

-RESEARCH ARTICLE-

THE ROLE OF EARNED VALUE MANAGEMENT IN IMPROVING MANAGERIAL ACCOUNTING PRACTICES AND ACHIEVING SUSTAINABLE DEVELOPMENT

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—Abstract—

This study seeks to explore the impact of Earned Value Management (EVM) on enhancing Managerial Accounting Practices (MAPs) to achieve the goal of responsible consumption and production (SDG 12), specifically within the context of production and manufacturing companies and projects. The objective is to improve product quality while addressing inefficiencies. It examines how traditional manufacturing systems, prevalent in most companies and projects, can be improved through EVM, thereby contributing to the achievement of SDG 12 and aligning product quality with customer needs and expectations. The research aims to enrich the theoretical framework with practical applications, highlighting the role of EVM in refining MAPs and its contribution to SDG 12, ultimately enhancing the company's competitive standing and promoting economic and environmental sustainability. Employing a descriptive analytical approach, the study applies financial and cost data from a sample company. The findings indicate that EVM plays a crucial role in fostering innovation in local manufacturing, improving product quality, and reducing costs by enhancing resource and energy efficiency. Additionally, it helps identify weaknesses and inefficiencies, facilitating the transition towards the production of sustainable products.

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INTRODUCTION

The United Nations Environment Program (UNEP) articulated in 1999 that meeting the needs of present generations without compromising the ability of future generations to meet their own needs forms the foundation of Goal 12 of the Sustainable Development Goals (Wu et al., 2023; Zencir & Korkmaz, 2024). Sustainable consumption and production do not imply reduced consumption or production, but rather a shift towards more efficient practices that enhance the quality of life (Gamage et al., 2023; Guo, 2024). The International Institute for Environment and Development highlights that sustainable consumption and production revolve around economic activities such as the selection, utilisation, and management of products' end-of-life stages. It also focuses on investigating the potential for modifying and transforming these activities to yield social and environmental benefits (Gebara et al., 2024).

EVM quantifies the achieved value from work performed on a project at any point in time. It is an objective period measure of work achieved and is used for managing projects through measurement of performance against budget and schedule compliance (Legislatifa et al., 2024). EVM is a robust mechanism of control that compares planned goals with achieved project accomplishments against time and cost. By ascertaining incurred costs and comparing them with planned costs, EVM creates the achieved value against the planned value at the point of time. It also identifies differences in terms of time and cost and makes it simple to identify their causes and take corrective action so as not to repeat them (Saeed et al., 2022). Through EVM, planned costs are compared with achieved costs and work achieved is assessed with any differences in the two brought to the forefront (Damianov & Gasparotti, 2024). EVM is an integrated technique of planning and control that unites cost, time, and measurement of performance. It is used for foretelling potential differences in project outcomes and sending early signals of deviations to be addressed (Obaida & Thijeelb, 2020). Through EVM, managers are in a position to monitor project performance at various stages throughout the lifecycle of the project and determine if the incurred costs are greater than or less than the planned budget, if the project is progressing as planned according to schedule, and if the achieved work is as planned in the project plan (Setyopurnomo et al., 2025).

EVM is seen as a collection of tools, methods, and processes that provide both financial and non-financial information, assisting management in decision-making and monitoring the company's financial performance (Chut, 2020). It can be defined as a set of techniques relied upon by senior management to develop cost management strategies aimed at achieving the desired objectives (Denys, 2024). Management

accounting methods are understood as tools used by management to analyse both financial and non-financial data for strategic decision-making (Tran Thanh Thuy, 2025). These methods aim to enhance corporate performance by delivering accurate and reliable information regarding costs, investment profits, and operational activities (Bila & Bilyi, 2024). Production and manufacturing organizations are faced with numerous challenges of wastage of resources, improving efficiency of operations, and sustainable growth. By offering practical tools such as EVM and improving MAPs, organizations are in a position to monitor and control their product costs. This not only encourages management towards the adoption of local and innovative production processes but also facilitates the shift from traditional production processes. With the help of EVM and improving MAPs, organizations are in a position to enhance the product's quality, avoid wastage and losses of resources, and thus reduce the cost of production, hence contributing to overall better quality (Alvarez et al., 2021).

The issue of concern in this case is the limitation of traditional production systems and their inability to meet the challenges of cost savings in production. This research focuses on the way production firms can benefit from the application of EVM and improvement of MAPs towards meeting SDG 12 with the objective of improving product quality, saving costs, and making the project sustainable. The applicability of this research is in providing information and insight into the application of EVM, improvement of MAPs, and their role towards improving product quality, saving costs, and making the project sustainable with the ultimate purpose of meeting customers and their expectations (Khalilov, 2024). Optimum achievement of cost and time integration is where the foundation of cost estimation is compatible with the estimation period of time, which is usually achievable for small-scale projects. However, with the growth of the size of the project, it becomes more difficult to harmonize costs with the period of time (Anwar et al., 2024). Among the most crucial ways of gauging the effectiveness and efficiency of the resources and the related costs in meeting the goals of the project is cost performance. It is related to three main processes: cost planning, estimation, and cost control. Cost performance is also expressed using the Cost Performance Index (CPI) that measures the effectiveness and efficiency of the costs and resources in meeting the established goals of the project within the planned cost and time limits (Hariyadi et al., 2024). CPI is calculated through earned value divided by the actual cost while TPI is calculated through earned value divided by planned value. A ratio of one and more reflects a positive outcome and less than one reflects a negative outcome (Noviawati & Yopi, 2020).

Problem Statement

The conventional production systems of manufacturing are confronted with the challenges of achieving efficient and sustainable operations, particularly in highly environmental and economic footprints industries such as cement production. Despite the need for sustainable growth, most businesses are bogged down with traditional

production processes that are counter-productive to operational efficiency, cost management, and environmental conservation. Cement production is characterized with complicated processes and high rates of consumption of resources and calls for innovative ways of addressing interrelated challenges of high production costs, inefficient utilisation of resources, weak sustainability practices, and adherence to international sustainable growth targets such as Sustainable Development Goal 12 (SDG 12) of responsible production and consumption. Conventional management accounting practices are not effective in providing detailed information on gaps in performance, wastage reductions, and strategic improvement at various stages of production. EVM is a strategic tool for filling such gaps. It offers a systematic procedure for measuring time and cost performance and identifying areas of improvement in operations. In pursuit of the research objective, the second part reviews existing theoretical contributions, the third part explains the research methodology, the fourth part provides the outcomes, and the final part provides the conclusion.

Research Goals

1. The objective of this research is to analyse the influence of EVM and MAPs on product quality, cost savings, and sustainability of cement production. EVM is found to ensure better utilisation of resources as well as better project performance, and MAPs provide a method of decision-making that focuses on the most critical factors, which have significant influence on the performance of cement companies.
2. In the current study, EVM and MAPs are implemented to identify areas of inefficiency within cement manufacturing processes and propose potential avenues for improvement. Both EVM and MAPs enhance firm productivity and performance. EVM enhances cost management, whereas MAPs offer a clear-cut framework for addressing high energy usage.
3. Additionally, the research explores the critical role of EVM and MAPs in enhancing the competitiveness of the Iraqi Cement State Company. This is achieved by improving operational efficiency, reducing operational costs, and ensuring alignment with sustainability goals. The empirical findings suggest that these frameworks enhance key performance indicators, enabling companies to meet market expectations while minimising environmental pollution.
4. The study outlines methods for improving resource optimisation, energy efficiency, and waste minimisation in cement manufacturing. Innovative green strategies, such as optimising energy use through AI and adopting circular economy principles, are recognised as effective measures for reducing by-products and maximising resource utilisation.

Inquiry Statements

1. How do EVM and improved MAPs contribute to enhancing product quality, reducing production costs, and promoting project sustainability in alignment with SDG 12?
2. What are the key factors influencing the efficiency and effectiveness of EVM and MAPs in the cement manufacturing industry?
3. How can the Iraqi Cement State Company optimize its production processes through EVM and MAPs to strengthen its competitive position?
4. What are the main challenges in implementing EVM and MAPs, and how can they be addressed to improve economic and environmental sustainability?

LITERATURE REVIEW

EVM is the most widely adopted project management method, integrating cost, schedule, and scope to assess a project's progress. By leveraging EVM, organizations can identify cost and schedule variances, providing the necessary data to make informed decisions and optimise resource utilisation (Avlijaš, 2024). Similarly, MAPs have evolved to incorporate sustainability objectives, particularly in manufacturing, enabling more efficient resource utilisation, minimisation of waste, and improved cost-saving measures (Mukwarami & van der Poll, 2024). Small and medium-sized enterprises (SMEs) contribute significantly to the economy of the Kingdom of Saudi Arabia (KSA), accounting for approximately 33% of the gross domestic product (GDP), with around 2 million such enterprises operating in the country. Owing to their pivotal economic contribution, there is more urgency to make them more competitive, secure their survival, and enhance growth. Research has established that strategic management accounting practices are vital in achieving such objectives through provision of vital information for decision making, pricing, measurement of performance, and planning. SMEs are supported in managing ever-changing economic conditions through management accounting (Ojra et al., 2021; S, 2021).

The role of sustainable management practices is essential in bridging risk and sustainable development. A firm's risk-taking culture is reported to be favorable for sustainable management accounting practices that are vital in sustainable risk management. Sustainable management accounting practices are employed in the present research to ensure organizational resilience and sustainability in uncertain circumstances (Abu Afifa et al., 2024). Empirical research examined the impact of Management Accounting Practices (MAPs) on administrative performance in commercial banks. The study analysed costs, budgeting, strategic analysis, and performance measurement. Using descriptive research and causal comparisons, data from 20 Nepali bank directors confirmed that modern MAPs positively influence administrative performance (Maharjan, 2024).

Experts advocate for encouraging both producers and consumers to consider sustainable development during the production and consumption of goods, with

particular emphasis on evaluating the social outcomes of SDG 12 at the point of consumption. The study explored the integrated factors influencing consumers' perceptions, attitudes, and purchase intentions towards environmentally friendly products in developing countries (Setyopurnomo et al., 2025).

The foundation of sustainable development is sustainable production and consumption, one of the United Nations Sustainable Development Goals (SDGs) core principles and of Goal 12. Goal 12 aims at promoting sustainable production and consumption patterns. A research based on existing data and studies facilitated progress towards Goal 12 achievement as it was in harmony with global efforts such as the Global Compact principles, the United Nations Development Programme, and the 10-Year Framework for Sustainable Consumption and Production. Empirical studies highlight the continued international collaboration in achieving Goal 12 and in the long-term contribution towards sustainable economic growth (Vázquez-Burguete et al., 2023). Further research explored consumer behavior of developing countries towards green product purchase. A study of 327 respondents who provided data through using a structured questionnaire and model identified key drivers of consumer behavior. It identified green product trust, information quality, and environmental awareness as key factors that have strong impacts on consumers' attitude and purchase decisions. It emphasized that green advertisement and environmental labels have vital roles in determining sustainable consumption behavior (Abbas et al., 2024).

Regarding performance measurement, research on EVM and Earned Schedule (ES) management has been conducted with the objective of improving project efficiency. EVM research has identified factors that are most often accountable for determining the accuracy of performance measurement, especially schedule variance. Research on the causes of project failures and recommendations for enhancing the accuracy of schedule measurement, especially for balanced activity-based projects, has been conducted. Based on such research, productivity can be maximized and scheduling challenges can be addressed through optimizing EVM processes (Capone et al., 2024). The studies indicate the call for theoretical models and standardized measurement tools to measure the contribution of MAPs towards organisational performance. A study highlights the importance of alignment of MAP approaches with industry demands and business conditions for financial performance and also the complexity of MAPs and the requirement for tailored applications (Assad et al., 2024). MAPs have evolved to focus more on sustainability and environmental accountability, with studies showing that improved MAPs and sustainability principles lead to better cost management, operational effectiveness, and long-term competitiveness (Appannan et al., 2023). Integrating performance measurement tools, such as the Balanced Scorecard, into MAPs has also enhanced financial and non-financial decision-making in manufacturing firms (Hansen & Schaltegger, 2016).

A study of the application of MAPs within SMEs in Jordan found that SMEs in Jordan apply fewer MAPs compared to their industrialized nation peers. Based on interviews and questionnaires, the research found that the maximum potential of MAPs is not being achieved within SMEs in Jordan despite their potential to impact product cost determination, contribute towards planning, management control, and identification of issues. Research supports enhancing managers' awareness of MAPs within SMEs (Jaradat et al., 2021). Also, studies of MAPs in Saudi pharmacies (KSA) established the benefits of using MAPs for improving product cost management, labor costs, and operational efficiency in the health sector (Alomi, 2023). Overall, such studies highlight the role of MAPs in improving organisational functioning, financial and operational performance, and sustainable development. They suggest the upgrading of management accounting systems across sectors to enable better decision-making, risk management, and business success with the need for greater empirical research to address industry-specific issues and develop strategies to meet existing business and sustainability needs.

METHODOLOGY

The research problem addresses the issues of traditional production systems and examines means of reducing production costs for production firms using EVM and improving MAPs to achieve SDG 12 for sustainable consumption and production. It is intended to increase product quality, reduce costs, and ensure project sustainability. It is intended to develop the theoretical framework through practical implementation through examining the role of EVM and improved MAPs towards improving product quality, reducing costs, improving project sustainability, and improving the competitiveness of the sample firm. It is intended to contribute to economic and environmental sustainability. The importance of the research lies in providing data on EVM, improving MAPs, and demonstrating their role in improving product quality, reducing costs, and enhancing project sustainability, in alignment with customer needs and expectations. The research hypothesis posits that EVM, and the improvement of MAPs contribute to enhancing product quality, reducing costs, and promoting project sustainability through the lens of SDG 12.

Sample

The sample for this study is the Iraqi Cement State Company in Karbala, which is part of the Iraqi Ministry of Industry and Minerals. Data from the company's financial records in 2019 have been selected for analysis. The company operates eight factories, with ten more managed by the private sector. The board, led by its chairman, is responsible for independently creating and setting its production and marketing policies. The company produces cement in accordance with international standards and plays a key role in supplying local markets with national cement products. Since its

establishment, the company has consistently pursued success, excellence, and distinction.

Method of Measuring Variables

MAPs were assessed in line with SDG 12 by focusing on renewable energy practices and the implementation of equipment designed to reduce fossil fuel consumption in kilns. Operational efficiency was improved by identifying the causes of delays in certain production stages and working towards enhancing work schedules to achieve a better balance between resources and time. Waste reduction in the production process and an increase in production efficiency were key goals, reflected in heightened environmental awareness, staff training, and improvements to delayed stages, particularly the final grinding and clinker stages. EVM was evaluated by calculating the time performance indicator, comparing the planned quantities of cement production with the actual data to determine the deviation. The calculation followed the equation outlined by [Institute \(2008\)](#).

$$SV = EV - PV \dots (1)$$

Time deviation (SV) in EVM is used to assess time performance in project management. It determines the SV of the project. A positive SV indicates that the project is ahead of schedule and a negative SV indicates that the project is behind schedule. EV is the work done so far according to plan and PV is the work that was to be done until now. The Time Performance Indicator of EVM quantifies the project performance in terms of time and is computed using the formula suggested ([Wiranegara et al., 2024](#)).

$$SPI = \frac{EV}{PV} \dots (2)$$

RESULTS

Cost Data in the Research Sample Company

To implement EVM analysis in the research firm example, key project activities, their durations, and costs must be thoroughly analysed. This enables accurate progress measurement, budget performance tracking, and schedule adherence. Proper monitoring ensures effective project management, supports informed decision-making, and enhances overall project efficiency, ultimately leading to successful execution and goal achievement.

Statement of the Production Stages and the Planned and Actual Quantities in the Research Sample Company

This involves examining production stages as well as planned and achieved quantities in cement production as illustrated in [Table 1](#). Through this analysis, it is possible to have a clear picture of planned vs. achieved differences in performance for better decision-making as well as for optimizing improvement strategies for performance.

Table 1: Quantities and Production Stages Involved in Cement Manufacturing

T	Production Stages	Planned Quantities	Actual Quantities
1	First Stage: Grinding Raw Materials	2015100	2081256
2	Second Stage: Cooking (Furnace)	1615090	1666030
3	Third Stage: Grinding (Clinker)	1112303	1063642

The statistics in [Table 1](#) give a planned vs. actual production analysis of three key production stages of cement production: raw material grinding, kiln processing, and grinding of the clinker. A planned vs. actual production level analysis puts differences and efficiencies in perspective in the production process and provides useful insights into areas of improvement. At the production stage of raw material grinding, actual production of 2,081,256 units was greater than planned production of 2,015,100 units by 66,156 units, reflecting favorable variance. This increase in efficiency can be due to reasons such as better processes of operations, better machinery functioning, or better management of raw materials. Excess production at this stage is crucial as it offers a continuous supply of ground raw materials to subsequent stages and avoids bottlenecks in the overall production process. A similar trend is noticed in the second stage of production, the kiln process, where actual production of 1,666,030 units was greater than planned production of 1,615,090 units by 50,940 units. This increase points towards better kiln efficiency due to better fuel efficiency, better heat distribution, or less processing time. Since the kiln stage is crucial for raw material transformation into clinker through high-temperature processing, any increase in efficiency in this stage goes a long way towards stabilizing overall production and cutting costs.

However, the clinker grinding phase deviates from the positive trend, with actual production (1,063,642 units) falling short of the target (1,112,303 units) by 48,661 units. This negative variance suggests inefficiencies in machinery performance, production processes, or raw material procurement. Since clinker grinding is crucial for ensuring the quality and consistency of the final product, inefficiencies in this phase can lead to delays in meeting market demand, increased operational costs, and potential disruptions in the supply chain. The data from [Table 1](#) highlight strong performance in the initial and intermediate phases but underscore the need for targeted interventions in the clinker grinding stage. Addressing these inefficiencies through equipment optimisation, preventive maintenance, or workflow adjustments could enhance production efficiency and ensure smoother operations.

Costs of Production Stages Involved in Cement Manufacturing in the Research Sample Company

In this step, the planned and actual costs associated with each stage of production—raw material grinding, kiln processing, and clinker grinding—are analysed, as outlined in [Table 2](#).

Table 2: Costs of Production Stages Involved in Cement Manufacturing

T	Production Stages	Planned Quantities	Actual Quantities
1	Quarry Stage	13784694	14177982
2	Rubber Conveyor Stage	5559941	5578988
3	Raw Material Grinding Stage	30261305	31386118
4	Kiln Stage	40002700	42107888
5	Intermediate Product Costs (Clinker)	89608640	93250976
6	Costs of Sold Clinker	(27741067)	(33583180)
7	Costs of Used Clinker	61867573	59667796
8	Final Grinding Stage	19580905	20449345
9	Packaging and Packaging Stage	5889274	6140982
10	Cement Manufacturing Costs	87337752	86258123
11	÷ Production Quantity	1112303	1063642
12	Cost Per Ton of Cement Product	78.520	81.097

Using EVM Analysis in the Research Sample

The cost data derived from the research sample will be utilised for the EVM analysis of the product, as presented in the subsequent tables.

EVM Analysis According to the Schedule Variation (Time Variation) in the Research Sample

In this stage, the variation in the production quantities involved in cement manufacturing is determined by comparing the previously planned data with the actual data from the cement production process, as illustrated in [Table 3](#). The raw material grinding phase exceeded expectations, with production surpassing the planned amount by 66,156 units. This improvement in efficiency can likely be attributed to enhanced grinding techniques, reduced machine downtime, or more effective material utilisation. The higher-than-expected production in this phase is a positive indicator, ensuring a consistent supply of ground raw materials to subsequent stages of manufacturing. Similarly, the kiln phase showed a favourable variance, with actual production exceeding the planned amount by 50,940 units. This would mean that the operations of the kiln were effective due to either better heat utilisation, good furnace reliability, or energy management. A successful kiln phase is vital as it offers timely supply of the clinker for grinding.

The grinding stage of the clinker revealed production issues where production was short of planned production by 48,661 units. This shortcoming is indicative of production faults that can arise due to poorly maintained equipment, delayed maintenance schedules, or unavailability of raw materials. Because the grinding stage of the clinker is vital to production, any disruptions here can slow down the overall production

process and also cause additional costs or delay meeting market demand. Overall, [Table 3](#) highlights successful execution in the initial phases, while emphasising the need for improvements in the clinker grinding phase to sustain overall production efficiency. Addressing these issues through enhanced machine maintenance, automation, or better raw material management could help ensure actual production meets planned targets and contribute to improved sustainability.

Table 3: Variation from the Schedule (Time Variation) for the Quantities Entering Cement Manufacturing

T	Variation from Schedule (Time Variation)	SV	Interpretation / Analysis
1	Stage 1: Grinding Raw Materials	66156	Positive variation indicates that the product is ahead of the planned time.
2	Stage 2: Cooking (Kiln)	50940	Positive variation indicates that the product is ahead of the planned time.
3	Stage 3: Grinding (Clinker)	48661	Positive variation indicates that the product is ahead of the planned time.

EVM Analysis According to Schedule Variation (Time Variation) in the Research Sample

In this step, the cost variability of cement production is determined through the comparison of planned costs with the incurred costs during the production of cement as shown in [Table 4](#).

Table 4: Variation from the Schedule (Time Variation) for Cement Production Costs

T	Variation from Schedule (Time Variation)	SV	Interpretation / Analysis
1	Quarry Stage	393288	Positive variation indicates that the product is ahead of time and planned.
2	Rubber Conveyor Stage	19047	Positive variation indicates that the product is ahead of time and planned.
3	Raw Material Grinding Stage	1124813	Positive variation indicates that the product is ahead of time and planned.
4	Kiln Stage	2105188	Positive variation indicates that the product is ahead of time and planned.
5	Intermediate Product Costs (Clinker)	3642336	Positive variation indicates that the product is ahead of time and planned.

T	Variation from Schedule (Time Variation)	SV	Interpretation / Analysis
6	Costs of Clinker Sold	5842113	Positive variation indicates that the product is ahead of time and planned.
7	Costs of Clinker Used	2199777	A negative variation indicates that the product is behind time and planned.
8	Final Grinding Stage	868440	Positive variation indicates that the product is ahead of time and planned.
9	Packaging Stage	251708	Positive variation indicates that the product is ahead of time and planned.
10	Cement Manufacturing Costs	1079629	A negative variation indicates that the product is behind on time and planned.

Analysis of EVM According to the Time Performance Index (Time Index) in the Research Sample

In this step, the time performance index for the quantities involved in cement manufacturing is calculated by comparing the previously planned data with the actual data from the cement production process, as illustrated in [Table 5](#)

Table 5: Time Performance Index (Time Index) for the Quantities Involved in Cement Manufacturing

T	Time Performance Indicator (Time Indicator)	SPI	Interpretation / Analysis
1	First Stage: Grinding Raw Materials	1.033	The index is greater than 1, meaning the product is ahead of the planned schedule.
2	Second Stage: Cooking (Furnace)	1.032	The index is greater than 1, meaning the product is ahead of the planned schedule.
3	Third Stage: Grinding (Clinker)	0.956	The index is less than 1, which means that the product is behind the planned schedule

EVM Analysis According to the Time Performance Index (Time Index) for Cement Production Costs in the Research Sample

In this step, the time performance index for cement production costs is determined by comparing the previously planned costs with the actual costs incurred during the cement production process, as shown in [Table 6](#).

Table 6: Time Performance Index (Time Index) for Cement Manufacturing Costs

T	Time Performance Indicator (Time Index)	SPI	Interpretation / Analysis
1	Quarry Stage	1.029	The index is greater than 1, which means that the product is ahead of the planned schedule
2	Rubber Conveyor Stage	1.003	The index is greater than 1, meaning the product is ahead of the planned schedule.
T	Time Performance Indicator (Time Index)	SPI	Interpretation / Analysis
3	Raw Material Grinding Stage	1.037	The index is greater than 1, which means that the product is ahead of the planned schedule
4	Kiln Stage	1.053	The index is greater than 1, which means that the product is ahead of the planned schedule
5	Intermediate Product Costs (Clinker)	1.041	The index is greater than 1, which means that the product is ahead of the planned schedule
6	Costs of Sold Clinker	1.211	The index is less than 1, which means that the product is behind the planned schedule
7	Costs of Used Clinker	0.964	The index is greater than 1, which means that the product is ahead of the planned schedule
8	Final Grinding Stage	1.044	The index is greater than 1, which means that the product is ahead of the planned schedule
9	Packaging Stage	1.43	The index is less than 1, which means that the product is behind the planned schedule
10	Cement Manufacturing Costs	0.988	Interpretation / Analysis

Source: Prepared by Researchers.

Analysis of EVM in Improving Management Accounting Practices for the Quantities of Production Stages Involved in Cement Manufacturing

In this step, a detailed analysis of the results from the application of EVM in enhancing management accounting practices is presented, as shown in [Table 7](#).

Table 7: Analysis of EVM in Improving Management Accounting Practices for the Quantities of Production Stages Involved in Cement Manufacturing

T	Production Stages	SV	SPI	Overall Performance of Analysis Results	Proposed Improvement
1	First Stage: Grinding Raw Materials	66156	1.033	Advanced performance with noticeable improvements	The increase in actual quantities compared to planned amounts indicates no issues. The proposed improvement involves applying new technologies to reduce both environmental and economic costs.

2	Second Stage: Cooking (Furnace)	50940	1.032	Good performance with slight progress	The rise in the actual quantities against planned quantities reflects no problems. The suggested improvement is to utilize alternative fuels and increase the control technology so that there is better process integration and production sustainability.
3	Third Stage: Grinding (Clinker)	48661	0.956	Late performance as it needs continuous improvements	The quantities realized as opposed to planned quantities indicate equipment inefficiency. The improvement suggested is to raise periodic maintenance and ensure a regular supply of raw materials.

Source: Prepared by Researchers.

Table 8: Analysis of EVM in Improving Management Accounting Practices for Cement Manufacturing Costs

No.	Production Stages	SV	SPI	Overall Performance of the Analysis Results	Overall Performance of Analysis Results
1	Quarry Stage	393288	1.029	Good performance with noticeable progress	The increase in quantities of production as planned shows that there are not any serious issues. The proposed improvement is to prioritize the usage of new efficient technologies for boosting efficiency, reducing losses, and maximizing raw material extraction and transportation. It will reduce costs and enable the transition to new energy sources, hence increasing sustainability in the cement sector and reducing environmental footprints.
2	Rubber Conveyor Stage	19047	1.003	Good performance with little progress	The increase in quantities from planned quantities is an indicator of no issues. Recommendations for improvement are using corrosion-resistant materials, using energy-efficient equipment, and using predictive maintenance to enhance efficiency, reduce downtime, and conserve costs.
3	Raw Material Grinding Stage	1124813	1.037	Advanced performance through continuous improvements	The increase in actual quantities over planned amounts indicates no issues. Proposed improvements include advanced grinding technologies, intelligent process control, corrosion-resistant materials, and better maintenance management to reduce costs and boost efficiency.
4	Kiln Stage	2105188	1.053	Advanced performance through continuous improvements	The increase of actual quantities over planned quantities is indicative of no issues. Recommendations for improvement are to raise energy efficiency, shift to alternative fuels, apply heat recovery technologies, and optimize operations and maintenance.
5	Intermediate Product Costs (Clinker)	3642336	1.041	Good performance through continuous improvements	The increase in the actual quantities as compared to the planned amounts reflects no problems. Proposed improvement is exhibited through heat recovery technologies and carbon emission reduction technologies such as upgrading furnaces, alternative fuels, and grinding and storage processes. Additionally, using new technology and developing new technologies for carbon capture will reduce the environmental impact and cost.

No.	Production Stages	SV	SPI	Overall Performance of the Analysis Results	Overall Performance of Analysis Results
6	Costs of Sold Clinker	5842113	1.211	Good performance with noticeable improvements	The increase in the actual quantities compared to planned quantities indicates no problems. The proposed improvement is revealed through enhancing production efficiency, energy saving, and cost saving through improving the efficiency of furnaces, using alternative fuels, and heat recovery from wastage and thus saving environmental costs.
7	Costs of Used Clinker	2199777	0.964	Late performance as it needs continuous improvements	The production quantities decreased compared to planned quantities due to production issues. Solutions proposed are expanding transportation and maintenance, improving furnace efficiency, adopting new combustion technologies, reducing carbon emissions, expanding production capacity, and optimizing marketing to make the production of clinker more profitable.
8	Final Grinding Stage	868440	1.044	Good performance with little progress	Actual quantities greater than planned amounts indicate no issues but expansion. Planned improvement includes greater energy efficiency in mills, corrosion prevention, better maintenance of equipment, and using advanced maintenance practices for cost savings. Improved pollution and noise abatement practices would also assist in reducing environmental and health costs.
9	Packaging Stage	251708	1.43	Good performance with noticeable progress	Actual quantities are higher than planned quantities, indicating no issues. Proposed improvements are using new technology to raise efficiency levels, reduce wastage, adopt cost-effective and green packaging materials, bring in automated packaging, and using large containers. Innovation in packaging materials and environmental compliance will save costs and improve environmental performance.
10	Cement Manufacturing Costs	1079629	0.988	Late performance as it needs continuous improvements	The actual quantities are lower than planned, indicating production issues. The strategy focuses on improving energy efficiency, enhancing raw material quality, refining grinding and calcining operations, and optimising maintenance and materials management. Best practices and advanced techniques, such as alternative fuels, renewable energy, and carbon capture, will help reduce costs.

Analysis of EVM in Enhancing Management Accounting Practices for the Costs of Production Stages in Cement Manufacturing: This step provides a detailed analysis of the EVM results in improving management accounting practices, as presented in [Table 8](#)

DISCUSSION OF RESULTS

Based on the detailed analysis of the EVM results and the improvement of management accounting practices, their role in enhancing performance to achieve project sustainability, in line with SDG 12, is as follows:

1. **Renewable Energy:** The installation of solar panels to power equipment, alongside technologies aimed at reducing fossil fuel consumption in furnaces, significantly lowers energy costs and environmental impact.
2. **Recycling and Waste Reduction:** The adoption of recycling practices for secondary materials generated during operations, combined with improved waste management systems, helps minimise losses and optimise resource utilisation.
3. **Sustainable Product Design:** Enhancing product design to reduce raw material consumption, improve efficiency, and produce recyclable products lowers long-term costs and enhances operational efficiency.
4. **Addressing Production Delays:** Detailed analysis of delays in production stages, such as mechanical failures and resource shortages, supports the identification of influential factors and improvements in work schedules. Automation and AI techniques can further enhance performance by analysing data, predicting risks, and optimising resource distribution through automated scheduling.
5. **Resource Recycling:** Recycling materials from higher production levels such as clinker for subsequent production stages reduces costs and improves efficiency.
6. **Waste Minimization in Production:** Improving efficiency of the production process and reducing losses of raw materials and energy ensures effective sustainable use of resources and wastage is minimized.
7. **Increased production efficiency:** Enhanced equipment performance and optimized resource consumption maximize production processes with minimal environmental impact.
8. **Environmental Awareness and Training:** Employees are trained in sustainable production practices to enhance sustainability culture and work towards long-term environmental goals.
9. **Later Stage Improvement:** Optimizing the final grinding (clinker) stage, increasing equipment efficiency and saving time and wastage maximizes productivity. Additionally, improving supply strategy and reduced reliance on imported clinker with local resources can enhance sustainability and costs.

These strategies align with SDG 12, fostering responsible consumption and production while ensuring environmental and economic sustainability.

CONCLUSION

Empirical research examines the impact of EVM and MAPs at various stages of production with emphasis on their role in contributing to product improvement in terms of product quality, sustainability of production, as well as cost savings. There is significant variance in planned and realized production performance indicating production difficulties. Through the assistance of expertise, effective operations management has been attained. Outcomes indicate that processes such as kiln processing and grinding of raw materials performed better than predicted. However, grinding of the clinker was not as effective as predicted, indicating the potential for better procedure and equipment adjustments. The research highlights the contribution of MAPs in balancing cost management with sustainability goals. It points to the manner in which SDG 12 (Responsible Consumption and Production) is integrated into production and accountancy practices through the focus on the use of renewable energy, avoidance of wastage, and productivity improvement. By adopting MAP-based practices such as optimizing the schedule of labor, consumption of fossil fuels, and enhancing maintenance routines, the research suggests that production yield can be maximized while saving costs. SV and SPI indicate that some stages met their deadlines but must be closely monitored to prevent delay.

The research focuses on the role of regular maintenance, process automatization, and effective material management practices in maximizing operational efficiency. The study points towards the continuous improvement of production processes to become competitive in current production systems. The research establishes the close interrelationship of EVM, MAPs, and sustainable production technologies in the cement industry. It concludes that firms can become competitive and ensure long-term economic and environmental benefits through data-driven decision-making and cost management practices with sustainability as their primary focus. The paper makes valuable contributions towards future research on EVM and MAPs and offers groundwork for sustainable manufacturing practices for SMEs and the adoption of new digital technologies such as IoT-based monitoring systems and AI.

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