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FACTORS CAUSING INEFFICIENT INFRASTRUCTURE PROCUREMENT AND DELIVERY MANAGEMENT IN SOUTH AFRICA

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Infrastructure projects should be procured efficiently to achieve the intended outcomes and value for money. However, the research literature indicates that many infrastructure projects end up with a wide gap between the intended and actual outcomes. This problem may partly be due to inefficiency in the infrastructure procurement process and this puts value for money for a project at risk. Research is needed to develop a better understanding of the factors that contribute to inefficiency in infrastructure procurement. This study analyses factors responsible for inefficient infrastructure procurement and delivery management in South Africa using a focus group discussion method. Data was generated from 14 groups created from 81 professionals. Performance audit[2] reports on two infrastructure projects were given to the groups to analyse why the problems identified in the performance audit reports arose in the first place. The factors identified by the groups were analysed and categorised. The significant ones were funding challenges, poor governance and leadership role of the client, lack of client skills and technical capacity, and poor contract management. The findings have implications for clients, academic departments and professional bodies. The findings can inform the development of appropriate interventions to enhance capacity and resolve problem areas. The value of this paper lies in providing technical insights into the causes of inefficient infrastructure procurement and delivery management beyond the four broad factors identified in the Auditor-General's performance audit report.

Keywords: focus group discussion, infrastructure procurement, performance audit, procurement inefficiency

INTRODUCTION

Infrastructure projects must be delivered efficiently to achieve the intended outcomes and value for money (Laryea and Watermeyer, 2014). However, several studies in the research literature (cited in the literature review section) indicate that many infrastructure projects end up with a wide gap between the intended and

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[2] A performance audit is an independent audit process to evaluate the measures taken by the management of a state entity to ensure that resources were procured economically and used efficiently and effectively.

actual outcomes for several reasons that are sometimes not systematically investigated, documented and understood.

This paper argues that systematic identification and analysis of factors responsible for inefficiency in the procurement and delivery management of infrastructure projects can help to identify problem areas and design ways to enhance performance and outcomes. However, completed projects are not always audited to identify success or failure factors. In some cases, the reason may be due to a lack of access to the relevant data. Here, in this research, a performance audit of two infrastructure projects conducted by the Auditor General of South Africa in 2016 provided a useful opportunity to closely analyse those infrastructure projects and establish a detailed understanding of reasons why there was a failure to achieve the intended outcomes and value for money in the implementation of those projects. As indicated in the literature review, several construction projects in the South African content experience poor outcomes and the findings of this study provides useful insight for more efficient infrastructure planning and execution.

81 construction professionals attending a short course on Infrastructure Procurement and Delivery Management (IPDM) in Johannesburg and Cape Town in 2018 were divided into 14 groups to examine performance audit reports on two infrastructure projects and analyse why the problems encountered in smooth delivery of the two projects arose in the first place. The factors identified by the 81 professionals was the main data analysed in this study to generate some explanations on the factors causing inefficient infrastructure procurement and delivery management in South Africa. Therefore, the aim of this study was to examine factors responsible for inefficiency in infrastructure procurement and delivery management.

LITERATURE REVIEW

The purpose here was to conduct a review of salient literature on key issues constraining efficient and effective procurement and implementation of infrastructure projects particularly in the South African context.

Construction procurement strategy

One key point explained in a research by Laryea and Watermeyer (2014) on innovative construction procurement and contract strategies used in the Wits University capital projects programme was that one of the root causes of projects ending up with a wide deviation between expected and actual outcomes was due to a lack of procurement strategy. The purpose of a construction procurement strategy is to identify the best way to achieve the intended objectives of a project and value for money (OGC, 2007). It was argued by the authors that if this strategic exercise is competently executed by those responsible, the deviation between expected and achieved outcomes should be as small as possible. However, construction clients often experience the problem of delivery outcomes that significantly exceed the planned budget and time specifications.

A key reason for poor infrastructure project outcomes in South Africa may also be due to the traditional approach used for delivering projects. According to Fitzgerald and Hodgson (2010) the established construction procurement methodology is based on a traditional model that separates the design and

construction process, making the design consultants responsible for the design, specifications and bills of quantities, which are then used to invite tenders from prospective contractors. Tenders are then awarded, often to the lowest bidder, setting the scene for adversity, claims, budget overruns and poor performance.

Cost and time overruns in infrastructure projects

Therefore, a considerable attempt was made to identify research studies in the construction management literature and systematic reports that provide explanations on the root causes of inefficient and ineffective delivery of infrastructure projects. The paper by Laryea (2019) on procurement strategy and outcomes of a new universities project in South Africa reviewed some research studies on causes of significant deviations from expected project outcomes in infrastructure projects in, for example, Australia, China, Ghana, Iran, Jordan, Kuwait, Malaysia, Nigeria, South Africa, South Korea and the USA. Several theories have been put forward by academic researchers to explain reasons for the perennial wide deviations clients experience between expected and actual outcomes in infrastructure projects. The majority of such theories are found in mostly survey-based studies on causes of project cost and time overruns by authors such as Frimpong et al. (2003), Koushki et al. (2005), Lee (2008), Ameh et al. (2010), Bhargava et al. (2010), Nkado (2010), Memon et al. (2010), Pourrostam and Ismail (2011), Memon et al. (2011), Love et al. (2012), Thomas (2013), Sweis et al. (2013), Doloi (2013), Shrestha et al. (2013), Ismail et al. (2014), Shehu et al. (2014), Rajan et al. (2014), Cheng (2014) and Fombad (2015). These include poor cost estimation, lack of information in the early stages, design changes and scope creep, technical difficulties, optimism bias, managerial incompetence, strategic misrepresentation, inability to accurately identify and quantify risks, lesser reliance on data mining, heavy reliance on contractors' performance.

However, it was observed by Laryea (2019) that a majority of these survey-based studies in the construction management literature focus superficially on causes of cost and time overruns in infrastructure projects rather than root causes. A similar observation was made by Flyvbjerg et al., 2018 in a discussion paper which touched upon the root causes of cost overruns in projects and posited that psychological and political bias are the underlying reasons for cost overruns in projects. However, Love and Ahiaga-Dagbui (2018) counter argued that cost overruns are largely a result of errors caused by scope changes and complexity. Laryea (2019) noted that dealing with causes or symptoms will not necessarily address the root cause(s) of cost overruns. However, assuming that the human bias variable suggested by Flyvbjerg et al. (2018) was properly addressed in a project, an appropriate construction procurement strategy would still be required to set the basis to achieve intended project outcomes. A private sector infrastructure project may not be fraught with the problem of psychological and political bias but still experience deviations from expected outcomes due to a lack of (or inadequate) appropriate procurement strategy.

Performance audit of infrastructure projects

A key source of data pertaining to this question was the office of the Auditor General of South Africa. Since 1993, the Auditor General of South Africa conducts and publishes performance audits of services and projects delivered in the public sector. According to the Auditor-General South Africa's website

(https://www.agsa.co.za/Auditinformation/Performanceauditing.aspx), "performance auditing is an independent auditing process to evaluate the measures instituted by management to ensure that allocated resources are procured economically and utilised efficiently and effectively".

Two infrastructure projects that had a performance audit conducted on them in 2016 were the Urban Renewal Programme at the Gauteng Department of Human Settlements; and provision of water infrastructure at the Department of Water and Sanitation. The water infrastructure audit report reflects on the success of implementation and subsequent performance of the water infrastructure programme that was implemented on behalf of the national Department of Water and Sanitation. This audit was conducted at 7 district municipalities that were supported by the department, covering 6 provinces. The audit of urban renewal programme was limited to 4 projects in Gauteng and was initiated at the request of the provincial Departments of Human Settlements and Cooperative Governance and Traditional Affairs and focused on the extent and quality of delivery of renewal projects compared to the original intentions of this programme. The four key challenges which hampered efficient and effective delivery of services applied to all of them. In all three cases, the AG highlighted the following themes which hampered efficient and effective delivery of services and projects: Leadership and oversight; Funding; Project management and operations; and Intergovernmental coordination.

The studies reviewed in this section including Laryea and Watermeyer (2014); Fitzgerald and Hodgson (2014) and the performance audit reports provided a framework to understand some of the root causes of significant deviations between expected and actual outcomes in projects.

RESEARCH METHOD

The methodology used to conduct the study and used to identify factors responsible for inefficiency in infrastructure procurement and delivery management was a focus group discussion which is a qualitative research technique (summarised in Figure 1). A focus group discussion (FGD) provides a useful way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest (Saunders et al., 2016. A FGD is a structured discussion used to obtain in-depth information from a group of people about a particular topic. The purpose of a focus group is to collect information about people's opinions, beliefs, attitudes, and perceptions, not to come to consensus or make a decision per se (Saunders et al., 2016).

Two separate infrastructure procurement and delivery management (IPDM) courses were delivered by the School of Construction Economics and Management at Wits University in 2017. The first one, held in Johannesburg on 25 August to 1 September 2017, was attended by 61 delegates from various provinces in South Africa. The second one, held in Cape Town on 2-6 October 2017, was attended by 20 officials of the Western Cape Department of Transport and Public Works. Altogether there were 81 participants (see Table 1).

The participants were given two assignments to complete as part of the requirements for achieving a certificate of competence from the university. Therefore, it is assumed that the participants took these assignments seriously for the purpose of achieving their certificates. Assignment one was focus on developing a construction procurement strategy and assignment two was focused on analysing three different performance audit reports produced by the Auditor General of South Africa in 2016 on some infrastructure projects delivered by various government departments. The three performance audit reports deal with the management of pharmaceuticals, water infrastructure and urban renewal projects by the government departments responsible for the projects.

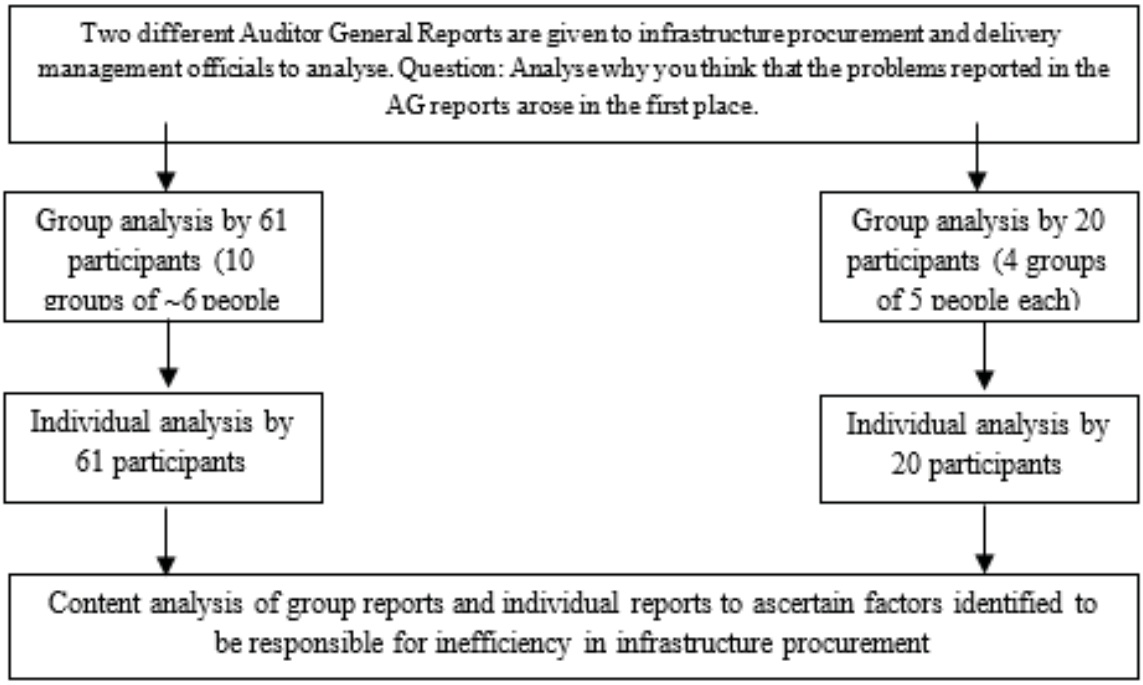

Fig. 1 Summary of the methodology used to identify factors responsible for inefficient infrastructure procurement

The audit on pharmaceuticals was undertaken to determine whether medicines and medical supplies were managed in a manner to ensure that patients receive their prescribed medicines on the day of their visits to healthcare facilities. In the process, 109 health institutions and 10 medical depots were visited over two years.

The water infrastructure audit report reflected on the success of implementation and subsequent performance of the water infrastructure programme that was implemented on behalf of the national Department of Water and Sanitation. This audit was conducted at 7 district municipalities that were supported by the department, covering 6 provinces.

The audit on an urban renewal programme was limited to 4 projects in Gauteng and was initiated at the request of the provincial Departments of Human Settlements and Cooperative Governance and Traditional Affairs and focused on the extent and quality of delivery of renewal projects compared to the original intentions of this programme.

In terms of the data collection for this study, the IPDM course participants were divided into random groups, and each group was tasked to analyse why they think that the problems reported in the 2016 AG performance audit reports arose in the first place. The specific wording of the assignment to the groups was as follows:

> "Performance auditing is an independent auditing process to evaluate the measures instituted by management to ensure that allocated resources are procured economically and utilised efficiently and effectively and, if necessary to report thereon. Performance auditing encourages learning and change within the public sector by providing new information and drawing attention to various challenges. It contributes to improvement and reform in public administration, providing the government with recommendations based on independent analysis.
>
> Performance auditing plays an important role in keeping the legislature well informed about governmental actions and the outcome of its own decisions. It increases public transparency and accountability, providing objective and reliable information on how public service perform.
>
> A number of media releases and performance reports have been published including the following:
>
> - Media release dated 30 November 2016: Auditor-General tables three performance audit reports dealing with the pharmaceuticals, water infrastructure and urban renewal projects
> - https://www.agsa.co.za/Portals/0/Media%20release/2016%20Media%20release/2016%20MEDIA%20RELEASE%20(3%20PA%20REPORTS)%2030%20Nov16.pdf
> - Media release dated 1 June 2016: Auditor-general reports an overall, encouraging five-year improvement in local government audit results
> - https://www.agsa.co.za/Portals/0/MFMA%202014-15/Section%201-9%20MFMA%202014-2015/FINAL%20MEDIA%20RELEASE%20(MFMA%202016)%20FN.pdf
> - Performance audit on water infrastructure at the Department of Water and Sanitation dated November 2016
> - https://www.agsa.co.za/Portals/0/AGSAReports/Water%20Infrastructure%20and%20Public%20Report.pdf
> - Performance audit of the effectiveness of the Urban Renewal Programme of the Gauteng Department of Human Settlements dated November 2016
> - https://www.agsa.co.za/Portals/0/AGSAReports/AGSA%20Performance%20Audit%20Gauteng%20department%20of%20Human%20Settlements%20-%20Part%201.pdf

You are required to produce a written report on your analysis of the performance audits. Analyse why you think that the problems reported in the AG report arose in the first place."

The same assignment was given to all groups. There were ten groups for the course in Johannesburg and four groups for the course in Cape Town so altogether 14 groups produced reports addressing the assignment question. Each group was allocated one hour to analyse the root causes of the problems but almost all groups spent about two hours working together on the assignment and then they gave group reports and presentations on the factors collectively identified during the course. After the course, each individual course participant was given four weeks to do a detailed analysis of the performance audit reports and submit an individual report. The overall research methodology and data collection approach is summarized in Figure 1.

Given the focus here on infrastructure procurement and delivery management, it was decided to focus the data collection and analysis on the two infrastructure implementation related cases i.e. water infrastructure and urban renewal projects. These two projects are the ones available on the A-Gs' website and they provided detailed information for the focus group analysis.

DATA COLLECTION AND PRESENTATION

The data for the study comprised of the outputs generated by the 14 technical groups of infrastructure procurement and delivery management officials from eight Provinces (see Table 1) who analysed the performance audit reports and identified the key reasons for inefficient project delivery.

Table 1: Participants and their Provinces

Province	Number of participants
Eastern Cape	24
Free State	3
Gauteng	4
KwaZulu-Natal	2
Limpopo	7
Mpumalanga	3
Northern Cape	0
North West	7
Western Cape	20
Total	81

Notes
No. of attendees (IPDM course in Sept 2017): 61(59 public sector; 2 private sector)
No. of attendees (IPDM course in Oct 2017): 20 (20 public sector)

Profile of participants

The 81 respondents from 31 different organisations were predominantly public sector officials but two participants were from private sector. The participants' organisations comprise of municipalities, national and provincial departments (education, treasury, health, public works, human settlements, economic development, etc.) and parastatal organisations. The job title and roles of the participants included chief director, director, deputy director, supply chain management official, project manager, control works inspector, programme

manager, chief architect, chief engineer, and chief quantity surveyor. The participants are considerably experienced infrastructure officials with average work experience of ~15 years.

The 81 participants were divided into random groups for the purpose of undertaking their assignments. Each group spent a minimum of 2 hours reading and analysing the cases with their technical knowledge. It is assumed they approached the group analysis with importance and a good technical understanding of project implementation requirements.

RESULTS

The factors identified by the 14 technical groups were systematically analysed and categorised to enable a meaningful interpretation of their frequency and magnitude. See Table 2. The following categories were developed through a qualitative process of the researcher going through the data and interpreting it qualitatively.

Categorisation and coding of data provided by participants

Each of the 14 groups submitted a written account of their group conversations and the factors they identified to be responsible for the procurement inefficiencies identified by the A-G. The factors identified by each group were categorised qualitatively, coded and presented in Table 2. The following categories or codes were developed by the researcher. The categories were developed through a colour coding process as the researcher read through the factors identified and interpreted the meaning of each one to assign a category or code for the qualitative analysis.

1. Poor project scope definition and management [code: -1-]
2. Funding and financial management problems including payment [code:-2-]
3. Poor governance and leadership role of the client [code: -3-]
4. Poor contract management [code: -4-]
5. Poor planning [code: -5-]
6. Poor Communication [code: -6-]
7. Ineffective stakeholder and community engagement [code: -7-]
8. Lack of skills and technical capacity in the client organisation [code: -8-]
9. Non-compliance with supply chain management (SCM) regulations [code: -9-]
10. Poor information management system (Poor recordkeeping and filing practices [code: -10-]
11. Poor project implementation practices leading to poor performance [code: -11-]

Table 2: Analysis of causes of construction procurement inefficiency in the Water Infrastructure Project

	Codes used to analyse the list of factors presented by the groups										
Technical Groups	-01-	-02-	-03-	-04-	-05-	-06-	-07-	-08-	-09-	-10-	-11-
Group 1		x		x	x	x			x	x	
Group 2		x	xx	x	x	x	x	x		x	
Group 3		xxx	x	x	xx	x		x	x	xx	x
Group 4	x	xx	x	xxx	xx	x		xx		x	x
Group 5	xxxx	xxx	xxxx	xxx	x	x	xxx	xxx		x	x
Group 6	x	xx		xxxxx	xx		xxx	x			x
Group 7	x	x			xx			x			xxxx
Group 8		xx	x	xx	xx		xx	x			xx
Group 9	x		xxxxxx	x			x	x			x
Group 10		x	xxx		x			x	x		
Group 11	x	xx	x	x							
Group 12		xxxx	xx	xxxx				xxx			x
Group 13	xx	xxxxx	x		x	x		x	x	x	xx
Group 14	x	xx	xxxx	xxx	xxxx	x	x	x		x	x
No of Groups	8	13	11	11	11	7	6	13	4	7	10
Frequency of factors	12	29	26	25	19	7	11	17	4	8	15

Table 2 Notes

Legend for number codes

[-01-] Poor project scope definition and management
[-02-] Funding and financial management problems including payment
[-03-] Poor governance and leadership role of the client
[-04-] Poor contract management
[-05-] Poor planning
[-06-] Poor Communication
[-07-] Ineffective stakeholder and community engagement
[-08-] Lack of skills and technical capacity in the client organisation
[-09-] Non-compliance with supply chain management (SCM) regulations
[-10-] Poor recordkeeping, filing practices, and information management systems
[-11-] Poor project implementation practices leading to poor performance

Eleven categories or codes were generated for all of the factors identified by the 14 groups. These were used to analyse the list of factors presented by the groups. The analysis of 173 factors causing inefficiency in infrastructure procurement and delivery management which were generated by the groups in relation to the Water Infrastructure Project performance audit report is presented in Table 2. The analysis of 47 factors causing inefficiency in infrastructure procurement and delivery management which were generated by the groups in relation to the Urban Renewal Project is presented in Table 3.

Table 3: Analysis of causes of construction procurement inefficiency in the Urban Renewal Programme

	Codes used to analyse the list of factors presented by the groups										
Technical Groups	-01-	-02-	-03-	-04-	-05-	-06-	-07-	-08-	-09-	-10-	-11-
Group 1	x	x	x			x	x	x	x	x	
Group 2		x	xx	X			x	x		x	
Group 3		xxx	x	X	xx	x		x	x	xx	x
Group 4											
Group 5	xxx	xxx	xxxx	xxx	x		xx	xx			x
Group 6											
Group 7											
Group 8											
Group 9											
Group 10											
Group 11											
Group 12			x								
Group 13											
Group 14											
No of groups	2	4	5	3	2	2	3	4	2	3	2
Frequency o factors identified	4	8	8	5	3	2	4	5	2	4	2

Table 3 Notes
The same 11 categories were used for the data analysis in both projects
Most technical groups identified similar factors to be responsible for the project implementation challenges experienced in the urban renewal programme to be similar to the ones experienced in the water infrastructure project and hence chose not to present repetition of the factors. However, five groups provided a separate analysis for both projects

Some of the key issues identified by the groups in relation to each of the eleven categories codes presented in Tables 2 and 3 are summarized as follows. This presentation is in no order of significance and a ranking of the factors is presented in the discussion section.

Poor project scope definition

A key reason both projects experienced difficulty in implementation was because of poor scope definition by the client's team. A summary of issues identified by the technical groups were as follows:

1) Unclear, needs analysis, deliverables and delivery strategies
2) Use of unconventional methods, disruptive acceleration of projects and inappropriate technologies
3) Mismatched between Growth and infrastructure delivery/ management
4) Poor definition of project scope and objectives, and identification of stakeholder requirements

5) Misalignment of project control budgets and project life cycle costs (which did not ensure that expenditure was within the allocations
6) Lack of rigorous cost control discipline to contain costs within the budget)
7) Changes made by the client (Scope not properly define)
8) Project scope not well defined
9) Lack of alignment between Scope and budget
10) Lack of business development plan and no strategic brief outlining implementation scope
11) Poor project scope definition
12) Absence of condition assessments (forms part of scope definition for future projects)
13) Inappropriate technologies (caused failures)

Funding and financial management problems

The technical groups identified Funding and financial problems as a major factor affecting the efficient implementation of the construction projects. Across the two projects, this factor ranked significantly high. Specific issues mentioned were as follows:

1) Poor budgeting (Spending within the budget (understanding set-offs) / prioritisation, Costing the needs of the community rather than the historic information)
2) Budget misalignment/inefficiencies
3) Delays in payments (Non-compliance to 30day)
4) Inapt funding /budgeting approach (leading to overspending of budget)
5) Lack of funding at the municipal level and unsustainable funding model
6) Failure to pay supplier within the regulated 30 days
7) Poor funding arrangements and agreements for water programmes
8) Disintegrated funding arrangements with project planning
9) Unclear funding arrangements (did not stipulate the amount that should be contributed by water service)
10) Unsustainable Funding model
11) Late payment of contractors
12) Lack of resource planning, inappropriate budget allocations/ funding and poor spending of capital budgets
13) Lack of adoption of Value for money principles
14) Budgeting (Lack of funding and budget planning and Mismanagement of funds)
15) Late payments to constructors (delays in the processing of payment certificates, led to liquidation of some contractors)
16) Acute shortage of funds (to address all the backlogs)
17) Inability to secure funding (Lack of effective value chain orientation)
18) Late payments to contractors (procurement of materials, payment of salaries and even led to the liquidation of the contractors)
19) Delays in securing co-funding agreements
20) Lack of payment governance (30-day payment policy not adhered to)
21) Delayed payments (no buy-in from all role-players leads to decreased urgency to ensure payments are concluded, no proper SOPs)
22) Irregular fund allocation and cross-funding of projects (no detailed five-year plan and lack of understanding of Treasury regulations and policies)

23) Funding agreements not integrated and incomplete
24) Late payment of contractors
25) Non alignment of funding sources
26) Lack of funding
27) Delay in payment of creditors
28) Funding and Budget issues (Funding not aligned to other project phases)
29) Late payment of emerging contractors
30) Lack of funding (due to inadequate planning and foresight leading to infrastructure failure)

Poor governance and leadership role of the client

Poor governance and leadership role of the client was identified by the technical groups as one of the leading causes of inefficiency in construction procurement. Some specific issues identified by the groups are summarised as follows:

1) Intergovernmental Structures not in place
2) Commitments that were not followed through
3) Roles of the key role players was not clear – no coordination
4) Ineffective Internal control systems
5) Poor monitoring (resulting in stock loss, infrastructure deterioration/increased maintenance costs & poor infrastructure projects quality)
6) No Skills audit was conducted for 15 years
7) Professional in professional (due to lack of mentorship and collaboration programmes)
8) No alignment between strategy and operational plans
9) Lack of integrated planning, communication and coordination of institutional dependencies
10) Lack of accountability (poor leadership & oversight)
11) Lack of leadership, (Lack of accountability from senior leadership, Poor contract management from the client)
12) Lack effective and efficient governance structures (Lack of controls and inadequate use of controls- SPO's)
13) Poor institutional practices (institutional value not upheld)
14) Non-adherence to Principles of governance (included delegations of authority transparency, procurement policies and procedure, with the inclusion of demand management)
15) Lack of strategic and effective leadership
16) Lack of accountability, transparency and due processes in the institutions
17) Non-alignment of Institutional values with project deliverables.
18) Lack of project governance (resulting in the decrease of project success rates)
19) Lack of leadership and oversight (leading to a lack of accountability in terms of the separation of duties)
20) Lack of supportive departmental structures
21) No governance of formal approvals (lack of communication, people working independently – silo mentality, no infrastructure management system, no monitoring policies in place)
22) Lack of clear roles and responsibilities in terms of leadership and proper communication

23) Lack of role-player engagement (lack of inadequate communication channels, no clear understanding of who the role-players are)
24) Lack of quality assurance (no monitoring and evaluation of processes or work, no policies or SOPs)
25) Lack of compliance with legislation
26) Lack of monitoring and adherence to policy
27) Poor monitoring of policies and procedures

Poor contract management

Another problem identified by the technical groups was in relation to inefficient management of projects in the contract phase. Specific issues mentioned were as follows:

1) No project Manager (no accountability)
2) No maintenance agreement in place
3) Constant changes to construction programme (resulted in delays)
4) Delays in contractual agreements
5) Accelerated implementation of projects (causing key process to be compromised)
6) Lack of formal agreement (regarding co-funding between Department and water service authorities)
7) Insufficient project risk management (Implementation was negatively impacted)
8) Lack of balance in the project priorities
9) Lack of formal agreements (between the WSAs and DWS to ensure coordination caused by Poor Management & Planning)
10) Inefficiencies in project management
11) "Adjustment to construction programmes (Inter-dependencies between individual contactors' contracts resulted in significant delays)
12) Finalisation of contractual agreements delayed
13) Prolonged construction programmes resulted in an overall increase in construction costs.
14) Prolonged construction programmes resulted in an overall increase in construction costs.
15) Containment of project costs (Prolonged construction programmes resulted in an overall increase in construction costs.
16) Undefined contractual obligations (lack of supply chain management process and quality of tender documentation, lack of management and monitoring of implementation)
17) Insufficient project timelines (not reviewed at Stage 1 nor during the project life-cycle)
18) Under-pricing by contractors (no proper tender evaluation of price carried out)
19) Delayed contractual agreements
20) Lack of operations and maintenance strategy
21) Lack of conditional assessments
22) Use of unconventional methods (caused high operating costs)
23) Lack of coordination, operation & maintenance agreements
24) Deterioration and lack of maintenance of infrastructure and delays in project delivery

25) Lack of effective contracts for coordination, operation and maintenance

Poor planning
The key factors relating to poor planning were as follows:

1) Poor planning and monitoring
2) Resources are not used economically
3) Delivery based on pressure rather than plans
4) Poor planning on projects
5) Ineffective HR Plan
6) Poor planning & project management, lack of community needs alignment and infrastructure delivery oversight
7) Unclear Strategies (not clear on how it will be implemented as the business plans were not credible
8) Poor planning (Lack of coordination between role players to ensure timeous service delivery & the ability to effectively fund the project)
9) (Lack of forward planning on O&M roles and responsibilities)
10) Poor project Planning (Insufficient time for the preparation - Ground Water quality tests was not performed before it was distributed to customers)
11) Lack of planning for the delivery of different infrastructure components
12) Lack of infrastructure plan to prioritize projects and align funds
13) Poor project planning (construction programmes)
14) Lack of integrated planning
15) Lack of integrated planning of IDP/budget/SDBIP/sectorial plans
16) Lack of detailed planning & execution
17) Lack of integrated planning of projects
18) Lack of succession planning and a resultant understaffing of the professional workforce

Poor communication
The key factors relating to poor communication practices were as follows:

1) Poor communication-Working in silos
2) Poor communication/integration amongst critical stakeholders (leading to poor budget management, delays in projects and non-compliance to regulations)
3) Lack or poor communication between role-players
4) Late applications
5) Lack of and poor communication internally and with stakeholders
6) Poor communication
7) Poor communication up and down the delivery chain

Poor stakeholder and community engagement
The key factors relating to poor stakeholder and community engagement practices were as follows:

1) Poor stakeholder engagement
2) Lack of stakeholder engagement
3) Lack of collaboration with communities, lack of integrated planning, proper communication and coordination

4) Lack of co-operation (from relevant sector departments including, Gauteng Human Settlements)
5) Most of the delays caused by the community.
6) Estimating the effect of cost increases
7) No proper stakeholder engagement
8) Break in Communication to community
9) Community unrest because there was no clear engagement with communities causing the construction delays
10) Poor cooperation (led to delays finalising water user licenses)

Inadequate skills and technical capacity of the client

The key factors relating to role and capacity of the client were as follows:

1) Challenges were experienced in the more detailed work
2) Inadequate technical and HR support, capacity and skills (no operations and maintenance people).
3) Outdated recruitment and selection policy
4) Lack of retention policy and succession plan
5) Lack of technical capacity (due to resignations and retirement of staff)
6) Lack of professional qualification (Project managers not registered with professional bodies, which indicated a critical skills gap)
7) Inadequate capacity to operate and maintain infrastructure (No Maintenance agreements in place, lack of appropriate skills development programs and Poor communication between directorates responsible for planning budgeting)
8) Lack of capacity and skill (resources to ensure the successful implementation of the projects)
9) Inability to perform accelerated programmes (caused by Lack of skills)
10) Lack of capacity to operate & maintain completed infrastructure
11) Inability to perform accelerated programmes
12) Lack of proper expertise to manage budget and capacity to manage it
13) Lack of capacity (due to lack of succession planning, lack of understanding of capacity needs, no skills development or transfer, private versus public, cannot compete with private salary) expectations
14) Technical challenges (stage 6: Production not implemented, no specification committee, no norms and standards)
15) Inadequate Human Resource Planning (recruitment & selection, retention & succession plan, shortages, lack of qualified staff)
16) Lack of technical personnel
17) Lack of staff/capacity/succession planning
18) Staffing/ Capacity (Ageing workforce and lack of succession planning in water engineering and scientists)

Non-compliance with SCM regulations

The key factors relating to non-compliance with supply chain management regulations which all organs of state must adhere to were as follows:

1) Lack of access of services/services disruptions
2) Non-compliance with environmental and other relevant regulations
3) Non-compliance with supply Chain Management prescripts

4) Non-compliance with SCM prescripts
5) Weaknesses in SCM function (caused contractor payment delays resulting in poor contractor performance and service delivery)

Poor recordkeeping, filing practices and information management system
The key factors relating to poor information management systems were as follows:

1) Lack of effective records management system
2) Poor document management.
3) No cost norms nor a database of similar past infrastructure
4) Lack of formal SDA's
5) No written SDA's (leading to no accountability or reaching of objectives)
6) Inadequate document management
7) Lack of documentation (affected maintenance implementation)
8) Lack of documentation (affected maintenance implementation)
9) Poor documentation of system condition assessments (resulting in delays in reaction to plant breakdowns and servicing thus rendering delivery ineffective and resulted in a lack of planned funding for operational and maintenance interventions

Poor project implementation practices
The key factors relating to poor project implementation practices were as follows:

1) The key factors relating to poor planning were as follows:
2) Poor delivery of water to communities
3) Projects either not achieved or not assessed by municipality, poor post-construction maintenance and lack of oversight regarding disposals
4) Poor contract and supplier performance management
5) Poor performing contractors
6) Performance (Time, Cost and Quality- the projects did not achieve the institutional value proposition)
7) Delays (due to adjustments in construction programme to address on-site-related queries and concerns)
8) Project failures in projects abound (Missed deadlines; Late payments; No or late contractual agreements; Accelerated delivery causes no; Weak contractors; Poor planning; Shortage of funds during construction; Community unrest; Poor scope definition; Land & Licensing issues not dealt with; Lack of integration with interdependent Infrastructure)
9) Project delays (Delayed payments to service providers)
10) Inadequate performance by the contractor (Community unrest)
11) Delays in implementing construction program (Appointed contractors lack technical capacity to execute works)
12) Unacceptable additional costs to the project
13) Terminating the services of the non-performing contractors (contracts were terminated because the contractors were unable to deliver the technical quality)
14) Poor contractor performance (lack of supervision by contractor and expertise, no allocation of sufficient resources, no monitoring by department)
15) Poor performance of contractors

16) Accelerated implementation -compromised projects
17) Poor quality of infrastructure
18) Poor facilities / asset management (which includes conditions assessment)
19) Lack of implementation of SOPs (standard operating practices)

DISCUSSION

The aim of this study was to identify and examine factors responsible for inefficiency in infrastructure procurement and delivery management. The data generated by 81 participants in the IPDM course who were given performance audit reports on two infrastructure projects and asked to identify reasons for the inefficiencies in delivery provided a basis to address the research aim.

Table 4: Ranking of factors causing infrastructure procurement and delivery management inefficiency in the Water Infrastrucre Project (WIP)

	RANKING BY NUMBER OF GROUPS AND NUMBER OF FACTORS IDENTIFIED										
Technical Groups	-01-	-02-	-03-	-04-	-05-	-06-	-07-	-08-	-09-	-10-	-11-
No of Groups	8	13	11	11	11	7	6	13	4	7	10
RANKING	7	1	3	3	3	8	10	1	11	8	6
Frequency of factors	12	29	26	25	19	7	11	17	4	8	15
RANKING	7	1	2	3	4	10	8	5	11	9	6
AVG	7	1	2.5	3	3.5	9	9	3	11	8.5	6

Note: Cross referenced to Tables 2 and 3

The reasons identified by the 14 groups are summarized in Tables 2 and 3. Details of the factors categories were presented in the previous section. A ranking of the key causes of construction procurement inefficiency in the two projects examined is presented in Table 4.

Table 5: Ranking of factors causing infrastructure procurement and delivery management inefficiency in the Urban Renewal Programme (URP)

	RANKING BY NUMBER OF GROUPS AND NUMBER OF FACTORS IDENTIFIED										
Technical Groups	-01-	-02-	-03-	-04-	-05-	-06-	-07-	-08-	-09-	-10-	-11-
No of groups	2	4	5	3	2	2	3	4	2	3	2
RANKING	7	2	1	4	7	7	4	2	7	4	7
Frequency of factors identified	4	8	8	5	3	2	4	5	2	4	2
RANKING	5	1	1	3	8	9	5	3	9	5	9
AVG	6	1.5	1	3.5	7.5	8	4.5	2.5	8	4.5	8

Note: Cross referenced to Tables 2 and 3

The ranking could be done in one of two ways. First, the ranking can be done by the number of groups who identified factors relating to each particular category.

Alternatively, the ranking can be done by the number of factors identified in relation to each particular category. Ranking based on either method was done and presented in Tables 4 and 5. The rankings based on either criterion are not far apart in terms of significance (see Tables 4, 5 and 6).

Table 6: Combined Ranking

Causes of inefficiency in IPDM	Ranking		
	WIP	URP	Combined
[-01-] Poor project scope definition and management	7	7	7
[-02-] Funding and financial management problems	1	2	1
[-03-] Poor governance and leadership role of the client	2	1	1
[-04-] Poor contract management	3	4	4
[-05-] Poor planning	5	8	5
[-06-] Poor Communication	9	9	10
[-07-] Ineffective stakeholder and community engagement	9	5	7
[-08-] Lack of client skills and technical capacity	3	3	3
[-09-] Non-compliance with SCM regulations	11	9	11
[-10-] Poor information management systems	8	5	5
[-11-] Poor project implementation practices	6	9	9

Note: Cross referenced to Tables 4 and 5
Legend – WI – Water Infrastructure Project; URP – Urban renewal programme

The combined overall ranking is shown in Table 6. The analysis demonstrates that the major causes of inefficiency in IPDM are issues pertaining to funding and financial management, poor governance and leadership role of the client, lack of client skills and technical capacity, and poor contract management. An article by Watermeyer (2019: 36) on the critical role played by the client in delivering infrastructure project outcomes presents evidence of a case study on the new universities project which was presented to approximately 130 senior government officials involved in infrastructure projects at two separate workshops, sponsored by National Treasury. The participants at both workshops identified procurement strategy, governance, client leadership and a skilled client team as the critical innovations and practices that led to these successful project outcomes. Although these are different projects in different contexts, there is a significant overlap in the factors responsible for success and failure in infrastructure project implementation and outcomes. The key overlapping ones are role of the client and governance.

CONCLUSIONS

The performance audit reports on two infrastructure projects was analysed by 14 groups of built environment professionals. The groups were required to analyse why they think that the problems reported in the AG report arose in the first place. These factors they generated essentially explained the root causes of inefficiency in the procurement and delivery management practices which led to poor project outcomes. The significant causes of inefficiency in infrastructure procurement were identified as funding and financial management challenges, poor governance and leadership role of the client, lack of client skills and technical capacity, and poor

contract management. Three of the findings overlap significantly with recent findings by other industry groups in South Africa and this was interesting given the differences in nature and context of the projects. The findings provide clients and those responsible for infrastructure procurement and delivery management in South Africa with knowledge on problem areas in public infrastructure project implementation. Academic institutions and professional bodies can also use the findings to identify appropriate areas for the design and provision of courses aimed at strengthening organisational and professional capacity to deal with key challenges in infrastructure project implementation.

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REFERENCES

Ameh, O.J., Soyingbe, A.A. and Odusami, K.T. (2010), "Significant factors causing cost overruns in telecommunication projects in Nigeria", Journal of Construction in Developing Contries., Vol. 15, pp. 49-67.

Bhargava, A., Anastasopoulos, P.C., Labi, S., Sinha, K.C. and Mannering, F.L. (2010), "Three-stage leastsquares analysis of time and cost overruns in construction contracts", Journal of Construction Engineering and Management, Vol. 139 No. 3, pp. 267-279.

Cheng, Y.M. (2014), "An exploration into cost-influencing factors on construction projects", International Journal of Project Management, Vol. 32 No. 5, pp. 850-860.

Doloi, H. (2013), "Cost overruns and failure in project management: understanding the roles of key stakeholders in construction projects", Journal of Construction Engineering and Management, Vol. 136 No. 11, pp. 1207-1218.

Fitzgerald, P. and Hodgson, S. (2010), "Funding higher education infrastructure investment: the case of Wits University, South African Regional Universities Association (SARUA)", Leadership Dialogue Series, Vol. 2 No. 2, pp. 28-42.

Fombad, M.C. (2015), "Governance in public–private partnerships in South Africa: some lessons from the Gautrain", Journal of Southern African Studies, Vol. 41 No. 6, pp. 1199-1217, doi: 10.1080/03057070.2015.1117240.

Frimpong, Y., Oluwoye, J. and Crawford, L. (2003), "Causes of delay and cost overruns in construction of groundwater projects in a developing countries: Ghana as a case study", International Journal of Project Management, Vol. 21 No. 5, pp. 321-326.

Hughes, W., Champion, R. and Murdoch, J. (2015), Construction Contracts – Law and Management, 5th ed., Routledge, London.

ISO (International Organization for Standardization) (2010) ISO 10845-1:2010: Construction Procurement – Part 1: processes, methods and procedures, ISO, Geneva, Switzerland

Koushki, P.A., Rashid, K. and Kartam, N. (2005), "Delays and cost increases in the construction of private residential projects in Kuwait Constr", Management Economics, Vol. 23, pp. 285-294.

Laryea (2019) Procurement strategy and outcomes of a new universities project, Engineering, Procurement and Architectural Management, Accepted for publication

Laryea, S. and Watermeyer, R. (2014), "Innovative construction procurement at Wits University", Proceedings of the ICE - Management, Procurement and Law, Vol. 167 No. 5, pp. 220-231.

Lee, J.K. (2008), "Cost overrun and cause in Korean social overhead capital projects: roads, rails, airports, and ports", Journal of Urban Planning and Development, Vol. 134, pp. 59-62.

Love, P.E.D., Wang, X., Sing, C. and Tiong, R.L.K. (2012), "Determining the probability of project cost overruns", Journal of Construction Engineering Management, Vol. 139, pp. 321-330.

Memon, A.H., Rahman, I.R., Abdullah, M.R. and Azis, A.A.A. (2010), "Factors affecting construction cost performance in project management projects perspective of project management consultant", International Journal of Sustainable Construction Engineering Technology, Vol. 1, pp. 30-35.

Memon, A.H., Rahman, I.R., Asmi, A. and Azis, A.A.A. (2011), "Preliminary study on causative factors leading to construction cost overrun", International Journal of Sustainable Construction Engineering Technology, Vol. 2, pp. 57-71.

Nkado, R.N. (2010), "Cost escalation of major infrastructure projects: a case study of Soccer City Stadium in Johannesburg", in Laryea, S., Leiringer, R. and Hughes, W. (Eds), Proceedings of West New universities project in South Africa, West Africa Built Environment Research (WABER) Conference, Accra, Ghana, pp. 265-270.

OGC (Office of Government Commerce) (2007) Procurement and Contract Strategies: Achieving Excellence in Construction Procurement Guide 6, OGC, Norwich, UK

Pourrostam, T. and Ismail, A. (2011), "Significant factors causing and effects of delay in Iranian construction prShehu, Z., Endut, I.R., Akintoye, A. and Holt, G.D. (2014), "Cost overrun in the Malaysian construction industry projects: a deeper insight", International Journal of Project Management, Vol. 32 No. 8, pp. 1471-1480.

Rajan, T.A., Gopinath, G. and Behera, M. (2014), "PPPs and project overruns: evidence from road projects in India", Journal of Construction Engineering and Management, Vol. 140, pp. 1-10.

Shrestha, P.P., Burns, L.A. and Shields, D.R. (2013), "Magnitude of construction cost and schedule overruns in public work projects", Journal of Construction Engineering, Vol. 20, pp. 1-9.

Sweis, G.J., Sweis, R., Rumman, M.A., Hussein, R.A. and Dahiya, S.E. (2013), "Cost overruns in public construction projects: the case of Jordan", Journal of American Science, Vol. 9 No. 7, pp. 134-141

Watermeyer, R. (2019) The critical role played by the client in delivering infrastructure project outcomes, SAICE Civil Engineering Magazine, January/February 2019 Issue, pp.32-38