IJIE

Penerbit

INTERNATIONAL JOURNAL OF INTEGRATED ENGINEERING
ISSN: 2229-838X e-ISSN: 2600-7916

Vol. 18 No. 3 (2026) 523-540
https://publisher.uthm.edu.my/ojs/index.php/ijie

Choosing The Right Performance Rating Method: A Comparative Review of Performance Rating Methods in Time Study

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DOI: https://doi.org/10.30880/ijie.2026.18.03.034

Article Info

Received: 6 August 2025
Accepted: 24 April 2026
Available online: 9 June 2026

Keywords

Time study, time studies, performance rating, industrial engineering, manufacturing, production, review

Abstract

Time study is a widely used work measurement technique in industrial engineering, providing a systematic approach to determine standard times for task completion. Central to this process is performance rating, which is a critical adjustment mechanism that converts observed work time to a standard performance level, directly impacting the fairness and accuracy of established time standards. Despite decades of industrial application, performance rating remains contentious due to inherent subjectivity and significant inter-observer variability, yet limited comparative research exists to guide practitioners in method selection. This paper addresses this gap by presenting a systematic comparative review of 4 principal performance rating methods, which are speed rating, the Westinghouse system, synthetic rating, and objective rating. Through critical analysis of their operational mechanisms, contextual applicability, and practical limitations, this review reveals that method selection should be strategically aligned with task characteristics, operational complexity, and resource availability rather than pursuing a universal approach. The findings provide guidance for industrial engineers and operations managers to optimize performance rating accuracy through informed method selection and appropriate implementation strategies, with proper training and calibration identified as essential enablers of reliable results across all methods.

1. Introduction

In industrial engineering and operations management fields, time study is a cornerstone technique for measuring and improving work efficiency [1]. As organizations continuously seek to enhance productivity, reduce costs, and optimize labor utilization, time study provides a systematic method for establishing standard times for task completion [2]. At the heart of this method lies performance rating, which is an evaluative process used to adjust observed times based on the assessed pace of a worker relative to a defined standard. Performance rating serves a critical function in translating observed work time into normal time, which is then used to calculate standard time. However, despite its widespread application, performance rating remains one of the most subjective and debated components of time study. Variability in observer judgment, differences in interpretation, and lack of standardization across industries contribute to significant challenges in ensuring reliability and accuracy. With the advancement of technology, there has been a growing interest in automating or enhancing performance rating methods using digital tools, video analysis, artificial intelligence, and wearable devices [3,4]. These innovations aim to reduce human bias and improve the objectivity of ratings [5,6].

Although individual performance rating methods are well-documented in the industrial engineering literature and specific case studies, a notable lack remains in comprehensive comparative analyses that evaluate their relative advantages, limitations, and contextual applicability within diverse industrial settings. Practitioners often select methods based on organizational tradition or familiarity rather than systematic evaluation of appropriateness for specific operational contexts. This gap is particularly problematic given the significant impact of performance rating accuracy on standard time determination, which in turn affects production planning, cost estimation, workforce scheduling, and compensation systems. Furthermore, as manufacturing environments become increasingly diverse, ranging from high-volume repetitive operations to complex mixed-model production, the need for strategic method selection has intensified.

This review addresses these challenges by synthesizing existing knowledge into a structured comparative framework, providing practical decision-making guidance that extends beyond theoretical descriptions to actionable implementation criteria. By critically examining the operational requirements, accuracy determinants, and contextual boundaries of each method, this paper provides a practical reference for both academic researchers seeking to advance work measurement theory and industrial practitioners requiring evidence-based guidance for method selection and implementation.

1.1 Time Study

Time study is a fundamental work measurement technique in industrial engineering used to determine the time required for a trained and qualified worker to perform a specific task under standardized working conditions. Time study serves several key objectives, which are outlined below [7].

i. To evaluate the tasks involved in completing a job, with the aim of reducing or eliminating unnecessary or repetitive actions, thereby minimizing the physical effort required by workers.
ii. To assess and compare the time taken to perform tasks using different methods.
iii. To establish the most efficient procedure for carrying out a specific job.
iv. To set standardized working conditions that promote optimal performance.
v. To identify the ideal number of workers and machines required for a task.
vi. To determine the appropriate ratio between manpower and machinery to ensure both are used effectively and efficiently.
vii. To offer reliable data that supports production planning, scheduling, and decision-making processes.
viii. To evenly distribute tasks among team members to achieve balanced workloads.
ix. To calculate the normal time required to complete a task, which can serve as a foundation for implementing wage incentive programs for employees.

The time study process involves observing and recording the time taken to complete work elements during task execution. These recorded times are then adjusted using a performance rating factor to account for the worker's pace relative to a defined "normal" performance level. The resulting normal time is further modified by adding allowances for fatigue, delays, and other contingencies to arrive at the standard time [8,9]. Time study can be summarized as Fig. 1 below.

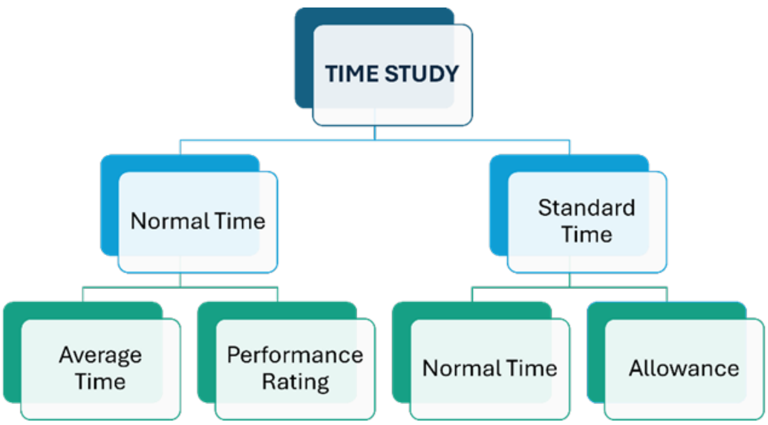

Fig. 1 *Components of time study*

Time study is commonly applied in environments where repetitive or cyclical tasks are performed, such as in manufacturing, assembly lines, warehousing, and service operations. By identifying inefficient practices, eliminating unnecessary motions, and optimizing task sequences, time study contribute directly to the continuous improvement and lean management initiatives within organizations. Although time study offers various benefits, it also has certain limitations, as outlined below [7].

i. The standard time recorded can vary between observers, and even a single observer may assign different standard times on separate occasions for the same task.
ii. Time study is partly subjective, as it relies on the observer's judgment when selecting statistical measures, estimating allowances for personal needs, and other related decisions.
iii. The accuracy of the standard time may be compromised if the operator's performance rating is incorrectly assessed during the observation.
iv. The presence of an observer may influence workers' behaviour, leading them to act differently than they normally would. This can negatively impact the validity of the data collected, and in some cases, may also lead to resistance from labour unions against the use of stopwatches or time studies.

1.2 Importance of Time Study

Time study plays a critical role in enhancing productivity and operational efficiency, specifically within manufacturing and production environments. It involves systematic observation and measurement of the time required to complete specific tasks, with the goal of identifying inefficiencies, establishing standard times, and streamlining workflows [5]. The insights gained from time study support efforts to improve process performance, lower operational costs, and optimize resource utilization. One of the primary advantages of time study is its ability to reveal inefficiencies and guide process improvements [10]. By analyzing the time consumed in each element of a task, organizations can detect delays, redundant motions, and potential safety risks. This allows for targeted improvements, such as minimizing unnecessary movements, reallocating labor, optimizing machine usage, and redesigning workstation layouts to enhance productivity and ergonomics.

Time study also serves as a foundation for setting standard times, which act as performance benchmarks [11]. These benchmarks are essential for realistic production planning, capacity estimation, and workforce management. Standard times enable managers to establish achievable output targets, improve scheduling accuracy, and determine staffing needs. Furthermore, time study provides a fair and objective basis for incentive systems, ensuring that employee compensation is aligned with performance and task complexity [5]. Beyond operational improvements, time study contributes directly to productivity gains and cost reductions [1]. Streamlining workflows reduces idle time and enhances output per labour hour, leading to better utilization of resources and higher profitability. The data collected through a time study can also be used to monitor employee performance, identify skill gaps, and inform training and development initiatives.

In addition to production optimization, time study data supports broader business functions. It informs decisions related to product mix, batch size determination, line balancing, and lead time reduction [12]. This data-driven approach facilitates more accurate forecasting and strategic planning, enabling organizations to respond more effectively to changing market demands. In summary, time study is an essential tool in industrial engineering for improving work processes, establishing performance standards, and supporting informed decision-making. By offering objective insights into task performance and process flow, it enables organizations to drive continuous improvement, enhance productivity, and achieve greater operational efficiency.

1.3 Normal Time and Standard Time

In the context of time study, understanding the difference between normal time and standard time is essential for accurately evaluating and planning work activities. These 2 measures serve as key components in the development of reliable time standards used in productivity assessment, performance management, and operational planning.

Normal time refers to the time a worker would take to complete a task working at a normal or average pace, neither rushing nor dawdling [8]. It is derived by applying a performance rating factor to the observed time [12]. Since the pace of different workers can vary, the performance rating is used to normalize this variation by adjusting the observed time to reflect what would be expected from a worker performing at a standard level of effort. The calculation for normal time is expressed as Eq. 1 below [2].

$$Normal\ Time = Average\ Time \times Performance\ Rating \tag{1}$$

Standard time, on the other hand, accounts not only for the normalized task duration but also includes additional allowances to accommodate for unavoidable delays, rest periods, fatigue, and personal needs [8], [13]. These allowances are essential to ensure that the standard time is realistic and fair, reflecting actual working conditions rather than ideal or uninterrupted scenarios [9,14,15]. Standard time can be calculated using Eq. 2 [2,16].

$$Standard\ Time = \frac{Normal\ Time}{(1 - Allowance)} \quad (2)$$

Both normal time and standard time are crucial in workforce planning, cost estimation, and performance evaluation [14]. Setting an accurate standard time ensures fairness for workers and efficiency for management [5]. Misestimation, whether from incorrect performance ratings or inappropriate allowances, can lead to unrealistic expectations, worker dissatisfaction, or operational inefficiencies.

In practice, determining appropriate performance ratings and allowances is a challenging task, which often requires experienced judgment or the integration of technological tools to enhance objectivity and accuracy [17]. As such, the reliability of both normal time and standard time heavily depends on the quality of performance rating and the validity of the allowances applied [9].

2. Performance Rating

Performance rating is a critical component of time study, a process used in industrial engineering to measure and analyze the time required to perform tasks, to establish standard times for efficient workforce management [18]. Performance rating involves observing a worker's performance during a time study and adjusting the observed time to reflect what a "normal" worker would take under standard conditions. This adjustment, known as the rating factor, is crucial for determining normal time, which, when combined with allowances, yields standard time [19]. The choice of rating method can significantly impact the accuracy and fairness of time standards, influencing labor costs, productivity, and worker morale. Standard performance is usually represented as 100%, with ratings above 100% indicating above-average performance and below 100% indicating below-average performance [20].

2.1 Method of Performance Rating

Performance rating methods are techniques used in time study to evaluate a worker's pace relative to a standard performance level. The aim is to adjust observed time to normal time, ensuring that differences in speed, skill, or working conditions are accounted. Different methods vary in complexity and focus. As shown in Fig. 2 below, there are 4 primary performance rating methods, which are speed rating, Westinghouse system, synthetic rating, and objective rating [21]. The details of each method are discussed in the following subsections.

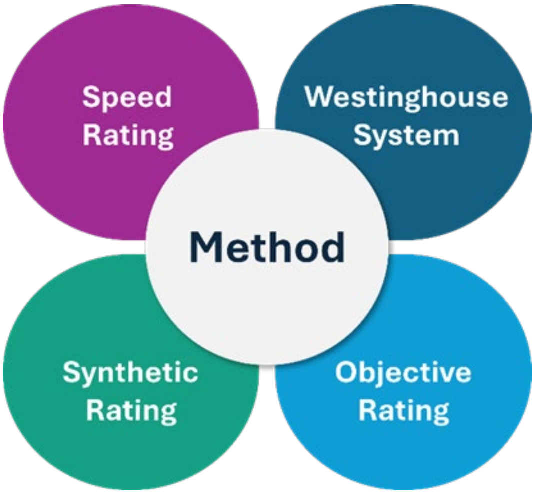

Fig. 2 *Methods of performance rating*

2.1.1 Speed Rating

Speed rating, also referred to as pace rating or tempo rating, is one of the simplest and oldest performance rating techniques in time study. It evaluates only a single factor: the rate or tempo at which a worker performs a task, relative to a predefined standard pace, commonly set at 100% [17,22]. In this method, the analyst compares the observed speed of the worker's movements with the standard benchmark. The focus is solely on pace, without considering qualitative factors such as skill, consistency, environmental conditions, or work method [21]. As a result, speed rating is classified as a single-factor approach to performance evaluation.

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The primary objective of speed rating is to adjust observed times to normal times, ensuring consistency in time standards. If the worker's observed pace exceeds the standard, for instance 120%, the observed time is reduced proportionally. However, if the pace is below standard, such as 80%, the observed time is increased accordingly [19]. Due to its simplicity, speed rating remains a widely used method, especially in industries and tasks where pace is the primary determinant of performance and qualitative differences in technique are minimal. Nonetheless, its single-factor nature also means it may overlook important influences on task performance, making it less comprehensive than multi-factor methods such as the Westinghouse or objective rating systems.

The operational procedure of the speed rating method involves visually assessing a worker's pace to a standard performance benchmark generally defined as 100%, representing the pace of a well-trained, motivated worker maintaining a steady and average tempo under normal working conditions [23]. The method focuses exclusively on tempo, without adjusting for factors such as skill, effort, or workplace conditions. The speed rating process involves 5 main stages, as shown in Fig. 3 below.

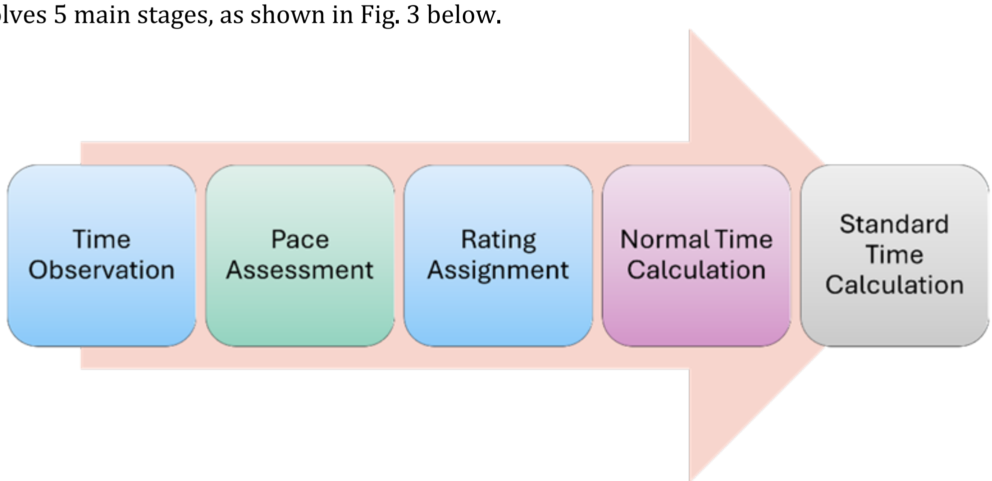

Fig. 3 *Steps in applying the speed rating method*

The first stage is time observation. During time observation, the analyst uses a stopwatch or another timing device to measure the time required for a worker to complete a task or its elements. This measurement, which is known as the observed time, serves as the baseline for further calculations. Concurrently, the analyst conducts a pace assessment, comparing the worker's speed to a standardized benchmark, which is generally defined as 100% for a trained and motivated individual performing under normal conditions. In the rating assignment stage, the analyst expresses the worker's pace as a percentage relative to the standard, with 100% indicating a normal performance, values above 100% indicating a faster-than-normal pace, and values below 100% indicating a slower-than-normal pace.

The normal time calculation adjusts the observed time to reflect what it would be if the worker had been operating exactly at the standard pace. Finally, the standard time is determined by adding the predetermined allowance, which accounts for rest, fatigue, and other delays, to the calculated normal time. The speed rating's simplicity and rapid application make it a prevalent choice in contexts where pace is the dominant factor influencing task performance. However, its subjective nature and exclusion of qualitative factors can limit accuracy in more complex or variable work environments. The reliability of speed rating depends on several interrelated factors [17,24-28]:

i. Observer's judgment and training: Since this method relies heavily on the analyst's internal concept of a "normal" pace, subjective bias is a key limitation. Training, especially with calibrated reference materials such as rating films or videos, can significantly improve accuracy and inter-rater consistency.
ii. Clarity and standardization of reference pace: A clear and universally understood benchmark for 100% pace is essential. Variations in how observers interpret this reference can affect ratings.
iii. Worker variability: Individual differences in body mechanics, technique, or physical ability, as well as changes in pace due to fatigue, motivation, or task complexity, can influence the perceived speed. Averaging ratings over multiple cycles can help mitigate this variability.
iv. Task characteristics: Simple and repetitive motions are generally easier to rate accurately, whereas tasks with irregular or complex motion patterns increase subjectivity and the likelihood of error.
v. Environmental conditions: Poor lighting, excessive noise, or physical obstructions may hinder the observer's ability to make an accurate assessment.
vi. Rater fatigue and bias: Extended rating sessions can reduce concentration, while previous ratings or personal impressions of the worker may unconsciously influence current judgments.

2.1.2 Westinghouse System

Originating from Westinghouse, this method is one of the older and well-established techniques, often cited in industrial engineering literature for its comprehensive factor-based approach. The Westinghouse system, developed in 1927 at Westinghouse Electric Corporation, is a foundational method in work measurement for assessing worker performance through 4 key factors, which are skill, effort, working conditions, and consistency [29,30]. These factors, detailed in Table 1, provide a comprehensive framework for capturing both the worker's capabilities and the contextual elements affecting performance.

This system provides a structured approach to performance rating by integrating both quantitative and qualitative evaluations, enabling analysts to adjust observed times to standardized performance levels. Each factor is assessed on a linguistic scale ranging from poor to superskill, with corresponding numerical values [29,31,32]. This multifactor approach allows analysts to capture a more holistic view of a worker's performance, beyond just pace or motion. Definitions and impacts of each factor are provided in Table 1.

Table 1 *Factors considered for Westinghouse system*

Factor	Explanation	Impact on Performance Rating
Skill	Skill signifies the level of expertise, proficiency, and competency that a worker brings to a task, impacting overall productivity.	The system recognizes that workers with varying skill levels approach tasks differently, leading to adjustments in the performance rating to reflect the specific skill requirements.
Effort	Effort refers to the amount of physical or mental exertion invested by a worker in a task, acknowledging commitment and energy.	The system considers the level of effort exerted by the worker. Workers demonstrating greater effort may be assigned higher ratings, recognizing the influence of diligence and hard work on overall performance.
Conditions	Working conditions refer to environmental factors and equipment quality, significantly affecting a worker's efficiency.	The system acknowledges that variations in conditions may influence performance, leading to adjustments in the rating to accommodate factors hindering or facilitating efficient work
Consistency	Consistency refers to a worker's ability to maintain a steady and reliable pace over time, contributing to a stable workflow.	Workers demonstrating consistency in performance may receive higher ratings, acknowledging the significance of sustained, reliable effort for overall efficiency.

To apply the system, an analyst assigns a rating to each factor by referring to the standard Westinghouse rating table, as shown in Table 2 below. These ratings are then converted to numerical values using the Westinghouse tables and summed to calculate the tempo ratio, T_r [21]. The final performance rating multiplier is then calculated using Eq. 3 below.

$$R = 1 + T_r \tag{3}$$

Where:

$R = performance\ rating$

$T_r = Skill + Effort + Condition + Consistency$

This performance rating multiplier is subsequently applied to the observed time to determine the normal time for a task, accounting for variations in worker efficiency and workplace conditions. By integrating both observable performance and contextual work factors, the Westinghouse system's structured methodology ensures consistent and reliable performance ratings, making it a valuable tool in time study applications.

2.1.3 Synthetic Rating

Synthetic rating is a performance evaluation method that estimates normal time by comparing the observed duration of task elements to Predetermined Motion Time Standards (PMTS), rather than relying solely on the analyst's subjective judgment [34]. This approach uses established time values for fundamental human motions such as reaching, grasping, moving, and releasing, derived from extensive empirical studies. Developed to improve objectivity and consistency of performance rating in time study, synthetic rating minimizes the influence of personal bias by anchoring assessments to standardized motion data [21]. These predetermined times serve as benchmarks for evaluating task performance under normal working conditions, allowing analysts to quantify an operator's efficiency with greater accuracy and repeatability. By referencing published PMTS data, synthetic

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rating enhances the reliability of work measurement and provides a more scientific basis for determining standard times in industrial settings.

Fig. 4 presents the sequential steps involved in applying the synthetic rating method. The process begins with the decomposition of the observed task into its basic elemental motions, such as reach, grasp, move, and release. Each of these motions is then assigned a synthetic time value by referencing standard data tables from an appropriate PMTS, such as Methods-Time Measurement (MTM) or MODAPTS. Once all elemental times have been identified, they are aggregated to obtain the total synthetic normal time for the task. Subsequently, the performance rating is calculated by comparing the observed time with the synthetic normal time using Eq. 4 below [16,34].

$$Performance\ Rating\ (R) = \left(\frac{Synthetic\ Normal\ Time\ (P)}{Observed\ Time\ (A)}\right) \times 100 \tag{4}$$

Finally, the standard time is determined by applying an allowance factor to account for fatigue, delays, and other personal or unavoidable interruptions [16]. This systematic approach enhances consistency in performance assessment and reduces the subjectivity often associated with traditional rating methods.

Table 2 *Components of the Westinghouse rating systems [31,33]*

Skills Ratings			Effort Ratings		
+0.15	A1	Superskill	+0.13	A1	Excessive
+0.13	A2	Superskill	+0.12	A2	Excessive
+0.11	B1	Excellent	+0.10	B1	Excellent
+0.08	B2	Excellent	+0.08	B2	Excellent
+0.06	C1	Good	+0.05	C1	Good
+0.03	C2	Good	+0.02	C2	Good
0.00	D	Average	0.00	D	Average
−0.05	E1	Fair	−0.04	E1	Fair
−0.10	E2	Fair	−0.08	E2	Fair
−0.16	F1	Poor	−0.12	F1	Poor
−0.22	F2	Poor	−0.17	F2	Fair
Condition Ratings			**Consistency Ratings**		
+0.06	A	Ideal	+0.04	A	Perfect
+0.04	B	Excellent	+0.03	B	Excellent
+0.02	C	Good	+0.01	C	Good
0.00	D	Average	0.00	D	Average
−0.03	E	Fair	−0.02	E	Fair
−0.07	F	Poor	−0.04	F	Poor

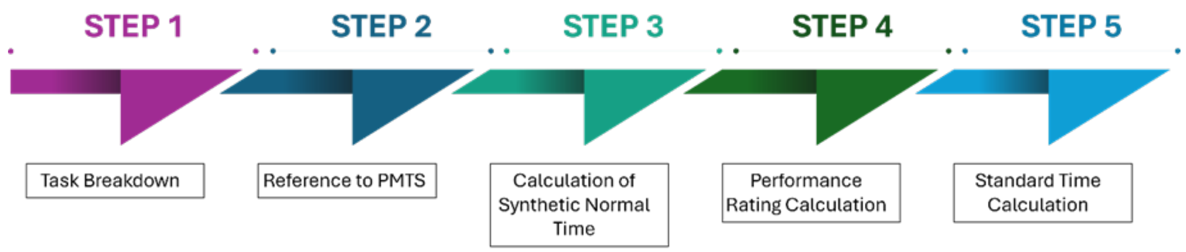

Fig. 4 *Steps in applying the synthetic rating method*

This ratio reflects how an operator's observed performance compares with a standard benchmark. A rating above 100% indicates that the task was performed faster than the standard pace, while a rating below 100% suggests a slower-than-normal performance. The principle behind synthetic rating is to anchor the performance evaluation in standardized motion data, thereby reducing the influence of subjective judgment. By comparing the observed time for each task element with its corresponding PMTS value, analysts can calculate a performance ratio for each element. The overall performance rating is often taken as the average of these ratios.

The synthetic rating method inherently accounts for factors embedded within the predetermined motion time systems (PMTS) it utilizes. These include physical aspects such as reach distance, object weight, posture, and motion complexity, all of which are standardized in PMTS data tables. Unlike traditional rating methods that separately evaluate subjective elements, including skill or effort, synthetic rating reflects these aspects indirectly, through the comparison between observed time and the synthetic standard. A worker's pace, proficiency, and efficiency are interpreted by how closely or quickly they perform relative to the predetermined benchmark. The effectiveness and reliability of the synthetic rating method are influenced by several critical factors. Table 3 below shows factors influencing the synthetic rating method [17,18,25-28,35,36].

Table 3 *Factors influencing synthetic rating*

Factor	Explanation
Availability of PMTS data	The method relies on task-relevant PMTS databases. If suitable data is unavailable, especially for industry-specific or highly customized operations, this method cannot be effectively applied.
Accuracy and relevance of PMTS	The quality of this method depends on how accurately the PMTS reflects real-world conditions. Using outdated or misaligned data can lead to distorted performance assessments.
Task complexity and structure	This method is best suited for repetitive and structured tasks composed of well-defined motion elements. For complex, non-standard, or variable tasks, the segmentation and matching process becomes more challenging and may require customized time values, increasing the study's complexity and preparation time.
Analyst expertise	The precision of this method is heavily dependent on the skill and experience of the analyst. Accurate task breakdown, correct selection of PMTS categories, and proper data interpretation require thorough training and familiarity with the chosen predetermined time system.
Quality of time measurement	Accurate recording of the observed task duration is essential. Errors in timing or incorrect identification of motion boundaries can significantly skew the resulting performance rating.

This method is particularly valuable for ensuring consistency and repeatability in performance measurement across different operators, tasks, and time study sessions. It supports more reliable standard time determination and can serve as a benchmark for setting fair production targets, wage incentives, and training needs.

2.1.4 Objective Rating

Objective rating is a performance evaluation method designed to improve consistency, fairness, and objectivity in time study. Unlike traditional approaches that blend various performance attributes into a single and subjective judgment, objective rating separates key components, specifically pace (speed of motion) and job difficulty (skill or task complexity), and evaluates them independently [21,37]. This structured and 2-step approach reduces observer bias and enhances rating reliability. The method was originally developed by Mundell and Danner (1960) as a response to the limitations of purely subjective techniques. It introduces a more analytical process by combining subjective pace evaluation with an objective assessment of task difficulty, thereby creating a hybrid rating system. Analysts use reference charts, rating scales, or predetermined benchmarks to guide their assessments, promoting transparency and standardization in performance measurement.

In practice, the analyst first measures the worker's pace, which reflects the speed and rhythm of task execution. This is followed by a separate evaluation of task difficulty, which considers the complexity of the motions involved, the precision required, physical or mental demands, and other relevant work conditions. The 2 ratings are then integrated into a single performance rating factor, offering a more nuanced representation of worker efficiency [34]. By accounting for both human performance and job characteristics, the objective rating method supports more equitable and repeatable evaluations, especially in environments where task complexity varies significantly across work elements. This makes it particularly useful in operations involving a wide range of skill levels or task types.

As mentioned above, the objective rating method quantifies worker performance through a 2-stage process designed to enhance fairness, consistency, and accuracy in time study. It separates the assessment of pace from task difficulty, then integrates both to calculate a performance rating multiplier. Fig. 5 below illustrates the flow process to calculate standard time by using the objective rating method.

In the first stage, the analyst assesses the speed or tempo of the worker's motions relative to a standardized benchmark, which is commonly set at 100% for a qualified worker performing under normal conditions. This

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evaluation is made independently of the task's complexity and is often supported by reference scales, for instance, 5-point or 10-point speed scales or visual aids such as reference videos or computer-aided [3].

The second stage involves adjusting the initial pace rating to account for the inherent difficulty of the task [22]. This is based on 6 standard factors that influence physical and cognitive workload, which are [16]:

i. Amount of body movement involved
ii. Use of foot pedals
iii. Bimanual coordination (simultaneous use of both hands)
iv. Eye-hand coordination
v. Material handling precision
vi. Weight or resistance encountered

Each factor is assigned to a percentage adjustment based on empirical data, such as that published by Mundel and Danner (1960). The total difficulty adjustment factor is calculated by summing the adjustments across all applicable factors. Table 4 below shows the details of the job difficulty factor [34].

Fig. 5 *Flow process for standard time by using the objective rating method*

Table 4 *Details of the job difficulty factor [34]*

Description	Notation Letter	Conditions	Per Cent Adjustment
Amount of body movement involved	A	Fingers used loosely	0
	B	Wrists and fingers	1
	C	Elbows, wrists and fingers	2
	D	Arms, etc	5
	E1	Trunks, etc	8
	E2	List with leg from floor	10
Use of foot pedals	F	No pedals or one pedal with fulcrum under foot	0
	C	Pedals or pedals with fulcrum outside the foot	5
Bimanual coordination	H1	Hands help each other or alternate	0
	H2	Hands work simultaneously doing the same work	18
Eye-hand coordination	I	Rough work, mainly feet	2
	J	Moderate vision	2
	K	Constant but not closed	4
	L	Watchful, close	7
	M	Within 1/64"	10
Material handling precision	N	Can be handled roughly	0
	O	Only roll control	2
	P	Must be controlled, but may be squeezed	3
	Q	Handle carefully	4
	R	Fragile	5
Weight		Identified by the actual weight for resistance	

Following this, the overall performance rating is computed using Eq. 5 below [16,34]. The final performance rating is then applied to the observed time to compute the normal time before calculating the standard time.

$$R = P \times D \quad (5)$$

Where:

$R = performance\ rating$
$P = pace\ rating$
$D = combined\ difficulty\ factor$

This method ensures that the pace of work is judged independently from the task's complexity, offering a balanced and standardized evaluation. It is particularly valuable in diverse work settings where task difficulty varies significantly, allowing analysts to normalize observed times more fairly across different job types. The accuracy, consistency, and overall effectiveness of the objective rating method depend on several interrelated factors. These influence both the quality of the performance assessment and its practical application in various work environments. The factors influencing the objective rating method are [25-28,35,36]:

i. Observer training and competence: The reliability of this method hinges on the analyst's ability to consistently apply standardized criteria. Accurate differentiation between pace and task difficulty requires trained observers who are familiar with rating scales and benchmark references. Regular calibration and inter-rater reliability checks are essential to minimize variability and ensure consistency across different observers.
ii. Quality and relevance of reference materials: The precision of pace evaluation depends on the quality of rating charts, standard scales, or video benchmarks used during assessment. These references must be validated, clearly defined, and relevant to the tasks being studied. Inadequate or outdated materials can distort the pace assessment and introduce subjectivity.
iii. Completeness and accuracy of difficulty adjustment tables: The job difficulty adjustment relies on predefined tables that assign percentage values to specific task characteristics. The completeness, relevance and contextual accuracy of these tables, such as those developed by Mundel and Danner, are critical. If the tables fail to represent certain work conditions or job attributes, the resulting rating may not accurately reflect actual task demands.
iv. Task characteristics and suitability: This method is best suited for manual, repetitive, and measurable physical tasks. For operations involving cognitive effort, fine motor control, or highly variable work patterns, separating pace from difficulty becomes more complex and may reduce the method's effectiveness. In such cases, standard difficulty factors may not adequately capture task intricacies.
v. Environmental and ergonomic conditions: External factors such as lighting, noise, workspace layout, and interruptions can influence both worker performance and the analyst's ability to observe accurately. These factors may inadvertently affect pace or introduce errors in difficulty judgment, specifically if not accounted for during evaluation.
vi. Time and analytical requirements: The dual-step nature of the method, which requires separate assessments of pace and difficulty, makes it more time-intensive than simpler performance rating systems. This can be a limitation in fast-paced environments or when assessing tasks with multiple complexity factors, as it demands detailed segmentation and analysis.

2.2 Critical Comparative Analysis of Performance Rating

Each performance rating method embodies varied philosophical approaches to performance assessment, reflecting different priorities in the balance between simplicity, objectivity, comprehensiveness, and practical applicability. The following sections provide a critical analysis of the strengths and limitations of each method, examining not only their operational characteristics but also their contextual suitability and practical constraints. Understanding this variation is essential for informed method selection, as the choice influences the accuracy, reliability, and organizational acceptance of established time standards. Table 5 (presented at the end of this section) synthesizes these findings into a comparative framework to facilitate decision-making.

2.2.1 Speed Rating

This section outlines the key advantages and limitations of the speed rating, providing a balanced perspective on its applicability in time study practice.

Advantages:

i. As one of the most straightforward performance rating methods, speed rating can be applied quickly with only a stopwatch and the analyst's judgment.

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ii. While experience improves accuracy, the method is easy to learn and accessible for analysts with basic time study knowledge.
iii. No specialized equipment or extensive databases are required, making it cost-effective for both small-scale and large-scale studies.
iv. Applicable across most time study scenarios, including element-by-element analysis, and practical in field conditions where detailed multi-factor assessments are not feasible.
v. The concept of rating pace relative to a “normal” speed is simple to explain to both workers and management, aiding transparency.

Disadvantages:

i. The method depends entirely on the observer’s perception of “normal” pace, which may vary widely between analysts without proper calibration.
ii. Inconsistent internal benchmarks, prior impressions, or fatigue can influence judgments.
iii. Focuses solely on speed or tempo, overlooking other performance factors such as skill, quality, consistency, task complexity, and environmental conditions.
iv. In jobs involving varied motions or significant mental effort, slow performance may reflect task demands rather than reduced effort, making ratings less accurate.
v. Without structured training and regular calibration, ratings can differ substantially across analysts, reducing repeatability.

2.2.2 Westinghouse System

This section outlines the key advantages and limitations of the Westinghouse system, providing a balanced perspective on its applicability in time study practice.

Advantages:

i. Evaluates performance across 4 factors, which are skill, effort, conditions, and consistency, offering a more nuanced view than pace-only methods.
ii. Balances multiple aspects of performance, minimizing the risk of over-rating or under-rating based solely on speed.
iii. Uses standardized tables and rating scales, improving repeatability, analyst training, and cross-study comparisons.
iv. Breaks performance into separate dimensions, allowing targeted interventions, whether identifying poor working conditions or skill gaps.
v. Applicable across industries and suitable for both simple and complex manual tasks in manufacturing, assembly, or service environments.

Disadvantages:

i. Analysts must thoroughly understand and consistently apply the 4-factor rating scales, requiring considerable training and calibration.
ii. Evaluating each factor individually takes longer than single-factor methods such as speed rating.
iii. Despite its structure, the method still relies on observer judgment, which can lead to variability between raters.
iv. Differences in experience or interpretation of factors such as “effort” or “consistency” can affect reliability.
v. Accurately rating certain factors, such as “conditions,” may require supplementary environmental measurements.

2.2.3 Synthetic Rating

This section outlines the key advantages and limitations of the synthetic rating, providing a balanced perspective on its applicability in time study practice.

Advantages:

i. Rely on PMTS rather than subjective judgment, reducing observer bias.
ii. Standardized time values ensure uniform ratings across different analysts, studies, and locations.
iii. Based on published and validated time data, making results easier to justify and audit.
iv. Effective in structured and high-volume environments such as manufacturing or assembly lines where PMTS data is readily available.
v. Synthetic calculations can be reviewed, replicated, and stored for future process analysis.

Disadvantages:

i. Limited to elements for which accurate and relevant PMTS values exist. Tasks without relevant PMTS data require time-consuming custom analysis.
ii. Developing and maintaining comprehensive PMTS databases requires substantial expertise, time, and resources.
iii. Less adaptable to non-repetitive, variable, or cognitively complex tasks, as PMTS primarily addresses physical motions.
iv. If only representative elements are rated, variability between task elements may not be fully captured.

2.2.4 Objective Rating

This section outlines the key advantages and limitations of the objective rating, providing a balanced perspective on its applicability in time study practice.

Advantages:

i. By explicitly separating pace from job difficulty, the method provides a more structured evaluation than single-factor systems, hence reducing the influence of personal bias in holistic judgments.
ii. The inclusion of predefined difficulty factors ensures that workers performing more complex or physically demanding tasks are not unfairly compared with those on simpler tasks.
iii. The use of standardized adjustment tables promotes greater consistency and reproducibility across different analysts, workplaces, and studies.
iv. Clear definitions for both pace and difficulty allow new analysts to be trained more effectively, as they can learn to distinguish between different performance components.
v. By separately identifying pace and task complexity, organizations can determine whether performance issues stem from insufficient effort/speed or inherent job difficulty, allowing more targeted interventions.
vi. This dual-component approach can improve transparency, helping both labour and management understand how ratings are derived.

Disadvantages:

i. Although more structured than simple pace rating, the initial pace assessment and difficulty factor assignment still rely on human judgment, which can introduce bias or variability.
ii. The 2-step process of rating pace and adjusting for difficulty, which often uses extensive tables. This can be time-consuming, especially for high-variability tasks.
iii. Proper application requires training to ensure accuracy in both pace judgment and difficulty factor assignment, making it less accessible to inexperienced analysts.
iv. Mistakes in either pace rating or difficulty factor selection can amplify in the final rating, consequently reducing accuracy.
v. This method works best for observable, repetitive manual tasks. However, it may be less effective for cognitive, highly variable, or creative work where difficulty is hard to define.
vi. For simple and low-complexity jobs, this method’s detailed evaluation may be unnecessarily elaborate compared to quicker and simpler rating systems.

2.2.5 Comparative Synthesis and Critical Analysis

A comparative analysis of the 4 performance rating methods reveals fundamental trade-offs between simplicity and comprehensiveness, objectivity and flexibility, and speed and accuracy. Speed rating offers unmatched simplicity and rapid application, making it economically good for high-volume studies where pace dominates performance variation [38]. However, this efficiency comes at the cost of substantial subjectivity and inability to account for qualitative performance dimensions [39]. The method essentially assumes that all performance variations can be captured through pace observation alone, an assumption that holds only in narrowly defined operational contexts [39,40].

The Westinghouse system addresses the limitations of speed ratings by incorporating multiple performance dimensions, offering a more holistic assessment framework [29]. By thoroughly evaluating skill, effort, conditions, and consistency, it acknowledges that performance is multifactorial. However, this comprehensiveness introduces complexity and extends study duration [41]. More critically, the method still relies fundamentally on subjective judgment for each factor, potentially introducing additional bias rather than eliminating it. The structured rating scales provide consistency scaffolding but cannot fully eliminate the interpretive variability inherent in qualitative assessment [25].

Synthetic rating represents a paradigm shift toward objectivity by anchoring performance evaluation in empirical motion time data rather than observer judgment. This data-driven approach enhances repeatability and reduces bias, making it specifically valuable for establishing defensible standards in unionized environments or for cross-facility benchmarking [42,43]. However, its effectiveness is fundamentally constrained by PMTS availability and applicability. The method is highly effective for repetitive and well-structured operations that can be broken down into motion-level elements; however, it becomes less practical for variable, cognitive, or service-oriented tasks where suitable predetermined data are unavailable [44]. Furthermore, the substantial investment required to develop and maintain comprehensive PMTS databases may exceed the resources available to smaller organizations [43].

Objective rating attempts to synthesize the benefits of structured assessment with practical applicability by separating pace evaluation from task difficulty adjustment. This separation provides conceptual clarity and promotes fairness across tasks of varying complexity [44]. The standardized difficulty adjustment tables offer consistency benefits like PMTS-based approaches while remaining applicable to tasks lacking detailed motion data. However, the method's hybrid nature introduces complexity without fully eliminating subjectivity. Both the initial pace assessment and the difficulty factor selection remain judgment-dependent, potentially introducing bias at multiple decision points [45]. Additionally, the extensive difficulty adjustment tables and 2-stage evaluation process demand analyst training and extended study time.

A critical consideration often overlooked in method selection is the interaction between method characteristics and organizational context. The simplicity of speed rating can become a false economy if inaccurate assessments lead to frequent revisions of standard times or cause dissatisfaction among workers [43]. Conversely, synthetic rating's theoretical objectivity provides limited practical value if relevant PMTS data is unavailable or when the cost of implementation outweighs the marginal gains in accuracy. The Westinghouse system's multi-factor approach may enhance credibility and organizational acceptance even if absolute accuracy improvements over speed rating are modest, especially in settings where time standards directly affect compensation or performance evaluation. Table 5 presents a structured comparison of the 4 performance rating methods across key evaluation dimensions, synthesizing the detailed analysis presented in preceding sections to support evidence-based method selection.

Table 5 *Comparative analysis of performance rating methods*

Evaluation Criterion	Speed Rating	Westinghouse System	Synthetic Rating	Objective Rating
Primary focus	Pace/tempo only	Multi-factor (skill, effort, conditions, consistency)	Comparison to PMTS benchmarks	Pace separated from task difficulty
Objectivity level	Low (highly subjective)	Moderate (structured but subjective)	High (data-driven)	Moderate-high (hybrid approach)
Complexity	Very simple	Moderate	High (requires PMTS knowledge)	Moderate-high
Application speed	Very fast	Moderate	Slow (element-level analysis)	Moderate
Training requirements	Minimal	Moderate-high	High (PMTS expertise)	High
Equipment/ resources	Stopwatch	Rating tables	PMTS databases	Difficulty adjustment tables
Best suited for	Repetitive pace-dominant tasks	Operations with variable skill/conditions	Structured repetitive tasks with PMTS availability	Mixed-complexity operations
Limitations	Ignores qualitative factors, highly subjective	Still relies on judgment, time-consuming	Limited to tasks with PMTS, high setup cost	Complex still contains subjective elements
Inter-rate reliability	Low without calibration	Moderate	High	Moderate-high
Organizational acceptance	May face credibility challenges	Generally well-accepted	High (defensible standards)	Good (perceived fairness)
Implementation cost	Very low	Low-moderate	High	Moderate

Evaluation Criterion	Speed Rating	Westinghouse System	Synthetic Rating	Objective Rating
Suitability for variable tasks	Poor	Good	Poor	Very good

2.3 Selection of Performance Rating Methods

The selection of an appropriate performance rating method is a critical step in ensuring accurate and fair study results. The most suitable method depends on factors such as the nature of the task, the complexity of work elements, industry practices, required accuracy, available resources, and the level of analyst expertise. In repetitive and pace-dominant tasks such as conveyor-based assembly, basic packaging, or order-picking in a warehouse, speed rating is often the preferred choice. Its simplicity and quick application make it practical for situations where the primary factor influencing performance is the worker's pace. For example, in a beverage bottling plant where each worker repeatedly places caps on bottles, the speed of motion is the key determinant of output, making speed rating both efficient and sufficient. However, because it focuses only on pace and ignores qualitative factors, it may not be suitable for complex or variable tasks.

When qualitative aspects such as skill, working conditions, and consistency remarkably influence performance, the Westinghouse system offers a more holistic evaluation. This method is well-suited for manufacturing and assembly industries where environmental conditions and worker techniques vary across operations. For instance, in an electronics assembly line, differences in lighting, workstation ergonomics, and operator skill can affect output quality and speed. By considering multiple factors, the Westinghouse system provides a fairer and more comprehensive performance adjustment. While more time-consuming and requiring greater observer training, it is widely accepted due to its balanced and structured approach.

For high-volume, structured, and repetitive tasks where established PMTS exist, the synthetic rating method offers the highest degree of objectivity and repeatability. By referencing standardized motion time data, it minimizes subjective judgment and ensures uniformity across studies and locations. This method is effective in industries like automotive assembly, electronics manufacturing, or high-speed packaging, where tasks can be broken down into elemental motions such as "reach," "grasp," or "move." For example, in a printed circuit board (PCB) assembly process, synthetic rating can compare the observed time for soldering a component to its PMTS benchmark, ensuring consistency regardless of the analyst or location. However, its effectiveness diminishes when suitable PMTS data is unavailable or when tasks are non-repetitive and complex.

In work environments where task complexity varies greatly, such as aerospace manufacturing, precision machining, or maintenance operations, the objective rating method can provide a more equitable assessment. By separating pace from task difficulty, it ensures that a worker performing a highly demanding task is not unfairly compared with one performing a simple task at the same pace. For example, in an aircraft maintenance setting, removing a panel with multiple fasteners and tight clearances would score higher on difficulty than replacing a standard access panel, even if both are performed at the same speed. The objective rating method accounts for such differences, making it especially valuable in mixed-complexity operations. Although it requires more time, detailed reference materials, and trained observers, it delivers a balanced evaluation when fairness across varied job types is essential.

While the preceding discussion has analysed each method as a discrete approach, industrial practice increasingly acknowledges that optimal performance assessment often requires a strategic combination of methods tailored to specific operational contexts. Rather than adhering rigidly to a single method across all tasks within an organization, progressive operations adopt differentiated approaches based on task characteristics, strategic importance, and available resources. This pragmatic flexibility reflects the understanding that the most suitable method is context-dependent rather than universally applicable.

A common hybrid approach involves using a synthetic rating for core, high-volume, repetitive operations, while applying an objective rating to variable or complex tasks that lack comprehensive PMTS coverage. For example, an automotive assembly plant might employ a synthetic rating for standardized assembly operations supported by MTM or MODAPTS data, while utilizing an objective rating for inspection, adjustment, or problem-solving tasks where motion-level analysis is impractical [46,47]. This differentiation optimizes the accuracy-efficiency trade-off, concentrating analytical resources where they provide maximum value while maintaining practical feasibility across the full spectrum of operations.

Another prevalent combination hybrid strategy combines speed rating for routine monitoring and periodic auditing with more comprehensive methods, such as Westinghouse or objective rating, for initial standard establishment or formal standard revisions. This approach leverages the efficiency of speed ratings for ongoing verification that actual performance remains aligned with established standards, while ensuring that the foundational standards themselves are established through more rigorous methods. The comprehensive methods provide the foundation of accuracy and credibility, whereas speed rating supports sustainable, ongoing oversight without imposing excessive resource demands.

Some organizations implement tiered approaches in which the choice of performance rating method is guided by the strategic or financial importance of the operation. High-value or bottleneck processes may justify the use of synthetic rating due to its superior objectivity and repeatability, whereas supporting operations can be evaluated using simpler methods. Similarly, tasks governed by labour agreements, regulatory standards, or frequent performance disputes may warrant more comprehensive methods that enhance defensibility and transparency, even when simpler approaches would be technically adequate.

The effectiveness of hybrid approaches depends critically on the clear documentation of method selection criteria and the consistent application of these criteria within defined categories. Organizations must establish explicit guidelines specifying which methods are applicable to specific task types, thereby promoting uniformity across time studies and among analysts. In the absence of such a structure, hybrid systems risk devolving into ad hoc method selection driven by individual analyst preference rather than strategic rationale, potentially introducing inconsistency that undermines the credibility and reliability of the overall time study program. Ultimately, the chosen method should align with the operational context, desired accuracy, and available resources, affirming that performance ratings are both fair and practically applicable.

3. Conclusion

Performance rating remains a vital element of time study, serving as the bridge between observed task times and the establishment of fair and realistic standard times. This review has highlighted that no single method is universally superior. Rather, the suitability of each depends on the specific characteristics of the work, industry requirements, and organizational priorities. Simpler methods, such as speed rating, can provide quick and cost-effective assessments in environments where pace is the dominant performance factor, whereas more structured approaches like the Westinghouse system capture multiple qualitative dimensions, making them well suited for operations with greater variability in skill, conditions, or technique. Methods grounded in predetermined data, such as synthetic rating, offer the highest degree of objectivity and repeatability in structured, high-volume settings, while the objective rating method delivers a balanced assessment for mixed-complexity tasks by separating pace from job difficulty. Across all methods, the effectiveness of performance rating depends heavily on the skill, training, and calibration of the analyst, as well as the quality of reference materials and consistency in application. As industries move toward automation, digital video analysis, and wearable technology, future performance rating practices are expected to become increasingly objective, data-driven, and integrated with broader productivity management systems. However, the fundamental challenge will remain, which is translating observed work performance into equitable and accurate time standards. By selecting methods that align with task complexity, environmental conditions, and organizational goals, and by investing in proper training and quality control, organizations can ensure that performance ratings support productivity improvement, cost control, and fair labour practices in a wide range of industrial settings.

Acknowledgement

This research was supported by Universiti Tun Hussein Onn Malaysia (UTHM) through the Matching Grant [Q274] and Industrial Grant [M116]. The author would also like to thank the Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, and Intec Precision Engineering Sdn. Bhd. for providing the necessary research facilities for this study.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Aida Husna Ahmad, Shahrul Azmir Osman, Saliza Azlina Osman, Tay Sin Kiat;* ***data collection:*** *Aida Husna Ahmad, Shahrul Azmir Osman, Haziq Asyraaf Abu Bakar, Mohd Faris Afiq Mohd Azhar;* ***analysis and interpretation of results:*** *Aida Husna Ahmad, Shahrul Azmir Osman, Saliza Azlina Osman;* ***draft manuscript preparation:*** *Aida Husna Ahmad, Shahrul Azmir Osman. Shahrul Azmir Osman reviewed the results and approved the final version of the manuscript.*

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