurbish as no two equipment is exactly the same. This is the reason why RTS projects mainly use historical data to determine the estimates. This can be a simple method of estimating, but could also be very inaccurate because without cautious utilization of post bid data, this practice will lead to an inaccurate estimate (Chou, 2009).

Inflation and currency fluctuations have serious impact on the cost of construction, especially if the project involves importation of materials from another country (Emuze and Kadangwe, 2014). Forecasting the trend of inflation in Sub-Saharan African countries is particularly very difficult, and as such, the impact is felt on procurement, purchasing decisions, collective bargaining agreements with local unions and overall cash flow management (Gunhan and Arditi, 2005). Schedule delays and implementation mechanism could also lead to cost overruns. There are many possible triggers: (1) the scope could have been underestimated or increased because of customer requests; (2) customers can request changes in the design or project requirements during the course of a project which cause completed work to require rework; (3) the original plan may not be practicable (for example, too aggressively scheduled, or failing to take rework into account); or (4) other risks might have occurred, such as lack of staff due to hiring delays or delayed completion of upstream projects (Ford *et al*., 2007).

A RELATIONAL OUTLOOK ON OPTIMISM BIAS, PATHOGENS AND COST OVERRUN

Infrastructure development projects are infamous for over-running cost and schedule budgets (Flyvbjerg *et al*., 2003; Matta and Ashkenas, 2003; Love, 2011), and such overruns increases construction cost on a daily basis (Flyvbjerg, 2005). Notable reasons for these overruns include material price fluctuations, contractor delays in deliverables, changes in specifications and scope, inflation, design changes, funding problems, among others (Enshassi *et al*., 2009). In addition, major projects are often exposed to performance problems with origins in upstream project activities where multi-factor decisions are embedded (Morris *et al*., 2011). The case of poor estimating at the beginning of the project serves as an example. Cost estimation is very important in project management as it has a huge influence on decisions. When the estimate is based on insufficient information in the form of uncertainties, it is generally incorrect. Beside uncertainties, optimism bias and strategic misrepresentation constitute reasons for cost overruns in major infrastructure projects (Flyvbjerg, 2008).

Optimism bias is an inclination to estimate items more confidently without a reality check; and strategic misrepresentation is about purposely under-estimating cost and time for political and strategic reasons (Giezen, 2012). The reason for under-estimating could relate to the need for the project to proceed based on the initial estimate. Optimism bias occurs when decision makers were over-optimistic about the outcome of their planning endeavours (Flyvbjerg, 2008). This entails over-estimating the likelihood of positive events and under-estimating risk and loss (Love, 2011). However, the actions of strategic misrepresentation and optimism bias could stimulate pathogens in the project implementation environment. Citing the work of Busby and Hughes (2004), pathogens has been likened by Love (2011) to latent conditions that lay dormant within a system until they are triggered by an error. The fact that they are latent means pathogens could reside within a system for a considerable length of time and become an integral part of work practices in a firm. These pathogens contribute to errors in different forms, which include the deliberate practices of people, the nature of work / task to be performed, the circumstance in which the project is embedded, the structure and operation of an enterprise, the system of an organisation, and the technical features of the tool / tools employed in a process (Busby and Hughes, 2004 cited by Love, 2011).

Recent discourses have also shown that misrepresentation, optimism bias and pathogens can work in unison or independently to produce excessive cost and schedule deviation in a major project. The cost overruns associated with major projects are influenced by multi-factor decisions at the early stages of procurement. The degree of complexities in a particular project thus determines the proneness of such project to cost overrun due to changes in scope, specifications, material prices, and cost estimates, to mention a few. The exposition on RTS projects extends the literature on project complexity. A keen look at RTS projects reveals that such projects are characterised with complexity, non-linearity, and dynamism, which often exist on the edge of chaos (Bertelsen, 2003). The construction industry is struggling to cope with the increasing complexity of major projects because complexity, inter-alia, determine planning, co-ordination and control requirements in a project; influences the selection of expertise and experience requirements of human resources; influence the selection of suitable procurement arrangements; and determine project performance in terms of cost, quality, time and other considerations (Baccarini, 1996).

Thus, managing RTS projects within a complex environment mandate the ability to take cognizance of systems from varying perspectives so as to apply a range of tools and methodologies that suits the needs of a prevailing situation (Remington and Pollack, 2008).

METHODOLOGY

A case study approach is used to examine the underlying dynamics that are contributing to cost overrun. The case study, which is based on interviews and relies on verbal reports, is exploratory in nature (Flyvbjerg, 2011b). The single case was chosen because it represents a typical example of a more general problem related to cost overrun in South Africa (Flick, 2014). From a methodological perspective, this single case study detailed a single project through interviews and documents so as to provide insights and ideas in the early stages of investigating cost overrun in South Africa (Fellows and Liu, 2008). The research design focuses on preconstruction decisions and actions. Therefore scope creep, change orders, the relationship between cost overrun and value for money and other elements of complexities, which are synonymous with major projects were not interrogated. Interviews were conducted with participants from the SOE that does RTS projects in South Africa. This refurbishment project started off with a budget of R4.3 billion after contract negotiations and at R14.6 billion, completion is yet far away. A protocol was developed for the interviews, which were based on a purposive sample (Flick, 2014). The protocol was guided by three research questions. Interviews were conducted among professionals who are experienced in the phenomenon under study. In depth interviews were conducted, over a period of four weeks, at the project offices of the interviewees. The interviewees were all part of the management structures of the project. The face-to-face interviews were approximately 40 minutes long, and the interviews were digitally recorded prior to transcription. The interviewees were four male and one female, and held different portfolio within the project team. The five interviewees were chosen as they are currently addressing cost matters in the case project. The selection of the interviewees was influenced by their current job profile and experiences in the specific project. The interviewees have background training and experience in engineering and project management. Descriptive narrative, which is noted with single cases (Tracy, 2013), is used to present the findings in the next section.

RESEARCH FINDINGS - THE CASE STUDY

How does the SOE compile the scope of RTS projects before the commencement of the works?

In response to the above question, the interviewees and the analysed company documents show that the client (the SOE) base the scope of RTS projects on previous work that has been done as well as visual inspections carried out in the power station through life extension studies, which included checking the conditions of equipment and their components. Sometimes, it is not easy to open every component in the plant, so samples were taken to determine the scope of work for items such as vessels and pumps.

Participant 1 elaborated that she will base the scope of the work done on other RTS projects so that lessons learnt can be used to avoid past mistakes. She mentioned that she is not certain that proper feasibility studies were done, and if it was done, specialists and engineers should be held accountable where necessary. However, Participant 2 stated that he will base the scope on a full site inspection, although it was very expensive. The participant noted that if a proper inspection was not done, the extent of repair, replacement and new built cannot be accurately determined. He contends that it is prudent to spend slightly more on inspections so as to ensure a more accurate scope of works is determined. In the same context, Participant 3 says he would also base scope of RTS works on inspections, but the inspections will have to be done in detail and make sure all items are covered. By doing more detailed plant inspections, the SOE would be able to get a better understanding of the condition of the plant, and, would have an idea of whether it is better to replace the components or refurbish them. According to the participant, most of the mothballed stations were built around 50 years ago. Some of the plant items are in a state where it cannot be refurbished and need to be replaced. The technology used 50 years ago is not the same as today. So a detailed inspection would be the best option. Where it is difficult to get an investigation done, then he would look at similar work done previously and see what the scope was and use such information. However, there appear to be a cautionary tone with the latter perspective. Looking at other stations that were refurbished may also not be very accurate as the stations were built in different time and locations. If a station was built in 1950 and has 9 generating units, there is a chance that the first unit was built in 1950 and the ninth unit was build 5 years later. This would mean that the condition of the first and the last unit would not be the same. So basing the scope on other refurbished stations would be the last option of this participant.

In contrast to the opinion of the first participant, Participant 4 stated that feasibility studies were done before decisions to proceed were made with the RTS projects. The time it takes to build a new plant is assumed to be more than the project duration for the refurbishment an old plant. Thus, refurbishment appears to be an attractive option for a firm in urgent need of power generation capability. This is where feasibility studies become relevant. The participant noted that by doing a feasibility study, the SOE was able to see that it is feasible to refurbish the old plant than build a new one. The participant equally mentioned that although it is feasible to refurbish an old plant, it should also be priced more accurately. Similarly, Participant 5 mentioned that risk assessments were done, although with hindsight, it appears that the assessment were not exhaustive enough. The participant conceded that risk assessment was done, but the extent of which it is done only covers upstream activities and thus, it assisted to a limited extent. From this participant view, the risk assessments have probably helped to reduce cost overruns, but not to a huge extent as the RTS project still encountered cost overrun. In the exact words of the participant, *"maybe they never allowed enough time to be able to work around the risks"*. It can be observed that insufficient time to undertake proper assessment is a factor in relation to RTS projects.

What is the magnitude of cost overruns that are experienced on RTS projects in the SOE?

In general terms, the participants of the study observe that the magnitude of cost overruns on RTS projects is huge. The participants were experiencing huge cost overrun on the specific RTS project in which they were engaged. In terms of the specific project, all the participants mentioned poor planning as a major cause of the situation. The participant noted that cost overrun impact taxpayers in South Africa negatively as the main source of project fund is the national treasury. The effect of the cost overrun on the SOE is negative in terms of budgeting, cash flow and image. According to Participant 1, cost estimates should have been more effective, and, it should have taken realistic market considerations into account, in addition to a 10-20% premium on top of the estimates in the form of contingency. The second participant was more focus on planning. The participant opined that he would spend more time on planning, and he would do the life extension studies properly and not partially; he would need to know if there is potential improvement and what can be reused and what cannot be reused and that needs time, and that in particular is *"what we don't really do"*. Furthermore, the transcribed data show that Participant 3 concurs with Participant 2. The third participant mentioned that he would make sure that *"we plan properly"*. The participant noted that the SOE should have examined and used lessons learned in similar projects. The participant concluded that he would rather spend much more time planning instead of rushing to the execution phase of the RTS project. The perception of Participant 4 and 5 were not different from the planning related views.

What can be done to prevent scope induced cost overruns on future RTS projects in the SOE?

All participants were in agreement that unclear scope and inadequate planning influenced the encountered cost overrun on the case RTS project. If the scope has been clearly defined in the beginning, it would have closed all procurement / purchase related loop holes. It would eliminate suppliers coming with ridiculous prices and would minimize compensation events. The first participant summarise her view by saying *"a typical RTS project is where the station is old and one does not really know what exactly needs to be done in detail, so when the scope is poorly defined, there is a high chance that you would hit cost overruns. Unclear scope means you are not too sure what you need to do. When you are not sure what you need to do then you find unexpected expenses along the way."* The participant further suggests that in order to control costs, there is a need to involve all the disciplines (engineers and financial experts) in the planning process from the onset. The project leaders also need to ensure that the costs are market related. A realistic picture of the project should be compiled alongside adequate contingencies. The nature of the contract or the structure of the contract will also affect cost control, so the correct type of contract should be placed to make sure the client does not incur losses. Participant 1 also mention that expert advice on good cost control measures that can be used in order to make sure value for money is attained, must be sought. In this regard, the participant advocates the placement of cost monitoring system from the start of each RTS project.

According to the second participant, the scope of each RTS project must be drawn up by experienced persons who have a valid knowledge of the particular project in order to minimize cost overruns. In the South African construction environment, there must be collaboration where lessons learned can be shared. The participant also highlights the fact that experienced professionals should place RTS contracts so as to ensure adequate accountability. On the one hand, Participant 4 stated that people involved in placing contracts put their own interests first instead of the business interests. Once people start putting the business interests before theirs, then we would see the extent of cost overruns reducing in South Africa. On the other hand, Participant 3 reason that the SOE overspend is because of poor management and inexperienced people that handle projects, especially in Government. Verbatim, the participant says *"in these days we tend to give contracts to people that are inexperienced and know almost* *nothing, instead of giving this work to people or companies that have been doing this kind of work for many years."*

The interviews show that scope, planning and inspection were highlighted as aspects that may have contributed significantly to the cost of the RTS project (Table 1). All the interviewees noted the interdependence of these aspects and their ability to alter the cost of an RTS project. In essence, the perceptions of the interviewees suggest that the RTS project may have fallen victim to 'planning fallacy'. When planning fallacy takes root in a project, managers make decisions based on optimism rather than on a rational weighting of gains, losses, and probabilities - risks (Flyvbjerg, 2011a). Manager tend to overestimate benefits and underestimate project performance parameters by projecting forecasts of success without paying adequate attention to potential for mistakes and miscalculations.

Table 1: Overview of major perceptions of the interviewees

Aspect	Comments
Scope	Scope is determined through the input of life extension studies
	Scope is influenced by the advice of experts
Planning	Planning is affected by upstream / executive decisions
	Ineffective cost estimate and measures is a feature of poor planning
	The experience and expertise of project actors affect planning outcomes
Inspection	RTS project scope and planning depend on life extension studies
	Inspection is a determinant of repair and replace decisions
	Inspection is dependent on expert knowledge

DISCUSSION

Although a consensus about the management decisions that should have been made to ensure that the project was delivered as initially envisaged was not discernable from the study participants, the narrative in the findings shows that optimism bias and pathogens may have combined to produce the cost overrun in the RTS project. The optimism bias occurred through the decisions of the project sponsors based on the theoretical assumption that it is cheaper and quicker to fix an old power station in the South African construction environment that have been challenged by performance problems (Valentin and Vorster, 2012). The bias was fuelled by the need to limit load shedding and power cuts in the country. The recognition of the complexities and latent dynamics related to RTS projects shows that the optimism bias led to a series of events, which mirror the attributes of pathogens. The work of the project was started using tentative information where design and construction activities overlapped so as to meet the shortest delivery time. In this situation, individuals may repeat inappropriate practices, such as taking short cuts and not following due processes (Love, 2011), especially in relation to life extension studies, inspections, and cost estimation. The lack of quality management during the planning process is evident from the opinions of the interviewees. The planning gaps therefore made variation orders, request for information, site instructions, and non-conformances, constant features of the RTS project. The pathogens that eventuate in the project pertain to practise, circumstance, industry, and task. For example, the haste in project commencement led to inadequate assessment of risks and poor estimation of cost, which in turn opens the floodgate for huge compensation events that is fairly in tandem with the practice of the industry. The nature of the task is also a factor in that the refurbishment of old equipment is not a guarantee of expected performance in operation. Most importantly, a pathogen that seems to pervade the entire industry is the lack of needed expertise, especially when specialist knowledge is a requirement for the achievement of project objectives.

The examined case project supports the argument that the processes that have the greatest impact on project success in the construction sector are activity definition and project plan development. Leaders of this project appear not to have invested enough effort in this regard. Thus, the improvement of project performance at the planning phase of a project should concentrate more on the accurate identification of all project activities; and ensure that a high-quality project plan is approved by key stakeholders (Zwikael, 2009).

The analysis of Love *et al*. (2012) supports the findings of this single case as the circumstance of an optimistic feasibility and life extension studies was used to produce the construction work packages due to surging electricity demand in South Africa. The organisation and industry nature introduced knowledge and skills related issues that affected the compilation of the planning documents (task), which failed to circumvent problems at the implementation stage. Through underestimation of cost and time, and overestimation of benefits (Buehler *et al*., 1994), the case RTS project can be assumed to be a victim of planning fallacy as mentioned earlier. Koole and Spijker (2000) noted that people would underestimate task-completion times when planning fallacy is not addressed. In other words, the conventional planning method, which relies on insider view, should be replaced with better forecasting method that depends on outside view (Flyvbjerg, 2011a). A better forecasting method in this context could be the *"reference class forecasting"*, which identifies a relevant reference class of past projects; establish a probability distribution for the selected reference class; and then compare the specific project with the reference class distribution so as to determine the most likely outcome for the specific project (Flyvbjerg, 2011a).

CONCLUSIONS

The need and worth of infrastructure projects is not disputed, but their final cost is a concern. The reported innate features of major projects – project complexity and cost overrun, are evident in this project. The case study shows that the approach to planning, which was laden with hasty decisions constitutes the major reason for the runaway costs of the project. The face-to-face interviews of five key project participant in the case RTS project that have exceeded its initial budget significantly show that improper estimation of 'what must be done' at the planning stage influenced the magnitude of cost overrun encountered on the project. The informants contend that the urgency of the RTS projects may have influenced the decision to go ahead with construction without a realistic estimation of the required activities. The urgency was the fertile ground for the implantation of optimism bias, which effectively stimulates pathogens, and then, confirms the symptoms of planning fallacy. The practice, industry, task and circumstance based pathogens thus influenced the magnitude of the cost overrun that has been reported on the RTS project. The notable insight provided by the exploratory study is that resident pathogens in a complex project environment can work in unison with optimism bias to engender cost overrun.

The case points to the fact that in order to curtail cost overrun on RTS projects, informed decisions should be promoted at the planning stage. This can be achieved by ensuring that life extension studies and risk assessment are compiled without haste before project implementation. Such a mechanism should promote quality management in the design and all pre-construction activities. Provision for adequate planning time should be made by the project sponsors that are not relying on 'strategic misrepresentation / optimism biases' for the commencement of the projects. All key parties to the project should also get involved in the planning processes and inputs from each discipline should receive recognised considerations. The use of a better forecasting method should equally be advocated. However, additional research is required to establish the exact mechanism that would address excessive optimism in planning and pathogens on an RTS project environment. Although this particular case project focused directly on the topic and has been insightful from the client perspective, the single case is a precursor to further multiple studies related to cost overruns in the South African infrastructure sector. It is imperative to conduct further studies so as to eliminate bias and reflexivity errors from interventions that will begin to address the problem in the sector. Future studies would also consider the inputs of other members of the construction supply chain.

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