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Compliance with Building Material Specifications among Informal Skilled Construction Workers in Dar es Salaam, Tanzania

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Abstract: Informal construction workers rarely comply with Building Material Specifications (BMSs) due to incompetence emanating from knowledge gaps, cost reduction strategies among clients, poor material use and lack of quality checks and control mechanisms. Based on logistic regression model results on the relationship between compliance and knowledge transfer on BMSs, this study has noted a mismatch between informal knowledge transfer practices and compliance with BMSs during construction. This mismatch is partly attributed to inappropriate knowledge transfer on BMSs. Compliance with BMSs is mainly driven by appropriate knowledge transfer and trainer-trainee agreement for effective knowledge transfer. The "carrots and sticks" approaches to enforcing compliance with BMSs among informal craftsmen have marginal effect on the ultimate compliance behaviour of craftsmen. The conclusion is that although social capital through social network is considered useful for knowledge transfer it does little to induce internalisation of knowledge on BMSs leading to non-compliance. That is, positive attribute of knowledge transfer may not necessary yield positive compliance levels. However, since this argument is strongly tied to compliance as measured along instrumental, normative and constraints dimension, it may slightly change in an environment where habits and routine have a major role to play in construction practices.

Keywords: Informal construction, Informal learning, Building specifications, Knowledge transfer, Skilled workers

INTRODUCTION

It is well understood that the informal construction practices provide employment to many construction artisans and entrepreneurs (Hedidor and Bondinuba, 2017; Odediran and Babalola, 2013). The nature of operation is however, informal while production costs are relatively low since most of them rely on personal knowledge and skills as their entrepreneurial capital (Alananga Sanga and Lucian, 2016). Furthermore, informality in the built environment describes a legal status rather than a production process or the quality of properties built although most such properties are built incrementally and at a lower standard than those built according to building standards or regulations (Monkkonen and Ronconi, 2013). In this regard, informality in the construction industry is a manifestation of non-compliance behaviour in response to vague and/or unclear regulations or over-regulation (Polese, 2015; Hoai and Yip, 2017). In response to non-compliance, building failure is notable and often appreciated as such in high rise building but when normal incrementally built residential building collapses no one notices. Adewole, Ajagbe

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and Arasi (2015) and Oloyede, Omoogun and Akinjare (2010) establishes that the collapse of buildings in Nigeria particularly those constructed informally was attributed to the use of incompetent craftsmen[1] who limitedly observed Building Material Specifications (BMSs). Even where rules and regulations are not explicit, compliance is still relevant (Agyemang and Boateng, 2019). In this regard, BMSs may be a common pool resource that is transferred across generations of informal construction workers (Mselle and Alananga Sanga, 2017).

This study is based on informal construction practices in Dar es Salaam, Tanzania where informal construction practices comprises both individual skilled workers and firms that carry out their construction activities in the shadow economy. United Republic of Tanzania (2014) indicates that by 2014 the informal construction sector employed 6.2% of the total employment in Tanzania. According to Phoya et al. (2018), the informal construction practices in Tanzania are predominantly constituted of skilled workers of lower levels of education. It is characterised by enterprises and skilled worker who lack formal contracts, proper training, good pay, face other financial constraints, tend to limitedly comply with health and safety, and are generally not organised. Informal construction of houses for example, is mainly incremental with the process taking between 1 to 20 years with an average of 10 years before being fully habitable (Alananga and Lucian, 2016). There are several challenges to such incremental approaches to housing such as incidences of low quality workmanship, theft of materials, abandonment of sites, materials supply constraints amongst others (Alananga, Lucian and Kusiluka, 2015; Mselle and Alananga Sanga, 2018).

In terms of knowledge transfer, the mutual dependence between formal and informal sectors (Mselle and Alananga Sanga, 2017) suggest for a good training ground in informal construction practices for those with limited access to formal vocational training. The knowledge gap is however on the type of knowledge transferred through informal construction site practices and its respective compliance upon graduation. BMSs being for a larger part documented is hardly reachable by informal mentors and mentees. With limited access to knowledge on BMSs during training, these informal skilled workers are likely to end up not complying with any or most of BMSs. In Alananga and Lucian (2016), it is noted that application of skills rather than BMSs among informal skilled workers may be associated with cost reduction strategies among incremental housing builder. However, such cost reduction marginalises sustainability issues where the life span of houses and habitability are sacrificed to achieve short term housing needs. As a result non-compliance with BMSs has been among the major causes of building collapse in Tanzania (Meena, Moirongo and Munala, 2018). By moving towards documented and well researched BMSs, informal crafts can move up the quality radar in terms of the quality of built units. Unfortunately, what is being held or known and transferred or shared among informal craftsmen in terms of skills on materials quality, mix and curing is still not well known. An understanding of knowledge transfer on BMSs among informal construction workers provides an answer to the fundamental question of access to formal sources of knowledge on BMSs by informal construction workers and whether and by how much should there be policy initiative to bridge formal-informal BMSs knowledge gap in the construction industry as a whole.

Compliance Theories

Traditional views on compliance consider motivation, as an important determinant of compliance (Simpson, 1992; Vaughan, 1998). Based on Table 1, motives behind compliance can be instrumental whereby cost (disincentives) and benefits (incentives or rewards) of something the subject of compliance induces compliance or non-compliance behaviour (Hucklesby, 2009). Under this framework, individuals are rational decision maker with the sole interest of maximising self-interests. These individuals focus on deterrence and enforcement in their calculations of benefits and costs (Zaelke, Kaniaru and Cameron, 2005). Freys (1997) further compounds that, individual compliance can be influenced by intrinsic and/or extrinsic motivations. Extrinsic motivation is the push for an individual to comply which comes from outside and pushes an individual towards a particular compliant/non-compliant behaviour. Table 1 also suggests that extrinsic compliance is instrumental compliance (Étienne, 2010). This is in line with Zaelke, Kaniaru and Cameron (2005) who suggest that instrumental compliance can be enhanced by raising the penalty (sticks) for non-compliance, increasing monitoring to increase the probability of being caught for non-compliance or changing legal rules to increase the chances of conviction. Similarly, the desire for profit or extra-gains or some incentives (carrots) offered for observing BMSs could be an important inducement for compliance behaviour among informal craftsmen.

Table 1. Frameworks of Compliance

S/N	Bottom's Compliance Factors	S/N	Nelli's Compliance Factors	Compliance Typology
1	Incentives and disincentives	1	a. Incentive-based compliance b. Threat-based compliance c. Surveillance-based compliance	Instrumental compliance
2	a. Moral acceptance b. Attachment c. Legitimacy	2	Trust-based compliance	Normative compliance
3	a. Physical restrictions b. Restrictions on access to target c. Structural constraints	3	Incapacitative compliance	Constraint
4	Habit and routine			Habit and routine

Source: Nellis (2006) and Bottoms (2001) as summarised by Hucklesby (2009)

Intrinsic motivation on the other hand suggests that individual complies due to motives driven from within, without any external reward but due to love of activity itself (Freys, 1997). Based on Table 1, normative compliance may be considered intrinsic in nature. This is because it is based on moral obligation, commitment or attachment (Nellis, 2006; Bottoms, 2001). Normative compliance can be divided into three sub-groups: moral acceptance of a norm, which arises through the process of socialisation and may be strengthened by attachment and social relationships where by subjects' social capital, that is, their social networks, are important to desistance processes and legitimacy which relates to perceptions of justice and fairness (Hucklesby, 2009). It is imperative to understand that the way supervisors deal with subordinates influence compliance. Associated with normative compliance is Nellis's (2006) third category of compliance, trust-based whose conceptual entomology is linked to the sense of obligation to honour a promise either to authorities enforcing compliance or supervisors (Hucklesby, 2009).

The third category of compliance is constraint as outlined by Bottoms (2001) which is similar to Nellis's (2006) notion of incapacitative-based compliance. Under the constraint category, compliance may be affected by the regulated entities' capacity (knowledge of the rules, financial and technological ability to comply) and commitment (determined by norms, perception of the regulator and incentive for compliance) (Zaelke, Kaniaru and Cameron, 2005). Nellis's (2006) incapacitation suggests prevention whereas constraint relates, amongst other things, to physical measures, which are imposed on subjects to reduce opportunities for no-compliance (Hucklesby, 2009). Bottoms's (2001) final mechanism of compliance is habit and routine. This type of compliance occurs "unthinkingly" and derives from and is linked with, other sources of compliance (Hucklesby, 2009). In fact habits and routines may be shaped by personal characteristics of subjects required to comply with something.

Compliance with BMSs in Informal Construction Practices

According to Hedidor and Bondinuba (2017), informal construction craftsmen rarely comply with BMSs due to low level of knowledge and skills, and sometimes inappropriate skills learnt from their respective master craftsmen. Non-compliance with BMSs is therefore attributed to incompetence among informal craftsmen, cost reduction strategies among clients, poor material use and lack of quality checks and control mechanisms (Oyedelea et al., 2015; Oladeji and Awos, 2013; Chendo and Obi, 2015). Empirical studies on compliance allude to a number of factors that motivate compliance. Polese (2015) argues that capacity to ensure compliance in a given situation depends on the capacity to prize, punish and propose solutions that people can live with in the short term. In this regard, compliance is instrumental since subjects are concerned primarily about potential punishment for non-compliance (Hucklesby, 2009). These observations could also be relevant in informal housing construction practices where informal craftsmen may be subjected to both incentives, supervision, punishments and monitoring during execution of their tasks (Hedidor and Bondinuba, 2017; Odediran and Babalola, 2013).

Informal construction practices in developing countries are heavily biased against compliance to BMSs. Ngugi, Mutuku and Gariy (2014) carried a laboratory test on samples of sand collected from different informal construction sites and established that the sand was dirty and not suitable for construction due to high contents of clay, silt and organic matters. Along similar practices, Oladeji and Awos (2013) and Anosike and Oyebade (2012) noted that block producers produce up to 43 blocks per 1 cement bag. Non-compliance to block standards among block producers can be attributed to laxity of standards enforcing authorities. However, since the production process is mainly informal, appropriate mechanisms to enforce BMSs are completely lacking leading to non-compliance (Hedidor and Bondinuba, 2017; Oladeji and Awos, 2013; Anosike and Oyebade, 2012; Isaksson et al., 2012).

Social ties play an important role in informal construction practices where training and work access are defined along social networks (Alananga Sanga and Mselle, 2018; Mselle and Alananga Sanga, 2017). If appropriate BMSs knowledge is transferred along these social networks (Agyemang and Boateng, 2019), compliance is likely to be higher among those in the network than those outside. The only threat to social network in informal construction practices is appropriateness of knowledge transfer on BMSs which as for other forms of apprenticeship is highly dependent on the knowledge set of the master craftsman and his/her willingness to transfer (COTVET [Council for Technical and Vocational Education and Training], 2016; Alananga Sanga and Mselle, 2018). This is because if the knowledge transferred is inappropriate there could be "compliance to inappropriate knowledge". This is because non-compliance to BMSs has been noted to be either due to poor specification knowledge transfer or inappropriate ingredients used in material mix thus resulting into use of poor quality construction materials (Makenya, 2018). Poor specification knowledge transfer may be associated with both habits and routines of master craftsmen or might be a constraint towards BMSs compliance since BMSs knowledge transfer is either incomplete or ineffective as shown in Figure 1. The habits of the master could also determine the sequence and structuring of the training which are important determinants of knowledge transfer (Lave and Wenger, 1991; Billett, 2010).

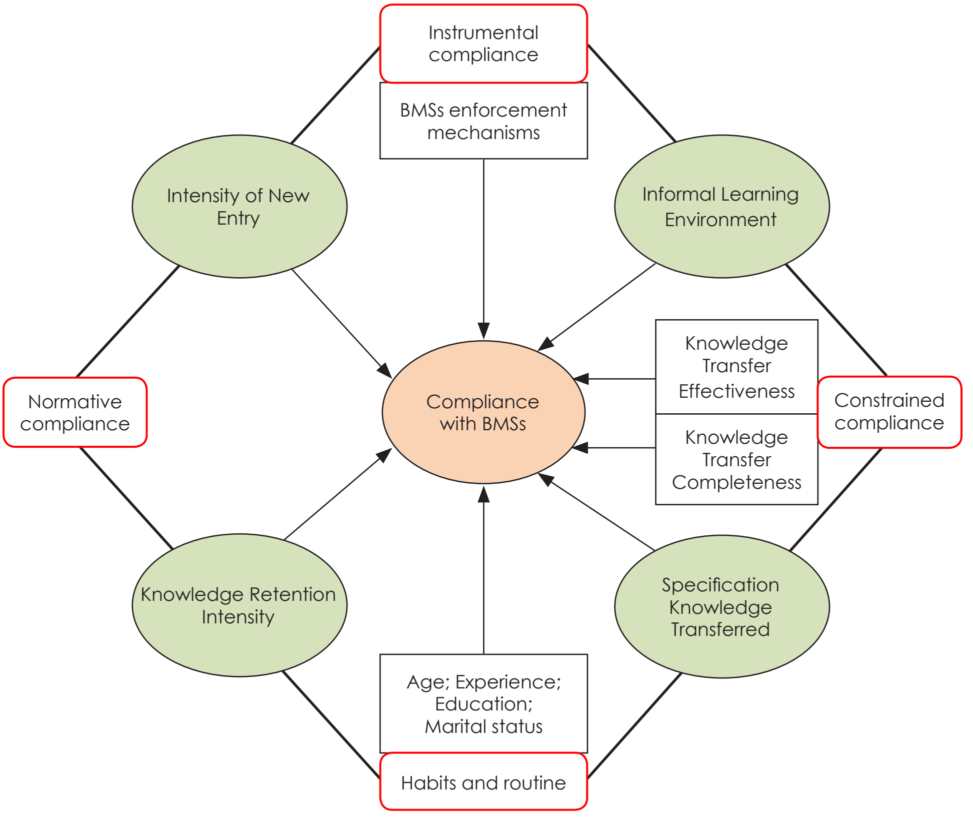

Figure 1. Conceptual Framework for the Determinants of Compliance with BMSs among Informal Construction Craftsmen

In law enforcement paradigms, Hucklesby (2009) observes that support from family and friends in the form of moral support, togetherness or reminders on the risks of non-compliance, influences compliance positively. This could be the case in informal construction where master craftsmen who mentor blood related mentees may have extra incentives to support, remind and even guide craftsmen towards compliance with BMSs (Mselle and Alananga Sanga, 2017). This emphasis on social-cultural aspects has however, been criticised on the ground that it de-emphasises factors such as the economic class and education of business owners and an appreciation of the surrounding opportunity structures and the wider socioeconomic context onto which the informal entrepreneurs operates (Ram and Jones, 1998; Rath, 2000). It is therefore important to take aboard factors such as education and economic status in an attempt to understand compliance with BMSs among informal craftsmen as part of habits and routine. Similarly, studies on apprenticeship in sectors other than construction suggest that attitude of both mentee and master craftsman is an important determinant of tacit knowledge transfer (Agyemang and Boateng, 2019; Anokye and Afrane, 2014; Apunda, de Klerk and Ogina, 2017). This study therefore incorporate mentors attitude as part of the informal learning environment while social networks defines the intensity of new entry (Alananga Sanga and Mselle, 2018). Furthermore, since knowledge transfer in informal practices is basically tacit in nature (Nonaka and Takeuchi, 1995; Windsperger and Gorovaia, 2010), normative compliance may be shaped by knowledge retention intensity of each mentee through increasing the chances of retaining knowledge by writing, asking others or more practices on whatever they have learned about BMSs (Teerajetgul and Charoenngan, 2006; Windsperger and Gorovaia, 2010).

The key to BMSs compliance in informal construction practices can be linked to the levels of work-related risks and expertise vested unto master craftsmen in relation to clients' demand of adherence to BMSs. The degree of awareness and understanding of the subject BMSs could be central in ensuring compliance. Baldock et al. (2006) however, note that for small entrepreneurs, knowledge of standards relevant to the enterprise is negatively correlated with compliance with those regulations. In the informal construction practices, compliance to water quality has been observed to be low whereby contaminated water from rivers tends to be used simply because of lack of knowledge on the impact of such contaminants on concrete setting and hydration (Oladeji and Awos, 2013). Similarly, since informal apprenticeship practices are not formerly regulated (though there are rules and norms) (Agyemang and Boateng, 2019), it might be difficult to definitively enforce BMSs thus knowledge of BMSs may be negatively correlated to compliance. However, the existence of informal mechanisms through which compliance may be attained could induce some compliance with BMSs. This study considers awareness and understanding of BMSs as central in enhancing compliance in terms of specification knowledge transferred. Specification knowledge transfer on BMSs may be appropriate or inappropriate based on existing building codes but compliance to appropriate BMSs must be directly related to knowledge transfer (Alananga Sanga and Mselle, 2018; Mselle and Alananga Sanga, 2017).

Empirical observations in informal construction practices in developing countries point to major disparities in BMSs knowledge among craftsmen. Oladeji and Awos (2013) observes that although the recommended ratio for mortar mix is 1:2 or 1:3, some crafts were using up 1:4 and in some cases there were derived formula of 5:2 and 4:2 for good and relatively good quality sand, respectively. This resulted into poor quality products as it was established by (Makenya, 2018) whereby volume batching and inappropriate ratio were behind poor quality blocks produced in Dar es Salaam, Tanzania. In terms of building blocks specifications, BS (British Standards) 2028 (1978) suggest a mix ratio of around 1:6 to 1:8 but in informal construction practices sandcrete blocks uses mix ratios of up to 1:12 (Anosike and Oyebade, 2012). Anosike and Oyebade (2012) further observed that sandcrete blocks sampled from informal block producers had block strengths that fall below the recommended 3.5 N mm^{-2} to around 1.2 N mm^{-2} to 1.7 N mm^{-2}. Sabai et al. (2016) and Makenya (2018) revealed that about 41% of the non-load bearing blocks had a compressive strength below 3.0 N mm^{-2} in informal construction practices. In addition to that Makenya (2018) observed that most producers of blocks test them by dropping and observing whether they break or crumbles and some customers test block strength by scratching the edges of the block to see the extent of waning out. All these types of tests are inappropriate for block strength testing. Anosike and Oyebade (2012) observed that blocks were not properly cured thus affecting hydration process of the blocks.

The major reason for non-compliance with building block specifications is that most blocks are produced by small industries operating with little knowledge and skills on producing standards and high quality blocks. Observations in Tanzania suggest that, the poor quality of blocks produced was due to technical reasons such as quality of the aggregate, extent of compaction, water/cement ratio and quality of sand (Sabai et al., 2016; Makenya, 2018). Similar reasons for non-compliance to block strength were observed by Oladeji and Awos (2013) and Anosike and Oyebade (2012). In Ghana, the source of material mix ratio used was based on craftsmen's or clients' individual experience or instruction of the clients who however, had no skills or experience of construction (Hedidor and Bondinuba, 2017). While it is easy to control the quality of industrial ingredients such as cement and reinforcement, the quality of sand and aggregate sourced locally has been noted to be difficult to control (Rubaratuka, 2013). All these reasons for non-compliance with BMSs point to different constraints towards compliance behaviour among informal craftsmen.

Along the same lines of constrained compliance, the level of construction supervisors and clients' interest on BMSs and the financial and time resources available may be important in inducing compliance behaviour among informal craftsmen. Constrained compliance is also manifest through response to water shortage. Drilled water with chloride contents has often been used in response to water shortage despite the knowledge of its effect on strength of concrete (Rubaratuka, 2013). Similarly, informal housing developers face challenges with regard to sources of sand and often times sand is collected from unknown sources such as polluted rivers or ground and therefore contain disastrous contaminants. In a similar fashion, developers while constrained by limited space to store reinforcement bars, they may end-up improperly storing them thus accelerating rusting before such bars are incorporated into concrete (Rubaratuka, 2013). Researches on batching methods used in small construction site have further established that despite of being bad practice, volume batching is commonly used (Oladeji and Awos, 2013). In additional to volume batching, recommended ratio are often not used during batching process among informal craftsmen (Olusola et al., 2012). Both Olusola et al. (2012) and Hedidor and Bondinuba (2017) notes that around 70% of the sampled craftsmen had no knowledge of the impact of volume batching on concrete strength or lack of equipment for mass batching. These informal construction practices strongly points to knowledge on BMSs as major constraints at the heart of BMSs-compliance behaviour among informal craftsmen.

The previously noted variations in building materials specification in informal construction practices could be a reflection of serious hurdles to knowledge transfer effectiveness or completeness of informal learning (Brooker and Butler, 1997). The informal craftsmen may not comply if they are constrained with incomplete BMSs knowledge as well as ineffective BMSs knowledge transfer. It is noteworthy to exemplify here that even where both knowledge transfer effectiveness and completeness of informal learning are low informal craftsmen may resort to external assistance to enhance their understanding of BMSs through their informal networks. Nguluma (2006) notes that the lack of formal agreements on different undertakings in informal construction practices is among the source of non-compliance behaviour. Baldock et al. (2006) observe that the use of sources of external assistance and membership of a trade associations, are significantly associated with compliance. Informal construction however, entails limited external assistance as well as lack of trade unions, indicators for higher levels of non-compliance with BMSs in response to knowledge completeness and effectiveness indicators.

Rubaratuka (2013) notes that in most construction site in Dar es Salaam, concrete curing was not properly done simply out of shear neglect or constrained understanding. Drunkenness and drug abuse could be among the key for such neglect. Gender-wise, men tend to judge risks of non-compliance as being smaller and less problematic than do women (Baldock et al., 2006). It should further be noted that female's styles of management are more relational oriented, nurturing and caring (Cooper and Lewis, 1999; Mukhtar, 2002). Thus, female artisans are more likely to comply with BMSs given their desire for strengthening relationships within workplaces. The informal construction practices in many developing countries is however, dominated by males, thus opening narrow gender gaps in BMSs compliance. Furthermore, being married or cohabiting or living with children tends to be associated with a higher likelihood of non-compliance (Hucklesby, 2009). This could also be relevant in informal construction practices where larger family size do not only reflect marital status but also more responsibilities at home (Jayawardane and Gunawardena, 1998; Odediran and Babalola, 2013). The chances of adopting inappropriate BMSs tend to be higher among those with larger family size as they attempt to maximise gains through some cost saving strategies during material purchase. Oladeji and Awos (2013), Anosike and Oyebade (2012) and Makenya (2018) note that cost saving motives were behind non-compliance to block strength standards. It has further been observed that many informal crafts cure concrete once a day instead of twice a day as a labour and cost saving strategy (Oladeji and Awos, 2013). Thus habits and routine as captured by the personal characteristics of the informal craftsmen may be important determinants of compliance behaviour.

METHODOLOGY

The findings of this study are based on two data collection approaches. The study started with interviews of well experienced craftsmen and on reaching 20 interviews it was obvious that little value was being derived from additional interviews as narratives significantly departed from each other. So instead of providing unique narratives in an interview study, it was decided that quantifying the responses to determine patterns would significantly add value. The interview were however not completely discarded, they were coded and incorporated into the data set for further quantitative analysis. The interpretative analyses of interview data therefore, provided a leeway for the administration of questionnaires rather than being analysed separately.

Sampling and Sample Size

Due to the fact that informal skilled workers are neither registered nor regulated, there are no statistics on their number within Dar es Salaam city. As such it was not possible to compute the sample size *aprior* for survey administration. The questionnaire was thus designed based on the assumption that, there are many informal skilled and unskilled workers in the construction industry to such an extent that we can consider the population from which the sample was to be drawn as statistically large. For that matter the study utilised the Cochran equation for calculating sample size as provided in Cochran (1963). This sample size computation formula is shown in Equation 1.

$$n_0 = \frac{Z^2pq}{e^2} \qquad \text{Eq. 1}$$

where n_0 is the sample size to be computed, Z^2 is the abscissa under the normal curve that cuts off an area, α at the tails ($1 - \alpha$ equals the desired confidence level, 95%). Tracing the value of Z in statistical tables at 95% confidence level, it was noted to be 1.96 where e is the desired level of precision considered in this case as 0.05, p is the probability that an attribute of interest, i.e. "comply" is present in the population commonly, with such probability being assumed to be 0.5, meaning that there is equal chances of observing or not observing a phenomenon of interest and q is $1 - p$. The confidence or risk level is ascertained through the well-established probability model called the normal distribution and an associated theorem called the Central Limit Theorem. By applying this formula with the given constants, the minimum sample size for questionnaire administration was determined to be 384.

The respondents were selected based on the random selection of respondents from all the construction sites that were encountered by the researcher. The construction sites were selected incidentally but respondents from each site were randomised by giving them an identifier which was then picked at random by the prospective respondents to obtain the minimum number of respondents required. In sites where respondents were less than 10, efforts were done to interview all of them. The original focus of this study was on craftsmen who are involved in masonry and related works. However, given the multidimensional nature of craftsmen in the city, other forms of crafts were also included. As a result, the sample composition was incidental rather than systematic. However, this incidental nature of the sample composition did not impair the original hypotheses on the relationship between knowledge transfer and compliance with BMSs. That is regardless of type of skills learnt; the modalities of knowledge transfer specifically on BMSs remain the same.

Survey Data Collection

The data were collected mainly through a questionnaire that was designed to encompass the variables summarised in Tables 2 and 3. The interview guide questions provided a structure for the design of the questionnaire. The first part of the questionnaire captured detailed information about the respondents to allow specific controls in assessing the determinants of knowledge transfer. In the second part, the questionnaire was designed to capture general knowledge transfer information among informal skilled and unskilled workers. The sections implicitly embed the concepts of this study to elicit information on the kind of mentee the mentors in informal construction practices. The third part was constructed out of the motivation theoretical proposition to capture motives for knowledge transfer. The fourth and the fifth parts of the questionnaire were the most detailed. They covers inquiries into the different types, mixtures and curing techniques that are part of the formal BMSs in order to gauge not only the transfer but also the appropriateness of implementation practices. The questionnaire was then administered in five municipalities of Dar es Salaam city between August and November 2017. Although the questions were closed ended, each question provided an opportunity for additional responses. Furthermore, since the self-administration of questionnaire is limited by relatively lower response rate, this study opted for a researcher administered questionnaire to maximise the number of respondents in order to attain the 384 respondents required.

Table 2. Building Materials Used to Evaluate Compliance

S/N	Abbrev.	Description of Specification Knowledge Transfer or Compliance with BMSs Item Being Evaluated	Measurement Scale
1	*RCMix*	Appropriate mix of cement, sand and aggregate for floor concrete	Ratio in mm
2	*RBMix*	Appropriate cement and sand mix for block making	Ratio in mm
3	*RthColum*	Appropriate diameter of iron bars for columns	Number in mm
	RthSLB	Appropriate diameter of iron bars for slab	Items
	RthBM	Appropriate diameter of iron bars for beam	Items
4	*nRColum*	Appropriate number of iron bars for columns	Number in mm
	nRSLB	Appropriate number of iron bars for slab	Items
	nRBM	Appropriate number of iron bars for beam	Items
5	*aggBM*	Size of aggregate for beam	Items
6	*aggSLB*	Size of aggregate for slab	Norminal
7	*wtrWrks*	Quality of water for use in construction	Nominal
8	*sand*	Quality of sand for use in construction	Nominal
9	*BLKStrg*	Measuring the strength of blocks	Nominal
10	*WDLoad*	Allowable days for concrete to cement before load bearing	Items
11	*WDCurry*	Allowable days to water concrete before construction continues	Items
12	*Spacing*	Spacing of roof ketches (Rafter spacing)	Number in mm

Table 3. Description of Variables for Regression Analysis

S/N	Variable	Abbreviation	Measurement Scale
	Dependent variable		
1	Compliance to BMSs	*Comply*	Dummy (1 = probability of compliance levels that are on or above average; 0 = Otherwise)
	Descriptive of covariates		
1	Age	*Age*	Years
2	Experience	*Experyears*	Years
3.0	Knowledge transfer: Probability of specification knowledge transfer	*Knowtrans*	Ration 0 to 1
3.1	Appropriateness of specification knowledge transfer: Probability of appropriate specification knowledge transfer	*Apprknowtrans*	Ration 0 to 1
	Description of categorical variables		
4	Education	*Educ*	Nominal categories (1 = Drop-out and Standard 7 or lower; 2 = Form 4; 3 = Vocational Education Training Authority or Diploma)
5	Marital status	*MarrStatus*	Dummy (1 = Married; 0 = Otherwise)
6.0	BMSs enforcement mechanisms	*SEM*	
6.1	Self-quality control mechanism	*QCAself*	Dummy (1 = Yes; 0 = Otherwise)
6.2	Technician quality control mechanism	*QCASentechn*	Dummy (1 = Yes; 0 = Otherwise)
6.3	Client quality control mechanism	*QCAClient*	Dummy (1 = Yes; 0 = Otherwise)
6.4	Supervisor quality control mechanism	*QCASuper*	Dummy (1 = Yes; 0 = Otherwise)
6.5	Local government authority quality control mechanism	*QCALGA*	Dummy (1 = Yes; 0 = Otherwise)
6.6	No quality control mechanism	*QCANone*	Dummy (1 = Yes; 0 = Otherwise)
7.0	Informal learning environment	*ILE*	

(*continued on next page*)

Table 3. (*continued*)

S/N	Variable	Abbreviation	Measurement Scale
7.1	Training has a fixed time	*FITlerntime*	Dummy (1 = Yes; 0 = Otherwise)
7.2	Training has a specific trainer	*FITTrainer*	Dummy (1 = Yes; 0 = Otherwise)
7.3	Training has specific learning steps	*FITprespsteps*	Dummy (1 = Yes; 0 = Otherwise)
7.4	Training has fixed learning duration	*FITDUr*	Dummy (1 = Yes; 0 = Otherwise)
7.5	Training has an instruction before practical	*FITNextstepinform*	Dummy (1 = Yes; 0 = Otherwise)
7.6	Training involve writing	*FITWrite*	Dummy (1 = Yes; 0 = Otherwise)
7.7	Training has an assessment	*FITAssess*	Dummy (1 = Yes; 0 = Otherwise)
7.7	Trainer was supportive	*TDTSupportive*	Dummy (1 = Yes; 0 = Otherwise)
7.9	Trainer had frequent access to projects	*TDTFreqjobAcc*	Dummy (1 = Yes; 0 = Otherwise)
7.10	Trainer did not provide adequate training	*TDTFreqjobchange*	Dummy (1 = Yes; 0 = Otherwise)
7.11	Trainer had no job sequencing	*TDTMean*	Dummy (1 = Yes; 0 = Otherwise)
7.12	Trainer changed trades frequently	*TDTUnreljobassign*	Dummy (1 = Yes; 0 = Otherwise)
7.13	Trainer was too harsh	*TDTTooharsh*	Dummy (1 = Yes; 0 = Otherwise)
8.0	Intensity of new entry	*INE*	
8.1	Casual labour	*NECasuallabour*	Dummy (1 = Yes; 0 = Otherwise)
8.2	Vocation education training (VET)	*Neformtrain*	Dummy (1 = Yes; 0 = Otherwise)
8.3	Working with relative	*NERelat*	Dummy (1 = Yes; 0 = Otherwise)
8.4	Overseeing construction work	*NESuper*	Dummy (1 = Yes; 0 = Otherwise)
8.5	Failing in education	*NEFailEdu*	Dummy (1 = Yes; 0 = Otherwise)
8.6	Job search	*NEJobSearch*	Dummy (1 = Yes, 0 = Otherwise)

(*Continued on next page*)

Table 3. (*continued*)

S/N	Variable	Abbreviation	Measurement Scale
8.7	Friends advice	*NEAdvicefroFriend*	Dummy (1 = Yes; 0 = Otherwise)
9.0	Knowledge retention intensity	*KRI*	
9.1	Writing	*KRIWriting*	Dummy (1 = Yes; 0 = Otherwise)
9.2	Remember	*KRIRemember*	Dummy (1 = Yes; 0 = Otherwise)
9.3	Ask others	*KRIAskothers*	Dummy (1 = Yes; 0 = Otherwise)
9.4	More practical	*KRIMorepract*	Dummy (1 = Yes; 0 = Otherwise)
9.5	Teach others	*KRIteachOther*	Dummy (1 = Yes; 0 = Otherwise)
10.0	Knowledge transfer effectiveness	*KTE*	
10.1	Train relatives only	*KTETrainrelonly*	Dummy (1 = Yes; 0 = Otherwise)
10.2	Time to start training	*KTEInformstarttime*	Dummy (1 = Yes; 0 = Otherwise)
10.3	Assigned trainer	*KTEAssigntrainer*	Dummy (1 = Yes; 0 = Otherwise)
10.4	Time for instruction	*KTEInstrtime*	Dummy (1 = Yes; 0 = Otherwise)
10.5	Steps in training	*KTESteps*	Dummy (1 = Yes; 0 = Otherwise)
10.6	Writing	*KTEMustwrite*	Dummy (1 = Yes; 0 = Otherwise)
10.7	Assessment	*KTEAssess*	Dummy (1 = Yes; 0 = Otherwise)
10.8	Practical assessment	*KTEPracticalassess*	Dummy (1 = Yes; 0 = Otherwise)
10.9	Assessment of work	*KTEAssessWork*	Dummy (1 = Yes; 0 = Otherwise)
11.0	Completeness of informal learning	*CIL*	
11.1	Specific training duration	*CTMDur*	Dummy (1 = Yes; 0 = Otherwise)
11.2	Trainer-trainee agreement	*CTMTrainerTraineeAgr*	Dummy (1 = Yes; 0 = Otherwise)
11.3	Assessment arrangement	*CTMAssess*	Dummy (1 = Yes; 0 = Otherwise)

(*Continued on next page*)

Table 3. (*continued*)

S/N	Variable	Abbreviation	Measurement Scale
11.4	Curriculum or guideline	*CTMCurri*	Dummy (1 = Yes; 0 = Otherwise)
11.5	Quality graduates	*CTMGradqty*	Dummy (1 = Yes; 0 = Otherwise)
11.6	Good system for questioning	*CTMGdsystemforqns*	Dummy (1 = Yes; 0 = Otherwise)
11.7	Good system for practicing	*CTMGdstemforpract*	Dummy (1 = Yes; 0 = Otherwise)

Data and Analysis

The analysis was carried out in three stages; the first part involved computation of the level of specifications knowledge transfer that each craftsman received from his/her mentor based on Equation 1. The second part of analysis involved computation of the level of compliance with BMSs which was transferred during the learning process. The overall level of both compliance with and specifications knowledge transfer in the informal construction practices was then evaluated based on the proportions of BMSs items for which the craftsman received instructions out of the total number, which for this study was 12. To analyse knowledge transfer on BMSs, the mean score for each BMSs was computed based on the BMSs listed in Table 2. For quantifiable BMSs items, it was necessary to capture the actual amount while for other BMSs items, dummy responses were used during data collection. Ultimately however, for each respondent, the dummy responses on whether they were taught about a particular BMSs item or not were entered as "Yes" or "No" responses respectively.

This provided the probability at which a craftsman received instructions on BMSs and whether it was appropriate or otherwise. However, since that was considered inadequate to provide the generalisation over the full sample, it was divided by the overall probability that a craftsman will have received specifications knowledge transfer during training period for the entire sample as shown in Equation 2.

$$Knowtrans = \frac{\text{Specification knowledge items transferred to individual} \Big/ \text{Specification knowledge items available}}{\text{Specification knowledge items transferred to individual to all craftsmen} \Big/ \text{Specification knowledge items available to all craftsmen}}$$

$$= \frac{SK_i \Big/ TSK}{\sum_{i=1}^{N} SK_i \Big/ N * TSK} \qquad \text{Eq. 2}$$

where *Knowtrans* is equivalent to specifications knowledge transfer, it can be appropriate or inappropriate. Appropriate BMSs knowledge transfer (*Apprknowtrans*) arises when master craftsmen transfers the same specification items based on well-known building codes from professionals' point of view. A similar approach is used to develop a compliance with BMSs, an index that measures the level at which an informal craftsman is likely to comply with BMSs in his/her practices compared to the situation facing an average craftsman. In the third stage, both *Knowtrans* and *Apprknowtrans* are included in the analysis of compliance (*Comply*) as independent variables as in Equation 3.

$$Comply = \ln\left(\frac{p_i}{1 - p_i}\right) = \beta_0 + \beta_1 X_1 + ... + \beta_k X_k \qquad \text{Eq. 3}$$

The quantity on the left hand side of the equation $\ln\left(\frac{p_i}{1 - p_i}\right)$ is the "linear predictor" of the log odd of compliance given the values of k = 11 explanatory variables X_1 to X_k two of which measure the level of knowledge transfer (*Knowtrans* and *Apprknowtrans*) and the other X_s are as summarised in Figure 1. The β's are the regression coefficients associated with the k explanatory variables. Equation 3 can be written in terms of the probability that an informal craftsman will comply with BMSs and other control variables as in Equation 4:

$$p_i = \frac{\exp\,(\beta_0 + \beta_1 X_1 + ... + \beta_k X_k)}{1 + \exp\,(\beta_0 + \beta_1 X_1 + ... + \beta_k X_k)} \qquad \text{Eq. 4}$$

where p_i is the probability of compliance with BMSs by craftsman i; β_k are the k coefficients of the explanatory variables considered as determinants of the probability for compliance with specifications p_i and X_k are the k = 12 categories of independent variables shown in Table 3. Since *Comply* is continuous, a value of 1 is entered for compliance levels that are on or above average and a value of 0 is entered for compliance levels that are below average. The purpose is to explain and/or predict the behaviour of *Comply* = 1 using the specified explanatory variables. The hypothesis is that compliance with BMSs in informal construction practices is shaped by the level of knowledge transferred during learning (*Knowtrans* and *Apprknowtrans*). If informal craftsmen do transfer knowledge on BMSs then their mentee are likely to practice it than not.

FINDINGS AND DISCUSSION

Descriptive statistics for covariates are presented in Table 4. All the respondents reached were males aged between 19 to 68 years with an average of around 34 years. This non-gender bias depended on the desire to obtain some site randomness and relates to the dominant gender unless other construction activities other than incremental housing are included. The craftsmen experience was observed to range from around half a year to 40 years with an average of 11 years. The informal construction workforce is therefore relatively younger and has relatively limited number of experienced craftsmen with the majority lying on the lower side of the median. Table 4 further provides observations on knowledge transfer in informal construction practices. The index of knowledge transfer ranges between 0.08 to 0.99 with an average of 0.67 while appropriate knowledge transfer ranges between 0.02 and 0.80 with an average of 0.59. These observations suggest that some of the knowledge transferred on BMSs is inappropriate by a magnitude of 8% on average alongside Makenya (2018).

Table 4. Descriptive Statistics for Control Categorical and Covariates

	Frequency	Percentage	Minimum	Maximum	Mean
Age group					
29 years old and below	123	30.4			
30 years old to 39 years old	190	47.0			
40 years old to 49 years old	75	18.6			
50 years old and above	16	4.0			
Total	404	100.0	19.00	68.00	33.78
Years of experience group					
3 years and below	25	6.0			
4 years to 10 years	222	53.2			
11 years to 20 years	164	39.3			
31 years and above	6	1.4			
Total	417	100.0	0.67	40.00	11.12
Education level					
Dropout	19	4.7			
Standard VII	312	77.6			
Form IV	48	11.9			
Vocational Education Training Authority	21	5.2			
Diploma	2	0.5			
Total	402	100.0	289	38	20
Marital status					
Married	281	81			
Otherwise	66	19			
Total	347	100.0			
Knowtrans	403	100.0	0.08	0.99	0.67
Apprknowtrans	407	100.0	0.02	0.80	0.59

In terms of categorical variables, it was noted that on average the BMSs enforcement mechanisms have 3.82 times more responses on existence than otherwise an indicator of the prevalence of some quality control mechanisms in informal construction practices. The craftsmen sampled are around 2.95 times more likely to have experienced a positive informal learning environment than otherwise. The reverse is also true for negative learning environment where respondents are only 0.44 times more likely to have experienced negative informal learning environment. Generally, the informal learning environment is around 7 (2.95/0.44) times more likely to offer a positive learning environment than otherwise providing a clear indication that the informal learning processes and the trainers' attitudes are viewed positively by the mentee.

In terms of the intensity of new entry, the data indicate that out of the seven evaluated modes of entry into informal construction practices, four are less likely to be used as entry modes these are formal training, failure in formal education, job search and advice from a friend. In terms of knowledge retention intensity, informal craftsmen predominantly rely on memory and verbal techniques to retain the knowledge they have learnt through informal practices potentially to reflect the tacit nature of knowledge that is being transferred (Fricke and Faust, 2006). For knowledge transfer effectiveness, it was noted that knowledge transfer is 1.79 times more likely to be effective than being otherwise an indicator that informal knowledge transfer is marginally effective provided the existence of final assessment, sequencing of tasks, instruction time and learning starting time. The final evaluation of compliance is based on completeness of informal learning. It was observed that knowledge transfer is 1.77 times more likely to be complete than being otherwise an indicator that informal knowledge transfer is marginally complete provided the existence of final assessment, study guidelines, trainer-trainee agreement, produces high quality graduates and has a fixed learning duration.

Table 5. Compliance with BMSs Model Fit Summary

Model Summary				Hosmer and Lemeshow Test		
Step	**–2 Log Likelihood**	**Cox and Snell R Square**	**Nagelkerke R Square**	**Chi-Square**	**df**	**Sig.**
1	243.645	0.324	0.487	3.611	8	0.890
43	269.992	0.271	0.407	5.715	8	0.679

With regard to the determinants of compliance with appropriate knowledge on specification, the results are presented in Tables 5, 6 and 7. Table 5 provides the model fit statistics whereby the Nagelkerte R square ranges between 40% to 49% which for logistic regression may be considered adequate for interpretation. The Hosmer and Lameshow test suggest that the observed and predicted values are not significantly different from one another an indicator of higher ability of the model to predict or classify cases. Table 6 provides the predictive power of the models for the first and the 43rd in terms of the contingency table. The results suggest that the first model correctly classifies around 83% of all observations while the final model correctly classifies around 81% of the cases. These model fit information are considered in this study adequate enough for interpreting the results of the final model.

Table 6. Compliance with BMSs Model Classification Table

Elimination Steps	Observed		Predicted: Comply No	Predicted: Comply Yes	Percentage Correct
Step 1	Comply	No	44	38	53.7
		Yes	21	244	92.1
	Overall percentage				83.0
Step 43	Comply	No	36	46	43.9
		Yes	18	247	93.2
	Overall percentage				81.6

Note: The cut value is 0.5

For the purpose of this study, craftsmen competence is reflected in education attainment which is important in shaping habits and routine. As people advance in education, it is anticipated that the chances of observing BMSs tend to be higher as both the ability and motivation to attend formal and informal training increases (Odediran and Babalola, 2013; Jayawardane and Gunawardena, 1998). Table 7 shows that none of the craftsmen characteristics turned-up into the final model. Age of the mentee, having formal vocation education or diploma and being married all have positive contribution on the probability of compliance though not statistically significant. Having more experience and lower levels of education increases the chances for non-compliant behaviour. Given the observations on the four demographic attribute, it seems habits and routine of informal craftsmen are not significantly related to compliance with BMSs contrary to expectations in Figure 1. This observation could be attributed to the fact that informal construction practices are predominated by low levels of education with almost similar kind of habits and routines. Thus, compliance with BMSs is mainly determined outside habits and routines.

As noted in the literature part of this study, among the core determinants of compliance include quality control mechanisms (Chendo and Obi, 2015; Oladeji and Awos, 2013; Oyedelea et al., 2015). Table 7 indicates that three of the six evaluated quality control mechanisms entered into the final model. Quality control through a senior technician increases the log off of compliance by 1.12 or 3.22 times than if other mechanisms of quality control are adopted. The highest level of compliance is achieved if quality control is checked by the client whereby it is 4.37 times higher than if other methods are used. Compliance declines significantly if quality control is vested onto a site supervisor. The log odd of compliance is 1.46 lower when quality control is through a supervisor than if it is otherwise. These observations confirm the need to vest quality control functions to clients and senior technician in order to achieve higher levels of compliance with BMSs and to avoid vesting such responsibility onto site supervisors. Unlike the literature that posits lack of BMSs enforcement mechanisms as a source of non-compliance (Hedidor and Bondinuba, 2017; Oladeji and Awos, 2013; Anosike and Oyebade, 2012; Isaksson et al., 2012), this study suggest BMSs can be complied to provide an appropriate informal BMSs enforcement mechanism is adopted.

Table 7. Determinants of Craftsmen's Compliance with Appropriate BMSs

	Step 1					Step 43				
	B	**Standard Error**	**Wald**	**Sig.**	**Exp(*B*)**	***B***	**Standard Error**	**Wald**	**Sig.**	**Exp(*B*)**
Age	0.02	0.05	0.18	0.67	1.02					
Experyears	–0.04	0.06	0.36	0.55	0.96					
Educ			1.27	0.53						
Educ_Sec	–0.23	0.59	0.16	0.69	0.79					
Educ_Dip	0.98	0.97	1.03	0.31	2.67					
MarrStatus	0.47	0.54	0.76	0.38	1.60					
BMSs enforcement mechanisms										
QCAself	–0.03	0.67	0.00	0.97	0.97					
QCASentechn	1.12	0.70	2.59	0.11	3.06	1.17	0.56	4.36	0.04	3.22
QCAClient	1.22	0.82	2.23	0.14	3.39	1.47	0.65	5.21	0.02	4.37
QCASuper	–1.46	0.74	3.89	0.05	0.23	–1.46	0.58	6.33	0.01	0.23
QCALGA	–0.11	0.47	0.06	0.81	0.89					
QCANone	–0.28	0.78	0.13	0.72	0.76					
Intensity of new entry										
INECasuallabour	–1.04	0.85	1.52	0.22	0.35					
INeformtrain	–0.15	0.50	0.09	0.77	0.87					
INERelat	0.00	0.65	0.00	1.00	1.00					
INESuper	0.20	0.57	0.13	0.72	1.22					
INEFailEdu	–0.69	0.65	1.13	0.29	0.50	–1.09	0.47	5.42	0.02	0.34
INEJobSearch	–1.48	1.13	1.71	0.19	0.23	–1.46	0.67	4.69	0.03	0.23
INEAdvicefroFriend	–0.83	0.79	1.10	0.29	0.44	–1.08	0.53	4.11	0.04	0.34

(continued on next page)

Table 7. *(continued)*

	Step 1					Step 43				
	B	**Standard Error**	**Wald**	**Sig.**	**Exp(*B*)**	***B***	**Standard Error**	**Wald**	**Sig.**	**Exp(*B*)**
Informal learning environment										
FITlerntime	–0.82	0.66	1.54	0.22	0.44					
FITTrainer	0.17	0.80	0.05	0.83	1.19					
FITprespsteps	0.63	0.74	0.72	0.40	1.87					
FITDUr	0.12	0.64	0.04	0.85	1.13					
FITNextstepinform	0.18	0.55	0.11	0.74	1.20					
FITWrite	0.07	0.62	0.01	0.91	1.07					
FITAssess	0.65	0.71	0.84	0.36	1.92					
TDTSupportive	1.28	0.94	1.85	0.17	3.60	1.45	0.62	5.39	0.02	4.25
TDTFreqjobAcc	0.92	0.64	2.08	0.15	2.50					
TDTFreqjobchange	–0.17	0.52	0.10	0.75	0.85					
TDTMean	–0.40	0.96	0.18	0.67	0.67					
TDTUnreljobassign	1.20	0.63	3.63	0.06	3.31					
TDTTooharsh	0.09	0.80	0.01	0.91	1.09					
Knowledge retention intensity										
KRIWriting	0.07	0.70	0.01	0.92	1.08					
KRIRemember	1.07	0.81	1.78	0.18	2.92					
KRIAskothers	–1.87	0.98	3.64	0.06	0.16	–1.40	0.64	4.73	0.03	0.25
KRIMorepract	–0.66	0.58	1.30	0.26	0.52					
KRIteachOther	–0.09	0.62	0.02	0.88	0.91					

(continued on next page)

Table 7. (*continued*)

	Step 1					Step 43				
	B	**Standard Error**	**Wald**	**Sig.**	**Exp(B)**	**B**	**Standard Error**	**Wald**	**Sig.**	**Exp(B)**
Knowledge transfer effectiveness										
KTETrainrelonly	–0.39	0.65	0.35	0.55	0.68					
KTEInformstarttime	–0.59	0.89	0.45	0.50	0.55					
KTEAssigntrainer	0.21	0.71	0.09	0.76	1.24					
KTEInstrtime	–1.13	0.82	1.92	0.17	0.32					
KTESteps	0.47	0.72	0.43	0.51	1.60					
KTEMustwrite	–0.52	0.60	0.74	0.39	0.60					
KTEAssess	1.18	0.75	2.51	0.11	3.26					
KTEPracticalassess	–0.12	0.55	0.05	0.83	0.89					
KTEAssessWork	–1.18	0.74	2.52	0.11	0.31	–1.08	0.61	3.14	0.08	0.34
Completeness of informal learning										
CTMDur	0.54	0.64	0.70	0.40	1.71					
CTMTrainerTraineeAgr	1.52	0.81	3.55	0.06	4.57	1.18	0.46	6.60	0.01	3.25
CTMAssess	–0.44	0.80	0.30	0.59	0.65					
CTMCurri	–0.27	0.81	0.11	0.74	0.77					
CTMGradqty	0.60	0.62	0.93	0.34	1.83					
CTMGdsystemforqns	–0.04	0.75	0.00	0.96	0.96					
CTMGdstemforpract	0.19	0.66	0.08	0.78	1.21					
Specifications knowledge transfers										
Knowtrans	–2.32	1.03	5.04	0.03	0.10	–2.13	0.76	7.92	0.01	0.12
Apprknowtrans	17.30	3.15	30.25	0.00	3.26E+07	14.19	2.27	39.14	0.00	1.45E+06
Constant	–10.16	2.86	12.64	0.00	0.00					

In terms of the characteristics of informal learning, out of the 13 evaluated indicators, only one appeared in the final model as statistically significant. The log odd of compliance with BMSs is higher by 1.28 or 4.25 times if the master craft is supportive than if he/she is otherwise. These observations provide an important indication that the behaviour of informal craftsmen can create a learning environment that can support or deter knowledge transfer on building specifications alongside Agyemang and Boateng (2019), Ram and Jones (1998) and Rath (2000). For the purpose of compliance with BMSs in informal construction practices, master craftsmen must be perceived supportive by their respective mentee. Although the literature stresses on the importance of job sequencing in informal learning to build a structured knowledge or learning platform (Lave and Wenger, 1991; Billett, 2010), informal practices that involved sequencing in this case seem to yield insignificant outcome in terms of compliance with BMSs. It seems BMSs knowledge transfer follows different channels when compared to other construction skills especially when it comes to compliance with BMSs.

The way an informal craftsmen entered into the industry (intensity of new entry) might be an important determinant of compliance with building specification knowledge. Table 7 suggests that three of the seven evaluated entry factors significantly reduce compliance with BMSs. The log odd of compliance with BMSs is lower by 0.69 among craftsmen who entered after failing in education than those who entered otherwise; it is lower by 1.48 among those who entered through job searches than otherwise and is lower by 0.83 among those who entered following friends' advice than those who entered through other means. Entry through relatives and supervisor is positive on compliance though not statistically significant contrary to expectations (Hucklesby, 2009; Alananga Sanga and Mselle, 2018). It seems failure in education is also a BMSs compliance failure; random job searches are also detrimental to compliance as well as entry through friends' and relatives' advice. Potentially, craftsmen entering after failing in the formal education system or through random job search and through friends and relatives have limited incentives to internalise the work process and learn about BMSs, an indicator of dependence to their masters to supervise them. There is a strong indication here that normative attributes are a major factor behind non-compliance behaviour among informal craftsmen contrary to Mselle and Alananga Sanga (2017) where social connectivity is an important determinant of knowledge transfer.

In terms of knowledge retention intensity, Table 7 suggest that asking others significantly reduces compliance behaviour among informal construction craftsmen contrary to Teerajetgul and Charoenngan (2006) and Windsperger and Gorovaia (2010) on the effectiveness of these mechanisms in knowledge retention initiatives. The log odd of BMSs compliance is lower by 1.87 when the craftsmen retain construction knowledge through asking others than when retaining knowledge using other methods. "Asking others" therefore is an inappropriate knowledge retention mechanism to guarantee compliance with BMSs among informal craftsmen. Compliance may be enhanced if trainees adopt writing and remembering as knowledge retention initiatives alongside Teerajetgul and Charoenngan (2006) and Windsperger and Gorovaia (2010) though these were not statistically significant. A key feature in learning is competence and by dwelling more on BMSs: "the do and don't", master crafts must not only understand them but also display the different ways through which such BMSs are applicable. Since writing is rarely used as a knowledge retention option, informal craftsmen must rely on verbal means to transfer and retain knowledge (Nonaka and Takeuchi, 1995; Windsperger and

Gorovaia, 2010). Additionally, Anokye and Afrane (2014) and Apunda, de Klerk and Ogina (2017) argues that informal learning specifically apprenticeship involves mechanism of learning such as listening and observing of the master craft and implementation of the lessons through practicing rather than writing.

Among the nine knowledge transfer effectiveness indicators that were entered into the model, only assessment of work done was observed to be significant and negatively correlated with compliance with BMSs. The log odd of compliance with specification was lower by 1.18 among master craftsmen who continuously assess trainees to ensure knowledge transfer effectiveness than those not adopting it. Continuous assessment is therefore a weak tool to ensure knowledge transfer effectiveness for the purpose of achieving higher degrees of compliance with BMSs contrary to expectations (Brooker and Butler, 1997). Probably assessment induces cramming among learners as it is in a formal learning process, thus reducing both knowledge and compliance. Assignment of a specific trainer, sequencing the training tasks and final assessment are the only knowledge transfer effectiveness factors that contribute positively towards compliance though were observed to be statistically not significant. The nature of informal construction however, does not guarantee knowledge transfer even when there is continuous assessment of tasks. As noted earlier, the learning-by-doing is more dependent on availability and intrinsic demand to learn even without the need to be assessed or being informed of when to start or finish (Lave and Wenger, 1991; Freys, 1997).

Furthermore, the observations in this study suggest that enhancing knowledge transfer effectiveness through prioritising relatives only during knowledge transfer is a weak mechanism to ensure compliance with BMSs though not statistically significant. Thus, although knowledge can be transferred or shared through social networks (Mu, Peng and Love, 2008; Alananga Sanga and Mselle, 2018), the fact that only relatives are given priority reduces seriousness in learning about BMSs thus eliminating much of the compliance potentials. When mentee are under their blood mentor, the mentee dependence on master's knowledge tends to be higher and it seems BMSs knowledge is left with the master in as long as the mentee believe that it is the responsibility of the master craftsman to maintain quality of the output. The fact that informal construction knowledge transfer is basically through social networks reduces the potentials that BMSs knowledge will be transferred and complied later. Seven indicators were included in assessing completeness of informal learning and only one turned out to be a significant determinant of compliance with BMSs. The log odd of compliance with BMSs is higher by 1.52 when there is a trainer-trainee agreement than when it is otherwise alongside Nguluma (2006) though verbal agreement were questionable. Therefore, completeness of informal learning through instituting trainer-trainee agreement during knowledge transfer offers an added advantage in terms of compliance with BMSs regardless of the type of the agreement.

If an indicator of general compliance is used, it is noted that compliance tend to be negatively correlated to knowledge transfer an alarm that construction practices are misaligned in favour of inappropriate building specification knowledge. It is only when compliance with appropriate BMSs is considered that one observes a positive relationship between knowledge transfer and compliance. Informal construction practices are therefore genuine practice for transferring appropriate knowledge on specification though the majority of those who believe they comply with specification are in fact out of appropriate compliance in line with the observations by Hedidor and Bondinuba (2017). The findings do not auger well with Freys's hypothesis that both intrinsic and extrinsic motives induces compliance (Freys, 1997), it seems extrinsic motives finds its way more strongly than intrinsic in informal construction practices. Generally, it is concluded here that knowledge transfer matter for the attainment of higher level of compliance with building specification but what matters most is that knowledge on building specification need to be appropriate.

CONCLUSION

Compliance with BMSs in informal construction practices is mainly constraint driven since such practices entail knowledge transfer on BMSs through trainer-trainee agreement and knowledge transferred on BMSs is to a larger extent appropriate. Compliance is marginally instrumental because of enforcement of quality through senior technicians and clients and is least determined by habits and routines because of appropriateness of knowledge transfer on BMSs. Non-compliance behaviour is however both normative and instrumental since it is principally determined by entry factors such as failure in formal education, job search and advice from friends. For knowledge transfer effectiveness, it is evident that trainees should not be in any way connected to their master and that situation provides a major departure from the general knowledge transfer propositions. BMSs are well internalised when the learner has no connection with the trainer. Thus, although social capital through social network is a useful knowledge transfer mechanism this study suggests that it does little to enforce internalisation of knowledge on BMSs leading to non-compliance. It is therefore, evident that positive attribute of knowledge transfer on BMSs are not necessarily positive on compliance to the same. While one may guarantee BMSs knowledge transfer through social capital, the same is a recipe for non-compliance on BMSs in practice.

The basic argument advanced in this paper is not only on the appropriateness of BMSs but also the relative strength of habits and routines in shaping compliance in other aspects other than BMSs. More important is the observation that informality parse is not an indicator of non-compliance in the construction industry. This contradicts the existing body of knowledge that links informal construction practices with non-compliance to BMSs (Polese, 2015; Hoai and Yip, 2017; Agyemang and Boateng, 2019; Adewole, Ajagbe and Arasi, 2015; Oloyede, Omoogun and Akinjare, 2010). Another important departure relates to learning modalities whereby it is suggested that sequencing and structuring of training programmes yield positive outcome in compliance (Lave and Wenger, 1991; Billett, 2010). The observation in this study holds this argument contentious as no statistically significant relationship was noted between compliance and sequencing or structuring of the learning processes among informal construction workers. Furthermore, social connectivity which is very strong in knowledge transfer on BMSs is significantly detrimental to compliance. Despite these observations, it is evident that some craftsmen are aware that most of what they do is incompatible with appropriate BMSs. The policy recommendations advocated in this article require aligning the formal and informal skill training programmes and activities to allow for the enforcement of compliance to appropriate BMSs knowledge. Similarly, since a substantial number of craftsmen have been observed to transfer inappropriate BMSs to one another, there is a need for an active learning programme to instil and inculcate BMSs knowledge and compliance culture among informal craftsmen. Most important is the fact that not everything that supports effective knowledge transfer will automatically yield positive compliance behaviour thereafter. While one may guarantee knowledge transfer on BMSs through social capital, the same is a recipe for non-compliance with BMSs during practice. Any training of informal workers on BMSs must create a conducive learning environment where trainers are supportive, are bound with agreements on expected output including transferring appropriate BMSs.

There are additional challenges with the recommendations for integrating the informal learning process into the formal one. The fact that informal learning is highly valuable for the adoption of tacit knowledge suggests that formalising informal learning can intrinsically eliminate much of its learning potentials. The practice of storing knowledge in papers and computers reduces the incentive to learn and internalise knowledge for application elsewhere but with formal knowledge repository the incentives to internalise BMSs knowledge is significantly reduced. This is because craftsmen can easily consult documents in the due process or can retrieve information from repository and use them on-the-fly. Expertise becomes vested into things that cannot improve it. The life of BMSs knowledge may be considered highly active if it resides in the memory of the craftsmen; it can grow and later be transferred in a more advanced manner than originally stored. But the fact that consultation of physical objects such as paper and computers is now possible, the ability of human brain to process data, information and improve thereon has significantly been reduced.

NOTES

1. The *Cambridge Advanced Learner's Dictionary and Thesaurus* defines a craftsman as "a person who is skilled in doing or making something" while the *Collins Online English Dictionary* (Collins, 2020) defines it as "a person who makes things skilfully by his hands". The different crafts recognised include masonry, carpentry, joinery and steel bending. So, the use of synonyms such as skilled workers and artisans are tolerated in this article.

REFERENCES

Adewole, K.K., Ajagbe, W.O. and Arasi, I.A. (2015). Determination of appropriate mix ratios for concrete grades using Nigerian Portland-limestone grades 32.5 and 42.5. *Leonardo Electronic Journal of Practices and Technologies*, 14(26): 79–88.

Agyemang, F.G. and Boateng, H. (2019). Tacit knowledge transfer from a master to an apprentice among hairdressers. *Education and Training*, 61(1): 108–120. https://doi.org/10.1108/ET-12-2017-0200.

Alananga Sanga, S. and Mselle, J. (2018). Informal construction practices as knowledge incubators: A literature review. *Macrothink Journal of Business and Economic Research*, 18(1): 13–37.

Alananga, S. and Lucian, C. (2016). Cost shares and factor-cost ratios in owner-built incremental housing in Dar es Salaam, Tanzania. *Journal of Construction in Developing Countries*, 21(1): 113–130. https://doi.org/10.21315/jcdc2016.21.1.6.

Alananga, S., Lucian, C. and Kusiluka, M. (2015). Significant cost-push factors in owner-built incremental housing construction in Tanzania. *Construction Management and Economics*, 33(8): 671–688. https://doi.org/10.1080/01446193.2015.1090007.

Anokye, P. and Afrane, S. (2014). Apprenticeship training program in Ghana: Process, institutional dynamics and challenges. *Journal of Education and Practice*, 5(7): 130–141.

Anosike, M. and Oyebade, N. (2012). Sandcrete blocks and quality management in Nigeria building industry. *Journal of Engineering, Project and Production Management*, 2(1): 37–46. https://doi.org/10.32738/JEPPM.201201.0005.

Apunda, E.A., de Klerk, H.M. and Ogina, T. (2017). Technical knowledge and skills development in the informal sector in Kenya: The case of custom tailors. *International Review of Education*, 63: 341–361. https://doi.org/10.1007/s11159-017-9643-4.

Baldock, R., James, P., Smallbone, D. and Vickersô, I. (2006). Influences on small-firm compliance-related behaviour: The case of workplace health and safety. *Environment and Planning C: Government and Policy*, 24(6): 827–846. https://doi.org/10.1068/c0564.

Billett, S. (2010). *Learning through Practice: Models, Traditions, Orientations and Approaches.* London: Springer.

Bottoms, A.E. (2001). Compliance and community penalties. In A. Bottoms, L. Gelsthorpe and S. Rex (eds.), *Community Penalties: Change or Challenges*. Cullompton, Devon: Willan Publishing, 87–161.

Brooker, R. and Butler, J. (1997). The learning context within the workplace: As perceived by apprentices and their workplace trainers. *Journal of Vocational Education and Training*, 49(4): 487–510. https://doi.org/10.1080/13636829700200028.

BS (British Standards) 2028 (1978). *Precast Concrete Blocks*. London: British Standard Institute.

Cambridge Advanced Learner's Dictionary and Thesaurus. Cambridge: Cambridge University Press. Available at: https://dictionary.cambridge.org/dictionary/english/craftsman [Accessed on 8 May 2019].

Chendo, I. and Obi, N. (2015). Building collapse in Nigeria: Causes, effect, consequences and remedies. *International Journal of Civil Engineering, Construction and Estate Management*, 3(4): 41–49.

Cochran, W.G. (1963). *Sampling Techniques*. 2nd Ed. New York: John Wiley and Sons, Inc.

Collins (2020). Thesaurus for craftsman from the Collins English Thesaurus. Available at: https://www.collinsdictionary.com/dictionary/english-thesaurus/craftsman [Accessed on 9 October 2020].

Cooper, C.L. and Lewis, S. (1999). Gender and the changing nature of work. In G.N. Powell (ed.), *Handbook of Gender and Work*. London: Sage Publications, 37–46.

COTVET (Council for Technical and Vocational Education and Training) (2016). COTVET: Building capacity through the National Apprenticeship Programme. Available at: https://www.graphic.com.gh/features/features/cotvet-building-capacity-through-the-national-apprenticeship-programme.html [Accessed on 25 February 2019].

Étienne, J. (2010). Compliance theories: A literature review. *Revue Française de Science*, 60(3): 493–417. https://doi.org/10.3917/rfsp.603.0493.

Freys, B.S. (1997). *Not Just for the Money: An Economic Theory of Personal Motivation*. Cheltenham, UK: Edward Elgar Publisher.

Fricke, C. and Faust, B. (2006). Knowledge transfer: Acquiring implicit knowledge. *International Journal of Nuclear Knowledge Management*, 2(1): 46–56. https://doi.org/10.1504/IJNKM.2006.009618.

Hedidor, D. and Bondinuba, F.K. (2017). Exploring concrete materials batching behaviour of artisans in Ghana's informal construction sector. *Journal of Civil Engineering and Construction Technology*, 8(5): 35–52. https://doi.org/10.5897/JCECT2017.0439.

Hoai, A.T. and Yip, N.M. (2017). A regime of informality? "Informal housing" and the state-society relationship in transitional Vietnam. *TRIALOG 123*, 4/2015: 20–29.

Hucklesby, A. (2009). Understanding offenders' compliance: A case study of electronically monitored curfew orders. *Journal of Law and Society*, 36(2): 248–271. https://doi.org/10.1111/j.1467-6478.2009.00465.x.

Isaksson, R., Idman, O., Lenhav, Oscar and Sätterman, J. (2012). Visualising improvement and innovation potential: The case of sustainable building in Dar es Salaam. In S.M. Dahlgaard-Park, J.J. Dahlgaard and A. Hamrol (eds.), *How May Organizations Use Learning, Creativity and Innovation in Realizing Their Dreams of Excellence and Recover from the Economic Crisis?: Proceedings*. Poznań, Poland: Comprint, 741–754.

Jayawardane, A. and Gunawardena, N. (1998). Construction workers in developing countries: A case study of Sri Lanka. *Construction Management and Economics*, 16(5): 521–530. https://doi.org/10.1080/014461998372060.

Lave, J. and Wenger, E. (1991). *Situated Learning Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

Makenya, A.R. (2018). Assessment of production and quality of concrete blocks in Dar es Salaam Tanzania. *International Research Journal of Engineering and Technology (IRJET)*, 5(3): 360–375.

Meena, V., Moirongo, B. and Munala, G. (2018). Causes of reinforced concrete building failure in Dar es Salaam. *International Journal of Scientific Research Engineering and Technology*, 7(6): 472–478.

Monkkonen, P. and Ronconi, L. (2013). Land use regulations, compliance and land markets in Argentina. *Urban Studies*, 50(10): 1951–1969. https://doi.org/10.1177/0042098012471982.

Mselle, J. and Alananga Sanga, S. (2018). Constraints facing incremental housing construction in Dar es salaam, Tanzania. *Journal of Construction in Developing Countries*, 23(1): 1–20. https://doi.org/10.21315/jcdc2018.23.1.1.

________. (2017). Knowledge incubation in informal construction practices: A critical review of the literature. *International Journal of Construction Engineering and Management*, 6(3): 63–77. https://doi.org/10.5923/j.ijcem.20170603.01

Mu, J., Peng, G. and Love, E. (2008). Interfirm networks, social capital, and knowledge flow. *Journal of Knowledge Management*, 12(4): 86–100. https://doi.org/10.1108/13673270810884273.

Mukhtar, S.M. (2002). Differences in male and female management characteristics: A study of owner-manager businesses. *Small Business Economics*, 18: 289–311. https://doi.org/10.1023/A:1015235402335.

Nellis, M. (2006). Surveillance, rehabilitation and electronic monitoring: Getting the issues clear. *Criminology and Public Policy*, 5(1): 103–108. https://doi.org/10.1111/j.1745-9133.2006.00104.x.

Ngugi, H., Mutuku, R. and Gariy, Z. (2014). Effects of sand quality on compressive strength of concrete: A case of Nairobi County and its environs, Kenya. *Open Journal of Civil Engineering*, 4(3): 255–273. https://doi.org/10.4236/ojce.2014.43022.

Nguluma, H.M. (2006). The role of *mafundi* in housing construction in informal settlements in Dar es Salaam. *The Journal of Building and Land Development*, 13(2): 84–93. https://doi.org/10.4314/jbld.v13i2.41411.

Nonaka, I. and Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation.* New York: Oxford University Press.

Odediran, S. and Babalola, O. (2013). Employment structure of informal construction workers/artisans in Nigeria. *Global Journal of Management and Business Research*, 13(11): 25–40.

Oladeji, O. and Awos, O. (2013). Assessment of materials and process variables on regulatory compliance of sandcrete blocks: A case study of Ogbomoso, Nigeria. *International Journal of Engineering Research and Applications*, 3(6): 793–799.

Oloyede, S., Omoogun, C. and Akinjare, O. (2010). Tackling causes of frequent building collapse in Nigeria. *Journal of Sustainable Development*, 3(3): 127–132. https://doi.org/10.5539/jsd.v3n3p127.

Olusola, K., Babafemi, O., Adewumi, J., Umoh, A., Olawoy, A. and Babatunde, J. (2012). Effect of batching method on fresh and hardened properties of concrete. *International Journal of Research and Reviews in Applied Sciences*, 13(3): 773–779.

Oyedelea, L.O., Jaiyeobab, B.E., Kadirib, K., Folagbadeb, S.O., Tijanic, I.K. and Salamid, R.O. (2015). Critical factors affecting construction quality in Nigeria: Evidence from industry professionals. *International Journal of Sustainable Building Technology and Urban Development*, 6(2): 103–113. https://doi.org/10.1080/2093761X.2015.1033662.

Phoya, S., Kikwasi, G., Sospeter, N.G. and Novatus, M. (2018). Selection of risk management strategies in informal construction sector. *Journal of Civil Engineering and Architecture*, 12: 408–415. https://doi.org/10.17265/1934-7359/2018.06.002.

Polese, A. (2015). Informality crusades: Why informal practices are stigmatized, fought and allowed in different contexts according to an apparently ununderstandable logic. *Caucasus Social Science Review*, 2(1): 1–26.

Ram, M. and Jones, T. (1998). *Ethnic Minorities in Business.* Knutsford, UK: Small Business Research Trust.

Rath, J. (2000). Immigrant businesses and their economic, political-institutional and social environment. In J. Rath (ed.), *Immigrant Business: The Economic, Political and Social Environment*. Basingstoke, UK: Macmillan, 1–19.

Rubaratuka, I. (2013). Challenges of the quality of reinforced concrete buildings in Dar es Salaam. *International Journal of Engineering Research and Technology*, 2(12): 820–826.

Sabai, S., Isaksson, K.R., Maganga, J. and Minja, S. (2016). Relevance, consequences and change needs of the current Tanzania concrete bricks and blocks standard TZS 283:2002. Paper presented at the *2nd International Conference on Advances in Cement and Concrete Technology in Africa*. Dar es Salaam, Tanzania, 27–29 January.

Simpson, S.S. (1992). Corporate-crime deterrence and corporate-control policies: Views from the inside. In K. Schlegel and D. Weisburd (eds.), *Whitecollar Crime Reconsidered*. Boston: Northeastern University Press, 289–308.
Teerajetgul, W. and Charoenngan, C. (2006). Factors influencing knowledge creation. Emperical evidence from Thai construction projects. *Journal of Engineering, Construction and Architectural Management*, 13(5): 584–599. https://doi.org/10.1108/09699980610712382.
United Republic of Tanzania. (2014). *Economic Survey 2014*. Dar es Salaam: Ministry of Finance.
Vaughan, D. (1998). Rational choice, situated action and the social control of organizations. *Law and Society Review*, 32(1): 23–61. https://doi.org/10.2307/827748.
Windsperger, J. and Gorovaia, N. (2010). Knowledge transfer attributes and the choice of knowledge transfer mechanism in networks: The case of franchising. *Journal of Management and Governance*, 15(4): 617–640. https://doi.org/10.1007/s10997-009-9126-5.
Zaelke, D., Kaniaru, D. and Cameron, E.K. (2005). *Making Law Work: Environmental Compliance and Sustainable Development*. London: Cameron May Ltd.