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Application of artisanal dimension stone in the building industry: factor analysis of the regulatory environment in Nairobi, Kenya

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Application of artisanal dimension stone in the building industry: factor analysis of the regulatory environment in Nairobi, Kenya

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This is an assessment of the regulatory environment in which artisans operate to produce dimension stone in Nairobi where the quarrying of the same becomes an aspect of artisanal mining; an activity that is fraught with regulatory issues in developing country situations. Regulation is considered in the context of formal and informal rules of engagement that provide opportunities and constraints to the artisans. A structured interview schedule was used to obtain data about the regulatory environment from a sample of key stakeholders. These data were thereafter applied to factor analysis where principal components were extracted using the Monte Carlo parallel analysis method. Four principal components were extracted and include: Component 1 is 'environmental regulations'; Component 2 is 'fiscal rules and regulations'; Component 3 is 'regulatory laws and informal practices and Component 4 is 'friendly building regulations'. The constraint components were found to outweigh the opportunities leading to the conclusion that the regulatory environment is hostile to the artisans.

Keywords: artisans; dimension stone; principal component analysis; regulation

Background and context

Artisanal dimension stone has been used in the building industry since the beginning of human civilization. Before the industrial revolution, dimension stones (or stone blocks for building walls) were cut, shaped, dressed and transported by manual (i.e. non-motorized) means. The advent of the industrial revolution, among other things, introduced power tools and machinery for cutting, shaping and dressing dimension stone for masonry applications. The critical impact of the industrial revolution, in this case, was that it discontinued artisanal production of dimension stone and eliminated the use of hand-cut stone in building construction in the industrialized world. Hence, the production and use of artisanal dimension stone became a dead phenomenon. Whereas in the industrializing world, the production of artisanal dimension stone and its use in the building industry remains as a live phenomenon in which hand-cut blocks of stone remain useful materials in the construction of walls of buildings as is the case in Nairobi, Kenya.

Consequently, in the industrialized world, research in artisanal dimension stone is either archaeo-technical or patho-technical in nature (K'Akumu, 2010). Archaeo-technical, in this case, refers to the archaeologists' study of the technical aspects of artisanal dimension stone production and its use in the pre-industrial past. Such studies include: Jope (1964) and Alexander

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(1995) on building stone industries in mediaeval England; Prudden (2003) on Somerset building stone; Nylander (1967) and Sharon (1987) on stone cutting and its use in Israel and Jackson and Marra (2006) on Roman stone masonry, among others. Patho-technical, on the other hand, refers to building pathology where research concentrates on the diagnosis and restoration of decaying artisanal dimension stone that was used in the construction of pre-industrial buildings. This forms part of the technical aspects of architectural conservation. For instance, Přikryl and Viles (2002), Přikryl (2004), Přikryl and Smith (2007), Saiz-Jimenez (2004), Smith and Turkington (2004), Sabbioni (2003) and Smith (2003) are few examples of the works taking the patho-technical perspective on artisanal dimension stone.

In the industrializing countries such as Kenya, research in artisanal dimension stone mainly takes the socio-technical (see, for instance, K'Akumu, 2013) and socio-environmental (see, for instance, Wells, 2000) perspectives. In both perspectives, regulation has proven to be the major problem issue. In such countries, both the formal and informal sectors coexist such that there are mechanized quarries that are formally regulated and artisanal quarries whose activities are informally (not completely formally) regulated. However, no study has been undertaken specifically on the issue of regulation. Therefore, this study focuses on the regulatory environment of artisanal dimension stone (consisting of quarries and the applications of their products in the building industry) in Nairobi, Kenya.

In the industrialized countries, such as the USA, regulation is restricted to formal administrative institution models in terms of Department, Authority or Independent Agency (Clark & Kinder, 1991). In this context, regulation consists of legislation as well as rules issued by these administrative/state agencies such as utility commissions (see Geiger & Hoffman, 1998). Such formal regulatory institutions exist in Kenya too, but as a developing country, and where an informal activity such as production and the use of artisanal dimension stone is concerned, restricting regulation to formal institutions is not adequate. Therefore, in this study, regulation is construed in the broadest sense to include all mechanisms of both intentional and unintentional social controls, i.e. in the context that societal norms and values join intentional policy initiatives to construct what is in effect 'an environmental approach to regulation' (Saltman & Busse, 2002, p. 9). Within this context of regulation, this study considers the regulatory factors that influence the use of artisanal dimension stone in Nairobi. Consequently, this study posed two basic research questions concerning the production and use of artisanal dimension stone in Nairobi:

(1) What opportunities does the business environment provide through regulation?
(2) What constraints does the business environment impose through regulation?

In light of the above, the main objective of this study is to find out the 'most influential' factors or forces in the regulatory environment acting to inhibit or facilitate the production and use of artisanal dimension stone. To identify these 'most influential' forces, this study has included the factors suggested or implied by the literature as a part of the observable variables and thereafter applied the factor analysis in order to come up with key underlying factors or components. Identification of principal components would help the policy-maker to address the most critical issues concerning the regulatory environment of artisanal dimension stone in Nairobi (Figure 1).

Literature review

Artisanal mining was defined by D'Souza (2005) as an activity that employs manual or low-technology mining that is conducted on a minor scale often by individuals or families operating under circumstances mostly considered illegal or informal. This definition makes it interesting to study its regulatory environment. Lu (2012), for instance, describes small-scale mining that artisanal

Figure 1. Rough ashlars being loaded onto trucks in one of the stone quarries of Nairobi to be carted to building sites.

mining, is part of, as an activity 'usually characterized as informal, illegal and unregulated by government'. Indeed four characteristics of artisanal mining stand out in any definition or description (see, e.g. Buxton, 2013; Common Fund for Commodities, 2008; Deb, Tiwari, & Lahiri-Dutt, 2008; Ingram, Tieguhong, Schure, Nkamgnia, & Tadjuidje, 2011), i.e. its small-scale character, questions on its legality, its informality and its negative socio-environmental effects. All these four attributes bring implications for its regulatory environment.

Further artisanal mining is characterized by problems such as limited capacity including knowledge (Sinding, 2005), lack of assets and restricted entitlements, e.g. insecurity of tenure on mining titles (Pedro, 2006). Its activities are hampered by limited access to mineral rights and deposits (Mutemeri & Petersen, 2002). Although artisanal (informal) and the formal sectors are more often than not regulated by the same legislations for environment, labour, mineral rights, mineral exploration, mining permits etc., the former's compliance is generally low owing to low levels of education of the artisans, unavailability of capital for investments and generally inadequate technological options at the disposal of the miners (Shen & Gunson, 2006).

Noetstaller, Heemskerk, Hruschka, and Drechsler (2004) writing on the profiling of artisanal and small-scale mining in Africa noted that it is still largely an informal and often clandestine activity due to, among other things, the bureaucratic licencing procedures. Informal in this context means 'operating without an applicable or appropriate legal framework' (Buxton, 2013). Informality in respect to artisanal mining conforms to the International Labour Organization (1972) definition that viewed informal regulatory environments as characterized by low-entry barriers to entrepreneurship in terms of skills and capital requirements; family ownership of enterprises; small scale of operation; intensive production with outdated technology; and unregulated and competitive markets (Buxton, 2013).

In addition, Noetstaller et al. (2004) observed that mining authorities were usually reported to be unable to effectively support and control the activity due to inadequate human and operational resources, hence, leading to its known harmful effects such as environmental degradation, child labour, and poor health and safety standards. Its health, sanitation and safety conditions are particularly poor since diseases such as respiratory and sexually transmitted infections are frequently observed in mining communities, in addition to mining-specific hazards such as accidents due to rock-falls (Noetstaller et al., 2004).

Although it can be seen as a response to government's failure to properly set and implement appropriate laws (Buxton, 2013), informality is not equivalent to anarchy. The informal systems often have rules and processes based on experiences from social and cultural traditions (Buxton, 2013). Hence, regulation in this environment takes effect by cultural norms and social contracts – a form of 'legal pluralism' in which traditional, informal and formal rules overlap and operate simultaneously (Cleaver, 2000).

Therefore, artisanal mining has received positive considerations in the development literature, and certain regulatory measures have been proposed to address its negative characteristics. In the case of China, for example, Shen and Gunson (2006) have argued that the potential contributions of artisanal mining far outweigh its negative impacts but on the condition that the central government should do more to regulate, guide and encourage its development as an industry and create a sound business environment for its operators. To this end, they recommend the establishment of an 'appropriate system of laws and regulations and a suitable institutional structure for administration' as prerequisite infrastructure for the effective management of small-scale mining (Shen & Gunson, 2006, p. 433).

As part of the process of dealing with the informal character of artisanal mining, Communities and Small-scale Mining (CASM) suggested the certification of its products in terms of origin and ethical quality (CASM, 2008). Ethical quality certification will contain, for example, the negative socio-environmental effects of the activity. Carstens, Garrett, Lintzer, Priester, and Hentschel (2009), on the other hand, have suggested transparency that 'may help the state developmentally engage with the [artisanal mining] sector, as it would better understand the political economy of taxation and trade, and it may also capture more revenues from the sector'.

In Kenya, Davies and Osano (2005) identified artisanal mining as an unregulated activity comprising the mining of construction materials, among other products. Artisanal dimension stone is one such construction material. The production and use of artisanal dimension stone brings implications for the regulatory environment. A number of studies have been reported on the quarrying of artisanal dimension stone in Nairobi, however, none has specifically written about its regulatory environment. Although not making it their point of focus, the authors have commentated on the regulatory environment to some extent. Wells (2000), for instance, writing on the environmental concerns in artisanal dimension stone quarrying in Nairobi, touched on the institutional constraints and the regulatory frameworks that affect the environmental management of the activity.

One of the institutional arrangements, brought up by Wells (2000) is the fact that the quarries are not worked by land owners but by concession holders who pay the latter for private or public land to obtain permission to quarry stone. Wells (2000, p. 30) found that the miners spend about 10% of their venture capital 'for licences and "inducements"'. On the regulatory framework, Wells (2000) noted that the Mining Act (the legislative framework guiding mining in Kenya) excluded any kind of rock or stone, hence, making it hard for the government to control quarrying especially in private lands where most of it is done. On public land, miners needed a licence to operate a quarry from the Forestry Department who ensured the former comply with the requirements of rehabilitation. This is as far as environmental management of the activity is concerned.

Writing on the informal sector of the construction industry in Nairobi, Wells (2001) further noted that in the city materials such as stone and sand are produced by small-scale enterprises in the informal sector and distributed by other such enterprises. This placed the activity in the informal sector where regulation becomes an issue. Indeed Wells and Wall (2003) contended that the production and use of building materials such as artisanal dimension stone has been promoted by the 'informalisation' of the construction systems in developing African countries where the activity presents a great challenge to regulation and may entail the risk of unsafe or unsanitary structures, degenerated conditions of employment and probable environmental degradation.

Wells and Wall (2003) writing on the 'expansion of artisanal stone quarrying' in Nairobi attributed its gaining of the market share as walling materials to several factors. In terms of regulation, the critical factor is that the private sector clients building in the informal system tend to be less particular about the standard of finish than public sector clients building in the formal system with its more exacting standards.

One of the latest in the literature on artisanal dimension stone is K'Akumu, Jones, and Blyth's study (2010) that looks at the market environment of dimension stone as a product of the building material industry in Nairobi. In its consideration of the enabling environment of the product, this article made several observations that hinge on the regulatory environment of the subject product. These include the following:

- The use of *jua kali* (informal) systems of transactions based on personal trust in a part of the economy that avoids compliance with legal requirements such as labour and environmental management laws.
- The Department of Mines and Geology regulates the activity through licencing of blasters and control blasting materials.
- The building code supports the production and use of stone by specifying it as one of the standard materials for wall masonry.
- Architectural professionals (such as architects, engineers, quantity surveyors and building contractors) may recommend the material to their clients in some cases.
- There is of entry because only semi-skilled or unskilled labour is required.
- The operators pay tax in terms of cess to the city council.
- Inadequate policy support, e.g. in terms of infrastructure provision as in the case of bad roads.
- The activity is controlled by the National Environmental Management Authority (NEMA) and the Provincial Administration.
- The activity is sometimes subjected to government bans.

From the foregoing literature review, this study generated 26 variables in the regulatory environment for purposes of the factor analysis as listed below:

(1) High fees National Environment Management Agency (NEMA).
(2) Cartels manage disputes.
(3) Police do not enforce law effectively.
(4) Regulations of supplies of explosives.
(5) Industrially produced dimension stone more acceptable to the formal sector.
(6) Building regulations/codes.
(7) Implementation of building regulations/codes.
(8) Tax/cess is issued by Nairobi on stone mined.
(9) Cartels control market for *jua kali* stone.
(10) Licences to blasters.

(11) Implementation of environmental laws.
(12) *Jua kali* dimension stone gives poor finish.
(13) Environmental laws.
(14) Poor roads.
(15) Transportation problems.
(16) Issue permission for quarrying.
(17) *Jua kali* dimension stone not acceptable to planning authorities.
(18) Implementation of planning laws.
(19) Tribalism effects demand.
(20) Market for *jua kali* dimension stone unreliable.
(21) Commonly accepted informal practice in construction.
(22) Planning laws.
(23) *Jua kali* dimension stone used in building because of its low cost.
(24) *Jua kali* dimension stone accepted by building regulations.
(25) Informal market for *jua kali* stone works through trust.
(26) Local administration resolves disputes.

Research methods

The 26 variables, with the potential to influence the regulatory environment of artisanal dimension stone as identified from the literature, were developed into prompts in the measurement instrument in which the respondents were asked a two-part question corresponding to the regulatory environment as follows. Prompt 1: Can you tell me what rules and regulations and their implementation helps or hinders in the production, specification and sale and distribution of *jua kali* dimension stone? The underlying idea was to establish opportunities/constraints in the regulatory environment that are available for stakeholders in the production and use of artisanal dimension stone.

The 26 variables were listed as prompts under the question and the respondents were further prompted to indicate for each variable whether it was a negative or positive influence. Prompt 2: Indicate whether the following factors are negative or positive influences. Since the respondents were not expected to have complete knowledge of the factors prevailing in the regulatory environment, they were given a third option to indicate that they were unable to comment (or had no opinion) on the variable under consideration.

For purposes of scale development, where the respondents had an opinion on the variable, they were prompted to indicate the strength of the variable's influence on a scale of 1–5, where 1 represented least and 5 represented greatest strength. This gave a total of 11 possible responses; 5 negative, 5 positive and 1 neutral. In the final coding for SPSS data set, the responses were re-coded into an 11-point Likert scale as given in Table 1.

The data set generated was thereafter applied to the factor analysis.

After designing the measurement instrument, it was administered in terms of an interview schedule to a sample of respondents who included practicing architects, quantity surveyors, civil and construction engineers, building contractors and the quarrying operators. A total of 148 responses were realized.

Data analysis

The analytic procedure, in this study, is a factor analysis involving the principal components analysis (PCA) using the Oblimin with Kaiser Normalization rotation method and the Monte Carlo PCA for parallel analysis. As explained by Hinton, Brownlow, McMurray, and Cozens

Table 1. Coding of the measurement instrument.

Initial code	Re-code	Scale code
Negative 5	Negative strongest	1
Negative 4	Negative strong	2
Negative 3	Negative average	3
Negative 2	Negative weak	4
Negative 1	Negative weakest	5
Unable/no opinion	Neutral	6
Positive 1	Positive weakest	7
Positive 2	Positive weak	8
Positive 3	Positive average	9
Positive 4	Positive strong	10
Positive 5	Positive strongest	11

(2004), the factor analysis is useful in examining the correlations between variables in the questionnaire data to establish sets of underlying variables or factors that explain the variation in the original (questionnaire/measured) variables. When correlations between the variables are high, it is possible to confuse some of the factors and/or that some variables may be redundant measures. Factor analysis allows the large number of the questionnaire variables to be reduced to more limited sets of important and useful factors.

Before embarking on the factor analysis, tests were done to ensure the suitability of the data for this purpose; including the Kaiser–Meyer–Olkin measure of sampling adequacy (KMO test). According to Hinton et al. (2004), a KMO test outcome of 0.5 or higher establishes the suitability of the data for the factor analysis. Another test that this study performed is the Bartlett test of sphericity, which was to establish whether there are relationships to investigate (Hinton et al., 2004). The two tests yielded KMO and sig. values of .848 and .000, respectively (Table 2) meaning that it was appropriate to go ahead with the factor analysis procedures.

The analysis proceeded to factor extraction, which yielded seven components generated by the default Kaiser Criterion, as given in Table 3. A scree plot for the components has also been generated as shown in Figure 2. The next step was to make a decision on the number of factors to be retained in the analysis using the Monte Carlo PCA for parallel analysis. The Monte Carlo random Eigenvalues have been generated as shown in the appendix.

A comparison of the default Kaiser with the parallel analysis Eigenvalues led to the retention of four of the seven initial components as given in Table 4.

Thereafter, another set of the factor analysis was conducted with a restriction to four components.

Results

The output of this second analysis included the component correlation matrix (Table 5) and the pattern matrix (Table 6). The component correlation matrix indicates that the components are not correlated since the correlation coefficients exhibited are far less than .3.

Table 2. KMO and Bartlett''s test.

KMO measure of sampling adequacy		.848
Bartlett's test of sphericity	Approx. χ^2	2375.910
	Df	325.000
	Sig.	.000

Table 3. Total variance explained.

	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings[a]
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total
1	8.558	32.914	32.914	8.558	32.914	32.914	6.793
2	2.925	11.249	44.163	2.925	11.249	44.163	2.670
3	2.293	8.817	52.980	2.293	8.817	52.980	2.303
4	1.708	6.569	59.549	1.708	6.569	59.549	1.914
5	1.400	5.385	64.934	1.400	5.385	64.934	4.931
6	1.194	4.594	69.528	1.194	4.594	69.528	2.935
7	1.085	4.172	73.700	1.085	4.172	73.700	2.793
8	.800	3.075	76.775				
9	.735	2.825	79.601				
10	.621	2.388	81.988				
11	.597	2.294	84.283				
12	.555	2.135	86.418				
13	.459	1.765	88.183				
14	.419	1.613	89.795				
15	.384	1.477	91.272				
16	.340	1.308	92.580				
17	.313	1.203	93.783				
18	.279	1.071	94.855				
19	.247	.950	95.805				
20	.234	.899	96.704				
21	.208	.800	97.504				
22	.173	.664	98.168				
23	.144	.555	98.724				
24	.129	.498	99.222				
25	.103	.397	99.618				
26	.099	.382	100.000				

Note: Extraction method: PCA.
[a]When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 4. Comparison of eigenvalues from SPSS and Monte Carlo outputs.

Component	Actual eigenvalues from SPSS	Random eigenvalue from Monte Carlo	Decision
1	8.558	1.8662	Accept
2	2.925	1.7165	Accept
3	2.293	1.6139	Accept
4	1.708	1.5299	Accept
5	1.400	1.4548	Reject
6	1.194	1.3708	Reject
7	1.085	1.3036	Reject

On the other hand, the pattern matrix was used to interpret the analysis since it indicates how variables load onto the extracted components.

From the pattern matrix, the following interpretations were made:

- Component 1 is *environmental regulations*.
- Component 2 is *fiscal rules and regulations*.

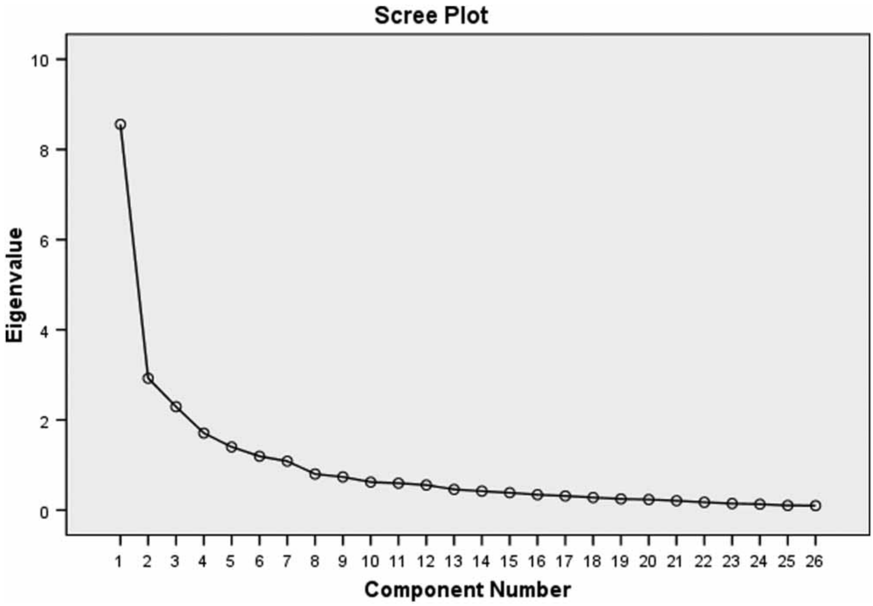

Figure 2. Initial scree plot.

Table 5. Component correlation matrix.

Component	1	2	3	4
1	1.000	.002	.252	−.198
2	.002	1.000	.056	−.068
3	.252	.056	1.000	−.019
4	−.198	−.068	−.019	1.000

Notes: Extraction method: PCA.
Rotation method: Oblimin with Kaiser Normalization.

- Component 3 is *regulatory laws and informal practices*.
- Component 4 is *friendly building regulations*.

Discussion

From the results of the factor analysis displayed in Table 6, it has been pointed out that the first component in the regulatory environment is *environmental regulations*. This is a bit general as is always the case with all first components in the factor analysis. The variables loading onto this component were as follows:

- High fees NEMA.
- Industrially produced dimension stone more acceptable to the formal sector.
- Cartels manage disputes.
- Police do not enforce law effectively.
- Building regulations/codes.
- Regulations of supplies of explosives.

Table 6. Pattern matrix[a].

	Component			
	1	2	3	4
High fees NEMA	.901			
Cartels manage disputes	−.870			
Police do not enforce law effectively	−.864			
Building regulations/codes	−.859			
Industrially produced dimension stone more acceptable to the formal sector	.858			
Regulations of supplies of explosives	−.723			
Implementation of building regulations/codes	−.691			
Tax/cess is issued by Nairobi on stone mined	.682	−.425		
Cartels control market for *jua kali* stone	−.664		.463	
Licences to blasters	−.624	.485		
Implementation of environmental laws	.595			
Jua kali dimension stone gives poor finish	.550		.508	
Environmental laws	.368			
Poor roads		−.825		
Transportation problems		−.820		
Issue permission for quarrying		.576	−.543	
Jua kali dimension stone not acceptable to planning authorities		.565	.381	
Implementation of planning laws	.338	.377	.343	
Tribalism effects demand			.676	
Market for *jua kali* dimension stone unreliable			.632	
Commonly accepted informal practice in construction			−.492	
Planning laws			.450	−.355
Jua kali dimension stone accepted by building regulations				.765
Jua kali dimension stone used in building because of its low cost				.709
Informal market for *jua kali* stone works through trust				.442
Local administration resolves disputes			−.314	.362

Notes: Extraction method: PCA.
Rotation method: Oblimin with Kaiser Normalization.
[a]Rotation converged in 14 iterations.

- Implementation of building regulations/codes.
- Tax/cess is issued by Nairobi on stone mined.
- Cartels control market for *jua kali* stone.
- Licenses to blasters.
- Implementation of environmental laws.
- *Jua kali* dimension stone gives poor finish.
- Environmental laws.
- Implementation of planning laws.

The variables point majorly to a negative force in the regulatory environment. As stated already, this is a very general component; therefore, it may defy specific solutions. However, solutions given to specific components that follow may add up to its solution.

The variables that loaded onto the second component, *fiscal rules and regulations*, included the following:

- Tax/cess is issued by Nairobi on stone mined.
- Licenses to blasters.

- Poor roads.
- Transportation problems.
- Issue permission for quarrying.
- *Jua kali* dimension stone not acceptable to planning authorities.
- Implementation of planning laws.

This component too represents a negative force in the regulatory environment. The negative connotation is in the fact that as the City Council of Nairobi collects revenue in terms of cess from the produce of artisanal stone quarries, the roads and transport infrastructure is neglected. There are also issues to do with the licencing of blasters that is done by the Department of Mines and Geology and quarrying permission under the docket of NEMA. Concerning the issue of taxing the produce, it is imperative that the city council should provide road and transportation infrastructure. This would boost productivity and achieve greater revenue collection.

Licensing of blasters and issuance of permit to quarries, on the other hand, are necessary controls. This may also be a governance issue that requires initiatives from the artisanal operators themselves. One of the reasons why the artisans may find these regulations prohibitive is because they work as solo operators. If they were to form an association as producers, it would be easy for them to tackle such governance issues. For example, the World Bank is promoting associational activities of artisanal miners through the programme: CASM. CASM's main objective is to address the socio-environmental problems stemming from artisanal and small-scale mining such as the ones being tackled in this study. Several other countries have their national body of CASM except Kenya. Since artisanal stone quarrying operators fall under CASM activities, they could form such a group and benefit from its programmes.

The variables that loaded onto the third component, *regulatory laws and informal practices*, included the following:

- Cartels control market for *jua kali* stone.
- *Jua kali* dimension stone gives poor finish.
- Issue permission for quarrying.
- *Jua kali* dimension stone not acceptable to planning authorities.
- Implementation of planning laws.
- Tribalism effects demand.
- Market for *jua kali* dimension stone unreliable.
- Commonly accepted informal practice in construction.
- Planning laws.
- Local administration resolves disputes.

This component also represents negative forces in the regulatory environment for artisanal dimension stone. It implies the failure of formal laws to benefit players in the artisanal sector of the industry and the emergence of informal practices to rule over these players. The fairness of informal regulation, such as cartelism and tribalism, can be gainsaid obviously. Again the solution to this lies in the governance possibilities that would arise from associational initiatives of artisanal operators such as forming a marketing cooperative or another body that could plug into CASM at a national or an international level.

The variables that loaded onto the fourth component, *friendly building regulations*, included the following:

- Planning laws.
- *Jua kali* dimension stone accepted by building regulations.

Table 7. Research questions and answers.

Research questions	Answers/factor analysis results
(1) What opportunities does the business environment provide through regulation?	• Stone-friendly building regulations
(2) What constraints does the business environment impose through regulation?	• Environmental regulations • Fiscal rules and regulations • Regulatory laws and informal practices

Table 8. Eigenvalues for and TVE by retained factors.

Factor	Eigenvalues	TVE (%)
Environmental regulations	8.558	32.914
Fiscal rules and regulations	2.925	11.249
Regulatory laws and informal practices	2.293	8.817
Stone-friendly building regulations	1.708	6.569
Total	–	59.549

- *Jua kali* dimension stone used in building because of its low cost.
- Informal market for *jua kali* stone works through trust.
- Local administration resolves disputes.

This component represents a positive force in the regulatory environment for the production and use of artisanal dimension stone in Nairobi. Since the friendly building regulations would enhance the marketing of artisanal dimension stone, it behoves the artisanal operators to take advantage of this positive situation in the market. They can do this by implementing the solutions that have been recommended so far in the foregoing discussion.

Conclusions

Factor analysis has helped to establish whether the regulatory environment is hostile or friendly, or whether the business environment is strong on opportunities or constraints. We can go back to the research questions to determine to what extent the factor analysis results provide answers to them. To that effect, the factor analysis results answer the research questions as summarized in Table 7.

From the table, it becomes apparent that this study has provided some answers to the key research questions. The table also classifies the factors according to opportunities and constraints (Dawson, 1996) or according to friendly and hostile environmental factors (Lusthaus, Adrien, Anderson, Carden, & Montalvan, 2002).

The distinctions between the types of components are based on factor variance. The PCA successively extracts factors based on the maximum variance between the variables. For instance, the first factor extracted accounts for the largest amount of variance in the variables, while the second consists of the next largest amount of variance which is not related to or explained by the first one meaning that the two factors are not related (orthogonal) to one another and so on (Bryman & Cramer, 1997; Fox & Skitmore, 2007). Both the Eigenvalues and percentage of total variance explained (TVE) indicate the magnitude or relative strength of each component within the regulatory environment.

It is worth noting that, in this case, the first principal component can be classified under constraint (Dawson 1996) or hostile (Lusthaus et al., 2002). It is worth noting also that the constraints explain more variance than opportunities, i.e. 52.980% (total for environmental regulations, fiscal rules and regulations, and regulatory laws and informal practices) out of 59.549%, as given in Table 8. Therefore, this study concludes that the regulatory environment for artisanal dimension stone in Nairobi is relatively hostile from the point of view of the artisanal producers. Therefore, the inevitable recommendation is that policy-makers should address the hostile principal components as the use of artisanal dimension stone is important in building the city.

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Appendix. Printout of output from Monte Carlo parallel analysis.

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Number of variables: 26
Number of subjects: 148
Number of replications: 100

Eigenvalue	Random eigenvalue	Standard dev.
1	1.8662	.0891
2	1.7165	.0621
3	1.6139	.0509
4	1.5299	.0439
5	1.4548	.0426
6	1.3708	.0393
7	1.3036	.0345
8	1.2419	.0292
9	1.1853	.0309
10	1.1261	.0306
11	1.0734	.0264
12	1.0203	.0271
13	0.9690	.0269
14	0.9239	.0284
15	0.8770	.0303
16	0.8301	.0294
17	0.7871	.0306
18	0.7433	.0274
19	0.7016	.0251
20	0.6555	.0262
21	0.6109	.0264
22	0.5703	.0251
23	0.5267	.0237
24	0.4824	.0261
25	0.4359	.0273
26	0.3834	.0327

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Monte Carlo PCA for parallel analysis.