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Original Article

Assessing the Level of Regulatory Compliance in Construction Projects in Nairobi City County, Kenya

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Abstract - *This study assesses the level of regulatory compliance in construction projects in Nairobi, Kenya, using a cross-sectional research design and mixed-methods approach. Primary data was collected using a semi-structured questionnaire administered to construction site supervisors from a random sample of 261 projects, while the secondary data was obtained from the National Construction Authority's (NCA) Online Project Registration System (OPRS) database. Analysis of objective data shows an overall compliance level of 64.75% for Nairobi, which, according to most compliance matrices, is considered to be of medium level, with areas East of the Central Business District (CBD) showing lower compliance levels compared to those to the West. Descriptive data from primary and secondary sources shows differences in mean, with primary data indicating higher levels of compliance M=0.940 and a lower variation of SD=0.016, while secondary data shows a lower mean M=0.842 and SD=0.054. Further, an independent sample t-test shows statistically significant differences, suggesting that on-site qualitative assessments captured more details than standardized checklists. This implies that current compliance reports generated from standardized inspection checklists are inclined to overgeneralize and ignore subtle concerns. This underscores the need for site-specific evaluations integrating both qualitative and quantitative data for comprehensive compliance assessments. CFA also successfully loaded surrogates of all the latent factors of regulatory compliance into Project Registration Status (RS), Project Site Conditions (SC), and Project Workforce Status (WS), presenting crucial areas where regulatory interventions can be focused. The study thus recommends detailed compliance protocols, incorporating both qualitative and quantitative data and continuous, systematic auditing to identify subtle issues. Such action could inform improved policy decisions and more consistent enforcement of construction regulations. The study thus provides new knowledge on regulatory compliance in Nairobi and proposes measures for addressing regulatory gaps epitomized by unabated cases of failure and collapses of buildings.*

Keywords - *Regulatory compliance, Construction project, Levels of compliance, Urban Development, Project Management.*

1. Introduction

The subject of building regulation and regulatory compliance has a long history from antiquity that varies depending on the technological, cultural, and geographic disposition. In the first proposition of this continuum, existing evidence shows that traditional or tribal societies around the globe had measures for restorative justice in the form of 'blood money' way before the first major religions made similar prepositions [12]. This includes the ancient King Hammurabi's collection of 284 laws, which set, amongst others, rules about a builder's duties and responsibilities to his client, and the wide-ranging collection of 'fitting' penalties for an array of harms [11, 12, 23]. Code of Hammurabi's Edict 229, which dates from circa 1772 BC, for instance, provided that "If a builder build a house for a man and do not make its construction firm, and the house which he has built collapse and cause the death of the owner of the house, that builder shall be put to death" [14]. Accounts from religious books, such as the Holy Bible, also indicate the existence of similar provisions. According to the New International Version [18], the Bible states, "When you build a new house, make a parapet around your roof so that you may not bring the guilt of bloodshed on your house if someone falls from the roof."

Similarly, early civilizations had comparable propositions in the form of written and unwritten rules, laws, or codes meant to assign responsibilities to individuals involved in construction and, through them, ensure safety, health, order, and harmony in the way societies functioned. These include ancient Greece with the ancient Greek legal system, ancient Rome with the Roman law considered the bedrock of civil law in several contemporary societies, and prehistoric China, known for the Confucian codes of conduct, which revolved around people's obligations to be virtuous without having the

law decreeing their conduct. This approach to addressing social issues compares well across civilizations. It shows that building regulations have existed for a long time and that, from the onset, they were enacted to provide basic benchmarks for health, safety, and general well-being.

Heijden [12], while recognizing the historical advancements in this area, demonstrates that regulation as a practice, profession, and discipline has progressed significantly over the last 4,000 years from dull, rigid, and extremely legalistic provisions to the current, more innovative regulatory interventions. More significant changes in building regulatory compliance, for instance, emerged in response to the housing health and safety-related crisis occasioned by epidemics that emerged in the aftermath of the Industrial Revolution and associated overcrowding. As a result of these and many other catastrophes, such as the Great Fire of London, many governments worldwide have created modern-day building laws, codes, regulations, and standards, as well as regulatory agencies meant to provide specialized oversight and enforcement of these measures. These measures require, among other measures, the registration of construction projects to ensure continuous monitoring and the regulation of building construction experts. Due to the evolving nature of construction-related issues, the industry requires a responsive regulatory space where measures are put in place to ensure the interests, interactions, and transactions of diverse stakeholders are predictable through the establishment of rules, rewards, and penalties that are continuously reviewed [12].

2. Review of Literature

2.1. Regulatory Compliance

Regulatory compliance refers to the degree to which the regulated observes regulations [1]. Proponents of regulation hold that regulatory compliance is essential for economic efficiency, promoting consumer choice, addressing market failures, achieving social solidarity and security, unburdening the justice system so that not every breach is processed by the justice system, and also guiding the people to avoid bad choices out of misinformation [7, 12, 13]. Proper regulation, therefore, is a critical factor for consideration in every undertaking in the modern world, particularly for construction that remains operationally human-centric. The International Labour Organization (ILO) approximates the building segment in developed nations to be employing 6% - 10% of the workers but sadly making up for 25% - 40% of occupational fatalities, a figure that may even be higher in developing countries [15]. This makes construction one of the most unsafe industries, with the risk of fatal injury being two and a half times higher than in the manufacturing industry and five times higher in mortality rate. These statistics are further compounded by the manifestly high number of structural failures, and building collapses in the industry, as well as the consequential economic losses associated with defective buildings and processes, complex regulatory procedures, and the resultant low levels of regulatory compliance witnessed during construction. One of the author refer to this as the Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) phenomenon of the industry that prevails across the globe. As an example, during the 10 years of the construction of the Panama Canal, it is estimated that over 25,000 construction workers lost their lives.

According to Coglianese [5], a regulation is considered successful when it resolves or at least decreases or ameliorates the problem(s) that compelled a government to formulate and implement it. Parker and Nielsen [20] note that despite regulations being executed to attain policy objectives, their performance depends on the supplications of individual citizens and businesses. Coglianese [5], World Bank Group [27], and Heijden [12] propose that governments should develop or keep supportive institutional atmospheres for organized research on regulatory results to generate more and better regulatory evaluation. Regulations should, therefore, be responsive to the complicated socio-economic and political settings in which they are implemented [20]. Apart from the need for continuous capacity building as a good practice, USAID [24] outlines the need for simple step-by-step guidelines for regulatory implementation to ensure transparency, efficiency, effectiveness, and equity. Humanitarian organizations such as the Global Shelter Cluster [9], for instance, have been cited for emphasizing the importance of customization through the development of detailed guidelines for the responsible delivery of building construction in humanitarian settings, taking into consideration the fact that building codes can be inconsistent in some settings with humanitarian imperatives.

The World Bank Group [27] has reviewed several emerging practices in building control in various jurisdictions such as Austria (which focuses on the builder rather than the building), Colombia (focuses on privately run permitting process), France (focuses on building regulatory systems driven by insurance), Norway (focuses on code compliance run by professionals), Singapore (focuses on efficiency enhanced through use of electronic permitting systems), the UK (focuses on approved private-sector inspectors and inspection agencies carrying out inspections), and Australia (focuses on giving builders a private-inspections option). The 2014 Government Regulatory Practice Initiative (G-REG) in Aotearoa, New Zealand, which is a convergence of central and local government regulatory bodies, opted to provide ‘illustrative’ regulatory reform, among others [12]. These proposals generally targeted the planning, permitting, inspection, and compliance certification processes for the enhancement of regulatory compliance. From the reviewed sources, the level of building regulatory compliance in these jurisdictions was not established.

Levels of regulatory compliance remain a focal subject in the quality and safe delivery of building works. Emuze and Mhlwa [28], for instance, established little relationship

between the work done by workers in terms of quality compared to their wages, mirroring findings from Elbashir [29], who linked 85% of quality hitches in the building to managerial issues, and only 15% to employees. Further, according to Adewale et al. [30], most defects in buildings (about 50%) are traced back to the design stage in the office, 30% to activities on-site, and 20% to the manufacture of construction materials and components. The design stage is, therefore, the most critical stage, and it should be thoroughly subjected to quality assurance before actual construction works if the desired compliance levels are to be attained.

Regulatory successes in buildings have been found to revolve around the skills and experience of the project's consultants, the promoter's (client) willpower, the functional organization and capabilities of the constructor, and the supervisory team's capabilities [31]. Bureaucracy, cost of compliance, time taken and interpretation, too much paperwork, the temporary nature of most labour force, workers looking at issues of quality as immaterial, intricacy in measuring outcomes, subcontracting, and ineffective communication have also been cited as imperative [32]. Others include corruption, political interference, institutional barriers, procurement-related barriers, weak capacities of project team members, undercutting, and weak monitoring systems [33]. Ashworth [31] simplifies these obstacles into seven 'M' factors as markets, men, money, management, materials, methods, and machines, with men identified as the most overbearing issue. These are further recategorized by CIDB [33] into construction-related barriers, design-related barriers, and procurement-related barriers. According to Albtoush et al. [34], facets of quality and safety should relate to conformance to regulations, codes, and standards, as failing to adhere to them may lead to poor quality, dangerous constructions, disputes, and, ultimately, regulatory non-compliance.

2.2. Regulatory Enforcement

Compliance and enforcement are the main apprehensions of regulators, as laws that are not efficiently applied hardly achieve the intended social and economic objectives [35]. To make regulation workable or enforceable, Heijden [36] identifies adequacy, feasibility, legal certainty, and adaptability of laws as significant factors that ought to be considered. Coglianese and Kagan [37] highlight two models of regulatory enforcement. The first treats regulatory enforcement largely as a legal procedure, where regulations are regarded as authoritative legal norms whose violation should lead to punishment, and the second regards enforcement as a social procedure intended to stimulate cooperation and demand corrective responses to breaches. Regulations should, therefore, be supported by certain threats, normally negative ones like penalties, derived from institutional sources such as parliaments, ministries or agencies, or even the electorates through different forms of plebiscites, specifically aimed at preventing misconduct and business behaviour that can be detrimental to society. These are principally cautionary and intended to avert injurious occurrences and should be responsive to the complicated socio-economic and political settings in which they work [20].

Liu et al. [38] and Gunningham [35] note that the regulations are ordinarily inspired by the fear of discovery and punishment by government enforcement agents, the fear of embarrassment (social license), and an internalized sense of responsibility to conform. This aligns with the observations of Sutinen and Kuperan [39], who outline factors determining compliance as potential illegal gain, severity and certainty of sanctions, individuals' moral development and standards, perceptions of rules enforcement, and other social and environmental influences. Differences in enforcement styles should, therefore, be linked to aspects such as the legal characteristics of the regulated, the political influences, the beliefs of the government in power, and the repercussions of serious incidents attributed to regulatory negligence [37]. Accordingly, Coglianese [5] notes the importance of quantification of regulatory improvement outcomes in the wake of enforcement, as well as the identification of clear indicators that can be used to draw inferences on the degree of regulatory compliance. These can help in the development of supportive regulatory and institutional atmospheres [27].

2.3. Gap in Literature

While several authors have discussed the subject of regulatory compliance, the theme remains dynamic and highly pertinent. It is important to note that over the years, there has been a shift in building regulation from highly prescriptive approaches to performance-based ones and from behaviour correction to behaviour formation [12, 40]. Progressively, scholars such as Radaelli [41] and Eliantonio and Spendzharova [7] have proposed the need for more tailor-made, wholesome solutions rather than generic 'quick fixes.' Some of the recent studies, for instance, focus on subjects such as total quality management, cost of quality, health, and safety, and critical success factors, among others, as presented by Basu [42], Wawak et al. [43], and CIDB [33] but not specifically on the subject of the level of building regulatory compliance. This includes studies by Al-Musleh [44], Dagbjartsdótti [45], and Syaj [46], which relate to this study but are very specific to their contexts.

Similarly, local studies such as NCA [17] focus inconclusively on the causes of the exacerbated failure and collapse of buildings in Kenya, while others such as NCRC [53], Omollo [49], Omollo [50], NBI [51], and the Commissions of Inquiry [52] emphasize the need for 'enhanced' regulatory measures without specifically addressing the subject of the levels of regulatory compliance. These authors, therefore, seem to agree that (i) issues of regulatory compliance are current and context-specific; (ii) no study can provide answers to all questions on the subject; and (iii) the subject of building regulation is dynamic, hence

requires constant study. This position is further supported by Lovegrove [48] and Gelder (1997), who also notes that successful and correct use of regulations is a complicated and knowledge-intensive mission, with Coglianese [5] noting the necessity for continuous determination of regulatory outcomes to avoid situations where outcomes slip over time. These studies, therefore, present a continuous exploration of the subject of regulatory compliance as a necessity for continuous learning.

World Bank Group [27] recommends that regulatory agencies in the building industry review and improve regulatory measures every 5 to 10 years.

3. Regulatory Compliance in Kenya

Kenya, a country in the Eastern part of the African continent, runs a devolved governance structure composed of the National government and 47 devolved units called counties, of which Nairobi City County (NCC) is one them, as shown in Figure 1.

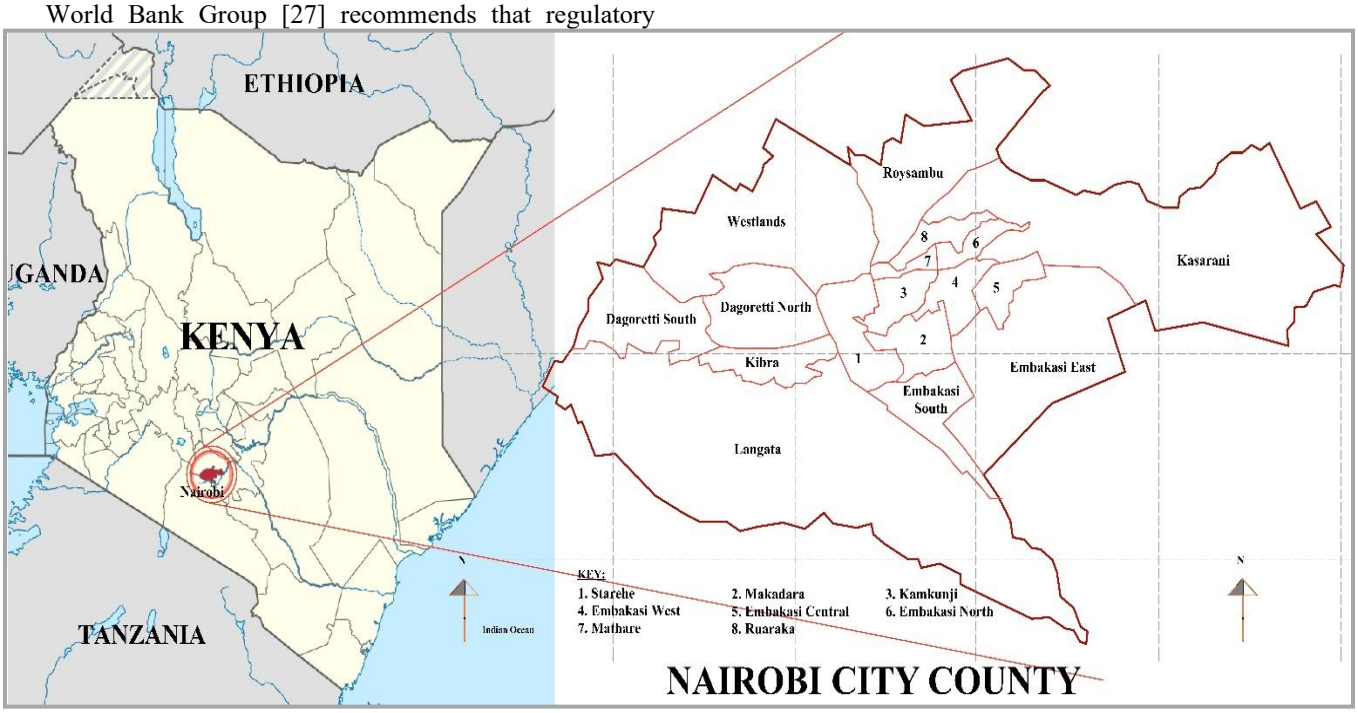

Fig. 1 Location of Nairobi City County (NCC) in kenya

Building regulatory compliance in Kenya follows the devolved structure, with some regulatory aspects requiring fulfilment at the national level and others at the devolved units. While the planning departments of the devolved units act as the principal implementors of building regulations at the County level, several national government agencies have also been put in place to provide regulatory direction and oversight. These include the National Construction Authority (NCA), which is mandated to regulate the construction industry and coordinate its development through, among others, the registration of building contractors, registration of construction workers, and registration of construction projects. NCA is also required to, among others, undertake quality assurance activities on all construction works and advise the line Minister on issues touching on the construction industry [47]. Others include the Engineers Board of Kenya (EBK), tasked with the regulation of the practice of engineering; the Board of Registration of Architects and Quantity Surveyors (BORAQS), tasked with the regulation of the practice of architecture and quantity surveying; and the National Management Environmental Authority (NEMA) mandated with the supervision and coordination of all environmental matters within the country as the principal agency implementing environmental policies.

Section 17 of Kenya's National Construction Authority Regulations 2014 requires developers to register all construction projects at least 30 days before the commencement of construction works through the NCAs Online Project Registration System (OPRS). This can only be done after a developer has satisfied a number of requirements that include: (i) obtaining a construction approval permit from the relevant county planning department; (ii) obtaining an Environmental Impact Assessment (EIA) or Environmental and Social Impact Assessment (ESIA) licence from NEMA depending on the attributes of the project; (iii) engaging a contractor duly registered with NCA; (iii) engaging project consultants (the engineer (s), architect, and quantity surveyor duly registered with respective professional regulatory bodies, such as the EBK and BORAQS; (iv) other statutory and regulatory approvals such as the Energy and Petroleum Regulatory Authority (EPRA) licence, Water Resources

Authority (WRA) licence, and the Kenya Civil Aviation Authority (KCAA) license where applicable; (v) providing a bill of quantities summary page duly signed and stamped by a registered quantity surveyor; (vi) provision of a copy of developer's Kenya Revenue Authority (KRA) Personal Identification Number (PIN); (vii) signed contract or agreement between developer and the contractor; and (vii) supervision commitment letters from nominated professional project consultants. Satisfying these requirements presents the first level of regulatory compliance. It is, however, important to note that the functions of all these entities are independent and require a developer to process approvals from one entity to another independently. The second level of regulatory compliance, which is the main component of building regulatory compliance, happens during project execution in line with section five (5) of the National Construction Authority (NCA) Act 2011. This is where NCA carries out continuous quality assurance activities that entail random visits to construction sites and inputting inspection data into the OPRS. NCA uses a seven (7) item checklist to measure compliance in this second level.

These include checking to ensure: (i) the engagement of NCA duly registered contractor on site; (ii) erection of sign board showing all approvals and the professionals engaged in the project; (iii) the display of adequate safety signs on-site; (iv) ensuring all persons in a construction site adorn the necessary Personal Protective Equipment (PPE); (v) provision of sufficient hoarding and fencing of the project site; (vi) possession of project-specific valid NCA Project Compliance Certificate; and (vii) engagement of NCA accredited skilled construction workers and construction site supervisor (s) in the construction activities.

Failure to meet any of these requirements during construction can lead to project suspension. Previously unregistered projects identified at this stage but found to have all the necessary documentation during the random inspections may be registered in the OPRS and checked for compliance according to the requirements of the second level of regulatory compliance. Failure to meet the established criteria for this category of projects can lead to immediate suspension and closure of construction activities until all items in the criteria are met. Despite this seemingly robust Kenyan regulatory compliance system, data from multiple sources shows that over 100 incidents of structural failure and collapses have been registered since the 1990s, resulting in over 200 fatalities and huge destruction of property. Most of these have occurred within Nairobi City County and have been linked to issues of regulatory non-compliance [20]. Questions have been asked and studies conducted as to what causes and/or promotes these regulatory challenges amid 'enhanced' regulatory measures, with most studies insinuating the presence of deep-seated deficiencies in the regulatory compliance systems, some of which this study attempts to unravel.

4. Methodology

The study used a cross-sectional research design and a mixed-methods strategy combining primary and secondary data. Creswell and Creswell [6] define mixed-methods design as an approach that uses qualitative and quantitative data and combines primary and secondary data in the study of a phenomenon. In this study, the level of regulatory compliance of construction projects in Nairobi, which is one of the 47 Counties, was compared across secondary and primary data to detect or identify patterns of association as argued by Mugenda and Mugenda [16]. Nairobi, which is also the capital city of Kenya, was chosen as it records the highest number of registered and unregistered projects and experiences the highest number of incidents of failure and collapse of buildings per square kilometer each year, most of which are linked to aspects of non-compliance [17].

To assess the level of regulatory compliance in Nairobi, the county was further broken down into its 17-no. Constituency administrative units. These are Dagoretti North, Dagoretti South, Embakasi Central, Embakasi East, Embakasi North, Embakasi South, Embakasi West, Kamukunji, Kasarani, Kibra, Langata, Makadara, Mathare, Roysambu, Ruaraka, Starehe, and Westlands constituencies.

The target population for the study was all construction projects within the Nairobi County area of jurisdiction as registered in the National Construction Authority's (NCA's) Online Project Registration System (OPRS) database for the year 2023 under the buildings category (both public and private). The total number of projects forming the sampling frame was 816 projects. Out of these, a random sample of 261 projects was selected using Cochran's [4] formula for finite population. The primary data was collected using a semi-structured questionnaire administered to the construction site supervisor or any other qualified person who had been part of the randomly selected projects long enough to understand their management, technical, and quality aspects.

The questionnaire assessed the levels of regulatory compliance of the sampled projects and classified them into project registration status (RS), project site conditions (SC), and project workforce status (WS). The respondents were required to rate the compliance levels of the projects they were involved in on a scale of 1-7, with one (1) being the lowest and seven (7) being the highest. Out of the targeted 261 projects, responses were received from 232 project sites, reflecting a response rate of 88.9%, which was adequate for the study. On the other hand, the study's secondary data was obtained from the National Construction Authority Online Project Registration System (OPRS) compliance database. This entailed an analysis of compliance data for construction projects within Nairobi County inspected in the year 2023, based on the seven (7) items checklist previously outlined. A census of the 1,742 identified during the period under study was conducted, as shown in Table 1.

Table 1. Sampling frame

Item	Number of projects	Method of data collection
1. Projects registered in OPRS in 2023	816	Survey
2. Outcome of quality assurance checks conducted on ongoing projects	1,742	Secondary data (from OPRS)

Data was analyzed using both descriptive and inferential statistics. The descriptive data included the measures of central tendency on the level of regulatory compliance obtained from the primary data. On the other hand, frequency tables were used to show the level of regulatory compliance of projects across various inspection checklist items for the secondary data. An independent sample t-test was used to compare the level of compliance across secondary and primary data sets. Confirmatory Factor Analysis (CFA) was used to test whether measures of each construct were consistent with the researcher's understanding of information extracted from theory and literature for the specified latent factors of a model. CFA allowed the researchers to assess the observed data to ensure they aligned with the specified model by providing evidence for the validity of the proposed factor structure. Correlation analysis was also used to establish the relationship between the level of compliance obtained from primary and secondary data.

5. Results

5.1. Level of Regulatory Compliance from Survey

The assessment of project regulatory compliance levels based on Project Registration Status (RS) was defined by four parameters, as shown in Table 2. These were assessed using the mean (μ), standard deviation (σ), and the coefficient of variation (CV), which is a ratio of the standard deviation to the mean. Among the RS indicators, NCA inspectors observed the most consistent compliance in regular site compliance checks (M = 6.60, SD = 0.99, CV = 15%), reflecting strong uniformity in inspection practices. This was followed closely by the full implementation of the project's Environmental Management Plan (EMP) (M = 6.58, SD = 1.03, CV = 16%). Regular site inspections by county government inspectors and NEMA compliance monitoring had the same mean (M = 6.53), with "NEMA conducts regular compliance monitoring of the sites" revealing slightly higher variability(SD = 1.16, CV = 18%), indicating a somewhat broader range of responses in these areas compared to "County government inspectors undertake regular staged site inspections" (SD = 1.09, CV = 17%; respectively). Indicators within the Project site conditions (SC) category demonstrated relatively low CVs, pointing to strong consistency. Both adequate hoarding/netting/fencing and procedural handling of specification changes had the lowest variability (M = 6.65, SD = 0.95 and 0.94, respectively; CV = 14%). Safety signs display (M = 6.62, SD = 0.99, CV = 15%) and proper handling of construction materials (M = 6.61, SD = 0.96, CV = 15%) also exhibited consistent responses. Other parameters, such as dumping of debris on approved sites (M = 6.59, SD = 1.05, CV = 16%) and environmental protection (M = 6.58, SD = 1.03, CV = 16%), showed slightly higher variation. Overall, CVs in this category ranged from 14% to 16%, suggesting reliable and standardized practices in site management. The most consistent compliance across the entire dataset was found in the use of personal protective equipment (PPE) by construction workers (M = 6.68, SD = 0.87, CV = 13%) under the Project workforce status (WS) indicator, underscoring the strong enforcement of worker safety protocols. Other items in this category showed slightly greater variability: presence of a trained first aider on site (M = 6.63, SD = 1.13, CV = 17%), accreditation of skilled workers (M = 6.59, SD = 0.92, CV = 14%), regular site visits by consultants (M = 6.58, SD = 0.89, CV = 14%), and involvement of registered NEMA experts (M = 6.51, SD = 1.08, CV = 17%).

Table 2. Descriptive statistics on the level of regulatory compliance

Indicator	Mean	SD	CV
Project Registration Status (RS)			
a. NCA inspectors undertake regular site compliance checks	6.6	0.992	15%
b. We implement the project environment management plan (EMP) fully	6.58	1.033	16%
c. County government inspectors undertake regular staged site inspections	6.53	1.085	17%
d. NEMA conducts regular compliance monitoring of the site	6.53	1.158	18%
Project Site Conditions (SC)			
a. Hoarding/netting/fencing has been adequately provided on site	6.65	0.947	14%
b. Changes in project specifications are handled procedurally	6.65	0.942	14%
c. Safety signs are adequately displayed on this construction site	6.62	0.99	15%
d. Poor quality materials are not stored in this construction site	6.61	0.931	14%
e. All construction materials are handled appropriately to maintain quality	6.61	0.961	15%
f. All debris and excavated materials are dumped on sites approved by the county	6.59	1.053	16%

g. General environmental protection is ensured at all times	6.58	1.029	16%
h. A record of all material test results is kept	6.58	0.981	15%
i. Materials are always inspected for quality before admission to the site	6.57	0.982	15%
j. Material tests are conducted at all relevant stages of this project	6.57	0.995	15%
Project Workforce Status (WS)			
a. Construction workers adorn adequate personal protective equipment (PPE)	6.68	0.865	13%
b. There is always a trained first aid person on-site	6.63	1.125	17%
c. The skilled construction workers on site are accredited	6.59	0.922	14%
d. Consultants, e.g., engineers, architects regularly visit the site for inspections	6.58	0.894	14%
e. A validly registered NEMA expert helps in the implementation of EMP	6.51	1.077	17%

5.2. Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was used to check that the factor model was associated with a given set of observed variables [21]. Measures of constructs were tested to see if their understanding (or factor) aligned with the mapping that had been provided. CFA was used to measure the validity of the latent variables associated with regulatory compliance in construction projects in Nairobi City County, Kenya.

In particular, it was used to validate the three proposed factors of Project Registration Status (RS), Project Site Conditions (SC), and Project Workforce Status (WS). Each item's factor loadings and their confidence intervals shed light on how well each observed item corresponds to its construct. This is especially true in studies of construction compliance, which consider regulatory compliance, safety compliance, and workforce legitimacy as latent constructs that must be measured indirectly [19, 22].

5.2.1. Project Registration Status (RS)

CFA results demonstrate that all four indicators under the latent factor of "Project Registration Status" are heavily loaded onto the factor with loadings between 0.760 and 0.950 ($p < .001$). The highest loading was recorded for "NEMA conducts regular site compliance monitoring of the site" (0.950), which was closely followed by "county government inspectors undertake regular staged site inspections" (0.925), as shown in Table 3. These measures indicate that multi-agency inspection regimes are strongly associated with the perception of regulatory compliance. The indicator with the lowest but moderate loading value was "NCA inspectors undertake regular site compliance checks" (0.760).

Table 3. Factor loadings for project registration status

Factor	Indicator	Estimate	Std. Error	z-value	p	95% Confidence Interval	
						Lower	Upper
Project Registration Status (RS)	1. NCA inspectors undertake regular site compliance checks	0.760	0.050	15.056	< .001	0.661	0.859
	2. We implement the project environment management plan (EMP) fully	0.901	0.066	16.816	< .001	0.982	1.241
	3. County government inspectors undertake regular staged site inspections	0.925	0.067	17.902	< .001	1.073	1.337
	4. NEMA conducts regular compliance monitoring of the site	0.950	0.054	17.641	< .001	0.845	1.056

5.2.2. Project Site Conditions (SC)

All seven indicators for Project Site Conditions had high and statistically relevant factor loadings between 0.902 and 0.996. The most loaded indicator of all was the presence of a fully kitted first aid kit on site (0.996), followed by the dedicated fire assembly point (0.984) and hoarding, netting, or fencing of the site (0.983), as shown in Table 4. The high loadings for this factor denote that the construction site's physical and regulatory readiness is a robust and powerful component of compliance, suggesting strong internal consistency of the construct.

Table 4. Factor loadings for project site conditions

Factor	Indicator	Estimate	Std. Error	z-value	p	95% Confidence Interval	
						Lower	Upper
Project Site Conditions (SC)	1. There is a site board showing details of all project implementers in this project	0.971	0.066	15.296	< .001	0.875	1.132
	2. There is an environment management plan (EMP) for this project	0.960	0.055	18.825	< .001	0.930	1.146
	3. A geotechnical survey was undertaken for this project	0.902	0.047	19.308	< .001	0.811	0.994
	4. Hoarding/netting/fencing has been done on this project site	0.983	0.049	20.011	< .001	0.887	1.079
	5. There is a dedicated fire assembly point in this project site	0.984	0.048	20.511	< .001	0.890	1.078
	6. There is a fully kitted first aid kit available on-site	0.996	0.049	20.315	< .001	0.900	1.093
	7. The OSHA abstract declaring this project site as a workplace is displayed	0.972	0.048	20.080	< .001	0.877	1.067

Table 5. Factor loadings for project workforce status

Factor	Indicator	Estimate	Std. Error	z-value	p	95% Confidence Interval	
						Lower	Upper
Project Workforce Status (WS)	1. The main contractor undertaking the works on site has a valid NCA license	0.823	0.043	19.056	< .001	0.738	0.907
	2. I have a valid accreditation as a site supervisor	0.878	0.071	12.424	< .001	0.739	1.016
	3. Construction workers adorn personal protective equipment (PPE)	0.810	0.046	17.654	< .001	0.720	0.900
	4. There is an appointed safety officer on site	0.803	0.041	19.664	< .001	0.723	0.883

5.2.3. Project Workforce Status (WS)

Also, all workforce-related indicators demonstrated robust statistical significance ($p < .001$) and values from 0.803 to 0.878. The indicator "I have a valid accreditation as a site supervisor" received the greatest loading of 0.878, meaning that individual credentials greatly influence perceptions of compliance relative to regulatory bounds. The absence of an NCA license for the main contractor (0.823) and workers' use of personal protective equipment (0.810) further indicate professional compliance and disregard for safety policies, as shown in Table 5.

5.3. Compliance Status in Specific Compliance Items per Constituency during Project Execution

Project compliance levels were determined for each of the 17 constituencies that comprise Nairobi City County based on a six-item quality assurance checklist developed by NCA. The seventh checklist item was not considered, given that all the 1,742 projects under consideration had been registered and had valid compliance certificates, as shown in Table 6. The six remaining items thus were (i) the proof of supervision predicated by documentary evidence in form of minutes of site meetings, issued site instructions, and/or evidence of material test results; (ii) adequacy of safety signs at construction sites; (iii) level of engagement of accredited construction site supervisors and skilled construction workers; (iv) display of detailed signboards; (v) adequacy of the provision and usage of personal protective equipment (PPEs); and (vi) provision of sufficient hoarding and fencing around construction sites. The highest compliance level was noted for the display of detailed signboards showing all necessary approvals and the professional engaged in the project at a 94% level of compliance, followed by the provision of sufficient hoarding and fencing around construction sites with an average compliance level of 91%. The lowest compliance level was noted under the requirement to engage accredited construction site supervisors and skilled construction workers, with an average compliance level of 79%, suggesting a critical need

for enhanced workforce management and training. In terms of average compliance scores per constituency, the highest compliance was noted in Makadara, which scored 97% across the six items, followed by Ruaka at 93%. On the flip side, the lowest compliance was registered in the Mathare constituency, with an average level of compliance of 56%, followed by the Embakasi North constituency, with an average level of compliance of 58%, indicating that these constituencies need more stringent compliance supervision practices.

Cumulatively, the average score of the registered 1,742 projects on all six (6) checklist items observed during quality assurance when assessed separately was noted to be 86%, as shown in Table 6. However, the actual cumulative compliance when all factors are jointly assessed per project drops significantly to 64.75%, as shown in Table 7. This means that once registered, some developers don't fully implement the conditions of the certificate of compliance. As a result, most of the projects end up being suspended and/or closed for non-compliance during execution.

Table 6. Performance of registered projects during quality assurance at execution

Constituency	No. of projects	(a)	(b)	(c)	(d)	(e)	(f)	Average score
		Level of Compliance						
1. Dagoretti North	141	89%	91%	80%	96%	91%	96%	91%
2. Dagoretti South	68	82%	78%	75%	88%	76%	88%	81%
3. Embakasi Central	19	79%	68%	74%	89%	68%	84%	77%
4. Embakasi East	146	85%	86%	83%	94%	88%	88%	87%
5. Embakasi North	2	100%	50%	50%	50%	50%	50%	58%
6. Embakasi South	51	90%	90%	82%	98%	96%	98%	92%
7. Embakasi West	28	86%	86%	61%	96%	82%	86%	83%
8. Kamukunji	237	88%	75%	73%	93%	73%	88%	82%
9. Kasarani	177	81%	69%	70%	93%	73%	84%	78%
10. Kibra	8	75%	100%	63%	100%	100%	100%	90%
11. Langata	204	90%	85%	81%	95%	88%	94%	89%
12. Makadara	26	100%	100%	96%	92%	96%	96%	97%
13. Mathare	11	82%	36%	36%	73%	36%	73%	56%
14. Roysambu	159	90%	83%	80%	95%	86%	91%	88%
15. Ruaraka	27	100%	89%	81%	93%	93%	100%	93%
16. Starehe	168	90%	72%	82%	91%	73%	91%	83%
17. Westlands	270	94%	84%	89%	97%	86%	94%	91%
Overall Compliance	**1,742**	**89%**	**80%**	**79%**	**94%**	**82%**	**91%**	**86%**

Key:

a) Proof of supervision by project consultants
b) Provision of adequate safety signs on site
c) Presence of accredited construction workers on site
d) Presence of a signboard showing all approvals and the professional engaged in the project
e) Provision and use of adequate PPEs on-site
f) Provision of sufficient hoarding and fencing on-site

Table 7. Cumulative project compliance levels per constituency during execution

	Registered Projects				
Constituency	Compliant Projects	% Compliance	Non-Compliant Projects	% Non-compliance	Total
1. Dagoretti North	105	74.47%	36	25.53%	141
2. Dagoretti South	42	61.76%	26	38.24%	68
3. Embakasi Central	10	52.63%	9	47.37%	19
4. Embakasi East	105	71.92%	41	28.08%	146
5. Embakasi North	1	50.00%	1	50.00%	2
6. Embakasi South	35	68.63%	16	31.37%	51
7. Embakasi West	13	46.43%	15	53.57%	28
8. Kamukunji	132	55.70%	105	44.30%	237
9. Kasarani	88	49.72%	89	50.28%	177
10. Kibra	4	50.00%	4	50.00%	8

11. Langata	135	66.18%	69	33.82%	204
12. Makadara	22	84.62%	4	15.38%	26
13. Mathare	4	36.36%	7	63.64%	11
14. Roysambu	112	70.44%	47	29.56%	159
15. Ruaraka	18	66.67%	9	33.33%	27
16. Starehe	97	57.74%	71	42.26%	168
17. Westlands	205	75.93%	65	24.07%	270
Grand Total	**1,128**	**(64.75%)**	**614**	**(35.25%)**	**1,742**

A gradient map showing compliance levels in Nairobi was then plotted for all 17 constituencies, as shown in Figure 1, using the data drawn from Table 7. It was observed that compliance levels varied spatially, with areas located to the East of Nairobi's Central Business District (CBD) registering lower compliance rates compared to those to the West of the CBD. Further inquiry reveals areas to the East of CBD as more populous than those to the West.

The levels of compliance were therefore correlated with available data on population density drawn from the Kenya National Bureau of Statistics (KNBS) [8]. The analysis revealed a strong negative correlation between compliance levels and population density, with a Pearson correlation coefficient of -0.818 (p=0.004). This indicates that compliance levels tend to decline significantly as population density increases.

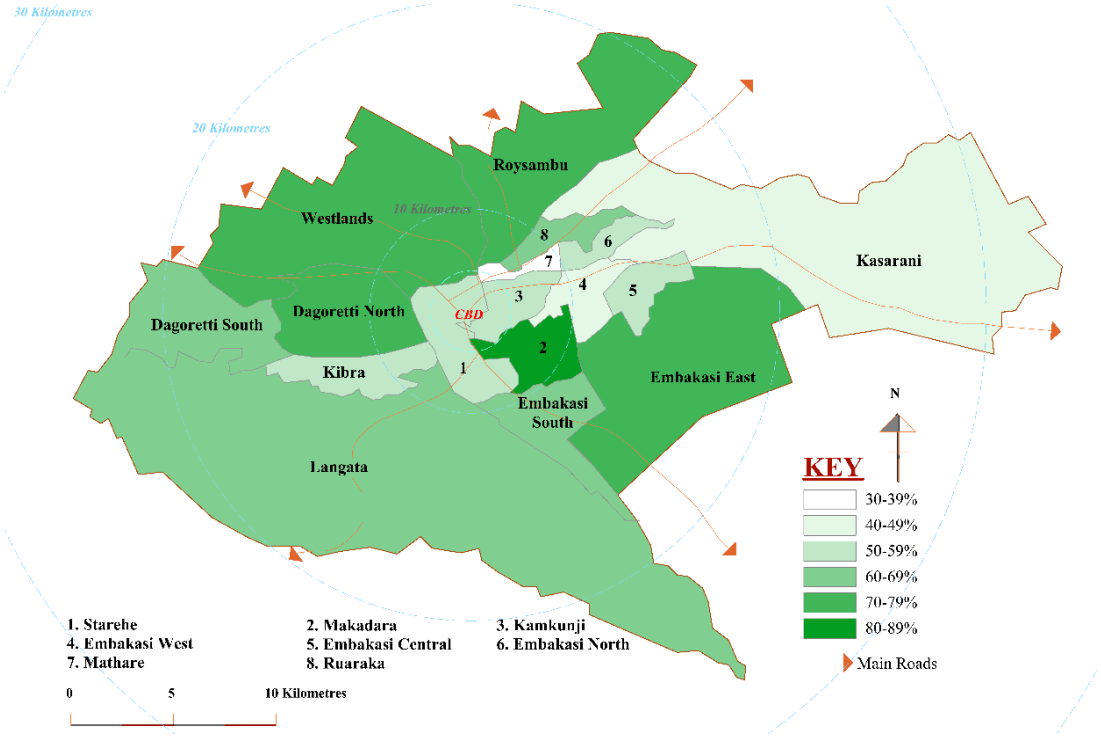

Fig. 2 Percentage compliance levels of projects across spatial planning zones

Mathare constituency, for instance, had the highest population density, with 68,941 people per square kilometer, and also recorded the lowest compliance level at 56%. Conversely, constituencies like Westlands and Lang'ata, which had lower population densities of 911 and 3,167 people per square kilometer, respectively, exhibited higher compliance levels, with Westlands achieving 91% and Lang'ata 89%.

5.4. Comparative Analysis

The level of regulatory compliance of construction projects in Nairobi was compared across secondary and primary data to detect or identify patterns of association, as shown in Table 8. Out of the six checklist items listed in Table 6, one item, the presence of a signboard showing all approvals and the professional engaged in the project, was omitted as it did not have a corresponding item in the primary data collected. It was found that the average level for proof of supervision by project consultants stood at 0.89 with secondary data, while the primary data depicted a higher mean of 0.94. In terms of the provision of safety signs, the secondary data scored a level of 0.80, while the primary data scored 0.93. Concerning the engagement of accredited construction workers on site, the secondary data scored 0.79, while the

primary data recorded 0.92. Further, the secondary data recorded a compliance level of 0.82 for the provision of PPE, while the primary data showed a higher score of 0.95. Finally, regarding the sufficiency of hoarding and fencing, the secondary data showed a compliance score of 0.91, while the primary data reflected a slightly higher score of 0.96, as shown in Table 8.

Table 8. Compliance level for primary and secondary data

Checklist Items	Compliance Score Primary	
	Secondary	Primary
1. Proof of Supervision by Project Consultants	0.89	0.94
2. Provision of Adequate Safety Signs on Site	0.80	0.93
3. Presence of Accredited Construction Workers on Site	0.79	0.92
4. Provision of Adequate PPEs on Site	0.82	0.95
5. Provision of Sufficient Hoarding and Fencing on Site	0.91	0.96

This paper further examined the difference in average compliance levels for the primary and secondary data. An independent sample t-test was used to assess the differences. The test generated a p-value of 0.008, which is less than 0.05. This implies a statistically significant difference in the compliance level depicted by the secondary and primary data sets, as shown in Table 9. While the primary data exhibited a higher mean (M=0.94, SD=0.016, CV=1.7%), the secondary data produced a slightly lower average compliance level mean (M=0.842, SD=0.054, CV=6.5%). The distribution's Coefficient of Variation, shown in Table 10, also indicates the presence of uniformity of the variability in the primary and secondary data sets across the various specified projects. Such variation in the compliance outcome levels may be due to variations in the objectives of the two datasets or could be informed by how compliance was checked.

Table 9. Independent samples T-Test

	W	P
Compliance level	25.000	0.008
Note. Mann-Whitney U test.		

Table 10. Group descriptives

		N	Mean	SD	SE	CV
Compliance level	Primary	5	0.940	0.016	0.007	1.7%
	Secondary	5	0.842	0.054	0.024	6.5%

6. Discussions of Findings

The level of regulatory compliance in building works is an important indicator of the state of the built environment in terms of health and safety, which is targeted at the well-being of construction workers, the public, and, later, the building occupants. Establishing an accurate level of regulatory compliance for building works is a complex and intricate exercise that largely relies on the goodwill of project parties [33]. This was exemplified in the case of building regulatory compliance of building projects in Nairobi, where, while all the 1,742 projects had 100% compliance at the registration stage, this percentage dropped significantly to an overall figure of 64.75% during project implementation. According to most compliance matrices, this level is considered medium. Levels of regulatory compliance were also found to vary spatially, with more populous areas to the East of Nairobi CBD exhibiting low compliance levels compared to those to the West. This means that the enforcement of regulations should be varied based on the attributes of the geographical location if compliance outcomes are to be achieved [50].

To understand the reasons for these variations in levels of compliance, further primary data was collected and compared to the secondary data obtained from the analysis of quality assurance activities, where the data exhibited significant differences. The descriptive analysis of primary and secondary data differed in mean, where primary data showed higher levels of compliance as evidenced by a mean of 0.940 and a lower variation of SD=0.016 (CV=1.7%), while secondary data had a lower mean of 0.842 and an SD=0.054 (CV=6.5%). While these variations could be due to differences in project conditions and approaches in compliance data collection methodologies, they imply that the reports from compliance officers, which are an outcome of standardized inspections, are inclined to overgeneralize site conditions and ignore some subtle concerns.

This finding is supported by Bizjak and Kontic [3] and the Commission of Inquiry [52], who emphasize the need for systematic auditing of compliance protocols to evaluate and monitor compliance performance and ultimately to lead to the identification of any subtle issues. Such a position is also shared by Baldwin et al. [2], who argue that general project conditions and levels of inspection have to be accounted for to enhance reliability. Continuous standardization of compliance measures, apparent in Bizjak and Kontić [3], can assist in reducing such exhibited differences and lead to the enhancement and uniformity in the regulatory approach [7, 12, 13].

The independent sample t-test also showed a statistically significant difference, suggesting that the on-site assessment (primary data) could be relatively more elaborate than the secondary data obtained from the administrative documents. These align with the findings of Willar et al. [25] and the Commission of Inquiry [52], who discuss how different project conditions and levels of inspection can lead to variations in collected data, emphasizing the importance of addressing these variations to improve the robustness of research based on existing data. The CFA for construct validity used to check the factor model confirmed all three

factors: Project Registration Status (RS), Project Site Conditions (SC), and Project Workforce Status (WS) as the latent variables of regulatory compliance, with all surrogates under each loading heavily into the factors hence supporting the construct [21].

These findings have important implications for policy-makers and regulatory bodies. Winge et al. [26] highlight the significance of integrating questionnaire-based primary data with administrative inspection records to create comprehensive regulatory policies that accurately reflect compliance levels. Such integration could inform better policy decisions and lead to consistent enforcement of construction standards. These findings also underscore the importance of site-specific assessments in capturing true compliance levels and suggest using multiple sets of data to develop more robust compliance evaluations that can be used to improve compliance tools in line with calls for standardized frameworks [3]. Indeed, Winge, Albrechtsen, and Arnesen [26] recommend that different data sources should be used to supplement each other, especially where existing legislation frameworks for regulation need improvement [12, 24, 27].

Further, to achieve regulatory compliance goals, enforcement is required (Heijden [36]), and this is made possible only by addressing socio-environmental influences, which is critical [39]. The classification of the latent factors of regulatory compliance into Project Registration Status (RS), Project Site Conditions (SC), and Project Workforce Status (WS) thus presents thematic areas where regulatory interventions can be focused.

7. Conclusion and Recommendations

The study assessed the level of regulatory compliance in construction projects within Nairobi City County, Kenya, revealing a medium overall compliance level of 64.75% for projects registered in 2023. This level of compliance is considered medium according to most compliance matrices. This finding is significant because this level of compliance could directly correlate to the prevalent cases of failure and collapse of structures in Nairobi. Notably, Nairobi reportedly experiences the highest number of building failures and collapse incidents per square kilometre among all 47 counties in Kenya. Another key finding of the study was the significant differences observed when comparing regulatory compliance levels assessed using primary data (qualitative, on-site assessments) and secondary data (quantitative, based on the NCAs standardised inspection checklists).

These disparities imply that reports generated from standardised inspection checklists, which formed the basis of the secondary data, are inclined to overgeneralise regulatory issues observed at construction sites by potentially overlooking subtle or understated concerns. These differences further point to the need for continuous, systematic auditing of the existing compliance systems to evaluate their efficacy in monitoring regulatory compliance. While the variation in secondary data may be influenced by different project conditions and approaches used during data collection, it underscores the need for more nuanced and comprehensive approaches to evaluating regulatory compliance.

The study thus recommends the use of detailed compliance protocols that incorporate both qualitative and quantitative data. Integrating data from diverse sources will help identify the understated issues, such as the attributes of the geographic location that may need to be amended or incorporated into the existing compliance protocols. This can also be crucial for the development of comprehensive regulatory policies that are based on an accurate reflection of true industry compliance levels. Through this, regulations will be made more workable and enforceable.

7.1. Novelty/Contribution

The study makes a significant contribution as the first known research undertaking in Nairobi City County, Kenya, that specifically aims to establish the level of regulatory compliance in construction projects by explicitly drawing comparisons between secondary and primary data. To the authors' knowledge, no similar studies have been conducted in this jurisdiction using this comparative approach.

By doing so, the study highlights significant differences observed between compliance data captured through different methods. This study thus presents new knowledge that not only presents factual information on existing levels of building regulatory compliance in Nairobi but also proposes measures that can be used to improve it, especially amid the pre-existing regulatory compliance challenges.

Further, while construction regulation and compliance are not new subjects, understanding how they function in every context, the intended and unintended effects on individuals and businesses, and the outcome of their implementation remain critical. The findings of this study, therefore, not only fill an important gap aimed at continuous improvement of regulatory compliance protocols in the industry but also contribute to a discourse that started in antiquity and continues to date. Overall, the study fills an important gap by providing context-specific data and a comparative methodological insight not previously applied in Nairobi, contributing meaningfully to the continuous improvement of regulatory compliance protocols in the construction industry.

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