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IMPACT OF PROJECT MANAGER'S LEADERSHIP COMPETENCES ON COMPLEX MEGA INFRASTRUCTURE PROJECT PERFORMANCE: A LITERATURE REVIEW.

Nyariranwge, Maxwell; Babatunde Oluwayomi
School of Construction Economics, University of the Witwatersrand, Johannesburg, Gauteng, South Africa

Abstract
This study aims to establish the impact of project managers' competences in addressing project complexity and enhancing complex infrastructure projects delivery success. The objectives include determining the dimensions and levels of project complexity; delineating the competences required to manage project complexity; establishing an integrative project performance evaluation criterion; and developing a model that validates the impact on infrastructure projects performance by linking the different complexity dimensions with required competences. This study constitutes the conceptual phase of an on-going broader research. Consequently, the methodology used is an integrative review of the existing literature on the key concepts including project management, leadership and complexity. The study's results showed that infrastructure projects are complex adaptive systems, which cannot be adequately managed by controlling tripple constraint factors. Project managers must be flexible, innovative and able to learn and adapt new behavioral patterns, in order to adequately manage the complexity levels and dimensions involved. Additionally, the need for project managers' capabilities to balance between administrative processes, adaptive and generative leadership styles was emphasised. Consequently, a Complexity-Leadership Alignment Model was developed to validate the link between the project manager's leadership competences and ability to deal with different dimensions and levels of project complexity. In conclusion, this study underscores the role played by the project managers' competences in enhancing infrastructure projects delivery success. The limitation is that the findings only illuminate key constructs, which will be empirically tested under the subsequent phases of the study.

Keywords: Mega infrastructure projects, Project complexity, Project leadership, Project management, Project performance

1 Introduction

The role of mega infrastructure projects in the economic development particularly among developing countries, characterised by a myriad of socio-economic challenges, cannot be overemphasised (Srinivasu and Srinivasa Rao, 2013). The underperformance of these infrastructure projects, hence, represents a significant but avoidable loss of economic value (Liu, 2009). In South Africa, the economic profile shows a 5% contribution from construction sector (Statistics South Africa, 2015). South Africa embarked on an infrastructure-focused development policy since the year 2000. This resulted in the rolling-out of mega projects like the Gautrain Rapid Rail system, the Gauteng Freeway Improvement program and the Bus Rapid Transit projects across thirteen cities (Presidential Infrastructure Coordinating

Commission, 2012; Economic Development Department, 2011). The government has also set a target to generate a minimum of two million jobs prioritising skilled, semi and unskilled youth categories from previously disadvantaged groups, by the year 2020 (Development Department, 2011). Intense public sector investment in infrastructure projects was one of the core drivers to create employment and stimulate economic growth through various multiplier effects (Presidential Infrastructure Coordinating Commission, 2012; Economic Development Department, 2011).

The successful delivery of mega infrastructure projects is very critical, as they are largely financed from public funds and, hence, compete for priority with other critical social services. The performance of mega infrastructure projects attracts socio-political interest, which affects the reputation of the organisations involved. Mega infrastructure projects are complex systems, which can neither be easily understood through simple linear approaches, nor effectively managed through controlling efficiency measures of time, cost and quality (Hazy and Uhl-Bien, 2013). The general underperformance of mega infrastructure projects (Murugesan, 2012, Riaz et al., 2014) has, therefore, brought the current delivery processes, approaches and management philosophy under scrutiny (Riaz et al., 2014; Shenhar, 2012).

This study underpins the attribution of project failure to qualitative factors such as the project manager's leadership competences, internal and external complexity and gaps in the project management philosophy (Shenhar, 2012; Thamhain, 2012; Back, 2012; Jacques et al., 2007). Consequently, the aim of this study is to establish the impact of project managers' competences in addressing project complexity and enhancing infrastructure projects delivery success. The objectives include determining the dimensions and levels of project complexity; delineating the competences required to manage project complexity; establishing an integrative project performance evaluation criterion; and developing a model that validates the impact on infrastructure projects performance by linking the different complexity dimensions with required competences. The subsequent sections below is a review of existing literature, focusing mainly on the key study constructs, which include project management philosophy, mega infrastructure project complexity and required project leadership competences. This is subsequently followed by a summary of the main findings and associated conclusions.

2 Literature Review

This section of the paper establishes the different constructs regarding project performance, based on an integrative review of existing literature. The investigation draws from the analysis of the main factors behind project performance, which, as outlined in the preceding sections of this paper, include the gaps in the current project management philosophy, project complexity and project managers' leadership competences.

2.1 Project Management Philosophy

Although project performance has been studied for a long time, there has been no universally accepted definition, measurement criteria or what constitutes project success (Han et al., 2013). Different studies have come up with an inexhaustible list of measurement metrics, which have resulted in inconsistencies in the conclusion. In an attempt to deal with the ambiguity, minimize variability of factors and generate objective measures, a distinction has been made between project success and project management success (Han et al., 2013; Turner and Zolin, 2012).

Turner and Zolin (2012) proffered the need to incorporate the priorities of different project stakeholders when measuring project performance. These different stakeholders' views and priorities vary in time after project completion. Shenhar (2012) underpinned this view by demonstrating that stakeholder judgement of project success has very little to do with the triple constraint factors. This was supported by cases where, despite exceeding planned time and budgets, some projects were still considered to be very successful, while those completed on

time and within budgets failed to satisfy the needs of investors. These findings underpinned some of the gaps associated with the performance evaluation criteria used under the traditional project management philosophy.

The narrow focus on project goals associated with traditional project performance evaluation criteria was refuted by Aubry and Hobbs (2010), because of the ambiguities involved. They recommended a broader criteria, which incorporates project delivery impacts on organizational value was recommended. The organisational impact was conceptualized under the economic and pragmatic dimensions (Almahmoud et al., 2012). While the former focuses more on demonstrating the direct economic contribution of projects to the organization's bottom line, the latter focuses on addressing the multifaceted nature of project performance beyond just financial indicators (Aubry and Hobbs, 2010). A balance between the two dimensions was recommended in order to harness both the financial and non-financial contributions that project management brings to organizational success. These successes elements include innovation, new organizational processes and employee and team development, as depicted under the balanced scorecard (Shenhar, 2012).

Almahmoud et al., 2012 distilled that a distinction must be made between success factors and success criteria. The former cover apriori conditions that contribute to positive results, while the latter are used to assess a concrete and measurable result a posteriori (Almahmoud et al., 2012). This view was also upheld by Turner & Zolin (2012) who advanced the need for triangulating performance evaluation criteria to adequately address the multi-faceted nature of projects. Project performance factors were grouped into five categories which include efficiency, impact on the team, impact on the customer, business success, and preparing for the future (Turner & Zolin, 2012). Time dimensions include the short term outputs (immediately after project completion), medium term outcomes (few months after project completion), and long term impacts (evaluated years after project completion) were explored (Shenhar, 2012). This study upholds the comprehensiveness associated with the proposed criteria in addressing the gaps highlighted by Aubry and Hobbs (2010) in the foregoing section. Consequently, this criteria is one of the core elements that will be used to develop a conceptual framework for the subsequent phases of this study.

2.2 Mega Infrastructure Project Complexity

Mega infrastructure projects are, generally, large scale in nature, require huge budgets, and are delivered through complex multiple partnerships between the private and public sectors (van Marrewijk et al, 2008). The delivery of these projects involves integrated project management organizations, which consist of multiple institutions, different skills and multi-disciplinary teams and complex contracts (van Marrewijk et al., 2008).These characteristics make mega infrastructure projects susceptible to uncertainty, political sensitivity and multi-stakeholder interest (van Marrewijk et al., 2008). Consequent to the factors above, these projects are perceived as complex adaptive systems, which need to be well understood and delivered using appropriate competences, to be successfully (Curlee and Gordon, 2011). Based on these key characteristics, this study uses the terms 'mega' and 'complex' interchangeably to refer to large scale infrastructure projects. In South African, projects qualify under this category include the Gauteng Freeway Improvement Program, Gautrain Rapid Rail Link, Medupi Power Station, Bus Rapid Transit (BRT) projects, and so on.

The performance of many mega infrastructure projects has been unsatisfactory (van Marrewijk et al., 2008). Mega infrastructure projects often overrun budgets, fall behind delivery schedules and fail to deliver and fully address the need behind their commissioning (van Marrewijk et al., 2008). For instance the cost of the Gautrain Rapid Rail Link ballooned from R3.5 billion - R30.462 billion between 2000 and 2011 (Fombad, 2013). Causes behind this failure involve different project complexity factors such as magnitudes of team competences, inaccurate

budget estimates, delays in critical decisions and approvals, changes in project specifications, diverging stakeholder interests, technological factors, and so on (Fombad, 2013).

2.2.1 Complexity Theory

The field of complexity has been studied over a couple of decades, broadly under Complexity Theory (Curlee and Gordon, 2011). Complexity Theory has a universal application across many disciplines such as mathematics, science, meteorology and social sciences, was born out of Chaos theory (Curlee and Gordon, 2011). There are three dimensions of complexity, which are algorithmic, deterministic and aggregate complexity (Mason, 2001). This study focuses more on aggregate complexity, which is concerned with how the interaction between individual elements in a system propagates complex behaviour. The key attributes of aggregate complexity include relationships between a system's internal structure and the surrounding environment, the resultant learning and emergent behaviour, and the different means by which complex systems change and grow (Hazy and Uhl-Bien, 2013).

A system is defined more by the nature of relationships than its constituent parts (Curlee and Gordon, 2011). Therefore, the capacity of a system is greater than the sum total of its constituent subsystems and elements. This implies that a system can have emergent qualities that cannot be easily traceable by analysing its constituent elements (Curlee and Gordon, 2011). Relationships define, and are influenced by a system's internal structure. Well-connected components form subsystems either sustain or destabilize the system's structure (Curlee and Gordon, 2011; Saywisch, 2010).

It was further distilled that complex systems also owe their existence to how they interact with their external environment (Curlee and Gordon, 2011). They achieve this by actively anticipating change and reacting to it, as well as shaping their environments through learning, referring to history and utilizing existing relationships and subsystems (Curlee and Gordon, 2011). Therefore, systems are not static but constantly evolve through self-organization to better interact with their environments. They also dissipate when they struggle to cope with pressures from the internal and external environmental forces (Hazy and Uhl-Bien, 2013).

Complexity Theory refutes the fundamental project management premise which prescribes rational approaches to simplify phenomena as well as finding "best" linear procedures in solving project challenges (Hazy and Uhl-Bien, 2013). The foundational basis of Complexity Theory is, hence, the notion that order, which is the kingpin of management principles of control, does not allow for sufficient flexibility to deal with all human interactions (Curlee and Gordon, 2011). This study underpins this view by positioning that the success and failure of a project is not only a result of how the triple constraints are managed but rather the outcome of complex interactions among individual elements and the resultant complex behaviour and relationship structures (Curlee and Gordon, 2011).

2.2.2 Complexity and Project Management

Projects by nature operate as complex open systems (Curlee and Gordon, 2011). Consequently, a system can be construed as: "an object which in a given environment aims at reaching some objectives (teleological aspect) by doing an activity (functional aspect) while its internal structure (ontological aspect) evolves through time (genetic aspect) without losing its own identity" (Vidal and Marle, 2008 pp. 1095). It then follows that projects as complex systems are defined by these key systematic characteristics (Vidal and Marle, 2008). This underscores the need for project managers to possess leadership competences that enable them to better understand complex systems so as to effectively and successfully deliver on infrastructure projects (Azim et al, 2010).

Project complexity levels lie on a continuum from control, complicated, complex to chaotic (Remington, 2011). The least complex projects are those where the project manager is in control most of the project processes and inter-relationships, while the most complex are those where there is complete chaos (Remington, 2011). This study opines that projects, as complex systems, are rarely in stable states for project managers to exercise full control, particularly given the dynamic nature of the inter-relationships involved. Consequently, this study posits creativity and innovation among project teams, as being the cornerstones for successful performance as opposed to excessive administrative and control processes. Complexity has further been articulated as "complexity in projects" and "complexity of projects" (Geraldi et al., 2011) and consequently categorised into five types including structural complexity, uncertainty, pace, socio political environment, and dynamics (Remington, 2011).

2.3 Leadership Styles and Project Performance

The failure of infrastructure projects across the globe has brought the efficacy of traditional project management tools, practice and competences under scrutiny (Ren et al, 2012). Human factors were highlighted as the main determinants of projects performance (Jiang, 2014; Zhang and Fan, 2013). Research accentuated that most engineering practitioners are trained to be reactive (and largely in relation to management of the triple constraint) and, consequently, are under-equipped to deal with complexities associated with infrastructure construction projects (Riaz et al., 2013). Different leadership competences have been established, resulting in a variety of theories and models (Dinh et al., 2014; Murugesan, 2012). However, this nomenclature has not been conclusive enough to establish a solid theory. The absence of such a theory, which adequately empirically links leadership with project success, represents a gap in the existing literature which still needs to be investigated (Crawford; 2014; Shao et al., 2012).

Based on the research gaps and shortcomings identified, this study's objectives are important as discussed subsequently. Firstly, leadership competences are required beyond traditional project management (Chaudhry et al., 2012). This enables project managers to embrace the different project complexity factors, anticipate challenges and opportunities and align these with the expectations of the different project stakeholders (Chaudhry et al., 2012). Secondly, mega infrastructure project environment are characterised by different complex factors and dynamics, which demand astute leadership skills beyond traditional project management competences (Riaz et al., 2013). Thirdly, the increasingly competitive project environment requires project managers with unique skills to inspire teams towards business success, growth and competitiveness (Crawford, 2014). Lastly, mega infrastructure projects operate as unique temporary organisations, with special characteristics (short lifespan, multi-disciplinary human resource composition, strict delivery scope, timelines and budgets), whose management demands a unique set of leadership competences beyond traditional project management (Eweje et al., 2012). On the basis of these important insights, this study underscores the need to deal with the gaps in the project management philosophy in order to equip project managers to deal with complexity and improve on performance.

3 Research Methodology

This paper is the first phase of an ongoing research, whose methodology consists of an integrative review of existing relevant literature. This is critical to explore the main constructs that address the research aim and objectives. The theoretical framework guiding this literature review consisted of complexity theory, project management and leadership theories, as well as project performance measurement models and frameworks. The main approach involved critiquing, synthesizing and reconceptualising of the literature findings since the elements under study are not new (Torraco, 2005). The integrative literature review process involved about five key stages. Firstly, relevant journals that deal with the project management,

leadership and complexity fields were selected using the Social Science Citation Index as well as the Web of Science (Torraco, 2005). Secondly, journal articles published between the year 2000 and 2015, focusing on project management, leadership and complexity, were selected. Thirdly, the most recent articles (2008-2015) were prioritised, although selected older ones were also reviewed to establish the trends in the key findings, arguments and conclusions regarding project management, leadership and complexity. The main criteria for selection included the articles' focus on the core constructs, the methodology used and the main findings and conclusions reached. This is summarised in Table 1.

Table 1. Summary of literature review methodology flow

THEORETICAL FRAMEWORK	RELEVANT LITERATURE SELECTION	CORE CONSTRUCTS	INTEGRATIVE LITERATURE REVIEW	KEY OUTPUTS (THIS STAGE)	KEY OUTPUTS (FSUBSEQUENT STAGES)
• Complexity Theory • Project Management Theory • Project Leadership Theory • Project Performance Measurement Models	• Journal Articles published between 2008 and 2015. • Limited number of journal articles older than 2008 • Limited number of other non-journal articles and books	• Project Management • Project Leadership • Project Complexity	• Critical Analysis • Synthesizing • Reconceptualization	• Trends across constructs • Relationships between constructs • Main knowledge gaps • Key conclusions • Key questions • Integrative model	• Conceptual Framework • Research questions • Research propositions • Research Methodology

(Source: Author)

The review processes focused on critical analysis of the articles, to distil key trends regarding project management, leadership and complexity, as well as relationships between these constructs. This was important in establishing critical gaps and in drawing specific conclusions relevant to the study purpose. The study topic, problem statements, aim and objectives were the lens through which the various articles were selected and reviewed. The last stage involved the synthesis of the main findings to establish a model which integrates project management, leadership and complexity. The model will be used to develop the conceptual framework which will guide the subsequent stages of the research.

4 Findings and Discussion

4.1 Project Management Philosophy

Through the review of literature, this study has established the need for project performance evaluation to address the overall project objectives and integrate them with broad organisational goals over different time dimensions (Shenhar, 2012). Consequently, project success was accentuated as a better evaluation criterion which addresses both internal and external efficiency and effectiveness than project management success. The latter only focuses on internal measures of efficiency regarding time, cost and quality (Han et al., 2013). A further triangulation of evaluation criteria was proffered in order to capture the financial and non-financial contribution of project performance to organisational value (Shenhar, 2012). Other elements incorporated in the criteria include the views of different stakeholders and the time dimensions involved (Turner and Zolin, 2012).

This triangulation improves the comprehensiveness of the evaluation criteria beyond that of the linear and unitary measures used under the traditional project management philosophy

(Hazy and Uhl-Bien, 2013). This is important, particularly given insights drawn from Complexity Theory outlined in the foregoing sections (Han et al., 2013). These findings underscore the limitations associated with the current project management philosophy and underpin the need for project manager leadership competences.

4.2 Mega Infrastructure Project Complexity

By reviewing existing literature, this study has established that the current project management approaches and practices often fail to effectively address the different complexity dynamics highlighted in the preceding sections (Turner and Zolin, 2012). This has been highlighted as a gap in the traditional project management philosophy. This gap can be underpinned by the exclusion of the subject of complexity from the Project Management Body of Knowledge (PMBOK), which has remained despite the persistent challenges faced by project managers in dealing with complexities within and beyond project boundaries (Han et al., 2013). On this basis of this gap, this study highlighted project complexity as one of the important constructs, which will be explored in greater detail in the subsequent phases. Of particular focus is the complexity dimensions and levels, as well as the required leadership competences alignment to adequately internalise and manage the former and improve on project performance.

4.3 Leadership Competences and Project Performance

Based on the output of the integrative literature review, this study has established the need for leadership competences beyond traditional project management capabilities (Clarke, 2012). This has been underpinned by the findings that at least 80 percent of project failure is associated with human factors (Shenhar, 2012). It was also distilled that project environments acts as complex adaptive systems (CAS), under which the project manager can either promote or stifle performance (Hazy and Uhl-Bien, 2013). CAS require capabilities in creative problem solving, learning and adapting. Consequently, in order to address the unique challenges involved in a CAS, project managers need to be flexible, innovative and open to learning and adapting new behavioural patterns (Ren et al, 2012).

Leadership under CAS requires the astute balancing between administrative, enabling and adaptive styles (Han et al., 2013. Administrative leadership involves bureaucratic processes of alignment, top-down control and reliance on leaders' vision and inspiration. Focus is also on planning and coordination to accomplish prescribed outcomes in an efficient and effective manner (as typically required under the traditional project management philosophy) (Han et al., 2013. Enabling leadership, on the other hand, establishes the necessary conditions that promote team creativity, innovation and learning, in solving problems. Lastly, adaptive leadership results from emergent change activities, in response to generative dynamics within a system. (Ren et al, 2012).

Another concept which has been established under the integrative literature review is emergence. This is a unique behaviour associated with complex adaptive systems as they respond to environmental pressure. It involves three elements of self-organisation and re-formation (Ren et al, 2012). This study has established that since mega infrastructure operate as complex adaptive systems (Hazy and Uhl-Bien, 2013), they are susceptible to emergence. Emergence suggest that, when bureaucratic processes and procedures are simplified, constraints associated with administrative leadership can channel and generate attributes that promote performance in a system (Ren et al, 2012). Consequently, in order to improve performance, project managers will be required to understand the complex adaptive system's emergence properties and design well-balanced, effective and responsive systems (Han et al., 2013). When project managers lack this understanding, they emphasise administrative and bureaucratic controls and, consequently, stifle the team's innovation, creativity and

entrepreneurship capabilities, which are important for performance (Ren et al, 2012). This is summarised in Figure 1.

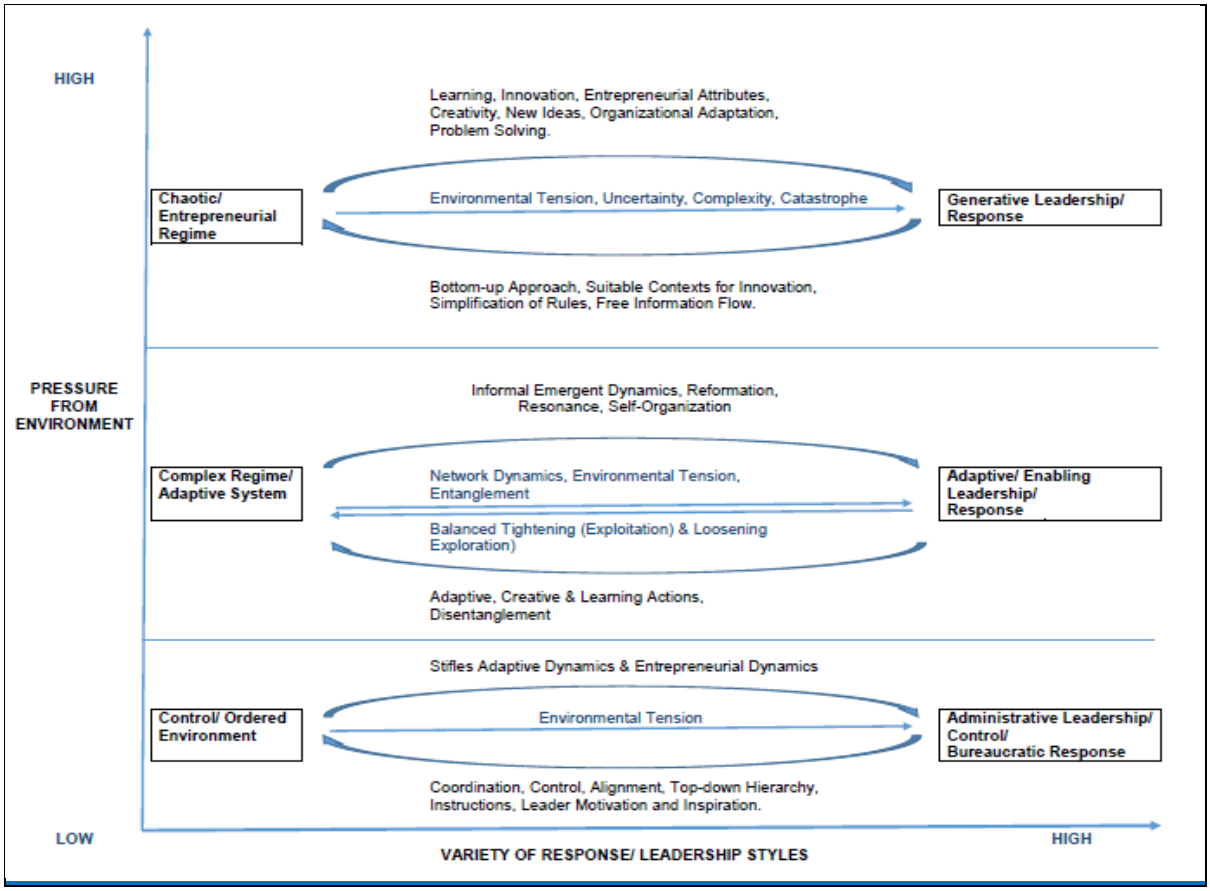

Figure 1. Categories of leadership styles for complex adaptive systems (Source: Adopted from Uhl-Bien et al., 2007; Hazy et al., 2007)

Other important complex adaptive system properties, which have been established through the integrative literature review are intertwinement or entanglement. These two properties manifest whenever the system's agents interact (Hazy and Uhl-Bien, 2013). They require project managers to carefully balance between the three leadership styles distilled in the preceding section. This balancing process involves emphasizing administrative and bureaucratic processes (which focus on drive efficiency) under stable conditions, and alternately activating and emphasizing adaptive leadership attributes during periods of turbulence, intense competition, uncertainty and complexity. Generative leadership attributes will be emphasized when entrepreneurial and innovative attributes are required (Ren et al, 2012). This is important in order to prevent administrative processes from suppressing adaptive attributes through too strict and rigid bureaucratic controls, which may consequently, stifle innovation, creativity and entrepreneurship (Ren et al, 2012). These processes have been accentuated as some of the gaps in the traditional project management practices. The competences required to enable project managers to achieve this go beyond the traditional project management philosophy.

The insights drawn from the foregoing sections of this study were crystallised into an integrative Complexity-Leadership Alignment Model. The model combines the leadership categorization and the complexity dynamics. Consequently, an attempt has been made to validate the impact of the project manager's leadership competences and ability to deal with different levels of complexity impacts on performance. The model is provided in Figure 2.

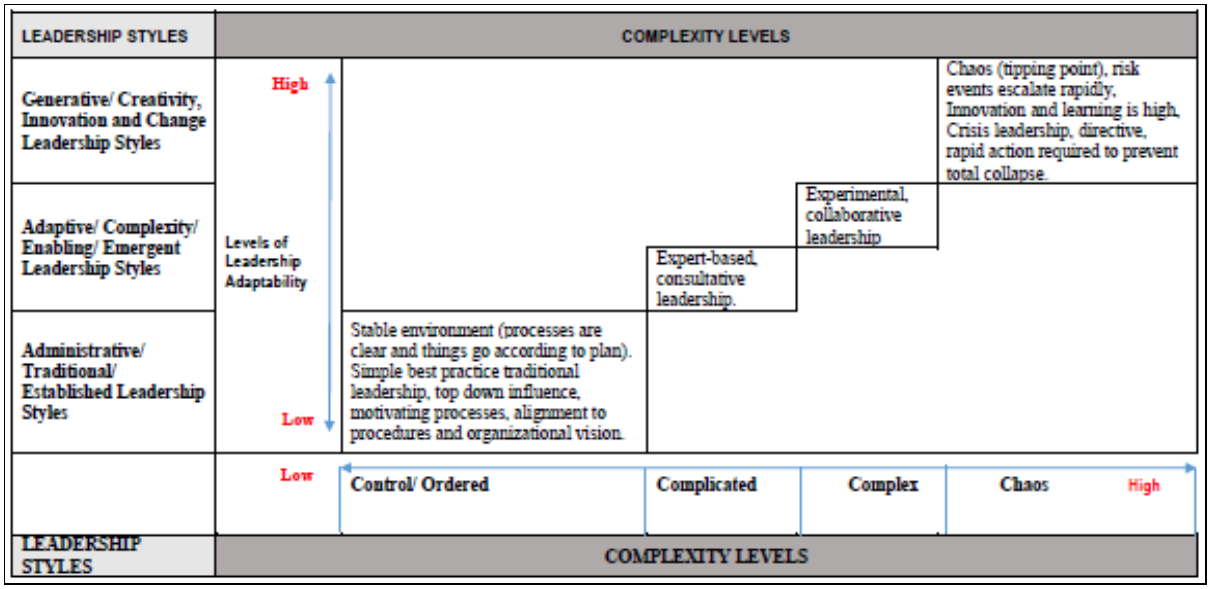

Figure 2. Complexity-Leadership Alignment Model (Source: Author)

5 Conclusion and Further Research

This study achieved the aim by distilling that the competences required under CAS are beyond traditional project management founding principles of controlling time, cost and quality. This raises a further question as to whether mega project success or failure can be ascribed to the project manager's training or individual agility. The study also achieved the first objective by highlighting the three dimensions of project complexity, where aggregate complexity was selected for more focus under the subsequent phase of this research. The question is whether all projects exhibit similar complexity dimensions and levels, and whether this happens across the entire delivery cycle. The second objective was also achieved through the delineation of administrative, adaptive and enabling leadership styles and the need for balance to deal with the emergence properties associated with complex adaptive systems. The question is whether the project management training sufficiently equips project managers to fulfil these requirements. The third objective was achieved by recommending project success as a more preferred comprehensive and integrative criterion than project management success. The questions remain regarding the role of different stakeholders in designing the project evaluation criteria, performance measurement metrics and key performance indicators. In order to address the fourth objective, this study developed an integrative Complexity-Leadership Alignment Model, which links project leadership and complexity in an attempt to validate the associated impact on project performance. This link will still need to be measured through analysis of empirical data. Overall, this study illuminated the inadequacy of the conventional project management philosophy, the dearth in project managers' leadership competences and project complexity as some of the critical factors behind the unsatisfactory performance of mega infrastructure construction projects. The questions which arose out of this stage of the study form the basis for further exploration under the subsequent stages.

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