Influence of Human Behavior on Success of Complex Public Infrastructural Megaprojects in Kenya

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Doi: 10.19044/esj.2017.v13n34p313 URL:http://dx.doi.org/10.19044/esj.2017.v13n34p313

Abstract

The main objective of this study was to investigate the influence of human behavior on the success of public infrastructural megaprojects in Kenya. The need for this study arose from the thesis that complexity due to human behavior is the main cause of waste and failure that results in infrastructural megaprojects being delivered over budget, behind schedule, with benefit shortfalls, over and over again. The study was designed as multiple-method research, based on virtual constructionist ontology recognizing that complexity is the mid-point between order and disorder. A cross-sectional census survey of 27 completed public infrastructural megaprojects was conducted using two interlinked questionnaires assessing human behavior constructs and project success. A total of 108 respondents made up of project managers, team members and organizational sponsors, participated in this study. Using both descriptive and inferential analysis, the results of this study have confirmed that human behavior significantly influences success of public infrastructural megaprojects. Optimism bias remains the main individual behavior that leads to cost and schedule underperformance in infrastructural megaprojects but loss aversion is the most occurring cognitive bias. In light of this finding, the study recommends that implementing organizations adopt structures that allow for continued business justification, focus on products and give project managers sufficient authority over project resources in line with the postulations of the structural contingency theory.

Keywords: Optimism bias, sunk cost effect, megaproject, complexity, human behavior

Introduction

The International Centre for Complex Project Management (ICCPM) describes complex projects as those characterized by uncertainty, ambiguity, with emergent dynamic interfaces, influenced by significant political or

external change, are run over a period which exceeds the product life cycles of the technologies involved or where significant integration issues exist; are defined by effect (benefit and value) but not by solution (product) at inception (Hayes & Bennet, 2011). This description is important in distinguishing complex systems from complicated ones, which have many moving parts that operate in patterned ways. Organizational complicatedness is usually measured based on the number of procedures, vertical layers, interface structures, coordination bodies and decision approvals (Morieux, 2011). Complex systems by contrast are imbued with features that may operate in patterned ways but whose interactions are continually changing. According to Sargut and McGrath (2011), three properties determine the complexity of the environment namely; multiplicity, interdependence and diversity.

Several studies linking complexity with project success have confirmed that complexity predominantly determines project success (Meyer, 2014; Hargen & Park, 2013; O'Donnell, 2010; Shermon, 2011, Flyvbjerg, Holm & Buhl, 2004; Vanston & Vanston, 2004). Infrastructural megaprojects are among the most complex category of project (Brady & Davies (2014). These projects are usually large-scale, complex ventures that cost billions of money, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people (Flyvbjerg, 2014). They are "greenfield" in nature as they often create new assets and utilize a variety of delivery models depending on their inherent complexity. In Kenya, megaprojects are increasingly used as the preferred delivery model for goods and services across a range of businesses and sectors. Such projects include the Standard Gauge Railway, the Konza techno-city, the LAPPSET Corridor and the Thika Superhighway, to mention but a few.

Inherent complexity in megaprojects is the main source of contextual risk which is usually referred to as typological risk (Omonyo, 2015). The magnitude of this risk increases as we move from an environment of low complexity towards high complexity. The effectiveness of project control is usually affected by typological risk in such a way that as the value of the typological risk increases, exercising project control becomes more difficult. This inability to control complexity has been recognized as a major factor in project failure for a number of years (Williams, 1999). However, complexity remains ambiguous and ill-defined in much of the project management literature (Geraldi, 2008). This could explain why complex infrastructural megaprojects are usually delivered over budget, behind schedule, with benefit shortfalls, over and over again; what Flyvbjerg (2014) characterizes as the "iron law of megaprojects". According to Kahneman and Tversky (1979) and Lovallo and Kahneman (2003), human behavior is the main

explanation for the iron law of megaprojects. It is this thesis that necessitated this study.

This study, through a cross-sectional census survey of completed complex public infrastructural megaprojects investigates the influence of human behavior on success of public infrastructural megaprojects in Kenya. The main contributions of this research include: confirming that human behavior has significant negative influence on success of public infrastructural megaprojects; optimism bias remains the main individual behavior associated with cost overruns and schedule delays; loss aversion is the most occurring cognitive bias among the individual systematic biases; and public infrastructural megaprojects in Kenya are delivered within a culture that does not recognize uncertainty, rapid change, emergence, connectedness and dependencies that characterize the context of these projects.

For the remainder of this article, I review relevant theoretical and empirical literature which presents an argument for the hypothesis of the study. This is followed by a description of the research design, data analysis and results together with a discussion of those results. The final section provides conclusions from the study and implications for both research and practice.

Literature Review and Hypothesis

To underscore the importance of complexity in determining project outcomes, Project Management Institute (PMI) published a global practice guide on navigating complexity in 2014. According to this standard, the causes of complexity in projects and programs are grouped into human behavior, system behavior and ambiguity. Of these causes, human behavior is said to be the main explanation for delivering megaprojects with cost overruns, behind schedule, with benefit shortfalls, over and over again (Kahneman & Tversky, 1979; Lovallo & Kahneman, 2003; Flyvbjerg, 2014). Human behavior may be the result of factors such as changing power relationships, political influence, and individuals' experiences and perspectives (PMI, 2014). These factors may hinder the clear identification of project goals and objectives, thus affecting the project delivery capability. The PMI Practice Guide for Navigating Complexity identifies four main constructs of human behavior namely; individual behavior, group, organizational and political behavior, communication and control, and organizational design and development. A broad description of each of these constructs and therefore, of human behavior, is to be found in the discipline of organization theory.

Organization theory describes a body of knowledge that brings together several management and organization theories. The main

approaches in organization theory stem from the works of the main schools of management thought namely; classical, human relations, systems, contingency, decision and social action (Mullins, 2007). As a body of knowledge, organization theory studies organizational designs and structures, relationships of organizations with their external environment and behavior of managers and technocrats within organizations. Besides suggesting ways in which organizations can cope with rapid change, organization theory provides a framework of studying organizations to identify the patterns and structures they use to solve problems, maximize efficiency and productivity and meet the expectations of stakeholders. A related (even though widely held as distinct) body of knowledge relates to organization behavior. Organization behavior involves understanding of individual and group behavior, and patterns of structure in order to help improve organizational performance and effectiveness (Mullins, 2007). The theories of organization behavior relate to the understanding, prediction and management of human behavior in organizations (Luthans, 2002).

According to Wagner and Hollenbeck (2010), the study of organization theory can be divided into three levels namely; micro, meso and macro. The first level involves the study of individuals in organization, the second level involves the study of work groups and the third level involves the study of how organizations behave. It can be concluded therefore that organization behavior is a subset of organization theory and that each of the levels in the study of organization theory represents the main constructs of human behavior in organizations, namely; the individual, the group and the organization (Mullins, 2007; PMI, 2014).

There are several management and organization theories that explain human behavior, some of which are described by Miles (2012). However, for the purposes of this study, three theories were used, namely; agency theory at the micro level, social identity theory at the meso level and structural contingency theory at the macro level. Agency theory, also referred to as principal-agent problem or agency dilemma, relates to risk sharing among groups that are in a contractual relationship. With its roots in behavioral economics, agency theory has been applied extensively in organization behavior (Eisenhardt, 1985; 1988). Agency problem occurs when cooperating parties have different goals and vision of labor (Jensen & Meckling, 1976). As such, this theory is concerned with resolving two problems that can occur in agency relationships-the first arising when the desires or goals of the principal and agent conflict and the second arising when it is difficult or expensive for the principal to verify what the agent is actually doing. The second is the problem of risk sharing that arises when the principal and agent have different attitudes toward risk. For instance, in a cost-plus percentage fee contract, a contractor may have no incentive to

reduce costs since the higher the delivery cost, the higher their fee. Likewise, a project manager may see no value in terminating a failing project because of individual benefit. Given the operation of the agency problem, organizations are faced with the problem of integrating the individual and the organization to enable successful delivery of its initiatives and this requires the understanding of both human personality and formal organization. This integration recognizes that individuals behave differently when acting in their organizational role than when acting separately from the organization (Chester, 1938). Thus, agency theory is key in explaining how individual behavior affects key organizational outcomes. This study takes the view that all dysfunctional individual behaviors and cognitive biases such as optimism bias, loss aversion, misrepresentation, etc., arise out of the lack of integration between individual and organizational goals, and also out of their differences in risk taking.

Many studies have been conducted linking individual behaviors with project success. For instance, in a study to establish the effect of optimism bias on the decision to terminate failing projects, Meyer (2014) showed that in-project optimism bias is a significant contributor to decision maker's motivation to continue with a failing project. For post-project optimism bias, the study showed that it is prevalent throughout the project and increases as the project approaches the end. The conclusions of this study are in line with the findings of Lovallo and Kahnemann (2003) whose research concluded that optimism and risk aversion were the main biases in forecasting and risk taking and that these two undermine executives' decision-making. Mackie and Preston (1998) also found optimism to be among the 21 sources of error and bias in appraisal of transport projects. In a study to identify systematic biases in project failures, Shore (2008) conducted research on 8 large projects and wrote case studies on each failure to demonstrate how organizational and project culture could contribute to those biases. The findings of the study confirmed that there are indeed systematic biases and culture in project failure that are worth exploring. The main premise of this study was the fact that systematic biases are common in the human decision-making process and this provides a fundamental reason why project failure should not be an unexpected result. In a study of the causes of cost overruns in 258 transport infrastructure projects across 20 nations, Flyvbjerg, Holm and Buhl (2004) used Regression Analysis and concluded that underestimation cannot be explained by error and is best explained by strategic misrepresentation, that is, lying, which is a manifestation of agency problem. This is in line with the findings in Bruzelius, Flyvbjerg and Rothengatter (2002) who in a study on improving accountability in megaprojects, argued that differences between forecasts and actual costs could only be explained by the strategic behavior of the project proponents.

They identify lack of long-term commitment, rent seeking behavior for special interest groups and the tendency to underestimate in tenders to get proposals accepted, as the main strategic behaviors of project proponents that adversely affect project outcomes.

A second set of organization theories that explain human behavior is the social identity theory as attributed to Tajfel (1978). This theory explains the behavior of individuals in groups based on the need to maintain their social identity. According to this theory, people work to achieve and maintain a positive social identity which is based on favorable comparisons made among groups to which a person belongs and groups to which a person does not belong, and if social identity is unsatisfactory, then people strive to leave their current groups and join more favorable groups, or they try to make their current groups more satisfactory (Tajfel & Turner, 1986). Social identity research findings suggest three important consequences for organizations (Miles, 2012), namely; employees select and perform activities that resonate with their social identities, and they tend to support organizations that support their social identities; social identification tends to influence important group outcomes, such as cohesion, cooperation, altruism, and positive evaluations of the group (Turner, 1982, 1984); and, as employees come to increasingly identify with the organization, then the values, ideals, and practices of that organization can be perceived as more unique, distinctive, and positive compared to other organizations. This theory provides key explanation for group behaviors such as groupthink, groupshift, self-organization and tribal mindset. It is at the centre of explaining the evolution of team and project culture.

The structural contingency theory is the third theory that explains human behavior particularly at the macro level. This theory stands on the premise that there is no one best organizational structure; rather, the appropriate organizational structure depends on the contingencies facing the organization (Burns & Stalker, 1961; Chandler, 1962). The theory posits that organizations will be effective if managers fit characteristics of the organization, such as its structure, with contingencies in their environment (Donaldson, 2001). Such contingencies could include organizational maturity, culture, opacity, among others. One of the most important concepts in the theory is alignment An organization whose characteristics align with the contingencies in its situation will perform more effectively compared to an organization whose characteristics do not fit with the contingencies in its situation. According to the theory, there are two main contingencies that need to be considered: organizational size and organizational task (Miles, 2012). This theory is critical in explaining the organizational design and development construct.

A number of studies have been conducted linking this theory to project outcomes. For instance, in a study involving a critical review of extant literature, Olaniran, Love, Edwards, Olatunji and Mathews (2015) conclude that complex interactions between project characteristics, people, technology, and structure and culture contribute to the occurrence of cost overruns in hydrocarbon megaprojects. In exploring the role of project management maturity (PMM) and organizational culture in perceived performance, Yazici (2009) conducted a survey-based research with 86 project professionals from the manufacturing and service sectors in the United States of America. This study revealed that PMM is significantly related to business performance but not to project performance. According to this study, organizational culture change towards sharing, collaboration and empowerment, is required in order to deal with (overruns) in project time, cost and expectations. In a study of cost and time overruns in public sector projects, Morris (1990) identified bureaucratic indecision and a lack of coordination between enterprises to be among the main causes of cost and time overruns in large public sector projects. Both these factors map onto organizational design and development as an aspect of human behavior. In a similar study, Kaliba, Muya and Mumba (2008) conducted a study on cost escalation and schedule delays in road construction projects in Zambia and found that administrative structures and inexperienced administrative personnel were among the factors that explained cost overruns.

In conclusion, the literature reviewed suggests that human behavior can have either positive or negative outcomes depending on the context. For instance, some positive psychologists postulate that optimism could be a very positive force at the workplace as it could motivate project teams to work harder, have high levels of inspiration and set stretch goals (Luthans, 2002). In the same veil, negative psychologists believe that optimism has a downside effect that could lead to dysfunctional outcomes. With this understanding, this study tested a non-directional research hypothesis that:

H_A1: *Human behavior has significant influence on success of public infrastructural megaprojects.*

Another set of theory relevant to this research study was the project success theory. Project success theory is generally presented as a body of knowledge bringing together various research contributions to the success school of project management. Our review shows that there have been various attempts over the history of project management to define suitable criteria against which to anchor and measure project success (McLeod, Doolin & MacDonell, 2012). The most recognized of these measures is the long established and widely used "iron triangle" of time, cost and quality (Atkinson, 1999; Cooke-Davies, 2002; de Wit, 1988, Ika, 2009; Jugdev, Thomas, & Delisle, 2001). However, the "iron triangle" dimensions are

inherently limited in scope (Atkinson, 1999; Ika, 2009; Wateridge, 1998). A project that satisfies these criteria may still be considered a failure; conversely a project that does not satisfy them may be considered successful (Baccarini, 1999; de Wit, 1988, Ika, 2009). The "iron triangle" only focuses on the project management process and does not incorporate the views and objectives of all stakeholders (Atkinson, 1999; Baccarini, 1999; Bannerman, 2008; de Wit, 1988; Jugdev & Muller, 2005; Wateridge, 1998).

In recognition that project success is more than project management success and that it needs to be measured against overall objectives of the project thus reflecting a distinction between the success of a project's process and that of its product (Baccarini, 1999; Markus & Mao, 2004; Wateridge, 1998), researchers have broadened the scope of project success to include three key measures, namely; process success, product success and organizational success (McLeod et al., 2012). Product success involves such criteria as product use, client satisfaction and client benefits. Organizational success criteria incorporates achievement of broader set of organizational objectives involving benefits to the wider stakeholder base (see Shenhar, Dvir, & Levy, 1997; Shenhar, Dvir, Levy & Maltz, 2001; Shenhar & Dvir, 2007; Hoegl & Gemuenden, 2001). This is plausible given that projects are a means of delivering the organization's strategic objectives. Proponents of this school of thought advocate for inclusion of success criteria such as business and strategic benefits.

Research Conceptual Model and Hypothesis

Figure 1 illustrates the hypothesized research conceptual model which is based on PMI (2014) and McLeod et al. (2012). According to this model, human behavior as defined by individual behavior, group behavior and organizational design and development, represent independent variable while success of infrastructural megaprojects (defined as process, product and organizational success) was identified as the dependent variable.

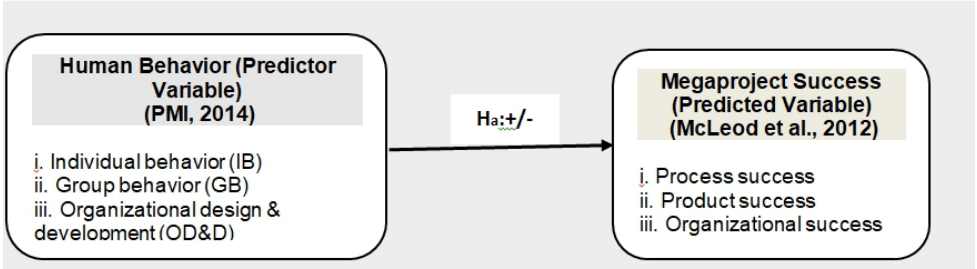

Figure 1: Proposed Research Model

Method

Context and Design

This study was operationalized through exploratory, descriptive and explanatory research goals based on Neuman (2003) classification of research goals. To achieve these goals, a post-positivist philosophy emphasizing virtual constructionist ontology (Gauthier & Ika, 2012) was assumed. This philosophy utilizes both interpretivist (Bryman & Bell, 2007) and pragmatist (Goldkuhl, 2012) epistemologies to generate knowledge based on a combination of deductive and inductive approaches. The choice of this philosophical perspective was guided by the social world of complex megaprojects. In this social world, complexity is the midpoint between order and disorder, and megaproject management is neither a practice nor a tool (as is the case with projects implemented in the modern social world) but a rallying rhetoric in a context of power play, domination and control (Gauthier & Ika, 2012).

This study was designed to be mixed-method research combining both quantitative and qualitative strategies (Burch & Carolyn, 2016). The mixed-method research provides an epistemological paradigm that occupies the conceptual space between positivism and interpretivism (Tashakkori & Creswell, 2007), the main epistemologies on which the virtual constructionist ontology thrives. To generate data for this study, a cross-sectional census survey design was used. This design entails the collection of data (predominantly by questionnaire or structured interview) on usually quite a lot more than one case and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to detect patterns of association (Bryman & Bell, 2007).

Population and Sample

This study had as its primary population public sector infrastructural megaprojects implemented by the government of Kenya since 2005. Following Flyvbjerg (2014), the minimum budget for megaprojects included in this study was approximately Ksh. 1 billion. Managers, team members, sponsors and key stakeholders of these projects constituted the population of respondents from whom data was collected. A total of 31 projects were included in this study. For each project, four respondents comprising the project manager, project sponsor and two project team members were surveyed. In total, 108 respondents participated in this study. A total of 27 completed infrastructural megaprojects, representing a response rate of 87.1%, were surveyed as part of this research. Of these projects, 2 were from Kenya Ports Authority, 2 were from Kenya Pipeline Company, 6 were from Kenya Airports Authority, 3 were from Kenya Power and Lighting

Company, 1 was from Kenya Electricity Generating Company, 5 were from Kenya Urban Roads Authority, 1 was from Kenya Civil Aviation Authority, 1 was from Geothermal Development Company, with the remaining 6 coming from Kenya National Highways Authority.

Instruments and Data Collection

Fieldwork for this study utilized two interlinked questionnaires namely, the human behavior assessment questionnaire and the project success questionnaire. The human behavior questionnaire was constructed based on the Practice Guide for Navigating Complexity (PMI, 2014) while the project success questionnaire was developed based on the works of Shenhar and Dvir (2001) and McLeod et al. (2012). Questionnaire survey is hailed to be an efficient data collection mechanism when the researcher knows exactly what is required and how to measure the variables of interest (Neuman, 2003). The human behavior scale comprised a 22-item Likert-type scale with the responses on each item being rated on a 5-point mutually exclusive scale where a rating of 1 denoted a "strongly agree" response, 2 denoted "agree" response, 3 denoted "somewhat agree" response, 4 denoted "disagree" response, while 5 denoted a "strongly disagree" response. A choice of either 1 (strongly agree) or 2 (agree) implied low complexity while a choice of either 4 (disagree) or 5 (strongly disagree) implied high complexity due to human behavior. A choice of 3 (somewhat disagree) implied a neutral and borderline response which did not communicate much on the complexity of projects studied and was therefore dropped from further analysis. The success scale comprised 18 items blending open and closed ended questions on one part and Likert-type questions on the other part. The first part involving closed and open ended questions was meant to assess process success while the Likert-type questions assessed product and organizational success on a scale of 1 (strongly agree) to 5 (strongly disagree).

The first phase of data collection involved a pilot study on four projects to test the reliability and validity of the instruments. The results of the pilot study showed that both instruments were reliable with the human behavior scale recording internal reliability of 0.879. The overall internal reliability of the success scale was 0.889, both these values are greater than the cut-off Cronbach's alpha of 0.7 (Nunnally, 1978). The pilot study results also demonstrated high concept, construct, and external reliability, in the study instruments. The second phase involved using revised study instruments to collect primary data from the remaining 24 projects. Generally, the projects surveyed had a budget at appraisal ranging from approximately Ksh. 1 Billion to Ksh. 40 Billion with 8 of these projects (29.6%) having a budget at appraisal of over Ksh. 10 Billion. The scheduled

duration for these projects ranged from 4 months to 72 months with most projects having a scheduled duration of above 20 months. The project locations were spread across several counties in Kenya. All the projects were turnkey, involving a variation of Engineer-Procure-Construct and Design-Build-Transfer delivery arrangements.

Data Analysis and Results

Collected data was processed and analyzed using Microsoft Access 2010, IBM's SPSS version 20 and Microsoft Excel 2010. Quantitative data analysis was conducted using both descriptive and inferential statistics. The main descriptive statistics used were the mean, standard deviation, coefficient of variation, indices, skewness, kurtosis and percentages. The inferential statistics used were F-test, t-test, Pearson correlation coefficients, coefficients of determination and tests of significance. Qualitative data analysis was done through expert judgment, scenario mapping and critical thinking. Data presentation was largely through text, figures, tables, numerical values and equations. The results are presented per construct in the sections that follow.

Infrastructural Megaproject Success

Infrastructural Megaproject success was measured along three constructs namely process, product and organizational success. Process success incorporates the traditional measures of efficiency (delivery within budget and time schedule) and quality. Efficiency was measured using the cost and schedule performance indices with the weighted average of these indices calculated to denote the overall efficiency index for the project. The CPI results show that 14 projects (52%) were delivered over budget, 9 projects (33%) were delivered on budget with the remaining 4 (15%) being delivered under budget. SPI results show that of the 27 megaprojects surveyed, 22 (81%) were delivered behind schedule, 3 (11%) were delivered on schedule while 2 (7%) were delivered ahead of schedule. Simple weighted averages of the CPI and SPI values were calculated to give the Weighted Project Efficiency (WPE) values for each project. Using these values, a total of 4 megaprojects (15%) had efficiency levels greater or equal to 1 (100%). The rest (85%) of the megaprojects were delivered at efficiency levels lower than 100%. As shown in Table 6, the energy sector projects had the lowest relative cost performance (CV=0.42) but had the highest schedule (CV=0.19) and overall efficiency (CV=0.14) performances. The roads sector scored highest on cost performance (CV=0.16) while ports (air and sea) projects scored lowest in both schedule performance (CV=0.47) and overall efficiency (CV=0.31).

SECTOR	DESCRIPTIVE STATISTICS FOR EFFICIENCY MEASURES								
	CPI			*SPI*			*WPE*		
	MEAN	STDEV	CV	MEAN	STDEV	CV	MEAN	STDEV	CV
Ports $n = 9$	0.85	0.17	0.20	0.79	0.37	0.47	0.80	0.25	0.31
Energy $n = 7$	0.97	0.41	0.42	0.78	0.15	0.19	0.88	0.12	0.14
Roads $n = 11$	0.91	0.15	0.16	0.66	0.19	0.28	0.79	0.12	0.15

Table 1: Project Efficiency by Sector

The process success score was determined by adding a score for project quality to the score for project efficiency. The quality score was based on the effect of changes (if any) to the scope baseline and was based on a scale of 1 (no or low impact) to 3 (high impact). The results showed that 6 megaprojects (22%) underwent more than three scope changes, 13 megaprojects (48%) underwent up to 3 scope changes while 8 megaprojects (30%) did not undergo any scope change. Product and organizational success were measured using a 9-item questionnaire of Likert-type scale with respondents being asked to respond to each item based on a 5-point scale (1=strongly disagree, 2=disagree, 3=somewhat disagree, 4=agree, 5=strongly agree). A score of 1 indicated low success score and 5 indicated high success score. Product success measures the effectiveness of the project in delivering a product that meets the customer requirements, improves customer performance, and satisfies customer needs. Organizational success measures the interaction of process and product success to meet organizational objectives, maximize stakeholder value, and enhance organizational innovation capacity to deliver future projects. The results indicate that the projects had a mean product success score of 4.09 with a standard deviation of 0.94, and a mean organizational score of 4.39 with a standard deviation of 0.82. The overall success scores were obtained by taking the simple weighted average of the mean success scores for process, product and organizational dimensions. With the highest score assigned to process, product and organizational dimensions being 8, 5, and 5 respectively, the highest possible mean composite success score was therefore 6.

Human Behavior

Human behavior was measured using three constructs, namely; individual behavior, group behavior and organizational design and development. Individual behavior was measured using a 7-item Likert type scale assessing cognitive biases in human behavior while group behavior was measured based on a 7-item Likert type scale assessing team commitment,

cohesion, co-responsibility, top management support and motivation. Complexity due to organizational design and development was measured using two sets of indicators- alignment, opacity and process maturity as one set, and organization structure, stakeholder engagement and culture as another. Complexity based on alignment, opacity and process maturity was measured using an 8-item Likert type scale. Data on organization structure and stakeholder engagement was collected using a checklist in which the respondents were required to select the statements that applied to their projects.

Based on the responses, the items on the individual behavior scale were mapped onto common cognitive biases that have been linked to project failures by past researches and in extant literature. The first item on the scale mapped onto the "framing effect" bias, the second item mapped onto "anchoring" bias, the third and the fourth items mapped onto "optimism bias", the fifth item mapped onto "misrepresentation/noble lying", the sixth item mapped onto "resistance to change" bias while the seventh item mapped onto "loss aversion/sunk cost effect" bias. Using the responses for those who either disagreed or strongly disagreed, the results show that loss aversion (sunk cost effect) was the most cited individual behavior exhibited by the projects (48.1%) followed by optimism bias (25.9%), misrepresentation (14.8%), anchoring bias (7.4%) and resistance to change (3.7%). Table 2 summarizes cost and schedule performance for projects exhibiting the identified cognitive biases, with the general result that projects that exhibited optimism bias had most of them delivered with budget overrun and schedule delay.

Individual Behavior	% of Projects Exhibiting Behavior	% Delivered Within Budget	% Delivered Within Schedule	% Delivered With Budget Overrun and Schedule Delay
Anchoring bias	7.4	50	0	50
Optimism bias	25.9	42.9	0	57.1
Misrepresentation	14.8	25	25	50
Resistance to change	3.7	100	0	0
Loss aversion (Sunk Cost effect)	48.1	46.2	15.4	46.2

Table 2: Individual Behaviors and Performance

Since individual behavior can collectively define the culture of an organization, the individual behavior systematic biases identified were mapped onto four dimensions of organizational culture using the Competing Values Model (Livari & Huisman, 2007), in order to determine the culture of each project. The dimensions are internal focus, external focus, stability and change. The results show that all projects exhibiting the identified biases mapped onto a project culture that can be characterized as having a preference for an internal focus and stability. These biases were associated

with escalation in cost and schedule overrun. Table 3 shows the mapping of the individual behaviors on the competitive values model.

Cognitive Bias	% of Projects Exhibiting Bias	Dimensions of Competing Values Model Implied			
		Internal Focus	External Focus	Stability	Change
Anchoring Bias	7.4				
Optimism Bias	25.9				
Misrepresentation	14.8				
Resistance to Change	3.7				
Loss Aversion (Sunk Cost Effect)	48.1				

Table 3: Cognitive Biases Mapped onto Competing Values Model

Analysis of project delivery was conducted based on the responses in the GB scale and summarized as shown in Table 4. Overall, the results show that low complexity (strongly agree/disagree responses) was associated with somewhat better project delivery compared to instances of high complexity (disagree/strongly disagree response).

Item in the Scale	Responses			
	Strongly Agree/Agree		Strongly Disagree/Disagree	
	% of Projects Delivering Within		% of Projects Delivering Within	
	Budget	Schedule	Budget	Schedule
Senior management team and other key stakeholders were fully committed to the project	48.2	18.5	-	-
The project had the support, commitment and priority from the organization and functional groups	52.0	20.0	-	-
The project team was cohesive and always worked towards common goals and objectives	54.2	20.8	-	-
Contractual terms were well understood by all parties involved	55	25	0	0
The project team members were co-located, co-incentivized and co-responsible for the outputs of their projects	38.9	16.7	33.3	0
The project team members primarily worked face to face (rather than virtually) throughout the life of the project	47.4	10.5	0	0
Team members or stakeholders were able to accept the project information that may have been contrary to their beliefs, assumptions or perspectives	50.0	16.7	25.0	0

Table 4: Cost and Schedule Performance Based on Group Behavior Responses

Responses to the first set of items measuring organizational design and development were analyzed and linked to cost and schedule performance as shown in Table 5. Whereas the distinction in cost performance based on complexity levels is not apparent, the results indicate that projects that had low complexity recorded relatively better schedule performance compared to those with high complexity.

Item in the Scale	Responses			
	Strongly Agree/Agree		Strongly Disagree/Disagree	
	% of Projects Delivering Within		% of Projects Delivering Within	
	Budget	Schedule	Budget	Schedule
Alignment:				
The project had clearly defined boundaries with other projects and initiatives that were running in parallel	47.8	21.7	100	0
The organization had the right people with the necessary skills and competences as well as the tools, techniques or resources to support the project	54.5	22.7	0	0
There was an effective portfolio management process within the organization to facilitate strategic alignment and enable successful delivery of projects	41.2	17.6	50	0
Opacity:				
The sponsor or project organization made decisions, determined strategies, and set priorities in a manner that promotes transparency and trust	50.0	20.8	0	0
There was open communication, collaboration and trust among the stakeholders and project team	47.8	13	0	0
Process Maturity:				
It was feasible to obtain accurate status reporting throughout the life of the project	52.2	21.7	100	0
The client created and ensured the use of common processes across all projects	47.4	21.1	66.7	0
The project manager had the authority to apply internal or external resources to project activities	45.5	18.2	40	10

Table 5: Delivery Based on Alignment, Opacity and process Maturity

Data on organization structure showed that the megaprojects studied fall into two main categories following the classification by Shenhar and Dvir (2007). Most of the projects were system projects which produced a

single outcome such as the KCAA Headquarter building, comprising a collection of assemblies, components and subsystems. Yet others, such as the Mombasa Port Modernization Project, were array projects (system of systems) that integrated a collection of systems functioning together to achieve a common goal. The results show that the number of layers in the governance structure of the projects was related to their cost and schedule performance in such a way that structures with less than 10 layers had better cost and schedule performance compared with those with more layers.

All the 27 megaprojects studied were organized in a "one-size-fits-all" approach with 9 (33.3%) of these megaprojects being delivered through a pure functional structure, 5 megaprojects (18.5%) through a weak matrix structure, another 18.5% being delivered through a strong matrix structure and the remaining 8 megaprojects (29.6%) being delivered through a projectized structure. The projects that were organized through a weak matrix structure had the highest relative variability in their mean success (CV=0.29) followed by those that were organized through a pure functional structure (CV=0.18). Projects organized through a strong matrix structure recorded the lowest relative variability in mean success (CV=0.13) followed by those utilizing a projectized structure (CV=0.16). On stakeholder management, the main forms of engagement were through site meetings and progress reports, with some projects involving stakeholders only in preparatory stages. Stakeholder engagement was a formal role in only 4 projects (14.8%) with 6 projects (22.2%) having a clearly documented stakeholder engagement plan that was used to manage stakeholders.

Hypothesis Testing

The human behavior complexity score for each project was determined based on the scores of the individual constructs. These scores were based on the mean response scores for each item in the questionnaire. Based on the scale, the lowest score was 1 (implying lowest complexity) and the highest score was 5 (implying highest complexity). The results show that individual behavior returned a mean complexity score of 2.21 with a standard deviation of 0.62, while group behavior had a mean complexity score of 3.29 with a standard deviation of 1.02. Organizational design and development recorded a mean complexity score of 1.97 with 0.60 standard deviation while the overall weighted complexity score had a mean of 1.87 with a standard deviation of 0.50. To enable use of these scores in parametric tests (such as correlation and regression analysis), their coefficients of skewness and kurtosis were determined to ensure that the data meet the normality assumption of parametric tests. The results show coefficients of skewness which are within the -1 to +1 range and coefficients of kurtosis

which are also within the recommended range of -2.2 to +2.2 (Sposito, Hand, & Skarpness, 1983).

To test the hypothesis that human behavior has a significant influence on success of public infrastructural projects, the mean scores of human behavior constructs were first correlated with those of project success constructs to determine if they have any association. The results showed that at 99% confidence level, there was a strong significant positive correlation between product success and organizational success ($r = 0.709$). At 99% confidence level, the results showed that: there is significant moderate positive correlation between individual and group behavior (r=0.674); the correlation between individual behavior and organizational design and development is moderately positive and significant (r=0.539); there is a significant strong positive correlation between group behavior and organizational design and development (r=0.783); and group behavior has the strongest significant positive correlation with the weighted human behavior complexity (r=0.995) followed by organizational design and development (r=0.0.866) and individual behavior (r=0.816).

On the relationship between human behavior and project success, the results indicate that at 99% confidence level, group behavior and overall human behavior have significant but negative correlation with process success (r=-.639, and r=-.575, respectively). At 95% confidence level, the results indicate that individual behavior and organizational design and development have significant but negative correlation with process success (r=-.387, and r=-.430, respectively) and that organizational design and development has a significant negative correlation with product success (r=-.415). It is indicated that at the 99% confidence level, all the three constructs of human behavior have significant, though negative correlation with the overall project success. Further, the results show that human behavior has a significant negative correlation with overall project success.

Causal relationship between human behavior (HB) and megaproject success (PS) was tested using OLS linear regression at the 95% confidence level using a two-tailed test. The results indicate that the overall model had a 46.3% predictive power (R^2=0.463). ANOVA results showed that the overall model was significant with $F_{(1,25)}$ = 21.530 and P<0.025. The results indicated that there was no serial correlation in the data used to conduct regression analysis given a Durbin-Watson statistic less than 2. Data was also checked for collinearity using the Tolerance and VIF statistics. The results indicated a VIF value much lower than 4 which is used as the threshold to indicate multicollinearity (particularly in small samples) (O'Brien, 2007). The problem of heteroscedasticity was checked using residual statistics in a scatter plot. The results indicated that almost all the residuals had a mean of 0.000 and were approximately equally spread

implying that the data was homoscedastic and was therefore good for OLS regression analysis.

The regression equation is presented below:

$$\bar{PS}_i = 6.421 - 0.681 HB_i$$

$$s(\hat{b}_i) = (0.377) \quad (0.147)$$

$$t = \ (17.05) \quad (-4.64) \qquad R^2 = 0.463$$

At 95% confidence level with a two-tailed test, if the $s(\hat{b}_i) < \left(\frac{\hat{b}_i}{2} \right)$, the null hypothesis that $b_0 = b_1 = 0$ is rejected and a conclusion is made that the betas are significant (Koutsoyiannis, 1992). In this study, the results show that the slope of human behavior is significant, implying that a one unit increase in the complexity score for human behavior reduces project success score by 0.681. Thus, the research hypothesis that human behavior has a significant influence on success of public infrastructural megaprojects is accepted.

Discussion

This study used developments in project success theory to identify the broader measures of project success. The findings agree in part with the trending view that megaprojects are always delivered over budget, behind schedule, with benefit shortfalls, over and over again (Flyvbjerg, 2014). With 52% of the projects having been delivered overbudget and 82% having been delivered behind schedule, the "iron law of megaprojects" is partly confirmed. Whereas existing positive literature indicates that one out of ten infrastructural megaprojects is delivered on budget and one out of ten megaprojects is delivered on schedule (Flyvbjerg, 2014), this study only confirms this to the extent that 11% of the projects were delivered on schedule. The short run results for project benefits, however, seem to disagree with the view that megaprojects are delivered with benefit shortfalls.

Results show that more of the variability in overall project efficiency is attributed to schedule performance than to cost performance and most projects that were delivered on or under budget experienced schedule delay. This is a key finding that may be pointing to the fact that most emphasis in megaproject management is directed on the cost element rather than to an integrated trade-off among cost, time and quality. It has been shown in earlier studies that project duration is positively associated with the size of cost overrun (Flyvbjerg et al., 2004). The findings of this study also add to

the growing view that operational excellence or process success does not necessarily imply project success (Baccarini, 1999; de Wit, 1988; Ika, 2009). For instance, when sectoral comparison was done, the ports sector had the lowest relative variability in process success (CV=0.29) but the highest relative variability in product (CV=0.20), organizational (CV=0.13) and composite (CV=0.12) success. The finding that a project that has high product success is also likely to have high organizational success supports the generally accepted project management principle of "focusing on products**"** as opposed to focusing on the activity (Axelos, 2017). The correlation results also showed that there is no significant correlation between process success and product or organizational success. This supports the argument of Baccarini (1999), de Wit (1988) and Ika (2009) who contend that a project that satisfies process criteria may still be considered a failure and a project that does not satisfy them may be considered successful.

The results of this study agree with the postulation of both positive and normative literature that optimism bias and the other biases in individual behavior have negative implications throughout the life cycle of programs and projects (PMI, 2014; Shore, 2008). With the results showing that projects exhibiting optimism bias had more incidences of delivery over budget and behind schedule compared to those exhibiting misrepresentation and loss aversion, this study is in consonance with the findings of Lovallo and Kahnemann (2003), Flyvbjerg et al. (2003), Kahnemann and Lovallo (1993), Wachs (1989:1986) and Meyer (2014), who posit that optimism bias is the main cause of delivery over budget and behind schedule.

The results also point to the fact that individual behaviors identified have more adverse effect on schedule performance compared to cost performance. Indeed, the mean cost performance for the entire sample was higher and more stable compared to the mean schedule performance. This finding may be pointing to the fact that public infrastructural megaproject sponsors feel more pressure from the public when projects are delivered over budget compared to when they are delivered behind schedule and so they prioritize cost performance over schedule performance. This may be counterproductive since previous studies have shown that implementation sluggishness has a significant relationship with cost escalation in infrastructure projects (Flyvbjerg, Holm, & Buhl, 2004).

The results of this study put misrepresentation in the second place among individual biases associated with cost overrun and schedule delay. Misrepresentation, which is sometimes referred to as "noble lying" has its support in Hirschman's theory and a postulation that if people knew in advance the real challenges and costs involved in delivering megaprojects, they would probably never have touched them and nothing would get built

(Flyvbjerg, 2014). In terms of occurrence on projects, this study finds that loss aversion has almost twice the frequency of optimism bias and thrice the frequency of misrepresentation. These results corroborate with those of Shore (2008) who found twice as many incidences of sunk cost effect (loss aversion) in comparison with overconfidence (optimism). Continued exhibition of loss aversion bias on projects does not support the generally accepted project management principle of "continued business justification" (Axelos, 2017). According to this principle, a project can be canceled any time during its life cycle whenever it is found that its business case is not viable, desirable or achievable.

Top management support and support from other key stakeholders have long been recognized in extant literature as a key factor that contributes to project success (PMI, 2014; Hauschildt, Gesche, & Medcof, 2000). This is even more important for infrastructural megaprojects which are transformational in nature and whose budget may be more than the entire implementing organization's asset base in real terms. In some cases, the project may be the only activity the organization is involved in over several years. For the most part, senior management confuse this support for micromanagement and may get involved in the day to day management of the project denying the project manager and the team the flexibility they require to manage the project as per the project charter. This micromanagement comes with a lot of interests, including issues of servitude (as identified in this study) which could lead to poor project delivery capability. It is not surprising therefore, that despite the centrality of top management support in delivering successful projects, this study found that less than 50% of the projects where senior management teams were fully committed to their course were delivered within budget and a dismal 18.5% were delivered within schedule.

Normative literature recognizes that team working can improve efficiency (Green, 1997) but team work does not guarantee in itself good results (Belbin, 1993). Rather, what is important is how the individuals within the group work cohesively together (Mullins, 2005). The various behaviors of the team members must mesh together in order to achieve objectives (Crainer, 1998). The results of this study confirmed that projects in which respondents strongly agreed that, the project team was cohesive and always worked towards common goals and objectives, recorded better cost and schedule performance with over 54% of those projects being delivered within budget. Again compared with the results in Flyvbjerg (2014), this is plausible.

The results of this study do not provide clear support for the benefits of co-locating, co-incentivizing and making teams co-responsible for project outputs. Normative literature postulates that co-location is a factor in

ensuring rapid and faster communication when managing projects in dynamic environments (Collyer, 2016) and it enhances the ability of team members to perform as a team (PMI, 2013). Besides co-location, co-incentivizing and making project teams co-responsible for project outputs is one way of dealing with the agency problem that manifests itself in infrastructural megaprojects. When teams are co-located, co-incentivized and co-responsible, innovation in handling emerging problems is usually enhanced and the teams are motivated to go out of their way in identifying early warning signs. It is expected that such teams are more agile and ambidextrous in resolving emerging issues and dealing with ambiguity and system dynamics. Working face-to-face on projects increases the chances of better performance. As the results of this study show, projects in which team members worked primarily face-to-face had better cost and schedule delivery compared to those that did not.

In strategic and organizational project management, projects are generally taken as the "tactics" of delivering strategic and organizational objectives. In that environment, the business case of the project is usually derived from that of the portfolio, programme or vision to which the project is directly traceable. In all cases, it is important that there exist an effective portfolio management process within the organization that facilitates strategic alignment to ensure that the right projects are implemented with the right resources within clearly defined boundaries and interfaces. Misalignment may result in conflicting priorities and direction for the program or project team (PMI, 2014). The findings of this study agree with this postulation and establishes that project misalignment adversely affects schedule delivery and to a considerable extent, budget delivery.

Organization design and development improves the organization's visioning, empowerment, learning and problem solving processes (Mullins, 2005), which are critical aspects of adaptive behavior that project managers require to successfully deliver complex megaprojects. However, this is only possible in an environment that promotes open communication and where project decisions, priorities and strategies are made transparently. Project complexity may increase where the organization conducts business in an opaque manner, leading to mistrust which may affect its outcomes. The findings of this study agree with this postulation to the extent that none of the projects in which decisions, strategies and priorities were made in a transparent manner, was delivered within budget or schedule. The results agree with the postulation in extant literature that effective communication has an impact on project execution and/or outcome (PMI, 2013; Olaniran, Love, Edwards, Olatunji, & Matthews, 2015).

It is also widely recognized in literature that trust within the project team and among team members has a positive effect on transfer of

knowledge (Holste & Fields, 20101; Maurer, 2010), which is critical for the team to explore and exploit decision choices in complex megaprojects. This study noted that in projects where there was no open communication, collaboration and trust among the stakeholders and project team, the probability of delivery within cost and schedule dropped from 47.8% and 13% respectively, to 0%. Perhaps this finding provides a first level reply to Olaniran et al. (2015) who postulated that there is need for further empirical research to examine how communication influences megaproject performance.

There is evidence that project management maturity (PMM) is significantly related to business performance but not to project performance (Yazici, 2009). A critical aspect of PMM is process maturity which involves ensuring common processes are followed across all projects-of course with a considerable amount of tailoring. On whether PMM has a relationship with project performance, this study posts mixed findings-on one hand it is concluded that lack of process maturity has negative relationship with schedule delivery while the results are mixed on the relationship between lack of process maturity and cost performance. Thus, the results of this study partly disagrees with the findings of Yazici (2009).

Project organization provides the basic framework within which decisions are made and projects governed. Project governance enables organizations to consistently manage projects and maximize the value of project outcomes (PMI, 2013). It is argued that a project organization structure cannot be bad but can be inappropriate given the complexity of the project and the overall level of organizational maturity. This argument is supported by existing empirical literature which shows that project organization based on a "one-size-fits-all" approach can deliver successful projects just as a "tight-loose" system of systems approach (Brady & Davis, 2014). The results of this study also support this view given that all projects studied were organized in a "one-size-fits-all" approach with 48.2% of these projects meeting their budget objective and 18.5% meeting the schedule objective. Strong matrix and projectized organization structures usually give the project manager full authority to make project decisions, within the constraints of the project charter. Project management success draws positive synergies from the authority of the project manager over project resources and it is highly likely that projects in which the project manager has near total authority over resources have more stable outcomes compared to those in which the project manager has weaker authority. The results of this study support this thesis, with the results showing more stable mean success results for projects utilizing strong matrix and projectized structures.

It is generally agreed that stakeholders can impact project outcomes and stakeholder satisfaction should be managed as a key project objective

(PMI,2013) just as time, cost, quality, risk, scope and benefits (Axelos, 2017). Both ISO 21500:2012 and the PMBOK® *Guide* place stakeholder management at the centre of project management theory. However, this study finds that there is an identifiable gap between the prescriptions of theory and actual practice. Indeed, the results show a practice that is long on management for stakeholders and short on management of stakeholders. This is despite the fact that communication and stakeholder management are critical success factors for projects in complex contexts.

In line with the findings of Shore (2008) who found that failed projects map onto a culture that can be characterized as having preference for internal focus and stability, based on the individual behaviors and biases that were identified, this study affirmed that all the projects exhibiting those biases operated in a culture characterized with internal focus and stability. This type of culture is generally suitable for organizations that operate in more deterministic environments characterized with more stable outcomes. Public infrastructural megaprojects are implemented in complex environments in which hindsight does not affect foresight and emergence is order of the day. These projects require a more adaptive culture capable of assimilating the emergence of external stimuli and inherent change.

Conclusion

The findings of this study contribute to and reinforce the developments in the behavior school of thought in project management research (Turner et al., 2010). The study advances the finding that human behavior has a significant influence on success of public infrastructural megaprojects. Individual behavior, group behavior and organizational design and development, all have a significant but negative correlation with process success. Only organizational design and development has a significant correlation with product success. Optimism bias remains the main individual behavior that leads to cost and schedule underperformance in infrastructural megaprojects but loss aversion is the most occurring cognitive bias. Despite the rapid change, uncertainty, dependency and emergence that characterize public infrastructural megaprojects, implementation of these projects still assumes a culture that is characterized by stability and internal focus.

Where the organization does not have the right people with the necessary skills and competences as well as the tools, techniques or resources to support the project, the probability of delivery over budget is escalated. Indeed, projects in which the project manager has near total authority over resources have more stable outcomes compared to those in which the project manager has weaker authority. Likewise, projects in which contractual terms are well understood by all parties involved, team members are co-located, co-incentivized and co-responsible for the outputs of their

projects, team members primarily work face to face (rather than virtually) throughout the life of the project, and team members or stakeholders are able to accept the project information that may be contrary to their beliefs, assumptions or perspectives, have better delivery capability.

Recommendation

As a step towards reversing the effects of the iron law of megaprojects, and in so far as poor performance in megaprojects is attributed to human behavior, it is recommended that implementing organizations adopt and utilize project structures that: allow project managers sufficient authority over project resources; allow for stakeholder satisfaction to be managed as a key project objective; allow for transparency in the manner in which organizations make project decisions; ensure right people with the necessary skills and competences as well as the tools, techniques or resources support the project; encourage innovation, creativity, learning and attainment of process maturity; and, ensure continued business case justification to assure that the project is and remains viable, desirable and achievable.

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