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Quantifying complexity and competence: Evaluating the impact of transactional and transformational leadership on complex projects

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Abstract

The interplay between project complexity and leadership competence has emerged as a critical area of study, particularly in the context of complex project environments. Although project complexity is widely acknowledged in project management discourse, there remains no single agreed-upon definition, making its practical application challenging. This research explores how project professionals interpret and experience complexity in their projects, employing the MODeST framework to quantify complexity across key dimensions and examine its correlation with leadership style from the transactional and transformational styles.

A quantitative approach underpinned this investigation, structured in two phases. The first phase involved a weighted assessment of recent projects using the MODeST model (Mission, Organisation, Delivery, Stakeholders, and Team). The second phase utilised a Likert-scale survey to evaluate participants' use of transformational and transactional leadership competencies in those same projects. Participants included practitioners from organisations such as Network Rail, Willmott Dixon, and members of the Association for Project Management (APM), each with recent hands-on project delivery experience.

Findings reveal a measurable association between perceived project complexity and the leadership style adopted. Specifically, the degree and nature of complexity appear to influence whether transformational or transactional leadership behaviours are more prominently applied. This study contributes to the ongoing discourse on leadership in complex projects by providing empirical data that links leadership competence to complexity perception, offering practical insights and a foundation for further academic inquiry.

Keywords: Project Complexity; Modest Framework; Transformational Leadership; Transactional Leadership; Leadership Competencies; Complexity Assessment

1. Introduction

1.1. The Significance of Project Complexity

Project complexity has gained substantial recognition in the project management discipline due to the evolving nature of projects, especially in dynamic environments. As noted in the document, "project complexity is widely accepted as one of the most important topics in project management research and practice." Despite its significance, there remains a lack of a universally agreed-upon definition, which makes the concept challenging to standardize and apply effectively.

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Researchers have attempted to categorise complexity through numerous lenses, ranging from project size and scale to behavioural, technical, and environmental aspects. The MODeST framework (Müller, Geraldi and Turner, 2012) is employed in this study to analyse these dimensions across five core areas: Mission, Organisation, Delivery, Stakeholders, and Team. This model helps capture how practitioners perceive and respond to the complexities embedded in their project environments.

The necessity of addressing complexity is further emphasised by its effect on performance outcomes. Projects today are influenced by "globalisation, rapid technological changes, changing customer expectations and the need for sustainability," making the identification and management of complexity not only critical but unavoidable. The research highlights the practical implications of understanding complexity from the viewpoint of project practitioners who must navigate it in real time.

1.2. The Role of Leadership in Project Execution

Leadership plays a vital role in how complexity is interpreted and managed. Within complex projects, decision-making, resource alignment, and stakeholder engagement are heavily influenced by the leadership approach. The thesis underscores that "effective leadership is one of the key competencies required for successful project delivery."

The study distinguishes between two primary leadership styles: transactional and transformational. Transactional leadership is described as focusing on structured tasks, clarity of roles, and performance monitoring, whereas transformational leadership is characterised by vision, inspiration, and motivation of teams. These styles influence how leaders manage challenges and adapt to project uncertainties. The document draws attention to the correlation between leadership style and the perceived level of complexity by project professionals.

Furthermore, the research argues that "the effectiveness of a project manager's leadership style can vary depending on the complexity of the project they are managing," reinforcing the notion that leadership must be responsive to project conditions rather than rigidly applied.

1.3. Research Purpose and Scope

This study aims to investigate the relationship between project complexity and leadership competencies among project practitioners. The central research question explores how transactional and transformational leadership styles align with the complexity dimensions identified in the MODeST framework.

Using a two-part quantitative method, the research collected data from professionals affiliated with Network Rail, Willmott Dixon, and members of the APM who had led projects within the last 12 months. The study assesses how practitioners perceive complexity in their projects and the leadership styles they employed. By quantifying these relationships, the study provides insights into how leadership can be adapted to better navigate complexity and ultimately improve project performance.

In conclusion, this research bridges a critical gap between theoretical understanding and practical application by offering empirical evidence of how leadership interacts with project complexity. It aims to support both scholarly discourse and professional development within the project management community.

2. Literature review

2.1. Understanding Project Complexity in Context

Project complexity has increasingly become a subject of interest in the field of project management, with the term appearing frequently in academic discussions. As the document identifies, complexity "has been explored from different angles, yet lacks a universally accepted definition." The difficulty in pinning down one precise explanation of complexity contributes to the practical challenges in applying it within project environments.

Several authors have defined complexity based on different dimensions such as size, number of elements, uncertainty, and interdependence. For example, Baccarini (1996) defined complexity as "consisting of many varied interrelated parts," while Williams (1999) considered complexity in terms of uncertainty and ambiguity. The thesis notes that "in general terms, complexity is used to define the degree of difficulty in a project due to the number and variety of interrelated parts."

The project environment has also evolved due to "rapid technological changes, changing customer expectations, and globalisation," which further complicates the management of modern projects. Complexity is not merely a technical issue but involves organisational, behavioural, and contextual elements that influence project execution.

2.2. Theoretical Foundations: The MODeST Framework

To conceptualise complexity in this research, the MODeST framework is applied. Originally proposed by Müller, Geraldi and Turner (2012), the MODeST model breaks down complexity into five core dimensions: Mission, Organisation, Delivery, Stakeholders, and Team**.** This framework is designed to reflect how practitioners perceive the complexity embedded in real-world projects.

The "Mission" refers to project objectives and their clarity or ambiguity. "Organisation" looks at internal structures and how they contribute to complexity. "Delivery" relates to tools, processes, and deliverables. "Stakeholders" are assessed based on number, diversity, and power dynamics, while "Team" examines the composition, skills, and alignment of the project workforce.

The document notes that this model allows for the "assessment of complexity from the practitioner's perspective," which aligns with the study's aim to quantify and correlate complexity with leadership behaviour.

2.3. Transactional vs. Transformational Leadership Styles

Transactional leadership is described as focusing on performance, role clarity, and reward-based motivation. It is often structured around clear authority and operational boundaries. In contrast, transformational leadership emphasises vision, inspiration, intellectual stimulation, and individual consideration. According to Bass and Avolio (1994), transactional leaders maintain the status quo, while transformational leaders seek to innovate and elevate their teams. The research document emphasises that "transformational leadership includes attributes such as charisma, idealised influence, and motivational capacity," which are considered essential in navigating complex project environments.

The study argues that both styles have their strengths depending on the project's complexity level. Transformational leadership tends to be more effective in dynamic and uncertain conditions, whereas transactional leadership is suitable for routine or structured contexts.

2.4. Previous Studies Linking Complexity and Leadership

The connection between complexity and leadership has been explored in various studies. For instance, Müller and Turner (2007) found that "leadership competencies are significant predictors of project success." Other researchers such as Turner and Müller (2005) also argue that specific leadership styles are better suited for certain types of projects based on complexity. The thesis also refers to empirical research suggesting that "transformational leadership is positively associated with project performance, particularly in highly complex settings." This supports the current study's intention to explore the correlation between perceived project complexity and leadership style.

Additionally, it is noted that while frameworks and theoretical models exist, "few studies have empirically tested how complexity influences the choice or effectiveness of leadership styles." This study contributes to addressing that gap by offering a data-driven examination of practitioner insights.

3. Research methodology

3.1. Research Design and Approach

This study adopted a quantitative research design, with a focus on collecting measurable data to assess the relationship between project complexity and leadership competencies. As stated in the document, this method was chosen because it "enables the researcher to quantify relationships between variables and to analyse data using statistical methods." The design was divided into two distinct phases: the first phase involved assessing complexity through the MODeST framework; the second examined leadership style preferences using a structured questionnaire.

The quantitative approach was particularly appropriate given the study's goal of "understanding how project complexity influences the leadership style adopted by project managers," thereby allowing objective comparison and correlation of responses.

3.2. Sample Selection and Participant Criteria

Participants were drawn from a target population of project professionals with recent, practical experience in delivering projects. To ensure relevance and credibility, the inclusion criteria required that respondents had "delivered at least one project in the past 12 months." The organisations engaged in the study included Network Rail, Willmott Dixon, and members of the Association for Project Management (APM).

This purposeful sampling ensured that the participants were directly involved in managing complexity and making leadership decisions in real project environments. Their practical insights were considered valuable in interpreting both the complexity elements and leadership behaviours.

3.3. Instrument Design: Complexity Rating and Leadership Survey

The data collection instruments were self-administered questionnaires designed specifically for this study. The first instrument measured project complexity based on the MODeST framework (Müller, Geraldi and Turner, 2012), which consists of five dimensions: Mission, Organisation, Delivery, Stakeholders, and Team. Participants were asked to rate their most recent project across these dimensions using a weighted scale to identify perceived complexity levels.

The second instrument was a Likert-scale questionnaire designed to capture respondents' assessments of transformational and transactional leadership competencies. This tool was adapted from Bass and Avolio's (1994) model and measured traits such as inspirational motivation, idealised influence, and management-by-exception. Respondents rated how frequently each leadership behaviour was demonstrated in the context of their most recent project.

3.4. Data Collection Procedure

The data collection was conducted electronically, using Microsoft Forms to distribute and capture survey responses. Participants were invited via direct email and LinkedIn, with clear instructions and a consent statement provided on the opening page of the form. The survey remained open for a defined period, allowing sufficient time for engagement across different sectors.

Each participant completed both sections of the survey in one session, ensuring consistency between the project complexity rating and the leadership assessment. This streamlined approach helped to reduce response fatigue and ensured more reliable data.

3.5. Ethical Considerations and Validity Measures

The research was conducted in compliance with standard ethical guidelines, ensuring voluntary participation, anonymity, and informed consent. As stated in the thesis, respondents were informed about the "purpose of the study, the confidentiality of their responses, and their right to withdraw at any time."

To improve validity, the questionnaire items were pilot-tested with a small group of practitioners before full distribution. Feedback from the pilot helped to refine the clarity and layout of questions, particularly in aligning terminology used within the leadership and complexity assessments.

Data integrity was maintained by limiting access to survey results to the principal investigator and by employing Excel-based validation checks during data analysis. These steps contributed to the overall reliability and internal consistency of the research findings.

4. Data Presentation and Analysis

4.1. Demographic Profile of Respondents

The study collected data from practicing project managers who had successfully completed a project in the past two years. Participants were drawn from organisations such as Network Rail, Willmott Dixon, and project practitioners affiliated with the University of Bedfordshire. Additionally, a separate Likert-scaled questionnaire was administered to members of the Association of Project Management (APM). These respondents were professionals with substantial project experience, ensuring the credibility of the data.

4.2. Perceptions of Complexity across Dimensions

Project complexity was measured using the MODeST framework, comprising five key dimensions: Mission, Organisation, Delivery, Stakeholders, and Team. The analysis revealed significant structural and dynamic complexities across all five MODeST dimensions:

- Mission: Uncertainty in requirements and frequent requirement changes contributed to perceived complexity.
- Organisation: Respondents identified mismatches between project structure and the broader organisational context, along with ongoing organisational restructuring as major factors.
- Delivery: Complexity arose due to lack of familiarity with the project methodology and the introduction of new methodologies mid-project.
- Stakeholders: Projects involving numerous and changing stakeholders were reported as more complex.
- Team: Low motivation and fluctuating levels of team morale were key issues.

These perceptions align with Maylor et al. (2008), who stressed the importance of both structural and dynamic dimensions of complexity and the interdependence among them.

4.3. Leadership Style Assessment Results

Leadership style was assessed using responses to items measuring characteristics of Transactional and Transformational leadership. Results showed a spectrum of leadership behaviours, with some respondents leaning toward transactional tendencies, emphasising structure, rewards, and defined roles while others exhibited transformational qualities such as vision setting, inspiration, and individualised consideration.

Findings supported the assertion from the literature that transformational leadership is more suited to managing uncertainty and complexity, particularly where team cohesion, adaptability, and stakeholder alignment are essential. Transactional leadership was noted as more applicable in highly structured, technically deterministic projects.

4.4. Correlation Analysis between Complexity and Leadership

Using quantitative methods, a correlation analysis was conducted to determine the relationship between the five MODeST dimensions of complexity and the leadership styles observed. The results indicated:

- A positive correlation between transformational leadership and complexity in the Stakeholder and Team dimensions. This suggests transformational leaders are more effective in environments with multiple, changing stakeholders and dynamic team compositions.
- A moderate correlation between transactional leadership and Organisation and Delivery complexity. This implies transactional leaders may be better equipped to handle complexity where clarity of structure and methodology is required.

These outcomes underscore the premise that no single leadership style universally mitigates complexity; instead, effective leadership is contextual, varying with the dominant complexity dimension.

4.5. Interpretation of Key Statistical Findings

The key findings reinforce the literature's perspective that complexity is multifaceted and best managed by aligning leadership style with the nature of complexity present:

- Transformational leadership correlates positively with dynamic, people-centric complexity.
- Transactional leadership shows strength in structured, process-oriented complexity.
- Projects with high complexity in Mission, Stakeholders, and Team benefit from leaders who can inspire, adapt, and foster engagement, hallmarks of transformational leadership.
- Projects with pronounced complexity in Organisation and Delivery dimensions are better served by leaders who provide clarity, enforce structure, and focus on execution traits linked to transactional leadership.

This analysis confirms the initial assumption that project complexity and leadership style are interrelated. By quantifying complexity through the MODeST model and mapping it to leadership behaviours, this study contributes to a better understanding of how competence in leadership can influence project success in complex environments.

5. Discussion of Findings

5.1. Practitioners' Understanding of Project Complexity

The research reveals that project practitioners have varied yet nuanced understandings of project complexity, aligning with what has been described in the literature as both descriptive and perceived complexity (Schlindwein and Ison, 2004). Practitioners' views reflected the dynamic and uncertain nature of projects, confirming that complexity is not solely an inherent feature of a project, but is also determined by the observer's perspective and experience (Geraldi and Adlbrecht, 2007).

Respondents commonly associated complexity with the MODeST dimensions (Mission, Organisation, Delivery, Stakeholder and Team), as outlined by Maylor et al. (2008). They acknowledged that unclear goals, frequent changes in requirements, restructuring of organisations, stakeholder volatility, and varying team motivations all contributed to the complexity of their projects. Complexity was therefore not limited to technical aspects but extended deeply into managerial and behavioural dynamics. The findings reflect Maylor's (2010) position that the interdependence of these dimensions adds to the overall project complexity and supports the idea that project managers' perception and interpretation are crucial for identifying and managing such complexities.

5.2. Variations in Leadership Style Based on Complexity Perceptions

From the data collected through questionnaires, it was evident that leadership style varied depending on the practitioners' perception of complexity. Respondents who encountered high stakeholder ambiguity and team volatility leaned more towards transformational leadership, characterised by emotional competence, communication, and the ability to inspire and lead through uncertainty (Müller and Turner, 2007). These findings correspond with the work of El-Sabaa (2001) and Dainty et al. (2005), who identified soft competencies such as team building, approachability, and mutuality as vital for project leadership.

Conversely, in projects where complexity was perceived more structurally such as clearly defined organisational frameworks or fixed delivery processes, leaders tended to employ transactional styles, focusing on goal achievement, defined responsibilities, and structured decision-making. This confirms previous literature that associates transactional leadership with engineering-type projects, where the scope and outputs are better defined and predictable (Müller and Turner, 2007). Thus, the style of leadership adopted was not static but adjusted according to the dominant form of perceived complexity.

5.3. Influence of Contextual Factors on Leadership Effectiveness

The effectiveness of leadership was not only influenced by the inherent complexity of the project but also significantly shaped by contextual factors such as organisational culture, project type, and stakeholder composition. These findings reinforce Remington and Pollack's (2007) argument that leadership effectiveness is often contingent upon the type of complexity present whether structural, technical, directional, or temporal.

For instance, in projects experiencing temporal complexity characterised by environmental shifts or strategic redirections transformational leadership proved more effective in maintaining team morale and direction. In contrast, where structural complexity prevailed, especially in projects involving multiple departments and fixed outputs, transactional leadership was seen as more appropriate due to its emphasis on procedures, deadlines and defined deliverables.

The study further supports the view of Geraldi and Adlbrecht (2008) that faith, fact, and interaction are pivotal in navigating complexity. Leaders operating in contexts marked by high ambiguity or interdepartmental friction leaned towards interactional leadership competencies, often blending both transformational and transactional behaviours to maintain stability while adapting to change.

5.4. Implications for Project Management Practice

The findings of this research have important implications for project management practice. First, they highlight the need for adaptive leadership, where leaders assess the dominant complexity dimension and calibrate their leadership approach accordingly. This supports the shift from traditional command-and-control models to more contextual, relational and flexible leadership.

Second, leadership training and development programs should not treat transactional and transformational leadership as mutually exclusive, but rather teach project managers how to integrate and alternate these styles based on the MODeST dimensions of project complexity. As shown by this study, the ability to switch between leadership styles depending on whether the challenge involves mission ambiguity, organisational restructuring, new delivery mechanisms, stakeholder dynamics or team motivation, is a mark of competence.

Third, organisations should incorporate complexity assessment tools, such as the MODeST framework, into their project initiation phases. Doing so will enable early identification of complexity hotspots, leading to better alignment of leadership style, team composition, and stakeholder management strategies. Finally, the importance of soft competencies such as communication, empathy, negotiation, and emotional intelligence cannot be overstated. As shown by Skulmoski and Hartman (2010) and El-Sabaa (2001), these competencies directly impact project success, especially under high complexity conditions.

In conclusion, this study confirms that quantifying project complexity through the MODeST framework, and aligning leadership style accordingly, enhances leadership effectiveness and project outcomes. The intersection of complexity and competence, as mediated through leadership style, is critical to the success of complex projects. This research adds to the body of knowledge by establishing a practical link between project complexity assessment and leadership style adaptation, offering tangible guidance for current and future project management practice.

6. Conclusion and Recommendations

Summary of Key Insights

This study explored project practitioners' perceptions of complexity, measured through the MODeST framework, and investigated the correlation between project complexity and leadership competencies/styles. The results clearly showed that complexity is not only structural but also dynamic in nature and that these two dimensions are highly interdependent. The MODeST dimensions Mission, Organisation, Delivery, Stakeholders, and Team served as the analytical framework through which complexity was quantified (Maylor et al., 2008).

The findings highlighted that project complexity was most perceived in stakeholder changes, mission ambiguity, and fluctuating team motivation. These dimensions directly influenced the effectiveness of the leadership style adopted. A correlation was identified between transformational leadership and dynamic complexities (e.g., stakeholder and team-related), whereas transactional leadership was more effective in structural complexities (e.g., organisational alignment and delivery methodology).

This supports Müller and Turner's (2007) conclusion that emotional competence and leadership style significantly influence project success depending on project type. It also corroborates Geraldi and Adlbrecht's (2007) view that project complexity is perceived through the lenses of faith, fact, and interaction emphasising the practical realities of leadership in complex settings.

Practical Applications for Leadership in Complex Environments

The research establishes that managing complexity in projects demands a flexible and situational leadership approach. The findings indicate that no single leadership style is sufficient; instead, project managers must be capable of adapting their style based on the predominant type of complexity they face. Where complexity was linked to organisational structure and deliverables, transactional leadership focused on clear tasks, roles, and responsibilities proved most effective. In contrast, in environments with evolving stakeholder requirements and shifting team dynamics, transformational leadership based on inspiration, motivation, and individual consideration yielded more positive outcomes.

The study confirms the relevance of soft skills (e.g., communication, negotiation, and team building), as noted by El-Sabaa (2001) and Dainty et al. (2005). These competencies are crucial when complexity arises from interpersonal or social dimensions. As such, project managers must balance technical and behavioural competencies to lead effectively.

Suggestions for Policy, Training, and Leadership Development

Given the study's outcomes, it is recommended that project management training and leadership development programmes should incorporate both transactional and transformational leadership theories, including their practical application in complex environments. In line with Skulmoski and Hartman (2010), training should go beyond technical

competencies and embrace behavioural competencies especially in the areas of communication, emotional intelligence, and decision-making under uncertainty.

Organisational policies should mandate the use of complexity assessment tools, such as the MODeST framework, at the initiation stage of all major projects. This will enable early recognition of structural and dynamic complexities, allowing for appropriate leadership style alignment and stakeholder engagement strategies. Professional bodies like PMI and APM should consider embedding adaptive leadership modules in their certification curricula to reflect the realities of leading in volatile project environments.

Furthermore, leadership development frameworks should be customised, recognising that different leadership styles suit different types of projects (Müller and Turner, 2007). As such, project managers should be assessed not only on their knowledge of processes but also on their ability to switch leadership styles in response to complexity variations.

Limitations of the Study

While this study provided valuable insights, it had certain limitations. The research focused primarily on practitioners from specific organisations (e.g., Network Rail, Willmott Dixon, and APM members), which may limit the generalisability of the findings. Also, self-reported questionnaires were the main instruments of data collection, which could introduce response bias based on personal perceptions and experiences.

Additionally, the study did not distinguish between industry-specific complexities or cultural variables that may influence leadership style adoption. The complexity assessment was also primarily based on the MODeST framework, which, while robust, might not capture the full range of complexities in all project environments.

Directions for Future Research

Further studies should examine the application of the MODeST model across multiple industries and geographical regions to validate its universality. Future research may also integrate comparative case studies to complement self-reported data with observed leadership behaviours in real-world settings.

In addition, more work is needed to explore the effect of cultural and institutional contexts on the relationship between leadership style and project complexity. Integrating models like the NTCP (Novelty, Technology, Complexity, Pace) model or Geraldi and Adlbrecht's (2007) Complexity of Faith, Fact, and Interaction may provide a more multifaceted understanding of how complexity manifests and is managed.

Finally, future research could investigate hybrid leadership models and how combinations of transactional and transformational behaviours might be most effectively sequenced or blended throughout different project stages.

In conclusion, this research contributes significantly to the understanding of how complexity and competence intersect in project environments. It affirms that leadership style is a mediating factor in managing complex projects, and that a one-size-fits-all approach to leadership is no longer sufficient. The integration of complexity quantification and leadership adaptability should be embedded into the core of project management best practices.

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