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Variation Management in Construction Contracts: A Comparative Study of PWD 203A (Rev. 01/2010) and PAM 2018

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Abstract

The Malaysian construction and development sector plays a vital role in driving national economic growth. Yet, project performance often suffers when stakeholders manage variations ineffectively, causing delays and reducing overall efficiency. Variations in major contracts typically result in financial overruns and extended project durations. Though standard contracts outline procedures, inconsistent application often leads to disputes and operational inefficiencies. Empirical evidence highlights the dynamic and uncertain nature of variation practices, wherein inadequate implementation exacerbates risks to project outcomes. This research seeks to offer a thorough insight in best practice through a comparative examination of Malaysia's prevalent standard forms of contracts (SFOC), PWD 203A (Rev. 01/2010) and PAM 2018. The aims of this research are to investigate the current variation management procedures outlined in PWD 203A (Rev. 01/2010) and PAM 2018, assess effective variation control methods, and formulate best practice models. A dual methodology was employed, which integrated comprehensive document reviews and semi-structured interviews with six interviewees: two project managers, one architect, one contract administrator, one contract manager, and one consultant from industry professionals, all contributing to a robust contractual analysis. Comparative analysis employs four strategies, which will be examined and supported by academic sources, professional standards, and contractual documentation from 2010 to 2024. Findings aim to reveal success determinants in effective communication, rapid decision-making, and contractual clarity enhancing variation governance and efficiency.

1. Introduction

Malaysia's construction sector is a key component of national development, highlighted by significant infrastructure projects like the Petronas Twin Towers and the Mass Rapid Transit (MRT) systems. Contributing 3.6% to GDP in 2023, amounting to MYR 56.66 billion, an increase from MYR 53.43 billion in 2022, the industry continues to grow, despite a decrease in the rates of timely and within-scope project completions (Mahmoud et al., 2019. Eigbe (2016) mentioned variations are often due to design modifications, unforeseen conditions, or

regulatory shifts which are inherent in complex projects. When poorly managed, these lead to cost overruns and disputes (Rezouki, 2022), underscoring the need for precise contract frameworks and proactive coordination as described by Mohammad et al., (2019) and Abdullah et al., (2022).

Successful management of variation in construction project delivery necessitates adherence up to standard and best practices. However, Arain et al. (2004) and Naji et al. (2022) demonstrate that inadequate compliance frequently causes project underperformance. Variations represent modifications or adjustments to project scope, typically driven by human, non-human, or systemic influences. Jima (2023) further classifies variations as either engineer-issued instructions or formally approved changes.

As a consequence of the literature review, Table 1 identifies three studies examining variation life cycles (VLC), emphasising management practices across planning, design, construction stages and framework. Although substantial studies have explored the causes of variations, there has been limited direct comparison of how the PWD 203A and PAM 2018 SFOC address these issues. This research actively addresses that gap by providing a structured comparative analysis.

As mentioned by Harbans Singh (2004) illustrated in Figure 1, Malaysia has established comprehensive SFOC such as Public Works Department (PWD) 203A (Rev. 2010), Construction Industry Development Board (CIDB) 2000 (Rev. 2022), Institute of Engineers Malaysia (IEM) 2011, and Pertubuhan Akitek Malaysia (PAM) 2018, complemented by Fédération Internationale Des Ingénieurs-Conseils (FIDIC) Red Book (2017).

Table 1 *Scholarly investigations into variation causes across the project life cycle*

No	List of Research's Author	Variation Life-Cycle Causes in Existing Literature		
		Planning & Design	Construction	Framework
VLC1	Siahaan (2024)		/	
VLC2	Ismaeil & Sobaih (2024)		/	/
VLC3	Albasyouni, & Ashraf (2024).		/	
VLC4	Ghimire et al., (2023)		/	
VLC5	Ismail, et al., (2023)		/	
VLC6	Akomah, et.al., (2023)		/	
VLC7	Bandara (2023)		/	
VLC8	Ali (2023)	/	/	/
VLC9	Ismail (2022)		/	
VLC10	Mohammad, et al., (2021).		/	
VLC11	Fadl & Nassar (2017)		/	/
VLC12	Wambeke (2011)		/	/
VLC13	Arain & Sui Pheng (2006)		/	/
VLC14	Arain (2005)		/	/
VLC15	Koirala et al., (2002)		/	/
Total of Research Managing Variation		1	15	7

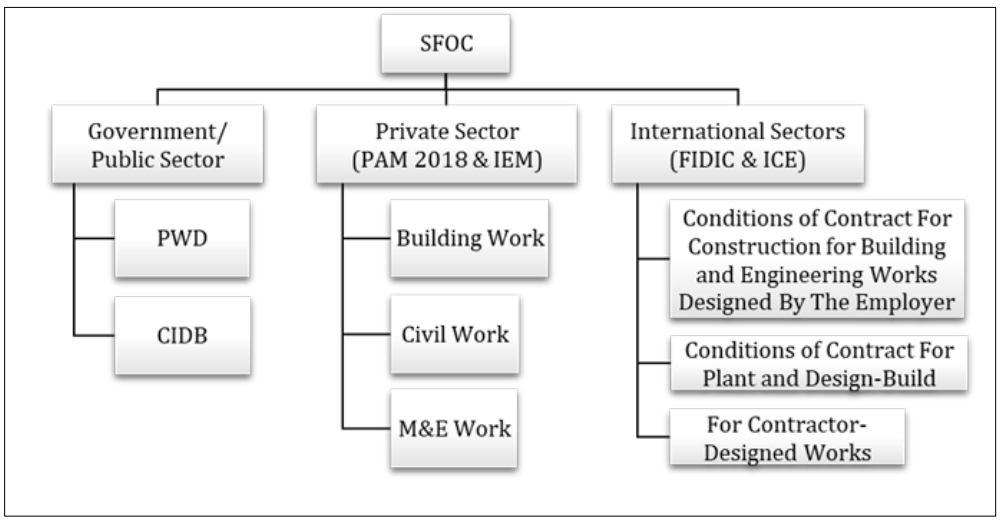

Fig. 1 *Standard form of contract in Malaysia (source: Harbans Singh (2004); PWD 203A rev. 01/2010; PAM 2018)*

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2. Background of Research

This study utilises a considerable volume of literature reviews to guarantee analytical depth and ensure credible outcomes. It investigates variation management practices in Malaysia's construction industry by examining influencing factors, statutory frameworks, and operational challenges. Construction projects involve several contractual parties with particular obligations, which adds complexity to the project lifecycle. To address this, Malaysia applies standard forms of contract tailored to different project types, providing structured procedures to manage variations effectively and mitigate disputes. Rajoo (1999; 2014) classifies these into four categories, including large-scale government initiatives, private developments, international undertakings, and general construction works. Berema et al., (2023) note prevalent use of PWD 203A, PAM 2018, FIDIC, CIDB, IEM, and NEC4 SFOC (Elkhayat et al., 2022). Berema et al., (2023) also highlight the importance of procurement strategies in enhancing transparency, while Mustapha (2011) emphasises the value of clear contractual standard forms in reducing risks.

Drawing on considerable sources from 2010–2024 and guided by Arain et al. (2004), Mohammad et al. (2017), Mohammad et al. (2019), and Siahaan et al. (2024), it proposes practical solutions to mitigate delays, strengthen coordination, and control project costs. Managing variation in Malaysian construction projects remains challenging due to fragmented practices, procedural rigidity, and low digital integration (Robertson et al., 1996; Ansari, 2014; Noruwa et al., 2022). Despite the existence of SFOC such as PWD 203A and PAM 2018, inefficiencies remain a major concern (Khalid et al., 2021; Ahmad et al., 2021; Rajoo, 2014; Zulkifli et al., 2024). This condition needs contextual modifications, as demonstrated by Gherardi & Nicolini (2000) and Akrich et al. (2002). Figure 2 illustrated the flowchart demonstrates the methodological sequence of this study. It actively integrates the chosen research paradigm with a structured narrative, ensuring clarity and coherence throughout the process. By linking conceptual design with practical investigation, the framework addresses inefficiencies in managing variations within construction contracts. This progression provides a systematic approach to connect theory, data collection, and analysis, ultimately strengthening the study's ability to generate practical insights for improving variation management practices.

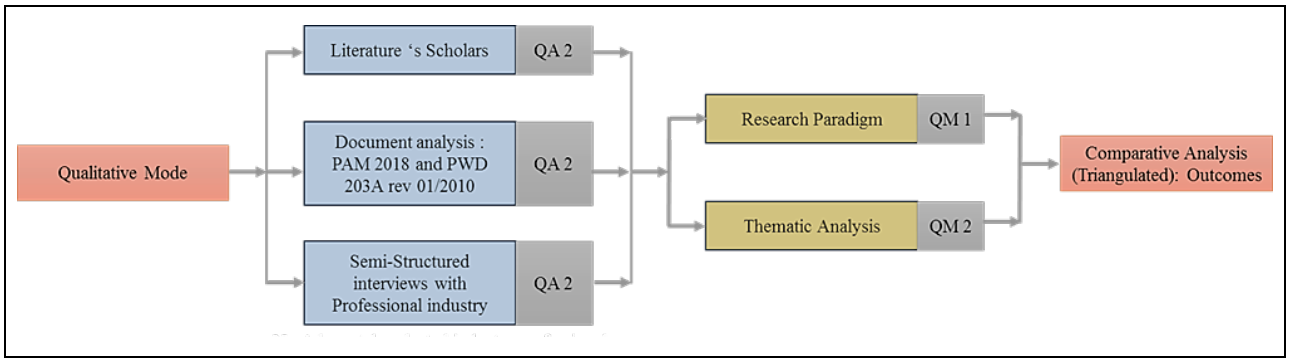

Fig. 2 *Research paradigm and thematic analysis contexts in qualitative research*

This study employs a qualitative approach that integrates document analysis, and semi-structured interviews with key industry stakeholders, including client representatives, consultants, contractors, and contract administrators (see Table 2). The research paradigm actively draws insights from literature, contractual documents, and publications spanning 2010–2024. To strengthen validity, the methodological framework applies four comparative strategies:

(i) Examines PWD 203A (Rev. 01/2010) and PAM 2018 clauses independently in unique approaches.
(ii) Identified and explores the development of common practices for possible standardisation.
(iii) Identifying and analyses contract-specific differences in processes and implications on project outcomes.
(iv) Proposing best practices for managing variations in Malaysian construction projects.

Table 2 *The summary list of interviewee details*

Interviewees	Age	Designation	Contract Experts	Project Experience
A	45	Project Manager	PWD 203A	More than 15 years
B	44	Architect	PWD 203A/ PAM 2018	More than 15 years
C	54	Contract Manager	PWD 203A	More than 15 years
D	50	Project Manager	PWD 203A	More than 15 years
E	61	Consultant (Engineer)	PWD 203A	More than 15 years
F	54	Contract Administrator (CA)	PWD 203A/ PAM 2018	More than 15 years

3. Literature Review

Inefficient contractual and project management practices frequently cause construction delays, cost overruns, disputes, and significant financial strain on project stakeholders. Mohammad et al. (2019) and Abdullah et al. (2022) revealed that inefficient variation management significantly contributes to project challenges. Therefore, conducting substantial reviews of previous studies is essential to develop best practice models addressing key variation causes.

3.1 Variation

Variation orders play a critical role in construction project management, reflecting the sector's dynamic and evolving conditions. Wambeke (2011) and Ismail et al. (2023) highlight that variations often emerge from design changes, unforeseen site conditions, regulatory shifts, or revised client requirements. The categorisation of variation orders plays a critical role in maintaining coordination, controlling costs, and ensuring timely delivery.

Scholars such as Ngwepe et al. (2015) and Ismail et al. (2023) group variations into four types: client-driven, consultant-driven, contractor-driven, and external. Each type carries unique implications and requires transparent, well-coordinated management, as illustrated in Table 3.

Table 3 *Types of variation order classification (VOC) in construction projects*

No	Variation Order Classification (VOC)	Reference
VOC1	Client variation orders	Ngwepe et al. (2015), Ismail et al., (2023)
VOC 2	Consultant – related variation order	
VOC 3	Contractor – related variation order	
VOC 4	Other related variation order	

3.2 Variation Categories

Siahaan et al. (2024) classified variation orders as primarily stemming from factors related to clients, consultants, and contractors, which aligns with the frameworks previously established by Ngwepe et al. (2015) and Ismail et al. (2023). These triggers are often intensified by indecision, delays, and financial constraints, disrupting project flow. As illustrated in Table 4, O'Brien (1998) and Balbaa et al. (2019) further classify variation categories into additive, deductive, and substitute, which is crucial for systematic variation control and dispute avoidance.

Table 4 *Categories of variation in construction projects*

No	Variation Categories (VCA)		Reference
	Categorise	Detail	
VCA 01	Additive Variation	Scope expansion via additional elements may elevate project costs and durations.	O'Brien (1998), Balbaa et al. (2019)
VCA 02	Deductive Variations	Scope reduction by omitting components may compromise functionality or aesthetic quality.	
VCA 03	Substitute Variations	Modification replacing original elements to satisfy client needs and address material constraints.	

3.3 Variation with Respect to PWD 203 A rev. 01/ 2010 and PAM 2018

PWD 203A (Rev. 1/2010) and PAM 2018 establish clear procedures for managing variation orders, covering issuance, approval, and execution stages. Under PWD 203A Clause 24.2 and PAM 2018 Clause 11.1 (see Table 5), variations include additions, omissions, or substitutions. The Superintendent Officer and Architect, respectively, exercise authority to implement these adjustments, ensuring effective management of uncertainties in project scope and sequencing (PWD, 2010; PAM, 2018).

Table 5 *Variation in the PAM 2018 and PWD 203A rev. 01/ 2010 contracts*

Variations include:	Standard Form of Contract	
	PAM 2018 - Clause 11.1	PWD 203A Clause 24.2
Additions, omissions, and substitutions of any work	(a)	(a)
Alterations of kinds or standards of materials, goods to be used in the works	(b)	(b)
Removal from the site of materials delivered for the works unless the removal is because the materials are defective	(c)	(c)

3.4 Causes of Variation

Ashworth & Perera (2018) pointed out about managing variation in construction necessitates a systematic and contractually grounded approach, ensuring transparency and control over procedural adjustments. Siahaan et al. (2024) observed that insufficient stakeholder engagement and weak specifications frequently generate inefficiencies. Consistently, three of six interviewees confirmed this issue, as reflected in Table 6.

Table 6 *Inefficiencies in variation management*

Interviewees	Quotations
A	"I concur with the inefficiencies in variation management, primarily arising from unclear specifications and design deficiencies".
C	"Poor managing variation can cause unnecessary changes, cost overruns, project delays and dispute".
E	"Effective project management requires a highly skilled and competent individual who fully understands the complexities of the project".

Ismaeil & Sobaih (2024) emphasised that enhanced digital tools and proactive planning play a pivotal role in mitigating risks and ensuring project alignment. Stakeholders must actively prioritize coordination and implement proactive variation management strategies:

Early Identification: Recognizing possible alterations before the project begins.

i. Clear Communication: Facilitate transparent, effective dialogue among all stakeholders.
ii. Competent Leadership: Appoint skilled professionals to oversee variation deviations.
iii. Proactive Monitoring: Regularly evaluate and respond to evolving project dynamics.

Consequently, enforcing structured variation systems reduces project problems and enhances outcomes. Table 7 summarises key variation causes, including design changes and coordination failures, as identified by fourteen previous scholarly studies.

Table 7 *List of variation cause in construction projects*

Item	Variation Cause / Reference	Siahaan et al. (2024)	Bandara (2023)	Alsohiman (2023)	Saki et al. (2022)	Mohammad et al (2019)	Adu & Opawole (2019)	Mahmoud et al (2019).	Walid et al (2019)	Oladiran et al (2018)	Ezeldin et al (2018)	Luqman O.O et al (2016)	Eigbe (2016)	Rasheed et al (2015)	Halwatura et al (2013)	Total Variation's causes
a	Change of Schedule	/	/	/				/	/	/	/	/		/		9
b	Changes of scope	/	/	/		/	/	/		/	/	/	/	/		11
c	Owner's financial problems	/			/	/	/	/	/	/	/		/			9
d	Inadequate project objectives	/		/					/	/	/			/	/	7
e	Replacement of materials or procedures	/							/	/	/	/	/		/	7
f	Impediment to prompt decision-making process	/	/	/	/	/		/	/		/			/		9
g	Change in design	/		/	/	/		/	/	/	/	/	/	/	/	12
h	Errors and omissions in design			/			/	/	/	/	/	/	/	/	/	10
i	Conflicts/ discrepancies among contract documents								/			/		/		3
j	Value engineering							/	/		/				/	4
k	Consultants' lack of required data										/			/		2
l	Discrepancy design details	/	/								/	/				4
m	Change in specifications	/	/	/			/		/				/			6
n	Technology changes		/						/	/		/		/	/	6
o	Lack of coordination		/		/			/	/	/	/	/		/	/	9
p	Design complexity	/							/	/	/	/				5
q	New Government regulation	/						/	/	/	/	/		/		7
r	Safety consideration	/							/		/				/	4
s	Defective workmanship							/	/	/		/			/	5
t	Contractor financial difficulties							/	/	/				/		4
u	Weather conditions	/	/						/	/	/		/	/	/	8

3.5 Contract Administrator's Roles in Managing Variation Within PWD 203A (rev.01/2010) and PAM 2018

Managing variations under PWD 203A (Rev. 01/2010) and PAM 2018 requires a structured methodological approach to ensure contractual compliance, financial governance, and project efficiency. This inquiry examines variation initiation, assessment, and approval within contractual frameworks, considering stakeholder dynamics and organizational procedures.

PAM 2018 emphasizes adaptability and efficiency, while PWD 203A prioritizes regulatory compliance, transparency, and cost control. *PAM 2018 Clause 2.2* employs a design-centric model leveraging professional discretion and flexible interpretation, whereas *PWD 203A Clause 24.3* relies on prescriptive governance, procedural rigor, and financial accountability. *PAM 2018 Clause 11.5, and 11.6* highlights professional autonomy and design flexibility for Architects and Quantity Surveyors, whereas PWD 203A enforces transparent governance as stated in PWD 203A clause 10.1(b) (Ahmad et al., 2011).

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Table 8 delineate the Contract Administrator's (CA) functional authority, contrasting the roles of the SO and Architect. As Harbans Singh (2011) and Teck (2019) affirm, standard contracts grant explicit instruction powers to SOs and Architects, with *PAM 2018 Clause 2.2* requiring instructions be titled "Architect's Instruction" (AI), enforceable through confirmation mechanisms. Proper instruction is thus central to variation legitimacy, enabling entitlements to extensions or additional cost claims (Teck, 2019).

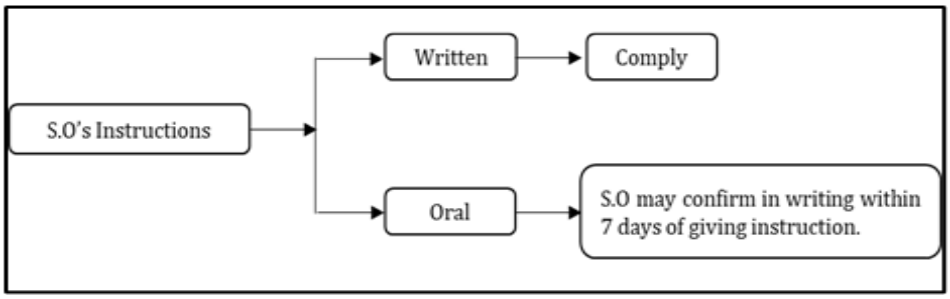
Table 8 *Distinguish duty and roles between the SO and the architect in PWD 203A Rev. 01/2010 and PAM 2018*

Aspect	PWD 203A Rev. 01/2010	PAM 2018
Appointment	Appointed by employer/government: Cl.3.1	Appointed by employer/client: Art. 3.6
Authority	Government's contract representative: Cl. 3.0	Architect's delegated contract manager: Cl. 11.5
Variation Approval	Approves with VO Committee consent: Cl. 24.3	Directly evaluates and approves: Cl. 11.5
Payment Certification	Certifies progress and final payments: Cl. 28 & 31	Issues interim and final certificates: Cl. 30.1 & 30.15
Dispute Resolution	Mediates but follows contract terms: Cl. 66	Assesses disputes before arbitration
EOT Assessment	Evaluates based on contract clauses: Cl. 43.1	Determines EOT based on conditions: Cl 23.8
Instruction Issuance	Issues written site instructions: Cl.24.1	Issues formal contract instructions: Cl.2.2

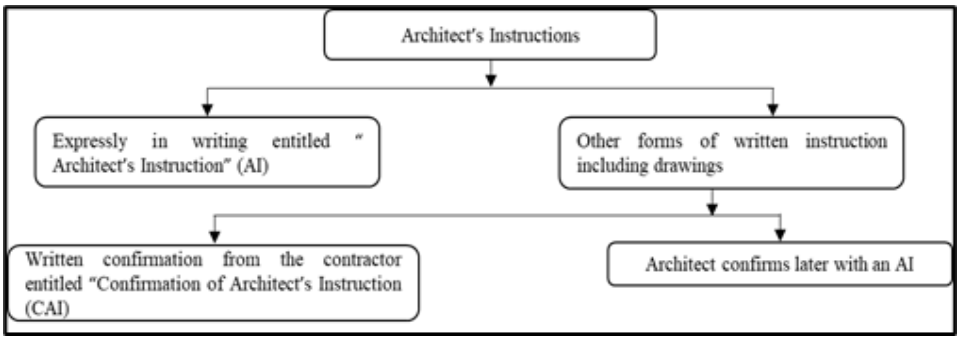
3.6 Comparative Analysis: Contract Competencies Between PWD 203A (rev.01/2010) vs PAM 2018

Figure 3 illustrates the differing administrative authorities in PWD 203A and PAM 2018. *PAM 2018 Clause 11.1* assigns the Architect as Contract Administrator, while *PWD 203A rev. 01/2010 Clause 3.1* places this role with the Superintending Officer (SO). *PAM 2018 Clause 11.2* enables contractors to challenge instructions beyond contractual scope, showing a consultative approach compared to PWD 203A's hierarchical system (Teck, 2019). Both require compliance with valid instructions, yet PAM 2018 allows broader clarification rights.

Table 9 contrasts PAM 2018's contractual flexibility and architect-led administration with PWD 203A's government-regulated, specification-driven framework. PAM favours contractor-friendly claims, clear risk allocation, and delegated authority, whereas PWD emphasises rigid procedures, bureaucratic approvals, and technical deliverables in managing variations.



(a)



(b)

Fig. 3 *Variation instruction outlines with respect to (a) SO's instruction in PWD 203A (rev. 01/2010); and (b) Architect's Instruction in PAM 2018 [1]*

Table 9 *Key competencies in managing variation between PWD 203A (rev. 01/2010) and PAM 2018*

Competencies Area	PWD 203A	PAM 2018	Key Differences
Nature of work	Government Project Technical specification and material standards focus.	Private Sector Projects Contractual obligation focuses.	i. PWD: Technical and regulatory oriented. ii. PAM: Contractual oriented
Managing Variation	Allow variation with cost and time impact	Architect's instruction	i. PWD: Rigid (Government policy) ii. PAM: Flexible (Private sectors)
Approval Authority	Government Agencies (SO)	Architects	i. PWD: Bureaucracy ii. PAM: Delegated Authority
Risk Allocation	Often borne by government	Clear risk-sharing	PAM clear for liability provision compared to PWD in dispute
Payment and Claim	Follows government procurement rules	Time-bound claims submission deadlines	PAM 2018 is more contractor-friendly
Documentation	Focus on technical deliverables	Contractual documentation provisions	i. PWD: Technical Deliverable. ii. PAM: Contractual Provision.

3.7 Comparative Analysis: Managing Variation Practices and Comprehension of Provision Contract Clauses in PWD 203A rev. 01/2010 and PAM 2018

Effective managing variation is a critical success factor in construction, especially under Malaysia's widely adopted and PWD 203A (Rev. 01/2010), and PAM 2018 contracts as elaborated by Amoah et al. (2021). Analysis integrates literature Latilo et al., 2024), interview findings, and contract review, revealing scope interpretation divergence, discretionary authority (Rosander & Kadefors, 2023), and valuation fairness issues Thompson, 2024).

The semi-structured interview findings, presented in Table 10, reveal that five of six interviewees agreed the main issue stems from insufficient comprehension of contractual knowledge. Both PAM 2018 and PWD 203A (Rev. 1/2010) acknowledge that variations may affect project timelines, allowing for Extension of Time (EOT) claims when supported by sufficient documentation as briefed by Saadan et al. (2024).

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Table 10 *Critical understanding in contractual knowledge among stakeholders*

Interviewee	Quotation
A	"The interpretation and application of contractual variation provisions are contingent upon the project stakeholders, including the project team and consultants, whose expertise influences the derivation and understanding of contract clauses".
C	"The adherence of the stakeholder to contract variation provision depends on several factors including project complexity, contracts administration and stakeholder interest"
D	"Stakeholders should always ensure that contracts include clear variation provisions, although this often depends on the project team's expertise"
E	"In most cases, stakeholders focus on minor variations, typically around 10% to 20%, while major variations exceeding 80% are rare".
F	"They should adhere to the contract's provisions all the time because there will be a deviation in contract provisions and breach of the contract issues in construction".

Table 11 highlights inconsistencies in EOT management under and PWD 203A (Rev. 01/2010), and PAM 2018. Findings show underestimated impacts, poor documentation, and reliance on informal dispute resolution, while omissions, risk allocation, and late valuations frequently cause tensions, delayed approvals, and payment disputes.

Table 11 *Triangulation comparative analysis: managing variation practices*

Theme	Reference	Literature Insight	Interview Synthesis	Contractual Reference	Research
Client-Initiated Scope Authority	Zulkifli et al. (2024), Abdullah (2022)	Unilateral client-driven variations	Contractor excluded from decisions	• PAM: Cl 11.1 • PWD: Cl 24.2	Hierarchical authority limits input
Formal Variation Instruction Chain	Rais (2020), Cheah (2019), & Thuraisingham (2013)	Role-specific instruction authority	Delegation breakdowns delay progress	• PAM: Cl 11.2 • PWD: Cl 24.1	Communication enhances procedural clarity
Contractual Valuation Methodology	Rais (2020), Abdullah (2022), Teck (2019)	Rate-based or negotiated valuation	PAM viewed as flexible	• PAM: Cl 11.5 • PWD: Cl 25.2	Valuation affects fiscal outcome
Extension of Time Mechanism	Abdullah, (2022), Rais (2020), Teck (2019),	Delay justification requires evidence	PWD extensions often delayed	• PAM: Cl 23 • PWD: Cl 43	Timeliness needs procedural efficiency
Automatic Variation Triggering	Rais (2020), Teck (2019), Pedia (2019),	Passive change initiates variation	Provisional sums often overlooked	• PAM:Cl.11.1(b) • PWD: Cl 24.2(b)	Cost drivers require anticipation
Dispute Management Framework	Abdullah (2022), Teck (2019)	Arbitration or alternative mediation	PAM resolutions seen faster	• PAM: Cl 34 • PWD: Cl 47	Informal resolution fosters harmony
Consultant Discretionary Powers	Rais (2020), Teck (2019), Pedia (2019)	Consultant-led change discretion	PAM allows agile decisions	• PAM: Cl 11.6; • PWD: 10(d) & 24.3.	Consultant power impacts decisions
Compliance Documentation Requirements	Teck (2019), Pedia (2019)	Documentation under audit scrutiny	PWD burdens with paperwork	• PAM: Cl.11.6(b); • PWD: Cl 10	Documentation enables procedural traceability

Theme	Reference	Literature Insight	Interview Synthesis	Contractual Reference	Research
Variation Risk Management Approach	Noliza, D. (2015) & Abdullah (2022).	Contractor-centric risk placement	Risk often unfairly transferred	• PAM: Cl 1.6(b); • PWD: Cl. 10(b), (d)	Risk sharing supports project resilience
Contract Adaptation Capability	Teck (2019), Rais (2020)	Contractual change responsiveness	PAM seen as adaptable	• PAM: Cl.11; • PWD: Cl.24	Flexibility enhances delivery success

3.8 Comparative Analysis: Time Related Impact in Managing Variation

Figure 4 presents the procedural workflow for Extension of Time (EOT) applications, outlining submission, evaluation, and approval stages that emphasize differing administrative roles under PWD 203A, and PAM 2018. The figure illustrates a sequential framework integrating planning, coordination, and control strategies to enhance decision-making and governance efficiency in managing variations under construction contracts.

Complementing this, Table 12 integrates findings from literature, interviews, and contractual practices of both contract frameworks, identifying key time-related impacts of variations including delays, disruptions, approval inefficiencies, and recovery issues. Together, these highlight procedural bottlenecks and underscore the contrasting governance approaches between PAM 2018's consultative flexibility and PWD 203A's regulatory rigidity.

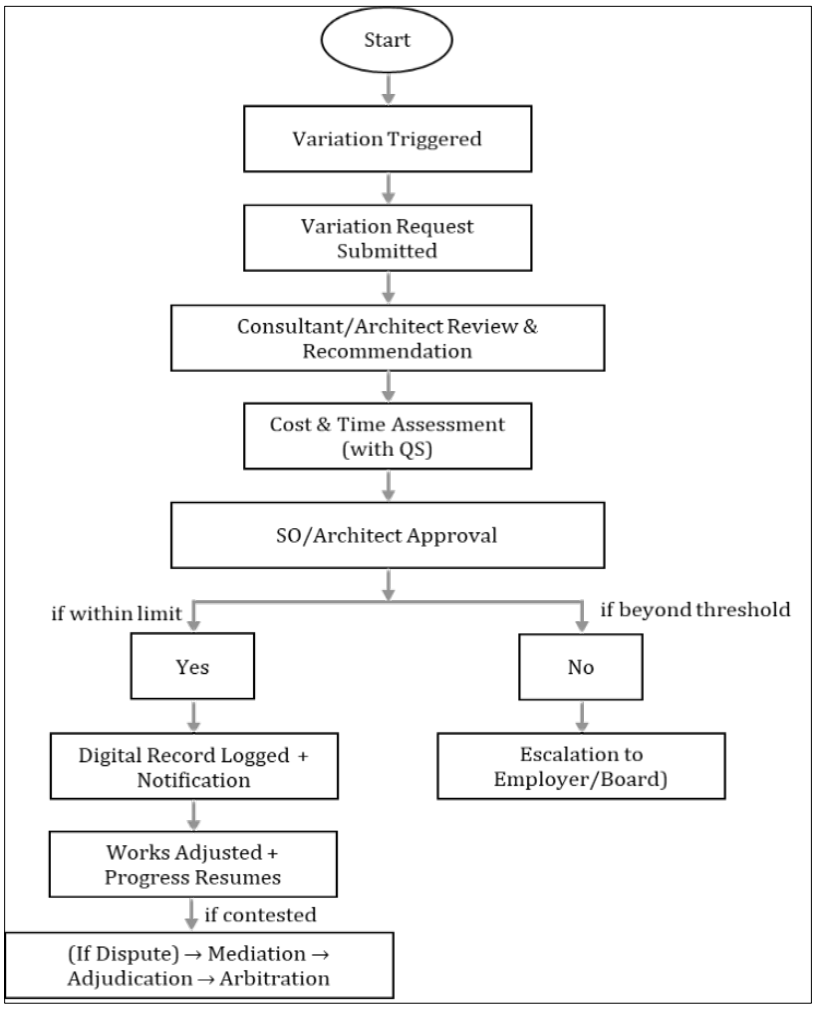


Fig. 4 *An outline of current practices of EOT approval PWD 203A (rev. 01/2010) vs PAM 2018*

Table 12 *Triangulation comparative analysis: time related impact in managing variations*

Source	Delay	Disruption	Approval	Recovery
Literature Review	Variations commonly extend project timelines.	Changes interrupt workflow, slow down operations.	Approval lags often cause work stoppage.	Inconsistent procedures and outdated practices limit speed.
Semi-Structured Interviews (A–F)	Delay severity tied to scope and activity affected.	Idle time during justification is frequent.	Contractors face slow or unclear approval steps.	Disputes and unclear records hinder time recovery.
PWD 203A Practices	Requires EOT under clause 43, but often delayed.	Unapproved variations stall progress.	Requires formal VO process; often slow in public projects.	Limited by strict documentation rules.
PAM 2018 Practices	Clause 23 governs EOT, but subject to architect's timing.	Variations outside critical path still affect rhythm.	Delays occur in architect's valuation and employer decisions.	Claims delayed due to complex assessment steps.

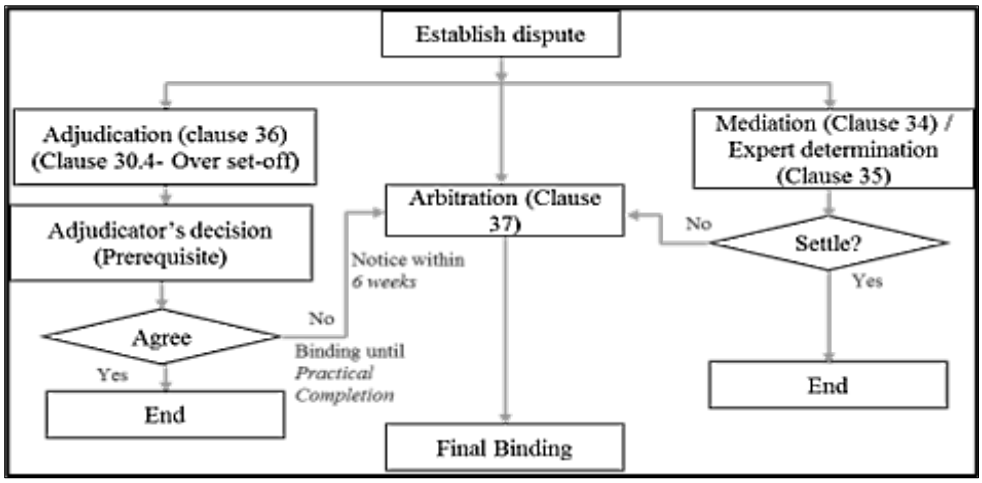
3.9 Comparative Analysis: Defined Procedures for Effective Dispute Resolution

Table 13 compares dispute resolution mechanisms under PWD 203A, and PAM 2018, highlighting variations in interpretation, process, roles, and outcomes as identified by Whaley (2020). Persistent contractual ambiguities are evident across literature, interviews, and practice. PAM 2018 demonstrates structured efficiency through adjudication, mediation, and arbitration, supported by CIPAA 2012, which provides clearer and faster resolution pathways. In contrast, PWD 203A relies primarily on the officer's decision and formal arbitration, often resulting in delays and limited authority.

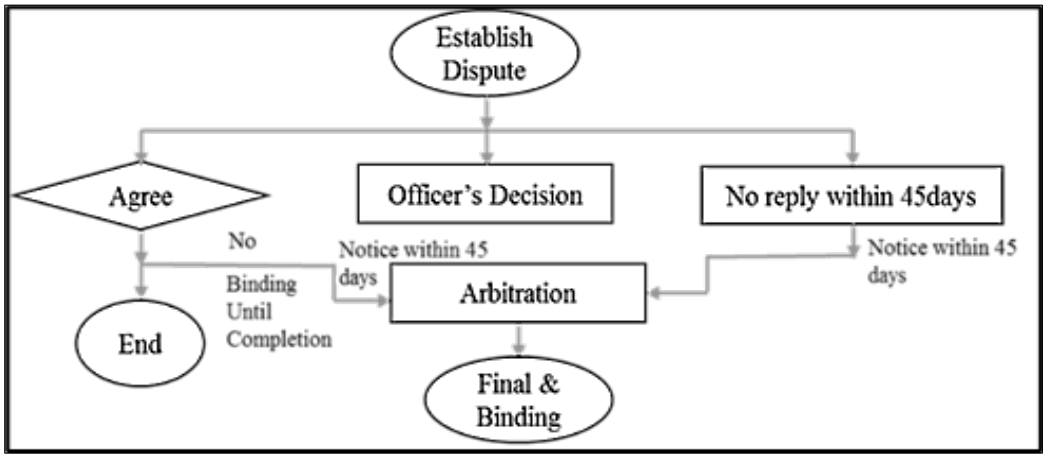
Supported by Table 13, Figure 5 highlights these contrasts by emphasising the procedural transparency of PAM 2018 and the pressing need to reform the public sector's PWD 203A (Rev. 01/2010) dispute resolution framework, as illustrated by Ahmad (2019). The thematic outcome emerges from a comparative analysis of the dispute resolution mechanisms within both SFOCs.

Table 13 *Comparative analysis: dispute resolution process*

Theme	Literature Review	Semi-Structured Interviews	PWD 203A (Rev. 01/2010)	PAM 2018
Interpretation	Contractual ambiguity persists	Role boundaries frequently overlap	Limited procedural clarity exists	Structured multi-path resolution
Process	Arbitration lacks timely effectiveness	Procedural initiation often delayed	Formal arbitration remains dominant	Adjudication ensures efficient handling
Roles	Undefined dispute decision roles	Accountability inconsistently observed	SO, authority structurally constrained	Architect neutrality explicitly required
Outcome	Resolution delays undermine progress	Effectiveness hindered by ambiguity	Prolonged timeline implications noted	Timely outcomes through adjudication



(a)



(b)

Fig. 5 *General dispute resolution in (a) PAM 2018; and (b) PWD 203A rev. 01/2010 contracts ([1], & [50])*

4. Recommendations and Conclusion

The study advances structured pyramid models and targeted recommendations to fulfil the research objectives and aims while strengthening variation management practices under PWD 203A rev. 01/ 2010, and PAM 2018 as illustrated in Figure 6 and Figure 7**.** Figure 6 presents a three-tier model that strengthens capacity building, standardizes variation order procedures, and embeds performance-oriented controls to minimize inefficiencies and ambiguities in roles, planning, scope, documentation, cost, time, and disputes. Meanwhile, By aligning developmental and operational strategies into three actionable steps. While, Figure 7 promotes dispute reduction and transparency, responding to the persistent cost, time, and quality challenges posed by variations:

(a) Step 1 (Bottom Tier) : Training and Capacity Building
The model prioritizes training and capacity building as its foundation, strengthening contractual literacy, ethical governance, and variation protocol knowledge. This proactive approach equips stakeholders to interpret and implement variation clauses effectively under PWD 203A, and PAM 2018.

(b) Step 2 (Middle Tier) : Variation Order Procedure and Process Management
The middle tier strengthens variation management by standardising workflows for initiation, assessment, approval, and tracking. By integrating digital tools and SOPs, stakeholders reduce delays, improve transparency, and ensure equitable evaluation of time and cost impacts.

(c) Step 3 (Top Tier) : Performance-Driven Measures in Managing Variation
The top tier applies performance-driven measures by auditing variation practices, benchmarking trends, and aligning decisions with cost, time, and quality indicators. Independent oversight and digital tracking enhance transparency, reduce ambiguity, and strengthen variation governance across PWD 203A, and PAM 2018.

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Emphasising professional development, digitalisation, and performance benchmarks, it advocates stronger contractual literacy and ethical governance among stakeholders. The findings identify five persistent issues: unclear responsibilities, fragmented dispute mechanisms, poor documentation, limited risk coordination, and capacity gaps. Collectively, the model proposes an integrated, scalable solution to elevate variation resolution efficiency in both public and private-sector construction contracts in Malaysia.

In conclusion, Table 14 presents strategic recommendations that actively advance an integrated reform framework for managing variations within Malaysia's construction industry. The proposed measures strengthen role clarity, embed ethical oversight, integrate digital technologies, institutionalise dispute resolution, and improve pre-contract planning, thereby ensuring resilient, accountable, and efficient contract management.

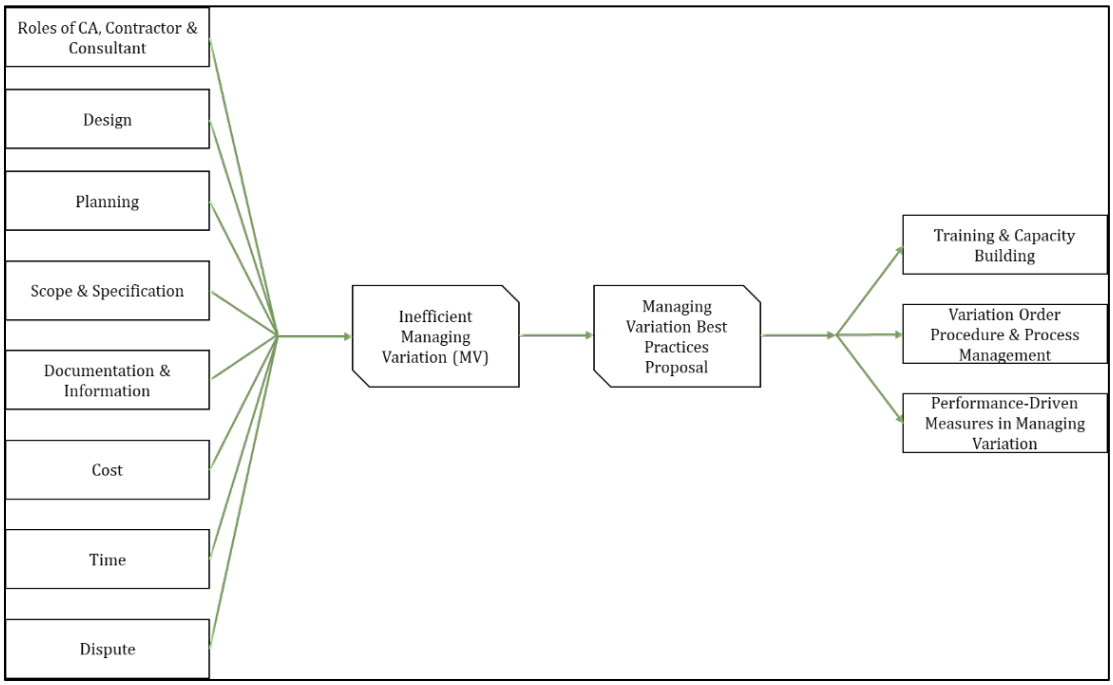

Fig. 6 *Integrated recommendation model for effective variation governance in malaysian contracts*

In response, this research develops a pyramid-based framework that integrates capacity building, standardized variation procedures, and performance-driven governance. It further promotes ethical oversight, digital integration, and early risk coordination to institutionalize proactive, transparent, and accountable variation management suited to Malaysia's evolving construction sector.

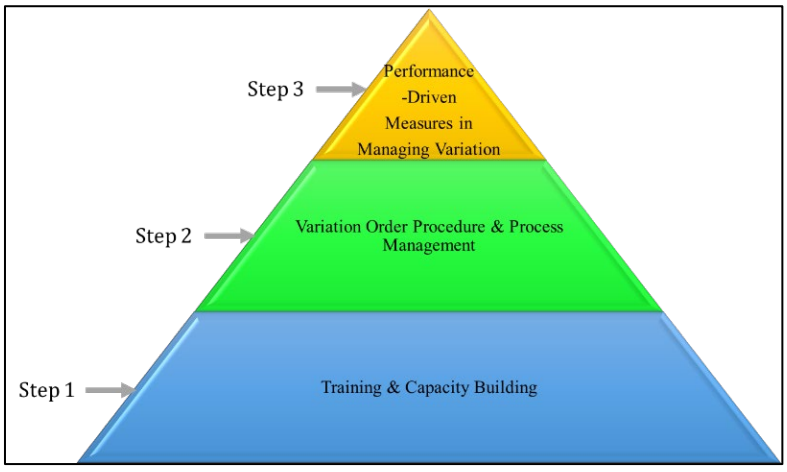

Fig. 7 *A series of strategic steps in best practices in managing variation*

Table 14 *Best practices recommendation in managing variation*

Aspect	Best Practice Recommendations
Role Definition	SOP-guided role delineation matrix
Dispute Resolution Mechanism	Hybrid system: adjudication → mediation → arbitration
Digital Administration	Use of digital tools for submission, tracking, and audit of variations
Pre - Contract Coordination	Mandatory design coordination workshops and feasibility studies
Governance and Ethics	Independent oversight and stakeholder training

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Conflict of Interest

The authors declare that there is no conflict of interests or competing financial interests associated with the publication of the paper.

Author Contribution

Author contributions: Study conception and design were carried out by ***Ishak, M.S.M., Ismail Z****. Data collection was performed by* ***Ishak, M.S.M.*** *Analysis and interpretation of results were conducted by* ***Ishak, M.S.M., Ismail Z****. The draft manuscript was prepared by* ***Ishak, M.S.M.*** *All authors reviewed the results and approved the final version of the manuscript*.

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