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TURNOVER INTENTION OF LECTURERS IN PUBLIC AND PRIVATE UNIVERSITIES: SYSTEMATIC LITERATURE REVIEW

Sean Calvin Shin Ching Yong & Siti Maziha Mustapha
Infrastructure University Kuala Lumpur, MALAYSIA

ABSTRACT

This paper presents a systematic literature review on the turnover intention of lecturers in public and private universities. The primary objective is to identify the main factors affecting lecturers' decision to remain or leave, as well as potential solutions that universities and other stakeholders can use to reduce staff turnover. Research questions that were answered by this study are: (i) What are the factors responsible for the turnover intentions of public and private university lecturers? (ii) What recommendations exist for curtailing turnover intention? The methodology adopted was PRISMA, which is an evidence-based approach to synthesizing information from different sources. The results showed some common themes emerged across both types of universities such as job satisfaction, organizational commitment, working conditions, pay structure, etc., while other factors like managerial support or work-life balance had more significant effects on lecturers' motivation in one type than another. Moreover, it was found that financial incentives have a major role to play when it comes to reducing employee attrition rates among teachers at both types of universities. Finally, various strategies were proposed such as providing better recognition systems; offering competitive salaries; creating flexible working environments; and improving communication within organizations, which can help reduce lecturers' motivation to leave their jobs prematurely.

Keywords:
Turnover Intention, Lecturer, Higher Education, Public University, Private University

INTRODUCTION

Turnover intention of lecturers in public and private universities has become a major challenge for both the universities as well as the government. The reasons behind this phenomenon are multifaceted, ranging from personal to organizational factors. This paper presents a systematic literature review of studies related to turnover intention among university lecturers in public and private universities around the world. Specifically, it aims to identify common themes that have emerged from these studies with regards to understanding why some lecturers choose not to stay on at their current institution or move on to other ones. Furthermore, it will explore how different types of organizational policies may influence lecturer's decisions regarding turnover intentions such as job satisfaction levels or salary differences between universities. In doing so, this paper hopes to provide insights into ways which can be used by organizations to reduce faculty attrition rates and improve employee retention strategies within higher education settings worldwide.

The importance of understanding turnover intentions among university staff is paramount due to its implications on productivity, quality assurance measures taken by universities and overall cost incurred while replacing employees. Moreover, there exists an interesting dichotomy when comparing results obtained from research conducted across various countries; while some suggest that certain external factors such as work environment play an important role in influencing one's decision-making process, others point towards internal variables like job satisfaction being more influential than any other factor, including salaries offered by competing organizations (Aziz et al., 2019). This is important in terms of adopting suitable strategies that can boost employee performance while also reducing turnover.

Turnover intentions have been cited in relationship to various variables. The moment at least one of these variables is identified, the chance that the lecturer is fully engaged in their work and has enough energy to deliver everything for their work increases (Anderson, 2014). It is thus essential that we gain greater insight into what drives individual preferences between staying and leaving their current organization taking into account all relevant information available about them before drawing any conclusions about causes leading towards increased faculty attrition rate observed currently amongst many academic establishments globally.

Objectives

The objective of this paper is to conduct a systematic literature review on the turnover intention of lecturers in public and private universities. The main goal is to identify the major factors influencing lecturer's decisions to remain or leave their current positions, as well as potential solutions that can be used by universities and other stakeholders in order to reduce staff turnover. Specifically, the following are the Research Questions of the study:

i. What are the factors affecting the turnover intentions of public and private university lectures?
ii. What recommendations exist for curtailing turnover intention?

LITERATURE AND STUDIES

The Concepts of Turnover Intention

Many scholars have defined turnover intentions in various ways. Park & Johnson (2019) define turnover intentions as the "desire to leave an organization" which is based on individual factors such as job satisfaction and motivation levels within a particular work environment or industry sector. Ooi & Teoh (2021) suggest that these intentions are related to employees' attitudes towards their current workplace and can be measured by analysing employee performance ratings over time compared with those of other organizations in the same sector or region. Priya et al. (2017) further explain that this concept also involves how well employees perceive their job roles relative to others in the organization; for instance, if they feel undervalued, then it could lead to them considering leaving for another role elsewhere where they may receive better recognition and rewards for their efforts.

Numerous scholars have devoted time and efforts to study the factors that contribute to employee's intention to leave their jobs. The study by Septriyan (2022) sought to understand the major causes of perceived organizational support on job satisfaction and turnover intention. The findings of that study show that job structure, work environment, autonomy or flexibility improve lecturers' job satisfaction and decrease their intention to leave.

From the above definitions, turnover intentions can be taken to refer to the desire of an employee to leave their current job. It is a measure of how likely it is that an employee will quit in the near future, and can be used as a predictor for actual turnover. Turnover intentions are considered important because they provide employers with insight into how satisfied employees are with their jobs, which can help them identify potential issues before they lead to larger problems or costly resignations (Russel et al., 2020; Thomas, 2019).

University Lecturers and Turnover Intention

As theorized by Rathakrishnan & Siew (2016), turnover intention is associated with the anticipation of a lecturer in terms of training, reward, recognition, and working conditions. When lecturers join the universities with some anticipation, the chances of negative behaviours, including turnover intention and absenteeism will increase, especially when such expectations are not met. When a peer receives a pay raise, promotion or bonus after working hard or even attaining their KPI (Key Performance Indicators), this is likely to motivate the other subordinates to work extra hard to receive similar paybacks. Past studies have demonstrated that the manifestations of dissatisfaction often result in turnover intention. According to Awang et al., (2015), this is directly linked to perceptions of dissatisfaction and is reliant on the rewards received by employees. Hence, the perception of dissatisfaction with rewards is linked to the increasing number of faculty staff expressing their intentions to quit these universities.

Evidence drawn from the research affirms that turnover intention is observed as the psychological readiness to leave higher institutions of learning, particularly when employees secure greener pastures elsewhere. Recent studies connecting training and development to turnover intention (Koon, 2018) have paid more attention to individual differences and interests. Nonetheless, earlier studies on turnover intention argued that moderating variables should serve to understand such phenomenon (Kim & Park, 2016). Some scholars do not consider lecturer turnover to be dysfunctional. However, according to Priya et al., (2017), employee turnover has often been an issue of concern for higher institutions of learning and business organizations. As such, a high percentage of employee turnover is detrimental to the organization and the employee, respectively. Turnover has a huge impact on the institutions' costs related to recruiting and selecting new personnel, training of newly recruited employees, and loss of knowledge acquired by the staff while on the job. Ultimately, turnover intention in any given organization results in understaffing, and this in turn leads to reduced productivity and effectiveness of the remaining staff.

Consequences of Lecturers' Turnover Intentions

University lecturers play a crucial role in the success of any university. They provide students with knowledge and skills that can be applied to their future endeavours, while also inspiring them to reach new heights. A lecturer with extensive experience can help students learn more effectively and bring out their innate desire to study and seriousness (Dong & Mustapha, 2021). However, when there is a high turnover rate among university lecturers, it can have serious consequences for both the institution and its students (Mughal et al., 2016).

The first consequence of university lecturers' turnover is that it leads to a decrease in the overall quality of education provided by a university (Amani & Komba, 2016; Hegazy, 2019). When experienced professors leave their positions, they are often replaced with less qualified individuals who may not be able to provide adequate instruction or guidance to students in their courses. This can lead to poorer grades among students and lower academic performance overall, which could ultimately affect how competitive graduates are when entering into job markets after graduation.

The second consequence of lecturer turnover is related directly to faculty morale and satisfaction within the universities themselves (Mohammadi & Karupiah, 2020; Nawaz & Pangil, 2016). Experienced professors leaving their positions due to dissatisfaction with working conditions or other factors can cause tension between remaining staff members who feel like they must pick up extra workloads left behind by those departing colleagues while also feeling undervalued for staying on board despite these issues occurring within the institution itself. Additional workloads appear to be one of the leading causes of mental illness of lecturers, which can lead to low morale and burnout (Zakirah & Juliana, 2021). This low level of morale amongst faculty members will eventually translate into poor teaching performances from them as well since they no longer feel motivated enough towards providing good instruction for students enrolled in courses taught by them.

Another consequence of high lecturer turnover rates is increased workloads on existing faculty members as well as administrative staff who must take up additional responsibilities such as finding qualified replacements quickly so courses do not get delayed unnecessarily which would further impact student performance negatively if classes were suspended until new instructors become available (Nawaz & Pangil, 2016). Lecturers must meet higher standards in educational practice (Dong & Mustapha, 2019) and training exceptional lecturers is a critical effort for the development of quality education. Furthermore, this puts extra strain on already limited resources such as budgeting costs associated with hiring temporary personnel while also taking away time from other tasks like research projects or developing innovative curriculums within departments. All these factors combined create an environment where quality instruction suffers greatly due to resources being spread too thin across multiple areas instead of focusing solely on one particular area that needs improvement.

METHODOLOGY

The methodology adopted for this study is a systematic literature review based on PRISMA. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement provides guidance on how to conduct a systematic review by outlining the steps that need to be taken when conducting one. This approach was chosen as it allows researchers to systematically search, appraise, analyse and synthesize the available evidence from published studies related to a specific research question or topic area. The goal of the systematic review was to investigate and synthesize existing empirical studies related to turnover intention of lecturers in public and private universities. A comprehensive search strategy was employed using keywords such as "turnover intention", "lecturer", "public university", and "private university". Empirical studies that are published in Scopus and Google Scholar served as resources for doing the systematic review following PRISMA guidelines recommended by Liberati (2009).

The PRISMA process has phases starting with the identification of literature for review which involved searching two separate databases; screening of the literature; determining eligibility criteria; data abstraction where relevant information was extracted from each eligible article including author name(s), year or publication date, title/topic area etc.; and finally analysis phase which involves synthesis or integration across all included articles into a single narrative report based on their findings.

Inclusion and exclusion criteria

In selecting research articles for a systematic literature review, it is important to have certain inclusion and exclusion criteria. These criteria are used to ensure that the results of the study are reliable and valid.

The first criterion is that all research articles must have an objective related to understanding turnover intentions of university lecturers; if it does not meet this requirement then it cannot be included in the study. Secondly, all papers must come from peer-reviewed journals since these provide higher quality sources than non-peer-reviewed ones due to their rigorous editorial process which ensures accuracy and validity before publication occurs. Thirdly, only studies involving university lecturers can be considered valid sources; limiting participants solely to university lecturers eliminates extraneous variables associated with different professions which could compromise results if taken into account during the analysis phase. Lastly, but most importantly, only articles published between 2016 - 2023 will be taken into account. This is to ensure that only recent information is taken into consideration.

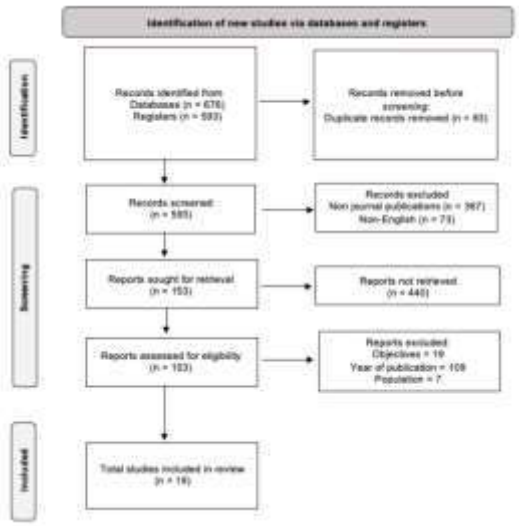

Figure 1: Flowchart of the Systematic Review Process

Table 1: Selection of the Literature Related to Turnover Intentions

Code	**Author**	**Year**	**Title**	**Objective(s)**	**Methodology**	**Participants / Institution type**	**Country**	**Findings**	**Recommendation**
A	Nawaz, M., & Pangil, F.	2016	The relationship between human resource development factors, career growth and turnover intention: The mediating role of organizational commitment	To examine the effect of salary, performance appraisal, training & development, and career growth on turnover intention	Quantitative	Lecturers/Private	Pakistan	Salary, Training & Development, Performance Appraisal, Career Progress and Promotion Speed impact turnover intention	To introduce career development programs for accommodating employee's career needs and also to provide career growth opportunities to satisfy their expectations
B	Saraih, U., Zin Aris, A. Z., Sakdan, M. F., & Ahmad, R	2016	Factors affecting turnover intention among academician in the Malaysian Higher Educational Institution	To investigate the effect of organizational citizenship behaviour (OCB), organizational commitment (OC) and organizational justice (OJ) on academicians' turnover intention	Quantitative	Lecturers/Public	Malaysia	Satisfaction with salary, advancement, distributive justice, and training are related to turnover. Organizational commitment was the only factor that was negatively associated with academicians' turnover intention.	
C	Nair, S., Mee, L. Y., & Cheik, A. N.	2016	Internal push factors and external pull factors and their relationships with lecturers' turnover intention	To examine the impact of three internal push factors--role overload, role ambiguity, and role conflict—and four external	Quantitative	Lecturers/Private	Malaysia	Role overload, role ambiguity, role conflict and external working location have a significant relationship with lecturers' turnover	Clear job descriptions should be given with good compensation packages.

				pull factors—job opportunity, compensation, working location, and university image—on lecturers' turnover intention				intention respectively.	
D	Amani, J., & Komba, A.	2016	Relationship between job satisfaction and turnover intention among lecturers in Tanzanian public universities	To determine the level of perceived job satisfaction among lecturers; To determine the association between job satisfaction and turnover intention; To determine the extent to which lecturers' job satisfaction and turnover intention differ by sex, age and work experience	Qualitative	Lecturers	Tanzanian	Negative relationship between job satisfaction and turnover intention. Male lecturers had a greater intention to leave their jobs than their female counterparts.	Universities should have highly innovative, motivated and productive teaching staff; job satisfaction should be given considerable attention.
E	Rathakrishnan, T., Imm, N. S., & Kok, T. K.	2016	Turnover intentions of lecturers in private universities in Malaysia	To examine the factors determining the turnover intention of lecturers in private universities in Malaysia	Quantitative	Lecturers/Private	Malaysia	Job security, supervisor support, compensation satisfaction, job autonomy, key performance indicators (KPI) achievability, and job satisfaction explained turnover intention.	The management must ensure good relationships among peers, immediate supervisors, job satisfaction as well as pay and benefits.

F	Ramasamy, V.	2017	Faculty's turnover in private higher learning Institutions: A phenomenal inquiry	To explore the reason why faculty resign from their job	Qualitative	Lecturers/Private	Malaysia	Employer image, availability of external job opportunities, social media bullying, unfair performance measurement, unfair compensation, work overload and job insecurity determine turnover rate.	Efforts must be made to address the factors responsible for turnover intentions.
G	Hussain, S., & Ghulam, A.	2017	Job satisfaction and turnover intentions among college faculty in Gilgit-Baltistan, Pakistan	To identify job satisfaction as a predictor of turnover intention among public and private sector college faculty in Gilgit-Baltistan, Pakistan	Qualitative	Lecturers/Private and Private	Pakistan	Job satisfaction was a significant predictor of employees' turnover intention. Participants from the private sector reported a higher level of turnover intention as compared to participants from the public sector. Also, married participants are more satisfied in their jobs compared to unmarried participants.	College administrators, business managers, and other concerned authorities to take possible steps to increase their employees' job satisfaction, so that their turnover intention would be decreased.
H	Manogharan, M. W., Thivaharan, T., & Rahman, R. A	2018	Academic Staff Retention in Private Higher Education Institute--Case Study of Private Colleges in Kuala Lumpur	To discover elements that are able to explain the lower retention rate among academic staff in private college	Qualitative	Lecturers/Private	Malaysia	Task and workload, conflict of role, being underpaid, and other intrinsic factors.	Compensation must be commensurate with workload.
I	Ainer, C. D., Subramaniam, C., &	2018	Determinants of turnover intention in the private universities in Malaysia: a	To investigate the relationship between role ambiguity, work	Quantitative	Lecturers	Malaysia	Role ambiguity, work overload, work-family conflict, co-worker warmth and co-worker	

	Arokiasamy, L.		conceptual paper	overload, work-family conflict, co-workers' warmth, co-workers' competence and turnover intentions				competence, were important factors that determine turnover intentions	
J	Alzubi, Y. Z. W.	2018	Turnover intentions in Jordanian Universities: The role of leadership behaviour, organizational commitment and organizational culture	To investigate the impact of leadership behaviour, organizational commitment and organizational culture on turnover intentions in Jordanian higher educational Institutes	Quantitative	Lecturers/Public	Jordan	Good leadership negatively affects employee turnover intention. Also, organizational culture is linked to turnover intention. Finally, organisational commitment influences employees' turnover intention.	University managers should recognize the behaviour of leadership in particular behaviour that is able to motivate the level of employee commitment to the organization and reduce employee turnover intention.
K	Windon, S. R., Cochran, G. R., Scheer, S. D., & Rodriguez, M. T.	2019	Factors Affecting Turnover Intention of Ohio State University Extension Program Assistants	To investigate the factors that influenced Ohio State University Extension program assistants' turnover intention	Quantitative	Lecturers	U.S.A	Lack of job satisfaction, supervisor satisfaction, and organizational commitment are related to employee withdrawal behaviour.	
L	Hegazy, N.	2019	The Impact of Employee Engagement on Turnover Intention; An Applied Study on The Egyptian Private Universities	To explore the relationships between Employee Engagement and turnover intention empirically in the higher education sector in Egypt	Quantitative	Lecturers/Private	Egypt	Dimensions of Employee Engagement including vigour, dedication, and absorption have a positive effect on turnover intention.	
M	Iornem, K. S	2019	A Comparative Analysis of Job Satisfaction and Turnover	To compare job satisfaction and turnover intentions among Private	Mixed method	Lecturers	Nigeria	Job security, advancement and growth determine turnover rate	

			Intentions Among University Lecturers in Nigeria	and Public University lecturers in Nigeria					
N	Abbas, M., & Iqbal, R	2020	Impact of Job Satisfaction on Employee Turnover Intents: Evidence from Private Universities in Karachi, Pakistan	To identify whether job satisfaction has any effect on the faculty members' turnover intentions in various private universities	Quantitative	Lecturers/Private	Pakistan	Workload, promotion, co-worker support, compensation, student behaviour, and time flexibility have a massive impact on turnover intentions.	If universities handle student behaviour and give the faculty full authority, then universities can expect lower turnover intentions from their faculties.
O	Mohammadi, S., & Karuppiah, P.	2020	Quality of work life and academic staff performance: A comparative study in public and private universities in Malaysia	To explore the relationship between the quality of work life (QWL) of academic staff in universities and how QWL affects their performance.	Quantitative	Lecturers/ Private and Private	Malaysia	Powerlessness and tolerance at the workplace affect performance in public universities, while dimensions of financial, co-worker relationships and tolerance at the workplace have a positive significant relationship with performance in private universities.	Since public organizations have a high level of bureaucracy; these programs or strategies should increase autonomy at different levels of the organization to reduce powerlessness. It is important to enhance the level of salary and other financial benefits for academic staff to improve their work performance
P	Mgaiwa, S. J.	2021	Academics' job satisfaction in Tanzania's higher education: The role of perceived work environment	To examine the relationship between Tanzanian academics' perceived work environment and their job satisfaction	Quantitative	Lecturers/Private and Public	Tanzania	The results demonstrated that academic freedom, participative decisions, teamwork, supervision, and resources statistically significantly predicted academics' job satisfaction over and above their marital status,	It proposes distinctive, accommodating, and desirable work environments that will make everyone enjoy and feel fulfilled by their jobs.

								gender, age, academic rank, and institutional type.	
Q	Septriyan, O	2022	The moderating role of perceived organizational support on the relationship between job satisfaction and turnover intention among academic staff of private universities in Malaysia	To examine the predictive role of job satisfaction on turnover intention, and to highlight the moderating role of perceived organizational support on the relationship between job satisfaction and turnover intention among academic staff for private universities in Malaysia.	Qualitative	Lecturers/Private	Malaysia	Job satisfaction and organizational support have positive relationships	Job structure, environment, autonomy, or flexibility to improve the employees' job satisfaction and to decrease turnover intention
R	Jing, Z., & Photchanachan, S.	2022	Influence of Development Environment Satisfaction on Turnover Intention of Young Doctoral Lecturers in Universities in Mianyang, China	To study the influence of young doctoral lecturers' development environment satisfaction on their turnover intention.	Quantitative	Lecturers/Public	China	Organizational commitment has a significantly negative influence on turnover intention.	Universities should make more efforts to improve the working environment and increase their satisfaction to stabilize talents and achieve the mutual development of young doctorate teachers and universities.

Data Abstraction and Analysis

For the analysis of the articles deemed to be eligible for this study, thematic analysis was adopted. Thematic analysis is a powerful tool for investigating qualitative data. According to Braun & Clarke (2006), there are stages of thematic analysis that should be followed in order to draw meaningful conclusions from the data. The first step taken was the familiarisation with the data, which involves reading through it carefully and noting the patterns or themes that emerge naturally from the material. The second step was the creation of initial codes, which involved assigning labels or categories to various pieces of information within the text so they could be easily identified during the review and synthesis stages.

The third stage involved compiling the codes into larger themes by looking for connections between different pieces of information across multiple sources; this helped to identify trends in the research materials more quickly than if they were simply reviewing each piece individually without considering its context within a broader

pattern or theme. Fourthly, there was a re-check for each of the themes against the coded extracts before proceeding further. This ensured accuracy and consistency throughout all the analyses. Finally, came the writing up of the report based on those named themes while connecting them back towards the research questions.

RESULTS AND DISCUSSION

The results of the review are presented in this section as answers to the research objectives.

Table 2: Characteristic of the Literature Selected

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	TOTAL
CP	√	√		√		√	√	√	√	√	√	√	√	√	√		√	√	**15**
JAD	√	√		√								√	√						5
JI	√	√			√	√	√						√						6
JA					√														2
KPI	√				√	√													3
CWS									√		√			√	√				4
OS		√			√					√							√	√	5
SB														√					1
TF																√			1
RF	√			√			√		√					√					5
DJ		√																	1
EI						√													1
EJO			√			√													2
PD																√			1
TD	√	√																	2
RA			√						√										2
RC			√					√	√										3
RO			√			√		√	√			√		√	√				7

Compensation - CP
Job Advancement - JAD
Job Insecurity - JI
Job Autonomy - JA
Key Performance Indicators – KPI
Co-Worker Support – CWS
Org./Supervisor Support - OS
Student Behaviour - SB
Time Flexibility - TF
Limited Research Funding - RF
Distributive Justice - DJ
Employer Image - EI
External Job Opportunities - EJO
Participative Decisions - PD
Training & Development - TD
Role Ambiguity - RA
Role Conflict - RC
Role Overload - RO

Table 2 identifies fifteen distinct factors which have been found to contribute to turnover intent among lecturers. Of these, the most commonly cited were Compensation (CP) and Role Overload (RO), each appearing in 15 and 7 pieces of literature respectively. Job Advancement (JAD), Job Insecurity (JI), Organisational and Supervisor Support (OS), and Limited Research Funding (RF) also appeared frequently at 5, 6, and 5 pieces respectively.

Factors Affecting the Turnover Intention

The turnover intentions of private university academics have been found to be higher than those of public universities. This is due to a variety of factors, including lack of advancement and job insecurity. Private university faculty are often faced with limited opportunities for professional development, as well as less job security. These issues can

lead to increased levels of stress and dissatisfaction among private university academics, which can ultimately result in an intention to leave their current position or institution altogether.

The lack of career progression opportunities within the structure at many private universities has contributed significantly towards the high rate at which faculty members intend on leaving their positions or universities altogether. Faculty members may feel that there is little room for them to advance professionally if they remain employed by the same institution; this could potentially cause them more frustration than satisfaction from working within such an environment over time, leading them down a path towards wanting out entirely instead staying put and continuing with their work there indefinitely.

The literature reviewed also revealed that married lecturers are less likely to quit their jobs as compared to unmarried lecturers. This is true for both private and public sector lecturers, with those from the private sector reporting higher levels of turnover intention than those from the public sector. The findings indicate that marriage may be an important factor in determining employee loyalty and commitment, with married individuals being more likely to remain in their positions over a longer period of time.

Recommendations for Curtailing Turnover Intention

The intention of lecturers to leave their current jobs is an important factor that has been studied in the literature. It is a complex issue, with many factors identified as contributing to this phenomenon. In both private and public sectors, compensation, job advancement opportunities, job insecurity, job autonomy and key performance indicators have all been identified as potential causes of turnover intentions among lecturers.

Compensation can be seen as one of the major drivers for turnover intentions among lecturers in both private and public universities. If they feel underpaid or not adequately compensated for their work, then it may lead them to look elsewhere for better pay or more suitable working conditions which could eventually result in them leaving their current positions altogether. This is consistent with the findings of Rathakrishnan & Siew (2016), in that lecturers' turnover intentions are related to reward, recognition, and work conditions. Job advancement opportunities are also highly influential when it comes to determining whether a lecturer will stay with a particular institution or move on. If there are no clear pathways available within an organisation, then, this can cause frustration amongst staff who wish to progress further within their careers but cannot do so due to limited options available from where they currently stand.

Job insecurity is another aspect which contributes significantly towards lecturer's decisions regarding staying put at a university or looking elsewhere. If they feel uncertain about future prospects such as salary increases or decreases, then, this could lead them to seek alternative employment options rather than remaining with the same employer over time despite any other benefits associated with doing so (such as good relationships established). Similarly, job autonomy plays its part too. Feeling restricted by management policies might make some individuals think twice before continuing down certain paths due to the lack of freedom experienced while carrying out duties assigned by superiors. Key Performance Indicators act similarly here too since these provide quantifiable measures against which individual performance can be judged, thus providing yet another reason why some people might decide against sticking around long-term even though other aspects may appear favourable overall.

Co-worker support is essential for lecturers as it allows them to feel like they have a team working with them towards common goals. When colleagues do not provide adequate assistance or appreciation of each other's efforts, it can cause feelings of isolation which can lead to an increased desire for change amongst lecturers. Similarly, when supervisors fail to provide appropriate levels of guidance or recognition, this too can contribute significantly towards lecturer turnover intentions as employees may perceive their work environment as unsupportive or hostile in nature. Because of this, training and development programmes need to place a greater emphasis (Koon, 2018) on the unique qualities and concerns of these lecturers.

Student behaviour also plays an important role in determining whether a lecturer will wish to stay at their current place of employment or move on elsewhere. If students display disruptive behaviours such as a lack of respect for authority figures, then this could be seen by some staff as detrimental enough that they would seek alternative job opportunities where they might receive better treatment from students who understand what is expected from them within educational settings. Time flexibility is another factor which contributes significantly towards employee attrition rates. If lecturers do not feel like they are given sufficient freedom over how long they spend teaching certain topics, then this could eventually erode their motivation, causing many individuals to look elsewhere for more suitable jobs instead of staying put. This is despite any potential financial benefits associated with remaining employed same institution. This is due to the fact that lecturers see their job roles as being relative to the values (Priya et al., 2017) that are associated with the university. Finally, limited research funding available at higher institutions of learning also has a significant impact on whether certain academics decide to remain within the same company. Without access

to funds necessary to carry out meaningful studies into areas of interest, researchers may consider leaving the organization in order to pursue projects elsewhere, where resources more readily available.

Distributive justice refers to how fairly resources such as salary or recognition are distributed among employees within an organization. If lecturers feel that they have been treated unfairly compared to their colleagues, then this can lead them to consider leaving for another job opportunity where they may receive better treatment or more attractive compensation packages. Employer image also plays a part in turnover intentions. If the reputation of an institution is poor due to low student satisfaction ratings or negative press coverage, then it could make potential new hires less likely to accept roles there leading existing staff members who want career progression elsewhere to look for other options too.

External job opportunities can also be influential when considering whether someone will stay with their current employer. If suitable alternative positions become available, which provide greater financial rewards or chances for promotion than what is on offer at the present place, then, this could tempt people away from staying put regardless of any internal issues like those mentioned previously being present at work. Participative decision-making allows individuals input into organizational matters which helps create feelings of ownership over outcomes. So, lack thereof might cause dissatisfaction amongst personnel while inadequate levels of training and development often result in low morale because without proper instructions, workers are not able to perform tasks effectively. This reduces productivity levels further, compounding discontentment. Role ambiguity, role conflict and role overload all contribute towards employee burnout through placing excessive demands on individuals with no clear indication as to exactly what duties should be undertaken leading them to feel overwhelmed and to be unable to cope adequately, resulting in an increased likelihood of resignation soon after.

The literature review on turnover intentions in both private and public universities has identified several recommendations to reduce the occurrence of employee turnover. First, the literature suggests that organizations should focus on improving job satisfaction among their employees. This can be accomplished by providing competitive salaries and benefits, offering career development opportunities, creating an environment of trust between management and staff members, encouraging open communication between all levels within the organization, and recognizing good performance with rewards or recognition programs such as bonuses or promotions for high-performing employees.

CONCLUSION

Overall, it can be concluded that there is no single factor responsible for determining an individual lecturer's intention to leave his or her job at a public or private university. Rather multiple elements need to be taken into consideration when assessing this issue. The results from this systematic review provide useful insights into how universities may approach managing staff retention by taking steps towards improving employee engagement levels and addressing any issues surrounding workloads and career progression opportunities which could potentially lead them away from their current positions within higher institutions of learning.

AUTHOR BIOGRAPHY

Sean Calvin Shin Ching Yong is a branding practitioner and certified trainer. His academic interests are brand identity, brand management, consumer behaviour and organizational culture. He is currently pursuing PhD in Education at Infrastructure University Kuala Lumpur, Malaysia. *Email: sean@intown.com.my*

Siti Maziha Mustapha, PhD is a Professor and researcher in the Faculty of Business, Information and Human Sciences of Infrastructure University Kuala Lumpur. She is an expert in education management, leadership, teaching and learning. *Email: maziha@iukl.edu.my*

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A REVIEW ON ANTECEDENTS OF IMPULSE PURCHASE BEHAVIORS IN LIVE STREAMING COMMERCE

Jing Zhou[1,2,] Mooi Wah Kian[1] & Chan Sai Keong[1]
[1]*Infrastructure University Kuala Lumpur, MALAYSIA*
[2] *Faculty of Foreign Languages, Jingchu University of Technology, CHINA*

ABSTRACT
Online impulse purchasing has been a topic of constant research interest due to the widespread use of e-commerce and social commerce. However, with the rapid advancement of information technology, new forms of e-business, such as live streaming commerce, has emerged. Despite the growing popularity ofive streaming commerce, there is a limited research on the impulse purchasing behavior in this context. To consolidate and synthesize current findings on it, this paper reviews publications from 2018 to 2023. The study adopts a stimulus-organism-response framework to classify the influencing factors on the impulse purchasing behavior. The findings suggest that a survey-based research and a stimulus-organism-response theory are among the primary research methodology and theory used in this field. Antecedents are categorized into three main groups: streamer-related, platform-related, and marketing-related stimuli. The paper presents the framework and provides recommendations for future research. This review contributes to the literature on the impulse purchasing behavior in live streaming commerce and provides guidance for practitioners seeking to engage consumers in this context**.**

Keywords:
impulse purchase, live streaming commerce, systematic review, stimulus-organism-response

INTRODUCTION

Impulsive buying behavior refers to the behavior of consumers who, without premeditation, develop strong desires to buy due to certain stimuli, and eventually make purchases (Abdelsalam et al., 2020a). With the rise of live streaming e-commerce, more and more consumers are doing their shopping through the live streaming platforms (Lun et al., 2021). In this context, studying consumers' impulsive buying behavior is of a great significance for the development of live streaming e-commerce. By deeply understanding consumers' impulsive buying behavior, more accurate marketing methods can be provided for the platform, user experience can be optimized, sales efficiency can be improved, and the development of live streaming e-commerce can be promoted (Lou et al., 2022). However, most research on live streaming e-commerce focuses on user participation and viewing, and very few studies have been devoted to studying consumers' impulsive buying behavior (Zuo & Xiao, 2021). The prevalence of the online impulse purchases and the lack of sufficient research attention in the context of live streaming commerce have been reported in the literature ((Lin et al., 2022; Lo et al., 2022; Lou et al., 2022; Zhang et al., 2022). To address the gap, the present study aims to consolidate and synthesize existing literature on the impulse purchase behavior in live streaming commerce, adopting a stimulus-organism-response framework, in an attempt to formulate a framework depicting the antecedents of impulse purchase. It is important to study impulse purchase behavior in this new context to better understand the drivers of the impulse purchases and to develop effective marketing strategies.

The findings of this study provide insights for marketers, brands, businesses, and other stakeholders in live streaming commerce and highlight the need for further research to keep up with the rapid advancement of technology. The study aims to answer the following questions:

1) What are the research trends and focuses?
2) What are the research methodologies, context and samples?
3) What are the antecedents of the impulse purchase in live streaming commerce

LITERATURE REVIEW

Impulse Purchase

Stern (1962) proposed that impulse purchase refers to a compelling, unplanned and a hedonically complicated purchase. Rook (1987) defines it as a sudden and strong, persistent urge to buy something at the spot. In the early stage, the significant features of impulse purchase are unintended, unreflective and spontaneous (Beatty & Elizabeth Ferrell, 1998; Stern, 1962). Later, scholars extended the definition by claiming that impulse purchase is a result of external stimuli (Chih et al., 2012; Vonkeman et al., 2017). The characteristics of an impulse purchase can be summarized into several categories. First, in contrast with a planned purchase, the impulse purchase behavior is often unplanned. Consumers do not have a pre-determinized intention to buy a specific product until they conducted buying behavior. Secondly, the time of decision making is often rapid and swift, oftentimes it is decided on the spot. Thirdly, the impulse purchase does not involve cognitive reaction from a consumer, in other words, it is often unreflective. The consumer rarely considers the reasons of buying or the consequences of purchase. Fourthly, such a behavior accompanies a strong urge to buy products immediately and involve an affective reaction which usually is hedonic. Lastly, the most recent research proposed that the impulse purchase behavior is a result of an extrinsic and intrinsic stimuli in the shopping context.

The most widely acknowledge types of the impulse purchase include pure impulse buying, reminder impulse buying, suggestion impulse buying and planned impulse buying (Stern, 2012). Pure impulse buying takes place when consumers making a purchase solely based on emotional turbulence instead of exposure to stimulus. For instance, when a consumer attempts to try some novel products or he/she wants to break a shopping pattern. This reminder impulse purchase happens when a consumer is being exposed to advertisements in a store and recalls the need to buy the product, perhaps because of low stock of that product. This group is often observed with sales promotion. The third type is the suggestion impulse buying. An individual may purchase products that recommended by friends or salesperson, although with no prior shopping intention, but the recommendation can trigger consumer's awareness of developing needs. The last type is planned impulse buying. Here, buyers often have a pre-determined shopping list before entering the store, but due to the random promotion campaign and other in-store stimuli, consumers purchased more than expected and planned.

Stimulus-Organism-Response Theory

Stimulus-Organism-Response (SOR) theory posits that an individual's cognitive and affective reaction are determined by external and internal environmental factors, further influencing a person's response towards such cues (Y. Y. Lee & Gan, 2020). Stimulus refers to factors that induce consumer's to buy a product or service, which yield significant influence on a person's cognitive state (normative evaluation, perceived usefulness, interactivity) and affective state (enjoyment, pleasure, trust etc.,), resulting avoidance or acceptance behavior. SOR framework is adopted for several reasons. Firstly, the model has been applied to analyze consumer's behavior in retailing for a long time. Secondly, impulse purchase behavior occurs due to the presence of situational factors. In live streaming commerce, these triggers have multiplied due to the application of new technology and new elements, such as streaming technology and streamers. Therefore, the selection of SOR theory has been justified.

RESEARCH METHODOLOGY

The purpose of the study is to review papers which help to gain insights into the consumer's impulse purchase behavior in live streaming commerce. Hence, to ensure the relevance of the reviewed paper, we selected English journal papers and conference proceedings between 2018 to 2023, the selection of the time duration is justified because live streaming commerce emerged in 2016 and have gained popularity since, the term live streaming commerce first appeared in literature in 2018 (Cai & Wohn, 2019). Keywords searching is employed to identify relevant publications in major academic databases including Googlescholar, Researchgate, Web of Science, Scopus etc. To incorporate more literatures and ensure the accuracy of review article, different phrases of similar meaning are used, namely "impulse purchase, impulsive purchase, impulse buying, online impulse buying, live streaming shopping, live streaming commerce, live stream commerce." The selection involves inclusion and exclusion criteria, only studies with empirical results can be incorporated. Sample size should be more representative to improve the reliability of the study (Xiaoxuan & Kian, 2021). However, since the studies pertaining to impulse purchase in live streaming commerce are still scarce, only thirteen full-text English paper with empirical findings are identified and selected.

DISCUSSIONS

The study reviews an extensive of the impulse purchase literature in the context of live streaming commerce from the following aspects. The first part discusses the general trends and focus on the impulse purchase studies. Secondly, the research methodology is examined. Thirdly, the research context and sample are sorted accordingly. Lastly, the antecedents of the impulse purchase are categorized in a systematic manner.

Overview of Research Trends and Focus

In general, the number of studies on the impulse purchase has been growing steadily recently. With the development of information technology and communication, the merge of e-commerce and social commerce has driven the increase of studies on online impulse purchase behaviors. However, despite the growing interests, the field of live streaming has been overlooked until recently. A noticeable trend has been detected that digital celebrity relationship with impulse purchase has begun to draw academic research attention (Zhou et al., 2022).

Overview of research methodology, context and sample

The primary research methodology employed by extant literature pertaining to the impulse purchase involve quantitative research. Live streaming consumers are selected and surveyed via questionnaires. Most research on impulse purchase in live streaming commerce do not stress the specific product context, unlike most online impulse purchase in other research context, which may suggest a future research gap. In terms of the sample, it is noticed that the primary source of sample is from Asia region, and majority of the study sample are selected from the China context. It could be due to the surge of live streaming platforms in China, and the fast development of live streaming commerce, especially during the phase of covid-19 pandemic. Diverse samples from different culture and background are called for to gain a more holistic understanding in impulse purchase domine. It was found that the prevalent theories are stimulus-organism-response (90%), other popular theories include social presence theory (J. Chen et al., 2021; Ming et al., 2021; Zhang et al., 2022), parasocial interaction theory (T. Y. Chen et al., 2021), flow experience theory (Vazquez et al., 2020), cognitive emotional theory, affordance theory and motivational theory. (Sun et al., 2019; Xie & Luo, 2021a).

ANTECEDENTS OF IMPULSE PURCHASE BEHAVIORS

Streamer-related stimulus

Streamer-related stimulus remains a heat research topic among impulse purchase behaviors. Studies have proposed that characteristics of streamer or hosts can positively affect consumer's impulse purchase (T. Y. Chen et al., 2021). For instance, physical features such as attractiveness can positively influence viewer's impulse buying (C. H. Lee & Chen, 2021). The extent to which consumers place trust towards the streamer's expertise is positively related to impulsive purchase. In addition, many studies stress the relationship formed between streamers and viewers, such as interpersonal relationship (Huang & Suo, 2021a), para-social interaction relationship (Li et al., 2021), attachment towards streamers, presence of streamers in a streaming event, which are found positively related to impulse purchase behaviors.

Platform-related stimulus

Platform-related stimulus refers to features of live streaming commerce operators that influence buyer's impulse purchase. With the proliferation of live streaming commerce platforms, e-retailors are constantly modifying platform features to improve consumer's shopping experiences, for instance, visibility, visual appeal, telepresence, purchase convenience can trigger impulse purchase directly or indirectly in live streaming shopping. Visibility is positively associated with impulse purchase (Xie & Luo, 2021 ; Li et al., 2021). In the context of live streaming commerce, shopping via real time video can be regarded as a social activity accompanied with virtual community. The streaming technology allows viewers to post, read simultaneously other viewer's comments and remarks, which often carry their opinion regarding the recommended products by the streamer. Therefore, the presence of viewer can have positive influence on impulse purchase intention (Ming et al., 2021).

Marketing-related stimulus

Traditional marketing strategies are widely used and are found equally effective in promoting consumer's impulse purchase intention. Product availability, scarcity, vicarious expression, and aesthetic appeal are found to trigger impulse purchases. (Abdelsalam et al., 2020a). Y. Chen et al. (2019) insert that product-related signals, namely vicarious expression and aesthetic appeal can affect consumer's impulse buying indirectly via trust and affection. When consumers are exposed to the marketing related stimulus in a live streaming event, for instance, or when sellers offer price promotion in a limited quantity of time, consumers are likely to buy recommended products out of their impulsive urges (Li et al., 2023a, 2023b). Akram et al., (2018) posit that when consumers are offered with a limited amount of products and time, consumers are more inclined to purchase impulsively.

Mediating factors of impulse purchase behaviors

It is imperative to study the direct correlation between two variables, but it is also necessary to look into the mediating mechanism of any variable correlation. The impulse buying behavior can be influenced by various mediating factors, including perceived usefulness, perceived enjoyment (C. H. Lee & Chen, 2021), perceived risk (Wu et al., 2020), utilitarian motivation and hedonic motivation (Zheng et al., 2019), trust (Wongkitrungrueng & Assarut, 2020). Perceived usefulness refers to the degree to which a consumer believes that using a particular product or service will enhance their performance or productivity. Perceived enjoyment refers to the degree to which a consumer enjoys the buying process. Research has indicated that perceived usefulness and enjoyment has a positive impact on impulse buying behavior (C. H. Lee & Chen, 2021; Zuo & Xiao, 2021).

Hedonic motivation refers to the desire to achieve emotional or sensory pleasure through a purchase decision. Utilitarian motivation refers to the desire to achieve practical or functional goals through a purchase decision (Zheng et al., 2019). Trust denotes the belief that a seller is reliable, competent, and has the consumer's best interests at heart (Yan et al., 2022). Perceived risk is characterized by the uncertainty and potential negative consequences associated with a purchase decision (Huang & Suo, 2021b). It has been found to have a negative impact on impulse buying behavior.

Overall, the literature highlights the complex and interdependent relationships between perceived usefulness, perceived risk, utilitarian motivation, trust, perceived enjoyment, and hedonic motivation with impulse buying behavior. These factors give impacts on the impulse buying behavior and may be moderated by each other and other contextual factors, such as the buying environment, product characteristics, and consumer demographics. Future research is needed to gain a better understanding of the underlying mechanisms of these relationships and develop effective strategies for managing impulse buying behavior.

Measurement of impulse purchase behaviors

Urge to buy impulsively, impulse purchase behavior, impulse buying decision, and impulse purchase intention are some of the key concepts used to measure impulsive buying behavior. Urge to buy impulsively refers to the sudden desire or impulse to make an unplanned purchase (C. H. Lee & Chen, 2021). It is a state of mind that triggers the impulse buying behavior. Impulse purchase behavior, on the other hand, refers to the act of purchasing a product spontaneously without any prior planning or intention (Abdelsalam et al., 2020b). The impulse buying decision is the cognitive process that follows the urge to buy impulsively and results in the actual purchase (Huang & Suo, 2021b). Finally, impulse purchase intention refers to the intention to purchase a product impulsively (Xie & Luo, 2021a).

Overall, the study of urge to buy impulsively, impulse purchase behavior, impulse buying decision, and impulse purchase intention is important for understanding consumer behavior and marketing strategies. By understanding the factors that influence these concepts, marketers can design effective strategies to encourage impulsive buying behavior and increase sales. Figure 1 presents the summary of antecedents and mediating factors of impulse purchase studies in the context of live streaming commerce.

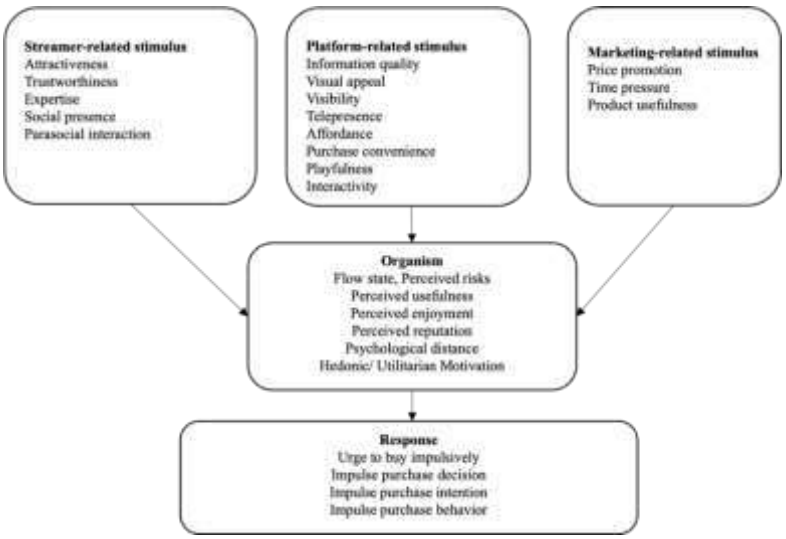

Figure 1： Overview of Influencing Factors on Impulse Purchase in LSC

CONCLUSIONS AND LIMITATIONS

The study aims to provide a holistic review of a study pertaining to the impulse purchase behavior in the context of live streaming commerce, which has received insufficient research interests due to the fast advancement of a new telecommunication technology. Through a systematic review of thirteen relevant journal papers, the study constructed a framework of antecedents of impulse purchase behavior in live streaming commerce based on the Stimulus-Organism-Response framework. Findings suggest that streamer-related, marketing-related, platform-related external stimulus can directly or indirectly lead to consumer's propensity of impulse purchase. Some actors can mediate the relationship between the abovementioned stimuly and impulse purchase behavior. The primary methodology employed in impulse purchase literature is a survey questionnaire. Based on the conclusions, consumer behavior in live streaming commerce has gained popularity, however, there is a lack of empirical studies regarding the new way of shopping. Future studies may consider conducting more empirical research. Secondly, despite the growing interest in the impulse purchase behavior, the mechanism of how streamer-related situational factors affect consumer's impulse purchase remains underdeveloped. Moreover, more diverse perspectives are called for to examine impulse purchase behavior in live streaming commerce. The study's insights can assist live-streaming e-commerce operators and other business stakeholders in developing effective marketing strategies.

AUTHOR BIOGRAPHY

Zhou Jing is a PhD candidate in Business Administration in IUKL. Her current research interests are on the topics of social commerce, live streaming commerce, impulse purchase, consumer behaviour and social marketing. She works as a Business English lecturer in Jingchu University of Technology, Hubei, China. *Email: zhoujing@jcut.edu.cn*

Mooi Wah Kian, PhD. is a senior Professor in Infrastructure University Kuala Lumpur (IUKL) and Masha University. His current research interests include consumer buying behavior, e-commerce marketing.

Chan Sai Keong, PhD. is the Dean for Faculty of Business, Information and Human Sciences, Infrastructure University Kuala Lumpur (IUKL). He received the B.A degree (Media Studies) from Universiti Malaya, the MBA degree (Marketing) from Universiti Putra Malaysia and the Doctorate degree (Marketing) from Universiti Teknologi Malaysia. His current research interests include ecological behaviour and beliefs, technology acceptance, e-commerce and influencer marketing.

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FLEXURAL CRACKS OF THE REINFORCED CONCRETE (RC) WITH THE ADDITION OF COCONUT FIBERS

Mohamed Emierul Qazzarul Khair Johari, Moaz Ghaiebeh & Syafiq Abdullah
[1] *Infrastructure University Kuala Lumpur, MALAYSIA*

ABSTRACT

In this study, the behaviour of flexural cracking in the highly reinforced concrete of the concrete beams of was examined. Investigations were conducted on 27 reinforced concrete beams with the dimensions of 150x150x500mm. The concrete strength is 25 map, with the bar diameter 12 mm in the tension and compression zone, and 8 mm for the links stirrups were the factors examined in this work. In between each link the length is 10 mm. In this study, the coconut fibres are used to strengthen the concrete's flexural properties and to control the cracks in the reinforced concrete members from spreading. In addition to the coconut fibres, the coconut fibre-reinforced concrete also contains cement, fine, water, and coarse aggregate. In this experiment, the flexural cracking behaviour of the reinforced concrete beams with varying percentages of the coconut fibres (3 and 6%) is compared to the control sample, at 7, 14, and 28 days. The beams are tested for the third-point loads. To assess the flexural cracking behaviour of the concrete beams, factors such as the first cracking load, maximum crack width, and crack number are also examined. The outcomes demonstrate that the inclusion of the coconut fibres greatly reduces the flexural crack width. After 28 days of cure, the concrete with a 6% fibre content had 68% smaller maximum crack width than the control concrete (without fibre). The outcomes also demonstrate that the inclusion of the coconut fibres increases the initial cracking load and maximum load.

Keywords:
Coconut fibers reinforced concrete (CFRC), flexural strength, flexural cracks, crack width, first crack load

INTRODUCTION

Many nations are looking for an affordable way to cut building expenditures as the economic growth is accelerating. Concrete serves as the major building material and is crucial to the development of structures like buildings, bridges, retaining walls, etc. According to a report published in 2022, the world's expected cement production for 2020 was 4.4 billion metric tons (Lim et al., 2020). The natural fibre that can be used for the building includes fibre that goes by other names, such as Coir fibre. Depending on the use, many types of fibres can be utilized, however brown fibre from natural coconut is typically used. Fibres are used to stop and restrict shrinkage caused by the curing of concrete and plastic. The addition of fibres to concrete may enhance the material's various qualities, including flexural toughness, flexural strength, fatigue resistance, impact resistance, and post-crack strength, provided that more studies and research development to be conducted (Behbahani., 2010). Besides that, there will be a failure if the structure of the beam column is a problem. According to Norhaiza & Zulhelmi (2023), a new approach in the structural design is required to avoid structural failures from occurring at the beam-column connection.

The unreinforced concrete cracks extensively and fails unexpectedly under stress. Concrete is typically reinforced with steel rebar. In the majority of the developing nations, is the process is pricey. Natural fibres are widely available in the tropical areas and when they are used, it will lower the price of the reinforced concrete and enhance its performance (Adisa et al., 2013). For the concrete structures to be designed correctly, the research on crack development behaviour in concrete under increasing loads and control of cracking becomes important. At active loads cracks form in the reinforced concrete members, if it is caused bythe cracks, it cannot be removed. At this point, it is accepted. The concrete is weak in tension, and that is why the reinforcement is added to the flexural concrete member's tension

zone to withstand the tensile force generated by the load applied (Mansor, 2014) Having that scenario, it is utilised in the construction all over the world. The concrete is a necessary the component of the buildings. The cost of the project will increase when more reinforced bars are incorporated into the design since reinforced bars are used in the majority of projects to ensure stability and safety because concrete has low flexural and stress resistance (Syed et al., 2020). Moving on to the concrete's physical performance, cracks can be seen in the concrete one day after casting. In certain circumstances, these fissures could enlarge over time. Wider cracks not only detract from the structure's aesthetics but also expose the steel reinforcement to the elements, which can lead to the corrosion.

This study is an experimental works which concentrating on the flexural behaviour of cracks in the reinforced concrete is to determine the value of the first crack load that occurs under the flexural test. Secondly, it is also to study the maximum crack width and the number of cracks in the flexural zone. Finally, it is to determine the maximum flexural strength of the reinforced concrete beam with the addition of the coconut fibre until it causes a failure. Besides that, one experiment includes coconut fibres with CFRC reinforced concrete in varying percentages to determine the flexure strength test on steel beam mold. In this study, 27 samples were created using various percentages. Three beams were used for each percentage, and the curing time are 7, 14, and 28 days. At the lab of Infrastructure University Kuala Lumpur (IUKL), all research testings are conducted. Overall, a realistic goal is to assess crack number, crack width, and the first crack that develops on the reinforced concrete beam.

LITERATURE REVIEW

Concrete is made up of cement paste, a cement and water mixture that acts as the binding agent, and aggregate of various sizes that are normally divided into fine (sand) and coarse categories (typically crushed stone or gravel). The filler, which makes up a greater portion of concrete and is a bulky aggregate that is less expensive than cement, Concrete's constituent materials come from stone that has been cast, rebuilt, or replicated. Concrete must be distinguished from stone as a distinct material with very differing durability, weathering, and maintenance needs (Karasin et al., 2014).

Concrete has high compression strength but poor tension strength. To be utilised in the construction, concrete is mixed with a material that has a high tensile strength. The oldest and most popular method is using steel to combine or strengthen concrete. In the reinforced concrete constructions, steel and concrete interact to allow the former to endure the compressive pressures and the latter to withstand the tensile stresses. Concrete typically cracks due to the brittle failure, which occurs abruptly and without warning. Steel has a more ductile behaviour, and when it is combined with concrete, it creates a composite material that can withstand more deformations before breaking (White G, 2013). According to Mohamed Eliwa & Mohamad Ayob, 2020, To create a safe and suitable environment design, the construction waste materials must result positively in the future innovation. A study by Norul Wahida, et. al, 2023, mentioned that, the laterite could aggregate as a normal aggregate in replacement in concrete mix. This shows that not only waste materials is being approached but many other materials are also possible.

A coconut fibre is one of the top fifteen plants and animal fibres in the world. The coconut fibre has a long history of use. After being employed for the first time in late 19th-century inventions, the coconut fibres are currently used to make a large variety of goods. More than 25 distinct products, such as ropes, beds, toothbrushes, and seatbelts, can be made from coconut fibres (Thu & Bui., 2021). The main advantages of attempting to modify the performance of concrete by adding fibres are to improve the plastic cracking characteristic of the material in the fresh state or up to about 6 hours after casting, to improve the tensile and flexural strength, to improve the impact of strength and toughness, to control cracking and the mode of failure using post-cracking ductility, to improve durability, and to improve the impact of strength and toughness (Bertelsen et al., 2020).Figure 1 shows the image of the coconut fruit layer in general, and the image is taken from Thu & Bui, 2021

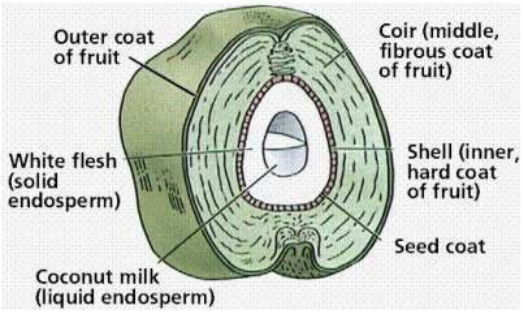

Figure 1 Coconut Fruit Layers (Thu & Bui, 2021)

Ali et al. (2012) examined the mechanical and dynamic properties of the coconut fibre in the reinforced concrete using data from earlier studies. The examination on the mixture levels of 1%, 2%, 3%, and 4% of CF by cement mass as well as fibre lengths of 2.5, 5 and 7.5 cm. According to the findings of the experiment, the features can vary and the strengths of CFRC can differ from those of conventional concrete depending on the length and composition of the fibres. The experimentation demonstrate that the concrete's flexural strength may be greatly increased by adding coconut fibres in all circumstances (Ali et al., 2012). This failure scenario occurs when the loads on the beam are larger than its bending moment. Failure mode occurs prior to flexural failure if the beam's shear strength is lower than its flexural strength (Sowik, 2019). The tructure cracks are described as the whole or partial division of a concrete structure into two or more parts as a result of cracks. Both during and after construction, cracks are indicators of structural movement (Zanke, 2020). Such movement is constant, and it frequently goes undetected because of its small size. Any type of construction with cracks loses structural integrity and safety in a specific way. The structural integrity and durability of a building are also weakened and compromised by cracks. According to S, 2018 the reasons for cracks that manifest as a result of the deterioration of concrete and corrosion reinforcement bars include unstable land selection, poor construction practices, inappropriate selection of constituent materials, shrinkage, and temperature impacts (S, 2018).

METHODOLOGY

This chapter details the experimental programmer used in this work. These details include information on the beam specimens, the materials used, and the preparation and testing procedures. The third point test was utilized to load 27 specimens of simply supported beams during the study's flexural testing. This test was used in order to determine the cracks determination. This is necessary to ensure the objectives of the study were achieved.

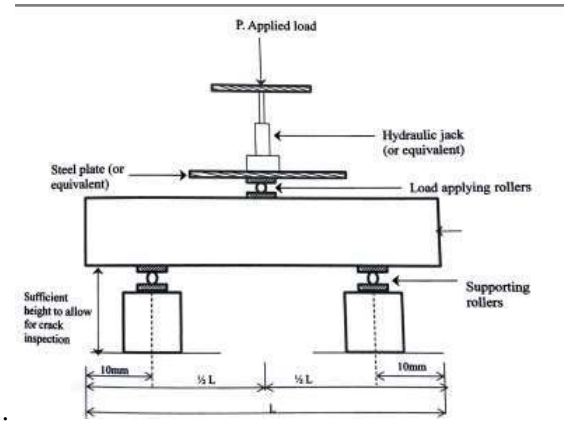

Figure 2: Third Point Loading Flexural Strength

Table 1 shows the experimental data such as test name, number of samples, percentage of fibre s and curing days.

Table 1: Mould Preparations of the study

Coconut fibre % (CF)	**Flexural test sample**			**Slump test**
	7 days	14 days	28 days	-
Control sample (0% coconut fiber)	3	3	3	1
Sample 2 (+3% coconut fiber)	3	3	3	1
Sample 3 (+6% coconut fiber)	3	3	3	1
Total samples	27			3

In this study, the BS8110 standard is used to provide the reinforced concrete design. The beam measures 150 x 150 x 500 mm, has 2T12 longitudinal bottom (tension) steel reinforcement in all beams, and top bars are still required to complete the reinforcement cage. The stirrup links are 8 mm in diameter and spaced 100 mm apart (design of Reinforced concrete beam shown in Figure 2). According to BS 8110: part 3: 1985, the nominal cover is 25 mm, and the characteristic strength of the reinforcement is fy = 460 n/mm2. The beam's dimensions and reinforcing details are shown in Figure 2.

The mixing process started with fine aggregates and cement are thoroughly combined to create a uniform mixture. The coconut fibre was added to the mixture until a certain uniform colour was achieved. The same mixture is combined with coarse aggregates, and water is added after that. To stop the bleeding care must be made to give water gradually at key points (Bui et al., 2017). Figure 3.2 shows the procedures in a specific time and material amount. All concrete ingredients are placed in a concrete mixer to get better blending if it's working, if not all mixing works will be done manually.

Figure 3: Beam mould 150 x 150 x 500m

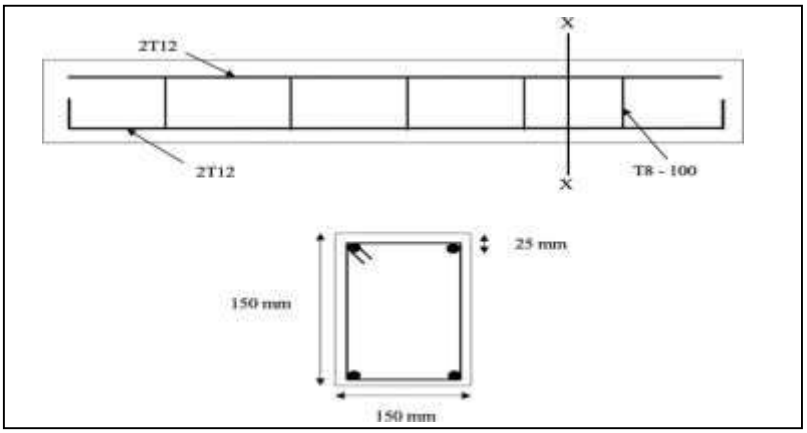

Figure 4: Reinforcement Bars Details based on Manual Calculation

This is an example concrete mix design for one beam with dimensions of 150 x 150 x 500 mm, with a volume of 0.0113 m3. 25 N/mm2 is the typical strength. The concrete mix design is shown in Appendix A of BS 5328; 1981.

Table 2 Mix Proportion of the concrete mixtures

Quantities	**Cement (Kg)**	**Fine aggregate (Kg)**	**Coarse aggregate (Kg)**
Per m^3	362	823	1005
Control Sample	4.1	9.26	11.31
3% CF	4.1	9.26	11.31
6% CF	4.1	9.26	11.31

Quantities	Water (Kg)	Fibre % by weight of cement (Kg)	Total weight (Kg)
Per m^3	210	-	-
Control Sample	2.36	-	27.03
3% CF	2.36	0.12	27.15
6% CF	2.36	0.25	27.28

According to ASTM F1575-03:2003, the three sets of flexural tests with the third point loading on 27 beams each were carried out. The third point loading flexural strength test loading configuration shown in Figure 2 was used to gauge the flexural strength of 150x150x500 mm beams. On the front, each specimen will be painted in colour. The first crack load, the largest crack width, and the total number of cracks following the failure were all measured during the experiment. The load that caused the test specimen's side to show the first indications of cracking is known as the first cracking load. All specimens from the initial cracking load that contained varying amounts of coconut fibres were examined. The load was recorded when the first crack in the reinforced concrete beam (RCB), which is when the measurement's results occurred.

Figure 5 16- Blade Feeler Gauge 0.05 to 1.00 mm

The first cracking load is the load where the first signs of cracking occured on the side of the test specimen. The first cracking load was checked for all specimens with different percentages of coconut fibres. The results of this measurement occured when the Reinforced Concrete Beam (RCB) was exposed to the first crack, the load was recorded. The crack width was measured by using a 16-blades feeler gauge, size 0.05 – 1.00 mm, with blade dimensions (L*W*H) 100*30*15 mm as shown in Figure 3.6. The number of cracks comes in the last stage after the concrete beam collapses.

ANALYSIS AND DISCUSSION

This study examined the flexural behaviour of the rectangular concrete beams reinforced with the coconut fibre using 27 beams (CF). The percentages of CF are 0, 3, and 6% by the weight of cement, respectively. Flexural fissures in the concrete beam are being looked into. Additionally, the total weight of the beams, the initial force that generated the crack, and the quantity of cracks that appeared in the bottom zone of the reinforced concrete beam. The curing and testing of the reinforced concrete beam occurred after 7, 14, and 28 days.

Slump Test

A slump cone is used to evaluate the consistency or workability of a concrete mix created in a lab. The results for the specific characteristics are shown in Table 3. The table shows that the slump decreased and workability decreased as the additional coconut fibre was introduced. This is because the amount of fibre in the mixture was increased in the compaction resistance. Figure 6 showcases the slump test being conducted in the laboratory.

Figure 6: Slump test results

Table 3: Slump Test Results

Mix	Slump (mm)
0% (control sample)	110
3% (CF)	100
6% (CF)	80

Load-Carrying Capacity

The load carrying capacity is a parameter in which the sample were tested in order to obtained the maximum capacity. The specimens were tested in 3-point load test. The replacement with the concrete fibre definitely affected the end results of the study.

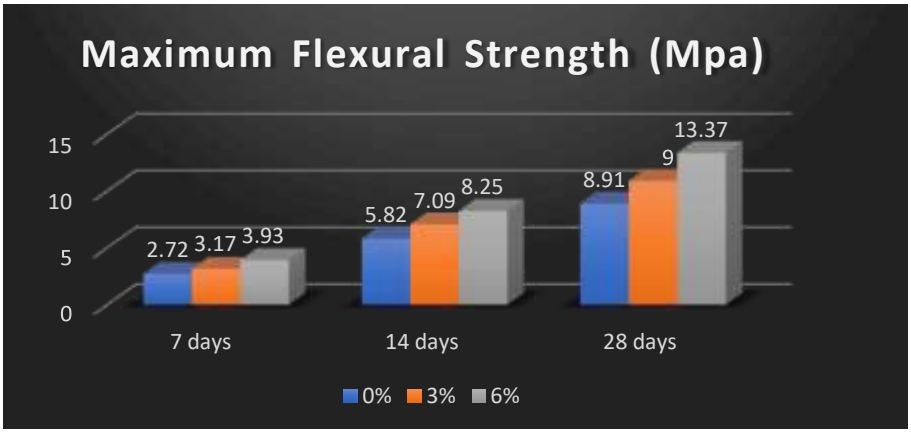

Figure 7 Maximum Flexural strength of CFRC Beams

Figure 7 shows that adding process of the coconut fiber to a reinforced concrete beam increased the flexural strength in all ages. When 6% of coconut fiber was added its gave the results of the height in all different ages compared to 3% and 0% of coconut fiber. It shows that the increment has resulted in the reflects on the maturity of the concrete. This increment has a promising results in which leads to a conclusion of the replacement of the concrete fibre is possible.

Crack Formation and Propagation: First Crack Load

The load that caused the test specimen's side to show the first indications of the cracking was the first cracking load. Figure 8 shows the loads at first cracking based on the experimental findings. The reinforced concrete beam containing 3% coconut fiber showed an increase of 19% compared to the control sample, RC beam containing 6% coconut fiber showed an increase by 33% compared to the control sample at 28 days of curing. This might be connected to the coconut fibre's enhancement of the link between concrete components and the resulting arresting of crack formation. The first crack load is very important in determining the capability of the concrete. This indicate that the addition of the coconut fibre has indeed increase the strength of the concrete.

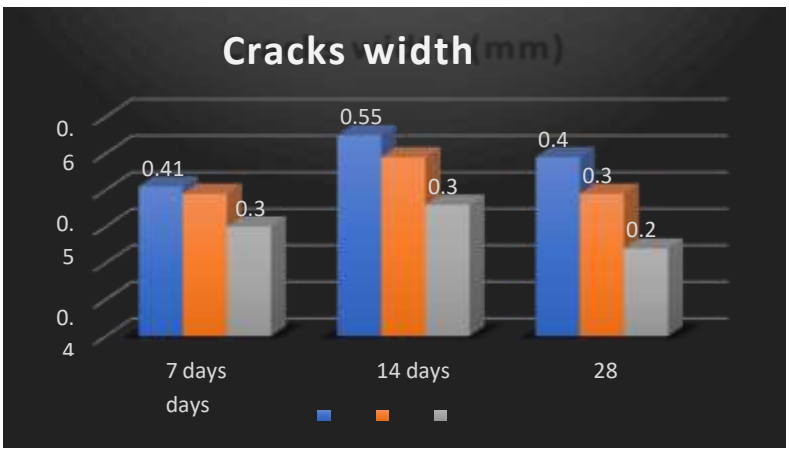

Figure 9 Maximum Crack Width of CFRC Beam

Crack Formation and Propagation: Cracks Number

The construction cracks can be considered as a part of the downfall of the failure. This test is to ensure the capabilities of adding the coconut fibre as a bonding material that can increase the strength of the reinforced concrete. The number of cracks decreased when 3% and 6% of the coconut fibre were added in the first 7 days. This can be seen in Figure 10 when after 14 days the number of cracks slightly increased when 6% was added compared to the control sample (0% CF). In 28 days the figure shows a significant increased in the number of cracks between 6% and the control sample. As shown in the figure indicated that by adding the coconut fibre does not increase the strength that much, but its near to the one with controlled mix. This is actually a promising results whereas in term of cost can be control as the coconut fibre are much cheaper than other concrete ingredients.

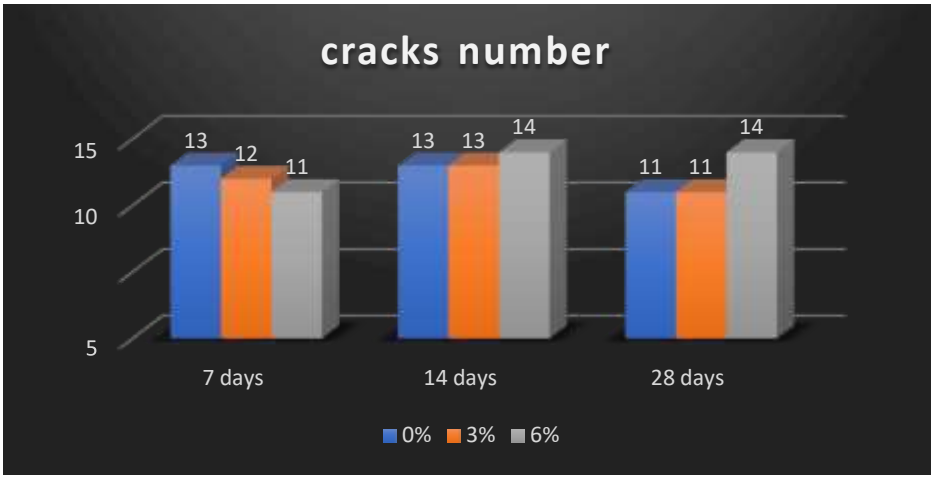

Figure 10: Cracks Number in CFRC Beam

CONCLUSION

According to the experimental findings, the additional of the coconut fibres improved the flexural strength and the ultimate load for the CFRC beams. The flexural strength of the reinforced concrete beams was 61 enhanced when the coconut fibre was added, regardless of age. When 6% of the coconut fibre was added, it produced outcomes for heights in all age groups that were superior to those of 3% and 0% of the coconut fibre. In conclusion, the addition of the coconut fibres to the concrete will increase the ultimate load, decrease the crack breadth, and improve the flexural strength. All of these will increase the first crack load. The coconut fibre ultimately produced great results at the lowest cost, thus the concrete manufacturers must begin using this type of concrete in the actual projects after confirming its effectiveness from all angles; including compressive strength, chemical reactions on concrete, etc

AUTHOR BIOGRAPHY

Mohamed Emierul graduated at Universiti Sains Malaysia with Master Degree of Science in Structural Engineering in 2017. His expertise is in Structural Analysis, Reinforced concrete, Project management and Construction Materials. *Email: emierul@iukl.edu.my*

Moaz Ghaiebeh graduated at Infrastructure University of Kuala Lumpur in 2022. Obtaining his Bachelor of Civil Engineering with Honours first class.

Syafiq Abdullah graduated at Universiti Sains Malaysia with in 2010 with Master of Science in Project Management. His expertise is in Construction Materials and Construction Management. *Email: syafiq@iukl.edu.my*

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THE MALAYSIAN STAKEHOLDERS COGNIZANCE ON CONSTRUCTIONS IN IMPLEMENTING A SUSTAINABLE INDUSTRIAL BUILDING SYSTEM (IBS) IN MALAYSIA

Muhammad Nasrol bin Jamal, Mohamed Emierul Qazzarul Khir Johari &
Syafiq Abdullah
Infrastructure University Kuala Lumpur, MALAYSIA

ABSTRACT

The construction industry and government of Malaysia have coined the term Industrialised Building System (IBS) to describe the enhancement of industrialization and the development of prefabricated components for building constructions. The purpose of this study is to create an awareness regarding the sustainable implementation of the Industrialised Building System (IBS) among private stakeholders in the Malaysian construction sector, notably in the Klang Valley region. The study aims to better identify stakeholders' existing level of IBS knowledge, with a focus on cost, time, and available programmes. Certain units of a building that comprises more time usage and workload are efficiently reduced by implementing manufactured components in the off-site and delivered later to the site. IBS is however a need that is persisting subconsciously and consciously as Malaysia has been relying on the dependency of other countries for their unskilled laborer. Thus, this study is intended to create cognizance among private stakeholders in Malaysia Construction in implementing sustainable Industrial Building System (IBS) in Klang Valley. A survey of the quantitative method of 126 construction workers from 400 private enterprises in Klang Valley was carried out. The study focuses on evaluating the effectiveness of time management in construction projects, evaluating project quality compliance, comparing construction quality and cost between conventional methods and IBS, and assessing private stakeholders' awareness and cognizance of the sustainability of IBS in the construction industry. The findings of the research are gearing towards investigating the potential of IBS in addressing building difficulties in Malaysia and focusing on its sustainable practices and the need to improve awareness among private stakeholders in the Klang Valley.

Keywords:
Industrialised Building System, Private Stakeholders, IBS Cognizance, Klang Valley, Malaysia

INTRODUCTION

The construction industries envision the circumstances that could occur with the implementation of the sustainable development in their building processes and functions that relatively sustain the ecology with the new discovery of business models, materials, and their processes. To aid in this development, humans need to revolve, work, and do continuous learning and enhancement to achieve a sustainable living standard (Yeang, 2011).

The concept of a sustainable Industrialised Building System (IBS) is defined as the modern method engaged with “green” elements, considerably advanced rather than the conventional system. The conventional IBS is not technically relevant due to its work performance being completely conducted on site. Dangers and risks of foreign and local workers gave effects to a poor quality of production when older IBS implementation occurs. The current IBS implements construction process to take place in factories and then transported to the site for components to be assembled. Additionally, Modular System correlates measurements between spaces, installation, and components to ensure that the constituent elements are fit with one another. The need for extension or cutting is excluded even though the components and fittings are readily served by different manufacturing companies and suppliers (W.A. Thanoon, 2003). Prefabricated construction or better known as the IBS is convenient for developers and stakeholders as it minimises the time for completion of construction process simultaneously and reducing

the cost needed. Components built in the factories are usually faster and an easier method for their high-quality performance (Rahim, 2009 & Ismail, 2009).

In Malaysia, IBS was introduced in 1960 when the Ministry of Housing and Local Government of Malaysia participated in the housing development program among other countries in the European region. Contrary to Malaysia's minimum number of existing residential buildings', the outcome of the program supervened the initiation of IBS implementation in the country (Thanoon, 2003). Since then many projects were launched with the use of IBS in Malaysia. For instance, Kuala Lumpur's Pekeliling Street Flats comprising of 17 stories with 3000 residential and 40 commercial units respectively. The project was built with the use of large IBS wall system and plank slabs. However, the usage of IBS had decreased in the 70s due to poor architectural design which affected the prefabricated buildings that disappointed consumers of precast concrete usage. The need for wet spaces such as toilets was required and the lack of providence of this utility lead to problems arising for IBS buildings.

In the 20th century, the government had promoted IBS usage in projects such as IBS Roadmap 2003-2010 to educate practitioners and policy makers on IBS problems to ensure the Malaysian construction competence level tops in the international standards. However, this goal was unsuccessful because only one out of five KPI goals were reached (CIDB, 2011). The five KPIs consist of Manpower, Monetary, Materials and Bumiputera Development that has subdivisions of IBS manufacturers and Bumiputera IBS Manufacturers. CIDB launched the IBS project called Roadmap 2011-2015. The implementation enforces on project quality, competency level, efficiency, and sustainability in the development. The construction business environment is becoming more complex these days, with more issues that must be addressed by teamwork (Yusuf, H. Y, 2021).

The government and the most important party, CIDB are in the ongoing process of achieving the use of IBS 70% in construction projects. (CIDB, 2016). Therefore, the keen interest in improvisation of sustainable IBS adaptation in Malaysia has developed. The use of more than 70% of IBS in the construction industry could produce more successes for the country and outstanding the standard internationally as mandated by the government. The construction industry has been experiencing persistent problems such as poor health and safety conditions, inferior working conditions, and non-achievement of quality, which have harmed construction productivity, overall performance, and image (Fateh,2020).

The Industrialized Building System (IBS) is a term used to refer to various pre-fabricated construction methods. The scale and size of components vary, from wall-sections to full-scale building floors, which are constructed separately in a controlled environment, and later assembled to form a full-fledged building or facility (CIDB, 2015). The objective of implementing the sustainable IBS in Malaysia is to improve the productivity rate, efficiency, and quality of construction projects. It also aims to promote sustainable and climate-friendly construction practices (CIDB, 2015). In terms of sustainability, the implementation of IBS is evaluated based on Political, Economic, Social, and Technological factors (PEST) (Taherkhani, 2014). The results show the need and the importance of considering social factors to improve the development of IBS for sustainable construction. This is the main reason why this study is aimed to provide cognizance for the construction industry in implementing IBS mainly targeting the private stakeholders. The need to it have been exposed to the aspects of IBS is essential. The construction industry has been battered by chronic problems such as poor health and safety conditions, poor working (Fateh,2020).

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Barriers in Adaptation to IBS System

The hindrances to embracing IBS are the extreme need labeling with the validated changes produced using traditional technique towards the incorporation of off-site advancement. It was expressed in this investigation that IBS technique requires diverse administration abilities and new processes (Hamid et al, 2009). In contrast to the conventional method of building structures, IBS conducts a reasonable segment by appropriate arranging of its cycles, plan, fabricating arranging and quality control to limit the deformities in the construction (Gibb, 2001 and Warszawsi, 1999). Another obstruction is a significant restriction in the information controlled by industry players. A large portion of the methodology towards more current ventures is conventional technique than IBS (Blissmas, 2006). IBS is additionally implanted with an exceptionally focused association that includes incorporation, coordination, and legitimate obsession of components as it includes numerous parties to complete one project (Pan et al, 2008). Furthermore, in terms of business approach it becomes another barrier to adopting IBS since the investment plans and selection of suitable project proposals needs to justify (Malik, 2006).

Subsequently, the primary obstructions to improve IBS in the business are simply on the outlook of the players generally in specialized terms. The IBS variation is expecting for changes in their underlying get together and their structure measures. The IBS positive results must be seen when the comprehension on IBS standards on the assembling terms along appropriate gather to the assembling measures. The government and CIDB is on the ongoing process of achieving the use of IBS 70% in construction projects. (CIDB, 2016). Therefore, the keen interest in improvisation of sustainable IBS adaptation in Malaysia has developed.

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Perception of Contractors in Malaysia Towards Industrialised Building System (IBS)

The wavering towards accepting IBS strategy in developments by the private workers for hiring purposes is the requirement to burn-through IBS in project improvements. Expansion in unfamiliar works in Malaysia for modest compensation and expanded time limitations in giving schooling and preparing to the laborers to agree with IBS technique helps in the choice of project workers picking ordinary strategy over present day framework (Kadir, Lee, Sapuan, Jaafar & Ali, 2006).

On-site of prefabrication is done in the surrounding of the site and later transported to the actual location and it includes advantages that satisfies budget of construction, time minimization and an improved performance quality (CIDB, 2003). The off-site construction is also understood to be built in factory and later transported to the site location. Even though, it is a way older finding, the argument above is strongly supported till present time.

Perception of IBS among Construction Project Managers in Malaysia

Underline on the view of IBS and the competency level of IBS in Malaysian development industry among Construction Management Project Manager, it is believed to come about that the development projects being included of IBS requires more competency than the conventional strategy's need. (Janipha, Jabar, Ismail & Aziz, 2013).

The primary factor for the competency level of development director in the result of a task and in territories explicitly expected to have the best conveyance of a venture (Crawford, 2005). It is clarified that solely after ten years; a construction management certified graduate would accomplish the situation as a project manager. In this manner, the normal numbers of undertakings directed in the time frame are

16 projects. In the middle of those sums, it is expressed that an average of 3 or lesser number of activities are directed with IBS (Jabar, 2013).

A different method is used in managing IBS and conventional development pays a big effect on construction project. This study shows a contrast in opinion that time is shortened and project completion within time duration is ensured because the plants and machineries are available to receive the components.

Public Perception Towards Implementation of IBS

As addressed by Zawawi (2009), numerous advantages advanced, the various insights among the partners have prompted the low utilization of IBS segments in the development business. Nevertheless, Onyeizu (2011) stated that since the beginning of the IBS introduction to the Malaysian construction industry and its promises to solve and improve the current construction method and scenario in the country, poor perception amongst the construction stakeholders towards it, is an issue which greatly contributes to the low usage of IBS components.

Thus, it led to the term "IBS" being misinterpreted with negative conception. As explained by Rahman & Omar (2006), the explanation that add to the negative origination of IBS term is past disappointments and ugly design. Development experts are questionable with IBS innovation and IBS' relation with potential post-development issues. Researchers concurred the negative insight towards IBS depends on the chronicled disappointment of off-site practices to convey improved execution, specialized challenges (e.g. Site specifics, delivery issues, interfacing problems and cost), lack of opportunities for benefiting from economies of scale, structural requirements associated with social, security, privacy and noise problems and the fragmented structure of the construction supply chain (Blismas & Wakefield, 2009; Idrus et al., 2008; Pan at al., 2004).

Cost and Quality between IBS and Conventional Method from Industrial Key Players' Perspective

A prior finding has announced that the IBS has continuously diminished the use and increment the future benefits for the partners, for example, project supervisors, specialists and designer through the execution of IBS which all the while lessens the expense of work and materials (Yunus, 2011). Another research in the following year stated that IBS and conventional method does not make a huge difference in construction material but does contrast in the labour cost reduction and the improvement of quality of production by IBS (Ahmad, 2005).

It is concurred that IBS saves cost and improves quality; and they should be cognizant in instilling the strategy as it is a perspective to consider among supervisors and central participants. Along these lines, level of insight on technique usage of IBS is required.

Contractors Perception on Time Effectiveness in Construction Project with IBS

According to CREAM (2010), one of the fundamental criteria for estimating the accomplishment of a task. Thus, the investigation accentuates on time improvement between IBS model and ordinary technique. For example, nail fixing and cutting of logs and wood contains a great deal of time (Bannet and Grice, 1985). Furthermore, another paper guaranteed that IBS abbreviates development time with better quality control as a result of its distinctive methodology in development (Warszarski, 1999). As per Gibb (2001), building development utilizing pre- assembled segments with fabricated under explicit conditions and determinations implies breaking an entire house unit into various parts and building them independently. Later embracing fixation to develop the whole house

It is concluded that the work scheduling time becomes very effective when IBS is used in the project. Therefore, IBS cognizance among stakeholders is needed as very little private companies are instilling it even though that have the basic knowledge of this method.

Levy Exemption for IBS Users

The Malaysian Construction Levy exemption on CIDB taxes of 0.125 % of the absolute expense of the IBS project towards the workers for hire that apply the arrangement of 50 % in their underlying parts in lodging structures (Hamid, 2008). Different discoveries contended that the exclusion of duty when a project has 50 % association of IBS is excessively less and not sensible (Shaari, 2006). The offer is not actually acknowledged by partners as the current levy that is being instigated is low when contrasted with the past demand forced of 0.25 %.

The IBS Score and the levy exemption value must comply with the consideration of contractors' budget constraints as well. The levy offered will be accepted and felt encouraged to adopt IBS when the percentage of levy increase and the IBS Score is set considerably (Shaari, 2006).

IBS Training

It is just rational to have skilled workers and supervisory group who are prepared sufficiently to support the development progress as the requirement for reconciliation between higher management and lower management, legitimate coordination and details of materials and coordination during assembly of parts are fundamental. The writing has featured the requirement for preparing to be given to the partners (Thanoon, 2003).

Another finding has stated that the higher the level of advancement in a project and the implementation of IBS will require different and more skilled worker as well compared to a simpler IBS project (Gibb, 2007). The author also stated that the already skilled labourers must be given training from time to time to be reskilled according.

METHODOLOGY

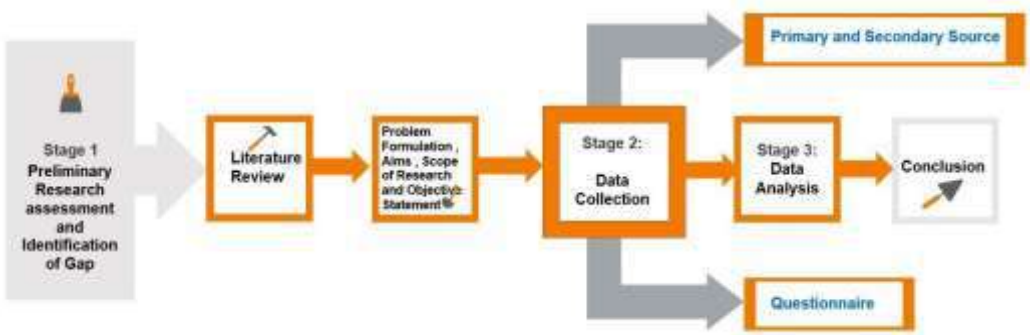

Figure 1: Flowchart of Research Methodology

Based on the figure above, this study method involves some literature review, and the dissemination of questionnaires to attain the emphasised aim of the research and objectives as stated. From August 2020 to January 2021 (when this study started) a total of 100 private stakeholders were identified as sample for the study. The strategic scheme is used to create an appropriate framework for the research, which contributes to a high-quality data collection and production of results. This research uses a quantitative method. The first section of the research study has a series of questionnaires. A systematic questionnaire is used in the research to gather data. One hundred private stakeholders make up the research sample, and in the context this research, this sample size is suitable for a quantitative study because it permits statistical analysis and generalisation of findings to a larger population of private stakeholders. The robustness and reproducibility of the investigation are enhanced by the deliberate selection of this sample size. In order

to accomplish the research objectives, a structured questionnaire for data collection is used, along with a sample size of 100 private stakeholders chosen through a strategic plan and a quantitative approach with statistical analysis tools.

IBS Professional Training Programme by CIDB

IBS Professional Training Program by CIDB is attended under 50 % of the respondents. The preparation is gone to by 33.9 % just of which are 42/124 members of the study. Then, the remainder of 66.1% of 82 respondents has not gone to the program as demonstrated in Figure 2, separately. The need to go to the program has not brought consideration up in many of the respondents when the information gathered was noticed. This is the main motivation behind the reason of more openness to IBS broadly is required in the nation to urge partners to accumulate data in the framework application. IBS is anything but a go for program since partners are not quick to go to nor get ready trainings teamed up with separate CIDB organizations of IBS programs that could use them into acquiring information on IBS that prompts an attainable status of its execution in current and future projects.

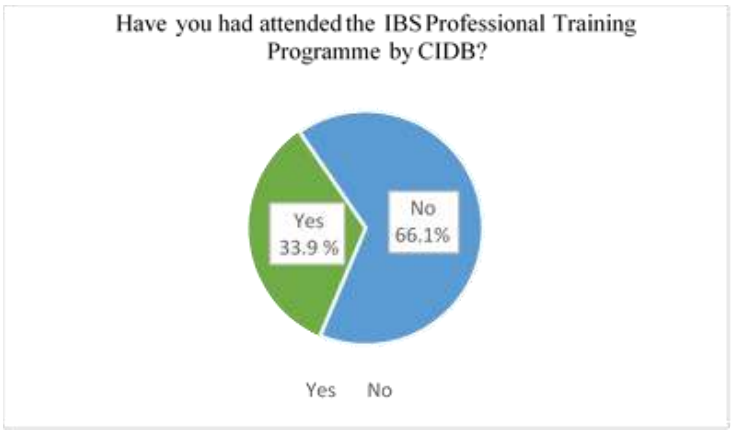

Figure 2: Percentage on attendees of IBS Training Programme by CIDB

The analysis results of attendance rate is approximately 50% of the respondents attended and out of 124 participants in the study, 42 individuals (33.9%) attended the program, while the remaining 66.1% (82 respondents) did not participate. The data indicates that the need to attend the programme did not receive much consideration from the respondents, and a noteworthy finding is that there is a lack of awareness or interest among respondents in the significance of attending the IBS Professional Training Programme. These factors account for the non-attendance. Moreover, Further, owing of the participants' lack of preparation for or limited knowledge base, there are implications for IBS implementation and a need for greater awareness as part of the data analysis. Instead of facilitating information gathering and promoting the application of IBS, the necessity of awareness focuses more on the critical need for enhanced awareness and promotion of IBS in the nation. There is a clear need for greater transparency and encouragement among stakeholders. The study's goals were to evaluate private industry stakeholders' awareness of and involvement in the IBS Professional Training Programme in Malaysia's construction sector.

Awareness on IBS Benefits in Construction

IBS provide many benefits and its applications as indicated are not all around publicized among half of the respondents. This is on the grounds that lone 49% of respondents can decipher the advantages as they

are associated with the IBS project itself and have known the essentials of its framework and planning. The other 51% have been utilized to the comfort of managing the conventional method for quite a long time who are the workers for hire and task administrators who may not probably acknowledge the more up to date technique which is IBS. The figure beneath deciphers that acknowledgement on benefits are available, yet the adaptation rate is less. The outcome shows that the degree of insight on advantages of IBS is on the edge of half of the scale. The cognizance to embrace the execution and improve where necessary.

Are you aware of the IBS benefits in construction projects?

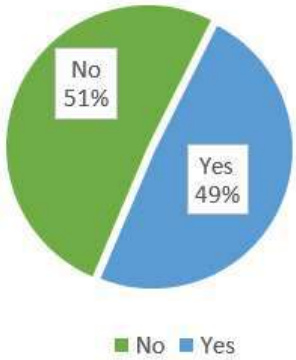

Figure 3: Awareness of IBS among private stakeholders

Concurrent IBS Production Shortens the Overall Construction Period

Respondents who are accustomed to practicing conventional method technique are not vulnerable against fresher innovative methodology as IBS, yet the graph underneath shows majority of the respondents have picked the third bar with 28.2%. The Neutral Bar is higher with 20.2%. A large portion of the separate respondents who disagree or strongly disagree are contractors and project manager who have been teaming up with conventional technique for a really long time with their number of working a very long time as demonstrated in figure 4 underneath. This shows an openness adequately long to detail out their unshakable assurance towards not wandering into IBS. The absence of comprehension on a simultaneous interaction which means work of IBS is delivered all the more effectively while other work is running nearby like preliminary activities in the interim, complex IBS structures are worked off-site.

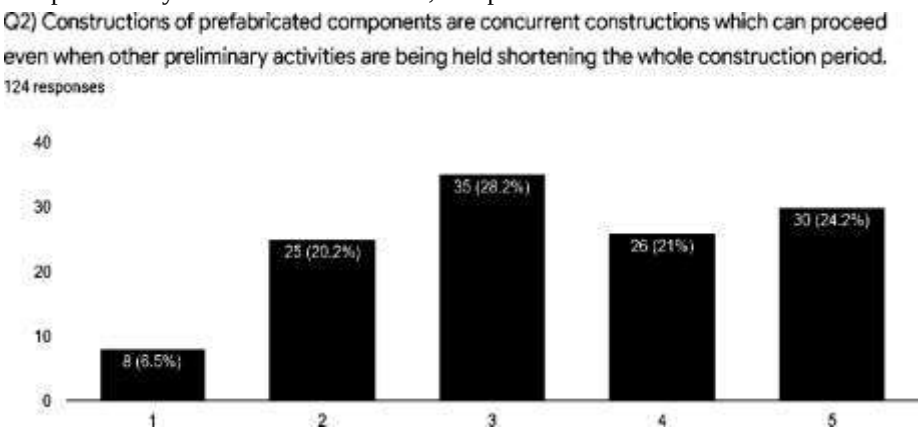

Figure 4: Concurrent IBS Production Shortens the Overall Construction Period

IBS Operations are Cheaper than Conventional Method

It is agreeable that the IBS development tasks are less expensive than traditional method. The add on charges are applicable to conventional method from time to time when necessary. The IBS is supposed to be a lot less expensive as their segments are developed on assembling off-site and that limits the on-site work. This is by one way or another comprehends by the respondents. In this way, 14.5% of the respondents strongly agreed in Figure 5. The other 10.5 % strongly disagreed regarding their rates as underneath. This shows that the respondents absolutely have an alternate opinion to the use of IBS. This is an immense motivation to why adaptation of IBS is resistant and slow.

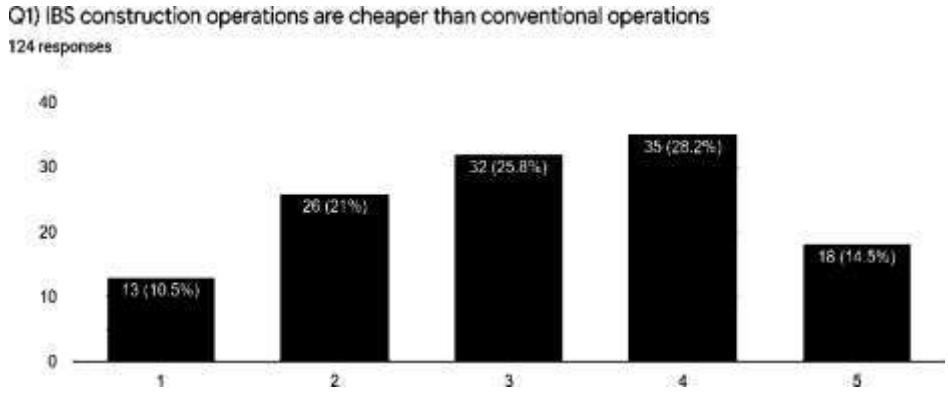

Figure 5: IBS operations are cheaper than conventional method

Lesser Labour Cost with IBS

An enormous level of respondents with 30.6 % of 38 individuals disagreed and 15.3 % of the respondents agreed. It is clear in the Figure 6 underneath that the vast majority of the partners have a recognize assessment on IBS and work cost. They do not want to adopt to the change as they still have perception that IBS does not aid in reducing the cost. This is because, the contractors who have responded to this are worried of the initial capital cost to endure in IBS projects. As these are small group of contractors who are incapable to afford the investment. This means IBS is adoptable with a little bit more revelations on a more depth IBS cost benefits to the stakeholders. Hence, the risks show very low, and the long-term production quality and cost saving factor is higher.

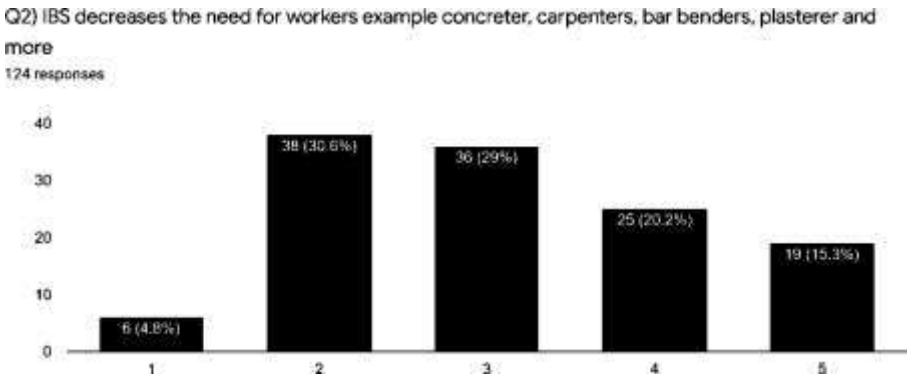

Figure 6: Lesser Labour Cost with IBS

Simplified Installation Process Improves Quality Control

In the information gathered as beneath, it is strongly shown that the vast majority of the respondents disagree to the factor that cost is reduced when IBS parts are planned and made of-site, that at the same time improves the quality as the climate is cleaner and more coordinated when based nearby. As deciphered in Figure 4.7 the degree of understanding this factor is low as 8.9 % of them have strongly disagreed and opposed this idea. This is because that a large portion of the respondents have encountered working with traditional method yet when uncovered of IBS and a portion of its advantages are still agreeable to them.

Plus, 12.1 % of the respondents have expressed strongly agreed to the statement. These are the respondents who are keen on IBS, for example, new alumni and post advanced education holders working in the construction industry as they opted the risk on capital expense which will later profit in overall cost decrease and quality improvement when IBS is in projects. Overall, with a decent implementation of IBS among private key partners is fundamental to take cognizance of the topic researched as the quality of components are easily managed.

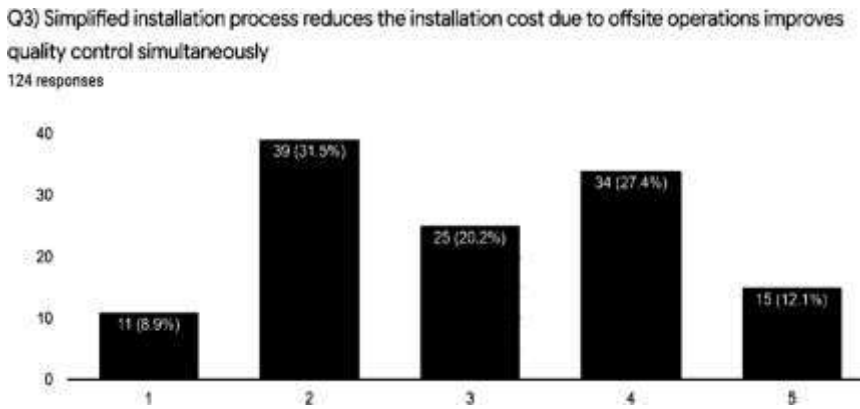

Figure 7: IBS Professional Training Programme

IBS Professional Training Programme

This program provides training to all work force of development group to expand the use of IBS and acquaint. The strategies of development measure were shown, yet it is strongly disagreed by 33.9 %. This shows that practically 50% of the respondents are not presented to this program with less acknowledgment to IBS Professional Training Program is investigated. Just 12.1 % of respondents know the program with scale selected as emphatically concurred. The plans are taken to the cognitive actions for it could help in more IBS for future undertakings. An action taken by higher supervisory group in implementing the program by higher management team will be useful to accomplish the objective in practicing IBS without any problem. The training has a high potential in impacting laborers without IBS foundation to acquire the down to earth information and execute in the working environment. Partners may discover ease in project coordination as the workers have been instigated of IBS information and execution abilities.

Investors also acquire trust in setting up the IBS project as the group have the comparing prerequisite of abilities and information. The cognizance to IBS is fundamental as evolved through this program. The program would build the degree of usage in IBS when key stakeholders also go to the CIDB workshop as a large portion of the accomplished partners are still promptly accessible to change their approach towards the construction industry. The requirement to initial construction cost and its benefits will be attained making dear of monetary loss is prevented as the long run profit is seen with understanding

of the IBS Professional Training Programme. Time effectiveness and the production of quality materials increasing the work efficiency is understood in the training programme as work progress stage by stage is explained. This will change the perception of key stackholders and project ideas of IBS in their future constructions. Stakeholders may encourage their entire project team. to understand and instill the modern system for their projects.

CONCLUSION

The study emphasises the importance of a thorough public education campaign to educate stakeholders about the benefits of IBS. While certain characteristics, such as time effectiveness, is acknowledged, changing entrenched practises remains difficult. To fully realise the promise of IBS, concerted efforts should be made to address concerns, increase knowledge, and stimulate active participation of private players in various IBS programmes. An objective of this research has been successfully achieved. The level of knowledge attained by the respondents in regards to IBS and its information are low. Most of the respondents are not entailed to the betterment of the Malaysian construction industry and have settled with the conventional method. This shows that the cognizance on IBS and its assurance in the development of its industry is low hence, it leads to the third objective of this study in providing cognizance to IBS among private industrial players.

Time effectiveness and its relativity to the quality of construction is successfully achieved when the data have shown apprehension on the improvement on time management on site will increase production quality was well understood by the postgraduates and fresh graduates mostly when compared to other category of occupation in the industry. It also exhibits that other stakeholders involved in the construction industry too have agreed to time and quality raise with IBS but with a very low percentage. The adaptation of IBS in a company begins with the superiors such as project managers and main contractors deciding to execute IBS in their projects. This shows that the time effectiveness in quality of a construction project is highly received. The only challenge remaining is the infusion of method in the future projects.

The reduction in construction work wages has decreased most of the construction cost. Most of the respondents do understand this factor. However, few of the population, still disagree due to the worry factor of unexpected expenses when the manufactured models have complications in dimensions and functionality. However, the convenience and trust built on conventional method is the obstacle faced in the process wanting to widen the use of IBS. This satisfies a portion of the research's third objective in terms of cost and quality. The quality is improved in proportion with the reduction of wastage on site. This supports the third objective as well as most of the respondents agree. Some of the respondents still do not accept the cost effectiveness due to lack of cognizance received on IBS capabilities.

The level of cognizance that is interpreted by the results obtained concluded that most of the population has shown maximum positive remark of one programme of all such as 'Construction Levy Exemption'. To conclude, it is true that more population is needed to take cognizance to more IBS programmes for better understanding. Final objective is achieved completely as distinctly that more private stakeholders need to take cognizance that are well provided by the IBS institutions and other organizations to inaugurate an IBS growth.

AUTHOR BIOGRAPHY

Muhammad Nasrol graduated at Universiti Teknologi Mara with Master Degree of Science in Facilities Management in 2016. His expertise is in Construction Technology, Construction Project management and Construction Materials. *Email: mnasrol@iukl.edu.my*

Mohamed Emierul graduated at Universiti Sains Malaysia with Master Degree of Science in Structural Engineering in 2017. His expertise is in Structural Analysis, Reinforced concrete, Project management and Construction Materials. *Email: emierul@iukl.edu.my*

Syafiq Abdullah graduated at Universiti Sains Malaysia with in 2010 with Master of Science in Project Management. His expertise is in Construction Materials and Construction Management. *Email: syafiq@iukl.edu.my*

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EFFECTS OF FLOODING ON URBAN LIVES AND PROPERTIES IN LAGOS, NIGERIA

Onifade, V.A.[1], Yoade, A.O.[2], Olatunji, S.A.[3] & Husseni, M.A.[1]
[1]*Department of Urban and Regional Planning, University of Lagos, Nigeria*
[2]*Department of Urban and Regional Planning, Redeemer's University Ede, Nigeria*
[3]*Department of Urban and Regional Planning, Federal University Oye-Ekiti, Nigeria*

ABSTRACT
Flooding in the past few decades has made people experience economic losses. Floods in Lagos, Nigeria have increased in many folds and have resulted in major loss of livelihoods, and destruction of economic and social infrastructure. This paper examines the effects of flooding on urban lives and properties in Lagos, Nigeria with the view to evolving best practices to limit its impacts on the residents' livelihood and properties. The paper assessed the causes of flooding, the garbage disposal method and the impact of floods on the residents. Data were sourced from both primary and secondary sources through field survey; 128 questionnaires were administered to the respondents which resulted in 124 being retrieved. Findings show that it takes about a whole day (24 hours) for water to dissipate, and that the most common garbage disposal method in the study area is through PSP (Private Sector Participation). Findings also showed that prolonged rainfall, strong winds, impervious nature of the soil, improper waste disposal, and inadequate drainage system are the major causes of flooding. The study concluded that flooding has effects on residents' lives and properties and often results in livelihoods being lost. Therefore, steps should be taken to dredge waterways and tributaries by the National Inland Water Authority (NIWA). Furthermore, the development of buildings should be closely monitored by the concerned Government agencies to ensure houses are not built on natural water drainage channels.

Keywords:
Flood, lives, properties, urban, drainage, environment

INTRODUCTION

Flooding has become a common environmental problem in Nigeria and it has a devastating impact on human livelihood and infrastructural development (Yin, Ye, Yin & Xu, 2015; Adegun, 2023). The menace often occurs when a body of water moves over and above an area of land and submerges it. It is an occurrence which is peculiar to many low-lying regions of the world, one of which is Lagos State. With this ever-increasing urban population vis-a-vis scarcity of dry lands, encroachment, illegal structures and slum developments, flooding has therefore become an issue and a challenge for the State Government. Lagos State can be described as an incomplete delta because it has only one estuary mouth. This estuary is the commodore channel (at Onikan and near Bar Beach) that discharges the entire contents of the Lagos Lagoon, Badagry Creek, Lekki Creek and Ologe Lagoon into the Atlantic Ocean (Tapia-Silva, Itzerott, Foerster, Kuhlmann & Kreibich, 2011; Rose & Abubakar, 2014; Dube, K., Nhamo, G. & Chikodzi, 2021).

In terms of relief, Lagos occupies a low-lying site, generally below 17m with many parts of the metropolis at or below sea level (Adegbola & Jolayemi, 2012; Lawson & Odunbaku, 2017; Yoade, Adeyemi & Adelabu, 2020). The characteristic flatness of the terrain of Lagos implies that the ability of surface water to drain rapidly away is restricted; joined with extensive impervious paving this often causes pools of standing water to build up very quickly following rain downpour. The climate of Lagos is similar to that of the rest of Southern Nigeria, which is characterized by two rainy seasons; rainy season 1 (April – July) and rainy season 2 (October – November). Season 1 produces the heaviest rains and consequently the most likelihood of flooding. The temperature averages about 270 C and humidity can be higher than 80%.

The work of Adelekan (2011) gives insight into the increasing risk of flooding in Lagos. From his expository studies, Lagos is expected to rank as the fifth most exposed city to climate change threats by 2070 (Rustum, & Adeloye, 2007; Yoade, Onifade, Olatunji & Husseni, 2023). A computation of the Climate Change Vulnerability Index (CCVI) identified Lagos as one of the ten cities with 'high risk' from climate change globally (Pender, 2006). An important effect of climate change in Lagos is the increasing severity and impact of both inland and coastal floods (Bates & Roo, 2000; Bubeck, P., H. De moel, Ouwer & Aerts, 2011; Cammerer, Thieken & Lammel, 2013; Huan & Manteghi, 2022).

The severity of flooding in Lagos has increased over the years and has had devastating effects on the residents' livelihoods, (Olajide & Lawanson, 2014; Vincet & Yusoff, 2022). The agonies of flood have become the lot of nearly every nook and cranny of Lagos metropolis. In various communities that have been experiencing it across the metropolis, the tales of woes and pains follow every heavy downpour that lasts more than three to four hours. It is more serious when the rain lasts more than four hours (Agbola, Ajayi, Taiwo & Wahab; Aderogba, 2012 Cirella & Iyalomhe, 2018; Yoade, 2018). Counting the cost of flooding further revealed that economic activities have been negatively disrupted, many lives have been lost (human and livestock), buildings have collapsed, and electricity supplies have been disrupted because poles have been damaged by flood. Many lives are at risk of malarial with the increase in mosquitoes as a result of stagnant waters brought about by floods. Due to the above reasons and many others, the study aims to assess the effects of flooding on urban lives and properties in Lagos State so as to find out the cause of flooding within the selected area in Lagos and proffer possible measures taken to curb flooding in the state.

LITERATURE REVIEW

Flooding

The earliest historical record of flooding in Lagos state dates back to 1947 when Lagos was only a small coastal settlement (Bates & Roo, 2000; Echandu, 2020; Yoade & Onifade, 2020 Dube, Nhamo & Chikodzi, 2021). The pattern of flood occurrence has however changed drastically over the decades. Flooding of the city has been recorded with increasing frequency over the years (Ajibade, McBean & Bezner-Kerr, 2013). Changes in the intensity and pattern of rain storms, land use changes, and subsequent changes in the hydrological fluxes of the urban watershed associated with urban growth, compounded by inadequate or lack of drainage infrastructure, poor waste management, poor urban planning, and poor development control, have strongly exacerbated flooding in Lagos over the decades (Dutta & Nakayama, 2009).

Adelekan (2011) detailed some of the major flooding events from the late 1960s until the present time, including heavy flooding events in the years 1968, 1969, 1970, 1971, 1972, 1974, 1999, 2000 and 2004. Also, Komolafe, Adegboyega & Akinluyi (2015) wrote that in recent years, pluvial flooding (rainfall-related) has arguably been more widespread. With the exception of 1973, the drought year, flooding in Lagos has occurred annually (usually between July and October rainy season) with increasing intensity and increased severity of impacts from 1960 onwards (Rose & Abubakar, 2014). Ajibade et al (2013), noted that more severe flooding has been recorded in selected areas of Lagos including Lagos Island, Apapa, Ikeja, Mushin, Surulere and parts of Ikorodu. Also, Adeaga (2005) and Fasona, Omojola, Odunuga, Tejuoso & Amogu (2005), having observed the pattern of flooding in Lagos State, submitted that Lagos is prone to three distinct categories of flooding. They are:

- Urban area flooding: generated by flat topography, excessive rainfall, inadequate storm water drainage system and the obstruction of natural water courses. Urban area flooding occurs in towns and cities located on flat or low-lying terrain.
- Coastal area flooding: due to inundation of the lagoon and coastlands with ocean storm surges and high tidal levels. Coastal flooding occurs in the mangrove belt areas.

- River flooding: this is due to unusually high levels of rivers and discharges from the network of rivers and uplands of Lagos. River flooding occurs in the flood plains of large rivers.

Causes of flooding

In an attempt to find a way of curbing flood in Nigeria, Lagos State in particular, many scholars have endeavoured to find out the reasons why flood occurs and the reasons they proffered are true of Lagos. According to Dutta et al (2013), the reasons for flooding are essentially attributed to two major factors which are the climatological and anthropogenic factors. Nkeki, Henah & Ojeh (2013) wrote that the Lagos metropolis kept on experiencing an increase in area extent and population size that is adversely affecting the physical environment and the drainage system in particular. The damage flood might cause tends to increase as more people settle on vulnerable flood plains and block drainage channels. There are indications that should there be any slightly heavier rainstorm for a relatively long period of time, the incidence of flooding will be in greater dimensions and more disastrous.

Tightly linked with the menace of flooding is waste management. Improper disposal of waste products and inadequate methods of waste collection could result in the display of waste on roadsides, beside major drains, and when it rains, this waste is washed into the drainage system and ultimately into the water courses which would lead to blockage of drains as well as pollution of Lagos Lagoons and creeks. Faced with all these, the Lagos state authorities have put several measures in place that attempt to tackle those difficulties. For example, several initiatives, ranging from community self-help programmes to a World Bank loan for drainage improvements, are being implemented. These include the drain dock programme in 2000, the emergency flood abatement gang, and Lagos Metropolitan development and governance project. However, these have only had minimal effects or none at all (Adelekan, 2011; Chormanski Okruszko, Ignar, Batelaan & Rebel, 2011; Mayomi, Dami & Maryah, 2013; Komolafe et al. 2014; Rose et al., 2014; Alves, Angnuureng, Morand & Almar, 2020).

Causes of flooding have been considered from diverse angles by researchers. Olajide and Lawanson (2014) established that flood is a natural phenomenon, caused mainly by natural events; however, the incidence of floods and its associated risks have been exacerbated by human-induced activities. Human activities such as deforestation, wetland reclamation, greenhouse gas emission, poor planning, improper development and poorly designed infrastructure, particularly drainage systems, are capable of increasing flood events and vulnerability to the associated risks. In the explanation provided by Agbonkhese et al (2014), flooding is not totally a natural phenomenon but an environmental hazard. It becomes a hazard when it impinges unfavourably on human activities as it frequently does because of the affinity which man tends to have for flood plains and coastal locations. They thereby, highlight five factors that often result in flooding. These include heavy rainfall synchronizing with spills of rivers; main rivers backing up the water in their tributaries; inadequate and inefficient drainage of low-lying and flat areas to the overflow; ponding back of stream flow by rising tides, particularly during spring tide conditions; and peak floods occurring at the same time in a main river and its tributaries.

Okoko (2008) submitted that flooding is essentially attributed to two major factors which are the climatological and anthropogenic factors. The climatological factors include prolonged rainfall, an increase in sea level and strong winds in the coastal areas. These three factors show how climate change indirectly aggravates flooding by altering the pattern of flooding in flood-prone areas. The anthropogenic factors have to do with man's interaction with his environment in the form of urbanization, deforestation, shoreline modification and deposition of sand and silt in drainage channels. Other causes established by Okoko (2008) include dam breaking, improper waste disposal and development of buildings on the waterways.

Effects of flooding

While many flood events in Lagos have been reported by the local media, only major flood disasters have been documented by global flood/disaster observatories. Recent flood events with severe impacts are those of 2010 in Ikorodu and the widespread floods of July 2011 and July 2012. In July 2011, heavy rainfall which lasted about 17 hours precipitated a total of 233.3mm of rainfall – the equivalent of the amount expected for the entire month. About 25 people were reported killed as a consequence of the floods while 5,393 persons were displaced from their homes (IFRC, 2011).

The total cost of the 2011 flood, in terms of goods and properties, was estimated at N30 billion by the Nigerian Insurance Industry (2013). Substantial properties lost to flood are not insured and are owned by middle-class and poor residents, some of whom live in informal settlements.

Also, in June 2012, 216.3mm of rainfall was recorded in a single rainstorm event. The resulting flood wrecked widespread and severe damage to infrastructure, roads, bridges, rail tracks, houses and other properties, and claimed seven lives (Ikusemoran, M., Anthony, U. & Maryah, 2012; Adelekan, 2016; Olatunji & Yoade, 2022).

The livelihoods and economic activities of residents were also affected by floods. The floods of 2010 which had severe impacts in Ikorodu were a result of the release of water from the Oyan dam upstream on the course of the Ogun River. As a consequence, the problem of flooding in Lagos is increasingly raising serious concerns among the general public and government.

The effects of flooding in Nigeria, especially Lagos State, is at an alarming rate that if preventive measures are not taken very urgently, future occurrence might be too costly. A study on the impact of flooding on residential property values, focussing on the Ajegunle-Ikorodu Local Government Area of Lagos State, shows the effects of flooding on human lives and property values. The effects of floods on countries, social life and the economy have been so great that it attracts worldwide attention. Yet, in spite of the inherent dangers that accompany flooding, man continues to carry out their daily activities, erecting properties in flood plains and renting accommodation in flood areas (Lawanson & Odunbaku, 2017. Ajegunle-Ikorodu is uniquely prone to perennial flooding arising from rainfall and water released from Oyan Dam. The findings of the research show that flooding affects property values but most residents prefer to remain in the area in spite of the menace of flood.

Aderogba (2012) wrote that the Lagos metropolis kept on experiencing increases in area extent and population size that is adversely affecting the physical environment and the drainage system in particular. The damages caused by a flood might increase as more people settle on vulnerable flood plains and block drainage channels. There are indications that should there be any slightly heavier rainstorm for a relatively long period of time, the incidence of flooding will be in greater dimensions and more disastrous. Research and investment should focus on the mapping of flood-prone areas for the purpose of planning and physical planning of upcoming suburbs should be in conformity with those in existence and the natural landscape (Jonkman, Bočkarjova, Kok, & Bernardini, 2008; Oyekale, 2013).

STUDY AREA

Lagos State is a low-lying coastal region occupying 180km of Nigeria's coastline. It covers an approximate 3,577Sq km which represents 0.45% of Nigeria's territorial land mass. The State drains two-thirds of the South West and is characterised by wetlands and basin for five major upstream rivers from neighbouring states to discharge into the Atlantic Ocean. The low-lying wetlands occupy 78% of the entire land mass of the State. It is also known that about 85% of Lagos's population resides in 37% of the State's land mass. Lagos State (Figure 1) has a land mass of about 3,577 square kilometres and it is located between latitudes 6° 23' N and 6° 41' and longitudes 2° 42'E and 3° 42'E on the Greenwich Meridian. It is bounded on the West by the Republic of Benin and on the South by the Atlantic Ocean. It is regarded as the smallest state in the country; however, it has the highest population density in the nation. According

to a 2006 census, the state is considered the second most populous state in the federation, with the population status placed at 9,113,605.

Lagos State is a low-lying coastal region with a 180km coastline on the South-western part of the country. Lagos State has about 279,000 hectares of low-lying wetland, which constitutes about 78% of its entire land mass and 22% of Lagos consists of lagoons and creeks. Lagos State has two main seasons which are the dry season and the rainy season. The dry season usually lasts from October to March while the rainy season lasts from April to October. The rainy season has two peak periods which are May to July and September to October, with rainfall being the heaviest during the first peak period. Floods usually result during these periods, which are aggravated by poor surface drainage systems on the coastal lowland. Lagos is also blessed with a littoral type of climate with the highest mean monthly annual rainfall recorded amounting to 450mm and annual mean rainfall of around 1850mm. The mean annual rainfall varies from one location to another. For instance, Ebute-Meta, Yaba and Bariga in the Mainland areas record 1750mm while Agege in the North West records 1567.2mm.

Lagos State has an extremely flat terrain with an average height of 0.8m above Mean Sea Level. Ajeromi/ifelodun, Apapa, Amuwo-Odofin, Badagry, Eti-Osa, Epe, Ibeju-Lekki, Kosofe, Lagos Island, Lagos Mainland, Ojo, Shomolu and Ikorodu Local Governments all have flat terrains and are naturally liable to coastal flooding because of the inability to rapidly evacuate run-off due to high water in lagoons and creeks, resulting from tidal levels and sea-level rise. Areas around Ikeja, Ifako/Ijaiye, which have an average elevation of over 25m above Mean Sea Level, are not usually affected by topography (Yoade, Onifade, Olatunji & Husseni, 2023).

Figure 1: Picture showing Lagos State Map
Source: Lagos State Ministry of Land and Physical Development, 2016

In the Köppen climate classification system, Lagos has a tropical wet and dry climate that borders on a tropical monsoon climate. There is a brief relatively dry spell in August and September and a longer dry season from December to March (Table 1).

Table 1. Climatic survey of Lagos, Nigeria

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	27.3 °C (81.2) °F	27.9 °C (82.2) °F	28.1 °C (82.7) °F	27.9 °C (82.1) °F	27.1 °C (80.8) °F	25.9 °C (78.5) °F	25.1 °C (77.1) °F	24.8 °C (76.6) °F	25.2 °C (77.4) °F	26.1 °C (78.9) °F	27.1 °C (80.7) °F	27.5 °C (81.4) °F
Min. Temperature °C (°F)	24.7 °C (76.5) °F	25.8 °C (78.4) °F	26.5 °C (79.6) °F	26.2 °C (79.2) °F	25.5 °C (77.9) °F	24.4 °C (76) °F	23.8 °C (74.9) °F	23.6 °C (74.4) °F	23.8 °C (74.9) °F	24.4 °C (76) °F	25.2 °C (77.4) °F	25 °C (77) °F
Max. Temperature °C (°F)	30.9 °C (87.7) °F	31.1 °C (87.9) °F	30.8 °C (87.4) °F	30.2 °C (86.4) °F	29.2 °C (84.6) °F	27.7 °C (81.9) °F	26.9 °C (80.3) °F	26.6 °C (79.9) °F	27.2 °C (80.9) °F	28.2 °C (82.8) °F	29.3 °C (84.8) °F	30.6 °C (87.1) °F
Precipitation / Rainfall mm (in)	39 (1.5)	54 (2.1)	100 (3.9)	145 (5.7)	231 (9.1)	302 (11.9)	227 (8.9)	155 (6.1)	204 (8)	190 (7.5)	93 (3.7)	43 (1.7)
Humidity (%)	75%	78%	81%	83%	85%	87%	86%	86%	87%	87%	84%	78%
Rainy days (d)	9	11	17	17	20	21	20	17	20	20	17	10
avg. Sun hours (hours)	8.2	7.9	7.7	7.6	7.0	5.9	5.8	5.4	5.6	6.3	6.9	8.0

METHODOLOGY

Research design

Both primary and secondary data were adopted for this study. This was done to accomplish direct field observation and collection of primary data.

Population and sample size

The justification for selecting Mushin LGA as the study area is that Mushin is one of the major commercial hubs in Lagos with a lot of business activities. These heavy commercial activities have also attracted the development of residential property within and around the area. Also, the areas for the focus of this study were selected among the numerous areas in Mushin because of the frequency of flooding activity that has been experienced in the past.

Eight neighborhoods in this settlement that frequently experienced flooding were selected for analysis in this study. These areas are Idi-Oro, Alamutu, Agege motor road, Olaniyi, Matuwo, Labinjo, Bankole and Ojuwoye. The research population for this study was located in a number of buildings in the selected flood-prone areas of the settlement, obtained through a reconnaissance survey. A total of 429 buildings were counted using Google Earth map.

Considering the fact that it was cumbersome to study all the buildings due principally to time, cost and accessibility, a subset of the population was studied.

The Evans Morris Model (2007) formula was used to determine the sample size;

$$n = \frac{NZ^2Pq}{e^2(N-1) + Z^2Pq}$$

Where n = sample size

N = Number of Buildings (429 Buildings) e^2= 10% = 1.0 (level of accuracy)

1 = Unity (a constant)

Z= 95%= 0.95 (level of significance)

Pq= 0.5(Population proportionality)

Therefore;

$$n = \frac{429 \times 0.95^2 \times 1.0}{0.05^2(429-1) + 0.95^2 \times 1.0}$$

n = 196

Therefore, a total number of 196 questionnaires was administered across the eight flood-prone street in the study area. A 100% survey was carried out in respect of the physical characteristics of existing structures including the condition of social basic amenities in the study area.

Data Collection

The research instruments used for the collection of data for this study included the questionnaire and personal interview. The questionnaires are a compilation of relevant and well-structured questions for selected routes. Personal interviews were conducted with relevant environment officials of Lagos State Public Works Corporation (LSPWC), drainage departments and residents of the study area. Research Assistants were also engaged to make the administering of questionnaires easier and less cumbersome. The Research Assistants were trained on the concept of the questionnaire, the content of the questionnaire, and the administration of the questionnaire to the targeted respondents

The sampling procedure that was adopted for the study was the systematic random sampling. This type of sampling procedure allows for samples to be taken at a predetermined regular interval or order. A building was selected in each area as a starting point for questionnaire administration and another questionnaire was administered at the next third building, after which the questionnaire was randomly distributed in the selected building to an available eldest person. Therefore, the eight neighborhoods that make up the flooded area served as the sample frame.

Data collection was by administration of structured and open-ended questionnaires. The questionnaire was designed to elicit information on the causes of floods, and impacts of floods on the respondents in the study area. Out of the 128 questionnaires sent out, 124 were retrieved back from the field. Field trips and observation of existing drainage facilities and channels were assessed. This includes the visitation of the six existing stormwater drainage channels that have been provided in different parts of Lagos and the studying of the connectivity and links.

Data Analysis and interpretation of the results

The data collected were analyzed using both descriptive and the Flood Causative Index (FCI), the Flood Effect on Human assets Indices (EHI), the Flood Effect on Physical assets Indices (EPI), and effects of flood which caused financial losses (EFI), which were generated by ranking calculated mean values of

the variables. Percentage distribution and interpretation of the data were done. Likert Scale was used to analyse respondents' levels on the causes and effects of flood; the variables were obtained using a five-point Likert-type scale ranging from strongly agree (rated as 5), to strongly disagree (rated as 1).

RESULTS

Descriptive results

Time taken for flood water to dissipate

Findings revealed that 42.2% of 88 respondents who responded to this question said that it takes about a day for flood water to dissipate in their area. Of the 42.2%, some further expressed that it could take less than three hours for flood water to dissipate in their areas. 10.2% expressed that it could take two days while 7.0% replied that it could take three days for storm water to dissipate in their area.

Table 2: Time taken for flood water to dissipate

Time	Frequency	(%)
1 Day	54	42.2
2 Days	13	10.2
3 Days	9	7.0
1 Week	4	3.1
Others	8	6.3
Total	88	68.8

Source: Author's Fieldwork, 2016

Garbage disposal method

Findings revealed that 89.8% of respondents said that the method of garbage disposal in their area is majorly by PSP (Private Sector Participation) through the use of garbage disposal trucks and the frequency of disposal is every week. This means that the weekly disposal of refuse should ensure and enhance the general cleanliness of the area but there are still cases of refuse piled up on the gutters and drains, impeding the flow of water.

Table 3: Garbage disposal method and frequency of garbage disposal

Garbage disposal method			Frequency of garbage disposal		
	Frequency	(%)		Frequency	(%)
PSP	115	89.8	Everyday	9	7.0
Truck Pushers	6	4.7	Every week	103	80.5
Burning	2	1.6	Every two weeks	9	7.0
Total	123	96.1	Total	121	94.5

Source: Author's Fieldwork, 2016

Causes of flooding in the study area

Findings as presented in Table 4 show that most (94.5%) of the respondents agreed that prolonged rainfall is a major cause of flooding in Lagos, while only 5.5% of them disagreed. 6.2% of the respondents agreed that an increase in sea level causes flooding in Lagos, while 93.8% of them disagreed. 81.3% of the respondents agreed that strong winds often result in flooding in their area. Only 18.7% disagreed. 36% of the respondents agreed that flooding occurs in Lagos due to the impervious nature of Lagos' land while 7% of them disagreed. From Table 4, 8.6% of the respondents agreed that the above assertion is true, whereas 91.4% of them disagreed. 84.4% of the respondents agreed that improper waste disposal is one of the factors that cause flooding in Lagos while the remaining 15.6% of the respondents disagreed. From this table, 92.2% of the respondents agreed that one of the reasons for flooding in Lagos is inadequate drainage system while only 7.8% of them disagreed. 95.3% of the respondents agreed that flooding occurs in Lagos because drainage facilities are not in good shape while 4.7% of them disagreed. Corroborating the findings of Adelekan (2011) Dutta et al. (2013), Nkeki, Henah & Ojeh (2013), Agbonkhese et al. (2014), Yoade et al. (2019), the reasons for flooding are essentially attributed to two major factors which are the climatological and anthropogenic factors.

Table 4: Causes of flooding in the study area

Causes Frequency (N=128)	Strongly Agree		Agree		Disagree		Strongly Disagree	
	F	%	F	%	F	%	F	%
Prolonged rainfall	75	58.6	46	35.9	3	2.3	4	3.1
Increase in sea level	4	3.1	4	3.1	56	43.8	64	50
Strong winds	56	43.8	48	37.5	14	10.9	10	7.8
Due to impervious nature of Lagos' land	77	60.2	42	32.8	5	3.9	4	3.1
Dam breaking	6	4.7	5	3.9	55	42.9	62	48.4
Improper waste disposal	49	38.3	59	46.1	10	7.8	10	7.8
People build houses on waterways	8	6.3	5	3.9	37	28.9	78	60.9
Inadequate drainage system	69	53.9	49	38.3	5	3.9	5	3.9
Drainage facilities are not in good shape	54	42.2	68	53.1	3	2.3	3	2.3

Source: Author's Fieldwork, 2016

Ranking results

Residents' perception of causes of flooding

Table 5 revealed that prolonged rainfall, with the highest Flood Causative Value (FCI) of 3.7 is believed to be the major cause of flooding in Lagos State. Drainage facilities are in bad shape (FCI 3.44), inadequate drainage (FCI 3.36), improper waste disposal practices (FCI 3.06) and impervious land (FCI 2.54) are also causes of flooding in Lagos State. This revealed that all the variables are major causes of flooding in the study area with FCI value greater than 3 except impervious land. Therefore, this finding aligns with the studies of Okoko (2008), Adelekan (2011), and Yoade et al. (2019), that established the anthropogenic causes of flooding with the interaction of the environment and urbanisation.

Table 5: Residents' perception on causes of flooding

Causes of flooding	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	FCI (mean score)	Deviation FCI - *FCI*	Standard Deviation (FCI - *FCI)*^{2}
	F	F	F	F	F				
Prolonged rainfall is a major cause of flooding in my area	33	59	6	26	3	474	3.7	0.81	0.6561
Increase in sea level is a major cause of flooding in my area	-	30	42	45	9	345	2.73	-0.16	0.0256
Windstorm often result to flooding in my area	1	6	31	69	19	123	2.21	-0.68	0.4624
One of the reasons why my area is often flooded is due to imperviousness of our land.	2	24	27	61	12	321	2.54	-0.35	0.1225
Improper waste disposal is one of the factors that cause flooding in my area	12	38	24	50	2	386	3.06	0.17	0.0289
My area is often flooded because people build houses on waterways.	-	11	12	73	29	255	2.04	-0.85	0.7225
One cogent reason for flooding in my area is inadequate drainage system.	5	73	10	38	-	423	3.36	0.47	0.2209
Flooding occurs in my area because the gutters and other drainage facilities are not in good shape.	19	60	3	43	-	430	3.44	0.55	0.3025
TOTAL	72	301	155	405	74	2757	23.08		2.5414

WV=weighted value; SWV= Sum Weighted value

Effects of flooding on physical assets

The Flood Effect on Physical Assets Indices (EPI) in Table 6 show that drainages are blocked with refuse (EPI 3.26), therefore, water cannot flow out and this causes damage to physical assets. Other effects of floods on physical assets include roads becoming non-motorable (EPI 2.69) and damage to electrical poles and cables (EPI 2.15). The analysis revealed that flooding affects major physical assets when refuse blocks the drainage channel and renders the road non-motorable.

Effects of flooding on human and financial assets

The Flood Effect on Human Assets Indices (EHI) in Table 7 show that many residents have been displaced by flooding with EHI (2.48), reduction in Manpower assets EHI (2.42), and loss of Human life (EHI 1.99). Effects on financial assets in Table 8 revealed that the cost of replacing and repairing properties that have been damaged by flood is high (EFI 3.67). Also, flood reduces tenancy rates in the area as well

as the price of tenancy if it is prone to flooding (EFI 2.94) and business owners have had to relocate due to the effects of flood which caused financial losses (EFI 2.83). It has shown that flooding has major effects on the livelihood and assets of the residents in the study area. This has corroborated the findings of Okoko (2008), Adenekan (2011), and Lawanson and Olajide (2014) that flooding has severe effects on the residents both physical and human assets.

Table 6: Effects of flooding on physical assets

Effect of flooding on physical assets	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	EPI (mean score)	Deviation EPI - *EPI*	Standard Deviation (EPI - *EPI)*^{2}
	F	F	F	F	F				
Drainage facilities in my area are blocked with refuse	13	50	25	33	5	411	3.26	0.78	0.6084
Roads in my area are not motorable due to damages caused by flooding	6	31	14	68	7	339	2.69	0.21	0.0441
Electrical poles and cables in my area have been damaged as a result of flooding	2	12	9	83	20	271	2.15	-0.33	0.1089
Many homes in my area have been abandoned due to the effects of flooding	4	9	14	79	20	276	2.19	-0.29	0.0841
Flooding has resulted in the collapse of some buildings in my area	2	12	7	79	26	263	2.09	-0.39	0.1521
TOTAL	27	114	69	342	78	1560	12.38		0.9976

Table 7.: Effects of flooding on human assets

Effect of flooding on human assets	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	EHI (mean score)	Deviation EHI - *EHI*	Standard Deviation (EHI - *EHI)*^{2}
	F	F	F	F	F				
Many residents in my area have been displaced by flooding	5	17	17	81	6	312	2.48	0.18	0.0324
Displacement of residents has grossly reduced	-	13	35	70	8	305	2.42	0.12	0.0144

manpower assets in my area									
Loss of human life is a constant experience whenever there is flooding in my area	2	10	11	63	38	247	1.99	-0.31	0.0961
TOTAL	7	40	63	214	52	864	6.89		0.1429

Table 8: Effects of flooding on financial assets

Effect of flooding on financial assets	Strongly Agree WV (5)	Agree WV (4)	Undecided WV (3)	Disagree WV (2)	Strongly Disagree WV (1)	SWV	EFI (mean score)	Deviation EFI - *EFI*	Standard Deviation (EFI - *EFI)*^{2}
	F	F	F	F	F				
The cost of replacing/repairing properties damaged by flood is very high	14	66	38	6	2	462	3.67	0.52	0.2704
Many traders/business owners in my area have left due to the financial loss they suffered because of flooding.	4	17	62	40	3	357	2.83	-0.32	0.1024
Many house owners in my area often complain of reduction in tenancy rate caused by the fear of occupying houses in a flood prone area.	6	32	41	43	4	371	2.94	-0.21	0.0441
TOTAL	24	115	141	89	9	1,190	9.44		0.4169

DISCUSSION

This work was carried out to examine the various factors responsible for flooding and its effects on lives and properties in Lagos State in order to proffer possible suggestions on how to control them. The study established that there are effects of flooding on the lives and properties of the residents of the study area which vary from displacement and reduction in manpower assets to loss of human lives. Also, the cost of replacing/repairing properties damaged by flood is very high, many traders /business owners in the area have left due to the financial loss they suffered because of flooding and it has invariably reduced the tenancy rate in some areas. This is in line with the findings of Okoko (2008), Adelekan (2011) and Yoade et al. (2019).

The second finding shows the relationship between anthropogenic factors (i.e. urbanization, dam breaking, improper waste disposal, development of buildings on waterways) and flooding in Lagos State. The challenge of urbanization in relation to flooding is common in every city in Lagos. Development

brings people from other places that are less developed and this often brings overpopulation as one of its characteristics. Consequently, people begin to erect houses and pave their compounds; roads are tarred; and motor parks are created, the whole city becomes industrialized, etc. This finding corroborates the studies of Adelekan (2011), Odunuga, Oyebande & Omojola, (2012), Aderogba et al (2012), Rose & Abubakar (2014), Sojobi, Balogun & Salami (2016), Olanrewaju, and Chitakira, Olanrewaju & Louw (2019). All these studies found that the infiltration rate reduced as the larger part of the available land has become impervious. Storm water which cannot be absorbed into the ground then becomes runoff and eventually results in flood due to lack of control.

This study also reveals improper waste disposal as a major cause of flooding almost in every part of Lagos which led to incessant flooding occurrences in the study area. It is disheartening to discover that in this era of enlightenment, some people are still ignorant of the fact that dumping of refuse into drainage facilities is injurious to people's health. Some also ignorantly engaged the services of truck pushers in the disposal of their refuse who eventually emptied them into water bodies and canals. Consequently, this results in waste materials such as plastics, polythene materials and the likes blocking drainage channels and hindering the free flow of stormwater and flood water. This finding confirms the studies of Pender (2006); Komolafe et al. (2014); Rose et al. (2014); Lucas (2021), Meng and Manteghi (2021); and Umar & Gray (2023). These studies found that the impacts of flooding are felt by the individual and by society, through loss of property and infrastructure, damage to farmland, displaced water-living wildlife posing threats, contamination of drinking water, spread of waterborne diseases, fatalities and loss of wellbeing, loss of livelihoods, economic depression, and hindrance in achieving social development goals such as safety and eradication of poverty.

Lastly, this study has also confirmed that the erection of buildings on waterways causes flooding in Lagos State. In many parts of Lagos, buildings are erected illegally in places where they have not been authorized to do so. Some of these buildings are erected on waterways and cause a blockage to the path of moving water, thereby resulting in damage to buildings and properties because the water has nowhere to pass through.

CONCLUSION

This study examined the causes and effects of flooding in Lagos State with the aim of suggesting the various ways by which floods can be controlled. This study raised certain questions as regards the various factors causing flooding in Lagos State. These issues have been verified empirically and the findings obtained in the study are justifiably presented. It is not out of place to say that flooding is a global phenomenon, but the impacts in many urban areas in developing countries can be overwhelming. It is easier to understand the threats of flooding in Lagos State by the attention generated by the media and the academic world, especially in literature relating to social and environmental sciences.

Flood has negatively impacted Lagosians in the past and also in present time. It has destroyed infrastructure and disrupted economic activities. However, based on the current practices in flood management and flood risk reduction in the context of living with floods, the actions of the Lagos State Government and other stakeholders towards addressing the challenges of flooding have arguably been limited. More so, up-to-date information on flood events in Lagos State is not readily available and all efforts to ensure a city that is resilient to flooding seem to have proved ineffective. One of the reasons for this ineffectiveness is partly due to reliance on structural methods being put in place. To achieve more functional control, non-structural measures must complement the structural measures to curb the flood menace in the State. The following recommendations have been put up to arrest the incidence of flooding before, during and after the occurrence.

Before flooding

- Research and investment should focus on the mapping of flood-prone areas for the purpose of planning. Physical planning of upcoming suburbs should be in conformity with those in existence and the natural landscape.
- Flood occurrence can be predicted but at times, it occurs without warning and needs to be planned for. The following steps can be taken;
    - Proper disposal of refuse to the right channels and desisting from patronizing local truck pushers who dispose of the refuse wrongly.
    - The planting of trees, shrubs and decorative plants in individual homes would help reduce surface runoff as some of the water resulting from rainfall would be absorbed into the ground.
    - The use of interlocking blocks for pavements in homes, industries and other areas is advised as it allows some measure of infiltration of water into the ground when it rains.

During flooding

- Temporary or permanent evacuation of residents of flood-prone areas, especially during the rainy season to protect lives and property.
- Turn off electrical appliances; and avoid power lines or broken electricity transmission cables.
- Avoid entering into stormwater as it may contain chemicals and hazardous materials that have been carried along the way from industries and factories.

After flooding

- In the case of homes which have been affected by flood, leave electrical appliances off until electrical personnel have checked and given the go-ahead to use the appliances.
- Proper house cleaning should be carried out after the flood to remove any contamination that might have been caused by contaminated stormwater or flood water.

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Onifade, V.A. PhD is a Senior Lecturer at Department of Urban and Regional Planning, University of Lagos, Nigeria.

Yoade, A.O. PhD is a Lecturer at Department of Urban and Regional Planning, Redeemer's University Ede, Nigeria

Olatunji, S.A. PhD is a Lecturer at Department of Urban and Regional Planning, Federal University Oye-Ekiti, Nigeria

Husseni, M.A. is a lecturer at Department of Urban and Regional Planning, University of Lagos, Nigeria

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APPLICATION PROSPECT ANALYSIS OF HYBRID FIBER CONCRETE SUBWAY SHIELD SEGMENT

Kong Linjie[1,2] & Norul Wahida Kamaruzaman[2]
[1]*Department of Construction Engineering, Zhejiang College of Construction*
[2]*Faculty of Engineering, Science and Technology, Infrastructure University Kuala Lumpur*

ABSTRACT
With the rapid development of social economy, the urban population is increasing day by day, and the traffic pressure is increasing. Subway tunnels will be an inevitable trend to alleviate the pressure of urban rail transit. However, currently, the shield tunnel segments used in subway tunnel engineering mainly use ordinary reinforced concrete. The brittleness and low crack resistance of the material itself cause a large number of cracks and damage during the production, transportation, and construction of shield tunnel segments, directly affecting the safety and durability of subway tunnel engineering. In response to the many unfavorable factors of ordinary reinforced concrete subway shield tunnel segments, this article preliminarily explores the use of hybrid fiber concrete instead of ordinary reinforced concrete through various literature and on-site investigations. By utilizing hybrid fiber reinforced concrete which has a record of excellent performance, the various shortcomings of ordinary reinforced concrete subway shield tunnel segments can be compensated. The research results of this article provide an important basis for the development and production of hybrid fiber reinforced concrete subway shield tunnel segments.

Keywords:
Subway shield tunnel segment; Fiber reinforced concrete; subway engineering

OVERVIEW

As an important component of the urban rapid rail transit system, the subway has gradually become the main force of urban public passenger transportation networks due to its characteristics of safety, speed, land conservation, low noise, low pollution, and energy conservation. In addition, this form of transportation is not affected by climate conditions. According to China Highway and Transportation magazine, the total length of urban rail transit in 50 cities in the Chinese Mainland will reach 9192.62 km in 2021, of which the subway will account for 78.9% (Yang Fengyuan, 2023).

With the development of the urban population and the increase of traffic pressure, the development of tunnel engineering will become an inevitable trend in urban underground rail transit. In the future, there will be more tunnel projects, indicating a rapid increase in demand for shield tunnel segments. The subway project is a century-old project, and it is necessary to study the key technologies of high-performance subway shield tunnel segments.

RESEARCH QUESTION AND HYPOTHESIS

At present, the shield tunnel segments are mainly ordinary reinforced concrete segments with a diameter of 6 meters. Through on-site investigation and research, it was found that the weight of the 1.2-meter-wide A-shaped reinforced concrete pipe segment is about 4 tons. During transportation and installation, a large number of cracks and even damage may occur in the pipe segment. The cracking and damage of pipe segments will undoubtedly seriously affect the safety and durability of tunnel engineering. On the other hand, for underground engineering, the carbonization of the structure itself, the corrosion of external erosion, and the electrochemical corrosion of stray currents in the tunnel require the shield tunnel segments to have good durability. In addition, tunnel engineering is located in an underground

environment, and its impermeability, corrosion resistance, and fire resistance will be important indicators of shield tunnel segments. These are problems that are difficult to overcome for ordinary reinforced concrete pipe segments.

Fiber reinforced concrete subway shield tunnel segment is a new type of composite segment that has received much attention and development in recent years. Compared with ordinary subway direct shield tunnel segments, it has better physical and mechanical properties. By replacing ordinary concrete with fiber reinforced concrete, the mechanical properties of subway shield tunnel segments, such as tensile strength, bending strength, wear resistance, impact resistance, fatigue resistance, toughness, and crack resistance will be improved. The durability is convenient, but it also has the advantage that ordinary reinforced concrete segments cannot be compared to. Its resistance to damage, permeability, carbonization, corrosion, and fire resistance will be significantly improved.

DEFECTS OF ORDINARY REINFORCED CONCRETE SUBWAY SHIELD SEGMENTS

Prefabricated reinforced concrete pipe segments are the main lining structure of tunnel engineering, capable of withstanding underground soil and water pressures. At present, the overall trend in tunnel engineering design and construction is to gradually increase the diameter of the tunnel, which leads to an increase in the size of the lining blocks. The most direct problem is that large areas of cracks and damage often occur during production, transportation and installation, directly affecting the quality of tunnel engineering. Through on-site investigation and analysis of the failure pattern of the pipe section, cracks in ordinary reinforced concrete pipe sections mainly take the following forms:

1) Cracks on the outer arc of the segment

This type of damage often occurs in two situations. The first is on the outer arc of the pipe segment after underwater repair, which belongs to the surface of fine cracks. Another type is surface cracks that appear after steam curing, which belong to concrete shrinkage cracks. The first type of crack is very common in the production process of tunnel segments and is also the most important fracture form of shield tunnel segments. It is only easy to see when the segments are damp. The second type of crack is caused by uneven surface temperature during the hydration process of large-volume concrete shield tunnel segments.

2) Side cracks of the segment

The main reason for this type of crack is the carbonation shrinkage caused by the alternating temperature changes during the curing process of dry and wet concrete, which is a type of carbonation shrinkage crack. Although the carbonation of concrete, such as the carbonation of hydration products such as C-S-H gel, usually takes a long time, the carbonation of concrete surface can be completed in a short time or even several hours, plus the superposition of drying shrinkage, when the tensile strength of surface concrete is not enough to resist the tensile stress generated by shrinkage. It directly leads to the surface cracking of concrete, resulting in micro cracks (Zhang Yaodong and Yu Wei, 2018).

3) Cracks in the hand hole of the segment

This kind of crack mainly occurs after the concrete is in the steam curing stage, where the main shape of the crack is eight, and is relatively thin and continuous. In general, the larger the hand hole, the more obvious the crack. The main reasons for its formation are, on the one hand, the concrete has a large self-shrinkage during the hydration process while on the other hand, the thermal expansion of the steel mold

produces a large temperature-concentrated stress. The superposition of the two results in a 45° direction of surface shrinkage crack.

The results show that the cracks of common reinforced concrete subway shield segments are mainly plastic shrinkage cracks. The main reason for the cracks is that the surface shrinkage cracks easily occur because of the large diameter, volume, thickness and arc of subway shield segments. From the perspective of the mechanism of crack generation, the main reason is that the shrinkage stress in the process of concrete curing is greater than the tensile strength of concrete.

Figure 1: Damage to ordinary reinforced concrete shield segment

In addition to the plastic shrinkage cracks generated in the production process, the ordinary reinforced concrete subway shield segments are often damaged during transportation and construction due to their large volume and heavy quality. The main forms of damage are as follows:

(1) Segment collapse: This refers to the segment edge damage caused by the uneven force of the shield on the pipe which may be caused by the careless transfer and installation of the segment and the improper attitude control of the shield machine.

(2) Segment misalignment: This refers to the damage caused by the unevenness between the two segments at the circumferential and longitudinal joints of the segment, the bad posture of the shield machine, the improper selection of segments, and the incomplete grouting behind the segment, and the careless installation, which is generally not easy to repair and can only be controlled during the driving process.

Cracks and damage of subway shield segments will cause the overall damage of subway lining structure, and then cause tunnel leakage and corrosion, which is a great challenge to the control of project quality and safety. According to the investigation of multi-city subways, the damage to ordinary reinforced concrete segments is mainly caused by excessive impact force and tensile stress (YAN Zhiguo, Zhu Hehua, Liao Shaoming, Liu Fengjun, 2016).

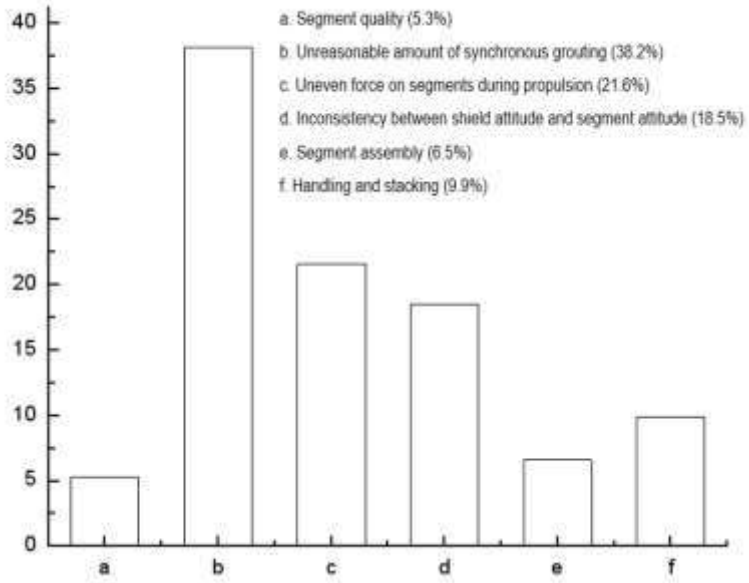

Figure 2: Schematic diagram of failure causes and proportion of ordinary reinforced concrete subway shield segments

In addition to cracks and damage, ordinary reinforced concrete subway shield segments are not ideal in terms of fire resistance and corrosion resistance. Fire resistance is an important index of tunnel engineering. Ordinary reinforced concrete segments do not consider the fire resistance factor. Fire resistance of tunnel engineering cannot be guaranteed; there are serious fire safety risks. In addition, because of its special engineering environment, the erosion of concrete structure is more complicated and severe than that of ordinary engineering. Subway projects are often located in strata with abundant groundwater and strong permeability, and the groundwater in China, especially the shallow groundwater, is seriously polluted and rich in corrosive media such as chloride ions and sulfate ions. Therefore, the subway shield segment, as a structure that has been immersed in groundwater for a long time, suffers from the dissolution of underground pressure water and the erosion of acidic groundwater. The groundwater contains sulfate, chloride ion erosion, etc.(Huang Wenxin , 2014)

RESEARCH STATUS OF FIBER CONCRETE

As one of the most important composite materials in construction, concrete has good compressive strength and durability, and is widely used in housing, roads, bridges and other engineering construction fields. At present, China's annual consumption of coagulation, reaching more than 10 billion tons, is the highest utilization rate of building materials (Industry Publicity Department of China Concrete and Cement Products Association, 2023). However, it also has some shortcomings, including low tensile and bending strength, impact resistance, knock resistance and poor toughness, etc. These shortcomings seriously limit the full play of the advantages of concrete. With the improvement of concrete strength, these shortcomings are also more prominent. As we all know, the higher the strength of concrete, the more negative its toughness, brittleness, crack resistance and structural ductility. Structural seismic performance and fire resistance will also be correspondingly reduced, and the durability of concrete structure will be more prominent (Han Dachun, 2010). Methods and approaches to improve the above properties of concrete have been constantly explored by many scholars for a long time, among which fiber-reinforced concrete

is one of the most widely studied and applied important approaches in recent years (Wang Zhengyou, 2002). At present, there are two main types of fiber reinforced concrete. The first is high elastic modulus short fiber reinforced concrete, which is represented by steel fiber. The second is the short fiber reinforced concrete with low elastic modulus, which is represented by polypropylene fiber and nylon fiber (He L J. , 2007).

Fiber concrete is a cement-based composite material composed of cement slurry, mortar or concrete as the base material and metal materials, inorganic materials or organic fibers as the reinforcement material. It is a new building material formed by mixing short and fine fibers with good properties such as high tensile strength, high limit elongation and high alkali resistance into the concrete matrix. By adding fiber materials to the matrix concrete, the development of plastic cracks in the early stage of the matrix concrete can be inhibited, the expansion of cracks in the matrix material under external load can be hindered, the degree of dry shrinkage and cold shrinkage can be reduced, and the properties of tensile, bending, explosion, impact and toughness of the matrix concrete can be greatly improved. And it will promote the durability of concrete impermeability, frost resistance, waterproofing and other great progress.

Fiber concrete first appeared in the early 20th century, with the earliest and most extensive research being on the application of steel fiber concrete. Russian experts applied steel fiber to concrete, beginning the development history of steel fiber concrete. In the United States, HP Porter added steel fibers to ordinary concrete and published the first research report on staple fibers. He proposed the uniform dispersion of staple fibers in concrete as a strengthening structural material. Granham, also from the United States added steel fiber to ordinary reinforced concrete and came to the conclusion that adding steel fiber could improve the strength and volume stability of concrete. American scholars J.P. Roomualdi and G.B. Busson published a series of research papers on the crack resistance mechanism of steel fibers, and developed the theory that the cracking strength of steel fiber concrete is determined by the average distance between steel fibers that plays an effective role in tensile stress. This is the famous "fiber distance theory". It opens a new era of practical research of fiber-reinforced concrete (Cox, H. L.,1952).

In the United States, fiber reinforced prefabricated wall panels, balconies, corrugated panels and hollow floors have been widely used in high-rise buildings, and a large number of highway pavements and bridge decks have been laid. A typical example is the surfacing project of the tank parking lot in Fort Hood, Texas, where steel fiber concrete is used as the cladding material, and the service life is increased by nearly eight times. The fiber concrete doped with fly ash was adopted at the Denver International Airport, which significantly reduced pavement thickness and saved a lot of investment (Chen Liang, 2006). In Canada, the Lafarge Cement Applied Research Center and the Industrial Materials Research Institute collaborated to establish the largest private fiber concrete laboratory in North America in 1985 to test the steel fiber concrete pavement. The test shows that the pavement thickness can be reduced by 20% when reinforced with glass fiber and 45% when reinforced with steel fiber (Rong Jianlin , 2006).

A research group (R.N.Swamyete, 1981) from the University of Sheffield in the United Kingdom has carried out research on the basic theory of fiber reinforced coagulation and engineering practical problems in design and construction, and achieved a series of results. Steel fiber-reinforced concrete has been successfully applied to prefabricated flooring in the high-rise parking lot of London Heathrow Airport, the runway and apron modification project of Frankfurt International Airport, and a Swedish rock stabilization and structural reinforcement project. In Europe, the most widely use for steel fiber-reinforced concrete is flooring and wall panels in industrial buildings, as well as pavement paving, followed by tunnel linings and various prefabricated building components (Morton, J.1997). In Japan, starting from 1973, companies have carried out research and development work of steel fiber concrete, and promoted the application of building structures, tunnel linings (such as the central highway Huinayama tunnel), road paving, airport runways, bridge decks and structural local reinforcement.

Since the 1970s, nylon, polypropylene, plant and other low-elastic fiber concrete and carbon, glass, asbestos and other high-elastic fiber concrete have also attracted the attention of scholars around the world with the development of steel fiber coagulants. Especially in Europe, Japan and the United

States, synthetic fiber concrete has been more widely studied and applied, and there are many examples for new construction and repair projects. In the United States, the amount of synthetic fiber concrete has accounted for 7% of the total output of concrete, which is far more than the previously developed steel fiber concrete (3%), and is regarded as a new development of modern concrete technology (Duan Fuqiang, 2017).

In view of the excellent properties of steel fiber concrete and polypropylene fiber concrete respectively, Kobayashi K et al. studied the bending properties of steel fiber - polypropylene fiber hybrid fiber concrete. The term "hybrid" first appeared in academic papers on fiber concrete, and since then, the research on hybrid fiber concrete has gradually increased. Later, Glavind and Aarre et al. showed that steel-polypropylene fiber concrete could increase the ultimate compressive strain of concrete.

Chinese research institutions have also done a lot of experiments in the field of fiber concrete, Professor Yao Wu et al. conducted experiments to study the effect of mixing carbon-steel fiber, carbon-polypropylene fiber and steel-polypropylene fiber on the mechanical properties of high-performance concrete at low content (the total fiber volume content of 0.5%), respectively. The three types of mixed fibers can all improve the compressive strength and elastic modulus of concrete. Qian Hongping et al. studied the effect of fiber hybrid (high-elastic modulus steel fiber, high-elastic polyvinyl fiber, and low-elastic modulus polypropylene fiber) on concrete shrinkage performance at various ages: whether it is a single fiber or mixed among fibers, the shrinkage rate of concrete can be significantly reduced, but the effect of fiber hybrid is significantly better than that of single fiber.

Huayuan et al. studied the bending fatigue properties of carbon fiber-polypropylene fiber concrete. The law of fatigue life and fatigue strength changing with the mixture amount of hybrid fiber is obtained as well as the fatigue equation of materials. The characteristics of fatigue residual strain accumulation, cyclic strain amplitude evolution and total fatigue strain amplitude development of hybrid fiber-reinforced concrete under high-frequency cyclic load are discussed, and a flexural fatigue deformation model of hybrid fiber-reinforced concrete material is established. Deng Zongcai et al. tested the bending fatigue characteristics of hybrid components of steel fiber and cellulose fiber, and found that hybrid fiber can give full play to the advantages of various fibers, and has a significant effect on improving fatigue properties than single-doped steel fiber and cellulose fiber.

Academician Sun Wei et al. systematically studied the effects of the mixing of steel fiber and polypropylene fiber of different scales on the physical properties of cement-based materials, and found that hybrid fiber significantly improved the permeability resistance of concrete, and the more dimensional layers of hybrid fiber, the better the permeability resistance. Wang Hongxi et al. also showed that the impermeability of concrete gradually improved with the increase of the total volume and content of fiber. Sun Jiaying's test found that only when the fibers were mixed in a certain proportion, the permeability resistance of hybrid fiber coagulants was better than that of benchmark concrete [24]. Yang Chengjiao et al. studied the impervious properties of hybrid fiber (steel fiber - polypropylene fiber) coagulation through experiments and found that the impervious properties of concrete were little affected by hybrid fiber, but the addition of air-entraining agent could improve the impervious properties of hybrid fiber concrete.

Ma Xiaohua conducted a freeze-thaw test on hybrid fiber high-performance concrete to study the effect of hybrid fiber on the freeze-thaw resistance of concrete. The study found that after 200 freeze-thaw cycles, the loss of compressive strength and splitting tensile strength of fiber coagulation is smaller than that of plain concrete; At the same time, after the freeze-thaw cycle, the toughness of fiber high performance concrete will decrease, but the toughness loss of single fiber concrete is greater than that of hybrid fiber concrete. The durability test of concrete by Huayuan et al. also shows that the freeze-thaw resistance of hybrid fiber concrete is better than that of benchmark concrete. Based on the existing mathematical model of concrete carbonation depth, Dong Yanwei et al. proposed a calculation model of hybrid fiber concrete carbonation depth through carbonation test. The compressive strength of benchmark concrete and different hybrid types of concrete after carbonization is basically the same with the change in trend of carbonation age, and basically increases with the growth of age.

Dong Xiangjun et al. found that the addition of steel fiber could not inhibit the burst of HPC under fire, and the burst degree increased with the increase of steel fiber content. However, polypropylene fiber can effectively improve the fire burst resistance of high performance concrete. The mechanical properties of high-performance concrete after fire are mainly played by steel fiber, while polypropylene has little effect on the properties after fire. Therefore, the hybrid method of polypropylene fiber and steel fiber can complement each other, and at the same time improve the fire knock resistance and mechanical properties of HPC after fire. He Lijuan also obtained the above similar conclusion through experiments, and the addition of hybrid fibers improved the compressive shear failure criterion value of concrete after high temperature. When steel fiber mixed with a content of 35kg/m^3 and polypropylene fiber mixed with a content of 2.5kg/m^3, the compressive shear failure strength value increased by 27.6% compared with that of reinforced concrete.

SIGNIFICANCE OF HYBRID FIBER CONCRETE APPLIED TO SUBWAY SHIELD SEGMENTS

Hybrid fiber-reinforced concrete (HFRC) is a new type of composite building material with excellent physical and mechanical properties. Compared with ordinary concrete, its tensile strength, flexural strength, wear resistance, impact resistance, corrosion resistance, fatigue resistance, crack resistance, explosion resistance and other properties are significantly more superior. The outstanding crack resistance and deformation resistance of mixed fiber-reinforced concrete can greatly reduce the crack width of components under the same load, greatly compensating for the shortcomings of ordinary reinforced concrete. At the same time, mixed fiber-reinforced concrete has good fire resistance performance, which can effectively solve the fire resistance requirements of special projects such as tunnel engineering; In addition, mixed fiber-reinforced concrete has excellent corrosion resistance and is fully adapted to the severe corrosive environment of underground engineering (Ning B. 2019).

Considering the defects of ordinary reinforced concrete shield tunnel segments, replacing ordinary concrete with mixed fiber concrete is undoubtedly an effective way to improve the safety and durability of tunnel engineering. By mixing high elastic modulus steel fibers with low elastic modulus polypropylene fibers, some or all of the steel bars in ordinary tunnel segments can be replaced, which also makes the mixed fiber subway shield tunnel segments better in terms of economic benefits. The main technical and economic advantages of mixed fiber concrete subway shield tunnel segments are as follows:

(1) It has better mechanical properties in terms of tensile, bending, and shear strength.

(2) It can effectively reduce plastic shrinkage cracks during the production process of pipe segments.

(3) It improves the required damage resistance of pipe segments during transportation and stacking processes.

(4) It improves the corrosion resistance of the shielding section;

(5) It is effective in improving the fire resistance of subway shield tunneling pipes to ensure the fire resistance of subway projects.

(6) It saves production costs, partially or even completely replacing steel bars, which undoubtedly greatly reduces the cost of pipe segments;

(7) It reduces the loss of steel molds, and partially or completely avoids the use of steel cages, improving the industrial production speed of segmented production, with output to possibly be more than doubled;

(8) It saves maintenance costs in the later stage due to its excellent performance, which greatly reduces damage to the pipe segments during engineering use;

In short, mixed fiber concrete has excellent performance and can fully compensate for the shortcomings of ordinary reinforced concrete subway shield tunnel segments.

APPLICATION STATUS OF HYBRID FIBERS IN SUBWAY SHIELD SEGMENTS

Concrete has become the largest and most widely used building material in construction engineering due to its high strength, good plasticity, and simple material source. However, it also has some drawbacks, including low tensile and bending strength, as well as poor impact resistance, blast resistance, and toughness. These shortcomings seriously limit the full utilization of the advantages of concrete, and as the strength of concrete increases, these shortcomings become more prominent. As is well known, the higher the strength of concrete, the poorer its toughness, brittleness, crack resistance, and structural ductility. The seismic and fire resistance performance of the structure will correspondingly decrease, and the durability of concrete structures will be more prominent (Chen Liang. 2006). For a long time, many scholars have been exploring methods and approaches to improve the above-mentioned properties of concrete, among which fiber-reinforced concrete is one of the most widely studied and applied important approaches in recent years (Halderen MWAM.1997). At present, there are two main types of fiber-reinforced concrete. The first is high elastic modulus short fiber-reinforced concrete, which is represented by steel fibers, The second, is the low elastic modulus short fiber concrete, which is represented by polypropylene fibers and nylon fibers (PU Ao. 2017).

With the deepening of research on fiber-reinforced concrete by various scholars, the achievements accumulated in the application process of fiber-reinforced concrete materials over the years, and the various drawbacks exposed by ordinary reinforced concrete in engineering practice, fiber-reinforced concrete has become an inevitable trend to replace ordinary reinforced concrete in important engineering projects. Although the application of fiber-reinforced concrete in domestic tunnel engineering is still in the experimental research stage, fiber-reinforced concrete has been widely used in tunnel engineering, especially in European countries where the technology of fiber-reinforced concrete subway shield tunnel segments has become quite mature.

With the continuous exposure of defects in ordinary reinforced concrete shield tunnel segments, many Western countries have begun to study the application of fiber-reinforced concrete in subway shield tunnel segments. Many countries have gradually started to use steel fiber-reinforced concrete instead of ordinary reinforced concrete in tunnel engineering. In European countries, the application technology of fiber-reinforced concrete pipe segments is becoming increasingly mature. Attempts to use mixed fiber-reinforced concrete prefabricated pipe segments in tunnel engineering projects include:

Section 34 of the German Essen Metro North Line (started in 1997): A 100-meter-long test line was constructed using prefabricated fiber-reinforced concrete on the Essen Metro North Line.

The "Second Heienoed Tunnel" of the Dutch highway tunnel (started in 1998): In the Netherlands, a 16-ring test tunnel was constructed using mixed fiber concrete segments in the "First Heienoed Tunnel" of the highway tunnel.

The "Trasvates Manabi" water conveyance tunnel project in Ecuador (started in 2000): In South America, Ecuador used mixed fiber concrete prefabricated pipe segments in the "Trasvates Manabi" water conveyance tunnel project, which is 11.4km long and has a diameter of 4m.

Barcelona Metro Line 9 (2009-2016) in Spain: A fiber concrete shield tunnel section was used in the construction of the Barcelona Metro Line 9. This project includes the installation of a tunnel lining composed of fiber-reinforced concrete.

Delhi Metro, India (Phase III, started in 2011): The expansion project of the Delhi Metro Phase III adopts a fiber-reinforced concrete shield tunnel section. The project is still ongoing, including the construction of a fiber-reinforced concrete section of a subway tunnel.

Türkiye Istanbul Metro (several lines, operating since 1989): Istanbul Metro and several lines have used fiber concrete shield sections in the construction of metro tunnels. The project began in 1989 and continued to expand, using fiber-reinforced concrete segments in tunnel lining.

The construction of Metro Line 5 in S ã o Paulo, Brazil (2004-2018) involves the use of fiber-reinforced concrete shield tunneling sections. This project was carried out from 2004 to 2018, using fiber-reinforced concrete sections for subway tunnel construction.

In China, the main engineering applications include the construction of a 50-meter steel fiber-reinforced concrete segment test section on the M6 line of the Shanghai Metro. Through various tunnel safety monitoring systems, real-time data (deformation and stress) of the segments during construction and operation are collected, and the advantages of steel fiber segments are systematically analyzed. The monitoring data shows that the experimental section is in good working condition and safe and reliable. The construction of Nanjing Metro Line 4 adopts fiber-reinforced concrete shield tunnel segments, which lasted from 2006 to 2012. The tunnel lining is composed of fiber-reinforced concrete segments. The shield tunneling section between Beitucheng Station and Shaoyaoju Station on Beijing Metro Line 10 has also attempted to apply steel fiber-reinforced concrete pipe segment technology. Engineering practice has shown that cracking is rarely found in the steel fiber-reinforced concrete section during transportation and installation, reducing a significant amount of maintenance costs in the later stage.

DISCUSSION AND CONCLUSION

From the trend of urban development, it can be seen that tunnel engineering is an inevitable trend in the development of urban rail transit. From the many drawbacks of ordinary reinforced concrete subway shield tunnel segments, it can be seen that using mixed fiber concrete instead of ordinary reinforced concrete to make subway shield tunnel segments can significantly improve the mechanical properties, durability, and economy of the segments. At present, the application research of fiber-reinforced concrete in subway shield tunnel segments is not yet mature; the research on the application of mixed fiber-reinforced concrete in shield tunnel segments is just beginning. In addition, the production and research of subway shield tunnel segments are also in their infancy, so further research on the application of mixed fiber concrete in subway shield tunnel segments will have good scientific research and industrial prospects.

AUTHOR BIOGRAPHY

Kong Linjie is a lecturer at Zhejiang College of Construction, China. She is conducting research and teaching in the construction courses for undergraduates. She is also currently a PhD candidate at Infrastructure University Kuala Lumpur. Her field of expertise are in the construction technology, construction material and concrete technology. *Email: 843913750@qq.com*

Norul Wahida Kamaruzaman, PhD is a lecturer at Infrastructure University Kuala Lumpur (IUKL). She is conducting research and teaching in the construction courses for undergraduates and postgraduates. Her field of expertise are in the construction technology, construction material and concrete technology. *Email: wahida@iukl.edu.my*

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A COMPREHENSIVE SWOT ANALYSIS FOR BLOCKCHAIN-BASED CLOUD DATA INTEGRITY VERIFICATION SCHEME

Li Zhenxiang [1], Jin Yuanrong [1], Wang Haipei [1] & Mohammad Nazir Ahmad [2]
[1]*Infrastructure University Kuala Lumpur, Malaysia*
[2]*Universiti Kebangsaan Malaysia, Malaysia*

ABSTRACT
In the current big data environment where data security is a major concern, the shortcomings of traditional centralised cloud data integrity verification schemes are gradually being identified. These include the lack of transparency in protocol enforcement and the risk of single points of failure. A growing number of researchers have undertaken significant research efforts to address these flaws. To address these challenges, some researchers have proposed a Blockchain-Based Cloud Data Integrity Verification (BBCDIV) scheme by combining blockchain technology with traditional cloud data integrity verification protocols. This paper provides an introduction and a comprehensive SWOT analysis of BBCDIV, a study that aims to assess the strengths, weaknesses, opportunities, and threats of blockchain technology in relation to data integrity in a cloud computing environment. This paper provides an overall view of the BBCDIV solution through an analysis and review of the literature and by considering internal and external factors. The conclusions of this paper highlight the potential advantages of blockchain technology in ensuring secure and reliable data storage and management in cloud environments, while also identifying potential challenges and limitations that need to be addressed for successful implementation. This SWOT analysis can provide a research reference as well as potential future research directions for researchers and practitioners in related fields.

Keywords:
Cloud Storage, Data Security, Integrity Verification, Blockchain, SWOT

INTRODUCTION

In recent years, cloud computing has been more widely used across a wide range of industries as the volume of data has increased dramatically (Oke et al., 2021). Cloud storage, cloud access and cloud management have emerged as a result (Mustafa et al., 2022). However, a number of data security issues, such as data leakage, unauthorised access and tampering (Bandari, 2023) often arise in cloud environments and these serious issues have led to considerable concern about data integrity and security. Various solutions have been proposed to address these challenges, and one very hot solution is the integration of blockchain technology into cloud data integrity verification schemes (He et al., 2021; X. Li et al., 2023; Liu et al., 2023; Yu et al., 2022; C. Zhang et al., 2022; Y. Zhang et al., 2022).

Blockchain was originally introduced as the underlying technology for cryptocurrencies such as Bitcoin and is widely used in finance and IT due to its decentralised and immutable nature (S. N. Khan et al., 2021). It provides a distributed and transparent ledger that enables secure transactions and data storage without the need for a trusted central authority to manage the organisation. Utilizing this feature of the blockchain, the blockchain can provide a technical basis for zero trust (Abdalla et al., 2022). Due to the decentralized and non-tamperable nature of blockchain, it can be used to establish trust and verification mechanisms to ensure the security and authenticity of transactions and information. Blockchain technology can be used for identity verification, data integrity verification, smart contract execution, etc., thereby enhancing the security and credibility of the zero-trust model.

The purpose of this paper is to present a comprehensive SWOT analysis for a blockchain-based cloud data integrity verification scheme. SWOT analysis is a strategic planning tool used to assess the strengths, weaknesses, opportunities and threats associated with a particular initiative (Nyamasvisva et

al., 2022). In the context of this study, the SWOT analysis provides a systematic assessment of the factors that can influence the success and effectiveness of the proposed programme.
The methodology used for this analysis involved a comparative analysis of relevant literature within the last three years in the relevant field, as well as a thorough review of internal and external factors. Internally, the advantages and disadvantages of a blockchain-based cloud data integrity verification scheme were assessed, considering factors such as scalability, efficiency and usability. Externally, the analysis explores the opportunities and threats associated with the adoption and implementation of the proposed solution, taking into account factors such as regulatory frameworks, market trends and potential security risks.

The findings of this study will clarify the potential advantages of implementing a blockchain-based cloud data integrity verification scheme. It will also highlight the challenges and constraints that need to be addressed to ensure its successful implementation. By providing a comprehensive assessment of the SWOT factors of the scheme, this paper aims to provide valuable insights and guidance to researchers, practitioners and policymakers interested in leveraging blockchain technology for secure and trusted data storage and management in cloud environments.

BACKGROUND

In the big data era, traditional storage technologies suffer from high construction costs, high maintenance difficulties and lack of flexibility (I. Khan et al., 2021), making it difficult to meet large-scale business needs. Cloud computing has emerged as a dominant paradigm for data storage, processing, and service provisioning due to its flexibility, scalability, and cost-effectiveness. To achieve efficient and secure storage and management of big data, more and more users are outsourcing their data to cloud storage. Cloud storage is an extension of cloud computing that uses virtualisation technology to integrate disparate storage devices into a huge pool of storage (Lei et al., 2021), providing users with highly flexible, resource-light, and on-demand rented storage services.

Cloud services allow users to outsource the storage and management of data, significantly reducing the cost of maintaining data. However, data outsourced to the cloud is exposed to many security threats, including data integrity breaches. On the one hand, the insecurity of the cloud storage system itself makes it vulnerable to external attacks such as illegal access, malicious tampering, destruction or deletion; on the other hand, cloud service providers may remove data that is infrequently accessed by users in order to conserve resources and make more profit (Gill et al., 2022).

Therefore, verifying the integrity of outsourced data in cloud storage is one of the keys to ensuring secure data storage and one of the keys to promoting the commercialisation of cloud storage services. The reliance on third-party cloud service providers raises concerns about data integrity, as users have limited control and visibility over their data. The risk of unauthorized access, data tampering, and insider threats has become a major challenge in cloud environments, necessitating robust data integrity verification mechanisms.

Traditional methods of ensuring data integrity, such as checksums and digital signatures, have limitations when it comes to cloud environments (Seth et al., 2022). These approaches typically rely on a centralized authority to verify data integrity, which can be a single point of failure and vulnerable to attacks. Moreover, the lack of transparency and auditability in traditional systems makes it difficult to detect and prove data tampering.

The emergence of blockchain technology in recent years has provided a new direction to address these issues, and a number of studies have combined blockchain with traditional cloud data integrity verification schemes. Blockchain technology has emerged as a potential solution to address these challenges. Originating from the Bitcoin cryptocurrency, blockchain offers a decentralized, tamper-resistant, and transparent mechanism for recording transactions and data. By leveraging the cryptographic properties of blockchain, data can be stored in a distributed ledger, where each transaction is validated

and linked to the previous one, forming an immutable chain of blocks. This decentralized and transparent nature of blockchain ensures data integrity and enhances trust among participants.
Integrating blockchain into cloud data integrity verification schemes can provide several benefits (Whyte et al., 2022). Firstly, it eliminates the need for a centralized authority, reducing the risk of a single point of failure. Secondly, blockchain's immutability ensures that once data is recorded, it cannot be altered or tampered with without consensus from the network. Thirdly, the transparent nature of blockchain allows for easier auditing and verification of data integrity, enhancing trust and accountability.

However, while the potential advantages of blockchain in ensuring cloud data integrity are evident, there are also challenges and limitations that need to be considered. These include scalability issues, high computational requirements, potential privacy concerns, regulatory constraints, and interoperability with existing cloud infrastructure (Habib et al., 2022). Understanding these factors and conducting a comprehensive SWOT analysis is crucial for assessing the feasibility and effectiveness of a blockchain-based cloud data integrity verification scheme.

BBCDIV: A PARADIGM SHIFT IN VERIFICATION TECHNIQUES

Concept Elaboration

Cloud storage provides data owners with flexible resource allocation and ample storage space (Almurisi & Tadisetty, 2022). Data owners no longer need to bear the burden of local data storage but can directly upload their data to cloud storage service providers through network devices. The service providers then manage the data and allocate storage space as needed, optimizing storage resource utilization. However, cloud storage also means that data owners lose direct control over their data, resulting in a lack of effective security and accuracy guarantees for cloud data. On the one hand, cloud storage service providers may delete data resources with low access rates to improve storage space utilization. On the other hand, untrusted cloud storage service providers may collude with adversaries to leak remote data for profit. To ensure the security of cloud data, integrity verification technology has emerged.

With the help of this technology, data owners can check the integrity of remote data without having to download the complete files (Han et al., 2022). As shown in Figure 1, data owners usually upload their data to cloud storage servers to reduce storage costs. They also employ third-party auditors to perform integrity audits on the cloud data and receive the verification results. When the verification results indicate incompleteness, it implies that malicious activities such as data loss or damage have occurred to the remote data. In such cases, data owners can hold the cloud storage service provider accountable.

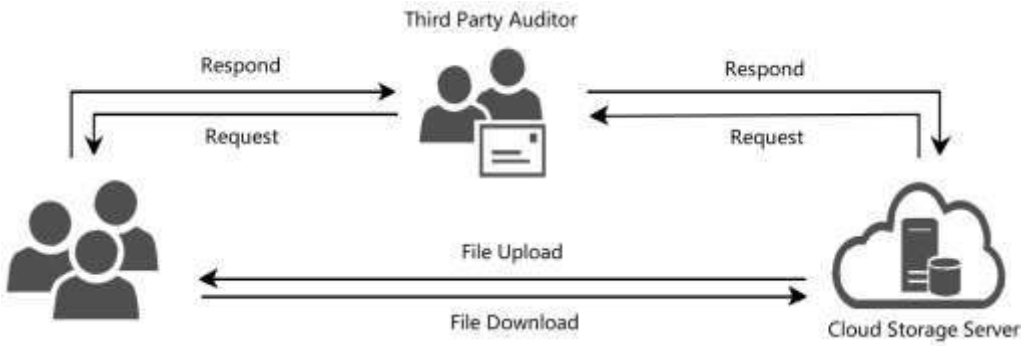

Figure 1. Integrity Verification Model for Cloud Data

Attack Model

In the cloud data integrity verification model, although third-party auditors can effectively assist data owners in performing integrity audits on remote data, the introduction of untrusted third-party auditors increases the risk of cloud data leakage (Razaque et al., 2021). Collusion attacks pose the most significant threat to existing cloud data integrity verification models. These attacks involve collusion between the cloud storage server and adversaries, collusion between the third-party auditor and adversaries, as well as collusion among the cloud storage server, the third-party auditor, and adversaries. Such malicious activities can result in data breaches or direct secondary attacks on cloud data, such as forgery, tampering, or substitution attacks.

Specifically, when the malicious cloud storage service provider receives data uploaded by the data owner, it performs illegal operations on the uploaded data (Wang et al., 2022). For example, it may forge new data content based on the uploaded data, tamper with a portion of the uploaded data, or replace the original data with other users' data. Ultimately, the untrusted third-party auditor generates verification results based on incorrect data content, leading the data owner to believe that the erroneous data content is the original data uploaded. This attempt aims to deceive the data owner and other users who download the data.

Technical Realization

The integrity verification protocol is a challenge-response interactive algorithm run by the verifier (i.e., the third-party auditor) and the cloud storage server (Rehman et al., 2021). It mainly consists of three stages: the challenge stage, the proof stage, and the verification stage. Unlike the ownership proof protocols mentioned above, the integrity verification protocol is verifier-centric, requiring the cloud storage server to generate correct responses in order to meet the verifier's challenges.

Challenge Stage: Assuming the data content is F, the verifier randomly generates a challenge value Chal based on the data content F and sends it to the cloud storage server.

- Proof Stage: The cloud storage server receives the challenge value Chal and computes a proof value Proof regarding the data content F stored. The server then returns the proof value Proof to the verifier.
- Verification Stage: The verifier runs the CheckProof(Proof) function to verify the correctness of the proof value and further determine the integrity of the data content F. Here, CheckProof(.) is a cryptographic verification algorithm.

The formal definition of the integrity verification protocol is as follows:

- (pk,sk) ← PkeyGen(1^λ): Public-private key generation algorithm. It takes a security parameter 1λ as input and outputs the public key pk and private key sk.
- φ ← HtagGen(pk,sk,C): Homomorphic signature generation algorithm. It takes a public key pk, private key sk, and ciphertext C as input and outputs the corresponding homomorphic signature φ.
- P ← GenProof(C,Chal,σ): Proof generation algorithm. It takes a ciphertext C, challenge Chal, and homomorphic signature φ as input and outputs the corresponding proof P.
- V ← CheckProof(pk,sk,Chal,P): Verification algorithm. It takes a public key pk, private key sk, challenge Chal, and proof P as input and outputs the corresponding verification value V, where V = 1 indicates successful verification, and V = 0 indicates verification failure.

To meet the requirements of data integrity verification in different application scenarios, researchers have made supplementary and improved algorithms based on the aforementioned foundational algorithms to adapt to specific scenario requirements (Ding et al., 2020; Gudeme et al., 2021).

BBCDIV STRENGTHS

BBCDIV has a number of distinct advantages over traditional validation methods. The key strengths of BBCDIV are outlined in Table 1.

Table 1. The Strengths of BBCDIV

No	Strength	Explanation
1	Decentralization and Trust	BBCDIV takes advantage of the decentralised nature of blockchain technology, eliminating the possibility of fraud by a centralised institution or any trusted third party. This decentralisation promotes trust between participants by ensuring that no single entity has control over the validation process. It reduces the risk of manipulation or tampering and increases the overall trustworthiness of the system.
2	Tamper-Proof Data Storage	The immutability and tamper-proof nature of blockchain form a strong foundation for data integrity verification in BBCDIV. Once data is recorded in the blockchain, it becomes virtually impossible to alter or tamper with without consensus from the network participants. This ensures the integrity and authenticity of cloud-stored data, providing a reliable and auditable record.
3	Transparency and Auditability	BBCDIV provides transparency and auditability of the cloud data validation process. Every transaction recorded in the blockchain is visible to all participants, promoting transparency and making the integrity of the data easily auditable. This transparency enhances trust between users and allows real-time verification of data, promoting traceability accountability.
4	Enhanced Security	The application of cryptographic algorithms in BBCDIV enhances the security of cloud data integrity verification. The decentralised nature of the blockchain reduces the risk of a single point of failure and makes the system more defensible against attacks.
5	Collaborative Verification	BBCDIV enables enhanced collaboration between cloud service providers, users and blockchain network participants. By involving multiple entities in the validation process, BBCDIV distributes responsibility and increases the overall trust in the system.

These advantages enable BBCDIV to be a more secure and reliable solution for verifying the integrity of data stored in the cloud. By leveraging the decentralised, tamper-proof, transparent and collaborative nature of blockchain, BBCDIV provides enhanced security, trust and traceability mechanisms.

BBCDIV WEAKNESSES

While BBCDIV, a blockchain-based cloud data integrity verification solution, has significant advantages, it is not free from concerns and it must be acknowledged that it also has some weaknesses and potential limitations. Understanding these weaknesses is essential to fully assess the viability and effectiveness of BBCDIV. Table 2 shows some of the possible weaknesses associated with BBCDIV.

Table 2. The Weaknesses of BBCDIV

No	Weakness	Explanation
1	Scalability Challenges	One of the main challenges of blockchain technology is its scalability. BBCDIV inherits this same potential weakness, with the size of the blockchain growing as the number of transactions increases, leading to potential performance bottlenecks. The validation process can become time-consuming and resource-intensive, affecting the overall efficiency of BBCDIV, especially in high-volume cloud environments.
2	Computational Requirements	Blockchain networks rely on consensus mechanisms, which often require significant computing power and energy consumption. This can create many obstacles, especially for organisations with limited computing resources.
3	Potential Security Risks	While blockchain technology itself is known for its security features, BBCDIV may still be exposed to security risks at different levels. These risks include vulnerabilities in the underlying blockchain infrastructure, potential attacks against consensus algorithms, or security weaknesses in the implementation of validation schemes.
4	Regulatory Considerations	The adoption of BBCDIV may raise regulatory and legal concerns. Blockchain technology is relatively new and rapidly evolving, and the regulatory framework is still under development.

Understanding and addressing these weaknesses will allow the potential of BBCDIV to be better utilised. This still requires further research and development work to overcome these challenges in order to achieve effective and secure cloud data integrity verification. By acknowledging these weaknesses and working to address them, BBCDIV can evolve into a more robust and practical solution for ensuring data integrity in cloud computing environments.

BBCDIV OPPORTUNITIES

BBCDIV can further increase its effectiveness, adoption and impact in the cloud computing space. These opportunities arise from the unique advantages of blockchain technology, which addresses some of the limitations of traditional integrity verification schemes. Table 3 shows the possible opportunities associated with BBCDIV.

Table 3. The Opportunities of BBCDIV

No	Opportunities	Explanation
1	Enhanced Data Governance	BBCDIV provides an opportunity to strengthen data governance practices in cloud computing environments. The decentralized and transparent nature of blockchain ensures greater accountability and traceability of data transactions. Organizations can leverage BBCDIV to demonstrate compliance with data integrity and privacy regulations, enhance their reputation, and build trust with customers and stakeholders.
2	Integration with Internet of Things (IoT)	The proliferation of IoT devices generates vast amounts of data (Fatin et al., 2022) that require secure and trustworthy storage and verification. BBCDIV can be integrated with IoT systems, enabling reliable and transparent data integrity verification for IoT-generated

		data. This integration opens up opportunities for applications in various sectors, such as healthcare, supply chain management, and smart cities.
3	Collaboration among CSPs	BBCDIV promotes collaboration among cloud service providers (CSPs) in maintaining the integrity of data stored in the cloud. CSPs can establish consortia or partnerships to collectively implement BBCDIV, thereby enhancing the overall trustworthiness of their services. Collaboration in data integrity verification can lead to shared best practices, interoperability standards, and improved security measures within the cloud ecosystem.
4	Development of Customized Verification Schemes	BBCDIV can be customized and tailored to specific industry requirements and use cases. Different sectors, such as finance, healthcare, or legal services, may have unique data integrity verification needs. Organizations can explore opportunities to develop specialized verification schemes using BBCDIV that cater to their specific industry requirements, ensuring compliance, security, and efficiency.
5	Integration with Artificial Intelligence (AI) and Machine Learning (ML)	The integration of AI and ML techniques with BBCDIV can enhance the efficiency and accuracy of data integrity verification. AI algorithms can analyze patterns and detect anomalies in the blockchain, enabling automated detection of potential data integrity breaches. ML models can continuously learn from verified data, improving the overall reliability and effectiveness of the verification process.

By leveraging these opportunities, researchers and practitioners can further develop and refine BBCDIV into a more advanced cloud data integrity verification solution. These opportunities enable continued innovation, collaboration and adoption of blockchain-based solutions to drive the transformation of cloud data integrity verification and unlock new possibilities in secure and trusted cloud computing environments.

BBCDIV THREATS

While BBCDIV, a blockchain-based cloud data integrity verification solution, offers significant benefits and opportunities, it is important to consider the potential threats and challenges that may hinder its adoption and effectiveness. Identifying and addressing these threats is critical to the successful implementation and utilisation of BBCDIV. Table 4 shows the main threats associated with BBCDIV.

Table 4. The Threats of BBCDIV

No	Threats	Explanation
1	Regulatory and Legal Challenges	The regulatory landscape around blockchain technology is still evolving and compliance with existing and future regulations may pose challenges to the implementation of BBCDIV. Ambiguities in data protection, privacy and intellectual property laws may create legal uncertainty and barriers to adoption.
2	Energy Consumption and	Blockchain networks, particularly those utilising proof-of-work consensus mechanisms, require significant computing power and energy consumption. The environmental impact of such energy-

	Environmental Impact	intensive operations is a growing concern, particularly in regions with strict environmental regulations or sustainability goals.
3	Scalability and Performance Limitations	Blockchain technology currently faces scalability limitations, especially when dealing with large numbers of transactions. As the blockchain grows, the validation process can become slow and resource intensive, impacting the overall performance and efficiency of BBCDIV.
4	Security Vulnerabilities and Attacks	Despite the inherent security features of blockchain technology, BBCDIV is not immune to security vulnerabilities and potential attacks. Vulnerabilities in smart contracts, consensus attacks or malicious activity against the blockchain network can compromise the integrity of the authentication process.
5	Economic and Cost Considerations	There may be significant costs involved in implementing BBCDIV and maintaining a blockchain network, including infrastructure setup, network maintenance and computing resources. The economic viability of BBCDIV may be influenced by factors such as cost effectiveness and return on investment.

By recognizing and addressing these threats, researchers, practitioners, and policymakers can work towards developing strategies and solutions to mitigate risks and enhance the effectiveness of BBCDIV. Collaborative efforts, industry standards, regulatory support, and ongoing research are vital for navigating the threats associated with BBCDIV and ensuring its successful implementation as a robust cloud data integrity verification scheme.

CONCLUSION

Combining blockchain technology with cloud data integrity verification can improve the reliability and stability of integrity verification protocols, eliminate the risk of single point of failure, and also make the operation of the protocol open and transparent, so that when the protocol is executed abnormally, it can be traced back to the party that violated it. Blockchain can provide a practical and effective solution to some of the inherent flaws of traditional centralised TPA-based integrity verification schemes, and has great application potential and research value (Wu et al., 2023).

In this paper, we present a comprehensive SWOT analysis of BBCDIV, a blockchain-based integrity verification scheme for cloud data. The analysis highlights the strengths, weaknesses, opportunities and threats associated with BBCDIV, providing a comprehensive view of its potential to ensure data integrity in a cloud computing environment. Table 5 summarises the strengths, weaknesses, opportunities and threats of adopting BBCDIV as an existing cloud data integrity validation solution.

Table 5. SWOT analysis of the BBCDIV

Strengths	**Weaknesses**
• Decentralization and Trust • Tamper-Proof Data Storage • Transparency and Auditability • Enhanced Security • Collaborative Verification	• Scalability Challenges • Computational Requirements • Potential Security Risks • Regulatory Considerations

Opportunities	**Threats**
• Enhanced Data Governance • Integration with Internet of Things • Collaboration among CSPs • Development of Customized Verification Schemes • Integration with Artificial Intelligence (AI) and Machine Learning (ML)	• Regulatory and Legal Challenges • Energy Consumption and Environmental Impact • Scalability and Performance Limitations • Security Vulnerabilities and Attacks • Economic and Cost Considerations

AUTHOR BIOGRAPHY

Li Zhenxiang is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. His research interests include Blockchain, Cloud Computing and Data Integrity Verification. *Email: 222923380@s.iukl.edu.my*

Jin Yuanrong is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. Her research interests include Cloud Computing and Load Prediction algorithms. *Email: 222923382@s.iukl.edu.my*

Wang Haipei is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. Her research interests include Cloud Computing and cyber security *Email: 223923726@s.iukl.edu.my*

Mohammad Nazir Ahmad AP. Dr, is an Associate Professor at Universiti Kebangsaan Malaysia (UKM) specializing in Ontology and Knowledge Management. He has a PhD in Information Technology, received substantial research grants, published extensively, and supervised multiple academic projects. He is actively involved in international associations and organizations related
to his field. *Email: mnazir@ukm.edu.my*

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EXPLORATORY REVIEW OF DEEP LEARNING IN HUMAN ACTION RECOGNITION: ADVANCING CURRENT MECHANISMS

Liang Zhantu [12], Jin Yuanrong[1], Li Zhenxiang[1], Sun xuekai[1] & Tadiwa Elisha Nyamasvisva[1]
[1]*Infrastructure University Kuala Lumpur, MALAYSIA*
[2] *Dongguan University of Technology, China*

ABSTRACT

Human action recognition, integral to areas like surveillance, robotics, and human-computer interaction, is a challenging endeavor. This paper presents an in-depth literature review of the application of deep learning technology in human behavior recognition. We aim to shed light on the potential of employing deep neural networks, notably Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Long-Short-Term Memories (LSTMs), to capture intricate spatiotemporal patterns inherent to human actions. An exposition on traditional methods of human action recognition is provided, underscoring their constraints in dealing with variability, complexity, and imperfect data. Grounded on this foundation, the paper discusses how deep learning models might circumvent these challenges. Through comparative analysis with existing methods, we highlight potential advantages of deep learning models in recognition accuracy, computational efficiency, and resilience to data variations. The essence of this review is not only to elucidate the capabilities of deep learning techniques in human action analysis but also to offer insights beneficial for researchers and professionals aiming to design precise and efficient human action recognition frameworks. The central contribution of this work lies in its synthesis of current methodologies, emphasizing the promise and potential of deep learning in advancing the field.

Keywords:
human action recognition, deep learning, convolutional neural networks, recurrent neural networks, spatiotemporal patterns

INTRODUCTION

Human action recognition has emerged as a critical research area in recent years due to its wide-ranging applications in fields such as sports analysis (Lai et al., 2022; Meng et al., 2020; Qiu et al., 2022), healthcare monitoring (Fridriksdottir & Bonomi, 2020; Lin et al., 2022; Paul et al., 2021), robotics (Gong et al., 2022; Luo et al., 2022; Moon & Seo, 2022), security (Arabi et al., 2022; Nyamasvisva & Arabi, 2022.) and video surveillance (Elharrouss et al., 2021; Khan et al., 2020; Majid et al., 2022; Nasir et al., 2022). The ability to recognize and understand human action patterns is essential for enabling advancements in these applications accurately and efficiently. Traditional approaches to human action recognition, including rule-based systems (Diao et al., 2022; Yang et al., 2021), template matching (Afza et al., 2021; Shahzad & Jalal, 2021), Hidden Markov Models (HMMs) (Elangovan, 2021; Ghadi et al., 2022), and Dynamic Time Warping (DTW) (Ram et al., 2023; Trelinski & Kwolek, 2021), frequently rely on hand-crafted features and constrained classification algorithms, which may not correctly reflect the complexity and variety of human action. However, with the advent of deep learning techniques, such as CNNs (Du & Mukaidani, 2022; Slade et al., 2022), RNNs (Loh et al., 2022; Zhang et al., 2022) and LSTM (li & Cao, 2023; X. Shen & Ding, 2022), significant progress has been made in the field of computer vision, leading to remarkable improvements in various tasks, including image recognition, object detection, and natural language processing.

The goal of this research is to overcome the drawbacks of conventional methods and create systems that are more reliable and accurate by utilizing the power of deep learning to improve human

action recognition algorithms. It is anticipated that by taking advantage of deep learning models' capacity to automatically learn discriminative features from raw data, these models will be able to capture complex action patterns, adapt to varying environmental conditions, and provide accurate recognition results even in the presence of noise or erroneous action data. The study subject, research motivation, problem statement, and conclusion are all introduced in this chapter.

RESEARCH MOTIVATION

The motivation for doing this research derives from the growing requirement for powerful and accurate human action recognition systems across multiple domains. Traditional approaches frequently rely on hand-crafted features and rule-based algorithms, which cannot capture the intricate intricacies and nuances of human activity (Sharma et al., 2022; X. Wang et al., 2023). As a result, the performance and applicability of these approaches in real-world circumstances is limited (Islam et al., 2022). Deep learning approaches have shown improved skills in dealing with complicated data representations and learning hierarchical features, making them well-suited for applications like as picture identification and natural language processing (Gaafar et al., 2022). By applying deep learning to human action recognition, there is the potential to revolutionize the field by achieving significant improvements in accuracy, efficiency, and adaptability.

Furthermore, the introduction of low-cost, high-quality action capture equipment, such as inertial sensors, depth cameras, and wearable devices, has supplied researchers with a wealth of data to study human behavior. Deep learning algorithms applied to these datasets have the potential to extract meaningful representations and patterns, leading to improved understanding and recognition of human action (C. Shen et al., 2022). Deep learning algorithms are becoming more popular and feasible as processing power and large-scale computer resources improve (Lauriola et al., 2022).

STATEMENT OF THE PROBLEM

The problem addressed by this research is the urgent need to develop advanced methods using deep learning techniques to overcome the limitations of traditional human action recognition systems. These systems often struggle to accurately and efficiently recognize and classify complex human behavior patterns in real-time under various environmental conditions (Arshad et al., 2022; Najeh et al., 2022; Yalçinkaya et al., 2023).

Traditional methods, such as template matching, have limitations in handling the inherent variability and complexity of human action (Saleem et al., 2023). Template matching relies on predefined templates for each action, which makes it difficult to handle variations in appearance, viewpoint, and timing (Pham et al., 2022). Moreover, template matching is sensitive to noise and occlusions, resulting in reduced accuracy and robustness (Solorzano & Tsai, 2023).

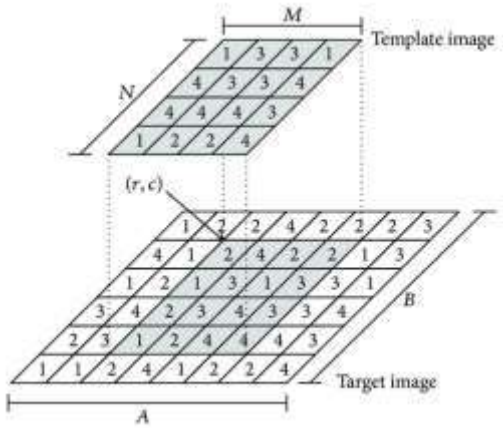

Figure 1: Object detection based on Template matching through use of best-so-far ABC (Banharnsakun & Tanathong, 2014)

Hidden Markov Models (HMMs) assume conditional independence between observations given the hidden states, which cannot hold for complex human actions (Lorek et al., 2022; Rojas-Salazar, 2022). They struggle to capture long-term dependencies and can be sensitive to noisy or incomplete data (Ahrends & Vidaurre, 2023). Additionally, acquiring labeled training data for HMMs can be a time-consuming and costly process (Şengönül et al., 2023).

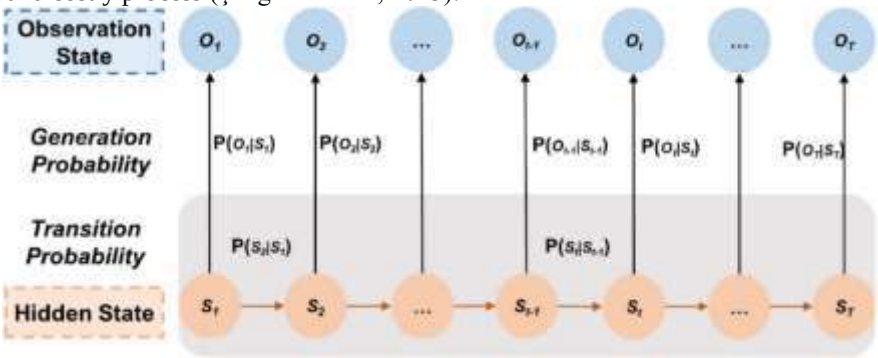

Figure 2: A fusion of a deep neural network and a hidden Markov model to recognize the multiclass abnormal behavior of elderly people (L. Wang et al., 2022)

Dynamic Time Warping (DTW) requires a predefined template sequence and is less effective for recognizing novel or complex actions (Singh et al., 2021). It is computationally expensive, particularly with large datasets or long sequences (Sedmidubsky et al., 2021). Furthermore, DTW does not capture the underlying structure or semantics of actions, limiting its ability to provide meaningful insights into the action patterns (Cortiñas-Lorenzo & Lacey, 2023).

Recurrent Neural Networks (RNNs) have difficulty accurately capturing long-term dependencies due to the vanishing gradient problem (Giovanni et al., 2023). To generalize effectively, they require a substantial quantity of labelled training data, which can be laborious and costly to acquire (Shahabi et al., 2022). RNNs are sensitive to noisy and incomplete data, as well as viewpoint and illumination variations (Deotale et al., 2022). Given these limitations, it is imperative to develop more effective and efficient systems for recognizing human actions. Deep learning techniques, such as CNNs

(Bilal et al., 2022; Javed et al., 2022; Lu et al., 2022; Uchiyama et al., 2023) and LSTM networks (Bansal & Chandra, 2022; Domingo et al., 2022; Sahoo et al., 2022; Stein et al., 2022), have shown promising results in various domains and can potentially address the challenges faced by traditional methods.

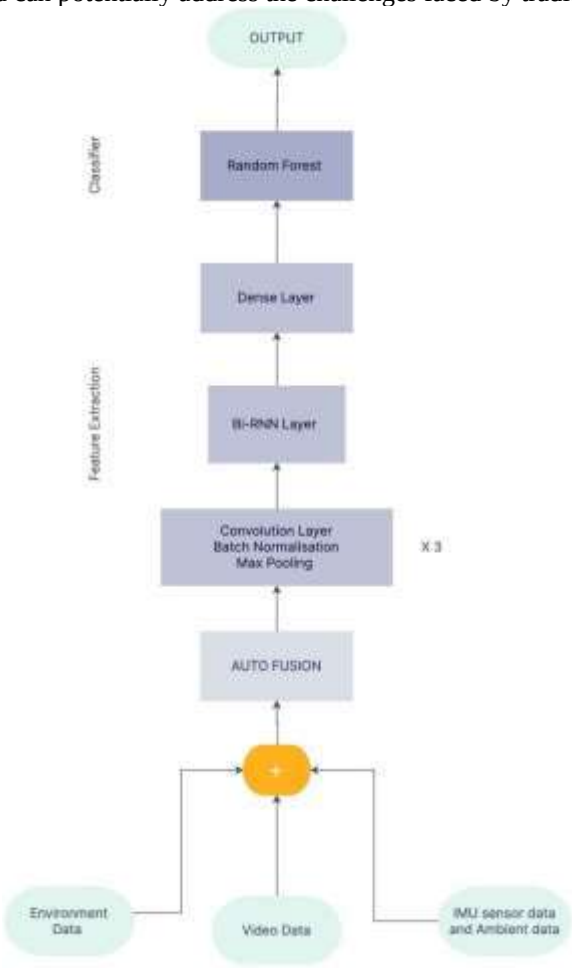

Figure 3: Ambient intelligence-based multimodal human action recognition for autonomous systems (Jain et al., 2023)

Researchers can capture meaningful representations of human action patterns by utilizing CNNs, which are designed to extract spatial features from images or video frames (Sun et al., 2022). This allows the system to effectively manage variations in appearance and perspective. In addition, CNNs can acquire features automatically from data, reducing the need for predefined templates (Tang et al., 2022). On the other hand, LSTM networks are explicitly designed to model temporal dependencies and long-term dependencies in sequential data (Al-Selwi et al., 2023). By integrating LSTM networks into human action recognition systems, the temporal dynamics of human actions can be precisely captured (Zhong et al., 2022). LSTMs can effectively manage noisy and incomplete data, making them suitable for real-world scenarios where these challenges are prevalent (Choudhury & Soni, 2023).

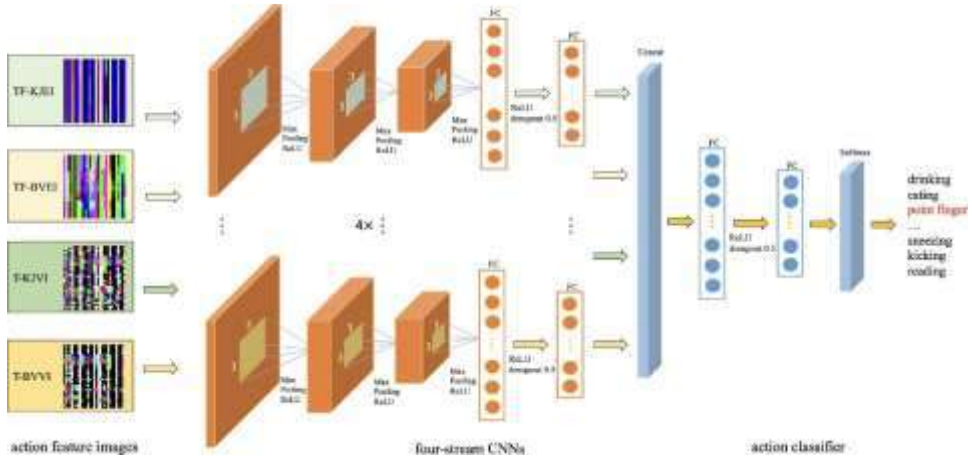

Figure 4: AFE-CNN: 3D Skeleton-based Action Recognition with Action Feature Enhancement (Guan et al., 2022)

Significant quantities of labelled training data are still required to train deep learning models. Recent advancements in data augmentation techniques, such as generative adversarial networks (GANs) (Qu et al., 2022), have made it possible to generate synthetic training data, thereby reducing reliance on large-scale manually labelled datasets. In addition, transfer learning and domain adaptation methods can be used to leverage pre-trained models on massive action datasets. This method permits the transfer of knowledge from related tasks or domains, allowing for more efficient training and improved generalization (Huang et al., 2022).

Table 1: SWOT Analysis of existing deep learning-based methodologies

	Algorithm	Strengths	Weaknesses	Opportunities	Threats
1	Hidden Markov Models	Assume conditional independence between observations given the hidden states	Can not hold for complex human actions	HMMs can model sequential data by capturing the underlying states and transitions between them. In the context of action recognition, HMMs can represent actions as sequences of states, allowing for the recognition of different action stages or sub-actions.	HMMs rely on the availability of labeled training data, which is labor-intensive and challenging to obtain for some action classes, and the computational complexity of training and inference is high
2	Dynamic Time Warping	It can lie in its flexibility to handle sequences of different lengths and speeds, its robustness to noise and variations within sequences, and its ability to perform nonlinear alignment, capturing complex temporal relationships.	It rely on a predefined template sequence, limited effectiveness in recognizing novel or complex actions, computational expense with large datasets or long sequences, and inability to capture the underlying structure or semantics of actions.	It allows for the comparison of actions with varying speeds or durations, making it suitable for recognizing actions with flexible timing.	DTW requires pairwise comparisons between sequences, resulting in high computational cost, especially for large datasets

3	Recurrent Neural Networks	Can model a collection of records (i.e. time collection) so that each pattern can be assumed to be dependent on previous ones	Suffer from the vanishing gradient problem, where gradients diminish exponentially over time, limiting their ability to capture long-term dependencies accurately.	RNNs can assign labels to individual frames or segments, allowing for detailed analysis of specific parts or sub-actions. By leveraging transfer learning and combining with other architectures, RNNs can learn from large datasets and fine-tune on specific human action recognition tasks, leading to improved performance.	RNNs in human action recognition face certain threats. They can struggle when the input data is noisy or incomplete, which can negatively impact their performance. Variations in factors like viewpoint or lighting conditions can introduce noise or distort the sequential patterns that RNNs rely on.
4	Convolutional Neural Networks	Can automatically learn features from data, reducing the reliance on predefined templates	CNNs can be sensitive to variations in viewpoint and lighting conditions, which affect their ability to generalize well across different action scenarios.	Can learn hierarchical representations of actions, enabling to recognize complex patterns and distinguish between different action categories	CNNs struggle with recognizing actions that involve fine-grained movements or subtle variations, as they primarily focus on capturing spatial features rather than temporal dynamics.
5	Long Short-Term Memory	Specifically designed to model temporal dependencies and long-term dependencies in sequential data	More complicated than traditional RNNs and require more training data in order to learn effectively. They are not well-suited for online learning tasks, such as prediction or classification tasks where the input data is not a sequence. LSTMs can be slow to train on large datasets	LSTMs can effectively handle noisy and incomplete data, making them suitable for real-world scenarios where such challenges are prevalent.	LSTMs struggle with Gradients decrease exponentially over time, hindering the ability to accurately capture long-term dependencies

As shown in Table 1, in the domain of human action recognition, while traditional algorithms such as HMM and DTW have demonstrated proficiency in certain areas, they face limitations when handling large-scale data, intricate actions, and varied environmental conditions. On the other hand, deep learning approaches, specifically RNNs, CNNs, and LSTMs, have showcased their superiority in the field of human action recognition.

Firstly, compared to HMMs and DTWs, RNNs and LSTMs are especially adept at processing extended time sequences and capturing long-term dependencies. LSTMs, in particular, were designed to address the vanishing gradient problem associated with RNNs. Additionally, CNNs excel at automatically learning features from data, reducing the reliance on predefined templates and offering a stark contrast to the constraints of DTW.

While deep learning algorithms have their set of challenges, such as sensitivity to data and training demands on extensive datasets, they bring unparalleled flexibility and accuracy to action recognition. Notably, as demonstrated by LSTMs, deep learning offers robust advantages when dealing with noisy or incomplete data.

THE PROPOSAL

In order to address variability, complexity, and chaotic or incomplete data in human action recognition, CNN or LSTM network structures are recommended. Utilizing CNNs or LSTMs requires a multistep process. The initial stage involves data preprocessing, which includes tasks such as resizing frames, normalizing pixel values, and dealing with missing or noisy data. Utilizing convolutional and pooling layers, which facilitate the acquisition of hierarchical representations, a CNN is then employed to extract spatial features from individual frames. Additionally, LSTM or other recurrent layers are incorporated to capture temporal dependencies and effectively model the dynamics inherent in action sequences.

The fusion of spatial and temporal information is achieved by establishing connections between the output of the CNN and the LSTM layers. During the training phase, the dataset is partitioned, and a suitable loss function is optimized through the use of an optimization algorithm, while applying regularization techniques like dropout or L2 regularization to mitigate overfitting. Augmenting the training data with diverse transformations is imperative to enhance the dataset's variability and adaptability, and when labeled data is limited, transfer learning techniques can be employed. Lastly, the model's performance is evaluated on an independent test set, employing appropriate metrics for assessment. The attainment of optimal performance necessitates a diligent process of experimentation and fine-tuning to cater to the specific characteristics of the dataset and the requirements of the task.

CONCLUSION

The development of advanced methodologies that leverage deep learning techniques, such as CNNs and LSTMs, can address the limitations of traditional human action recognition systems by improving accuracy, enabling automation, facilitating multimodal integration, and contributing to future technological advancements. These techniques offer the potential for more accurate, robust, and adaptable solutions for recognizing and classifying complex human action patterns and under various environmental conditions such as less light exposure, device noise, camera aperture. By overcoming the challenges of noisy and incomplete data, variations in viewpoint, and long-term dependencies, these methodologies pave the way for significant advancements in human action recognition research and applications. This paper therefore seeks to design an algorithm based on deep learning to improve the accuracy for human action recognition.

Successful research will aid in various fields and applications. In the field of surveillance and security, accurate human action recognition can improve the detection and classification of suspicious or abnormal behaviors, enhancing public safety and security. In healthcare and rehabilitation, it can assist in monitoring patients' physical activities, evaluating their functional abilities, and designing personalized therapy programs. Moreover, in sports and performance analysis, human action recognition enables the assessment of athletes' technique and form, providing insights for training optimization. Additionally, in the realm of human-computer interaction, advancements in action recognition can enhance gesture-based interfaces, enabling more intuitive and natural interactions between humans and computers. Furthermore, it can contribute to the development of robotics, enabling robots to understand and imitate human actions, enhancing their capabilities in various domains. Overall, successful research in human action recognition holds significant potential to benefit these areas and drive technological advancements.

AUTHOR BIOGRAPHY

Liang Zhantu is a Ph.D. in IT candidate at IUKL. His research direction is in human action recognition in the field of artificial intelligence. Liang Zhantu is currently working as an Information and Technology teacher at DGUT in China. *Email: 223923795@s.iukl.edu.my*

Jin Yuanrong is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. Her research interests include Cloud Computing and Load Prediction algorithms. *Email: 222923382@s.iukl.edu.my*

Li Zhenxiang is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. His research interests include Blockchain and Cloud Computing. *Email: 222923380@s.iukl.edu.my*

Sun xuekai is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. His research interests include the application of blockchain technology in smart education. *Email: 223923752@s.iukl.edu.my*

Tadiwa Elisha Nyamasvisva, PhD is a faculty member at the Faculty of Engineering and Science Technology in IUKL. His research interests are in Computer Algorithms, Data Analysis, Networking and Network Security, IT in Education. He is currently the Deputy Dean at the Center of Postgraduate Studies in IUKL and also Head of Postgraduate Programme (HOPP) for PhD in Information Technology and Master in Information Technology (MIT) programmes at the Centre of Postgraduate Studies in IUKL, *Email: tadiwa.elisha@iukl.edu.my*

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COMPREHENSIVE REVIEW OF THE APPLICATION OF BLOCKCHAIN IN SMART EDUCATION: IDENTIFYING GAPS AND RESEARCH DIRECTIONS

Sun Xuekai[1,2], Jin Yuanrong[2], Liang Zhantu[2] & Robiatul A'dawiah Jamaluddin[2]
[1]*Weifang University of Science and Technology, CHINA*
[2]*Infrastructure University Kuala Lumpur, MALAYSIA*

ABSTRACT
The rise of information technology has significantly impacted various sectors, including education, leading universities to embrace smart education for creating comprehensive learning ecosystems. However, the widespread adoption of smart education has also introduced challenges like information security and academic forgery. As a distributed ledger technology, blockchain offers technical advantages such as decentralization, anonymity, traceability, and tamper-resistance, making it a promising solution for addressing issues in university smart education. Despite being in its early stages, research on applying blockchain to smart education is gaining momentum. This paper aims to explore the research background and problem statement in this area, discussing potential blockchain applications, their advantages, and future challenges. By reviewing existing literature and problem statements, we emphasize the importance of integrating blockchain technology into the smart education environment of universities and provide insights for its extensive implementation. In summary, as technology matures and practical experience accumulates, blockchain holds immense potential for enhancing smart education in colleges and universities, providing students with a secure, reliable, and efficient learning environment.

Keywords:
Smart education; Blockchain technology; Higher education; Blockchain Application; Blockchain Challenge; Data Integrity

INTRODUCTION

As an emerging concept in the field of education, smart education at universities aims to use advanced information technology and communication technology to improve the quality of education, personalized learning and teaching management efficiency (Bhatia & Bhasin, 2023). However, the implementation of smart education at universities also faces a series of challenges such as data security and privacy protection, the objectivity of student learning evaluation, and the sharing and interoperability of educational resources. To meet these challenges and promote the development of smart education at universities, blockchain technology is widely considered to have the potential ability to solve existing problems of smart education (Sattar et al., 2023).

Although blockchain has also achieved some successful applications in other fields, its application in the field of smart education at universities is still in the exploration and initial stage (S. Liu & Li, 2023; Zhao et al., 2023). Therefore, this paper aims to explore the advantages and challenges of potential application of blockchain technology in smart education at universities, and propose relevant implementation strategies and suggestions.

RESEARCH BACKGROUND

The development background of smart education at universities can be traced to the rapid development of information technology and the popularization of the Internet. The emergence of the Internet has greatly changed the way people obtain and disseminate information, bringing many new opportunities and challenges to education (Majid et al., 2022). Educational institutions are actively exploring how to

use information technology to improve teaching quality, enhance student learning outcomes, and build a more flexible and intelligent teaching environment (Cui et al., 2023).

Smart education at universities is an important part of digital transformation in the field of education driven by information technology (Zhao et al., 2023). It utilizes advanced information and communication technologies to provide students with innovative solutions for personalized learning and teaching management. With the continuous pursuit of education quality and student development by society, smart education has gradually become the focus of attention for educational institutions (Tahora et al., 2023a).

In smart education, the utilization of advanced technological means enables educational institutions to enhance teaching efficiency and elevate the quality of education. By effectively leveraging shared campus resources, smart education optimizes resource allocation, thereby improving teaching efficiency. Additionally, by harnessing collected data and employing advanced analytics, smart campuses implement personalized learning, leading to more effective learning experiences (Sneesl et al., 2022).

PROBLEM STATEMENT

With the rapid development and wide application of smart education at universities, we cannot ignore the personal information security issues brought about by it. Smart education involves a large amount of personal data, covering students' personal information, academic performance, examination records, etc. as well as sensitive data such as personal information on teaching work, teaching materials, academic papers, and teacher-student evaluations (Dziatkovskii, 2023). The protection and security of these data are of great significance to safeguarding personal rights and promoting security of personal intellectual property rights (Saputra, Ochtaffia, & Apriani, 2023; Supriadi et al., 2023). However, there are often potential safety hazards and risks in the implementation of smart education during the collection, processing, transmission and use of personal data, (Kamruzzaman et al., 2023). Possible problems include data leakage, overflow, omission, digging, and even data forgery.

In addition, in the smart education environment, the problem of data forgery and tampering also needs to be highly scrutinized, and corresponding preventive measures should be taken (Huynh-The et al., 2023). Schools and relevant institutions should strengthen the verification and monitoring of data integrity and authenticity to ensure the accuracy and credibility of personal information and academic records (Arabi et al., n.d.,2022).

Therefore, it is very important to protect security of personal information and prevent data falsification in the implementation of smart education at universities. Only through comprehensive security measures and effective management mechanisms can we ensure proper protection of personal data and maintain the balance between personal rights and social stability (Patan et al., 2023a). This requires cooperation and increased attention by schools, educational institutions, governments and stakeholders. Advanced technology should be adopted to ensure the security of personal information in smart education systems.

Adding blockchain technology can effectively prevent personal information security issues and data forgery issues in smart education systems of universities, and provide more reliable data protection and security. By storing personal data in blockchains, the immutability and integrity of data can be ensured. The data in the blockchain cannot be tampered with or deleted, and any modification to the data will leave traceable signs. This way, students' personal information and data will be more reliably protected, reducing the risk of data tampering (Pu & Lam, 2023).

In smart education, important data such as students' personal files and academic performance can be stored and managed through blockchain technology to ensure their authenticity and integrity (Nyamasvisva& Arabi, 2022). Universities need to develop a blockchain-based technical framework for smart education, and develop applications on this basis. These applications can be used to solve current problems in smart education systems (Munasinghe et al., 2023).

OVERVIEW OF BLOCKCHAIN TECHNOLOGY

Definition of Blockchain

Blockchain is a decentralized, distributed digital ledger technology that records and verifies transactions across multiple computers or nodes. It is designed to provide a secure, transparent way to store and manage data without the need for a central authority (Oh et al., 2023).

In a blockchain, each transaction or data entry is bundled into a block and linked to the previous block by a cryptographic hash, forming a blockchain. The structure of the blockchain is depicted in Figure 1, illustrating how each block is connected to the preceding one through a hash pointer, creating an immutable distributed ledger. This chain-like structure ensures the continuity and security of data, where any alteration to one block would impact all subsequent blocks. The visual representation in Figure 1 vividly showcases the interlinking of blocks, establishing an immutable ledger, offering high transparency, traceability, and security, making blockchain a reliable solution for information storage and transactions (Elvas et al., 2023).

LITERATURE REVIEW

The resisting force is defined by the once the laboratory test was completed, the software analysis using the SLOPE/W was done to determine the FOS of the slope during failure using the Ordinary and Spencer analysis method. With the value of FOS during failure as a benchmark, two types of slope stabilisation work, such as the Changing Geometry method and Soil Nailing, were proposed to increase the stability and safety of the slope. A Changing Geometry method is converting the slope from steeper to gentler by trimming the slope or reducing the extra load applied on the slope, while Soil Nailing is constructed to withstand or resist against downward forces or pushing forces of soil masses. According to Shiferaw (2021), the method of Changing Geometry consider as one of the type chosen for the slope stabilaization work. Then again, the FOS will be computed using SLOPE/W to compare on stability increase of the slope due to the proposed stabilization work.

METHODOLOGY

ling. The software analysis was initially conducted on a trial and error basis, with around 15 trials for each section to determine the most approximate parameter and properties to be used for accurate analysis results.

Blockchain is constantly updated and synchronized between all participants in the network, ensuring the integrity and immutability of data (Pantan et al., 2023). Blockchain technology enables trust, transparency, and accountability by creating a decentralized and tamper-proof system that can be used for

a variety of applications represented by financial transactions, such as supply chain management, voting systems, and smart contracts (Y. Liu et al., 2023).

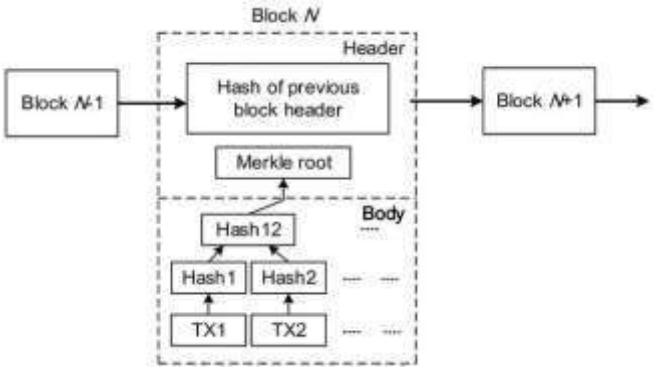

Figure 1: The Structure of Blockchain

Types of Blockchain

When studying the application of blockchain in smart education, it is crucial to choose the appropriate type of blockchain, which depends on the specific use cases, performance requirements, and security considerations required by the system. Common types of blockchains include public chain, private chain, and consortium chain. When selecting the appropriate type of blockchain, the education system needs to consider factors such as data privacy, security, performance requirements, and management controls. Generally speaking, smart education may choose consortium chains or private chains because they can better balance data privacy and management control, while providing sufficient transparency and security. However, this choice should be evaluated based on specific educational scenarios, It is important to find the most suitable type of blockchain. Figure 2 shows the relationships between various blockchains.

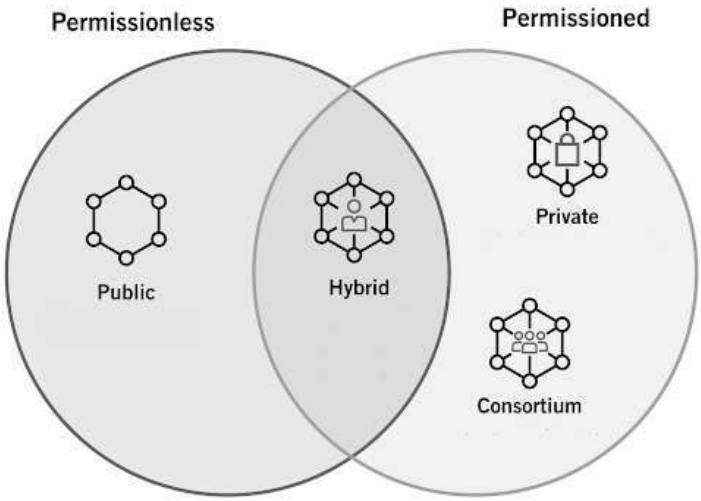

Figure 2: Four Types of Blockchain

The public chain refers to the blockchain that anyone at any node in the world, in any geographic location, can enter the system to read data, send transactions, compete for bookkeeping, etc. to participate in consensus. No organization or individual can tamper with the data in it; so, the public chain is completely decentralized (Loporchio et al., 2023).

The data of the consortium chain only allows different institutions in the system to read, write and trade. The PKI-based identity management system transactions or proposals are initiated through digital certificates, and consensus is reached through the verification of the common signature of the participants.

The private chain is different from the complete decentralization of the public chain. The access authority of the private chain is controlled by an organization, and the participation qualifications of each node are authorized and controlled by the organization. Since the participating nodes are limited and controllable, the private chain often has a fast processing speed, can support more than 1,000 data writes per second, and reduces the transaction cost of each internal node (Tan & Rodriguez Müller, 2023).

When the respective advantages of the public chain and the private chain are combined, a hybrid chain will appear. The development of hybrid chains is difficult, but has broad prospects. In the future market, there will definitely be giant companies developing underlying technologies and protocols. These giant companies will set up public chains, private chains or alliance chains for different purposes, based on different requirements for performance, security and application scenarios, grafting applications from different industries (Miriam et al., 2023)

THE APPLICATION AND ADVANTAGES OF BLOCKCHAIN IN SMART EDUCATION

Blockchain in Smart Education for Keep Student Records

One common application of blockchain in education is record keeping. There are essentially infinite student records, and establishing academic qualifications can be time-consuming, requiring extensive paper documentation and case-by-case checking.

When it comes to things like transfers across schools or states, blockchain can eliminate much of the overhead associated with this process and streamline verification procedures, saving educators and administrators time. A college enrolling a transfer student might use blockchain to authenticate their record and the courses they studied with a few simple clicks. The same idea applies to sharing records with an employer (Pradeep et al., 2023).

Blockchain in Smart Education for Digital Student Diploma

In the last few years, digital diplomas have become the foremost examples of how blockchain can be used in education. Using blockchain technology, the app provides a verifiable, tamper-proof diploma that can be easily shared with potential employers and other schools. Because of the inherent permanence, convenience, and security associated with blockchain, using this technology to store and share academic credentials, particularly diplomas, benefits students, institutions, and employers (Nargis et al., 2023). Table 1 shows the various advantages of blockchain-based digital degree certificates compared to traditional degree certificates.

Table 1: Advantages of Blockchain Digital Diplomas

Advantage	Blockchain digital diplomas	Traditional diplomas
Ownership Control	Students have ownership and control over their credentials	Schools have control over students' credentials
Verifiability	Employers and third parties can easily verify credentials	Requires additional steps and costs for verification
Streamlined Verification Process	Institutions benefit from a more efficient and cost-effective verification process	Time-consuming and costly verification processes
Fraud Prevention	Increases the authenticity and trustworthiness of credentials	Higher risk of forgery and fraud
Data Security and Privacy	Strong encryption and privacy protection features	Risk of data breaches and privacy concerns
Reliability and Integrity	Blockchain credentials are tamper-proof and verifiable	Traditional electronic credentials can be easily lost or tampered with

Benefits for students : Storing diplomas on a blockchain allows students to own and manage their academic achievements, providing them with the ability to share them when and where they choose. Historically, universities have owned and controlled student records, leaving students to rely on institutions to access and share their academic history and achievements(Christa & Mittal, 2023).

This model has obvious flaws. Physical records can be lost or destroyed, students may be required to pay fees to access them, and graduates of defunct institutions may struggle to find an authority to verify their academic achievement(Wang et al., 2023). The 130 sites spread across 38 states of the for-profit ITT Technical Institute abruptly closed their doors in 2016, leaving students and alumni without access to their data until the Department of Education intervened.

Blockchain enables students to take control of their academic identities by giving them ownership of their personal information. For graduates looking for work, for instance, this makes verifying the integrity of the credentials listed on their resumes much easier and offers them greater control over what an employer can access.

Benefits for institutions : Using blockchain to issue diplomas streamlines the verification process for higher education institutions, saving them time and money (Wang et al., 2023). According to recent research by the University of Rome, the process of authenticating credentials costs the institution over 19,000 euros yearly, or more than $20,000, which equates to almost 36 weeks of work. Blockchain-issued diplomas also make it considerably simpler for graduate schools to validate a student's academic record because they are essentially tamper-proof.

Using blockchain for digital diplomas offers employers several benefits. It simplifies the hiring process, as they only need a link to a secure digital version of a candidate's diploma, instead of requesting and verifying paper copies. The blockchain's robust security measures make it challenging for applicants to falsify their academic credentials, providing employers with increased assurance about the knowledge and skills of potential hires. Overall, blockchain implementation streamlines verification procedures and enhances the trustworthiness of academic records, leading to more efficient and informed hiring decisions (Sawant, 2023).

Blockchain in Smart Education for University Curricula

Blockchain technology has an impact on education that goes beyond record keeping. The management of university curricula has the ability to change as a result of this technology. For starters, blockchain enables the safe storage of electronic course materials and syllabuses. Institutions do use hard drives for this, but there is a chance that they could be corrupted or ruined. Another choice is cloud storage; however, it can be too expensive for some organisations (Pradeep et al., 2023). Figure 3 shows an online education security system based on blockchain technology.

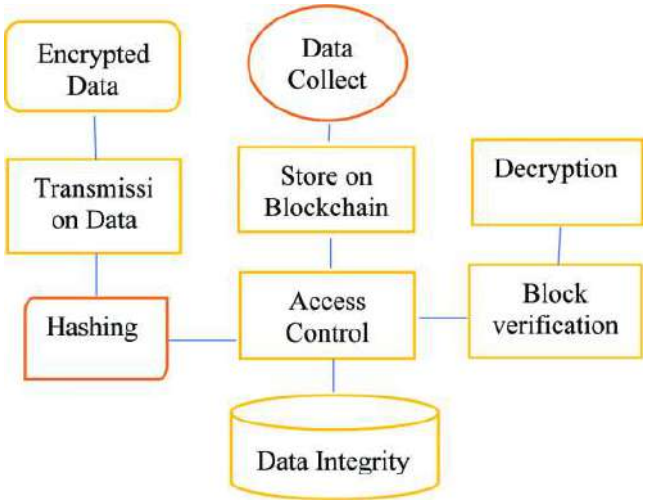

Figure 3: Blockchain-based online education secure system (Sawant, 2023)

Smart contracts on the blockchain may potentially facilitate the work of teachers. For instance, a teacher may create tasks for pupils as part of lessons and courses that are programmed into a blockchain. The blockchain's smart contract would automatically check that each job was completed before giving the student the next one, and so on, until all tasks were completed (Roshanzade, 2023).

The same smart contract technology might be used by teachers to help with grading. Students could take tests and examinations using computers or tablets, complete with questions, answers, and scoring criteria, into a blockchain. The student's score then becomes a part of their permanent academic record, maintained safely on the blockchain. The blockchain takes care of grading, freeing up professors' time to work on other academic projects (Roshanzade, 2023).

CHALLENGES TO USING BLOCKCHAIN IN SMART EDUCATION

Despite the potential benefits of blockchain, adoption is still relatively limited in the field. Nearly 50% of higher education respondents in the Gartner survey cited a lack of interest in using blockchain (Saputra, Ochtaffia, Apriani, et al., 2023). Much of this reluctance may stem from the challenges associated with implementing the technology, including issues of security, scalability, adoption rate, and cost.

Security: Blockchain is not impervious to threats, despite the fact that security is one of its distinguishing characteristics. Institutions must be careful about what data they save and how they choose to preserve it due to the sensitivity of the information stored on the blockchain - students' academic records and transcripts. Compliance with local, state, and federal data protection rules can be difficult.

Universities might need to use private or permission blockchains, encrypt data on the blockchains, or incorporate other tighter privacy protections (Patan et al., 2023b).

Scalability: Scalability can be a problem for blockchain applications in educational institutions due to the abundance of data they have about their students and alumni. The number of blocks needed grows as the amount of data included does, which slows down the speed of transactions taking place on the blockchain because each transaction needs peer-to-peer verification. This can be a major barrier when widely implemented. Positively, compared to permissionless blockchain, permissioned blockchain has a higher pace of transactions per second (Tahora et al., 2023b).

Adoption rate: Graduates only profit from ownership of their credentials if the schools or businesses they are applying to recognise the legitimacy of their credentials. Like other technologies before it, blockchain only functions when enough organisations and employers start to rely on it. But with a network of employment sites like Upwork and ZipRecruiter encouraging their use, as well as hundreds of colleges currently issuing and recognising blockchain credentials, they might soon become the norm rather than the exception (Awerika et al., 2023).

Cost: The cost of adopting and deploying any new technology might be high, even when it may result in savings in other areas. Computing power and updating current infrastructure can cost a lot of money. Additionally, many institutions might not have the knowledge and expertise required to manage student data on a blockchain platform, so they could have to spend money and time training school officials on how to use the technology (Mozumder et al., 2023).

RESEARCH GAPS

Research gaps refer to problems or gaps that have not been fully explored or solved in the field of applying blockchain technology in smart education at universities (Hu et al., 2023). While there have been some studies exploring the use of blockchain in education, the field is still in its infancy and there are still many issues that need to be further studied and resolved. Research gaps include the following:

Specific application scenarios of blockchain technology in smart education at universities: At present, there is still limited research on how to apply blockchain technology. Therefore, exploring and determining the specific application scenarios of blockchain technology in smart education at universities and how to integrate it with existing education systems is an important research gap.

Application of blockchain technology in smart contracts and automated processes: Smart contracts and automated processes can improve the efficiency and accuracy of educational processes. Exploring how to apply smart contracts in blockchain technology to automate educational processes such as tuition payment, course registration, and student evaluation, and evaluating its potential advantages and application value in university smart education is a direction worthy of in-depth study (Sharkey-Toppen et al., 2023).

CONCLUSION

Blockchain technology has great potential in smart education. It improves the transparency, traceability and security of student learning data, and provides students with personalized learning and certification mechanisms. Existing studies have focused on exploring the applications of degree authentication, learning achievement recording and learning resource management, and demonstrated the advantages of blockchain in solving problems such as academic fraud, learning achievement verification and unequal distribution of learning resources.

However, there are still some challenges and obstacles in achieving the widespread application of blockchain in smart education, including issues such as cost-effectiveness, compliance, security, adoption, scalability and standardization. To overcome these challenges, cooperation and attention from all parties, including schools, educational institutions, governments, and stakeholders, are needed. At the

same time, further research and exploration are needed on the best practices and solutions of blockchain technology in smart education at universities in order to further develop the smart education systems and improve the quality of students' learning environment.

Future research can focus on the following directions. First, there is a need to improve the scalability and performance of blockchain technology to meet the processing needs of large-scale education data. Secondly, in-depth research can be conducted on the combination of blockchain technology and education policy, and further explorations can be made on how to establish educational standards and policy frameworks adapted to blockchain technology. In addition, it is necessary to further study the acceptance of blockchain technology by users and develop corresponding training and support programs to promote the wide application of blockchain in the field of education.

In short, blockchain technology provides feasible solutions for smart education at universities, ensuring personal information security and data authenticity, and promoting the sharing and interoperability of educational resources. With the further maturity of technology and the accumulation of practical experience, blockchain has broad application prospects in smart education at universities, providing students with a safer, more reliable, and more efficient learning environment.

AUTHOR BIOGRAPHY

Sun Xuekai is currently a postgraduate student pursuing a PhD in Information Technology at Infrastructure University Kuala Lumpur (IUKL), Worked in Weifang University of Science and Technology as a teacher of information technology, within the Faculty of Engineering, Science, and Technology. His primary focus lies in researching the implementation of blockchain technology in the context of smart education. *Email: 223923752@s.iukl.edu.my*

Jin Yuanrong is student of the postgraduate programme PhD (Information Technology) at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. Her research interests include Cloud Computing and Load Prediction algorithms. *Email: 222923382@s.iukl.edu.my*

Liang Zhantu is a Ph.D. in IT candidate at IUKL. His research direction is in human action recognition in the field of artificial intelligence. Liang Zhantu is currently working as an Information and Technology teacher at DGUT in China. *Email: 223923795@s.iukl.edu.my*

Robiatul Adawiah Jamaluddin, **PhD** is an experienced lecturer with over 22 years of service in the field of education. She holds a PhD in Visual Informatics and is a senior lecturer at the Faculty of Business, Information, and Human Sciences at Infrastructure University Kuala Lumpur (IUKL). In addition, she serves as the Head of Innovative Teaching and Learning. Known for her innovative approach to teaching and learning, Dr. Robiatul is also a certified content creator, dedicated to helping students succeed.

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INVESTIGATION OF THE FACTORS INFLUENCING THE CONSTRUCTION DELAYS IN KLANG VALLEY MALAYSIA

Miss Basori Bano[1], Mohd Nizam Shakimon[1] & Siti Nur Aliaa Roslan[2]
[1]*Faculty of Engineering, Science & Technology, Infrastructure University Kuala Lumpur*
[2]*Faculty of Engineering, Universiti Putra Malaysia*

ABSTRACT

The Malaysian construction industry significantly contributes to the nation's economic growth and employment. However, project delays, a global issue, also plague this sector, impacting project completion. This study aims to identify delay factors and their effects on project completion, integrating the analysis of specific causes with specific effects, a novel approach compared to previous studies. Research methods include a literature review, a questionnaire survey on Malaysian construction projects, and interviews with project managers. The study also mines knowledge from a few projects through a single case-study approach. The research reveals some of the most critical causes of delays in Kuala Lumpur's construction projects. The causes and effects of delays may vary across countries, as indicated by semi-structured interviews conducted among major participant groups worldwide. The study suggests hiring quality contractors and replacing those causing delays with experienced workers. Regular team meetings, both on-site and in the office, are recommended to discuss delays, plan new dates for daily meetings, track project progress, and extend the closing date depending on EOT. The experience gained will enhance employee confidence and readiness to face future workforce challenges. Community engagement, contributing to social networking between the community, Malaysia, and the outside world, makes the industry's role more comprehensive and holistic.

Keywords:
Malaysian Construction Industry, Project Delays, Mitigation Strategies

INTRODUCTION

The history of the construction industry reveals the impact of construction on society and the creativity, ingenuity, and tenacity of the early master builders who achieved extraordinary feats of building science (Jackson, 2020). In the context of Malaysia, the construction industry plays a significant role in economic growth and employment. However, it is currently grappling with the serious issue of project delays, leading to time and cost overruns (A. Rahman, 2021). These delays, affecting every party involved in the construction project differently (Shehzad, 2019), are attributed to a variety of factors, including land acquisition, equipment breakdowns, poor site management, and low labour productivity (Santoso & Soeng, 2016). Contractors often struggle to identify and mitigate these causes during the construction process (Aziz & Abdel-Hakim, 2016), impacting not only project completion but also the industry's reputation and stakeholder satisfaction. This research aims to investigate these causes and effects within Malaysia's construction industry and propose effective delay mitigation strategies. The objectives include identifying key delay-contributing factors, analysing their impacts on project performance and stakeholder satisfaction, examining current delay management practices and challenges, proposing practical recommendations for improving time management and reducing delays, and validating these strategies through case studies and stakeholder feedback. This comprehensive approach hopes to contribute to the body of knowledge on construction delay management and provide valuable insights for practitioners and policymakers in the construction industry.

LITERATURE REVIEW

Construction sector is characterized by its project-focused nature, with firms being established to undertake projects. Each project is distinct and dynamic, undergoing a lifecycle that necessitates the collaboration of various groups and stakeholders to achieve completion (Fernández-Solís, 2009; Akintoye & Fitzgerald, 2000). The industry is perceived as a collection of industries due to the diverse groups involved in the construction process. The unique and dynamic characteristics of construction projects necessitate adaptability and flexibility within companies. The industry's fragmented nature can result in communication issues and inefficiencies, indicating a need for enhanced coordination and communication among the various stakeholders.

Despite the abundance of data, the construction industry often faces challenges in information management, leading to situations where practitioners need access to essential and relevant knowledge resources to address daily project-related issues (Kumar & Gupta, 2012; Egbu, 2004). This can impact performance, impede growth, and expose a company to the risk of failure. The data-rich but information-poor nature of the construction industry suggests a substantial opportunity for companies to enhance their decision-making processes by effectively managing and utilizing the wealth of knowledge generated from projects. Companies that fail to capitalize on this may find themselves at a competitive disadvantage.

The industry has been urged to adopt and implement suitable Information and Communication Technology (ICT) systems to enhance production, product quality, and delivery speed. However, the construction industry needs to be faster to adopt innovative technologies compared to other sectors, possibly due to scepticism about the benefits of using new technologies and insufficient data on return on investment (Dave & Koskela, 2009; Nitithamyong & Skibniewski, 2004 This slow adoption suggests a resistance to change and a need for more awareness about the potential benefits of these technologies, resulting in missed opportunities for improving efficiency and productivity. Therefore, there is a need for increased education and awareness about the benefits of ICT systems.

Organizational culture plays a significant role in successful companies such as Toyota and General Electric (Cameron & Quinn, 2011; Alvesson, 2012). The development of a corporate culture takes precedence over factors such as corporate strategy, market presence, and technological advantage by facilitating a standard interpretation system for organization members, creating continuity, binding organization members together, and energizing forward movement. The importance of organizational culture in successful companies suggests that companies must develop a solid corporate culture that aligns with their strategic objectives. Companies that do so may need help to achieve their goals and objectives. Finally, the knowledge, skills, and personal traits of project team members are not only crucial components of the overall organizational culture but also essential factors of the integrity and multi-functionality of the project team (Sumesh Sudheer Babu, 2017; Ali Mohammed Alashwal, 2017; Belassi & Tukel, 1996). The critical role of project team skills in project success implies that companies must invest in training and development to enhance these skills. Companies that pay attention to the importance of project team skills may need help with project execution and delivery. Therefore, there is a need for continuous skill development and learning among project team members.

In conclusion, the unique characteristics of the construction industry, knowledge management practices, adoption of ICT systems, organizational culture and project team skills all play crucial roles in the success of construction projects. Understanding and addressing these factors can lead to improved project outcomes.

METHODOLOGY

This study employs an array of interpretive techniques to decode, translate, and understand the meaning, rather than the frequency, of certain naturally occurring phenomena in the social world (Cooper & Schindler, 2011). It is viewed as an exploratory investigation which attempts to ascertain a phenomenon's existence (Dane, 1990).

The case study technique (Yin, 1994) is utilized to comprehend the comprehensive roles and responsibilities of the BOD and its relationship with management. This methodology, previously used in research to address "how" and "why" questions (Myers, 2009; Mouton, 2001), relies on the opinions expressed by participants during multiple interview sessions, as the researcher cannot control their attitudes and behaviours.

The qualitative approach, suitable for uniquely describing human experiences, encourages participants to collaborate with the researcher in interpreting the experiences under study (Dowling & Cooney, 2012). Qualitative researchers interested in studying human experiences from a field-focused, participant-centred, and process-oriented scientific perspective aim to explore social or human problems (Creswell, 2018). Therefore, in-depth interviewing was employed in this study, as it fosters a controlled situation (O'Hare et al., 2014), enabling the interviewer to elicit human experience effectively. This method facilitates the exploration of human experiences (Knight, 2002), supports the researcher in constructing a complex, holistic picture, and allows for the analysis of words, detailed views of respondents, and the conduction of the study in a natural setting.

In extracting raw data themes, the researcher grouped each section into commonalities or categories, establishing order and transitioning from specific to general (inductive). This process was deemed comprehensive when no additional meaningful groupings emerged. The study followed these steps, starting with clustering the quotes around underlying equivalence and considering emergent themes (Côté et al., 1995).

The methodology provides insight into the entire research process, which is crucial for achieving the research objectives. Given the qualitative nature of the research, a sample size of 8 was deemed most suitable. The chosen methodology guided the organization, structuring, and design of all the research procedures, including research design, population selection, sample selection, data gathering, and data analysis. The overall research method demonstrated the quality and originality of the research by maintaining trustworthiness, confidentiality, and credibility through field notes, interview recordings, and the preservation of participants' privacy.

RESULTS AND DISCUSSION

The primary objectives of this study were to examine the impact of construction delays and identify common issues plaguing numerous construction projects in the Klang Valley, Malaysia.

The research question led to an exploration of the challenges faced by the construction sector in the Klang Valley, as depicted in Figure 1.

Figure 1: Themes of problems encountered in the construction sector

Several management issues resulted in subpar performance, primarily due to lack of motivation, insufficient monitoring, and overwork. Consequently, clients still need to receive the expected output from the builders, leading to requests for revisions and further construction delays.

One participant highlighted the importance of having specific goals for each construction project, as different projects have unique objectives. For instance, the monsoon season in Malaysia often causes project delays and must be factored into the planning process.

The progress of payments is contingent on the timely completion of services. The work cost escalates if tasks need to be redone or take longer than expected. As a result, clients often need more time to make payments if the project is still in progress, leading to financial challenges for the construction companies.

A significant cause of accidents on construction sites is the lack of trained labour (Abdelhamid & Everett, 2000; Suraji et al., 2001). “Skilled labour” in the construction industry typically refers to individuals who have undergone extensive training and contribute highly specialized skills to construction projects. Many participants expressed concerns about the shortage of skilled labourers. This lack of skilled labour impacts the sustainability and efficiency of construction projects, leading to poor performance. As one participant noted:

> “Poor productivity arises from various issues, including sustainability and efficiency.”

Managerial issues related to labour often lead to poor performance. This subpar performance, unacceptable to clients, stems from factors such as lack of motivation, inadequate monitoring, and overwork. As a result, clients still need to receive the work as promised by the builder, leading to demands for revisions and further construction delays.

The term "shortage of material and funding" refers to a deficiency of resources compared to expectations, which may hinder the completion of the project. When clients request work revisions, it poses a significant challenge for the construction company, particularly in sourcing labour for the redo. Additionally, funding issues can lead to project delays.

Language barriers present another challenge, particularly for team leaders managing workers. In Malaysia, many individuals from different countries join construction companies as labourers. These workers often need help understanding the Malaysian language due to their diverse linguistic backgrounds, leading to miscommunications and subsequent workplace mistakes. Miscommunication, whether due to employee disputes or language barriers, can obscure the project goals for the workers, resulting in poor performance.

Ineffective communication can delay work as proper guidelines or instructions may not reach the workers due to miscommunication. One participant outlined this issue as follows:

> "There are instances where changes are made to drawings in the office, but these changes are not implemented on-site because the information is not delivered effectively"

The construction industry in Malaysia plays a pivotal role in the country's wealth generation, mainly through the development of socio-economic infrastructure and buildings. It provides employment opportunities to over a million people. According to one participant, sub-contractors often receive projects from the main contractor after going through 3-4 intermediaries. This process results in sub-contractors facing high risks for their work while receiving low returns. When both parties consent, a broker or a broker-sponsored sales representative negotiates the transaction between the buyer and the seller.

Each construction project should have a specific goal or objective, as articulated by one participant. Given the unique goals of different projects, each should be managed carefully. For instance, in Malaysia, the monsoon season often causes project delays and must be considered during planning.

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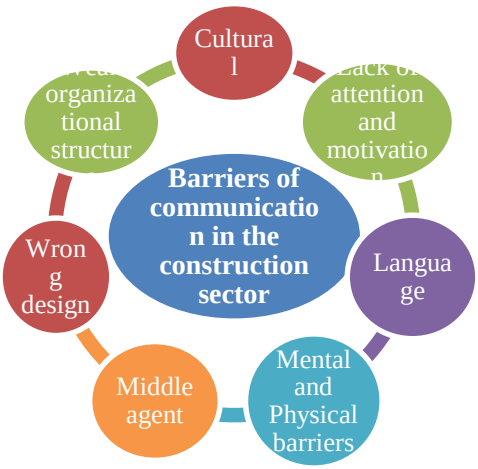

Figure 2: Barriers of Communication

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construction projects. Many participants expressed concerns about the shortage of skilled labourers. This lack of skilled labour impacts the project's performance.

Linguistic barriers are among the most common obstacles in communicating or delivering information to staff or workers. Construction projects often have large teams under one management, representing numerous nations and languages. This diversity can lead to difficulties in clear communication, especially for those from other countries adjusting to the Malaysian language. As a result, information cannot be effectively delivered. One participant noted that due to the volume of communications sent by many workers, the information could not be adequately received because of language barriers.

Global Data anticipates a 16.5% expansion in the Malaysian construction industry this year, supported by improving economic conditions. The government focuses on completing large infrastructure projects and increasing investment in industrial and energy projects. This study contributes significantly to understanding the construction sector, which plays a crucial role in the country's economy.

CONCLUSION

Successful project management is crucial for timely and budget-compliant completion, adhering to the project specifications. This study significantly contributes to understanding the construction industry's management of time. The findings provide managerial staff with a clear understanding of time management, enabling them to address these issues proactively.

This research has implications for our existing knowledge, particularly concerning the Malaysian construction industry's teaching-learning experience. It elucidates the impact of delays on the construction sector's elements in the Klang Valley. The implications of this study are discussed in two primary contexts: theoretical and practical.

The researcher examined the implications through the lens of two prominent theories used in this study: Kolb's experiential learning theory and situated learning theory. Kolb's experiential learning theory influenced the students' experience gained through learning using the construction approach in Malaysia. This theory emphasizes that learning must be a continuous process grounded in experience.

Furthermore, employees' experiences expand when they encounter new surroundings, whether planned or otherwise. The shift in the learning environment from the construction site to the surrounding community piques the interest of the construction company owners. It aligns with the situated learning theory by Lave and Wenger (1991), which states that learning should be specific to the situation or context in which the information is presented and applied.

In general, this research has clear implications, especially in broadening the application of both theories to explore employees' experiences through the teaching-learning approach. Unlike simple one-way instruction, a dynamic learning environment enhances the teaching-learning experience. It helps improve the understanding of the capabilities and values of the owners through networking with the construction industry community.

Undeniably, this research has identified the elements of construction delay formed through the company's active participation in this project. The construction process provides opportunities for employees and owners to gain experience while cooperating and serving their local community. Simultaneously, the researcher can engage in out-of-classroom activities that have a more significant impact than merely providing client guidelines. Projects must provide employees with clear guidelines about the owners' and workers' objectives and roles. This is because learning from the construction industry necessitates experts playing a crucial role as facilitators and assistants in guiding employees to complete their tasks.

AUTHOR BIOGRAPHY

Miss Basori Bano is student of the postgraduate programme Master of Civil Engineeringat Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. *Email: basoribanu@gmail.com*

Mohd Nizam Sakimon, PhD is a lecturer at Infrastructure University Kuala Lumpur (IUKL) Faculty of Engineering, Science and Technology. His research has focused on alleviating problems associated with reinforced concrete design, timber design and construction technologies. *Email: nizam@iukl.edu.my*

Siti Nur Aliaa Roslan, PhD is a senior lecturer at Universiti Putra Malaysia. Strong education professional with a Doctor of Philosophy in GIS & Geomatic Engineering and Master of Science (M.Sc.) focused in Remote Sensing & GIS from Universiti Putra Malaysia.

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Infrastructure University Kuala Lumpur

Infrastructure University Kuala Lumpur
Corporate Block, Unipark Suria,
Jalan Ikram-Uniten, 43000 Kajang,
Selangor Darul Ehsan.
Tel : (603) 8926 6993
Fax : (603) 87341021

www.IUKL.edu.my

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