

## ERP-Integrated Accounting Systems and Operational Efficiency in Rajasthan's Oil and Petroleum Enterprises

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### Abstract

*Industries that rely heavily on capital and process are increasingly turning to enterprise resource planning (ERP) systems as a means to connect financial accounting with critical operational tasks including production, shipping, inventory, and procurement. With the Barmer-Sanchor basin fields operated by Cairn Oil & Gas (Vedanta Limited), the upstream operations of the Oil and Natural Gas Corporation (ONGC) in the Jaisalmer basin, and the HPCL Rajasthan Refinery under development at Pachpadra, the oil and petroleum sector in Rajasthan is a major player in India's crude oil production. However, there has been little empirical research on how much ERP-integrated accounting systems have improved operational efficiency in this particular cluster of regional industries. This paper presents the results of a survey study that asked accounting, finance, and operations staff from oil and petroleum companies in Rajasthan about their experiences with ERP-accounting integration and how it relates to four aspects of operational efficiency: materials and inventory management, financial closing and reporting cycle time, procurement-to-payment efficiency, and cross-functional decision-support quality. The study found that approximately 34% of the variation in respondents' efficiency ratings can be explained by the level of ERP-accounting integration. The strongest specific association was found for procurement-to-payment efficiency, while the weakest was for cross-functional decision-support quality. The study used descriptive statistics, reliability analysis, Pearson correlation, and multiple linear regression to analyze the results. 158 respondents from 42 enterprises were surveyed using a structured, Likert-scale questionnaire. Finally, the report recognizes the study's limitations and suggests avenues for further research before discussing the practical significance of the findings for oil and petroleum firms in Rajasthan that are thinking about adopting or upgrading their ERP systems.*

**Keywords:** Enterprise Resource Planning, ERP-integrated accounting, operational efficiency, oil and petroleum sector, Rajasthan, Barmer basin.

### 1. Introduction

In the last 20 years, Rajasthan has become a major onshore hydrocarbon producer in India. Mid-2000s Cairn India discovered the Mangala, Bhagyam, and Aishwariya fields in Barmer-Sanchor. After that, they managed the fields. Today, Vedanta Limited's Cairn Oil & Gas runs them. After Vedanta bought Cairn India in 2011, Rajasthan's onshore fields generate 25% of India's crude oil. ONGC has long produced gas in Jaisalmer and Cairn. Hindustan Petroleum Corporation Limited and the Rajasthan government founded HPCL Rajasthan Refinery Limited (HRRL) to build a huge refinery-cum-petrochemical complex in Pachpadra, Barmer. This project will boost the state's downstream and upstream petroleum production. Companies along this upstream-to-downstream value chain confront more difficult accounting and operational issues than regular manufacturing or trading companies. These include oilfield contractors, logistics and transportation providers, exploration and production firms, and the vendor ecosystem. ERP systems link general ledger and financial reporting modules to procurement, inventory, maintenance, and production-operations data. This helps with joint-venture accounting, production-sharing-contract cost recovery, capital-intensive asset depreciation schedules, strict statutory and environmental compliance reporting, and a multi-location inventory of specialist drilling and processing equipment. Many accounting and information systems studies have found that ERP adoption improves organizational efficiency in manufacturing, retail, and services. Whether and through which channels ERP-integrated

accounting systems improve operational efficiency has received relative attention in India's oil and petroleum sector, particularly in the Rajasthan oil-producing cluster, where firms range from large, well-resourced operators like ONGC and Cairn Oil & Gas to much smaller oilfield-services and logistics contractors with thinner information-technology budgets. This study fills that gap by surveying Rajasthani oil and petroleum company accounting, finance, and operations specialists.

The paper's structure continues here. The literature on ERP systems, accounting integration, and corporate efficiency is examined in Part 2. In Section 3, we explore Rajasthan's oil and petroleum history. Working hypotheses and research goals are under Section 4. Section 5 explains the research method. Tables for reliability, regression, correlation, and descriptive analysis are in Section 6. Section 7 discusses results. Part 8 describes the study's limitations and advises more research, while Section 9 concludes.

## 2. Review of Literature

*Teltumbde, Tripathy, and Sahu (2002)* examined how Bharat Petroleum Corporation Limited (BPCL) employed ERP as part of a large-scale enterprise-wide transformation initiative. This study examined real-world instances to address "How can a huge Indian petroleum firm boost their organizational competitiveness, customer service, coordination, and business-process efficiency through ERP-based integration?" BPCL's previously fragmented business functions and SAP R/3 adoption caused organizational changes, which the authors explored using a case study. Because ERP deployment required not only technology installation but also fundamental changes in organizational processes and work culture, the study focused on change management. Enterprise-wide integration improved information environments, business processes, and customer attention, according to the results. ERP installations in petroleum enterprises must align technology, organizational procedures, employee adaptability, and change management, according to the report. This study is relevant to the current research because it shows how integrated ERP architecture may link accounting and operational operations in Indian petroleum industries.

By researching ERP deployment at Indian Oil Corporation (IOC), a major Indian petroleum company, *Bishnoi (2011)* found a causal link between ERP adoption and IOC's financial and operational success. We examined ERP's financial impacts on production and operational costs, profit margins, cost-benefit evaluations, and management oversight. The study used case-based analysis to examine ERP as an information backbone that may unify geographically dispersed organizational processes. The findings show that a well-executed ERP system can reduce operating and manufacturing costs, improve corporate process control, information integration, and complex organizational network management. According to research, ERP deployment requires big resources, organizational buy-in, risk mitigation, and change management efficacy. The data shows that ERP is a complete system for managing a company's operations and finances, not just an IT investment. This study suggests that Rajasthani petroleum companies may benefit from ERP-integrated accounting solutions to improve operational efficiency.

*Mishra and Mishra (2011)* evaluated ERP project performance in the oil and gas exploration business, focusing on integrated enterprise system possibilities, challenges, transition, and organizational results. The purpose was to understand how ERP optimizes and integrates corporate processes and impacts operational responsiveness, planning, coordination, and decision quality. The researchers used a case-study method to analyze oil and gas ERP deployment. Integrating ERP systems improves cross-departmental cooperation, strategic planning and decision-making, internal operations, and operational and customer reaction time, according to their research. The report also stressed learning from transition and identified implementation challenges. The authors say ERP benefits depend on execution quality and organizational integration. This study provides a sound conceptual foundation for the planned

Rajasthan study to better integrate accounting, finance, procurement, inventory, and operational processes to improve corporate efficiency.

*Madapusi and D'Souza* examined ERP system implementation and organizational effectiveness in 2012. Although not primarily targeting the petroleum industry, this study provides a good analytical foundation for ERP-integrated accounting system evaluations in Indian manufacturing environments. The purpose was to determine if ERP modules affect operational performance or if ERP enterprise-wide benefits all performance measures. The researchers used theory-driven empirical field-study to examine ERP adoption status and operational performance correlations. The data demonstrated that ERP modules had diverse effects on performance indicators, suggesting that ERP benefits vary by function and module. The study also showed that ERP system adoption affects organizational performance assessments in numerous ways. The authors recommend evaluating ERP success at the module and enterprise levels rather than binaryly. Integration of accounting systems with inventory, procurement, sales, production, and financial modules may affect operational efficiency in Rajasthan's petroleum enterprises in many ways, making this finding important to the proposed study.

*Basu, Upadhyay, Das, and Dan (2012)* studied Indian SMEs' ERP deployment problems. To determine what makes an ERP deployment effective in India, assess and prioritize those factors. The researchers did a complete literature review and used TOPSIS for multi-criteria analysis to prioritize implementation issues. Their research found that ERP effectiveness depended on management buy-in, implementation planning, resource availability, end-user participation, process redesign, and technology integration, not just the software. As the results showed, even with technically advanced ERP systems, inadequate consideration of these organizational and implementation issues may restrict ERP benefits. The analysis concluded that firms should regard ERP as an opportunity to improve their entire organization, not just an IT initiative. This study suggests that organizational preparation, staff competency, management commitment, system integration, and business process adaptation may affect operational efficiency gains from ERP-integrated accounting systems for Rajasthani petroleum firms.

*Azharuddin (2017)* examined how Iraqi and Indian oil companies employed data-mining for accounting and finance. The study examined how analytical technology on accounting and financial information systems affects financial decision-making and organizational information utilization. The study used comparative analysis to compare technology adoption in Iraqi and Indian oil firms. Indian oil companies employed SAP/ERP-based systems to integrate financial data with data-mining and decision-support capabilities, unlike Iraqi companies, which used manual procedures. The results showed that accounting information and analytical tools can help managers use financial data for decision-making. The research found that ERP-compatible accounting systems provide a better technical foundation for managers to analyze enormous amounts of financial data. This is relevant to the present research because transaction automation and accounting data integrated with ERP support real-time monitoring, cost control, forecasting, and managerial decisions in Rajasthan's petroleum enterprises.

*Archana, Varadarajan, and Medicherla (2022)* examined SAP, Oracle NetSuite, and Microsoft Dynamics 365 ERP deployment techniques. Analyzing ERP installation methods was the goal to uncover strategies that could improve ERP quality and organizational outcomes. The researchers compared budgets, resource needs, project methodology, system selection, and organizational requirements for significant ERP implementations. The results demonstrated that inadequate implementation methodology can cause insufficient best practice adoption, fractured project teams, poor decision-making, and lower business satisfaction. Methodical deployment planning improves solution quality and ERP capability to satisfy corporate needs. According to the paper, a successful enterprise-system deployment requires the correct ERP

installation approach. Accounting interacts with procurement, inventories, distribution, taxes, asset management, and operational control in petroleum enterprises, making technical and organizational ERP implementation crucial.

*Halimuzzaman and colleagues (2023)* examined the financial impact of ERP on Accounting Information Systems (AIS) in petroleum industries, which is similar to the suggested research topic. The main objective was to study how ERP adoption affects petroleum accounting information system structure, efficiency, correctness, and efficacy. The study proposed integrating accounting operations into an ERP system to process financial data. It would connect financial data to other corporate operations. ERP improves accounting process efficiency, financial data integration, information accuracy, and organizational decision support, according to the study. The results suggest that ERP-AIS integration can make accounting an integrated information system that aids financial control and management. ERP integration quality and quantity strongly correlate with accounting information system efficacy. Even though the empirical setting was outside Rajasthan, the research presents a useful technique for analyzing ERP-integrated accounting systems' impact on financial-process efficiency and operational performance in the state's petroleum sectors.

*Tulli (2024)* examined how ERP system digital transformation may increase oil and gas supply-chain efficiency using real-time analytics and decision-making. We wanted to see how IoT, AI, blockchain, and real-time analytics could improve operational outcomes in complex oil and gas supply chains by boosting ERP systems. Case studies and industry stakeholder data comprised mixed-methods. Digital ERP solutions improve operational cost reduction, inventory management, demand forecasting, information availability, and decision-making, according to research. However, technical integration was complicated and expensive. The research concluded that ERP systems are now digital decision platforms with integrated capabilities, not just transaction processing engines for administrative chores. Accounting data integration with inventory, supply-chain, procurement, and operational data improves cost monitoring and resource allocation and eliminates departmental information delays, making these findings useful to Rajasthan petroleum firms.

### 3. Contextual Background: Rajasthan's Oil and Petroleum Sector

Three essential pillars underpin Rajasthan's contemporary hydrocarbon economy. Mangala, Bhagyam, and Aishwariya fields are in the Barmer-Sanchor basin. Cairn Oil & Gas, a Vedanta Limited business, manages these mid-2000s oilfield, which began production in 2009. These fields have continuously produced around a quarter of India's crude oil since their peak. Rajasthan's contribution to India's domestic production exceeds its land area or population. The second pillar is the Jaisalmer basin, where ONGC has produced natural gas for decades with a network of oilfield service providers, drilling enterprises, and logistical firms that covers most of western Rajasthan. Third, the HPCL Rajasthan Refinery Limited (HRRL), a joint venture between Hindustan Petroleum Corporation Limited and Rajasthan, provides downstream refining capacity. HRRL is building a refinery-cum-petrochemical complex in Pachpadra, Barmer. The complex will handle Rajasthani and other crude oil. It also seeks to establish a regional downstream petrochemical and auxiliary cluster. Large upstream operators, oilfield-services and drilling contractors, logistics and transportation firms that move crude, equipment, and personnel across the Thar desert's difficult terrain, EPC contractors that build refineries and pipelines, and a wider base of smaller vendors, fabricators, and service providers for this value chain have united around these three pillars. The present study sampled this diverse community of enterprises, which varied in size, ownership structure, and information-technology maturity (Section 5). Methodologically, this diversity is crucial for the study. Large, publicly traded firms with ERP systems and smaller, family-run oilfield service providers make up the Rajasthan oil and petroleum cluster. Our diversity enables for a cross-sectional survey design that takes advantage of ERP-accounting integration depth variances,

which is excellent for our investigation because it eliminates experimental or quasi-experimental variation.

#### 4. Research Objectives and Hypotheses

*The following four goals served as the basis for this investigation:*

1. To determine how well oil and petroleum businesses in Rajasthan integrate their ERP systems with their accounting software.
2. To find out how efficient people think operations are along four dimensions: materials and inventory management, financial reporting and closing time, procurement-to-payment efficiency, and quality of cross-functional decision-support.
3. Analyze the correlation between estimated operational efficiency and the degree of ERP-accounting integration using statistical methods.
4. Determine which operational efficiency dimension(s) is/are most closely linked to ERP-accounting integration, and then explain what this pattern means for businesses in the industry.

*These aims inform the study's testing of the following null hypotheses.*

H<sub>01</sub>: Among Rajasthani oil and petroleum businesses, there is no correlation between ERP-accounting integration depth and operational effectiveness.

H<sub>02</sub>: The degree of correlation between ERP-accounting integration and the four distinct operational efficiency measures is not significantly different.

H<sub>03</sub>: There is no significant moderating effect of enterprise size (as defined by the number of people) on the link between operational efficiency and ERP-accounting integration.

##### 4.1 Conceptual Framework

The study's conceptual framework views ERP-accounting integration depth as the main independent variable, operational efficiency (which is determined by the four dimensions mentioned earlier) as the dependent variable, and enterprise size and type as control variables that are expected to impact operational efficiency both independently and potentially in combination with ERP-integration depth. The general logic of the ERP-accounting literature reviewed in Section 2 supports this framework. Instead of focusing on whether an ERP system is present or not, the theoretically relevant construct is the depth of integration between the accounting module and day-to-day data capture for procurement, inventory, and production operations. This is because two businesses can formally 'have' an ERP system but have vastly different levels of integration.

The framework further differentiates between the four operational efficiency dimensions based on the assumption that ERP-accounting integration will not have a uniform impact on all of them. To that end, sections 6.4 and 6.5 empirically examine this distinction, and section 7 delves further into the topic, but it is expected that transactional dimensions—such as procurement-to-payment efficiency and financial closing cycle time—which are close to the accounting function will have a stronger association with integration depth. On the other hand, sections 6.5 and 6.4 discuss this hypothesis, and Section 7 elaborates on this hypothesis.

#### 5. Research Methodology

**Research Design:** This study surveys a cross-section of businesses using a descriptive-cum-analytical approach, which is suitable for looking at correlations between the degree of ERP integration and the perceived operational effectiveness of those businesses at a single moment in time.

**Sample and Sampling Procedure:** The participants included accounting, financial, and operations staff from oil and petroleum companies in Rajasthan, including upstream operators, oilfield-services contractors, logistics providers, and EPC/engineering contractors. The 42 businesses having a presence in the Barmer, Jaisalmer, Jodhpur, and Bikaner districts were selected using a purposive sample technique. From each of these 42 businesses, willing participants were selected using a convenience sampling technique to fill out the accounting,

finance, and operations departments. A response rate of 91.9% was achieved from 172 surveys that were sent out; 158 of those returned were fully functional.

**Research Instrument:** The data was gathered through a structured questionnaire that had three parts: (i) demographic information about the respondents and the enterprise as a whole; (ii) a 12-item scale that measures the ERP-accounting integration; (iii) a 16-item scale that measures the perceived operational efficiency across the four dimensions listed in Section 4, with four items per dimension; and (iv) a 12-item scale that measures the depth of ERP-accounting integration, based on constructs used in the broader ERP-accounting literature that was reviewed in Section 2. Each item on the measure had a five-point Likert scale, where 1 meant strongly disagree and 5 meant strongly agree.

**Statistical Tools:** Every analysis was carried out at the 5% level of significance, with the exception of multiple linear regression, which involved descriptive statistics (mean, standard deviation), Cronbach's alpha (to assess scale reliability), Pearson product-moment correlation, and so on.

## 6. Data Analysis and Results

### Demographic Profile of Respondents

Of the 158 respondents that made it into the final tally, Table 1 shows their demographics and enterprise tier.

**Table 1: Demographic Profile of Respondents (N = 158)**

| Category            | Sub-Group                               | Frequency | Percentage (%) |
|---------------------|-----------------------------------------|-----------|----------------|
| Functional Role     | Accounting / Finance                    | 89        | 56.3           |
| Functional Role     | Operations / Supply Chain               | 69        | 43.7           |
| Enterprise Type     | Upstream Operator (E&P)                 | 31        | 19.6           |
| Enterprise Type     | Oilfield Services / Drilling Contractor | 48        | 30.4           |
| Enterprise Type     | Logistics / Transportation              | 36        | 22.8           |
| Enterprise Type     | EPC / Engineering Contractor            | 43        | 27.2           |
| Enterprise Size     | Small (< 100 employees)                 | 52        | 32.9           |
| Enterprise Size     | Medium (100–500 employees)              | 67        | 42.4           |
| Enterprise Size     | Large (> 500 employees)                 | 39        | 24.7           |
| ERP Platform in Use | SAP                                     | 58        | 36.7           |
| ERP Platform in Use | Oracle                                  | 34        | 21.5           |
| ERP Platform in Use | Tally ERP / Mid-market Solutions        | 51        | 32.3           |
| ERP Platform in Use | Other / Custom-built                    | 15        | 9.5            |

**Reliability Analysis:** All four operational-efficiency sub-scales and the ERP-accounting integration scale have Cronbach's alpha reliability values that are greater than 0.70, which is considered a widely accepted criterion for acceptable to good internal consistency (Table 2).

**Table 2: Scale Reliability (Cronbach's Alpha)**

| Scale / Sub-Scale                              | Number of Items | Cronbach's Alpha |
|------------------------------------------------|-----------------|------------------|
| ERP-Accounting Integration Depth               | 12              | 0.881            |
| Inventory & Materials Management Efficiency    | 4               | 0.796            |
| Financial Closing & Reporting Cycle Efficiency | 4               | 0.812            |
| Procurement-to-Payment Efficiency              | 4               | 0.834            |
| Cross-Functional Decision-Support Quality      | 4               | 0.759            |

| Scale / Sub-Scale                                  | Number of Items | Cronbach's Alpha |
|----------------------------------------------------|-----------------|------------------|
| Overall Operational Efficiency (16 items combined) | 16              | 0.905            |

### Descriptive Statistics

Table 3 shows the average item scores (range 1–5) for each operational efficiency dimension and the ERP–accounting integration scale, as well as the standard deviation of these values.

**Table 3: Descriptive Statistics of Key Study Variables (N = 158)**

| Variable                                       | Mean | Std. Deviation | Interpretation               |
|------------------------------------------------|------|----------------|------------------------------|
| ERP-Accounting Integration Depth               | 3.42 | 0.68           | Moderate-to-high integration |
| Inventory & Materials Management Efficiency    | 3.51 | 0.71           | Moderate-to-high             |
| Financial Closing & Reporting Cycle Efficiency | 3.29 | 0.74           | Moderate                     |
| Procurement-to-Payment Efficiency              | 3.58 | 0.65           | Moderate-to-high             |
| Cross-Functional Decision-Support Quality      | 3.11 | 0.79           | Moderate                     |
| Overall Operational Efficiency (composite)     | 3.37 | 0.62           | Moderate-to-high             |

In terms of ERP-accounting integration depth, respondents generally rate it as moderate-to-high (mean 3.42 out of 5). Out of the four operational-efficiency dimensions, procurement-to-payment efficiency ranks highest (mean 3.58), while cross-functional decision-support quality ranks lowest (mean 3.11). This pattern will be further explored in the regression and correlation analyses that follow.

**Correlation Analysis:** The four operational efficiency characteristics and the ERP-accounting integration depth score are shown in Table 4 with their respective Pearson correlation coefficients.

**Table 4: Pearson Correlation Matrix**

| Variable         | ERP Integration | Inventory Mgmt. | Closing Cycle | Procure-to-Pay | Decision Support |
|------------------|-----------------|-----------------|---------------|----------------|------------------|
| ERP Integration  | 1.000           | 0.512**         | 0.487**       | 0.561**        | 0.334**          |
| Inventory Mgmt.  | 0.512**         | 1.000           | 0.398**       | 0.445**        | 0.276**          |
| Closing Cycle    | 0.487**         | 0.398**         | 1.000         | 0.421**        | 0.298**          |
| Procure-to-Pay   | 0.561**         | 0.445**         | 0.421**       | 1.000          | 0.312**          |
| Decision Support | 0.334**         | 0.276**         | 0.298**       | 0.312**        | 1.000            |

\*\* Correlation is significant at the 0.01 level (2-tailed), N = 158.

In line with the descriptive pattern mentioned in Section 6.3, the strongest bivariate association with ERP-accounting integration depth is procurement-to-payment efficiency, followed by cross-functional decision-support quality, and all four operational-efficiency dimensions show positive and statistically significant correlations at the 1% level. The correlations range from  $r = 0.334$  for decision-support quality to  $r = 0.561$  for procurement-to-payment efficiency.

**Regression Analysis:** In order to test Hypothesis  $H_{01}$ , a multiple linear regression was conducted. The dependent variable in the regression was overall operational efficiency, which is the sum of all 16 efficiency items. The predictors were ERP-accounting integration depth, firm size (coded as an ordinal control variable), and enterprise type (entered as dummy

variables, with upstream operator as the reference category). Regression results are displayed in Table 5.

**Table 5: Multiple Regression Results — Dependent Variable: Overall Operational Efficiency**

| Predictor                            | Unstandardised B | Std. Error | Standardised $\beta$ | t-value | Sig. (p) |
|--------------------------------------|------------------|------------|----------------------|---------|----------|
| (Constant)                           | 1.482            | 0.211      | —                    | 7.024   | 0.000**  |
| ERP-Accounting Integration Depth     | 0.381            | 0.052      | 0.417                | 7.327   | 0.000**  |
| Enterprise Size (ordinal)            | 0.096            | 0.041      | 0.148                | 2.341   | 0.021*   |
| Oilfield Services Contractor (dummy) | -0.048           | 0.067      | -0.037               | -0.716  | 0.475    |
| Logistics/Transportation (dummy)     | -0.062           | 0.071      | -0.045               | -0.873  | 0.384    |
| EPC/Engineering Contractor (dummy)   | 0.031            | 0.069      | 0.023                | 0.449   | 0.654    |

### Model Summary

| Statistic                 | Value   |
|---------------------------|---------|
| R                         | 0.583   |
| R Square ( $R^2$ )        | 0.340   |
| Adjusted R Square         | 0.317   |
| F-statistic (df = 5, 152) | 14.98   |
| Significance (p-value)    | 0.000** |

The  $R^2$  value of 0.340 (Adjusted  $R^2 = 0.317$ ) explains approximately 34.0% of the variation in operational efficiency. All regression models are statistically significant ( $F = 14.98$ ,  $p < 0.001$ ). The ERP-accounting integration depth is the most significant predictor ( $\beta = 0.417$ ,  $p < 0.01$ ). This demonstrates that ERP-accounting integration increases perceived operational efficiency even after controlling for organization size and type. Enterprise size appears to be a lesser positive predictor ( $\beta = 0.148$ ,  $p < 0.05$ ). The sample's larger companies, regardless of ERP integration depth, show slightly higher operational efficiency. This may be because they have more accounting and IT professionals. After controlling for ERP-integration size and depth, no enterprise-type dummy variable reaches statistical significance, indicating that an oil and petroleum enterprise in Rajasthan's sub-sector (upstream, oilfield services, logistics, or EPC) does not predict perceived operational efficiency.

### Hypothesis Testing Summary

**Table 6: Summary of Hypothesis Testing**

| Hypothesis                                                                                         | Statistical Test                                 | Result                                                                             | Decision                                   |
|----------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------|
| $H_{01}$ : No significant relationship between ERP integration and operational efficiency          | Multiple Regression                              | $\beta = 0.417$ , $p < 0.01$                                                       | Rejected                                   |
| $H_{02}$ : No significant difference in association strength across the four efficiency dimensions | Comparison of correlation coefficients (Table 4) | r ranges from 0.334 to 0.561                                                       | Rejected                                   |
| $H_{03}$ : Enterprise size does not moderate the ERP–efficiency relationship                       | Regression coefficient on size control           | $\beta = 0.148$ , $p < 0.05$ (significant main effect; no interaction term tested) | Partially rejected — size is a significant |

| Hypothesis | Statistical Test | Result | Decision              |
|------------|------------------|--------|-----------------------|
|            |                  |        | independent predictor |

According to the data shown above, all three null hypotheses are either partially or completely rejected. This means that operational efficiency is positively and significantly correlated with ERP-accounting integration depth among the oil and petroleum enterprises in Rajasthan that were sampled. What is more, this correlation is stronger for certain operational efficiency dimensions (like procurement-to-payment efficiency) than for others (like decision-support quality). Lastly, enterprise size has an additional positive effect on operational efficiency that is independent of ERP-integration depth.

## 7. Discussion

Applying the general finding of the ERP-accounting literature described in Section 2 to the specific institutional setting of Rajasthan's oil and petroleum sector, the regression model indicated that ERP-accounting integration depth was the highest predictor of total operational efficiency. Overall, ERP-accounting literature supports this finding. The substantial procurement-to-payment efficiency connection ( $r = 0.561$ ) may be due to procurement in this sector. Oilfield operations require regular and urgent purchases of specialized equipment, spare parts, and consumables from a scattered vendor base. Real-time integration of the accounting/payables module and procurement records enhances vendor relationship management, shortens the purchase-order-to-payment cycle, and avoids duplicate or inaccurate payments. Respondents definitely see these benefits. In comparison, the weaker association found for cross-functional decision-support quality ( $r = 0.334$ ) indicates that ERP systems in the sampled enterprises are successfully streamlining transactional processes (inventory recording, financial closing, procurement-payment matching), but they are not being utilized as a source of integrated management information for cross-functional decision-making. Investment in reporting and business intelligence capabilities beyond transactional modules is usually required to fully utilize ERP systems for analytical and decision-support purposes, according to the literature. This investment may lag core-module implementation, especially among smaller and Enterprise size has a positive effect independent of ERP integration depth, as expected: larger businesses, especially upstream operators and EPC contractors, have more resources to support their ERP systems with accounting and IT specialists, additional training, and business process re-engineering. The literature evaluation identified these criteria as key moderators of ERP benefit. Policymakers and industry bodies aiming to support smaller vendors in this ecosystem should take note of this implication, as it suggests that smaller oilfield-services and logistics enterprises in the Rajasthan cluster may be adopting ERP-accounting integration at a similar nominal depth to larger enterprises (as indicated by the absence of a significant coefficient on the enterprise-type dummies once size is controlled for) without necessarily realizing an equivalent efficiency benefit.

**Practical Implications:** For enterprise leadership inside Rajasthan's oil and petroleum cluster, the findings propose three practical priorities. First, companies with shallow ERP-accounting integration, where the finance module is not tightly, real-time linked to procurement and inventory data, can benefit greatly from deepening that integration, particularly in the procurement-to-payment process, where the present study finds the strongest association with efficiency outcomes. Second, industry-association-sponsored training programs, shared-service ERP arrangements, or vendor-financed implementation support aimed at building complementary accounting and IT systems may benefit smaller oilfield-services and logistics companies more than larger ones, as the regression results suggest. Third, enterprises across the size spectrum that have already achieved reasonable integration in transactional areas but continue to rate cross-functional decision-support quality relatively low (as the sample does on

average) may find it worthwhile to invest specifically in reporting, dashboarding, and business-intelligence capability layered on top of their existing ERP-accounting integration, rather than assuming that further transactional-module investment alone will address this gap.

## 8. Limitations and Scope for Further Research

1. The study relies on respondents' self-reported perceptions of ERP-integration depth and efficiency, rather than objective performance metrics like financial closing days or inventory turnover ratios. Future research could triangulate the survey findings with objective data from participating enterprises' ERP systems.
2. A longitudinal design, which tracks enterprises through ERP implementation or upgrade, can better establish causality between ERP-integration depth and operational efficiency than a cross-sectional design, which only documents associations at a single point in time.
3. The study used purposive and convenience sampling to select 42 enterprises from Rajasthan's oil and petroleum cluster, so findings should be generalized with caution to the wider population.
4. Future research should consider ERP implementation factors like vendor choice, duration, and business-process re-engineering, which are identified as important moderators of realised ERP benefit.

## 9. Conclusion

This study examined how ERP-integrated accounting systems affect operational efficiency among oil and petroleum enterprises in Rajasthan, home to one of India's most important regional hydrocarbon clusters—the Barmer-Sanchor basin fields, the Jaisalmer basin gas operations, and the developing HPCL Rajasthan Refinery complex. Many thought that ERP-accounting integration improves operational efficiency, and the study validates this with a controlled survey of 158 accounting, finance, and operations professionals from 42 enterprises. Most strongly correlated with procurement-to-payment efficiency, least with cross-functional decision-support quality, and positively correlated with enterprise size. This study suggests that Rajasthani oil and petroleum companies considering an ERP system or ERP-accounting integration should expect improved operational efficiency, particularly in payables and procurement. To maximize ERP's decision-support potential, smaller oilfield-services and logistics organizations may need to spend in reporting, employee training, and business process re-engineering in addition to ERP-accounting integration. Subject to Section 8's restrictions, this research adds to sector-specific empirical data on an issue of immediate practical importance to a large part of India's energy economy on both a regional and national level. Over time, Rajasthan's hydrocarbon sector will grow and diversify. The state's downstream footprint will grow with the HPCL Rajasthan Refinery complex in Pachpadra, adding to its strong upstream foundation. Longitudinal research on ERP-accounting integration and operational efficiency is possible.

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