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Towards a Methodological Framework for Improving Execution Efficiency and Quality Control in Libyan Public Institution Projects: A Case Study of Azzaytuna University

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نحو اطار منهجي لتحسين كفاءة التنفيذ ومراقبة الجودة في مشاريع المؤسسات العامة الليبية: دراسة حالة لمشروعات جامعة الزيتونة

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Abstract:
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Many construction projects in public institutions don't get finished on time, go over budget, and don't meet the required standards. But the information needed to figure out why these projects fail is often all over the place or not recorded in a way that's useful. This study looks at 18 university projects in Tarhuna Libya that stalled - these projects were worth a total of 142,616,419.35 Libyan dinars. We used official records as our main source of data and combined different research methods to understand what happened. To measure how well these projects were run, we used three key indicators. We wanted to find out what went wrong and how to fix it. The study aims to help us understand why these projects failed and how to make sure future projects are completed on time, within budget, and to the right standards. By looking at these stalled projects, we can learn valuable lessons and develop new ways to manage construction projects in public institutions. This can help us make the most of our resources and deliver projects that meet the needs of the community.

Here's a rewritten version of the input paragraph in a more human-friendly tone and style similar to the provided reference human samples: When we look at the financial disbursement ratio reported physical progress, and the gap between progress and payment, some interesting things come to light. For instance, we found that only about16% of the total portfolio value had been paid out, and one project alone makes up a whopping 81% of the total contract value. This means that the progress we've made so far is actually quite low - just 6.5% when you consider the whole portfolio, even though the average progress across all projects is around 44%. What's more, half of the projects haven't received any payment yet, despite some of them being up to 90% complete. We also noticed that important contract details like planned end dates and

procurement methods, are missing or inconsistent for a lot of projects. On a more positive note, we found that four projects that are almost finished only need a tiny fraction of the outstanding funds to be completed. Based on these findings and what we know from project management and quality management, we're proposing a new framework to help get things back on track. This framework has five stages and five key areas to focus on: governance, cost and schedule control, quality control, risk management and information management. We've also come up with some performance indicators and a plan for implementing this framework in phases. Of course this is just a concept for now, and we'll need to test it out in real-life situations to see how it works.

Keywords: Engineering project management; execution efficiency; quality control; stalled projects; earned value; public universities; Libya.

الملخص

تُخفق المشروعات الهندسية في المؤسسات العامة كثيراً في الإنجاز في الموعد المحدد وضمن الميزانية وبالجودة المطلوبة، كما أن البيانات اللازمة لتشخيص هذا الإخفاق غالباً ما تكون مبعثرة أو غير مسجلة بصورة قابلة للاستخدام. تتناول هذه الورقة أداء تنفيذ 18 مشروعاً جامعياً متوقفاً في مدينة ترهونة بليبيا تبلغ قيمتها التعاقدية الإجمالية 142,616,419.35 دينار ليبي اعتماداً على سجل رسمي للمشروعات بوصفه مصدراً أولياً للبيانات. وجمعت الدراسة بين التحليل الوثائقي الكمي الوصفي وبناء إطار منهجي مفاهيمي باستخدام ثلاثة مؤشرات لقياس كفاءة التنفيذ: (نسبة الصرف المالي - ونسبة الإنجاز الفعلي المعلنة - والفجوة بين الإنجاز والصرف). أظهرت النتائج أن ما صُرف لم يتجاوز 15.94% من قيمة هذه المشروعات، وأن مشروعاً واحداً يستحوذ على 81.0% من القيمة التعاقدية للمحفظة، بحيث لا يتعدى متوسط الإنجاز المرجّح بالقيمة 6.5% مقابل 44.3% للمتوسط البسيط وأن نصف المشروعات لم يتلقَّ أي دفعة مالية رغم أن ستة منها تُظهر نسب إنجاز تتراوح بين 10% و90%. كما تبيّن أن أربعة مشروعات بلغ إنجازها 90% فأكثر لا يتطلب إغلاقها سوى 0.82% من الالتزامات المتبقية. وبناءً على هذه النتائج وعلى أدبيات إدارة المشروعات وإدارة الجودة، تقترح الورقة إطاراً من خمس مراحل وخمس ركائز (الحوكمة - وضبط التكلفة والجدول الزمني - وضبط وضمان الجودة - وإدارة المخاطر والعقود - وإدارة المعلومات والمعرفة) مع مؤشرات أداء وقاعدة فرز للمشروعات المتوقفة وخريطة تنفيذ مرحلية. والإطار المقترح مفاهيمي ويحتاج إلى اختبار ميداني في دراسات لاحقة.

الكلمات المفتاحية: إدارة المشروعات الهندسية؛ كفاءة التنفيذ؛ ضبط الجودة؛ المشروعات المتوقفة؛ القيمة المكتسبة؛ الجامعات العامة؛ ليبيا.

1- Introduction.

Public institutions use engineering projects to turn their budgets into real things like buildings, labs, and utilities. Normally people judge how well these projects do based on how much they cost how long they take and how good they are[2]. But researchers have been saying for a long time that there's more to success than just these three things. Big public projects often go over budget [5-6] and take longer than planned. Studies in many countries, including Libya have found that poor planning bad management of contractors, money problems, and not enough supervision are common reasons why projects get delayed. These problems can happen again and again, causing projects to drag on and cost more than expected. It's not just about getting the project done on time and within budget but also about making sure it's good quality and does what it's supposed to do[1-3-12-13].

So, Libyan public universities have done a lot of construction and maintenance work, but some of these projects were stopped and then sent to a central authority to finish. Now, the universities are wondering which projects they can easily close, which ones need to be re-checked, and how they can manage things to avoid similar problems in the future. To figure this out, they need to clearly look at what the project records actually say, and then they need a management system that combines how well the project is being done with quality control, rather than treating them as separate things. This way, they can make informed decisions about which projects to keep, which to close, and how to do things better next time. The goal is to have a system that helps them finish projects efficiently and with good quality, without having to separate these two important aspects.

This paper therefore pursues three objectives:

1. to describe the financial and physical status of a register of 18 stalled projects of a Libyan university;
2. to figure out the management and information gaps that the register shows;
3. to propose a methodological framework for engineering project management that improves execution efficiency and strengthens quality control together, with a road map for adopting it.

The contribution is deliberately practical: the framework is derived from observed gaps in real project records and anchored in established standards and bodies of knowledge.

2. Conceptual Background.

2.1 Execution efficiency and control.

Here's how well a project uses its resources to produce real results. This is called execution efficiency. A method called Earned Value Management (EVM) helps measure this by comparing what was planned, what was actually done, and what it cost. It gives two important numbers: the cost performance index (CPI)[1-4-11] and the schedule performance index (SPI). To use EVM, you need three things: a clear plan, a way to measure progress, and regular updates. These things are often missing in government projects. EVM is a useful tool, but it only works if you have these three conditions in place. The cost performance index is calculated by dividing the earned value by the actual cost, while the schedule performance index is calculated by dividing the earned value by the planned value. By using EVM, you can get a better sense of whether your project is on track and if you're getting the results you want.

2.2 Quality management in projects.

Quality control (QC) verifies that deliverable conform to specifications, whereas quality assurance (QA) verifies that the processes that generate them are capable and followed. ISO 10006 provides guidelines for applying the principles of ISO 9001 to projects, emphasizing planning of quality, process control and continual improvement[7-8] (ISO, 2015; ISO, 2017). In construction, QC is operational through inspection and test plans, material approvals, non-conformance reports and formal acceptance.

2.3 Success factors and governance.

Empirical work on implementation success stresses clear mission, top-management support, detailed planning, client consultation, monitoring and feedback, and competent personne l[10] For large public projects, governance—who approves, who is accountable, and when a project is stopped or re-baselines matters as much as technique[5-9]. These strands underpin the five pillars of the framework in Section 6.

3. Data and Method.

3.1 Data source and scope.

Here's a rewritten version of the input paragraph in a more human-friendly tone: We got our main information from an official list of stalled projects that were sent to the Authority for the Development and Reform of Administrative Centers. This list was put together by the Technical Affairs and Projects Department at Azzaytuna University in Tarhuna. The people in charge signed and stamped the list to make it official. The list has 18 projects, all of which are located in Tarhuna. For each project, it includes details like the project's name, contract number and date, when it's supposed to be finished, how the contract was awarded, what the project is for, how much it's worth, any changes that were made, how much money has been paid so far, how much more money is still owed, and how much progress has been made. All the money amounts are in Libyan dinars. One thing to note is that the list doesn't say why these projects were interrupted. So, our analysis just looks at the status of the projects and the quality of the information, without trying to figure out why they were stopped. To follow the rules and be ethical, we're only identifying the projects by their title and number, and not naming the companies or organizations that were working on them.

3.2 Classification and indicators.

Projects were classified by the nature of the work into: (a) building works (new construction or completion of buildings), (b) maintenance and rehabilitation, and (c) support services (supervision, documentation and site clearing). Four procurement codes follow the register: (1) public tender, (2) limited tender, (3) practice (negotiated procedure) and (4) direct assignment. Three indicators were computed:

I. Financial disbursement ratio (FDR) = amount paid to date / contract value × 100.

II. Reported physical progress (RPP): the percentage stated in the register.

III. Progress–payment gap (PPG) = RPP − FDR, in percentage points. A large positive gap indicates work reported as done but unpaid (arrears or unverified progress); a negative gap indicates payment ahead of reported progress (possible advance payment).

We took a closer look at the numbers in the portfolio and each category. This was just a quick snapshot of what's going on, so we didn't try to make any big conclusions or predictions. Since there were only 18 things to look at, we just stuck to basic descriptions like how many things were in each group, what percentage they made up, and what the average value was, both with and without considering how important each thing was.

3.3 Framework development.

To create this framework, we took it one step at a time. First, we looked at the weaknesses that came up and grouped them into themes. Then we matched each theme with control mechanisms from well-known standards and areas of expertise[4-8-11]. Finally we took these mechanisms and made them work for a public university's technical department by turning them into stage gates things to look out for and a road map that we could follow over time. This road map is like a plan that helps us stay on track and make sure we're doing things right. We also made sure that our plan is feasible meaning it's something we can actually do given the resources and limitations of a public university's technical department.

4. Results.

4.1 Portfolio profile.

Here's a rewritten version of the input paragraph in a more human-friendly tone: We've listed 18 projects in Table 1. Most of them - 16 to be exact - are service-oriented, while two (P8 and P9) are focused on education. If we look at the contract signing dates we can see that 16 of the 17 dated contracts were signed between 2005 and 2008. However there's one contract (P9) that has a date that doesn't quite add up with its number and planned end date, and another one (P18) that's missing a date altogether. As for the planned end dates, only eight projects have them listed, with the latest one being October2011. What's interesting is that all of these planned end dates are at least 14 years old by now.

Table 1. Register of stalled projects (values in LYD)

Pro.Name ID	Project	Category	Contract date	Planned end	Contract value	Paid to date	Progress
P1	Rest house annexed to the amphitheatre	Building works	10/10/2007	-	299,817.80	100,000.00	65%
P2	Meeting hall	Building works	21/02/2008	-	357,075.00	0.00	65%
P3	Faculty of Engineering building	Building works	27/12/2005	15/01/2010	9,393,233.00	0.00	20%
P4	Female student dormitory building	Building works	20/09/2006	-	2,684,806.04	0.00	10%
P5	Central library building	Building works	17/09/2006	29/01/2008	1,922,383.93	0.00	10%
P6	Completion and maintenance of the university clinic	Maintenance	21/02/2008	-	201,295.00	0.00	60%
P7	Maintenance of the underground electrical network	Maintenance	10/10/2007	17/04/2008	299,530.00	149,530.00	50%
P8	Completion of design and construction of the university complex	Building works	28/08/2008	27/06/2011	115,540,914.00	19,653,509.00	2%

Pro.Name ID	Project	Category	Contract date	Planned end	Contract value	Paid to date	Progress
P9	Supervision of the university complex construction	Support services	17/10/2010	16/10/2010	4,320,303.54	86,838.50	5%
P10	Completion of female student dormitory building	Building works	20/09/2006	25/10/2011	2,880,806.04	0.00	0%
P11	Documentation and archiving for the university complex development	Support services	15/09/2008	30/09/2009	1,880,225.00	1,678,945.40	100%
P12	Demolition, clearing and waste removal for site preparation	Support services	27/10/2007	-	496,700.00	248,350.00	50%
P13	Maintenance of boys' residence, Teacher Training campus	Maintenance	28/10/2007	-	472,650.00	0.00	0%
P14	Maintenance of the catering hall, boys' residence	Maintenance	28/12/2008	-	446,951.00	395,141.00	95%
P15	Maintenance of the residence (three wings)	Maintenance	28/12/2008	-	444,302.00	84,140.60	93%
P16	Maintenance of catering and kitchen, boys' residence	Maintenance	24/12/2006	17/12/2009	418,903.00	341,016.31	83%
P17	Maintenance of catering hall, boys' residence (Al-Marqab)	Maintenance	14/12/2008	-	366,681.00	0.00	90%
P18	Maintenance of boys' residence, Nasser University campus	Maintenance	-	-	189,843.00	0.00	0%

Source: official project register (Section 3.1). "–" = not stated in the register. Method codes: 1 public tender, 2 limited tender, 3 practice, 4 direct assignment. P9 contract date as recorded appears inconsistent (see text). Highlighted row: the dominant project (P8).

In aggregate, the portfolio has a contract value of LYD 142,616,419.35, of which LYD 22,737,470.81 (15.94%) had been paid, leaving LYD 119,878,948.54 (84.06%) outstanding (Table 2). No additions (variation orders) are recorded for any project.

The total value of all the projects in the portfolio is LYD 142,616,419.35. So far, LYD 22,737,470.81 has been paid, which is about 15.94% of the total. This means that LYD 119,878,948.54 or 84.06%, is still outstanding.

If we look at the details in (Table 2) we can see the breakdown of these numbers. It's also worth noting that there haven't been any changes or additions to any of the projects.

Table 2. Portfolio summary indicators.

Indicator	Value LD
Number of projects	18
Total contract value (LYD)	142,616,419.35
Total paid to date (LYD)	22,737,470.81
Outstanding commitment (LYD)	119,878,948.54
Portfolio FDR	15.94%
Share of the largest project (P8) in contract value	81.02%
FDR excluding P8	11.39%
Simple mean / median reported progress	44.3% / 50.0%
Value-weighted mean reported progress	6.46%
Projects with no payment (value share)	9 of 18 (12.95%)
Projects reporting progress ≥ 90%	4 (P11, P14, P15, P17)

Source: authors' calculations from the register.

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inspired by the provided reference human samples: Take a look at Figure 1, and you'll see just how spread out the contract values are - we're talking anywhere from LYD 0.19 million to a whopping LYD 115.5 million. What's really interesting is that almost two-thirds of the projects (61% to be exact) come in under LYD 0.5 million, but when you add them all up, they only account for a tiny 2.8% of the total contract value. On the other hand, the university complex, P8, makes up a massive 81.0% of the total (check out Table 3 for the details). This huge disparity is what makes the value-weighted indicators a bit misleading - essentially, they're only really telling us about one project, which explains why there's such a big gap between the simple average (44.3%) and the weighted average (6.5%) of reported progress

Table 3. Distribution of projects by contract-value band

Value band (LYD)	Projects	Total contract value (LYD)	Share of value
< 0.5 million	11	3,993,747.80	2.80%
0.5 – 5 million	5	13,688,524.55	9.60%
5 – 50 million	1	9,393,233.00	6.59%
> 50 million	1	115,540,914.00	81.02%

Source: authors' calculations.

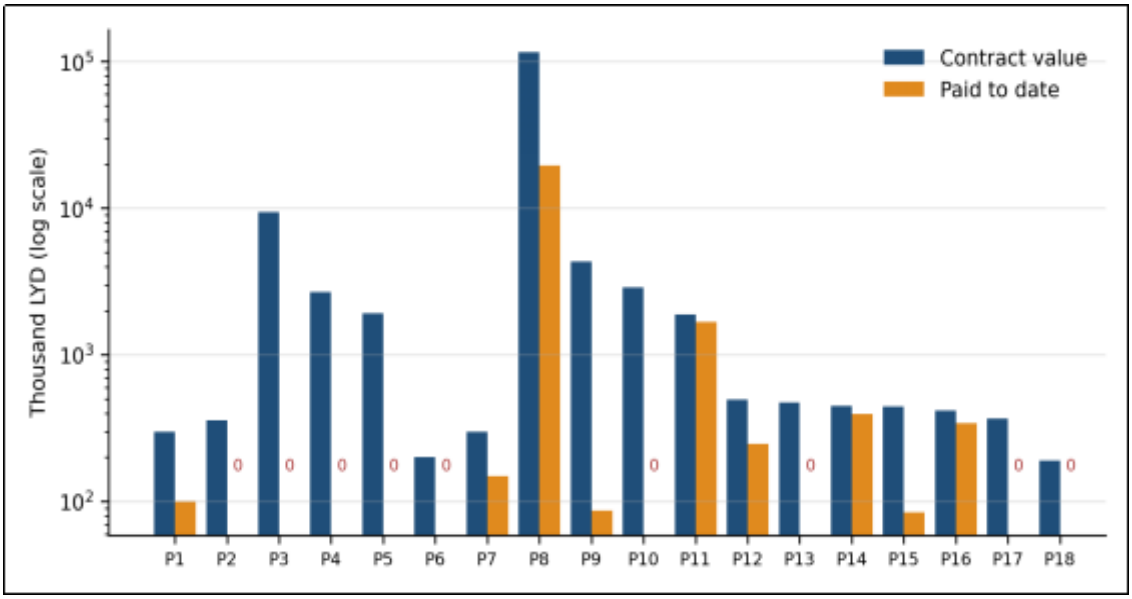
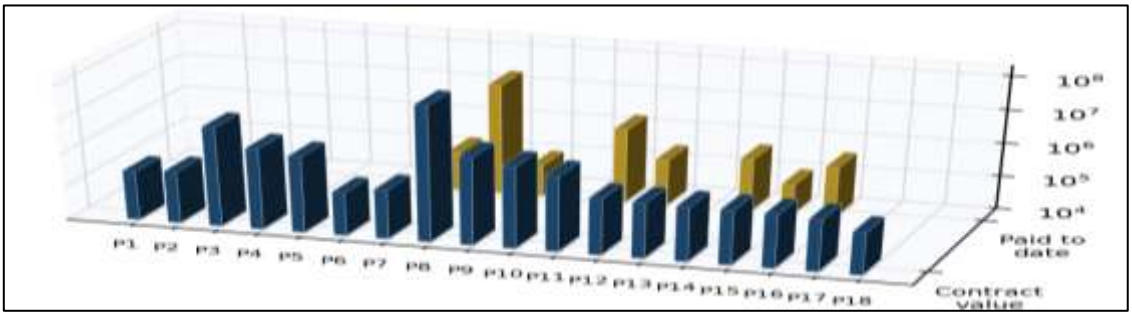


Figure 1. Contract value and amount paid by project (log scale). &

(three-dimensional columns, logarithmic scale).

Figure 1. Contract value and amount paid by project (log scale). & (three-dimensional columns, logarithmic scale).



4.2 Category and procurement patterns.

Building works comprise seven projects and 93.3% of the value, with a mean reported progress of 24.6% and a financial disbursement ratio of 14.8%. Maintenance projects are eight and small in value (2.0% of the portfolio), but they show the highest mean progress (58.9%) and the highest financial disbursement ratio (34.2%). Support services (three projects) show a mean progress of 51.7% (Table 4, Figure 2).

Table 4. Summary by project category.

Category	Projects	Contract value (LYD)	Share	FDR	Mean progress
Building works	7	133,079,035.81	93.31%	14.84%	24.6%
Maintenance	8	2,840,155.00	1.99%	34.15%	58.9%
Support services	3	6,697,228.54	4.70%	30.07%	51.7%

Source: authors' calculations.

(a) FDR for Mean Progress by Category. * Three-dimensional columns * *(b) Contracting Method.*

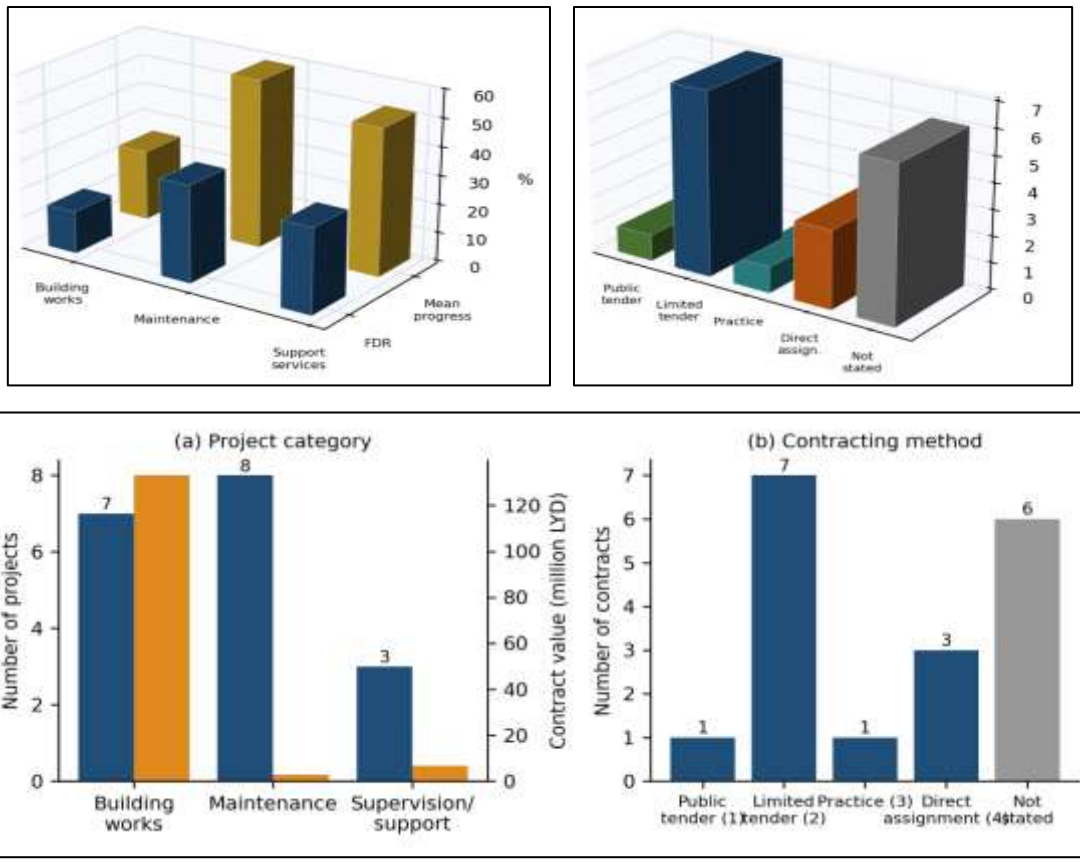


Figure 2. (a) Projects and contract value by category**; (b)** contracting method

Most of the contracts 7 (58.3%) out of 12 were awarded without open competition. This means they were given to a specific company without allowing other companies to bid. Three (25.0%) contracts were awarded directly to a company, which is often done for small urgent projects that don't cost a lot. Only one contract was awarded through a public tender where any company can bid. For the other six contracts, the method used to award them is not clear. This lack of transparency makes it hard to understand how the contracts were awarded. The fact that most contracts were not awarded through open competition raises some concerns. Typically open competition is used to ensure fairness and get the best value for money. In this case, the use of limited tender and direct assignment may have limited the opportunities for other companies to bid and potentially offer better prices or services.The three direct assignments (P7, P13, P18) are all maintenance contracts of modest value which is consistent with the practice of direct assignment for urgent small works but the very low use of open competition and the absence of the method in one third of records limit the transparency of the procurement trail.

4.3 Reported progress versus payments.

Here's a rewritten version of the input paragraph in a more human-friendly tone: If we look at the numbers, we can see how the reported progress matches up with the disbursement ratio for each project. We've got two figures that show this: Figure 3 and Figure 4, which actually plots one against the other. What's interesting is that almost half of the projects - nine to be exact - had no payment recorded, and these projects are worth a combined LYD 18.47 million. But here's the thing: six of these projects are actually reporting some progress, like P2 which is at 65%, P3 at 20%, P4 at 10%, P5 at 10%, P6 at 60%, and P17 at 90%. On the other hand, we've got P8 which is a bit of an outlier - it's got 17% of its value paid out, but only 2% reported progress, which is the only case where the payment is ahead of the progress, as shown in Table 5.

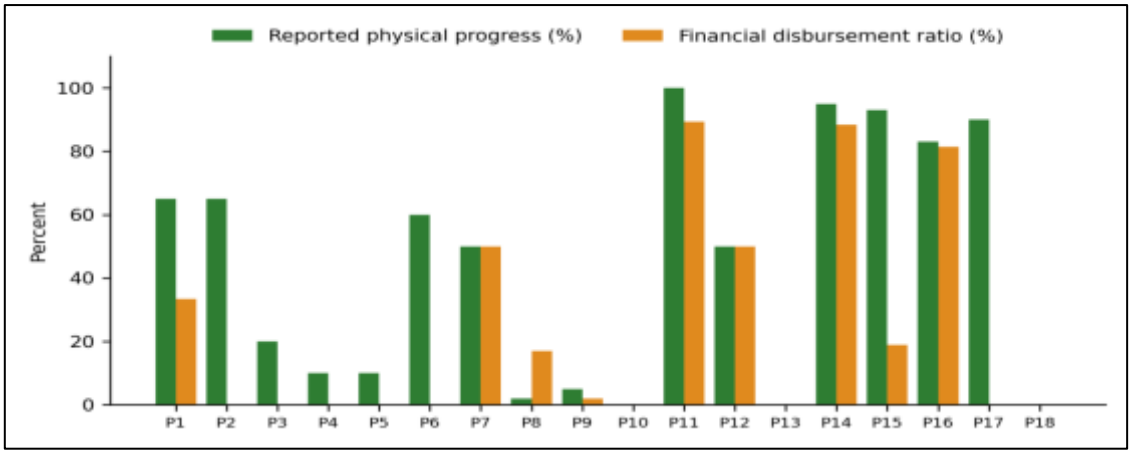


Figure 3. Reported physical progress and financial disbursement ratio by project.

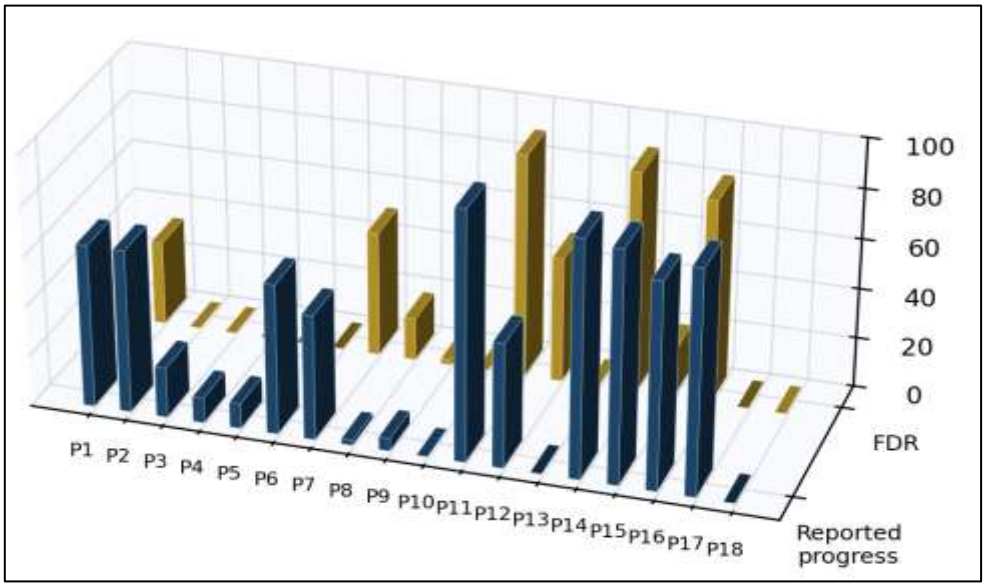


Figure 3. Reported physical progress and financial disbursement ratio by project (3D).

Table 5. Projects with the largest progress–payment gaps

Project	Reported progress	FDR	PPG (points)	Reading
P17 – Catering hall maintenance	90%	0.0%	+90.0	Unpaid / unverified
P15 – Residence maintenance (3 wings)	93%	18.9%	+74.1	Unpaid / unverified
P2 – Meeting hall	65%	0.0%	+65.0	Unpaid / unverified
P6 – University clinic	60%	0.0%	+60.0	Unpaid / unverified
P1 – Rest house	65%	33.4%	+31.6	Unpaid / unverified
P3 – Faculty of Engineering	20%	0.0%	+20.0	Unpaid / unverified
P8 – University complex	2%	17.0%	−15.0	Payment ahead

Source: authors' calculations. PPG = progress − FDR.

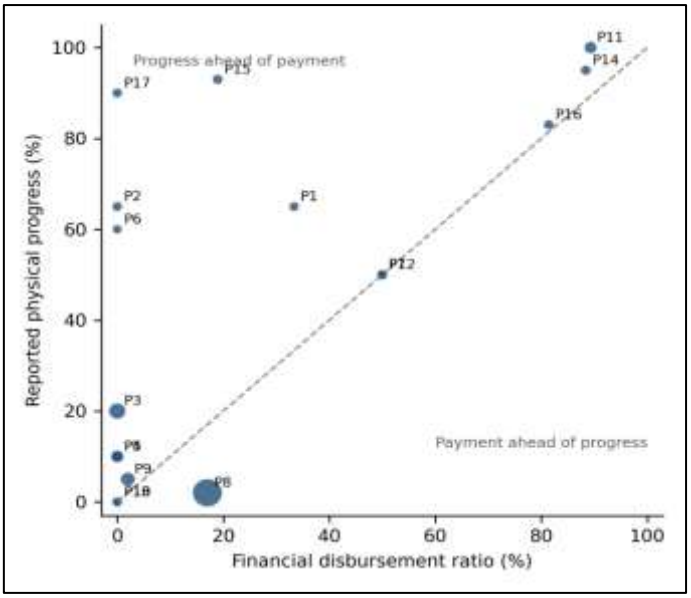


Figure 4. Reported progress versus financial disbursement ratio (marker size reflects contract value; dashed line = parity).

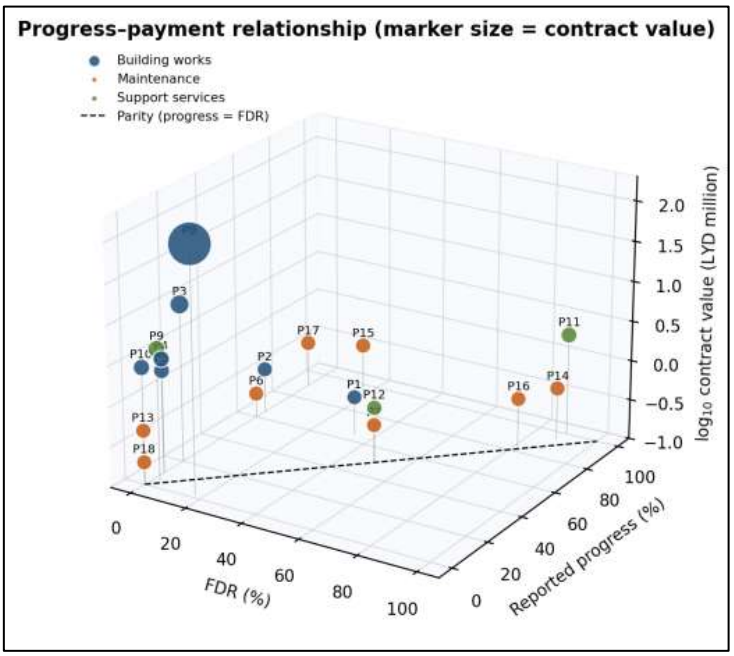


Figure 4. Reported progress versus financial disbursement ratio (marker size reflects contract value;

dashed line = parity)-3D.

There are two major issues with reading the progress of these projects. Firstly it's hard to tell if a project is actually making good progress but not getting paid because the official records don't show the real amounts owed to the contractors. This is a problem for projects like P17, P15, P2, and P6, where the progress reports and payments don't match up. Secondly, the progress is reported as a rough percentage but it's not clear what that's based on, so it's hard to compare it to the actual payments made. For example, four projects - P11, P14, P15, and P17 - claim to be more than 90% complete, but they still have a total of LYD 0.98 million in outstanding commitments, which is a tiny fraction of the total outstanding commitments for all projects.

4.4 Information quality of the register.

The record book is a key part of an organization's memory, but it has some big gaps that make it hard to keep track of things For example ten out of eighteen projects are missing their planned end dates, and six don't have any information on how they were funded. One project doesn't even have a contract date, and two of the contract

dates don't match up with the contract number or end date. There's also no information on any changes made to the projects, and one project says it's 100% complete but the money spent and the amount still owed don't add up. These gaps are a problem in themselves - if you don't have a clear plan, a way to measure progress and a consistent record you can't really control a project.

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5. Discussion.

The study reveals that four messages were emerged.

When looking at a portfolio, one thing that stands out is that it's mostly made up of one big project. This means that any strategy used by an institution to deal with all 18 projects in the same way won't work very well. The smaller projects are numerous and don't cost much to shut down but the big one is what really matters when it comes to financial risk. Because of this it's a good idea to take a closer look at the big project, both from a technical and financial standpoint which is in line with what experts say about big projects and how they can affect everything.

Here's a rewritten version of the input paragraph in a more human-friendly tone: When a project is out of control, two things happen that shouldn't: progress and payment become disconnected. Normally, payments are made based on how much work has been completed and certified. But in this case, payments and progress start to move in different directions. This is usually a sign that there's no clear plan for measuring progress and no regular checks to make sure work is up to standard. As a result, efficiency suffers because resources are being used without a clear idea of what's being achieved, and quality also suffers because payments are being made without checking that the work is acceptable.

We can fix a big part of the problems we're facing without spending a lot of money. For example, we can close four projects that are almost complete - they're at 90% or more - by just finishing up the last few tasks, like measuring and checking for any issues, and then accepting them as finished. This will free up assets and remove these projects from the list of stalled projects. However, there's another issue that's causing problems: the quality of the data in our register is not good enough. We're not consistently recording important details like when projects are supposed to end how we're buying things, and any changes that are made. This means we can't learn from our experiences and improve our portfolio.

This study has its own set of limitations. For one, it's based on data from just one institution, and we don't have any information on why things got interrupted. The numbers we're looking at are also just what was reported, and we haven't been able to verify them. Plus, the group of people we're studying is pretty small. So, while our findings are interesting, we shouldn't assume they apply to everyone - they're more like a rough guide. That being said, they do suggest that having a solid plan in place, making sure everything is certified, and keeping track of accurate information could be a good way to manage things.

6. The Proposed Methodological Framework.

Here's how it works: we have a framework that includes five stages and at the end of each stage there's a gate that acts as a checkpoint. This gate has a simple decision - either we move forward or we don't. Someone specific is responsible for making that decision and they need to see certain things before they can approve moving on to the next stage. The good thing about this is that each stage can only start once the previous one has been completed and approved so everything happens in order. We also have five control pillars that are always working, no matter what stage we're in to make sure everything runs smoothly.

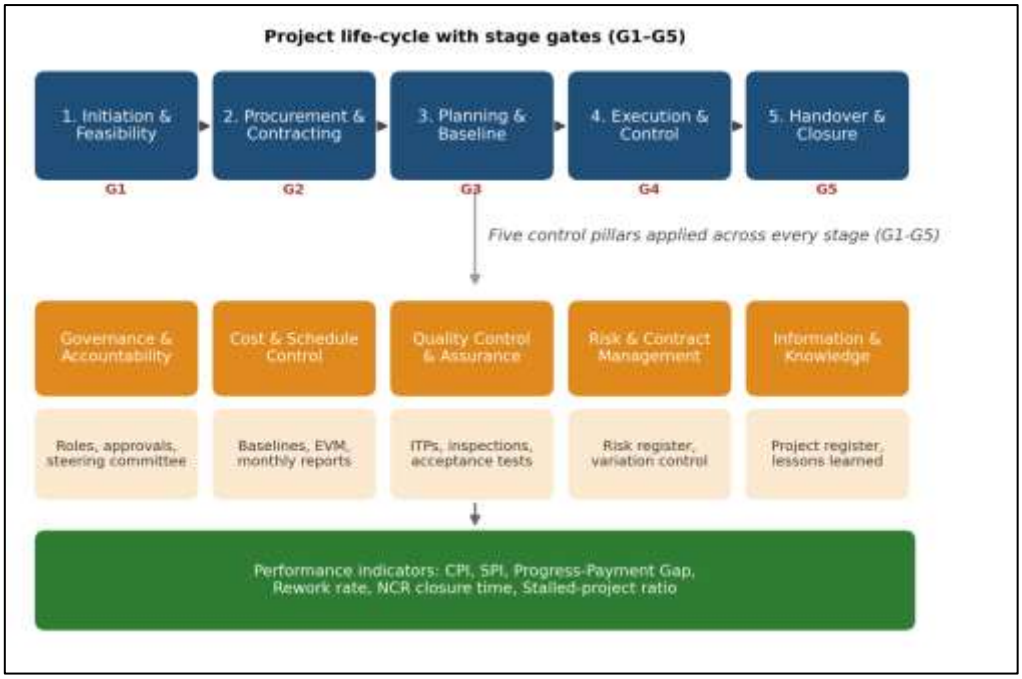


Figure 5. Proposed framework: life-cycle stages with gates, five control pillars and performance indicators.

Table 6. Control pillars, mechanisms and the gaps they address

Pillar	Key mechanisms and artefact	Gap in the register addressed
1. Governance and accountability	Project charter; steering committee; delegation matrix; gate approvals; independent review for projects above a value threshold	Dominance of one project; no recorded decision points; unclear accountability
2. Cost and schedule control	Approved baseline (WBS, schedule, budget); earned-value reporting (CPI, SPI); progress certified by quantities; payment linked to certificates	Progress–payment gap; missing end dates; no variation records
3. Quality control and assurance	Quality plan; inspection and test plans; material approvals; non-conformance reports (NCR); formal acceptance and snagging list	No evidence of inspection linked to progress; progress statements without basis
4. Risk and contract management	Risk register; procurement plan with preference for open competition and justified exceptions; variation and claims procedure; contractor performance file	Limited open tendering; method not stated; suspended contracts without exit rule
5. Information and knowledge	Single project register with mandatory fields and validation; monthly dashboards; close-out report and lessons learned	Missing and inconsistent dates; empty additions column; no institutional learning

Source: authors' proposal, informed by PMI (2021), ISO (2017) and Fleming and Koppelman (2010).

6.1 Triage rule for the existing stalled portfolio.

Here's a rewritten version of the input paragraph in a more human-friendly tone: We're dealing with a legacy portfolio, so we need to prioritize. To do this, we use a triage rule that decides what to do based on how much progress has been made and how big the project is - you can see the details in Table 7. First things first, we need to double-check the progress that's been reported. The numbers we have aren't verified, so a technical team should go to the site and measure the progress again to get an accurate picture.

Table 7. Triage rule for stalled projects

Condition	Action	Projects in the register
Verified progress ≥ 90%	Quantity measurement, snagging, final acceptance and financial settlement ("quick wins")	P11, P14, P15, P17

Condition	Action	Projects in the register
50% – 89%	Re-baseline the remaining scope; settle certified arrears; confirm contract validity	P1, P2, P6, P7, P12 (after verification)
< 50% with no payment	Technical re-evaluation and condition survey; decide to resume, re-scope or re-tender	P3, P4, P5, P10, P13, P18
Contract value above threshold	Independent technical-financial review before any decision	P8 (and P9 as its supervision contract)

Source: authors' proposal. Allocation of projects is indicative and based on reported, unverified progress.

6.2 Performance indicators.

Table 8. Core indicators of the framework

Indicator	Definition	Use
CPI	Earned value / actual cost	Cost efficiency; < 1 signals overrun
SPI	Earned value / planned value	Schedule efficiency; < 1 signals delay
Progress–payment gap	Certified progress % − payment %	Detect arrears or advance payment
Rework rate	Value of rework / contract value	Quality performance of the contractor
NCR closure time	Average days from NCR issue to closure	Responsiveness of quality control
Stalled-project ratio	Value of stalled projects / portfolio value	Portfolio health, reported to the steering committee
Register completeness	Share of mandatory fields completed and valid	Information integrity

Source: authors' proposal; EVM indices after Fleming and Koppelman (2010).

6.3 Implementation roadmap.

Table 9. Phased road map (Phased implementation road map (months from adoption)).

Phase	Timing	Main actions
I. Foundation	0 – 6 months	Verify and complete the project register; on-site measurement of all stalled projects; adopt templates (charter, baseline, inspection and test plan, NCR); form the steering committee; close the "quick-win" projects.
II. Control	6 – 18 months	Introduce monthly earned-value reports; link payments to certified quantities; apply stage gates to all new and resumed projects; training of technical staff in QC, EVM and contract administration.
III. Consolidation	18 – 36 months	Audit of compliance with the framework; publish dashboards; institutionalize close-out reports and lessons learned; review thresholds and indicators.

Phase	Timing	Main actions
		

Source: authors' proposal.

7. Conclusions and Recommendations.

Here's a rewritten version of the input paragraph in a more human-friendly tone: Take a look at the list of projects that have come to a standstill. You'll notice that a lot of the financial risk is tied up in just one project. The problem is, the progress being made on this project isn't matching up with the payments being made, and to make matters worse, the records are incomplete. These aren't just one-off mistakes - they're symptoms of a bigger issue with how we're managing these projects. We need to get back to basics and set some clear benchmarks, make sure we're measuring progress accurately, and keep a close eye on quality control. To tackle these problems, we've come up with a simple framework that breaks things down into five stages and five key areas to focus on. By following this approach, we can reduce the chances of more projects getting stuck in the same way.

The recommendations are:

Go back and check the status of all projects that are currently stalled and have a technical committee verify the results to make sure everything is accurate.

1. Start by closing out the four projects that are 90% or more complete.
2. subject the largest project to an independent review.
3. require approved baselines and certified progress as a condition of payment.
4. adopt a quality plan with inspection and test plans and NCR tracking for every contract.
5. mandate a validated project register.
6. prefer open competition and document the justification of any exception.

Future research should validate the framework through case studies and expert consultation (e.g. a Delphi study) investigate the causes of interruption with contractors and project owners, and track indicator performance after adoption.

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