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Article

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Management dynamics in the knowledge economy

Provided in Cooperation with:
National University of Political Studies and Public Administration, Bucharest

Reference: Okoye, Peter Uchenna/Okolie, Kevin Chuks et. al. (2022). Payment of labour wage for construction site operations with safety risk. In: Management dynamics in the knowledge economy 10 (2/36), S. 124 - 141. https://www.managementdynamics.ro/index.php/journal/article/download/452/440/1974. doi:10.2478/mdke-2022-0009.

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Payment of Labour Wage for Construction Site Operations with Safety Risk

Peter Uchenna OKOYE[1], Kevin Chuks OKOLIE[2], Oluchukwu Precious-Favour NZENERI[3], Gilbert Chidi OHAZULUME[4]

1 Nnamdi Azikiwe University, Along Enugu-Onitsha Expressway, 420110, Awka, NG; pu.okoye@unizik.edu.ng (corresponding author)
2 Nnamdi Azikiwe University, Along Enugu-Onitsha Expressway, 420110, Awka, NG; kc.okolie@unizik.edu.ng
3 Federal University of Technology, Ihiagwa, 460114, Owerri, NG; nzenerip@gmail.com
4 Nnamdi Azikiwe University, Along Enugu-Onitsha Expressway, 420110, Awka, NG; gc.ohazulume@unizik.edu.ng

Received: February 9, 2022
Revised: March 15, 2022
Accepted: April 12, 2022
Published: June 16, 2022

Abstract: The increasing rate of unsafe acts by construction workers during construction operations to earn more wages is raising new concerns due to its negative effects; including accidents on construction sites. This study, therefore, examined the relationship between the level of safety risk in different building construction operations/trades and methods of payment of wages for construction operatives to determine if the wage payment method was predicted by the level of risk in each operation. Prior to this, the study prioritised selected construction operations based on their safety risk level and rated the method of payment of wages for each operation based on their frequency of utilisation. A site-based survey was conducted using structured questionnaire and interview, administered to building tradesmen and labourers in South-East Nigeria. The study identified 12 high-risk level and 7 medium-risk level operations/trades. The study ranked roofing work as the riskiest building operation. It also found that negotiated lump sum, piece rate and time rate wage systems respectively, were the most prevalent wage payment systems in the payment of wages for operatives. Although the study also found that the level of risk has positive effect on the method of payment of wages (β = 0.214; *t*-stat = 0.640), it revealed that the level of risk involved in each operation/trade does not significantly predict the payment method used in payment of workers' wages (F-Stat (0.409) < F-Critical (4.451); p (0.531) > 0.05). It identified negotiated lump sum wage payment method as an emerging wage payment system in Nigeria construction industry and suggested for further investigation to unravel the circumstances behind its high acceptance. The study then craved for review of existing labour laws in Nigeria to capture the new trends in the labour management of risky operations on construction sites.

Keywords: labour wage; safety risk; tradesmen; construction operation; South-East Nigeria.

Introduction

Construction projects and sites are becoming more complex and dynamic with increasing safety risks resulting to high rate of accidents (Abdalla, Apramian, Cantley, & Cullen, 2017; Forteza & Carretero-Gómez, 2020; Youli, Yingjian, Xiaoxia, & Airan, 2018). In terms of workplace injuries and workers' unsafe behaviour, construction accounts for about 80-90% of the injuries (Anderson & Grytnes, 2021); despite that safety is one of the sustainability performance criteria for every construction project (Wu, Chong, Wang & Li, 2018). According to Nawaz, Linke and Koç (2019), ignoring safety can be costly for sustainability, whereas safety-related initiatives promote operationalisation of sustainability. Unfortunately, building construction operations are inherently risky and hazardous (Kozlovská & Struková, 2012; Muiruri & Mulinge, 2014; Zavadskas, Turskis, & Tamošaitiene, 2010), with construction workers constantly exposed to excessive risks at work (Almén, Larsson, & Thunqvist, 2012).

How to cite
Okoye, P.U., Okolie, K.C., Nzeneri, O.P.F., & Ohazulume, G.C. (2022). Payment of Labour Wage for Safety Risk Building Construction Site Operations. *Management Dynamics in the Knowledge Economy, 10*(2), 124-141. DOI 10.2478/mdke-2022-0009
ISSN: 2392-8042 (online)
Journal abbreviation: *Manag. Dyn. Knowl. Econ.*
www.managementdynamics.ro
https://content.sciendo.com/view/journals/mdke/mdke-overview.xml

Vol.10 (2022) no.2, pp.124-141; DOI 10.2478/mdke-2022-0009

However, some construction operations are considered riskier than others (Okoye, 2018). The high rate of accident in the construction industry is linked to peculiar factors of the industry (de los Pinos, José, García, & de las Nieves, 2017). There are also group of construction workers whose nature of work has made them to be more vulnerable to complex occupational health and safety problems than others (Liu, Li, Li, Li, Mao, & Yuan, 2021). The mostly recognised safety hazards during construction operations have always been working at height, working underground, working in confined spaces and close proximity to falling materials, handling load manually, handling hazardous substances, noises, dusts, using plant and equipment, fire, exposure to live cables, poor housekeeping and ergonomics (Kozlovská & Struková, 2012; Muiruri & Mulinge, 2014; De Silva & De Silva, 2015). These have made construction operations more risk prone and create an atmosphere of high uncertainty (Mhetre, Konnur, & Landage, 2016).

Expectedly, the high level of safety risk in construction operations comes with a huge cost to the construction business (Okoye, 2018) and affects the contractors' profit margin. Apart from clients, contractors and subcontractors, issues relation to the payment to construction operatives have been identified as risk contributors in the construction projects. Unfortunately, the construction industry generally suffers from poor payment practices (Ahmadisheykhsarmast & Sonmez, 2020; Luo, Das, Wang, & Cheng, 2019; Swai, Arewa, & Ugulu, 2020). The prevalence of payment risks has been linked to the increasing incidences of payment-related disputes and litigation in the construction industry (Mbachu, 2011; Ramachandra, 2013). In building construction projects, issues relating to payment have gone beyond clients' verses contractors to payment to the operatives. Henriod and Lantran (2000) noted that the prevalence of conflicts, claims, and disputes in the construction industry hinged on payment-related issues. Payment-related issues are also identified as one of the most significant factors affecting the workers' productivity (Bake & Makinde, 2021). Similarly, Omopariola and Windapo (2018) contended that construction activities are less interrupted when the payment system used is suitably aligned with the project environment. Rhee, Kim and Cho (2015) linked the safety behaviours of construction workers to the type of payment systems and working conditions of construction workers. Sherif and Kaka (2003) identified the level of risk as one of the factors influencing the selection of payment systems in construction projects.

In Nigeria, disputes over payment methods for settlement of site workers are very common on construction sites (Bake & Makinde, 2021). Consequently, building construction workers try to avoid such operations with high safety risk or charge high amount for such operations, thereby increasing the inherent risk in the project. To compensate for this, and ensure that the overall project objectives of time, cost, quality, safety, and environmental sustainability are met, Zou, Zhang and Wang (2007) suggested that such risk should be properly managed. Sequel to this, different payment mechanisms have been developed and applied for different construction operations as means of overcoming risk challenges occasioned by the nature of certain construction operations.

Although the role of payment systems in construction projects has been acknowledged, each payment system is appropriate for certain conditions of project and client circumstance (Motawa & Kaka, 2008). Motawa and Kaka (2008) considered that considering such alternative payment systems for such operations would allow for better and active participation of workers to facilitate the achievement of project objectives. Since the success of any construction project largely depends on the suitability of payment system adopted based on the project characteristics, construction operations and client requirements (Sherif & Kaka, 2003), identifying and selecting the most appropriate payment system for each building construction operation is very germane so as to reduce the safety risk tendencies. The aim of this study, therefore, was to establish the wage payment system used in paying building construction tradesmen and labourers and to establish the relationship between each wage payment system and the level of risk in each building construction operation/trade. In view of this, the objectives of the study were to:

1. Identify the level of safety risk involved in common building construction site operations;

2. Determine the wage payment method mostly used in each construction operation or trade;
3. Determine if the method of payment of wages for site operatives is predicted by the level of safety risk involved in each construction operation.

On this basis, the questions however, are: What is the level of safety risk involved in each of the construction operation? What is the most prevalent method of payment of wage for each of the construction operation/trade? It further postulated that:

H_0: The method of payment of wages for building tradesmen and labourers does not significantly depend on the level of safety risk involved in each construction operation/trade.

In view of this, the outcome of this study is expected to be a guide to construction site management towards selecting appropriate payment methods for different construction site operations, hence minimising issues arising from labour wage determination. It would also give a clue to construction workmen leaders or gang leaders of different building trades on what and how their payments are to be made for a particular construction operation. Construction policy maker could draw from the result of this study in making appropriate labour laws for construction site operations.

This work was organised into different subheadings. The Introduction established the background and aim of the study. It also highlighted the rationale and relevance of the study. The Literature review drew from the extant literature and established a literature gap which this study was intended to fill. The methodology sought out the methodological procedures adopted in this study to achieve the aim of the study. Findings generated through the methodological processes were presented in the result section, while the detailed discussion and validation of the findings of this study was presented in the discussion section. The summary of the findings, implications and recommendations arising from the study were contained in the conclusion.

Literature review

Risk in building construction site operations

Construction operations are referred to as any activity that contributes to the delivery of a construction project (Designing Buildings, 2020). Construction operations include the construction, alteration, repair, extension, installation, demolition or dismantling of buildings or structures, systems, works forming, or to form, part of the land (Revenue, 2021). They also include operations which form an integral part of, or are preparatory to, or are for rendering complete other construction operations including site clearance, earth-moving, excavation, tunnelling and boring, laying of foundations, erection of scaffolding, site restoration, landscaping and the provision of roadways and other access works; haulage for hire of materials, machinery or plant for use, whether used or not, in any of the construction operations (Revenue, 2021). Building construction operations can take place on greenfield sites, areas designated for industrial development or at a site with existing or historic activities (European Bank for Reconstruction and Development, 2010).

However, some of these construction operations pose high risk of injuries and more hazards to manage than others. They are also associated with endless lists of safety hazards that pose injury and illness threats to workers. Causes of accidents on construction sites are similarly associated with these construction operations (Li, Chau, & Zeng, 2019). For example, workers are frequently exposed to ergonomic and safety hazards from manual handling, power tools and equipment, noise, confined spaces and electricity, work performed from heights, excavation, irregular work hours, and exposure to weather extremes (Abdalla et al., 2017). Kaim, Alabi and Wusu (2020) revealed that greater percentage of construction workers had direct and indirect exposure to hazards of varying degrees.

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Although every construction activity involves some risk for injury, the magnitude of risk differs extensively across jobs or operations and some hazards are unique to specific operation, hence exposing construction workers to great health and safety risks while carrying out their job (Abdalla et al., 2017; Okoye, 2018). Among common construction site operations attributed to high rate of safety risk include excavation work, scaffolding work, crane operations, hoisting operations, forklift operations, ladder and electrical works (Purohit, Siddiqui, Nandan & Yadav, 2018). A report from (Bureau of Labour Statistics, 2009; Schneider & Susi, 1994; Memarian & Mitropoulos, 2012; Memarian & Mitropoulos, 2013) identified masonry as one of the construction operations with highest rate of accidents with lost workdays due to overexertion involving lifting. Baradan and Usmen (2006) found that ironworkers and roofers were the highest risk building trades. A study by Alinaitwe, Mwakali and Hansson (2007) showed that labourers are the most vulnerable workers followed by masons, carpenters, and plant operators on construction sites in Uganda, while Choi (2015) identified four occupation groups with the highest injury rates on construction sites as labourers, carpenters, iron workers, and machine operators. Ndiwa (2019) revealed that majority of workers in masonry work, carpentry, steel fixing, and roof work are exposed to very high ergonomics risks on building construction sites.

Similarly, onsite construction activities associated with both modular and conventional constructions such as unit transportation, module unit lifting, unit installation, roofing, scaffold, ladder, vehicle and finishes are also identified to cause accidents on construction sites (Jeong, Kim, Lee, Park, & Hyun, 2022; Kang, Siddiqui, Suk, Chi, & Kim, 2017). Mamman, Mohamed, Shittu and Adamu (2021) revealed that most building construction activities in Abuja are of medium risk level however, roof work, steel structure and electrical works had the greatest risk level. The study further revealed that in terms of frequency of risk occurrence, roof work and steel structure are building activities with medium risk level whereas electrical works, steel structure, roof work and lift installation are building activities with medium risk level in terms of severity of risk impact. Okoye (2018) revealed that masonry, carpentry (including formwork and roofing), and iron bending and steel fixing are common building trades associated with high risks; whereas electrical fitting & installation, painting, tilling, and plumbing are medium risk building trades.

Methods/modes of payment of wages for building tradesmen and labourers

Appropriate remuneration to construction operatives for work done on site is very important for uninterrupted flow of construction process and optimal productivity (Ramachandra, 2013). However, when this is not the case as usually observes in the Nigerian construction industry, it affects the overall project success and, in most cases, leads to payment disputes (Bake & Makinde, 2021). According to Fick, Cackler, Trost and Vanzler (2010), these payment disputes are indication of the nature of payment problems experienced in the construction industry.

Generally, there are different methods of payments of wages for construction site operatives. Basically, in the construction industry, payment of wages is made for work done either measured by the time worked (i.e., according to the period of time the worker is employed (time payments)), or by the output of the worker (piece payments) (Ajslev, Persson, & Andersen, 2015; Ansah, 2011; Bake & Makinde, 2021). Bake and Makinde (2021) reviewed different payment methods used in the Nigeria construction sites as a factor affecting labour productivity in the construction industry. They identified piece payments and time payments as the two major payment systems used in Nigeria. Other payment systems may include premium plan or profit-sharing scheme which are used in addition to the two basic methods as an incentive wages or bonus payment for increased productivity; target cost and guaranteed maximum price (Chan, Chan, Lam, Yeung, & Chan, 2011).

Rhee, Kim and Cho (2015) investigated the association between the type of payment and exposure to various hazardous factors as a heuristic study. The study examined the relation between the three types of payment such as basic fixed salary and wage, piece rate, and extra payment for bad and dangerous working conditions and exposure to hazardous factors like vibration, noise, temperature, chemical contact, and working at very high speeds. It found that the proportion of employees with a basic fixed salary was 94.5%, the proportion with piece rates was 38.6%, and the proportion who received extra payment for hazardous working conditions was 11.7%. It further revealed that piece rate was associated with exposure to working with tight deadlines and stressful jobs.

In time payments, a definite sum is paid for a fixed period of time, i.e., payments are paid at a fixed rate per hour, day, week, month; or other period, and each construction worker in a given category receives the same payment irrespective of differences in output (Kazimu, 2012). Under time rates system of payment, construction workers are paid for the amount of time spent on the site job. This is the oldest and most common system, and the payments are based on a certain period of time during the course of work (Bake & Makinde, 2021). The period of time may be an hour, a day, a week, a fortnight or a month the payment rate will depend upon the period of time.

In piece payments, payments depend upon output, each construction worker is paid according to the quantity of work done by him, and irrespective of time he takes (Chan et al., 2011). According to Judi and Abdul-Rashid (2010), piece rates are not suitable for all kinds of construction work, and also the system is liable to abuse if applied deceitfully. Kaka and Lewis (2003) noted that earnings are usually higher for construction workers on piece rates than for those on similar work paid on a time basis, and the danger of excessive speed is not great as the workers are not penalised if they fail to reach a given standard or target. Many individual workers, especially those who can achieve high output, favour piece rates or bonus payments which if reasonably fixed, enable them to earn more. Where conditions are suitable employers also prefer piece rates because of their inducement work people to concentrate and to do more work (Aje, Olatunji, & Olalusi, 2017).

On the other hands, construction workers usually prefer time rates, but are parties to many collective agreements including piece rates where these are suitable for the kind of work done. Wasteful handling of materials and tools is minimised (Berends & Dhillon, 2004). However, the cost per unit of production is uncertain because the quantity differs from time to time under time system (Kaka & Lewis, 2003). It is also very difficult to measure the efficiency of construction workers because all the workers of equal status are paid at equal rate (Kaka & Lewis, 2003). Rhee, Kim and Cho (2015) argued that it is only piece rate and extra payment for overtime, holiday work, bad and dangerous working conditions, etc. are related to occupational health and safety among the payment systems. A modified version of both target cost and guaranteed maximum price could be simply referred to as negotiated lump sum wage, where a lump sum wage to be paid to the tradesmen or labourer is negotiated for a specific volume of work. The extra payment for bad and dangerous working conditions and exposure to hazardous factors is a form of bonus wage payment system used to compensate for extra risk involve in a particular construction operation.

Methods/modes of payment of wages and safety on construction site

Studies (Johansson, Rask, & Stenberg, 2010; Rhee et al., 2015) have revealed that some types of wage payment scheme aggravate the occurrence of accidents in some industries including construction, in addition to having a negative effect on workers' health and safety. Oswald, Sherratt and Smith (2017) revealed that money is a very strong driver of health and safety conditions in construction. Therefore, Ding, Zhai, Wang, Zhang and Cai (2019) analysed the effects of variable payment methods on risk allocation. The study revealed that the setting of specific parameters for particular payment method is very difficult, due to many factors such as risk preference of both sides. According to Schneider

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(n.d) workers' compensation premiums which serve as incentives in construction industry are high especially for high risk level operations and trades such as structural steel erection, carpentry, and masonry.

Bender, Green and Heywood (2012) established that there is an increase in workplace injuries under piece rates and that piece rates are associated with a 5-percentage point increase in the likelihood of workers suffering an injury. A literature survey conducted by Johansson, Rask and Stenberg (2010) affirmed that the piece rate system negatively affected workers' health and safety. Similarly, a study by Ajslev, Persson and Andersen (2015) revealed that that group performance-based wages were associated with higher levels of physical exertion and time pressure, while no such association was found for pain and fatigue.

Although some studies have looked at the risks and payment systems in construction industry, there is little or no research on how payment of wages for construction site operatives, tradesmen or labourers who work in high-risk construction operations is made (Wells, 2016). Very little studies such as Henriod and Lantran (2000) and Rhee, Kim and Cho (2015) considered different payment systems made to the operatives in different building trades and operations by the contractors, while some others studied the health and safety effects of payment systems in construction industry (Ajslev et al., 2015; Bender et al., 2012; Ding et al., 2019; Johansson et al., 2010). The bulk of research related to this area focused on generic payment methods for construction contracts (i.e., payment of contractors) (Ding et al., 2019; Kaka, Wong, Fortune, & Langford, 2008; Motawa & Kaka, 2008; 2009; Walimuni, Samaraweera & De Silva, 2017), construction risks management (Bahamid & Doh, 2017; Banaitiene & Banaitis, 2012; Nketekete, Emuze, & Smallwood, 2016), contractors' cash flow modelling (Bake & Makinde, 2021; Park, Han, & Russell, 2005), factors influencing the selection of payment systems (Sherif & Kaka, 2003), and payment risk management (Mbachu, 2011). Nevertheless, these are not the focus of the current study. Additionally, there is limited research on the prioritisation of risk level of building construction operations/trades in Nigeria. It is, therefore, pertinent to address the existing knowledge gaps by not only identifying and prioritising the risk level of different building construction operations/trades, but also empirically determining the wage payment system for each operation/trade and how they interact with each other.

Methodology

The study was a site-based survey that made use of structured questionnaire administered to selected building site operatives (tradesmen and labourers) on building construction project sites in South-East, Nigeria. From the literature, 19 common building construction site operations/activities and 4 wage payment systems commonly used for payment of construction operatives in Nigeria were extracted and included in the survey.

The questionnaire was designed to capture the current safety risk level of common building construction operations/trades and wage payment systems used in each operation in the study area. It was also designed to investigate the probability of occurrence and the impact of safety risk of each building construction operation. Apart from the demographic information of the respondents, the probability of occurrence and impacts of risk of building construction operations were measured using a Likert scale of 1 to 5. The respondents were asked to express their opinion based on their perception on the frequency of occurrence and severity of impact of risk of the selected building operations on a 5-point scale. The frequency of occurrence included:1 = Rarely, 2 = Remote, 3 = Occasional, 4 = Frequent, 5 = Almost Certain (likelihood of risk occurrence); and 1 = Negligible, 2 = Minor, 3 = Moderate, 4 = Major, 5 = Catastrophic (severity of risk impact). On the second part, the respondents were asked to rate the payment systems used in each of the operation based on their frequency of use, on a scale of 1 to 4, where 1 = Least Frequently used, 2 = Less Frequently used, 3 = More Frequently used, 4 = Most Frequently used.

Since this study was a site-based study, the population of the study could not be easily determined. This is because there was very high volume of building projects of different magnitude both private and public going on in the study area. These projects were at different stages of completion with majority being privately owned residential and commercial building projects. The owners of the projects take charge of the management of the construction process. The construction process and site of most of the projects were not also organised, and there were irregular construction activities going on at the sites. However, Bujang, Sa'at and Tg Abu Bakar Sidik (2017) suggested that the minimum required sample size for most multivariate analysis is determined conventionally, using a rule-of-thumb derived from the Multiple Linear Regression. Siddiqui (2013) opined that appropriate sample sizes depend on the numbers of items available for factor analysis. On this premise, Tabachnick and Fidell (2013) recommended for the use of "50 + 8m" where "m" is the number of factors; whereas Siddiqui (2013) recommended a sample size of 200 for 10 items; 250 for 25 items; 400 for 90 items; and 1000 for 500 items. In this study, the questionnaire contained 4 latent variables measuring the wage payment systems and 19 factors measuring the risk level of construction operations. Hence, the sample size for this study would be approximately 220 building construction site operatives.

Meanwhile, it was expedient to specify the criteria for selection of both the sites and respondents for the study. The specification was necessary to minimise bias, give direction to the study and to achieve the objectives of this study. Thus, for a site to be qualified for selection, the following criteria must be met:

1. Active sites;
2. Sites with multiple of construction workers of different trades;
3. Large building project site with multiple activities/operations;
4. Site superintended by the owner is excluded; and
5. Not more than one person per trade per site would be selected.

In line with the foregoing criteria, more than 1000 building construction sites were identified for the study across the five states of the study area. A two-stage sampling procedure was employed in selecting the desired sample size. Firstly, a judgemental purposeful sampling technique was adopted in identifying the building project sites based on the stated criteria. Consent/permission was sought and obtained from the site managements for sites inclusion in the survey. The objectives of the study were made known to the site managements. The participants were further informed about the purpose of the survey, the content, and benefits. Their consent was also obtained before they were given the questionnaires to fill. To ensure anonymity, no information linking the respondents to their responses was contained in the questionnaire. No further ethical consideration was required for data collection through questionnaire survey. Although not all the sites that met the criteria granted permission for inclusion, those that granted approval were considered in the actual survey because the respondents were already aware of what was expected of them. Secondly, the study deployed a simple random sampling technique in selecting the site and respondents for the actual survey having identified the sites in the preliminary survey until the desired sample size was reached. Based on the selection criteria, 220 respondents comprising different building tradesmen and labourers were selected from various building construction sites across the study area. Subsequently, 220 copies of the questionnaires were administered to the selected respondents by hand.

To ensure a geographical spread across the states and make sure that the survey sample fit the purpose, the sample size was divided equally into 5. This meant that 44 respondents were selected from each of the five states that made up the study area. It should be noted that only building projects in urban cities and urban peripheries of the concerned states were considered for security and logistics reasons. After about 4 months of constant reminders to the respondents, 201 questionnaires were retrieved, however 2 were discarded for not meeting the requirement for inclusion in the analyses due to missing of vital information and improper filling of the questionnaire. Thus, 199 representing about 90.45% were certified suitable and therefore, used in the analysis. Improvement in the

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response rate contrary to the popular assumption of low response rate in this kind of survey study was as a result of persistent reminders to the respondents.

Oral interviews were also conducted with some of the respondents who are experienced (mainly with the foremen and gang leaders) to substantiate their responses in the questionnaire. The interviewees were purposefully selected based on their relevance to the objectives of the study. A quantitative risk analysis was carried out on the data generated through the questionnaire survey to assess the risk of different building operations. The probability of risk occurrence and the risk impact rating of each operation were computed based on the recommendation of the Code of Practice on Workplace Safety and Health (WSH) Risk Management (Workplace Safety and Health Council, 2011) and the Royal Institute of Chartered Surveyors (RICS) Professional Guidance for Management of Risk (RICS, 2015).

The probability of risk occurrence and severity of risk impact were computed using the Mean Value Method in Equations 1 and 2.

$$PRO = \frac{\sum_{j=1}^{5} j \times N_j}{\sum_{j=1}^{5} N_j} \quad (1)$$

$$SRI = \frac{\sum_{k=1}^{5} k \times N_k}{\sum_{k=1}^{5} N_k} \quad (2)$$

Where PRO = probability of risk occurrence; j = probability of occurrence rating scale (integer values between 1and 5); SRI = severity of risk impact; *k*= impact rating scale (integer value between 1 and 5); and N_j and N_k = number of the respondents selecting the probability of occurrence equal to *j* and *k* respectively.

The degree of risk (risk score) (R) that indicates the risk level was obtained from the risk prioritisation number computed from Equation 3. According to the Code of Practice on Workplace Safety and Health (WSH) Risk Management (Workplace Safety and Health Council, 2011), the degree of risk and associated description of risk level is summarised in Table 1.

$$R = \frac{\sum PRO}{N} \times \frac{\sum SRI}{N} \quad (3)$$

Table 1. Risk rating

Risk score scale	Risk level
1 ≤ x ≤ 4	Low
4 < x ≤ 12	Medium
12 < x ≤ 25	High

Source: Workplace Safety and Health Council (2011)

Where PRO = Probability of risk occurrence, SRI = Severity of risk impact, N = Number of item and x = actual risk score for the considering variable (building construction operation). Based on the average risk values, the risk level of each operation was ranked.

Based on the rating scores of the respondents on each wage payment system for each construction operation, the score for each operation was computed. The mean scores were used to determine the most frequent payment system used in settlement of wages of construction workers in each operation. Subsequently, the sum of the means of each wage system for each construction operation was computed to rank and determine the overall most frequently used wage system for payment of wages for construction operatives. The study further employed regression analysis and ANOVA to determine if the wage payment systems used was predicted by the level of safety risk involved in each operation or trade. The entire analysis was done using SPSS Version 25 software.

Results

Table 2. The result of risk analysis of common building construction operation/trade

S/N	Building Construction Operation/Trade	PRO/ Rating	SRI/ Rating	R	Risk Level	Rank
1	Roofing work (trusses and covering)	4.35	4.73	220.58	High	1
2	Block/brick laying	3.83	3.22	12.33	High	12
3	Reinforcement bar (cutting, bending and fixing)	3.96	4.31	17.07	High	10
4	Tilling work (including terrazzo and marble laying)	3.13	2.36	7.39	Medium	16
5	Painting	3.73	2.69	10.03	Medium	13
6	Electrical work	3.64	4.16	15.14	High	11
7	Mechanical and plumbing work	2.99	2.68	8.01	Medium	15
8	Formwork construction	3.98	4.40	17.51	High	6
9	Concreting work	4.01	4.34	17.40	High	7
10	Plastering and rendering	3.53	2.65	9.35	Medium	14
11	Demolition	4.15	4.47	18.55	High	3
12	Scaffold erection	3.98	4.33	17.23	High	8
13	Structural steel work	4.18	4.45	18.60	High	2
14	Excavation	4.00	4.40	17.60	High	5
15	Machine operation	4.06	4.40	17.86	High	4
16	Cladding work	3.93	4.37	17.17	High	9
17	Ceiling	2.90	2.31	6.70	Medium	18
18	Site preparation/clearance	2.85	2.33	6.64	Medium	19
19	Landscaping	2.94	2.30	6.76	Medium	17

Table 2 revealed that 12 operations are high risk level construction activities while 7 are medium risk level operations with none classified under low risk level. However, roofing work has the greatest risk level with an average risk score (R) of 20.58; whereas site preparation/clearance has the least risk level with an average risk score (R) of 6.64. The top 5 riskiest building operations are: Roofing work (R = 20.58), structural steel work (R = 18.60), demolition (R = 18.55), machine operation (R = 17.86), and excavation (R = 17.60).

The result also revealed that roofing work has both the highest likelihood of risk occurrence and severity of risk impact, with PRO and SRI of 4.35 and 4.73 respectively. On the other hand, site preparation/clearance has the least frequency of risk occurrence with a PRO of 2.85, while landscaping has the least severity of risk impact with a SRI of 2.30. Since none of the operations is a low-level risk operation, the result implies that almost all the building construction operations are risk prone. This further indicates that caution should be exercised while carrying out any building operation to minimise the tendency of being injured. The interview result revealed that working at high and the mode of operation and material handling made roof work and structural steel work respectively riskiest operations.

Table 3 revealed that different wage payment systems were applied in payment of wages for construction site operatives based on the nature and peculiarity of each operation. Although four common payment systems were identified and used in the payment of site operatives, the total scores (sum of means) of the respondents indicates that three payment systems are mostly applied. These are negotiated lump sum wage, piece rate and time rate payment systems. However, based on the sum of means scores, negotiated lump sum wage was ranked first (56.87) and closely followed by piece rate wage (51.27) and time rate wage (50.07) while bonus plus wage was ranked least (31.40). This implies that negotiated lump sum wage is the most frequently adopted payment system by the contractors for wages of construction operatives.

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Table 3. Rating of wage payment system mostly used for each building construction operation/trade

S/N	Building Construction Operation/Trade	PRW	TRW	BPW	NLW	Mostly used
1	Roofing work (trusses and covering)	1.6181	2.2362	2.3116	3.8342	NLW
2	Block/brick laying	3.7487	2.3869	2.2412	1.6181	PRW
3	Reinforcement bar (cutting, bending and fixing)	2.4523	2.3216	1.4573	3.7688	NLW
4	Tilling work (including terrazzo and marble laying)	3.6583	3.1608	1.3015	1.8492	PRW
5	Painting	1.8291	3.1709	1.3116	3.6583	NLW
6	Electrical work	1.8291	3.1709	1.3116	3.6583	NLW
7	Mechanical and plumbing work	1.8291	3.1709	1.3116	3.6583	NLW
8	Formwork construction	3.6583	3.1658	1.3166	1.8342	PRW
9	Concreting work	3.6583	1.8342	1.3166	3.1658	PRW
10	Plastering and rendering	3.6583	1.8342	1.3166	3.1658	PRW
11	Demolition	1.4271	2.2312	2.5729	3.7688	NLW
12	Scaffold erection	1.4271	2.2312	2.5729	3.7688	NLW
13	Structural steel work	1.8291	3.1709	1.3116	3.6583	NLW
14	Excavation	3.6583	1.8291	3.1709	1.3116	PRW
15	Machine operation	3.1658	3.6583	1.3166	1.8342	TRW
16	Cladding work	3.1658	1.8342	1.3166	3.6583	NLW
17	Ceiling	3.1658	3.6583	1.3166	1.8342	TRW
18	Site preparation/clearance	1.8291	3.1709	1.3116	3.6583	NLW
19	Landscaping	3.6583	1.8342	1.3166	3.1658	PRW
Total Score (Sum of means)		51.27	50.07	31.40	56.87	
Overall ranking based on rating across all operations		**2**	**3**	**4**	**1**	

PRW = Piece rate wage, TRW = Time rate wage, BPW = Bonus plus wage, NLW = Negotiated lump sum wage

The result of the interview revealed that operatives usually negotiate with contractors or subcontractor on what their wage rate would be for a particular work based on the nature, the difficulty, and the perceived risk inherent in the operation. They view this wage payment system as a win-win arrangement where all conditions attached to the work are discussed and a lump sum wage is negotiated and agreed. The result of the interview affirmed that the operatives also prefer piece rate wage where they can be paid according to their output. Most importantly, the operatives wanted to be in charge of the time they work and a wage commensurate to their efforts.

To ascertain if the wage payment system used is determined by the level of risk involved in each building operation or trade, the result of the regression analysis is presented in Table 4. Tables 4 revealed that wage system used for payment of construction operatives does not significantly depends on the level of risk involve in each operation. Although the regression result revealed that risk level has a positive effect on the wage payment system used with $\beta = 0.214$, t-stat = 0.640 and $p = 0.531$, the regression coefficient (R = 0.153), the R^2 (0.024) implies that only about 2.4% of the variances in wage payment system used could be explained in the risk level. This further implies that the level of risk involved in each building operation or trade is not a significant predictor of the wage system used for the payment of wages for building construction tradesmen and labourers. In this case, the null hypothesis is accepted, and the study concluded that the wage payment system does not significantly depends on the level of safety risk involved in each construction operation or trade. According to the site operatives, method of payment for each operation is considered on its merit and the choice and agreement of the site operatives and contractors or sub-contractors, but not necessarily on the level of risk in the operation.

Table 4. Regression analysis result for dependency of payment system on the level of risk of construction operations

Parameters	Unstandardised Coefficients		Standardised Coefficients	t-stat.	Sig.
	β	Std. Error	Beta		
Constant	1.286	0.486		2.646	0.017
Risk Level[b]	0.214	0.335	0.153	0.640	0.531
R	0.153[a]				
R^2	0.024				
Adjusted R^2	-0.034				
Std. Error of the Estimate	0.70413				
F- Stat.	194.750				
Durbin-Watson	2.377				
a. Predictors: (Constant), risk level					
b. Dependent Variable: payment system					

Table 5. ANOVA result for dependency of payment system on the level of risk of building construction operations

	Sum of Squares	df	Mean Square	F-stat.	F-critical	Sig.	Decision
Regression	0.203	1	0.203	0.409	4.451	0.531[a]	Accept H_o
Residual	8.429	17	0.496				
Total	8.632	18					
a. Predictors: (Constant), risk level							
Dependent Variable: payment system							

The ANOVA result in Table 5 affirmed that the wage payment method or mode used in the payment to operatives does not significantly depend on the level of safety risk involved in each operation at 5% significance difference. In this case, F-Stat (0.409) < F-Critical (4.451), and p (0.531) > α (0.05). This signifies that there are other competing factors more significant in the determination of the mode of payment to construction site operatives than the level of risk inherent in each site operation. The result of the interviews revealed that other factors such as type of organisation, type of employer-employee relations, degree of trade contractor utilisation, difficulty of the work, location, complexity, unions, laws, etc. are some of the factors that determine the mode of wage payment system applied in a particular operation.

Discussion

The result of this study revealed that all the building construction operations considered for this study are classified either as high risk or medium risk operations. Hence, it indicates that building construction operations are generally risky, though their risk levels vary. This implies that there are different levels of safety risks associated with different building operations depending on the nature and activities involved in the operation. Similarly, the frequency of safety risk occurrence and severity of impact of such risk associated with a particular operation differs. Expectedly, the nature of activities and mode of operation involved in different building operations are responsible for the safety risk involved in the operations as corroborated by Okoye (2018). This affirmed that multiple risk management approaches are desirable in line with the recommendations of the Health & Safety: Risk Assessment Methodology of the University of Melbourne, Australia (2017). This finding supports Abdalla et al. (2017) who found that the level of risk for injury and magnitude of risk differs across different operations and are unique to specific operation.

Specifically, 12 operations are classified as high-risk level whereas only 7 are classified as medium risk level. The top five riskiest operations are roofing work structural steel work, demolition, machine operation and excavation. This result aligns with the result of Purohit, Siddiqui, Nandan and Yadav (2018) who identified excavation work, scaffolding

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work, machine operations and electrical works as high safety risk common construction site operations. The result also agrees with Mamman, Mohamed, Shittu and Adamu (2021) who found that roof work, steel structure and electrical works had the greatest risk level but disagrees on account that most building construction activities are of medium risk level. The result equally supports Kang, Siddiqui, Suk, Chi and Kim (2017) who found that roof work, carpentry, masonry and steel fixing are high ergonomic risk building construction operations. This result, therefore, implies that measures must be taken to control and reduce the risk level in those operations associated with high risks since their risk level is unacceptable (Gadd, Keeley, & Balmforth, 2004). The fact that all the 12 high risk operations, except block/brickwork which scored 12.33 lied at the upper part (extreme) of the high-level categorisation, implied that extra caution has to be exercised and all necessary safety actions must be taken before the commencement of such high-risk operations to minimise accident incidence and injury on site.

On the other hand, those operations associated with medium risk level could be tolerated but a careful evaluation of the hazards should be carried out to ensure that the risk level is reduced to as low as reasonably practicable within a defined time period (Workplace Safety and Health Council, 2011). Unfortunately, the study indicates that none of these construction operations has low risk level. This is an indication that there is need to take safety precautions while executing any building operation to reduce the risk of construction accident on site.

From the 4 commonly applied wage payment methods for payment of construction operatives in the study area, the study revealed that only 3 – negotiated lump sum wage, piece rate wage and time rate wage are mostly applied. However, negotiated lump sum wage is the most prevalently applied method or mode of payment of wages for construction workers, among others. This could be as a result of dynamic nature of building construction operations and construction site where the contractor or sub-contractor and site operative (tradesmen and labourers) need to negotiate and agree on the wage for a particular operation. Further investigation on this revealed that this wage payment method minimises disputes arising from other payment systems used in the settlement of construction workers for the work done on sites, and it is an emerging wage payment system.

The closeness of the sum of means scores for negotiated lump sum wage (56.87), piece rate wage (51.27) and time rate wage (50.07) suggested that these three methods or mode of payment of wages are mutually effective and prevalent while bonus plus wage method is rarely used. This result contradicts the result of Rhee, Kim and Cho (2015) who found that about 94.5% of construction workers are on a basic fixed salary. The difference could be as a result of differences in the condition of work and labour laws in the two countries where the studies were carried out (i.e., Korea and Nigeria).

Surprisingly, the study revealed that the method of payment of wages used for payment for different construction operatives on sites does not significantly depends on the level of risk involved in each operation/trade. This implies that the level of risk in a particular construction operation does not predict the mode of wage payment system to be used in settling the operatives' wages. Although the level of risk has positive effect on the mode of payment system used, the insignificant effect suggested that the payment system applied by the contractors or sub-contractors for a particular operation depends on the multiplicity of factors. This could be as a result of the nature of construction work, the extent of work involved or based on the contractor's discretion as substantiated by the result of the oral interviews. This result is supported by the result of Muñoz-La Rivera, Mora-Serrano and Oñate (2021) which categorised the multiplicity of factors influencing the safety of construction projects. Furthermore, the result of interviews revealed that the wage payment system is quite different from the wage rate of the tradesmen and labourers. The respondents agreed that the wage rates are determined by the risk level inherent in the site operation but does not determine the payment method as per whether to engage in a piece rate, time rate or negotiated wage, etc. The respondents stated that

what is important is the choice of either the contractor, sub-contractor or the operatives and what would be of benefit to the parties. This result is attuned with Ding, Zhai, Wang, Zhang and Cai (2019) submission which stated that setting specific parameters for particular payment method is very difficult, due to many factors associated with risk preferences in construction projects and partly disagreed with (Sherif & Kaka, 2003).

Conclusions

The importance of safety on construction sites and payment for construction work has been widely acknowledged and canvassed. The risk level of various construction operations as well as different wage systems for payment of building construction site operatives have also been identified. However, how the risk levels of different site operation influence the choice of methods of payment of wages for construction workers remains a puzzle. The general belief would have been that the level of risk determines the choice of method of wages applied on a particular construction operation. Therefore, this study examined the relationship between the level of safety risk in construction operations and the choice of methods of payment of wages for such operations in Nigerian construction industry.

The study prioritised different building construction operations on the basis of risk levels. It established that most building operations are highly risky. It further found that the negotiated lump sum wage is the most prevalent method of payment of wages for construction workers/tradesmen. Furthermore, the study established that the level of risk in construction operations does not predicts the method of payment of wages for construction operatives. This suggested that each construction operation whether high, medium or low risk level operation has its peculiarities and characteristics that determine the choice of wage payment method or mode used in settlement of wages of workers regardless of the level of risk. It also suggested that there are multiplicity of factors influencing the contractors', sub-contractors' or the operatives' choice of wage payment method than the safety risk level of site operations.

Generally, the result of this study implied that labour issues arising from the payment of wages for construction operation could be minimised if appropriate payment method is selected. Since the study indicated that the method of payment of wages for construction operatives on sites does not significantly depends on the level of risk involved in different operations, it therefore, implied that parties to construction site operations are at liberty to choose the payment method that would be suitable to them. On the strength of these findings, this study provided the basis upon which the contractors or sub-contractors and operatives could come to terms in determining which wage system is suitable for a particular operation so as to avoid issues arising from improper choice of payment system and other associated problems.

Since safety is very paramount to construction site, this study provided useful information on the extent of safety risk involved in different construction operations. It would serve as a precursor for formulating effective safety management strategy and accident prevention mechanisms for different construction operations. Hence it is a veritable tool for the general management of construction site issues relating to payment for construction workers and operatives on site. Particularly, the construction site management personnel would be a direct beneficiary of this study in that it would give them clue on what payment method to be selected for a particular construction operation. Indirectly, it would be beneficial to the clients who are at the receiving ends of the disputes arising from payment methods. Construction workmen leaders or gang leaders of different building trades would also drive some benefits from this study in such a way that it would guide them on how to approach each operation with respect to the payment system that would be beneficial and commensurate to the nature and amount of work done on site.

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Furthermore, the study identified new wage payment system in the construction industry in the form of negotiated lump sum wage system which emerges as a result of dynamism in the construction business and environment. In this way, the findings of this study is of benefit to the construction workers who through this system exercise the right to negotiate for the wage suitable and equitable to the type and volume of work they execute on site. The fact that this system of payment is the most prevalent form of payment of wages calls for further investigations. In addition, the study has exposed the lapses in the existing labour laws in Nigeria, and thus, recommended for their review to capture the new trends in labour relations in the construction industry. A further study is also recommended to determine the relationship between the safety risks and the wages amount (rate) of different groups of construction tradesmen to ascertain if the amount of wages received by the construction workers for a particular operation is predicated by the level of safety risk in such operation.

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