USING INTERACTIVE MANAGEMENT TO EXPLORE THE FACTORS CAUSING DELAY OF MODIFICATION PROJECT IN A SOUTH AFRICAN POWER STATION

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ABSTRACT

Project delays are common problems in construction industry. The modification and shutdown (outage) projects in South African power stations are faced with project delays as well. The project delays have detrimental effects to the supply of electricity and impacts the advancement of South African economy. This paper explores the major determinants that influence untimely delivery of modification projects in a South African power station. Through the use of Interactive Management (IM) methodology, 21 principal project delay factors were identified and used for structuring a delay model. The model generated through the IM session is a digraph, showing the 'aggravate' relationship between the identified delay factors. The digraph reveals that the main determinant of modification project delays in this South African power station is the 'proficiency of a project manager'. Proficiency of a project manager relates to the ability of a project manager to accomplish the required project tasks based on his or her skills, competency, and experience within the project management field. The model developed through the IM session demonstrates that proficiency of a project manager in that South African power station is the driver of other project delay factors, such as the factors in a large circular loop lying in the second stage of the model, including 'poor leadership', 'poor communication', 'poor planning', 'insufficient risk management', 'scope creep' and so forth. The model serves as a starting point to revisit the power station's strategy in dealing with its project delays.

Keywords: Interactive Management, Systemic Thinking, Project Delay

INTRODUCTION

Project delays are common problems in the global construction industry. They affect the development of construction and the overall economy of a country (Luu et al. 2015). The delay in a project could result in increased costs and the reduction of income (Mulla and Waghmare 2015). In fact, some projects become uneconomical due to the time and cost overruns. Cruywagen (2012) supports this view and argues that, for the owner and contractor, delays could result in missing new opportunities due to unavailability of capital and resources to exploit them.

Eskom is the only major electricity supplier in South Africa. It supplies electricity for industrial, commercial, and domestic use. However, South Africans have been subjecting to load shedding which comes as a result of a limited generating capacity and the increasing demand for electricity. Eskom, with the governmental support, has implemented various projects throughout the Eskom business. These projects include building new power plants and refurbishing existing plants through modification projects to ensure adequate and uninterrupted supply of electricity to the country. Despite the concerted efforts in resolving the energy crisis, these projects continue to experience severe delays which exacerbate the crisis. The project delays also occurred in the modification projects in South African power stations.

Some authors, such as Frimpong et al. (2003), Haseeb et al. (2011), Baloyi and Bekker (2011), Marzouk and El-Rasas (2012), Mulla and Waghmare (2015), Albogamy et al. (2012), Sunjka and Jacob (2013), and Luu et al. (2015), conducted studies on identification of project delay factors in different projects. The prominent approach used by these researchers was the questionnaire methods. Baloyi and Bekker (2011) said that the research anchored in extended questionnaires or interviews has been a proven application of identifying major project delays determinants.

Different from the prevailing approaches, this paper recognizes the systemic relationship among the project delay factors. The systemic nature means that the delay factors are interdependent. Besides, structuring the interrelationships between the system elements is a subjective process. With this idea in mind, structuring the relationship between the delay factors may reveal the holistic picture regarding how the project delay factors are interlaced. In this way, the significance among the project delay factors can be determined. Once the effects between the delay factors are identified, a solution may be applied to focus on the drivers of delay. This paper adopts Warfield's Interactive Management (IM) to model the factors causing untimely delivery of modification projects in a South African power station". Warfield and Cardenas (2002) define IM "as a system of management invented explicitly to be applied intermittently in organizations to enable those organizations to cope with issues or situations whose scope is beyond that of the normal type of problem that organizations can readily solve". IM echoes systemic thinking. It is designed to deal with complex problems and embrace democracy in the inquiry process.

This paper starts by providing an overview of the backgrounds to the untimely delivery of projects in South African power stations. Following the backgrounds to the study. The IM inquiry process will be briefly described. The last part demonstrates how IM was used to structure the delay factors in the modification project of a South African power station.

BACKGROUNDS TO THE STUDY

South Africans were subjected to load shedding which came as a result of a limited generating capacity and an ever increasing demand for electricity. The lack of electricity supply and interruption of supply have been increasingly recognised as a serious constraint on sustainable economic growth, given the wide consensus on the important links between electricity and economic development (Fedderke et al. 2006). Therefore, timely delivery of projects by South African power station is of paramount importance in ensuring the continuous and uninterrupted supply of electricity. To address the electricity energy challenge, various projects are considered in South Africa. These projects include building new power plants and refurbishing existing plants through modification projects to ensure adequate and uninterrupted supply of electricity to the country. Despite the concerted efforts in resolving the energy crisis, these projects continue to experience severe delays which exacerbate the crisis.

The timely delivery of projects in South African power station is crucial as unplanned unavailability of a power station has the following knock-on effects:

- disrupting the maintenance shutdown (outage) projects schedule of other power stations;
- affecting electricity capacity of the national grid;
- possible load-shedding restricting supply to domestic, commercial, and industrial consumers; and
- detrimental consequences to the country's economic activities.

Given these effects, modification projects and outage projects are still challenged to be completed within the targeted period. This results in clients' loss of income. Conflicting views exist among the South African power station personnel regarding the reasons why some projects are not delivered on time. Some team members believe that the planning strategy is a major contributing factor to project delays. On the other hand, some team members believed that the lack of accountability and the commitment to adhere to the established time schedules were the causes for the project delays. The debacle of project delays and the dissonance between the relevant stakeholders constituted a need to conduct a study to explore why projects are not delivered on time in this South African power station.

This research adopts IM to identify the drivers leading to the project failure as IM is designed to deal with complex situations through a disciplined procedure. The output of IM is an archival digraph showing the interrelationships between the system elements. The next part briefly escribes IM process.

INTERACTIVE MANAGEMENT METHODOLOGY

The IM methodology has been used to investigate various problems, e.g. the factors impeding organizational effectiveness (Tuan, 2004), the process of conducting classification (Tuan, 2010), and the factors hindering the performance of basic education in Lesotho (Nthunya et al. 2017). In this study, three major steps of IM methodology were adopted to investigate the delay factors. The three steps are briefly described below.

The idea writing technique and the nominal group technique are both discussed under this section as one technique. The idea writing is seen as an extension of nominal group technique. Warfield and Cardenas (2002) describe nominal group technique as a process of generating ideas, clarifying ideas, doing a preliminary partitioning of the set of generated and classified ideas, based on the criterion of relative saliency, and helping to build a spirit of participation and teamwork or group morale. On the other hand, idea writing is described as an efficient idea generation process for eliciting the ideas relevant to a stated issue from one or more small groups (Warfield and Cardenas 2002).

The idea writing and nominal group technique processes are initiated by carefully formulating a triggering question (Warfield and Cardenas 2002). The triggering question used for identifying modification project delay factors is ‘which factors influence plant system modification projects and lead to the delay of project delivery’? The triggering question motivates the participants of IM workshop to generate their ideas regarding the issue in question. The facilitator of IM process collates the generated ideas and present them to the group. Following the idea writing, the group clarified the generated ideas and selected the ideas that each participant deemed essential.

The next step is idea structuring. This step involves answering a series of questions about determining whether the relationship of interest exists between a pair of posed elements. The participants collectively decided whether the relationship exists between the posed two elements. A contextual question is needed for the group to determine whether the relationship exists. The contextual question used for this study is ‘does delay factor A significantly aggravate delay factor B’. The computer software ‘Concept Star’ was used for structuring the project delay model. When the group answer a series of posed questions, a binary matrix is gradually filled in. Upon the group complete all of the questions, a digraph can be extracted from the binary matrix. Warfield (1976) explains the algorithm of extracting the digraph. However, the algorithm of extracting the digraph is not in the scope of this paper.

The third step is the interpretation of the produced model. The model reveals how the systems elements are interlaced. In this study, the model can show the sources of delay factors. The established model is amenable to change. If the group feel that they need to revisit certain decisions, they may discuss the decisions made before and make changes if necessary. After all, IM is not aimed at establishing universal laws. Its inquiry process is aimed at enhancing learning and consensus.

RESEARCH FINDINGS AND DISCUSSIONS

The South African power station management team, comprising senior members from various departments, had vested interest in the delay of modification projects. The department managers from the Outage Management Department, the Project Management Department, and the Plant Engineering Department were also considered to participate in the study of identifying factors causing modification project delays in this South African power station.

Warfield and Cardenas (2002) consider the following participants to be adequate for achieving a successful IM workshop:

- between 6 and 12 participants;
- experienced group leader;
- a computer operator; and
- possibly other staff available to document key comments by the participants.

The required number of participants corresponds to the number of representatives setup for a committee, organized to review certain issue(s), evaluate available options, and make collective decisions based on the majority rule. A questionnaire was prepared and sent to the participants as the starting point of this study. The number of participants involved in generating ideas was deliberately increased above the recommended maximum number of 12 participants recommended by Warfield and Cardenas (2002) to 18 participants. The objective of the extension of the number of participants was to assess whether a perception of a multitude of common factors causing modification project delays existed among a bigger population. The idea was not to have all eighteen participants present for the IM workshop, but rather to expand the spectrum and get more ideas with regard to factors causing modification project delays in the South African Power Station.

A total of 92 factors were identified by the participants through the idea generating technique. Through consultation with the participants, the list of 92 modification delay factors was reduced by merging, splitting and deleting certain factors. Furthermore the voting by participants reduced the number to total of 21 project delay factors which were the significant factors causing modification project delays in the South African Power Station, shown in Table 1.

Table 1. Significant project delay factors

Project Delay Factors		Description	No. of Votes
1	Poor leadership	Leadership has high demands, lack of control, and lack of support to predict strain outcomes. More and more experienced staff are leaving South African power station or changing departments. This is leading to a skills drain in those particular areas, leaving inexperienced staff to do the work.	2
2	Top management decision	Senior management decisions for strategic planning impact on the current projects in terms of allocating funds, resources and leads to park the modification projects for a period of time.	1
3	Poor co-ordination	At times the plan is perfect and all spares available, but lack of competent project team to drive the plan results in delays. Project team sometime exaggerated the urgency of their project work, which means functional line groups personnel leave their day to day plant work to attend to project work. Afterwards the functional line group realises that the urgency was misrepresented. This causes mistrust, and when there really is an issue, functional line groups are not willing assist with urgency.	2
4	Delayed delivery of materials/spares	Suppliers sometimes indicate shorter delivery times when bidding but once the manufacturing process starts there gets to be lots of changes in the lead times. Not ordering the spares in time, or the supplier not supplying the spare on time due to long lead time are some of the causes for delayed delivery of spares.	2

Table 1. Significant project delay factors

Project Delay Factors		Description	No. of Votes
5	Insufficient risk management in terms of risk analysis, response and control	Inadequate risk identification in terms of their probability, severity, and impact. In the event of the risk occurring, response to the risk are not planned for, and as such there are no action plan, no responsible party is identified, etc. – this results in scrambling and running around at the last minute when time is off the essence and reactive decisions being made and actions taken and this impact time.	3
6	Lessons not learnt	Outage projects and modification projects take place regularly. There are so many lessons we can take out during the reviews. These lessons came from many sources and are tracked until the administration bit is completed, in other words, the actions are closed out for the sake of providing evidence for auditory purposes of proper management. However, there are so many actions and too little learning because over the years the same mistakes are repeated and we start the learning cycle all over again.	1
7	Poor scope management/definition	Addition of work that is not properly understood and agreed to by the project sponsor and key stakeholders extend the execution period of the project. Inadequate approach used to perform feasibility studies. Walkdowns not being performed to verify plant configurations versus drawings.	1
8	Scope creep	Unforeseen problems during the feasibility study or implementation causes scope creep and further leading to the time delays.	1
9	Bureaucratic commercial and investment processes	The process of getting funds to implement the project and the process of sourcing services from the suppliers are normally very long due to the bureaucratic nature of the environment which is intended or based on good governance. These two processes combined normally take up to almost a year when all relevant committees are available with no moratoriums on committees. Investment committee approvals normally delay the modification projects. This is due to investment documents that are below par; at times the committee meetings are cancelled or postponed.	3
10	Inaccuracy of execution duration on the plan	After the modification project is handed to the Project Management (PM) construction team for implementation, the full interface requirements, i.e. various plant states or configuration, is not known at the time. This results insufficient details for planning, namely durations, and allocation of resources from lines. Project managers can be put in a situation where they are given a window by the Outage Department which does not align with schedule required to complete the work and be requested to find ways	1

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Project Delay Factors		Description	No. of Votes
		of reducing it without much consideration of: contractor's experience, plant availability and requirements, weather conditions, the environment.	
11	Cross-functional structure is not effective	Power Station Operating Unit makes use of cross-functional structure for modification projects. The project team does not report directly to the project manager. At times, there is conflict as the project team (design engineers, system engineering, maintenance personnel, etc.) have to prioritise their group, department functions.	2
12	PM does not fully understand how modification project fits into the outage project	To fit modification projects into the outage schedule typically requires plant configurations to be out of normal. This has other ramifications, mainly other additional work is needed from line function department to be in a position, i.e. make the plant ready to allow the modification project to proceed and progress. Sometimes project managers have limited knowledge of the plant and adequate resource arrangements and planning do not take place. To execute a plan, one has to be knowledgeable about the intricacies of developing a plan and strategies that can be employed to execute the plan.	3
13	Lengthy project management process with multiple departments involved	The protracted project management process lengthens the project life span and delays implementation. Too many independent departments are involved in the project (System Engineering, Design Engineering, Project Management, etc.) and often implementation has to be carried out by a contractor.	1
14	Delayed regulatory approvals	The period from submittal of designs to approval normally takes about 6 months. There are often substantial delays due to the competing priorities, resource constraints from the regulator, and sometimes longer review periods for the designs depending on the complexity of a particular project.	1
15	Resource constraints	Project leaders leaving the organisation result in a lack of seamless continuity when executing projects. Inexperienced new personnel are expected to manage modification projects without proper training. Design and subject matter expect manpower is scarce. This has led to delays in completing designs, which affect implementation dates.	2
16	Lack of discipline in executing the plan	An outage execution plan is drawn up and reviewed prior to an outage project execution phase as an outage preparation milestone and modification projects are part of this plan. More often the plan changes and there is a backlog of work which has to be managed. This results in work being done on	2

Table 1. Significant project delay factors

Project Delay Factors		Description	No. of Votes
		a first-come-first-served basis or from an indication from the outage organisation on important or critical work. A key issue in this regard is the review of maintenance windows which only considers the issues that result in maintenance windows being late rather than a breakdown of a series of delays which caused the maintenance windows to be late.	
17	Poor communication	Lack of or poor communication amongst team members, groups, and departments leads to project delays. Modification projects are always viewed in silos and information flow is restricted.	2
18	Project cost underestimation	Project costing estimates are sometimes inaccurate, causing discrepancies in projected versus actual costs. This is often attributed to lack of accurate information during the initial phase of the project which is caused by the fact that, at that stage, the solution is not yet known. Variances between the postulated and actual designs also contribute to this. Costing inaccuracies can lead to delays in placing contracts as the funds allocated may not be sufficient.	2
19	Outage project strategy, goals	Due to the outage project strategy or philosophy (short outages for refuelling and long outages for plant modifications), modification projects which are due for implementation may be postponed if their duration will challenge the outage project duration.	1
20	Poor planning	Inadequate project definition and planning and lack of attention to detail results in time delays.	4
21	Proficiency of a project manager	The proficiency and competency levels of the PM play a larger role in the success or failure of the project. Sometimes maintenance personnel are not trained to take over the project, SAP / BOMs are not updated and spares not ordered for maintenance, stakeholders are not involved during planning and construction as a result they do not accept the modifications during commissioning.	5

These factors were used for the model structuring phase to assess the interrelationships among the 21 identified significant delay factors. Six participants were involved in the model structuring phase. The decisions made by the participants regarding whether the aggravating relationship exists between a pair of posed elements are shown as Figure 1.

Votes:

1) 1---> 2 Yes
2) 2---> 1 No
3) 1---> 3 Yes
4) 3---> 1 No
5) 2---> 3 No
6) 3---> 2 No
7) 1---> 4 Yes
8) 4---> 1 No
9) 2---> 4 Yes
10) 4---> 2 No
11) 3---> 4 Yes
12) 1---> 5 Yes
13) 5---> 1 Yes
14) 1---> 6 Yes
15) 6---> 1 Yes
16) 1---> 7 Yes
17) 7---> 1 Yes
18) 1---> 8 Yes
19) 8---> 1 Yes
20) 1---> 9 Yes
21) 9---> 1 Yes
22) 1--->10 Yes
23) 10---> 1 Yes
24) 1--->11 Yes
25) 11---> 1 Yes
26) 1--->12 Yes
27) 12---> 1 No
28) 2--->12 No
29) 12---> 2 No
30) 3--->12 Yes
31) 12---> 3 Yes
32) 1--->13 Yes
33) 13---> 1 Yes
34) 1--->14 Yes
35) 14---> 1 Yes
36) 1--->15 Yes
37) 15---> 1 Yes
38) 1--->16 Yes
39) 16---> 1 Yes
40) 1--->17 Yes
41) 17---> 1 Yes
42) 1--->18 Yes
43) 18---> 1 Yes
44) 1--->19 Yes
45) 19---> 1 No
46) 2--->19 Yes
47) 19---> 2 No
48) 3--->19 Yes
49) 4--->19 Yes
50) 19---> 4 Yes
51) 1--->20 Yes
52) 20---> 1 Yes
53) 1--->21 No
54) 21---> 1 Yes

Figure 1. Voting results

In Figure 1, the arrow linking two elements means the posed contextual question about whether the relationship exists between the two elements. For example, ‘1→2 Yes’ means that the group debated the question ‘does element 1 (poor leadership) significantly aggravates element 2 (top management decision) and the group decided ‘Yes’. Upon all of the computer posed questions completed by the group, a digraph is extracted from the binary matrix, shown as Figure 2.

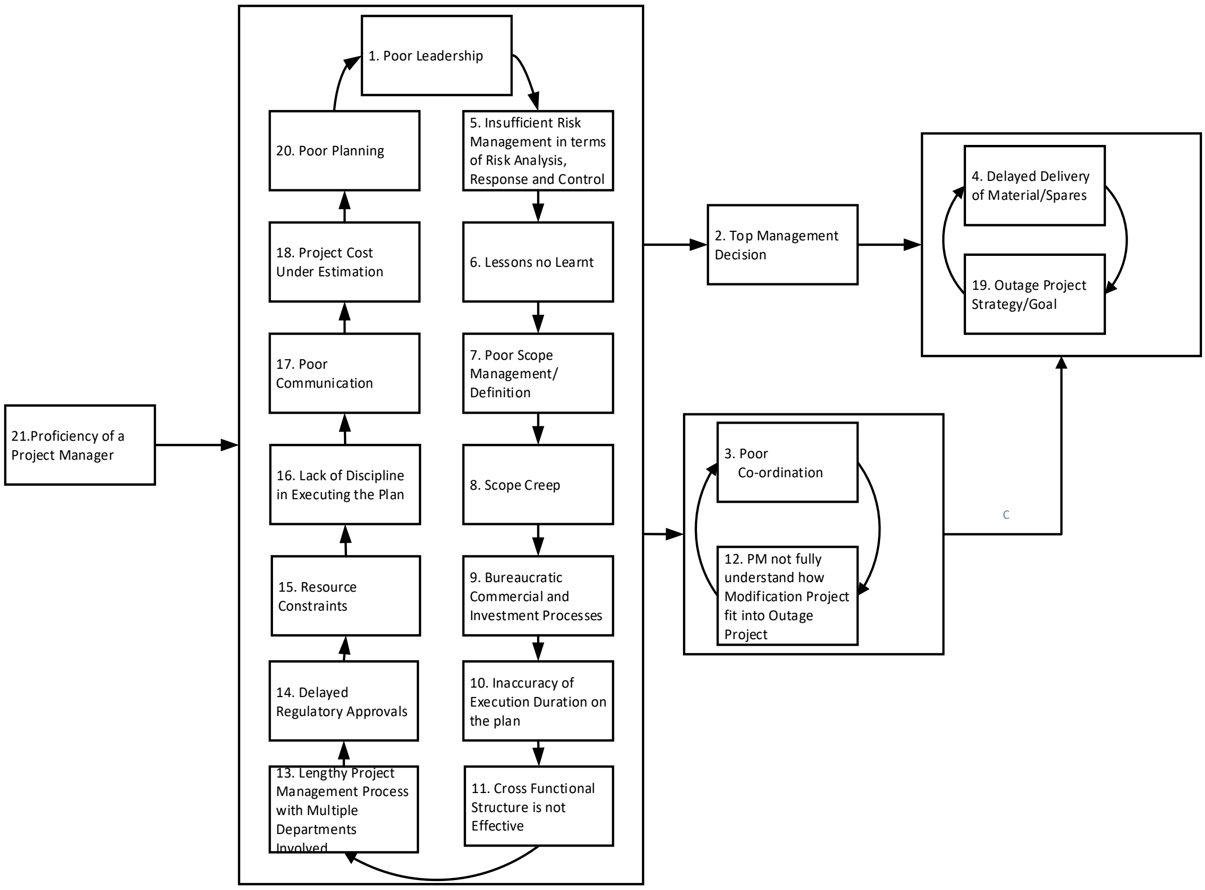

Figure 2. The aggravating relationship between the delay factors

Figure 2 reveals that “proficiency of a project manager” is the main determinant leading to the modification project delay. The delay factor “proficiency of a project manager” appears to be the driver of all other 20 project delay factors identified through the nominal group technique. It appears that the ‘proficiency of a project manager’ significantly aggravates the big loop lying in the second stage, comprised of fifteen elements. The two elements lying in the rightmost stage have no power to influence others. They are actually aggravated by the leftmost stage driver, i.e. the proficiency of a project manager. To eradicate the project delay in the South African power station, the power station needs to address how to equip the project manager with the skills needed for managing projects.

It is noteworthy, despite that the ranking in Table 1 also shows that element 21 (proficiency of a project manager) is the major problem, the elements in the big loop in Figure 1 don’t receive the same votes. However, their power of influencing the right stage elements is equivalent from a systemic point of view. When the group adopts the systemic approach, they see the problem in a different way.

CONCLUSION

The proficiency of a project manager has been identified as the major determinant resulting in modification project delays in the South African power station. It is recommended that the South African power station to focus its effort to address the first level drivers (i.e. "proficiency of a project manager"). It is believed that if this driver is addressed, modification project delays in the South African power station will be significantly mitigated.

However, the IM inquiry is not aimed at establishing universal laws. In other South African power stations, the driver causing delays might be different. In other countries, the participants of IM workshop might produce a very different model about their project delays. Even if the South African group runs the IM workshop again, they might generate a different conclusion. Human perceptions might change over time. The learning from the first workshop paves the path for the iterative learning. The purpose of learning is to enhance consensus among the relevant stakeholders to take actions to deal with an undesirable situation.

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