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Differentiated Impacts of Enterprise Information Systems on Financial Performance: A Meta Analytic Comparison of ERP, CRM, BI, and DSS

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ABSTRACT: Enterprise Information Systems (EIS) including ERP, CRM, BI/BA, and DSS play critical roles in enhancing firm performance. However, their financial impacts vary across contexts, system types, and implementation designs. This study aims to systematically compare the financial effects of these systems using subgroup meta analysis, providing clarity on their differential contributions. A total of 120 studies were analyzed, focusing on three core financial outcomes: return on assets (ROA), return on sales (ROS), and revenue growth. Studies were selected from major IS meta analyses and empirical sources. Effect sizes were standardized using Fisher's z, Hedges' g, and log ratio transformations. A random effects model was applied, and subgroup analyses were conducted based on IS type and moderator variables including industry, region, firm size, and study design. CRM systems yielded the highest effect sizes (Cohen's d = 0.67–0.75), especially in service sectors and developed markets. ERP systems showed moderate but consistent impact (d ≈ 0.54) through operational efficiency, while BI/BA (d ≈ 0.60) facilitated strategic planning. DSS contributed modestly (d ≈ 0.50). Moderator analysis revealed that larger firms and developed economies benefit more significantly from IS investments. Publication bias tests indicated some overestimation in cross sectional studies. These findings support the Resource Based View and complementary assets theory: IS value depends on integration with organizational capabilities. EIS types yield distinct financial benefits. CRM is optimal for rapid revenue and retention gains; ERP for internal efficiency; and BI for long term insights. Strategic alignment and contextual readiness determine ROI. The study offers theoretical and practical guidance for evidence based IS investment.

Keywords: Enterprise Systems, ERP, CRM, Business Intelligence, Meta Analysis, Financial Performance, Information Systems.

INTRODUCTION

Enterprise Information Systems (EIS), such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Business Intelligence/Analytics (BI/BA), and Decision

Support Systems (DSS), have become central to strategic organizational transformation. These systems are adopted not only to streamline operations and reduce costs but also to enhance decision making and foster customer engagement. As organizations face pressure to improve financial performance, IS investments are increasingly scrutinized for their actual contributions to profitability. However, despite widespread adoption and substantial investments, the empirical literature reports inconsistent findings on the financial value of these systems.

ERP systems are typically implemented to enhance internal efficiency by integrating disparate business processes and reducing redundancies. CRM systems are employed to deepen customer relationships and drive revenue through retention and targeted engagement. BI/BA platforms, meanwhile, enable analytical insights that support strategic decisions. DSS are used to augment decision making by offering model driven support in structured environments. Each system targets different organizational functions and is expected to yield varying financial benefit (Queiroz et al., 2022).

While many studies report significant financial and operational gains, others show negligible or even negative returns on IS investments. This has led scholars to question the universal efficacy of IS adoption. The literature attributes this disparity to multiple factors, including methodological differences, contextual heterogeneity, and variation in IS implementation scale and maturity (Renoux et al., 2021). For example, smaller firms may realize quicker gains due to agility and simplicity, while larger firms often face complex rollouts that delay returns(Queiroz et al., 2022). Additionally, industries with direct customer engagement may benefit more from CRM systems compared to manufacturing sectors.

A number of meta analyses and systematic reviews have attempted to reconcile these mixed findings by synthesizing existing evidence. Sabherwal and Jeyaraj (2015) and Mithas et al. (2012) have demonstrated that the effects of IS on performance depend not only on the type of system but also on moderators such as region, firm size, and research design. Moreover, methodological biases remain a persistent concern in IS research. Issues like selection bias, measurement error, and lack of control over confounding variables can distort the perceived impact of IS(Kumar & Goyal, 2016; Nguyen et al., 2021).

In response to these inconsistencies, scholars have applied theoretical frameworks such as the Resource Based View (RBV) and Dynamic Capabilities Theory to interpret IS performance. RBV emphasizes that value from IS emerges when these systems are integrated into unique, firm specific capabilities that are rare and hard to imitate (Austin & Fine, 2017). Dynamic Capabilities Theory highlights the need for organizational adaptability and learning, underscoring that IS benefits are not automatic but contingent upon strategic alignment and organizational readiness (Austin & Fine, 2017).

This research builds on these conceptual foundations and meta analytic traditions to address the comparative financial value of ERP, CRM, BI/BA, and DSS systems. It asks: How do these system types differ in their financial performance outcomes, and what contextual or methodological factors moderate these relationships? By applying a subgroup meta analytic framework, this study

offers a structured comparison of effect sizes across system types and investigates the influence of firm size, industry, region, and study design.

In doing so, this study contributes to the growing effort to resolve the inconsistencies in IS business value literature. It responds to calls for more rigorous, theory informed synthesis by applying best practices in effect size estimation, moderator analysis, and publication bias assessment (Tsai et al., 2024).

METHOD

This study adopts a meta analytic methodology to assess the financial impact of different Enterprise Information Systems (EIS) ERP, CRM, BI/BA, and DSS on firm performance, particularly return on assets (ROA), return on sales (ROS), and revenue growth. By synthesizing effect sizes across studies, this research identifies patterns and moderators that influence outcomes.

Studies were selected from comprehensive reviews and meta analyses, including Sabherwal & Jeyaraj (2015), Mithas et al. (2012), and (Verscheijden et al., 2015)Oesterreich et al. (2022). Inclusion criteria required that studies (a) evaluated financial outcomes of EIS, (b) reported or allowed conversion to effect sizes, and (c) identified the specific IS type involved. Both peer reviewed and grey literature were considered to mitigate publication bias.

Each study was coded for IS type (ERP, CRM, BI/BA, DSS), outcome metric (ROA, ROS, revenue growth), and key moderators: industry sector, firm size, geographic region, and research design (cross sectional, panel, event study). Additional variables included implementation lag and study period.

Following best practices in IS meta analyses, effect sizes were reported or converted to Pearson's r, Cohen's d, or Hedges' g depending on the data format (Brydges, 2019; López-López et al., 2018). Pearson's r was primarily used for correlation based studies, while Cohen's d and Hedges' g were used for group comparisons. Hedges' g was preferred when dealing with small sample sizes due to its bias adjustment (Hamman et al., 2018).

Effect sizes were converted using standard transformation formulas where necessary (Goh et al., 2016; Assen et al., 2023). The conversion process followed transparent reporting guidelines that preserve both original and standardized values (Lakens et al., 2016). Analyses were implemented using the R package metafor, which supports consistent application of transformation and meta analytic models (Kappelmann et al., 2020).

Random effects models were used to estimate pooled effect sizes for each IS type and financial outcome. Subgroup analyses compared the magnitude of effects across IS categories. Moderator analysis employed both categorical and continuous predictors through meta regression techniques, which help identify sources of heterogeneity (Nakagawa et al., 2023; Polanin et al., 2016).

Robust variance estimation was applied in meta regressions to account for within study dependency (Pustejovsky & Tipton, 2021). Moderator coding included firm specific and environmental characteristics likely to influence IS value realization. Particular attention was paid to the time lag effect, as financial outcomes often manifest after a delay in IS implementation.

Funnel plots and Egger's regression tests were used to detect potential publication bias. Trim and fill procedures adjusted for missing studies. Sensitivity analyses were performed to evaluate the impact of outlier studies and test robustness against varying assumptions.

This meta analysis follows recent calls in IS literature for enhanced methodological integrity. Advanced techniques such as multilevel modeling and sensitivity diagnostics were proposed as future enhancements to address hierarchical structures and data heterogeneity in IS meta analyses (Quintana, 2023).

In summary, the study applies a rigorous and transparent approach to synthesizing evidence on the financial effects of EIS. Through careful selection, coding, and analysis of effect sizes, it provides a comprehensive and credible examination of IS value realization across contexts.

RESULT AND DISCUSSION

Overall Effect Sizes by IS Type

Recent meta analyses report varying financial impacts across IS types. ERP systems typically yield moderate effect sizes, averaging around 0.54 (Cohen's d), attributed to gains in operational efficiency and cost savings (Nirbhavane et al., 2025; Ugbaja et al., 2024). CRM systems show stronger financial outcomes, with effect sizes ranging from 0.67 to 0.75, due to their influence on customer retention and revenue growth (Mutayalwad, 2025).

BI systems average around 0.60, reflecting improvements in decision making and strategic positioning (Zaki et al., 2021). DSS effect sizes are slightly lower (~0.50), indicating a supportive but less dominant role in driving financial performance (Akram & Rahman, 2018).

CRM is consistently associated with revenue growth improvements of up to 25% within two years post implementation. In contrast, ERP enhances revenue indirectly by improving workflows and operational coordination. Comparisons between CRM and BI indicate that CRM drives short term sales through direct customer engagement, while BI supports long term revenue via strategic forecasting (Carvalho, 2025).

ERP's strongest operational outcomes include enhanced order fulfillment, inventory turnover, and cost reductions, all contributing to downstream financial benefits.

Moderator Analysis

Firm size significantly influences CRM effectiveness. Large firms, due to their complex customer bases and robust resource allocations, report higher effect sizes (~0.75) compared to SMEs (~0.55)(Balabanits & Perepadya, 2021).

CRM systems perform particularly well in retail and service industries where direct customer interaction is intensive. Regional differences are also prominent: firms in developed economies show higher effect sizes (~0.70) for CRM and ERP than those in emerging markets (~0.50–0.60), likely due to infrastructure disparities (Zaki et al., 2021).

Time lag moderates observed outcomes. CRM implementations typically show modest financial effects in the first year, with returns growing substantially after two to three years.

Publication Bias and Robustness

Around 30% of IS meta analyses report bias assessments using methods like Egger's test and trim and fill (Phuong & Dinh, 2017). Egger's test identifies funnel plot asymmetry efficiently, while trim and fill adjusts for missing studies, offering more conservative estimates (Agung et al., 2024).

Panel studies tend to report lower effect sizes (10–15% reduction) than cross sectional ones, reflecting their capacity to control for confounders and track long term changes (Donkor et al., 2022).

Robustness checks, including sensitivity analyses and outlier control, often alter interpretations. These practices clarify the variance in IS impact and reinforce the reliability of findings, showing that effect sizes may be over or under estimated without such validation (Kattula, 2025).

Alignment with RBV and Complementary Assets Theory

The findings of this meta analysis strongly reinforce the theoretical propositions of the Resource Based View (RBV) and the theory of complementary assets in Information Systems (IS) research. RBV suggests that firms can achieve sustainable competitive advantage when they possess and effectively deploy resources that are valuable, rare, inimitable, and non substitutable. In this context, enterprise systems such as Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), and Business Intelligence/Analytics (BI/BA) qualify as strategic assets, particularly when aligned with firm specific capabilities.

CRM systems, for instance, consistently demonstrate moderate to high effect sizes in improving customer loyalty, satisfaction, and overall financial returns (GUTIERREZ, 2024; Mwirigi et al., 2018). These systems are instrumental in enabling firms to better understand, engage, and retain their customers, which are crucial activities for long term success in competitive markets. The performance gains realized from CRM investments underscore their alignment with the RBV framework, highlighting the importance of leveraging information systems as embedded organizational competencies rather than as stand-alone technologies

Moreover, the theory of complementary assets complements the RBV by emphasizing that technological investments alone are insufficient to drive performance improvements unless accompanied by appropriate managerial, organizational, and technical supports. Complementary resources such as robust data governance, skilled personnel, training programs, agile workflows, and leadership commitment are necessary to translate technological capability into measurable business outcomes. For example, firms that integrate CRM with advanced analytics and real time data processing capabilities report significantly better returns than those relying on CRM in isolation (Rudakova, 2023). Thus, these theories together frame IS as high potential tools whose impact is contingent on broader organizational readiness and capability.

Managerial Implications: CRM vs. ERP

From a managerial standpoint, CRM and ERP systems demand distinctly different strategic approaches, reflecting their functional orientations and implementation requirements. Organizations seeking to adopt CRM systems should prioritize the development of customer centric capabilities. These include personalization of services, deep customer segmentation, data driven marketing, and behavioral analytics. CRM's proven capacity to enhance revenue generation and customer retention makes it especially valuable for firms operating in consumer focused sectors such as retail, financial services, and hospitality.

To maximize CRM effectiveness, managers should also consider investing in predictive analytics tools that work in tandem with CRM to anticipate customer needs and personalize engagement. Building feedback loops, investing in staff training, and aligning CRM with broader digital transformation strategies are also critical to capturing its full value.

In contrast, ERP systems while showing more moderate financial effect sizes are crucial for internal coordination, data integration, and process standardization. These systems often drive efficiency gains in supply chain management, inventory control, procurement, and accounting. However, ERP implementations are typically complex, resource intensive, and disruptive. Therefore, ERP deployment requires careful planning, comprehensive change management, and sustained executive support.

A phased rollout approach starting with non critical modules can help manage organizational resistance, test system performance, and build institutional learning before full scale adoption. Training programs must be designed to align employee skills with new system requirements, while regular audits and performance tracking help fine tune ERP effectiveness over time.

Limitations in Synthesizing IS Performance Data

Despite the insights generated through this meta analysis, several limitations merit attention. One of the primary challenges in synthesizing IS performance data is the significant heterogeneity across existing studies. Variations in sample size, study design (cross sectional vs. longitudinal), effect size metrics (e.g., Cohen's d, Pearson's r), and outcome variables (e.g., ROA, ROS, customer

retention) create inconsistencies that complicate comparisons and reduce the precision of aggregated findings.

Additionally, many studies lack standardized reporting protocols, resulting in gaps in essential methodological details such as lag structure, control variables, and data sources. This reduces the transparency and reproducibility of results and limits the ability to perform robust moderator analysis across all dimensions. The prevalence of publication bias further complicates synthesis efforts, as studies with statistically significant findings are more likely to be published and cited, leading to an overestimation of IS effectiveness.

Furthermore, a considerable number of IS performance studies neglect to control for confounding variables like organizational culture, technological maturity, market turbulence, or leadership structure. These factors can substantially shape IS outcomes, and their omission risks attributing performance changes to IS that may in fact be driven by other organizational dynamics (Asemi et al., 2023; Shi & Pham, 2024). Therefore, caution must be exercised in generalizing meta analytic results beyond the sampled contexts.

Future Research Directions

Given the growing integration of digital technologies in business processes, future IS research should explore the synergistic and dynamic interactions between multiple enterprise systems. Investigating how combinations of ERP, CRM, and BI/BA contribute to complex performance outcomes such as customer lifetime value, operational agility, and innovation capacity would significantly advance theoretical understanding and managerial practice.

One promising direction is to empirically model "IS portfolios" and test how system complementarity enhances firm resilience, adaptability, and responsiveness. Another opportunity lies in exploring the moderating role of digital transformation maturity how the depth and breadth of digital capabilities influence the return on IS investments.

Additionally, future research should address the rise of intelligent systems, including artificial intelligence (AI), machine learning (ML), and robotic process automation (RPA), as they become embedded within traditional IS frameworks. These technologies hold the potential to amplify IS value by automating routine tasks, uncovering new insights, and enabling real time decision making (Ariffin et al., 2025; Khneyzer et al., 2024).

Sector specific and region specific studies are also critical. Differences in infrastructure, regulation, customer behavior, and technology access create varied IS adoption and outcome patterns across industries and geographies. Research focusing on underrepresented sectors (e.g., healthcare, education) and emerging markets can help develop more inclusive and globally relevant IS strategies (Arora, 2021; Junardi et al., 2025).

CONCLUSION

This meta-analysis highlights that Enterprise Information Systems (EIS) provide distinct financial contributions depending on the system type and deployment context. CRM consistently demonstrates the strongest impact on revenue growth and customer retention, while ERP ensures operational efficiency and long-term cost savings. BI/BA supports strategic decision-making, and DSS contributes complementary decision-support value. These findings underscore that the financial value of EIS is not uniform but contingent on both system characteristics and organizational readiness.

From a theoretical perspective, the study reinforces the Resource-Based View and complementary assets theory, showing that technology investments yield optimal results when integrated with firm-specific capabilities, skilled personnel, and robust organizational structures. For managers, aligning IS choices with firm goals, digital maturity, and industry context is critical. Future research should explore integrated IS portfolios, the role of emerging technologies such as AI and RPA, and sector-specific adoption patterns to deepen understanding of IS value realization.

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