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Leadership issues for road project engineers

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Leadership issues for road project engineers

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Abstract. Being a construction team leader is an enormous responsibility because leaders inspire and motivate others. This study aims to identify leadership development and required skills from engineers' perspectives. Using a qualitative approach from interviews with eight civil engineers, the authors explored their leadership issues and practices, especially in handling road project delays. The participants' diverse viewpoints and experiences led to road construction's four most common delay factors and how they responded to them. The research findings demonstrated that engineers in road projects require leadership competencies and extensive technical knowledge and experience to keep road projects on track. Since leaders accept responsibility, they must constantly learn to expand their knowledge and find new approaches to solve problems. This study generated a leadership chart highlighting road engineers' leadership competencies to engage, coordinate and communicate effectively with team members and other project stakeholders. Combining technical expertise and soft skills enhances engineers' ability to navigate construction complexities and adapt to changing trends.

1. Introduction

Leadership is defined in a variety of ways. This study, however, employs the one from Benator and Thumann's (2003) book, Project Management and Leadership Skills for Engineering and Construction Projects, which described leadership as "*the process of influencing individuals or groups to accomplish an organizational goal or mission*"[1]. A formal leader or manager is an individual holding a position of authority within an organisation or group, responsible for managing outcomes and subordinates [2]. Leadership deals with what leaders' goals or common goals (e.g., business, public agencies, political) and whom (supporters, members, participants) to lead [2]. It is a crucial component of organisational culture [3], and therefore enhancing individual capabilities, according to [4], is more important than the organisational structure.

Multiple studies demonstrated that leaders and leadership have long been recognised as influential factors in project success and failure [5]–[8], as well as construction site safety [9]. Success and failure in organisations or companies are defined by leadership, which is influenced by the personality of the top manager and the distribution of personalities within the group of managers [10]. The lack of experience of technical personnel has a substantial impact, including delays in highway or road construction [11] and disputes. Shortcomings such as inadequate skills to handle a claim-related [4] and lack of communication [12], [13] have contributed to a construction dispute. Disputes in construction can be referred to as prolonged disagreements over unresolved claims and protracted conflicts [14], such as delays, payments, and scope changes ([12], [15].

Reaching agreements on something, such as business deals, necessitates a strong leadership strategy [16]. Instead of finding failures related to leadership, this study highlighted the benefits of leadership in

construction, where construction researchers listed and linked construction performance with leadership style, team leader, and leadership experience [8], [17], [18]. [19] listed several ways to improve construction productivity on an oil and gas project, such as improving first-line (foreman) leadership, enhancing leadership at all levels, owners doing an excellent job in leadership, developing project construction leadership for adequate supervision, and provide leadership and planning training.

Malaysia appears to be internationally active in contributing research papers related to project delays, and the country is ranked third behind China and The United Kingdom [20]. However, insufficient studies address the leadership issues in construction projects in Malaysia. No matter how well the strategy and execution of construction works, delays are beyond the leaders' control due to unexpected or unforeseen delay events. Therefore, a leader must determine the response to manage and minimise the impacts of the delay on the work programme. The need for leadership is increasing in the civil engineering and construction sectors [21], and education for future engineers should focus on developing leadership skills [22]. This study provides readers with an overview of road construction delays and leadership development and highlights the competencies of road engineers. Thus, this study has the following objectives:

1. Identify the typical road construction delays and engineers' responses to mitigate them.
2. Explore engineers' leadership development and responsibilities.
3. Recommend essential leadership competencies for engineers to become great leaders.

1.1. Road Construction Delays

Over half of the construction projects require more time and money than anticipated [23]–[25]. [26] claimed that delays in road projects in Asian countries are associated with contractors' financial problems and poor planning. In African countries, the authors asserted that delays are related to financial/ funding problems of the owner and equipment and material issues. Although construction problems appear similar in developing countries [27], research shows that delay factors are generally specific to each country's environment, as covered in the following paragraphs. Delays have no consensus because they are specific to a project, country location and type [17], [28] including policy, working cultures and management style [29]. Cultural influences, manpower availability, political instability, and project contractual relationship also influenced delays [30].

In this study, the authors highlighted several studies that emphasised significant delay reasons and success factors in infrastructure projects in Asian and African countries. However, studies on road or highway projects in other continents will be included to relate to the delays in Asian or African countries.

In road construction in Egypt, the owners' financial problems, resource problems, the contractors' lack of experience, materials shortage, equipment failure, design errors, mistakes in soil investigations, poor subcontractor performance, rework due to design changes, and contractors' poor site management and supervision were all significant delays [17]. These delays indicated that clients and contractors contributed to substantial delays in road projects.

Related studies in South Asian countries will be listed. In Indian road-over bridge projects, land acquisition appears as a lead delay factor related to the acquisition process and resistance and objections of landowners [31]. Other significant project delays were various stakeholders, displacement of networks, legal requirements and claims and disputes. An earlier study on Indian road projects focused on the land acquisition delay, where the authors linked the administrative delay to the process [32]. Land acquisition issues, payment delays, design changes, and utility relocation delays were associated with cost overruns in road construction in Sri Lanka [33].

Referring to the land acquisition issues in road projects, a specific study of Right of Way (ROW) acquisition for highway construction in the United States mentioned the concern related to the design process. The issues were inadequate understanding, unawareness of site needs, and lack of communication among those involved in the design process to exchange information related to design issues for ROW acquisition in highway construction [34]. According to a case study of the motorway project in Sydney, Australia, by [35], the project faced numerous legal issues since there was insufficient preparation for evicted owners, which resulted in objections. The opposition beyond the initial period delays the large-scale project.

Numerous research has also been conducted in Southeast Asia regarding delays in infrastructure projects. In Cambodia, rain and flooding were the top delays in road construction [18]. Policy flaws and owners' fiscal ability in Vietnam directly influenced highway schedule delays [36]. Incomplete drawings, improper resource management and contractor's financial problems seemed to be the most critical aspects of the timely completion of road projects in Thailand [37].

In Malaysia, time performance for road projects was associated with excusable delays such as superintending officer's instruction, late instruction, directive upon a dispute, delay in giving site possession (land acquisition), delay by parties engaged by the government, and inability to foresee (unforeseen ground conditions, materials shortage, delays in getting import permit and power supply) [38]. Among these delays, delayed site possession can contribute to significant time overruns. The average time delay found in a recent study was 31%, and a few road projects overshot their contract duration by more than 50% [39], [40]. Relocation of utilities, illegal structures in Right of Way (ROW), squatters, traffic management plan during construction, slope stability, environmental aspect, and labour were other challenges that could delay a road construction project [40]. The delay of utility relocations includes late information from related utility companies and their late actions involving relocation procedures [40].

Delay factors in several Middle East countries also varied. The most significant delay in Palestinian road projects has been caused by political circumstances [41]. In Bahrain, contractors contributed to the most delays in road projects due to poor planning and scheduling [42]. Similarly, inefficient planning was the most significant risk in highway construction in the United Arab Emirates (UAE), followed by unexpected ground utilities, quality and integrity of design, approval delays and delays in expropriation [43]. Meanwhile, land acquisition significantly delayed road and bridge projects in Saudi Arabia, followed by contractors' lack of expertise, redesigning, and haphazard underground utilities [44]. In Jordan, the leading delays in road and maintenance projects were mainly related to the owner, such as payment delays, slow decision making and changes in order specification [45]. Jordan's top five delay causes also embraced a mismatch between the location of infrastructure services from submitted drawings and the tender's approval. In Qatar, top delay factors in infrastructure projects were related to long response times from utility agencies, significant design changes during construction, ineffective planning and scheduling, and ineffective control of progress and scope changes [46]. Utility agencies' late responses and approvals in Qatar caused construction delays when no other work options were available. The Middle East countries reported delays in various causes, but utilities-related delays appeared in four out of six highlighted countries.

Several African countries also experienced delays in infrastructure projects due to multiple reasons. Payment delays contributed to the main delay factor in road projects in Zambia [47]. In Malawi, the primary reason for the delay was a fuel shortage [48]. Financial problems, delayed payment by the owner, scope changes and inadequate contractors' experience led to significant delays in road construction in Ghana [24]. In Libya, utility services caused critical delays in road construction, followed by budget availability, short contract duration, delay in progress payments, and effects of subsurface or underground conditions [49]. Meanwhile, cash flow problems contributed to significant delays in Sudan road construction [50]. In general, the reasons in the highlighted African countries were various but also linked to financial issues such as delay in payments and cash flow issues in three African countries, despite other reasons were also found substantial.

1.2. Construction delay mitigation strategies

Although the authors focused on road projects, this paper also highlighted construction delay mitigation strategies based on the highlighted delays, regardless of project type. Success factors in infrastructure projects may also be considered. For instance, top management experience and effective site management were critical success factors in highway projects in Pakistan [51]. Procedures and resources, construction sites and third-party involvement are among the eleven success criteria for highway projects highlighted in Malaysia [52].

The most frequent response or suggestion to construction-related problems is mitigation, as suggested by many studies worldwide [26], [53]–[55]. Understanding the underlying causes of road construction delays is the first step to mitigate the delays [17].

Related authors in road projects suggested suitable mitigation strategies for site possession delays. In Malaysia, recommendations to mitigate the delay include reducing red tape for the land acquisition process, resolving land issues before construction begins, detailed coordination between land surveyors and road designers, and project information sharing with those affected at the planning stage [38]–[40]. Next, squatters must be evicted before construction starts, with state governments having a crucial role in this process [39], [40].

In the United States, securing the possession of the Right of Way before construction begins, early inspections of properties to be acquired to identify any mistakes in the appraisal process, and involvement of related parties in the design process to reduce design changes were pointed out [34]. Meanwhile, Australia highlighted consultation with key stakeholders, which includes coordination, communication, engagement, and negotiation with affected landowners to expedite the acquisition process. In addition, a personal manager can be assigned to coordinate all interactions between affected landowners and the acquiring authority for smooth project implementation [35].

The lack of proper design in highway construction contributed to variations, resulting in construction claims [56]. In resolving design-related issues, adequate communication is needed in the design process, especially concerns about the limited knowledge and unawareness of the site requirement. The data system should also record any plan revisions for designers' actions [34]. Stakeholders' involvement in the design process is essential to reduce design changes [26]. Engineering judgements are also crucial in design, where a lack of specific knowledge, such as geotechnical concepts based on site conditions, can contribute to a project failure [57], [58]. In geotechnical issues, the judgements can be best developed by analysing prior achievements and failures, along with experiences, mentorship, and ongoing education [59].

Moreover, the timeline for design preparation should be increased and adequate to minimise design errors and get sufficient time to review the design. This action can minimise variations during construction [56]. Selecting qualified designers is crucial to minimise design issues and potential construction claims [56], [60].

Concerning utility services and their relocation, the planning and design of roads must include utility providers to provide related utility information [40], [60]. In addition, project teams can validate the infrastructure services location and other information at project sites before approval in tenders and drawings [45]. Inaccurate as-built data and unavailability of services' critical plan contributed to unexpected underground utilities [43]. Some utilities might not appear at all or appear in the incorrect location. In contrast, unknown utilities that were not shown on the contract drawings are encountered during construction [61], resulting in diverting or relocating the utilities [56]. Therefore, project teams needed correct as-built drawings to minimise the need to relocate existing utilities or structures connected to construction claims [56]. No substantial delay was caused by interfering utilities in a project when early negotiation with utility owners, a detailed Utilities Coordination Work Plan (required utility information to complement the design plans) and relentless communication were executed [61]. The author emphasised that the Utilities Coordination Work Plan required constant and aggressive communication, coordination, regular face-to-face meetings involving parties, and follow-up actions.

Regarding other issues related to improper planning, inefficient site management and red tape in construction, [54] provided several lists of mitigation measures. For improper planning, the measures include:

1. site investigation detailing the surface and subsurface conditions,
2. conducting feasibility studies to verify that the final designs match the actual on-site conditions, and
3. encouraging frequent site and technical meetings.

Next, assigning competent site managers [54] or qualified personnel [26] could reduce the effects of ineffective site management, which is mainly due to resources, labour, and equipment [54]. Meanwhile, communication protocols between parties must be established in dealing with red tape [54]. In addition to mitigating project planning issues, [26] recommended using project planning tools or simulations and evaluating resources and restrictions for construction works. Overall, communication is involved in all mitigation strategies listed in this section, which is crucial in getting and transferring information in the planning, design, and construction stages.

1.3. Leadership development and principles

Many leadership studies highlighted leadership development in detail, such as the one by Turner et al. (2018) [62]. However, this study briefly discussed the essential points of leadership development: learning, training, experiences, and practices. In the development context, some individuals considered taking on leadership roles or engaged in leadership activities self-selected for leadership training and brought their motivation [63]. Leadership development occurs in any context where leadership is practised and when a group of leaders is learning to address issues [64].

Leadership can be taught in technical and professional learning contexts [21]. Engineering students' leadership development can be cultivated by developing their professional competencies and leadership skills [22]. Most importantly, engineers must have a solid technical background, such as in the design phase, where design is regarded as the heart of engineers' work [65]. Competent designers are associated with knowledge, skills, and experience [66], whereas experienced engineers can reveal the inadequacy of designs [57]. Moreover, in handling and ensuring the performance of certain project delivery types, such as design-build projects, participants must be capable of design and construction coordination [67].

Beyond leadership development, those who want to lead usually learn the principle of leadership roles. The subject of 'What should a leader do?' was explored by [68], and the author found that the answer is based on leadership ethics and its philosophical approaches to ethics. The first understanding of leadership roles is linked to the goals. Leaders and followers must have shared plans to translate the goals into actions [69]–[71]. Leadership also supports ethical behaviours, such as followers emulating the leaders' moral conduct and increasing their moral actions in ethical leadership [72]. Leaders' actions and behaviour also influence the relationship between leaders and members [71].

Leadership should also encompass recognising and rewarding as motivation [73]–[75], enhancing social relationships and resolving interpersonal conflict [70]. Leaders' coaching also motivates others to perform [76]. Another principle is that leaders should let followers feel a sense of freedom at work by recognising their strengths and contributions [71], [73]. Moreover, knowledge sharing as a component of an organisation's culture [75] can help leaders encourage employee innovation [77]. In general, leadership entails the ability of leaders to command, inform, convince, influence, and motivate their followers.

1.4. Leaders' Roles and Responsibilities

A construction leader plays a significant role in influencing and contributing to project success. Self-awareness reflects leaders' understanding of their roles, capabilities, and emotional control [21]. In engineering projects, the primary responsibility of engineering managers is to ensure that the projects are executed within the stipulated time and cost [78]. Two-way communication between leaders and members, active participation, direction, and decisions are the typical leadership roles in construction projects [79].

A great leader promotes better communication through a clear vision and responsibilities to enhance the flow of information [80] between project parties. Using electronic documents helps facilitate good communication in projects [81]. Communicating clearly and often with all stakeholders is part of leadership best practices [82], which refers to the leader's ability to listen to others and convey ideas successfully [21], [83]. Moreover, leadership concerns whether a leader can persuade people to support a change by imparting values and meanings [84].

A leader delegates responsibilities to trusted team members or individuals who play essential organisational roles [82], [84]. However, they need to manage their subordinates well because slackers can undermine the efforts of other team members, encourage idleness, and ultimately reduce the team's efficacy as a whole [85]. Leaders should also participate and engage others in the decision-making process, and they make difficult decisions when they deviate from the group's consensus. However, not all decisions should be decided by group consensus due to timeframe [86]. Influential leaders in construction demand leadership qualities in their roles and responsibilities to successfully coordinate and communicate clearly with all project participants.

1.5. Leadership competencies

Leadership competencies have been acknowledged as a significant driver of project success. In road construction, selecting a team leader like a project manager with the necessary skills, tools, and practises helps reduce construction delays [50]. In this section, the authors briefly mentioned two theoretical frameworks linking leadership with project success and three studies on leadership competencies, as summarised in Table 1. The first theoretical framework is for effective Fourth Industrial Revolution (4IR) leadership. It is associated with leadership styles, traits, and intelligence [87]. The second theoretical framework linked transformational leadership with project success by including risk-mitigating strategies (project flexibility and visibility) [88]. Outstanding leaders possess several essential skills for leadership competencies, such as those by [89]–[91] that identified the following as the examples of leadership competencies: Communication, ethics, nurturing relationships, active listening, negotiation and problem-solving.

Table 1. Leadership competencies

Authors	Leadership descriptions	Competencies Recommended
[89]	25 important leadership competencies incorporated in seven important domains, resulting with leadership competencies model named DRENICA	Leadership Competency Model Drenica (LCMD) i) **D** Dignity and respect; Distributing rewards fairly; Decision Making ii) **R** Reflect; Relationship building; Responsibility for others; Reinforcing change iii) **E** Ethics; Enhancing task knowledge; Eliminating barriers to performance; Evaluating consequences; Explaining decisions with respect iv) **N** Nurturing relationships v) **I** Integrity and Honesty; Identifying problems; Intelligent risk taking vi) **C** Communication with community; Continuous learning; Critical thinking; Creative problem solving; Collaborating vii) **A** Active listening; Adaptability; Achieving goals
[91]	Disclosed the specific competency profile developed by those lead in work organizations.	i) ability to negotiate effectively ii) alertness to new opportunities iii) ability to assert your authority iv) ability to mobilize the capacities of others v) willingness to question the own and other's ideas vi) ability to come out with new ideas and solutions vii) ability to coordinate activities viii) ability to make your meaning clear to others
[90]	highlighted project managers' leadership and project success in several project types such as in	a) Low complexity i) communication skills

	low, medium and a high degree of complexity projects.	ii) Ability to achieve project objectives iii) Motivation to achieve the stated objectives iv) Awareness on one's own feelings and the ability to control them b) Medium complexity i) Managers in the field of ethical solution of emerging problems ii) involvement in the chosen course of action iii) multi-source analysis of these problems. c) A high degree of complexity i) all competences belonging to the management dimension (communication skills, resource management, achieving goals, inspiring, and developing others) ii) empathy, emotional resilience, and strategic perspective.

A complex project makes the flow of information more challenging [92]. For instance, making timely decisions is required for better contractual management [93] because delay in the decision-making process is part of construction delay risks [23], [24], [42], [45], [93], which can lead to change order in road projects [94]. Therefore, communication skills are deemed the most crucial aspect of construction. In the past 30 years, communication has been discussed as an essential management skill [83].

Beyond verbal communication, which is vital for enhancing the safety of construction sites [9], non-verbal communication through gestures or appearances, such as eye contact, facial expressions [83], or handshakes for business negotiation [95], is part of construction project communications as stated by previous authors [80], [96], [97]. Under intense external pressure, people act in ways that send out negative messages [83]. Other communication methods in project management included by [80] were written communication, visual communication, and electronic communication. Electronic communication was ranked the second highest effective method, and nonverbal as the least effective method. In project teams, communication and commitment influenced success in highway projects studied by [98]. All project participants in the construction industry must effectively communicate to ensure the proper flow of information to minimise understanding between parties and avoid delays [60].

The following essential skill to present is delegating responsibilities since leaders should be trained to empower their teams, a practice called shared leadership [99] to achieve team members' happiness [100]. Although several leadership theories and practices exist, which are not the focus of this study, the emergence of distributed leadership emphasises that leadership is no longer solely the job of one official leader [74]. A construction study linked transformational leaders with project success, where leaders foster collaboration and trust among project stakeholders [88].

Construction and civil engineers also demand team practices and problem-solving skills to deal with unexpected events and decision-making [21], [59], [65]. Working together as a team can make each member feels ownership over the project [60], [87]. In problem-solving, construction leaders must also have legal knowledge to comprehend the legal context of construction contracts [21]. Leaders can adapt knowledge and skills according to situations [87].

Next, leadership requires handling conflicts within a group and counteracting the effects on productivity and morale [101]. Conflicts can also happen between construction parties, where prolonged conflicts lead to construction disputes. Linked to the disputes is another essential competency, negotiation skills, because negotiation is the best strategy to reach a consensus [102] and resolve

construction disputes [103]–[105]. This nontechnical skill can be acquired through experience rather than formal learning [106]. It takes effective communication to resolve conflicts as soon as they arise [83].

Furthermore, interpersonal skills are generic skills applicable to leaders. [107] examined interpersonal skills as a crucial component of leadership that influence leaders' well-being. They focus on two widely recognised skills: emotional skills (understanding and controlling emotions) and political skills (e.g., influence, convincing), also known as social judgment skills. Leadership requires a high level of understanding and the ability of leaders to handle interpersonal relationships judiciously [87].

In addition, teamwork or networking was among the 19 leadership competencies listed by [21] for construction professionals. Working and communicating well in a team is referred to as teamwork. Meanwhile, networking requires time to develop a relationship with colleagues and clients. The construction site, which also holds site meetings at site offices, is a great place to network with professionals and other project stakeholders. Clients, designers, contractors, project managers and the public are a few examples of construction project stakeholders [108], [109].

Multicultural skills are also part of leadership, which describes a person's leadership to be aware of their culture and cultivate interpersonal skills to enable and support the innovation process [75]. Other skills to be presented by leaders include planning, problem definition, goal analysis, idea evaluation, wisdom, sensemaking, and creative thinking [110].

Overall, leadership encompasses knowledge and competencies that have a positive relationship in increasing road project performance, where leaders set realistic goals for projects by prioritising tasks, gather project team members to find solutions, track progress and communicate with other project stakeholders for collaborative actions in minimising delays.

2. Research Methodology

Although many prefer the quantitative approach [109], this study adopts the qualitative method through interviews to explore the leadership skills which require engineers to conduct and decide their creative thinking and problem-solving skills in road projects. Instead of listing and ranking the issues without further explaining the detailed reasons for each highlighted case, interviews contributed to a better understanding of the study's concerns. This method can concentrate on engineers' experience of their leadership path reality.

Numerous construction and leadership studies also used interviews as a methodological approach. For example, [12] conducted interviews and content analysis to explore participants' viewpoints and get a more detailed explanation regarding construction dispute factors. Another example is the leadership development study, where the authors included several interviews to get more details on individual examples they shared on a survey and during focus group discussions [64].

A semi-structured interview protocol was developed following the summarisation of the literature. It allows the authors to have the freedom to design the set of interview questions for more detailed responses and viewpoints from participants [12]. The interview method highlighted the road project delays, mitigation strategies, leadership attributes and competencies and offered new ideas into fundamental principles.

We purposely chose eight participants, six certified professional civil engineers within the Public Works Department Malaysia (PWD). Purposive sampling enables the authors to achieve the research objectives by selecting specific participants with consent. The participants can give deep perspectives based on their experiences engaging in road projects for novel and intriguing insights into the highlighted matters.

Female and male engineers were invited to participate in the interview sessions to ensure gender equality in this study. Both genders can make better leaders depending on their experiences and issues discussed in this study. All participants had weighed in the decision-making process as a lead in a project or design team, district offices, a branch in the headquarters, and an agency in a state to ensure the reliability and validity of the results.

The interview sessions were conducted in three ways: (1) six virtual, (2) one face-to-face, and (3) one telephone. The interviews were recorded with permission without using any identifier related to a specific person to protect the participants' confidentiality [111].

3. Analysis and Findings

The authors gathered all the essential information of participants' perspectives, and the stages involved in the qualitative analysis in this study were as follows:

1. Transcribing, coding, categorising, and analysing the interview data. Qualitative data analysis software, Atlas.ti Version 9.1.3 was used to facilitate the authors by creating and inserting code into selected quotations on interview transcriptions to categorise the data.
2. Presenting the data in a table and a diagram highlighting the data's patterns to assist the authors and readers in comprehending the data.
3. Discuss the interview data for detailed elaboration on the causes of road construction delay, their mitigation strategies, and engineers' competencies in leading their team members and keeping projects on track.

The later writing draws conclusions based on the data patterns of engineers' leadership competencies. The authors identified patterns in the data and established logical classifications by grouping related themes into related categories under content analysis, as [12] applied. Contents related to road project delays, mitigation strategies, leadership development, attributes, and competencies were reported using content analysis. Depending on the participants' comfort and preferred language, interviews were performed in Malay and English. All interview sessions lasted for approximately 45 minutes to three hours, based on the information shared by the participants.

Table 2 shows the demographic data of participants involved in the interview sessions. Five participants, a director and four senior engineers, worked at the PWD headquarters in Kuala Lumpur. The sessions also involved a director in a state in the eastern part of Peninsular Malaysia and two district engineers in two districts in Pahang and Selangor. In terms of academic qualifications, five participants hold master's degrees, and the other three with bachelor's degrees. The demographic table indicated that five participants were highly experienced, with more than 20 years of working experience in the construction industry.

Meanwhile, three participants had over 15 years but less than 20 years of working experience. Most importantly, all participants had diverse experience in executing and leading a team in road and infrastructure projects, with four having experiences as Superintending Officers (SO) or SO's representatives, which gave significant weight to this study. This information demonstrates that the participants have appropriate academic qualifications, knowledge, and experience in implementing road projects. Therefore, they are deemed reliable regarding leaders' capability in this domain.

This study used the term "members" in the analysis section instead of "followers", as seen in the literature, because engineers lead project or design teams of road projects, and their subordinates are often referred to and called project or design team members.

Table 2. Demographic data of participants

Participant (Code)	Position/ Title	Gender	Education	Experience (Years)	Interview Time (Hours)	Location
P01	District Engineer/ Ir.	Male	Master's Degree	>15	+- 2.00	A district in Pahang
P02	Director/ Ir.	Male	Master's Degree	>30	+-3.00	A state in the eastern part of Peninsular Malaysia
P03	Director/ Ir.	Male	Bachelor's Degree	25	+- 1.50	Headquarters
P04	Senior Engineer/ Ir.	Female	Master's Degree	>20	+- 2.25	Headquarters

P05	Senior Engineer/ Ir.	Female	Master's Degree	>18	+-1.10	Headquarters
P06	Senior Engineer	Male	Bachelor's Degree	>17	+-1.50	Headquarters
P07	Senior Engineer/ Ir.	Female	Master's Degree	>23	+- 2.75	Headquarters
P08	District Engineer	Male	Bachelor's Degree	>20	+- 0.75	A district in Selangor

3.1. Leaders' response to road construction delays

Construction delays are frequent due to projects' complexity and uncertainties. Leaders, however, are crucial in keeping projects on track and minimising the effects of delays. All participants' experiences highlighted the delays they often encounter and found significant in road projects, as summarised in Table 3. Four typical delay factors in road projects that participants shared were counted more than once in the interview sessions, indicating that the participants shared similar experiences in the delay factors. The delays were related to the delay in giving possession of the site, contractors' poor site management, design-related issues, and relocation of utilities. Delayed site possession was mainly due to the government's default in giving the site to contractors to perform their contractual obligations. It was related to the land acquisition process and any encumbrances on the site, such as squatters or invaded Right of Way by unauthorised persons. Contractors' poor site management also appeared as the most frequent delay factor in road projects, which is linked to the practices of contractors. The subsequent delay perceived by mostly experienced design engineers was design-related issues such as improper design or design errors due to unawareness of the site conditions, and lack of specific design knowledge and inadequate experience. Another common and significant delay is the lack of planning in relocating utilities, which often contributes to delays in road projects. Each delay cause is explicitly presented in the following paragraphs.

Table 3. Summary of delay factors

Delay factors	Codes	Interview counts/ participants
Delay in giving possession of the site	a) Land acquisition process b) Squatters on the government land and Right of Way	3
Contractor's poor site management	Improper planning and scheduling, lack of coordination between parties	3
Design-related issues	a) Design knowledge and process such as for geotechnical issue	2
	b) Improper design/ incomplete design/ design errors due to the lack of awareness of the site requirements lead to design changes	2
Relocation of utilities	Delays in the relocation process/ lack of coordination with utility companies	2

Three participants shared similar views and experiences about delayed site possession in the implementation of road projects. We noted that land acquisition and site possession are given in parts, as roadway alignments were long, involving multiple landowners, requiring a longer process than a building project. Therefore, the client often experiences delays in acquiring private lands to allow work to proceed in some key areas. One activity might be unable to start several days after completing another,

causing a delay or a lag. The delay was frequently linked to land acquisition procedures, squatters and other illegal structures on government land or government Right of Way (ROW). Squatters' protests and demands by illegal occupants include ex-gratia payments that were challenging to fulfil due to additional costs, which, sometimes beyond the government's ability, can lead to road project delays [40].

In general, the participants implied that the lengthy land acquisition process due to several mandatory steps affects the time performance of Malaysian road projects, as [38] explained. Moreover, challenges in getting accurate and updated land records seemed to participants in increasing time to prepare land acquisition plans. Outdated land records may result in acquiring additional parcels of land previously identified as government land that was already privately owned. Previous studies that explored land acquisition delay in infrastructure projects also discovered delays in the land acquisition process, and it was the most critical factor affecting infrastructure projects [31], [44]. A recent study in Malaysia for 15 road projects also demonstrated that site possession delays resulted in average time overruns of 31%, with some delays exceeding 50% of construction duration [39].

Participants have then highlighted two necessary actions in dealing with site possession delays: (1) coordination with state governments and the acquiring agency and (2) community engagements involving affected persons. Both actions are vital to expedite the timeline for land acquisition and proceed with works at available working areas. Regarding coordination, the federal government must coordinate and frequently follow up with state governments and acquiring agencies after the application process, especially any urgent land matters to be approved. This can ensure that the land acquisition process is in tandem with the construction process. Coordination with state governments is also required since their powers on land matters are needed to enforce laws firmly regarding squatters and illegal structures. Enforcement must be done before projects' execution to remove any encumbrances on sites [39], [40]. Meanwhile, community engagement and consultation with affected parties involved with squatters or illegal structures on government land are crucial during the planning and design stages. [35] proved that coordinating and engaging with affected people can expedite acquisition.

In addition, to the above strategies, networking benefited the approval process, as shared by participants, by early notifying the counterparts to proceed with subsequent actions and providing more details on projects to facilitate preparing their reports. One participant also highlighted a best practice implemented in a large-scale road project. The approach substantially impacted the land acquisition process, where a project team assisted the acquiring agency in assigning additional staff for a predetermined period to prepare the required information for land acquisition reports. The idea was initially generated from a leader’s creative thinking to expedite the acquisition process [89], [110].

Another typical delay in road construction is contractors' poor site management, planning and coordination. This issue arose due to several problems related to the productivity rates of skilled and standard workers, machinery, and cash flow. Numerous studies discovered issues with contractors, who were held responsible for most delays in road construction, such as findings by [17], [26], [37], [60]. This issue necessitates close monitoring and investigation of real problems on-site or root causes [17] by leaders in the project teams from the top down. The most experienced participant suggested that engineer leaders at project sites, representing the government or client (S.O. or S.O.’s representatives), can help contractors by investigating concerns about insufficient workers on the job site. Workers can be considered a reliable source of information on problems on-site, especially when they are directly asked by the leaders on the client’s side (PWD). Therefore, these leaders can determine each activity's required workforce and duration. Once work activities with issues have been identified, the relationship among construction activities can be specified and adjusted to meet the required timeframe.

Design-related issues were also significant in road construction delays, counted four times in the interview sessions. Delays can occur due to the lack of awareness of the site requirements during the design process [34]. Some designers do not thoroughly investigate, clarify the project scope, and coordinate relevant information on-site between multiple government agencies and related parties during the planning phase. This will cause incomplete design and redesign to suit the site conditions during construction, eventually leading to variations, claims and delays [56]. The points related to unawareness of site conditions and redesign are like a highway and road construction study by [34], [44]. Incomplete drawings were also noted by [37] as a critical aspect in the timely completion of road projects in Thailand.

The data analysis implied that the required information exchange between design teams and stakeholders involved in the design process is poorly coordinated. Participants raised the design issues and reacted to the mitigation strategies similarly, where designers must work closely with all the project team members or stakeholders to acknowledge potential design issues from planning to construction stages [26], [34]. In case of redesign is required due to technical requirements or community concerns, a realistic plan should be set for designers to complete the design process within a reasonable timeframe, as spoken by the related participants. It is often expected that a revised design will be prepared immediately. However, leaders should give their designers ample time to avoid errors and variations during construction [56].

Another challenge pointed out by two participants is related to the design modifications and decision-making process on geotechnical design, such as ground improvements and stability aspects. Underground conditions have been mentioned in previous studies as contributing delay factors in road projects [38], [49]. The properties of the rock or soil, such as soil density and water content, will influence the design for geotechnical engineering. Design engineers with specific site experiences are required to predict the ground conditions, as the conditions can be varied and complex. Site conditions must then be verified by observation, and design assumptions must be tested to validate them to ensure structures achieve the design expectations and are safe against failure [59]. Therefore, engineering leaders that lead other engineers must have substantial technical knowledge and expertise to use continuous engineering judgement for design decision-making and prevent potential risks and delays, [57], [58]. Being an engineer demands constant learning to stay resourceful and passionate to confidently take on design tasks, providing invaluable support during professional and leaders journeys, as participants perceived.

Subsequent highlighted delay in road projects by participants is the delay in relocating utilities or utility services, as found by other studies [40], [43]–[46], [49]. Although the relocation is done concurrently with the project's commencement, lack of planning in the relocation process will cause delay to other construction activities, or no works alternative can be done until the relocation process is settled, as mentioned in a study by [46]. This issue includes late information from related utility companies and their late actions involving relocation procedures.

Project team leaders must effectively monitor construction-related activities to ensure utility problems do not impair project performance. The participants who usually face this issue implied that they must always lead their team in making comprehensive planning and early investigation through proper coordination and frequent follow-up with related utility companies, as highlighted by [61]. To be best avoided, accurate records of underground utilities are required during the planning phase, especially for newer utilities [56], [61]. Most notably, the involvement of utility providers or their representatives in coordination meetings or value management labs is crucial to avoid encounters with unmarked or unknown utilities during construction, which is in line with an action listed by [40], [43]. As [61] emphasised, participants agreed that leaders in road projects should constantly communicate with utility companies or service providers in multiple ways, such as initiating meetings from time to time [54] to get work reports and follow-up actions by the companies.

In conclusion, this section has several noteworthy points for the delay factors and mitigation strategies. First, delays in road projects are contributed by clients, contractors, designers and third-party (utility companies). However, initiatives and measures made during the planning stage remain the fundamental way to avoid or minimise the impacts of delays. Next, most participants react to mitigation strategies listed here similarly, and they clearly expressed that leadership roles and responsibilities play essential roles in handling road projects. The authors discovered that research that addressed mitigating approaches also held similar perspectives. Unsurprisingly, site possession is perceived to be a significant delay factor in road construction for the past 17 years [38], [39].

3.2. Development of engineers' leadership

Leadership development of this study found that extensive exposure, experience, and analysis of previous successes and failures in engineering fields can demonstrate leaders' potential. Excellent

learners make excellent leaders through constant learning. Participating in conferences, attending technical courses, or learning through knowledge sharing in organisations [75] can help engineers build their leadership capabilities and benefit their expertise. [77] acknowledged that knowledge sharing can encourage employees to progress and advance through innovation.

This study highlights two crucial leadership responsibilities for a technical agency: (1) Organising and tracking team performance and (2) motivating team members. In tracking members' performance, efficiently organising a project is essential to show exemplary leadership skills. Let the team members overwork is not recommended to keep them focused and productive. Leaders must balance members' workloads by prioritising urgent tasks and determining their scope of work [82], [84]. Highlighting vision is one of the best indicators to keep team members on the right track [69]. Therefore, mentioning a project timeline and sharing the exact project directions or goals [69]–[71] are essential to ensure the assigned work can be accomplished within a reasonable and indicated timeframe.

Frequent monitoring, such as short meetings between members, is vital for task performance. Messaging applications such as WhatsApp play essential roles in communicating efficiently and effectively through photos, videos, or document sharing. Leaders have recently embraced remote work and virtual communication, investigating digital communication channels such as Zoom, Skype and Google Meet for discussion and performance tracking. A previous study proved that electronic communication is an effective communication method in project management [80].

Assigning tasks to track team performance can be delegated to group leaders, which aligns with previous studies [74], [82], [84], [99]. In road project teams, selecting committed and cooperative members is one of the best ways to guarantee members' performance, as they are trusted to perform [82], [84].

Leaders must also deal with members who do not perform as well. Some members doing little or letting them get away with doing anything is simply the leaders' fault that must be avoided. [85] proved that idlers demotivate others to contribute more and reduce group efforts. In handling and motivating underperforming members, participating engineers believe leaders must investigate the root cause of underperformed members before offering solutions and allowing them to contribute [71], [87] to the most appropriate activity.

Furthermore, leaders should continually practice self-discipline to encourage and govern members' conduct, as leaders' demeanour displays their readiness to act [72], [91]. Leaders should also trust the members [82], [84] and not try to micromanage what happens in the team. They must highlight the ability of members to contribute [71], [89] ideas, thoughts, and even decisions that are not governed by policies or contracts, as this approach emphasises the empowerment of members [99] to make decisions. Never criticise team members' mistakes since leaders can let them experience failure too to improve.

Working together/ teamwork, as discovered in a study by [21], is another way to motivate team members to solve complex problems and avoid a silo working style. Coaching well [76] by sharing information, giving advice, appreciating by recognising members' contributions [73], and praising members publicly for doing a great job are excellent examples of motivating members to perform.

Besides leadership development and leaders' responsibilities, motivational aspects of becoming a great leader were shared by participants as encouragement and inspiration for engineers to become great leaders. Four motivational factors were counted in the interview sessions.

i. Passion because working at a technical agency must be full of a desire to serve and help road users and the public.
ii. Happiness shows leaders enjoy leading and have positive emotions in their work. A previous study shows the connection between leaders and members associated with positive feelings such as happiness and motivation [100].
iii. Sincerity, as it related to dedication, and the ability to successfully lead a group became an enduring enthusiasm for leaders.
iv. Trust because a leader is constantly expected to perform. The term "trust" also refers to the relationships between team members.

3.3. Recommendation of essential leadership competencies for engineers

Some critical competencies for effective leadership are identified in this study. Leaders must possess the following skills: communication, negotiation, delegation, conflict management, problem-solving and interpersonal. The first skill, considered the most important, is communication, and this aspect has been widely discussed in construction and leadership studies [21], [80], [82], [90], [98]. All participants agree that excellent leaders require good communication skills to perform since they need to communicate their plans and expectations to complete a project. Most prefer verbal over written communication, as it allows two-way communication to prevent misinterpretation [9]. However, written communication is also essential in projects [80] for recording information, mainly cost-related issues and vital decisions such as scope changes during construction. In addition, body language or facial expression tells the leaders' or employees' intentions [83] without indirectly interpreting the voice, which can be acquired. Previous authors also recognised non-verbal communication in construction [80], [96], [97].

Second, leadership also demands negotiation skills in the construction industry [91], [102], [106]. The skills require effective communication to influence project participants and team members to cooperate, reach an agreement, and avoid or resolve construction disputes. Prolonged conflicts related to construction progress payments and extension of time can be negotiated before the conflicts become disputes [12]–[14]. Negotiation can be applied to either team members or other project stakeholders to reach a consensus without dissatisfaction or refusal to cooperate. Understanding the negotiation skills and process leads to proper preparation and appropriate behaviour by leaders to improve negotiation performance in construction [102]–[106].

Third, delegation or transferring tasks to others is another skill that indicates the leaders' trust and confidence in their team members [82], [84]. Leaders should delegate and structure tasks of each road project based on the project's complexity and scale, as tasks must be determined according to team members' experience, expertise, and workloads [82], [84], [91]. Team leaders also establish tasks to be prioritised by re-evaluating initial project plans. This determination entails assigning the right team members with the required technical knowledge. However, assigning tasks based on various issues is essential to develop strength and give opportunities for team members to gain new knowledge [89]. Most importantly, any job must include a timeline mapping for accomplishing each activity.

The fourth essential skill is how engineers handle disagreements with team members through conflict management skills. Conflict often arises in leader-member or member-member relationships [101], with no exception for engineers in construction. [70] mentioned that the roles of leaders include managing interpersonal conflicts. Some decisions by leaders are not made based on group consensus, which leaves leaders to make difficult choices [86]. Therefore, a consensus in a construction team [86] can be achieved by presenting facts and figures related to projects, sharing previous experiences (projects' successes and failures) [59], and getting third-party (expert) opinions or involvement [52] to determine the final decision in construction design and delay works. Either leaders or members should justify their points of view for a more transparent discussion [91]. Although leaders prefer to reach a consensus on disagreements through discussion [86], they also believe that all leaders make crucial decisions in the team's prerogative. Leaders, however, should justify their final judgements. Leaders must admit their mistakes [73], accept responsibility, and improve after failure in case of wrong judgements.

The fifth skill is problem-solving skills, as emphasised for engineering professionals by [65]. This skill is entangled with road project delays and design-related issues, as discussed in subsection 3.1. Engineers must formulate the most appropriate mitigation measures and creative solutions to minimise delay effects. In doing so, leaders investigate the required resources and estimate the duration of construction activities with critical delays before setting a new realistic deadline to complete each activity and meet project objectives [90]. Moreover, leaders must encourage collaborative decision-making [86] to eliminate the silo mentality [21] that hinders team members and various government agencies from working together.

The sixth required skill is interpersonal skills, such as establishing a good relationship [70] between leaders and members and avoiding conflicts in teams, which are essential for leaders. This idea aligns with a recent study by [71]. Any shortcomings can be identified, and practical ideas can be solicited through good relationships [89]. Conflicts can hurt professional reputations and create trust issues

between members in the workplace. Therefore, leaders must always take responsibility when something goes wrong without blaming others [73], which could damage the relationship. Several ways suggested by participants to improve relationships between team members include organising social gatherings or engaging in group activities such as team dining. Some team leaders might not give relationship-building much thought. Still, bonds during social activities can help everyone on the team feel united to enhance their performance, foster excellent teamwork, and provide invaluable support throughout a leadership path.

In addition, engineers find networking essential in leadership to solving problems and getting work done efficiently. As [4] identified, networking is one of the competencies required for construction professionals. [107] also mentioned the importance of networking skills in their leadership study. The networking approach can be associated with being relationship-oriented because the leader encourages collaboration through communication and positive relationship [89], [91].

Although the listed skills are essential in leadership, they are not enough for technical professionals, as pointed out by most participants. A high level of performance requires leaders' complete confidence to complement their leadership skills. Overall, having adequate technical knowledge and experience are crucial qualities to enhance these skills for engineers as they lead others and accept their leadership path in a technical agency. With this in mind, sufficient technical knowledge and experience are critical in the design and planning stage to make design verification and avoid design flaws. Extensive knowledge and experience are also vital to obtain maximum performance of projects during the planning and construction stages. Construction also requires field experience to organise teams and prevent site coordination problems.

4. Key leadership competencies for road engineers

Discussion from the previous sections led to the summary of leadership principles in a chart. Figure 1 summarises leadership competencies for engineers in the context of technical agency and leaders' do's and don'ts. The limitations of the chart are that only a small sample of eight civil engineers within a single organisation (PWD) participated. It could not be considered representative due to the uniqueness of the participants' views. Although all had experience in the private sector, their working experience in government projects is more extensive. Future research may involve engineers from private sectors or multinational companies to offer insights on leadership development, skills, and challenges in handling private or international projects. We highlighted how specific leadership competencies support leadership roles to improve team project performance. The findings show that communication often presents in highlighted leadership competencies: teamwork, networking, negotiation, resolving conflict, and influence. Communication is inextricably intertwined with other skills covered in this study.

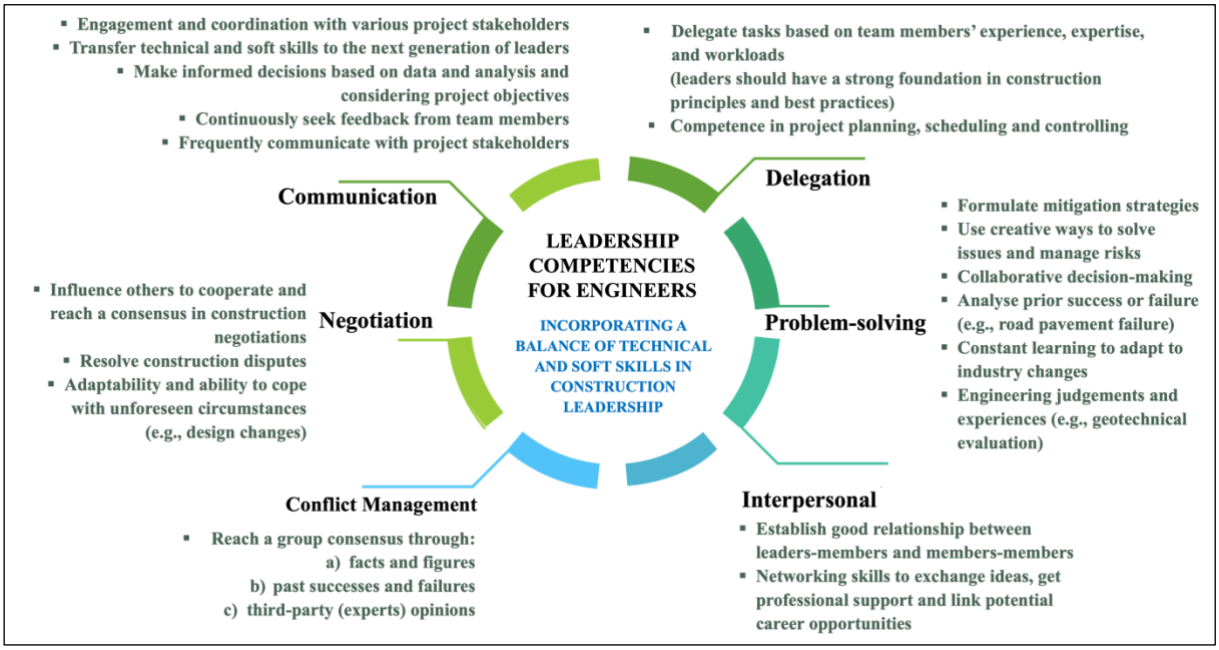

Figure 1. Leadership competencies for engineers

5. Conclusion

Leaders are significant in leading a project, especially when the project goes off the rails and unexpected challenges arise. This study enriches understanding of leadership issues among civil engineers. The authors employed a qualitative method to identify leadership development and competencies from engineers' perspectives. This study explores the typical delay reasons in road projects and how leaders should respond and deal with them. The authors summarise four delay factors in road projects highlighted by participants: (1) poor site management and coordination, (2) land acquisition, (3) design-related issues, and (4) relocation of utilities. Participants shared the delays due to their exposure positions on project or design teams. The findings show that extensive experience, analysis of past achievements and failures, and constant learning contributed to leaders' development. This study also illuminates six leadership competencies in road project implementation. Communication, negotiation, delegation, conflict management, problem-solving and interpersonal skills were listed as leadership competencies. The findings demonstrate that engineers as leaders need a firm grasp of extensive technical knowledge and experience to commence road projects successfully. Moreover, leaders' responsibilities always require effective communication to monitor performance, inspire others, and establish good relationships between members. Leaders must also adapt to many leadership theories to polish their talents and creativity, especially in problem-solving and decision-making. Overall, it is recommended that road engineers who take on leadership roles possess the soft skills highlighted in this study to complement their technical skills to flourish as leaders.

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