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Building an infrastructure project performance in the North-West Province Department of Public Works and Roads

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Abstract

Building and infrastructure projects at the North-West Province Department of Public Works and Roads (NW DPWR) often perform poorly in terms of overrunning both the original approved timeline and the budget. Adding to poor time and cost performances, these projects often do not meet the desired functional requirements. This article reports on findings of a study which investigated the causes of these poor performances in the NW DPWR. Fifty potential causes of poor performance were identified from literature. These factors were grouped under three main related categories of owner-related, contractor-related and consultant-related and were subjected to a questionnaire survey to identify the most critical causes of failure. The results were analysed using the Relative Importance Index (RII) and Spearman's Rank Correlation Coefficients. The results indicated that the most significant causes of poor building and infrastructure project performance in the NW DPWR include underestimation of project cost, the lack of experience in executing projects, contractor's cash-flow constraints, corruption and bribery during the bidding and contract award phase, as well as poor site management and supervision. Recommendations are made to prevent similar causes of projects failure in the NW DPWR in future.

Keywords: Building, construction projects, cost overruns, infrastructure, project performance, Relative Importance Index, schedule delays

Abstrak

Bou- en infrastruktuurprojekte by die Noordwes Provinsie se Departement van Openbare Werke en Paaie (NW DPWR) ondervind gereeld tydvertragings in projekvoltooiing sowel as probleme soos oorspandering en die gebrek aan voldoening aan funksionele spesifikasies. Hierdie artikel rapporteer resultate van 'n studie wat onderneem is ten einde die redes waarom projekte in die NW DPWR swak presteer, te ondersoek. Vanuit literatuur is vyftig potensiële redes vir projekfaling geïdentifiseer. Die redes is in drie verwante kategorieë gegroepeer, naamlik eienaarverwante, kontrakteurverwante en konsultantverwante kategorieë. Deur middel van 'n vraelysopname is die mees kritieke redes vir projekfaling geïdentifiseer. Die resulate is ontleed deur gebruik te maak van 'n Relatiewe Sterkte Indeks asook die Spearman Rangorde Korrelasie Koëffisiënte. Die resultate toon dat die mees beduidende redes vir projekfaling in NW DPWR sluit onderberaming van projekkoste, gebrekkige ervaring in projekimplementering, beperkte kontantvloei deur kontrakteurs, korrupsie en omkopery tydens die tenderproses en kontrakaanstellings, sowel as swak terreinbestuur en toesig in. Aanbevelings is gemaak om soortgelyke probleme met toekomstige projekte in die NW DPWR te beperk.

Sleutelwoorde: Gebou, konstruksieprojekte, koste-oorskryding, infrastruktuur, projekprestasie, Relative Importance Index, skedulevertragings

1. Introduction

The North-West Provincial Government (NWPG) has a constitutional responsibility to provide better services to the people of the North-West Province. The NWPG, through the Department of Public Works and Roads (DPWR), is mandated to provide office, residential and other service delivery facilities to provincial departments and political office-bearers. The initial policy of the NW DPWR, in full support of the objectives and targets of the government's Reconstruction and Development Programme (RDP), is to ensure that all South Africans have access to basic infrastructure (RDP, 1994: online). The Chief Directorate Infrastructure in the Department is responsible for infrastructure planning, design and project implementation of infrastructure assets to meet the needs identified by the client departments under the capital expansion (Capex) programme. The implementation of projects by the NW DPWR is based on the North-West Infrastructure Delivery Management System (NW IDMS), which provides a systematic approach to infrastructure delivery, covering the full life cycle from needs identification, planning and budgeting to procurement, construction, handover, operations and maintenance.

The NW DPWR often perform poorly in the delivery of all construction and maintenance projects on time, within budget and in accordance to the pre-determined requirements. A study undertaken by the South African Government in 2002 to determine the issues and gaps in the delivery of infrastructure reported that there was a shortfall in effective and systematic delivery systems, as well as a shortage in skills to deliver projects as per requirements (SAICE, 2016: 2). The most critical problems facing Government's infrastructure service delivery programme are the following:

- Delayed infrastructure investment, also known as the 'blocked infrastructure project pipeline', often due to inadequate planning allocation of resources, as well as excessive bureaucracy;
- Infrastructure delivery backlogs, particularly in respect of buildings infrastructure;
- Budgetary challenges in addressing backlogs in infrastructure delivery;
- Inheritance of unequal spatial distribution of infrastructure resulting in rural areas with limited access to basic, social and economic services;
- Underspending of capital expenditure;
- Poor application of project management practices, and
- Poor time management.

The South African Government has identified infrastructure development as a means to stimulate the economy (NPC, 2011: 137). The Government is the most significant construction client, contributing between 40% and 50% of the entire domestic construction expenditure (Dlungwana, Nxumalo, Van Huysteen, Rwelamila & Noyana, 2002: 2). According to Ramokolo and Smallwood (2008: 46), South Africa aims to invest 5.1% of South Africa's Gross Domestic Product (GDP) in construction. They also indicated that 45% of the more than 500,000 people, employed in the construction industry, are estimated to be working in the formal sector. In order to address infrastructure backlogs across the country, the Government is committed to invest in infrastructure development in order to achieve economic growth and address the backlog.

Approximately 60% of the projects being implemented by the NW DPWR are not completed on time and on budget, often resulting in service delivery protests by local communities. In a bid to get to uncover some of the problems experienced in the delivery of building infrastructure projects by the NW DPWR, a preliminary internal evaluation and analysis of project performances and operational deficiencies in the NW DPWR was done. It was evident that there were various challenges facing the NW DPWR in delivering building and infrastructure projects, including termination of contractors for poor performance, cost and schedule overruns on projects such as

Vryburg Mini Garona Office Park, Vryburg Hospital, and DPWR Head Office in Mmabatho. These problems were further exacerbated by poor procurement practices and poor controls in the delivery process. Despite overall poor performance, some projects were delivered successfully, namely Tlakgameng Community Library, new hostels at Bophelong Special School, and Tlou le Tlou Traditional Offices. The discrepancies in overall project performance prompted the researcher to investigate and identify the causes of infrastructure project failures in the NW DPWR.

This study aims to address the following three questions related to projects at NW DPWR:

- What are the general factors causing the time and cost overrun of building and infrastructure projects?
- What are the critical factors causing the time and cost overrun of building and infrastructure projects?
- What are the perceptions of owners, contractors and consultants regarding the causes of time and cost overrun of building and infrastructure projects?

2. Literature survey

Construction projects worldwide often suffer from poor performance in terms of time delays, cost overruns and quality defects. Pheng and Chuan (cited in Adebowale & Ayodeji, 2015: 1118) stated that, traditionally, successful delivery of a construction project hinges on the performance of the project manager, who must consider delivery time, budgeted cost and expected quality. However, with the delivery of projects predominantly a team effort, the allocation of single accountability for project performance to one individual might not achieve the desired results.

In the past, various studies investigated and analysed factors causing poor performance on construction-related projects (Table 1). The majority of these studies focused on identifying the major causes of time and schedule overruns, challenges facing contractors, as well as quality management in various construction projects. Table 1 provides a summary of some of the common causes for poor performance of construction-related projects as per categories identified.

Table 1: Summary of typical factors causing the poor performance of construction-related projects

Critical performance factors	*Authors*
Owner-related factors	
Delayed monthly payments for completed work	Assaf & Al-Hejji (2006: 349); Frimpong, Oluwoye & Crawford (2003: 321); Fugar & Agyakwah-Baah (2010: 111); Mansfield, Ugwu & Doran (1994: 254); Odeh & Battaineh (2002: 67); Sambasivan & Soon (2007: 526); Sweis, Sweis, Hammad & Shboul (2008: 671)
Owner's cash-flow problems	Al-Momani (2000: 51); Assaf & Al-Hejji (2006: 349); Kaliba, Muya & Mumba (2009: 522); Koushki, Al-Rashid & Kartam (2005: 294); Monyane & Okumbe (2012: 192); Sweis *et al.* (2008: 671)
Scope changes from owner	Al-Momani (2000); Assaf & Al-Hejji (2006: 349); Kaliba *et al.* (2009: 522); Koushki *et al.* (2005: 294); Monyane & Okumbe (2012: 192); Sweis *et al.* (2008: 671)
Delays in decision-making	Chan & Kumaraswamy (1997: 55); Monyane & Okumbe (2012: 192)
Contractor-related factors	
Inadequate and poor planning	Assaf & Al-Hejji (2006: 349); Dlungwana, Nxumalo, Van Huysteen, Rwelamila & Noyana (2002: 25-26); Sambasivan & Soon (2007: 526); Sweis *et al.* (2008: 671)
Contractor's financial difficulties	Aibinu & Odeyinka (2006: 667-677); Frimpong *et al.* (2003: 321); Sweis *et al.* (2008: 671)
Shortage of skilled labour	Baloyi & Bekker (2011: 63); Dlungwana *et al.* (2002: 25-26); Sweis *et al.* (2008: 671); Thwala & Phaladi (2009: 533)
Poor site management and supervision	Assaf & Al-Hejji (2006: 349); Chan & Kumaraswamy (1997: 55); Kaliba *et al.* (2009: 522); Sambasivan & Soon (2007: 526)
Underestimation of project cost	Dlakwa & Culpin (1990: 239); Fugar & Agyakwah-Baah (2010: 111); Mansfield *et al.* (1994: 254); Thwala & Phaladi, (2009: 535)
Lack of experience in executing projects	Koushki (2005: 294); Muhwezi, Acai & Otim (2014: 21); Nguyen & Chileshe (2015: 398); Sambasivan & Soon (2007: 526); Thwala & Phaladi (2009: 533)
Increase in material cost	Baloyi & Bekker (2011: 62); Dlakwa & Culpin (1990: 239); Koushki *et al.* (2005: 294); Mansfield *et al.* (1994: 254)
Consultant-related factors	
Poor design capacity and design changes	Al-Momani (2000: 51); Baloyi & Bekker (2011: 63); Jackson (2002: 4); Nguyen & Chileshe (2015: 398); Muhwezi *et al.* (2014: 13-23)
Incomplete designs by architect and engineering disciplines	Aibinu & Odeyinka (2006: 667-677); Baloyi & Bekker (2011: 63); KPMG International (2013: 4); Muhwezi *et al.* (2014: 13-23)
Architect's incomplete drawing	Aibinu & Odeyinka (2006: 675)
Design error made by the designers	Muhwezi *et al.* (2014: 13-23); Tumi, Omran & Pakir (2009: 268)

3. Research methodology

Due to the number of projects and stakeholders involved, it was decided to conduct a quantitative research design rather than a qualitative approach. As stated by Cooper and Schindler (1998: 21), a questionnaire survey assists with the standardisation of data gathering, decreases non-response errors and increases response rates. The number of people and entities participating in NW DPWR projects are numerous, and it is believed that the inputs and views of as many participants as possible will be valuable to objectively identify the key factor that leads to poor project performance. The structured survey questionnaire invitations were sent via e-mail. For this investigation, an e-mail distribution method offered the opportunity to access a bigger group of potential research participants.

3.1 Sampling method

A list of 310 approved consultants (258) and contractors (52) were obtained from the internal NW DPWR procurement database. This database is merely a list of consultants and contractors that are eligible to work for the Department and contains the contact their names, telephone numbers and email addresses. A total of 258 consultants were listed in the database and included architects, civil and structural engineers, electrical engineers, mechanical engineers, and quantity surveyors. A total of 52 contractor names were retrieved. Introductory letters and questionnaires were sent to all companies listed.

Owner participants included employees from NW DPWR who interfaced directly with consultants and contractors on projects and had the mandate to provide managerial and technical guidance on the projects as well as approve or disapprove project deliverables. A total of 45 project owner participants were identified to participate. A simple random sampling selecting method resulted in a sample size of 355, representing project owners (45), contractors (52), and consultants (258).

3.2 Data collection

A structured questionnaire was distributed electronically, via email, to a total randomly selected sample of 355 project owners, contractors and consultants involved in building construction projects under the NW DPWR Infrastructure Chief Directorate in South Africa. The major causes of construction projects failure in the NW DPWR topics listed in the questionnaire were extracted from reviews of the literature, resulting in the formulation of a questionnaire divided into two sections, namely the respondent's profile, and a ranking list of the 50 critical project failure factors where respondents were requested to rank each of the 50 critical project failure factors. The profile section consisted of questions pertaining to general demographics about the respondents. It was divided into three subsections: Type of organisation owner, consultant or contractor; the respondent's designation, and the professional experience of each respondent. To reduce the respondent's biasness, and facilitate coding of the questionnaire, closed-ended questions were preferred (Akintoye & Main, 2007: 601).

3.3 Response rate

A total of 100 validly completed responses were received, representing a response rate of 28.2%. According to Moyo & Crafford (2010: 68), contemporary built-environment survey response rates range from 7% to 40% in general. It is significant in respect of the reliability of the response rate that, although the number of questionnaires distributed to consultants seems disproportionally high, the response rate from this category was relatively low, thus not causing any bias towards the results. The questionnaire return rate is provided in Table 2.

Table 2: Questionnaire return rate

Respondents	*Questionnaires distributed*	*Responses returned*	*Response rate (%)*
Owner	45	30	66.67
Contractors	52	26	50.00
Consultants	258	44	17.05
Total	**355**	**100**	**28**

3.4 Data analysis and interpretation of findings

A 5-point Likert scale was used to measure the opinions of the respondents. Likert-type or frequency scales use fixed choice response formats and are designed to measure attitudes or opinions (Bowling, 1997; Burns & Grove, 1997). For the purpose of analysis and interpretation, the following scale measurement was used: 1 - no contribution to failure; 2 - slight contribution to failure; 3 - significant contribution to failure; 4 - very significant contribution to failure, and 5 - major cause of project failure. From this general data, each of the 50 critical project failure factors could be ranked from having no, slightly, significant, very significant or major contribution to project failure.

To interpret the general data, a combination of the following three descriptive statistical analysis methods was used:

- Relative Importance Index (RII);
- Spearman's Rank Correlation (r_s), and
- Probability values (p-values).

3.4.1 Relative Importance Index

The Relative Importance Index (RII) is commonly used to assess comparative results from research in the field of project performance (Aibinu & Odeyinka, 2006; Baloyi & Bekker, 2011; Chan & Kumaraswamy, 1997; Kikwasi, 2012; Muhwezi *et al.*, 2014). For this study, RII was used to determine the ranking of different causes of building construction projects failure from the point of view of owners, contractors and consultants.

$RII = \sum W / (A \times N), (0 \leq RII \leq 1)$ (1)

Where:

W = the weight given to each factor by the respondents and ranges from 1 to 5 as per the Likert scale.

A = is the highest weight (i.e. 5 in this case).

N = is the total number of respondents.

The cause with the highest index is the most important, and with the smallest number the least important. The rankings made it possible to cross-compare the failure factors as perceived by the three groups of respondents.

3.4.2 Spearman's Rank Correlation

This study used the Spearman's Rank Correlation (r_s) to identify and test the strength of a relationship between the rankings of any two parties for a single failure cause, while ignoring the ranking of the third party (Assaf & Al-Heijj, 2006; Fugar & Agyakwah-Baah, 2010; Odeh & Battaineh, 2002). The correlation coefficients are calculated using the following formula (2):

$$r^s = 1 - \frac{6\sum d^2}{(n^3 - n)} \quad \text{.......} \quad (2)$$

Where:

r_s = Spearman's Rank Correlation Coefficient.

d = the difference in ranking between any two parties.

n = the number of causes of failure, which in this case is 50.

The correlation coefficient varies between +1, which implies a perfect positive correlation (agreement) and -1, which implies a perfect negative correlation (disagreement). Values close to unity in magnitude imply good correlation, whereas those near zero indicate little or no correlation (Assaf & Al-Heijji, 2006). When r = 0, it means that there is no correlation (Assaf & Al-Heijji, 2006).

3.4.3 Probability values

The p-value is the probability of observing a sample value as extreme as, or more extreme than the value actually observed, given that the null hypothesis is true (Kamanga & Steyn, 2013: 82). To determine whether the parties displayed significant agreement in their rankings, the null hypothesis stated as owner and contractors, contractors and consultants, and owner and consultants do not agree on ranking of the causes of construction projects failure in the NW DPWR was tested at a 95% confidence level (2 tailed tests). The p-value indicates if the correlation is statistically significant. The analysis was aided by the use of MoonStats statistical software.

4. Results

4.1 Relative Importance Index

Table 3 shows a complete set of the survey results illustrating the RII as well as the ranking order where 1 shows the factors contributing the most to failure.

Table 3: Overall RII and rank of construction projects failure according to owner, contractors and consultants

ID	*Causes of failure*	*Owner*		*Contractors*		*Consultants*		*All parties*	
		RII	*Rank*	*RII*	*Rank*	*RII*	*Rank*	*Average RII*	*Rank*
	Owner-related factors								
1	Late payment of completed works	0.759	13	0.792	7	0.682	28	0.744	16
2	Owner's cash-flow problems or non-access to funds constraints	0.753	14	0.769	13	0.758	10	0.760	12
3	Late or delayed contract award by owner	0.593	45	0.536	50	0.526	49	0.552	49
4	Late reviewing and approval of design documents	0.620	44	0.608	42	0.600	43	0.609	44
5	Difference between selected bid and consultants' estimates	0.552	49	0.592	43	0.662	32	0.602	45
6	Delays in decision-making	0.733	19	0.746	23	0.702	24	0.727	18
7	Unrealistic design development period	0.653	40	0.738	25	0.714	20	0.702	30
8	Late issue of instructions	0.703	29	0.677	35	0.718	17	0.700	31
9	Owner interference	0.717	24	0.669	39	0.643	35	0.676	35
10	Poor project scope definition by owner	0.767	12	0.762	15	0.753	11	0.761	11
11	Owner initiated changes during implementation	0.703	29	0.592	43	0.645	34	0.647	39
12	Awarding of contracts primarily on price	0.772	11	0.776	12	0.823	5	0.791	6
13	Corruption and bribery during the bidding and contract award phase	0.857	4	0.800	5	0.809	6	0.822	4
14	Poor information dissemination by owner	0.640	42	0.685	34	0.679	29	0.668	36
	Contractor-related factors								
15	Late payment of subcontractors for completed works by contractor	0.827	6	0.769	13	0.716	19	0.770	10
16	Fluctuations in material, labour and plant cost	0.669	38	0.631	41	0.609	41	0.636	41
17	Contractor's cash-flow constraints	0.867	1	0.815	4	0.842	2	0.841	3
18	Underestimation of project cost	0.867	1	0.877	1	0.836	3	0.860	1
19	Shortage of skilled labour	0.793	8	0.762	15	0.786	9	0.780	8
20	Increase in material cost	0.683	33	0.585	45	0.595	45	0.621	42
21	Delay by subcontractor	0.673	35	0.672	38	0.636	38	0.661	37
22	Poor site management and supervision	0.747	16	0.862	2	0.832	4	0.813	5
23	Underestimation of time for completion by contractor	0.793	8	0.777	10	0.791	7	0.787	7

ID	Causes of failure	Owner		Contractors		Consultants		All parties	
		RII	Rank	RII	Rank	RII	Rank	Average RII	Rank
24	Contractor work overload	0.720	23	0.715	31	0.712	21	0.716	27
25	Lack of experience in executing projects	0.867	1	0.824	3	0.870	1	0.853	2
26	Unforeseen ground conditions	0.673	35	0.577	46	0.614	40	0.621	42
27	Inclement weather	0.513	50	0.546	49	0.507	50	0.522	49
28	Poor planning of material acquisition (shortage of available steel, concrete)	0.697	31	0.792	7	0.691	25	0.727	18
29	Poor risk management by contractor	0.733	19	0.704	33	0.740	13	0.726	21
30	Inadequate contingency allowance	0.587	47	0.569	47	0.595	45	0.584	48
31	Defective works and reworks	0.752	15	0.754	20	0.750	12	0.752	15
32	Incompetent subcontractor	0.747	16	0.731	28	0.791	7	0.756	14
33	Lack of effective communication by contractor	0.747	16	0.715	31	0.712	21	0.725	23
34	Deficiencies in the initial bill of materials	0.707	25	0.738	25	0.641	36	0.695	32
Consultant-related factors									
35	Discrepancy between design specification and building code	0.673	35	0.677	35	0.600	43	0.650	38
36	Incomplete designs by engineering disciplines	0.833	5	0.762	15	0.718	17	0.771	9
37	Incomplete design by architect	0.807	7	0.731	28	0.738	14	0.759	13
38	Poor quality of tender documents	0.707	25	0.754	20	0.738	14	0.733	17
39	Poor design capacity	0.733	19	0.762	15	0.676	31	0.724	24
40	Non-adherence to project schedule	0.707	25	0.777	10	0.595	45	0.693	33
41	Complexity of building design	0.587	47	0.677	35	0.536	48	0.600	46
42	Delays in issuing information to contractors	0.690	32	0.762	15	0.686	26	0.713	28
43	Owner-initiated changes during design	0.593	45	0.562	48	0.609	41	0.588	47
44	Lack of project coordination and integration	0.647	41	0.754	20	0.709	23	0.703	29
45	Poor project conceptualisation and design	0.680	34	0.800	5	0.686	26	0.722	25
46	Poor project scope definition by owner	0.660	39	0.785	9	0.735	16	0.726	21
47	Risk identification and allocation	0.628	43	0.646	40	0.636	38	0.637	39
48	Poor constructability	0.733	19	0.746	23	0.679	29	0.720	26
49	Poor stipulation of quality parameters	0.707	25	0.728	30	0.638	37	0.691	34
50	Lack of effective communication by consultants	0.793	8	0.733	27	0.656	33	0.727	18

The RII of each cause, as perceived by all respondents, was used to illustrate the relative ranking. The results revealed that the three groups of respondents differ in the factors they identified as causing construction projects failure in the NW DPWR and in their ranking.

4.1.1 Owners' viewpoints

The top five causes of construction projects failure in the NW DPWR identified by the owner representatives were the following:

- Contractor's cash-flow constraints;
- Underestimation of project cost;
- Lack of experience in executing projects;
- Corruption and bribery during the bidding and contract award phase, and
- Incomplete designs by engineering disciplines.

4.1.2 Contractors' viewpoints

The contractors perceived the top five major causes of construction projects failure in the NW DPWR to be the following:

- Underestimation of project cost;
- Poor site management and supervision;
- Lack of experience in executing projects;
- Contractor's cash-flow constraints, and
- Corruption and bribery during the bidding and contract award phase.

4.1.3 Consultants' viewpoints

The top five causes of construction projects failure in the NW DPWR identified by the consultants were the following:

- Lack of experience in executing projects;
- Contractor's cash-flow constraints;
- Underestimation of project cost;
- Poor site management and supervision, and
- Awarding of contracts primarily on price.

Notably, consultants did not rank any consultant-related factors in the top five.

4.1.4 Overall viewpoints

The top five overall views of all three parties to the survey were as follows:

- Owner and contractors ranked underestimation of project cost by the contractor as the major cause of construction projects failure in the NW DPWR;
- Owner and consultants ranked contractors' lack of experience in executing projects as the major cause of construction projects failure;
- Owner and consultants ranked contractors' cash-flow constraints as another major cause of construction projects failure in the NW DPWR;
- According to owner and contractors, corruption and bribery during the bidding and contract award phase by the owner is among the major causes of construction projects failure in the NW DPWR, and
- Based on their viewpoints, contractors claimed that poor project conceptualisation and design are major causes of project failure.

All three parties agree that the following causes are the least important:

- Inclement weather;
- Late or delayed contract award by owner;
- Inadequate contingency allowance by the contractor;
- Owner-initiated changes, and
- Complexity of building design.

4.2 Spearman Rank Correlation and p-values

Table 4 provides the values of correlation coefficients among the parties and their corresponding p-values.

Table 4: Correlation test of all factors among respondents

Owner and contractors		*Contractors and consultants*		*Owner and consultants*	
Spearman Rank Correlation Coefficient	p-value	Spearman Rank Correlation Coefficient	p-value	Spearman Rank Correlation Coefficient	p-value
0.694	0.000	0.736	0.000	0.763	0.000

The rank correlation coefficients calculated for all factors among the respondents were: 0.694 for "owner and contractors"; 0.736 for "contractors and consultants" and 0.763 for "owner and consultants", respectively. These values show that there is a positive correlation between the three groups. The p-values for the three groups were 0.000, denoting a significant relationship between the causes of construction project failure ranked by these three respondent groups. All the groups generally agreed on the ranking of the causes of construction projects failure in the NW DPWR.

5. Conclusions

Table 5 reveals the overall ranking of the top ten most important factors causing construction projects failure in the NW DPWR. All the major stakeholders agreed that seven out of the top ten causes of construction projects failure are linked to contractor-related factors. Four of the top five causes of construction projects failure in the NW DPWR are all contractor related. The highest ranked owner-related cause of construction projects failure is corruption and bribery during the bidding and contract award phase; incomplete designs by engineering disciplines is the highest ranked consultant-related factor. All the top ten factors are linked to the traditional view of project success/failure, which hinges on the 'iron triangle' parameters of time, cost and quality.

Table 5: Top ten factors causing failure of construction projects

ID	*Causes of failure*	*Average RII*	*Rank*	*Related category*
18	Underestimation of project cost	0.860	1	Contractor
25	Lack of experience in executing projects	0.853	2	Contractor
17	Contractor's cash flow constraints	0.841	3	Contractor
13	Corruption and bribery during the bidding and contract award phase	0.822	4	Owner
22	Poor site management and supervision	0.813	5	Contractor
12	Awarding of contracts primarily on price	0.791	6	Owner
23	Underestimation of time for completion by contractor	0.787	7	Contractor
19	Shortage of skilled labour	0.780	8	Contractor
36	Incomplete designs by engineering disciplines	0.771	9	Consultant
15	Late payment of subcontractors for completed works by contractor	0.770	10	Contractor

6. Recommendations

Given the results of the research the following recommendations are proposed:

- The NW DPWR should be wary of awarding tenders where the price of the recommended tender is below the pre-tender estimate by the quantity surveyor. The reason for low tender values could be due to various reasons such as desperation to get a contract and substitute the price with change order or an underestimation of the price of the works.
- Contractors should critically evaluate their ability and competency to successfully complete the required assignment. It is important for contractors to ensure that they understand the requirements of the project during the pre-contract and bidding period so that they go for works for which they have a competitive advantage.
- Contractors' cash flow should be evaluated prior to bud evaluation and should also be part of the evaluation criteria.
- Consultants should be encouraged to improve upfront planning. A schedule should be set to complete design documents on time, and the Department must ensure that they adhere to the agreed schedule in order to avoid delay of work completion. An agreed turnaround time for document reviews should be confirmed upon project kick-off.
- All parties should put in place policies that will help retain their valuable human resources thereby avoiding high staff turnover.

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