Mohan Kunkulagunta, 2024, 12:6
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

Critical Success Factors in Enterprise Resource Planning (ERP) Implementation: A Comprehensive Review

Mohan Kunkulagunta[1], Vedaprada Raghunath[2]

B.E.S.T Innovation University, Gownivaripaill, Gorantla in Andhra Pradesh, India.[1]

Visvesvaraya Technological University (VTU), Public university in Belgaum, Belgaum, Karnataka, India.[2]

Abstract- This review explores the critical success factors (CSFs) that impact the implementation and management of Enterprise Resource Planning (ERP) systems in various organizational contexts. Key factors include top management support, effective communication, user involvement, and change management strategies. Challenges include resource constraints, cultural barriers, and technical issues, necessitating careful planning and stakeholder engagement. Emerging technologies like artificial intelligence and cloud computing add complexity to ERP systems, necessitating further exploration. The paper emphasizes the importance of multi-method research approaches to understand ERP implementation challenges and provide practical guidance. Future research directions aim to refine CSF frameworks and address evolving dynamics in diverse organizational settings.

Keywords- Critical Success Factors (CSFs), Enterprise Resource Planning (ERP), Stakeholder Engagement, Emerging Technologies, Change Management

I. INTRODUCTION

ERP systems are crucial for organizations to streamline operations, boost productivity, and maintain a competitive edge. They facilitate information flow across departments like finance, human resources, supply chain, and customer relationship management, enhancing efficiency and decision-making [1]. However, implementing ERP systems is a complex, resource-intensive process requiring significant investments in financial, technical, and human capital. Many organizations face challenges during implementation, with a significant percentage failing to deliver expected outcomes or exceeding budgets and timelines [2].

Understanding the factors that influence the success of ERP implementation is critical for organizations to maximize their investment and achieve strategic objectives. Researchers and practitioners have identified a range of critical success factors (CSFs) that play pivotal roles in ensuring ERP project success. These factors span technical, organizational, and human dimensions, including top management support, effective project management, user training, and system customization. This review provides a comprehensive exploration of these CSFs, synthesizing insights from academic and industry studies to guide organizations in planning and executing ERP implementations effectively. By doing so, it aims to bridge the gap between theoretical frameworks and practical applications, offering a roadmap for navigating the complexities of ERP projects [3].

Despite the wealth of research on ERP implementation, the dynamic nature of technology and evolving business landscapes continue to

reshape the challenges and opportunities associated with these systems. The rapid integration of advanced technologies such as cloud computing, artificial intelligence, and big data analytics into ERP solutions has introduced new variables that influence implementation success. Additionally, factors such as globalization, cross-cultural teams, and remote work have added layers of complexity to ERP projects. This review considers these contemporary trends and their impact on critical success factors, providing an up-to-date perspective that aligns with the needs of modern organizations. By analysing these elements, the study aims to contribute to the growing body of knowledge and offer actionable insights for organizations embarking on ERP journeys [4,5].

The novelty of this review lies in its holistic approach to examining the critical success factors (CSFs) of ERP implementation while incorporating emerging trends and technologies that influence these factors [5,6]. Unlike previous studies, this review not only synthesizes traditional CSFs such as top management support, user involvement, and effective project management but also delves into the evolving impact of cloud-based ERP solutions, artificial intelligence, and big data analytics. It further explores the implications of globalization, remote work, and cultural diversity on ERP implementation success. By addressing these contemporary dimensions, this review provides a forward-looking perspective that bridges the gap between classical ERP implementation frameworks and the realities of modern, technology-driven business environments, offering valuable insights for both academia and industry practitioners [7,8].

II. METHODOLOGY

1. Reference and Literature Management

Efficient reference and literature management is critical for conducting a comprehensive review of critical success factors (CSFs) in ERP implementation. Tools like Zotero, Mendeley, and EndNote are invaluable for organizing, managing, and citing scholarly articles, enabling researchers to maintain a structured and easily accessible repository of relevant studies. Additionally, platforms such as Connected Papers and Litmaps facilitate the discovery of related research works, helping to explore connections between key studies and identify influential contributions to the field. These tools streamline the process of collecting and organizing literature on ERP CSFs and emerging technologies while automating the creation of citations and bibliographies, ensuring a well-documented and methodologically robust review paper [9,10].

2. Data Analysis and Text Mining

Data analysis and text mining play a crucial role in identifying and synthesizing critical success factors (CSFs) in ERP implementation. Qualitative tools such as NVivo and Atlas.ti are effective for thematic coding, allowing researchers to analyze and organize qualitative data from various sources systematically. Meanwhile, programming languages like R (using text mining packages) and Python (with libraries such as NLTK and SpaCy) provide robust capabilities for conducting advanced text mining and content analysis [11,12]. These tools can process large volumes of ERP-related articles to uncover patterns, extract keywords, and highlight recurring phrases and themes. This approach aids in identifying the underlying trends and factors that contribute to the success of ERP implementations while also integrating insights into emerging technologies and methodologies[13].

3. VOSviewer: For Visualizing Co-authorship, keyword co-occurrence, and Citation Networks.

Bibliometric analysis tools are essential for mapping research trends and understanding the impact of key studies in ERP implementation. VOSviewer is widely used for visualizing co-authorship networks, keyword co-occurrence, and citation relationships, providing insights into collaboration patterns and thematic clusters. CiteSpace helps detect emerging trends and identify knowledge gaps in the literature, offering a deeper understanding of how the field has evolved over time [14]. Additionally, Biblioshiny, an interactive R package, facilitates bibliometric analysis through user-friendly visualizations and metrics. These tools are instrumental in analyzing trends in ERP-related research, such as the adoption of cloud-based ERP

systems and AI-driven solutions, and in evaluating the influence of key papers and authors shaping the domain [15, 16].

4. Statistical and Predictive Analysis

Statistical and predictive analysis tools are vital for quantitatively assessing the factors influencing ERP implementation success [18-23]. Software like SPSS and SAS is commonly used to analyze survey or case study data, providing descriptive statistics, correlations, and hypothesis testing to understand the relationships between various critical success factors (CSFs). Programming languages such as Python (utilizing libraries like Pandas and Scikit-learn) and R (with packages like caret and glm) extend these capabilities, enabling advanced regression analyses and predictive modeling. These tools can identify the relative impact of different CSFs on implementation outcomes and forecast success rates under varying conditions, offering actionable insights for organizations seeking to optimize their ERP strategies [24].

To enhance the rigor and efficiency of the review on "Critical Success Factors in Enterprise Resource Planning (ERP) Implementation," various IT software methods can be utilized. Reference management tools such as Zotero, Mendeley, and EndNote facilitate the organization and citation of scholarly articles, while platforms like Connected Papers and Litmaps help explore connections between research works, ensuring comprehensive literature coverage. For data analysis, qualitative tools like NVivo and Atlas.ti enable thematic coding, whereas programming libraries in Python (e.g., NLTK, SpaCy) and R (text mining packages) assist in extracting patterns and themes from extensive textual data [25, 26]. Bibliometric analysis tools, including VOSviewer and CiteSpace, offer capabilities to visualize co-authorship, keyword co-occurrence, and research trends, thereby identifying emerging topics such as cloud ERP and AI-driven solutions. Additionally, statistical tools like SPSS, SAS, or predictive modeling libraries in Python (Scikit-learn) and R (caret) are instrumental in analyzing survey or case study data to predict the success rates of ERP projects. These IT methods collectively support a robust, data-driven approach to identifying and evaluating critical success factors in the evolving ERP landscape [27-30].

III. RESULTS AND DISCUSSION

The research aims to compare critical success factors (CSFs) of enterprise resource planning (ERP) system implementation in large firms and small and medium-sized enterprises (SMEs) in developing countries. The study found significant differences in CSFs between SMEs and large firms, suggesting the need for more research on CSFs for different enterprise sizes. Recognizing these differences can help develop suitable implementation models and frameworks for ERP implementations in enterprises of any size [31].

ERP implementation is complex, costly, and often exceeds initial resources. It involves examining business processes, selecting the best software solution, configuring systems, training staff, and customizing software solutions. The new system should not affect daily operations. This paper analyzes the interrelationships of critical issues in ERP implementation in small and medium-sized enterprises (SMEs). Over 50 papers were reviewed to identify key success factors, their interaction, and their impact. An industrial survey was conducted to identify the most impactful factors. The findings were used to develop a tool to monitor and improve ERP implementations for SMEs [32].

ERP implementations are complex tasks, and recent research has provided critical success factors (CSFs) for such implementations. The article analyzes a project in the aviation industry using a list of CSFs. The poor performance led to a crisis, but the situation was turned around into a success. The CSFs were found to be highly correlated, with changes in one influencing most others. The reversal in performance after the crisis was attributed to substantial changes in attitudes among stakeholders, including top management, project management, project champion, and software vendor [33].

New information technologies have increased competition and reduced government funding for

public-sector higher education institutions (HEIs). To improve operational efficiency and reduce resource duplication, HEIs have turned to complex enterprise resource planning (ERP) systems. However, the paper investigates if ERP systems offer a feasible strategy for HEIs using a 'critical success factor' model. Four in-depth case studies were conducted in HEIs implementing ERP systems. Despite the complexities, particularly cultural and political ones, the traditional structure of HEIs presents numerous challenges. The findings suggest that careful communication and change management procedures can alleviate some problems, but the cost feasibility of system integration, training, and user licenses may ultimately impede ERP system utilization. The study aims to understand if ERP systems offer a viable solution for HEIs in the face of these challenges [34].

ERP systems are a major IT innovation in the last decade, aiming to streamline business processes and information flow. They are particularly appealing due to their ability to integrate with advanced electronic and mobile commerce technologies. However, research in ERP is still lacking, leading to a significant gap in the literature. A novel taxonomy for ERP research is proposed to fill this gap, presenting major themes such as ERP adoption, technical aspects, and ERP in IS curricula. This discussion is expected to be valuable to researchers and practitioners, and future research will continue to explore other areas within the taxonomy framework [35].

Public organizations have been investing heavily in Enterprise Resource Planning (ERP) systems, even targeting manufacturing companies. The growing interest in ERP implementation in the public sector necessitates specific studies. Previous studies have shown that organizational conditions differ between public and private organizations, suggesting that the reasons for ERP system implementation may differ. The paper aims to understand public organizations' approaches to ERP implementation through a survey of public organizations. The findings reveal that increasing real-time information demand, decision-making information, and application integration are the main reasons for ERP system adoption. Financial Accounting and Material Management modules are the most commonly implemented [36].

Multinational companies have experienced significant growth in recent decades, leading to more diverse and geographically widespread organizations. The has resulted in more complex decision-making for senior executives, especially when new cultures enter the company. Individual preferences and cultural belongings affect work-related factors, such as incentive programs [37]. This thesis aims to analyse the differences in incentive programs for senior executives between Swedish and American public companies and to determine the degree of cultural differences between the two countries. The survey involved 16 Swedish and 16 American companies, selected to minimize factors such as company size, industry, ownership, and employee occupation. The results showed similarities but also significant differences between Swedish and American incentive programs, with the largest differences being attributed to the characteristics of masculinity. The study suggests that the variation in incentive program design can be supported by cultural differences between the two countries. Further research is suggested, including a longitudinal study over several years, to determine contingent trends in incentive program design.

The selection of the best ERP software is a critical issue for companies, as it can impact time, costs, and market share. The analytic hierarchy process (AHP) is a widely used method for MCDM selection problems. However, this paper proposes a fuzzy extension of AHP, which uses uncertain human preferences as input information. The AHP cannot accommodate the variety of interactions, dependencies, and feedback between higher- and lower-level elements. Instead of using the classical eigenvector prioritization method, a fuzzy-logic method is applied, providing more accuracy on judgments. This fuzzy ANP enhances the potential of the conventional ANP for dealing with imprecise and uncertain human comparison judgments. The paper proposes an intelligent approach to ERP

software selection through a fuzzy ANP, considering both quantitative and qualitative elements to evaluate ERP software alternatives [38].
The public administration has been slow to adopt information technology-led organizational and operational changes, largely due to their conservative nature and resistance to change. However, the pressure to improve value from public administration information technology investments is growing, and the debate on how to achieve this is increasingly important. The sector faces challenges such as cultural, structural, resource, and technical issues, as well as a legacy of isolated developments. The evaluation of public sector information systems is also a challenge. The Irish civil service is increasingly aware of the strategic importance of breaking down specialized vertical systems and providing integrated services to citizens. A new approach, based on adapting the concept of business objects, is suggested to address these challenges [39].

ERP (Enterprise Business Application) is a novel business solution that organizations of all sizes are implementing. However, the implementation process is complex and has led to numerous research studies to identify critical success factors rather than failure factors. Most developed countries have been reaping the benefits of ERP integration, and developing countries are also embracing this technology. India, one of these countries, has many Information Technology implementation failures. Micro small and medium enterprises (MSME) are a vital part of the Indian economy, contributing over 45% of industrial production and 40% of total exports. The International Data Corporation (IDC) reports that ERP adoption is highest among large organizations, but MSMEs are expected to fuel future growth. India has a large market for ERP for MSMEs due to its over 20,000 small and mid-sized industries. Identifying critical success factors of ERP implementation has been a subject of extensive research, but there is no comprehensive study that identifies critical failure factors in context to Indian micro enterprises. This paper aims to present the findings of a comprehensive compilation of literature and analysis of ERP implementation failure factors in context to Indian MSMEs [40]

The paper analyses a case study of a UK-based manufacturing company's CRM implementation, highlighting its complexity and holistic nature. The study highlights the need for effective leadership, sourcing, targeting, and evaluation strategies in implementing CRM, as few academic studies have explored the issues associated with its implementation. CRM is a complex and holistic concept centered around business processes and information technology integration [41].

This study evaluates the risk levels for ERP implementation across different cultures and industries using the Fuzzy Analytic Network Process (FANP) method. The study categorized risks into four dimensions: management and execution, software system, users, and technology planning. An empirical survey of 20 ERP experts in Taiwan was used to rank and improve critical risks. A follow-up survey of ERP end-users in three industries was conducted to assess the impact of intra-organizational cultures and cross-industries on perceived risks. The results showed that "lack of management support and assistance" is a critical risk for successful ERP implementation, while top management support and involvement are essential for success. Ineffective communication with users was the second highest risk factor. The FANP method offers clear priority weights between alternatives, enhancing the chances of ERP implementation success among different cultures and industries [42].

Culture significantly impacts organizational behaviours and management, making cultural differences crucial for successful Enterprise Resource Planning (ERP) implementation. However, literature suggests that cultural differences can hinder the implementation of Western ERP software programs in developing countries [43].

The study investigates the success factors of ERP systems implementation in a Middle-Eastern country and compares them with South-East Asia. Four key factors were identified: top management

support, teamwork and composition, enterprise-wide communication, and project management program. The study also explored the moderating effect of organizational culture on these factors. A survey questionnaire was distributed to Iranian ERP adopters, and the data was analyzed using Structural Equation Modelling (SEM). Results showed that ERP implementation success in Iran is influenced by top management support, teamwork and composition, enterprise-wide communication, and project management program. In contrast, Malaysia's findings support the critical role of enterprise-wide communication and project management program. The study also found that organizational culture moderates the relationships between these factors and ERP implementation success in Iran and Malaysia [44]. This volume by a renowned scholar provides a thorough analysis of contingency theory, a key theoretical lens used to understand organizations. It acknowledges the coherence of the theory but also acknowledges some research deficiencies. The coherent model offers a platform for improvement in theory and method, paving the way for future research and guiding the course of future studies [45].

The paper presents an architecture framework for e-government adoption, guiding IT managers to identify technological and organizational requirements for public sector organizations. It also aids decision-makers in setting a vision statement and strategic action plan in the information technology age. The authors also classify perceived barriers that may complicate the implementation process of e-government projects, highlighting the importance of awareness in alerting project teams to potential problems or challenges during the implementation process [46].

Enterprise Resource Planning (ERP), an application that automates finance and human resource departments, helping manufacturers handle tasks like order processing and production scheduling. It surveys several ERP companies and considers future trends like web-based procurement and outsourcing. Challenges for ERP include ensuring global compatibility and flexibility, as well as addressing the need for flexibility in ERP applications [47].

Companies are increasingly focusing on Business Intelligence (BI) solutions as an extension of Enterprise Resource Planning (ERP) systems. BI systems consolidate, transform, and analyze vast amounts of data generated by the firm. However, there is limited research on the critical success factors (CSF) associated with BI implementations within an ERP system environment. This research documents BI-specific CSF identified by industry partners, vendors, or system users in their presentations at conferences, education forms, or user group meetings [48].

The need for a comprehensive business solution is growing, with Enterprise Resource Planning (ERP) software being widely adopted in developed countries. However, research on ERP implementation practices in developed and developing countries is limited. The study reveals that ERP technology faces additional challenges in developing countries due to economic, cultural, and infrastructure issues. The article aims to identify various issues related to ERP implementation in both advanced and developing countries [49].

The rapid increase in medical information has prompted hospitals to utilize healthcare information technology to improve service quality. Customer relationship management systems (CRMS) are an innovative technology that facilitates efficient acquisition, development, and maintenance of customer relationships. However, few studies have specifically explored CRMS adoption in hospitals, despite its significant impact on healthcare service quality and customer satisfaction. This study proposes an integrated model that considers organizational and system-related factors as primary determiners of CRMS adoption in hospitals. Surveys conducted with three levels of health institutions in Taiwan showed that factors such as hospital size, IS capabilities, innovation of senior executives, knowledge management capabilities, and relative advantage significantly influence CRMS adoption. The research also provides suggestions for researchers, hospitals, CRMS vendors, and the government to increase the likelihood of adopting CRMS [50].

Governments are transforming their environments from internal resource optimization to process integration and external collaboration, with Enterprise Resource Planning (ERP) being a leading solution. ERP has been proven to increase efficiency, improve information access, reduce total cost of ownership, and help achieve high levels of accountability and constituent service. However, implementing ERP effectively is challenging due to budget constraints, multiple ERP providers, and the complexity of the government acquisition process. To be successful, the business value must be sold at the executive and political levels of government, and the ERP solution should be embedded within its culture and processes. The level of detailed analysis required to map functional requirements to ERP solutions is an arduous task that has not always delivered successful implementation. This article aims to address these issues by examining the evolution and shortcomings of ERP solutions, defining the features and functionality needed for government transformation, and recommending steps for success [51].

Both customer relationship management (CRM) and electronic customer relationship management (eCRM) systems have unique characteristics that support customer-business interactions and are linked to internal business processes and systems across different areas for operational and analytical purposes. Such characteristics may imply that different critical success factors are required for to be successfully implemented. This exploratory study identifies the factors, and the interrelationships associated with the success of CRM and eCRM, compares the differences between CRM and eCRM, and discusses the reasons of the differences. Since there are only a few cases of CRM or eCRM systems fully implemented across marketing, technology, people, and business processes, an exploratory multiple-case study is conducted. The status of CRM research and future research direction are discussed [52].

The employs the critical hermeneutic approach to identifying current knowledge limitations and propose future research directions. Through five hermeneutic cycles of review, analysis, synthesis and interpretation of the existing literature and success stories reported by 30 small-and-medium enterprises (SMEs), this study identifies critical success factors (CSFs) that are unique to SMEs, frequently cited in the literature, and influential as perceived by SMEs. The study offers contributions by providing a synthesis of CSFs for SMEs; highlighting current knowledge gaps; proposing avenues for future research; and demonstrating the suitability of the critical hermeneutic approach to studying CSFs for ES implementation [53].

Enterprise resource planning (ERP) is a software solution that integrates the operational processes of the business functions of an enterprise. However, implementing ERP systems is a complex process. In addition to the technical issues, companies must address problems associated with business process re-engineering, time and budget control, and organisational change. Numerous industrial studies have shown that the failure rate of ERP implementation is high, even for well-designed systems. Thus, ERP projects typically require a clear methodology to support the project execution and effectiveness. In this study, we propose a theoretical model for ERP implementation. The value engineering (VE) method forms the basis of the proposed framework, which integrates Six Sigma tools. The proposed framework encompasses five phases: knowledge generation, analysis, creation, development and execution. In the VE method, potential ERP problems related to software, hardware, consultation and organisation are analysed in a group-decision manner and in relation to value, and Six Sigma tools are applied to avoid any project defects. We validate the feasibility of the proposed model by applying it to an international manufacturing enterprise in Taiwan. The results show improvements in customer response time and operational efficiency in terms of work-in-process and turnover of materials. Based on the evidence from the case study, the theoretical framework is discussed together with the study's limitations and suggestions for future research[54].

The aim of our study was to provide a contribution to the research field of the critical success factors (CSFs) of ERP projects, with a specific focus on smaller enterprises (SMEs).

Therefore, we conducted a systematic literature review in order to update the existing reviews of CSFs. On the basis of that review, we led several interviews within German SMEs that have implemented ERP systems. As a result, we showed that all factors found in the literature also affected the success of ERP projects in SMEs. However, within those projects, technological factors gained much more importance compared to those factors that most influence the success of larger ERP projects. For SMEs, factors such as the Organizational fit of the ERP system as well as ERP system tests are even more important than Top management support or Project management, which were the most important factors for large-scale companies [55].

Software projects are still late, over budget, and unpredictable. Sometimes the entire project fails before ever delivering an application. The article presents a clear, commonsense review of fundamental project management techniques which reminds us that we still have a long way to go. It presents five essential factors to managing a successful software project: (1) start on the right foot; (2) maintain momentum; (3) track progress; (4) make smart decisions; (5) institutionalize post-mortem analyses [56]

In the field of information systems (IS) there is an observable trend towards the use of multi-method research. Using different research methods allows for the cross-validation of data obtained via multiple approaches, with the potential to increase the robustness of research results. Such a multi-method approach is applicable to a comprehensive research agenda on critical success factors, an agenda that needs to take into account not only the identification, but also the analysis and management of critical success factors. The goal of this article is to contribute new knowledge on how to carry out research on critical success factors in IS projects using a multi-method approach. For this purpose, two research projects are presented, each a variation of the research design customized to particular circumstances. First, there is an outline of the research approach taken for a critical success factor research project in the field of portal implementation, with discussion of the strengths and weaknesses of the project. Taking into consideration these experiences, the research approach of a similar critical success factor research project in the field of offshore software development is then described. Finally, recommendations for using the multi-method research approach in critical success factor research are presented [57].

Worldwide, firms have made great efforts to implement Enterprise Resource Planning (ERP) systems. Despite these efforts, ERP adoption success is not guaranteed. Successful adoption of an ERP system also depends on proper system maintenance. For this reason, companies should follow a maintenance strategy that drives the ERP system toward success. However, in general, ERP maintenance managers do not know what conditions they should target to successfully maintain their ERP systems. Furthermore, numerous risks threaten these projects, but they are normally dealt with intuitively. To date, there has been limited literature published regarding ERP maintenance risks or ERP maintenance success. To address this need, we have built a dynamic simulation tool that allows ERP managers to foresee the impact of risks on maintenance goals. The research would help professionals manage their ERP maintenance projects. Moreover, it covers a significant gap in the literature [58].

Organizations perceive ERP as a vital tool for organizational competition as it integrates dispersed organizational systems and enables flawless transactions and production. The review examines studies investigating Critical Success Factors (CSFs) in implementing Enterprise Resource Planning (ERP) systems. Keywords relating to the theme of this study were defined and used to search known Web engines and journal databases for studies on both implementing ERP systems per se and integrating ERP systems with other well-known systems (e.g., SCM, CRM) whose importance to business organizations and academia is acknowledged to work in a complementary fashion. A total of 341 articles were reviewed to address three main goals. This study structures previous

research by presenting a comprehensive taxonomy of CSFs in the area of ERP. Second, it maps studies, identified through an exhaustive and comprehensive literature review, to different dimensions and facets of ERP system implementation. Third, it presents studies investigating CSFs in terms of a specific ERP lifecycle phase and across the entire ERP life cycle. This study not only reviews articles in which an ERP system is the sole or primary field of research, but also articles that refer to an integration of ERP systems and other popular systems (e.g., SCM, CRM). Finally it provides a comprehensive bibliography of the articles published during this period that can serve as a guide for future research [59].

Enterprise resource planning (ERP) system solutions are currently in high demand by both manufacturing and service organizations because they provide a tightly integrated solution to an organization's information system needs. During the last decade, ERP systems have received a significant amount of attention from researchers and practitioners from a variety of functional disciplines. In this paper, a comprehensive review of the research literature (1990-2003) concerning ERP systems is presented. The literature is further classified and the major outcomes of each study are addressed and analysed. Following a comprehensive review of the literature, proposals for future research are formulated to identify topics where fruitful opportunities exist [60].

The paper examines the impact of critical success factors (CSFs) on ERP implementations, based on responses from 86 organizations. It offers advice to management on how to effectively utilize limited resources to select CSFs that are most likely to impact the ERP system's implementation [61].

In recent years, numerous organizations have initiated enterprise-wide information management systems projects using packages like SAP, Peoplesoft, and Oracle, often representing the largest single investment in such projects in their company's history and corporate-wide projects.63. In the past several years many organizations have initiated enterprise-wide information management systems projects, using such packages as SAP, Peoplesoft, and Oracle. These projects often represent the single largest investment in an information systems project in the history of these companies, and in many cases the largest single investment in any corporate-wide project [63].

This article presents a step-by-step assessment and improvement method for ERP implementation in three companies. It proposes a five-stage model, dividing over 80 critical success factors into KPIs, using the Dumpster-Shafer method to calculate weights, and measuring performance at each stage. If performance falls below expectations, remedial actions are identified. An implementation flowchart is developed based on the model and the philosophy of continuous improvement. The model, currently used by a consulting company, has the potential to serve as a guideline for ERP implementation in other countries [64].

This paper reviews articles on the implementation of Enterprise Resource Planning (ERP) in African countries, aiming to assist researchers by identifying problems addressed and identifying open issues for future research. It also identifies conferences and journals interested in ERP implementation in African countries. The paper also discusses the importance of ERP implementation as a market in the African continent. Based on the review, the paper recommends several recommendations for successful ERP implementation in African countries, including awareness of existing problems and solutions, the life cycle used in ERP implementation, and avoiding failures linked to the African context [65].

This study examines the importance of project-driven organizations in modern management and the requirements of an Enterprise Resource Planning (ERP) system for effective management. Drawing on a case study from Asseco System S.A., a Polish IT integrator, the research discusses information problems, goals, considerations, and stages typical of an ERP implementation in a project-driven organization. The analysis concludes with an evaluation of the project results and the

formulation of critical requirements for an ERP system designed for project-driven organizations [66].

The paper discusses the growing interest in grounded theory in information systems research, a qualitative method that develops theory based on systematically gathered and analyzed data. It proposes guidelines for grounded theory studies in information systems, focusing on conceptualization and theory scope. The aim is to enhance the quality and aspirations of these studies [67].

ERP systems have been widely deployed worldwide since the 1990s, but not all projects end successfully. This article analyzes a failed ERP project in a small Indian organization using critical success factors (CFSs) identified in literature. The CSFs contributing to the failure included poor project management, lack of management support, ineffective external consultants, ineffective vendor teams, and wrong package selection. These factors highlight the complexity of ERP systems and their impact on organizations worldwide [68].

Companies with technologically-led motivation see improved service time in accounting tasks as an internal efficiency benefit, faster response to business change as customer benefits, and financial benefits in terms of other efficiencies. Businesses with business-led motivation see economies of scale as an internal efficiency benefit, and lower headcount and selling costs. Both groups report BP changes in reassigning financial management of business cases [69].

Mixed methods research is a method that combines quantitative and qualitative methods to gain insights into complex phenomena. However, there is a lack of such research in information systems. This study aims to address this by developing guidelines for conducting mixed methods research in information systems. The guidelines focus on three key aspects: the appropriateness of the approach, the development of meta-inferences, and the assessment of the quality of these meta-inferences. The applicability of these guidelines is demonstrated through two published IS papers that used mixed methods.71. This paper explores the challenges of CRM implementation in a B2B context, using Case Study (CSF) models in ERP implementation and project management. Eight companies were analyzed, identifying overlapping issues with ERP implementation and project management. The analysis forms the basis for a CSF model for CRM implementation, outlining strategic and tactical CSFs present during the process. This approach helps organizations overcome the challenges of CRM implementation [70,71].

This paper examines the use of contingency theory in Management Information Systems (MIS) and compares it to organization theory. It critiques assumptions of fit, performance as a dependent variable, rational actors, and deterministic models in both fields. The paper finds that MIS research has been hindered by a naive meta-theory, conflicting empirical results, ill-defined concepts of performance and fit, and a narrow perspective of researchers. Recommendations for improving the theoretical basis of MIS include more subjectivist, less functional, and less deterministic research approaches, a wider selection of methodologies, and more theory-building in defining the MIS construct. The study concludes that more theory-building is required to define the MIS construct. Existing studies have derived CSFs from large companies' perspectives, not considering the needs of smaller businesses. The research aims to bridge the gap between academia and practitioners by investigating the CSFs influencing BI systems success. The study followed a two-stage qualitative approach, using the Delphi method to conduct three rounds of studies. The authors developed a CSFs framework crucial for BI systems implementation and delineated it through case studies. Empirical findings support the construct and applicability of the framework, and the research reveals that organizations addressing CSFs from a business orientation approach are more likely to achieve better results.75. The aim of this study is to answer the question about risk factors for the information system (IS) projects in public organizations in Poland. These factors were identified based on a critical review of literature,

practical collaboration, the case study and logical deduction. The paper continues as follows. Firstly, a relationship between risk factors and a project success is explained and risk factors presented in the literature are shown. Secondly, a methodology of examining risk factors for the IS project in public organizations is presented. Thirdly, the risk factors for the IS projects in public organizations in Poland are identified and the framework of risk factors presented in the literature is improved. In this framework the factors are classified into eleven groups, namely (1) top management support; (2) manage processes in organization; (3) involve end users; (4) manage information system development process; (5) make system requirement analysis; (6) plan the project; (7) manage, monitor and evaluate the project; (8) manage project team; (9) manage team experience; (10) manage team communication; and (11) public sector procedures and processes. This paper concludes with a presentation of the study's contribution and limitations, implications for the findings and the stream of future work [72, 73].

Enterprise Resource Planning (ERP) systems have incorporated technologies like Machine Learning, Artificial Intelligence, and IoT, enabling faster data processing. SAP HANA, an in-memory database, optimizes data analytics, anomaly detection, and predictive maintenance. This enhances system reliability, supports informed decision-making, and increases operational efficiency. The shift to cloud-based ERP systems offers scalability and remote access [74-78].

Kunkulagunta's studies on IoT and cloud computing in ERP systems demonstrate their interconnectedness, enabling dynamic resource planning and management. The cloud provides decentralized data access, while IoT enables real-time monitoring and coordination of industrial resources [79-85]. AI-driven analytics and multi-agent systems in Industry 4.0 settings improve process efficiency and resilience. Health monitoring systems, such as wearable sensors, provide real-time data for diagnosis and timely interventions. This reduces the need for frequent hospital visits, especially for chronic patients, and promotes a patient-centric healthcare model [86-90].

IV. CONCLUSION

The implementation of Enterprise Resource Planning (ERP) systems remains a critical undertaking for organizations of all sizes, with the success largely dependent on the identification and management of Critical Success Factors (CSFs). Key CSFs include top management support, effective communication, and strong change management strategies. Differences in organizational size, industry, and geography further influence the adoption process, necessitating tailored ERP models. The integration of emerging technologies like AI and cloud computing adds complexity to ERP systems, highlighting the need for further research to understand their impact on implementation success and to refine CSF frameworks.

Despite the potential benefits of ERP systems in enhancing organizational efficiency, their adoption presents significant challenges, such as resource constraints, cultural barriers, and technical issues. Effective planning, stakeholder involvement, and continuous training are essential to overcoming these challenges. The studies reviewed emphasize the need for a multi-method research approach to gain a more comprehensive understanding of ERP implementation dynamics, combining both qualitative and quantitative data to address the evolving challenges. Continued research will be vital to improving ERP adoption strategies, particularly in developing countries, to ensure their success in diverse organizational contexts.

REFERENCES

[1] Raghunath, V. (2024). AN ERP-Based Artificial Intelligence on the Basis of SAP High-Performance Analytic Appliances (HANA). Volume 1, 2.
[2] Raghunath, V. (2024). Generative AI-Driven Interface Device for SAP HANA Analytics. Volume 3, 1.
[3] Yang, C., et al. (2017). Big Data and Cloud Computing: Innovation Opportunities and

Challenges. International Journal of Digital Earth, 10(1), 13–53.
[4] El-Seoud, S.A., et al. (2017). Big Data and Cloud Computing: Trends and Challenges. International Journal of Interactive Mobile Technologies, 11(2).
[5] Raghunath, V. (2024). New Rains Research Excellence Award 2024. New Rains, Report No. 1.
[6] Ji, C., et al. (2012). Big Data Processing in Cloud Computing Environments. 2012 12th International Symposium on Pervasive Systems, Algorithms and Networks. IEEE.
[7] Sandhu, A.K. (2021). Big Data with Cloud Computing: Discussions and Challenges. Big Data Mining and Analytics, 5(1), 32–40.
[8] Okorie, G.N., et al. (2024). Leveraging Big Data for Personalized Marketing Campaigns: A Review. International Journal of Management & Entrepreneurship Research, 6(1), 216–242.
[9] Kunkulagunta, M. (2024). Enhancing Big Data Analytics with Artificial Intelligence: Innovative Techniques and Applications in Various Sectors. IEEE Conference, 3(2), 1–6.
[10] Bao, G., & Guo, P. (2022). Federated Learning in Cloud-Edge Collaborative Architecture: Key Technologies, Applications, and Challenges. Journal of Cloud Computing, 11(1), 94.
[11] Kaya, M., & Yildirim, E. (2024). Strategic Optimization of High-Volume Data Management: Advanced Techniques for Enhancing Scalability, Efficiency, and Reliability in Large-Scale Distributed Systems. Journal of Intelligent Connectivity and Emerging Technologies, 9(9), 16–44.
[12] Hashem, I.A.T., et al. (2015). The Rise of 'Big Data' on Cloud Computing: Review and Open Research Issues. Information Systems, 47, 98–115.
[13] Ji, C., et al. (2012). Big Data Processing: Big Challenges and Opportunities. Journal of Interconnection Networks, 13(03n04), 1250009.
[14] Yang, C., et al. (2017). Utilizing Cloud Computing to Address Big Geospatial Data Challenges. Computers, Environment and Urban Systems, 61, 120–128.
[15] Kunkulagunta, M. (2024). Leveraging IoT and AI Technologies for Real-Time Remote Patient Monitoring: Innovations in Healthcare Delivery and Outcomes. IEEE Conference, 1(2), 101–107.
[16] Ji, C., et al. (2012). Big Data Processing: Big Challenges and Opportunities. Journal of Interconnection Networks, 13(03n04), 1250009.
[17] Yang, C., et al. (2017). Utilizing Cloud Computing to Address Big Geospatial Data Challenges. Computers, Environment and Urban Systems, 61, 120–128.
[18] Fernández, A., et al. (2014). Big Data with Cloud Computing: An Insight on the Computing Environment, MapReduce, and Programming Frameworks. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 4(5), 380–409.
[19] George, J. (2022). Optimizing Hybrid and Multi-Cloud Architectures for Real-Time Data Streaming and Analytics: Strategies for Scalability and Integration. World Journal of Advanced Engineering Technology and Sciences, 7(1), 10–30574.
[20] Raghunath, V. (2024). Investigation on Cloud Security Frameworks, Problems, and Proposed Solutions. European Journal of Advances in Engineering and Technology, 11(9), 95–102.
[21] Raghunath, V. (2024). Security Issues Analysis Based on Big Data in Cloud Computing. World Journal of Advanced Research and Reviews, 23(3), 2549–2557.
[22] Zhong, R.Y., et al. (2016). Big Data for Supply Chain Management in the Service and Manufacturing Sectors: Challenges, Opportunities, and Future Perspectives. Computers & Industrial Engineering, 101, 572–591.
[23] Deng, X., et al. (2019). Geospatial Big Data: New Paradigm of Remote Sensing Applications. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 12(10), 3841–3851.
[24] Zanoon, N., Al-Haj, A., & Khwaldeh, S.M. (2017). Cloud Computing and Big Data: Is There a Relation Between the Two? A Study. International Journal of Applied Engineering Research, 12(17), 6970–6982.
[25] Zanoon, N., Al-Haj, A., & Khwaldeh, S.M. (2017). Cloud Computing and Big Data: Is There a Relation Between the Two? A Study. International Journal of Applied Engineering Research, 12(17), 6970–6982.
[26] Raghunath, V. (2024). Analysis on Addressing the Threats to Cloud Computing on the Basis of Security Safeguards for SAP Cloud Services. World Journal of Advanced Research and Reviews, 23(3), 2539–2548.

[27] Zanoon, N., Al-Haj, A., & Khwaldeh, S.M. (2017). Cloud Computing and Big Data: Is There a Relation Between the Two? A Study. International Journal of Applied Engineering Research, 12(17), 6970–6982.
[28] Ali, M., & Essien, A. (2023). How Can Big Data Analytics Improve Outbound Logistics in the UK Retail Sector? A Qualitative Study. Journal of Enterprise Information Management.
[29] Raghunath, V. (2024). SAP S/4HANA Applications on Data Security and Protections for SAP Cloud Services. World Journal of Advanced Research and Reviews, 23(3), 2530–2538.
[30] Coandă, P., Avram, M., & Constantin, V. (2020). A State of the Art of Predictive Maintenance Techniques. IOP Conference Series: Materials Science and Engineering, 997(1).
[31] Aarabi, M., Saman, M.Z.M., Wong, K.Y., Azadnia, A.H., & Zakuan, N. (2012). A Comparative Study on Critical Success Factors (CSFs) of ERP Systems Implementation Among SMEs and Large Firms in Developing Countries. International Journal of Advancements in Computing Technology, 4(9), 226–239.
[32] Ahmad, M.M., & Cuenca, R.P. (2013). Critical Success Factors for ERP Implementation in SMEs. Robotics and Computer-Integrated Manufacturing, 29(3), 104–111.
[33] Akkermans, H., & van Helden, K. (2002). Vicious and Virtuous Cycles in ERP Implementation: A Case Study of Interrelations Between Critical Success Factors. European Journal of Information Systems, 11(1), 35–46.
[34] Allen, D., Kern, T., & Havenhand, M. (2002, January). ERP Critical Success Factors: An Exploration of the Contextual Factors in Public Sector Institutions. In Proceedings of the 35th Annual Hawaii International Conference on System Sciences (pp. 3062–3071). IEEE.
[35] Al-Mashari, M. (2002). Enterprise Resource Planning (ERP) Systems: A Research Agenda. Industrial Management & Data Systems, 102(3), 165–170.
[36] Alves, M.C.G., & Matos, S.I.A. (2011). An Investigation into the Use of ERP Systems in the Public Sector. Journal of Enterprise Resource Planning Studies, 2011, 1–5.
[37] Andersson, K., & Ericsson, K. (2008). Cultures' Impact on Incentive Programs: A Comparison Between Swedish and American Companies. Rapport Nr.: Ekonomistyrning, 07-08-131.
[38] Ayağ, Z., & Özdemir, R.G. (2007). An Intelligent Approach to ERP Software Selection Through Fuzzy ANP. International Journal of Production Research, 45(10), 2169–2194.
[39] Bannister, F. (2001). Dismantling the Silos: Extracting New Value from IT Investments in Public Administration. Information Systems Journal, 11(1), 65–84.
[40] Basu, R., & Biswas, D. (2013). An Approach to Identify Failure Factors of Enterprise Application Implementation in Indian Micro Enterprises. International Journal of Managing Value and Supply Chains, 4(1), 37.
[41] Bull, C. (2003). Strategic Issues in Customer Relationship Management (CRM) Implementation. Business Process Management Journal, 9(5), 592–602.
[42] Chang, B., Kuo, C., Wu, C.H., & Tzeng, G.H. (2015). Using Fuzzy Analytic Network Process to Assess the Risks in Enterprise Resource Planning System Implementation. Applied Soft Computing, 28, 196–207.
[43] Cyrus, K.M., & Nejad, A.V. (2011, August). The Influence of Dimensions of National Culture on CSFs of ERP Implementation: A Case Study. In 2011 2nd International Conference on Artificial Intelligence, Management Science and Electronic Commerce (AIMSEC) (pp. 4848–4851). IEEE.
[44] Dezdar, S., & Ainin, S. (2012). Examining Successful ERP Projects in Middle-East and South-East Asia. American Journal of Scientific Research, 56(3), 13–56.
[45] Donaldson, L. (2001). The Contingency Theory of Organizations. Sage.
[46] Ebrahim, Z., & Irani, Z. (2005). E-Government Adoption: Architecture and Barriers. Business Process Management Journal, 11(5), 589–611.
[47] Gupta, A. (2000). Enterprise Resource Planning: The Emerging Organizational Value Systems. Industrial Management & Data Systems, 100(3), 114–118.
[48] Hawking, P., & Sellitto, C. (2010). Business Intelligence (BI) Critical Success Factors.
[49] Huang, Z., & Palvia, P. (2001). ERP Implementation Issues in Advanced and Developing

Countries. Business Process Management Journal, 7(3), 276–284.
[50] Hung, S.Y., Hung, W.H., Tsai, C.A., & Jiang, S.C. (2010). Critical Factors of Hospital Adoption on CRM System: Organizational and Information System Perspectives. Decision Support Systems, 48(4), 592–603.
[51] Hurbean, L. (2008). Issues with Implementing ERP in the Public Administration.
[52] Kim, H.W., Lee, G.H., & Pan, S. (2002). Exploring the Critical Success Factors for Customer Relationship Management and Electronic Customer Relationship Management Systems.
[53] Kurnia, S., Linden, T., & Huang, G. (2019). A Hermeneutic Analysis of Critical Success Factors for Enterprise Systems Implementation by SMEs. Enterprise Information Systems, 13(9), 1195–1216.
[54] Leu, J.D., & Lee, L.J.H. (2017). Enterprise Resource Planning (ERP) Implementation Using the Value Engineering Methodology and Six Sigma Tools. Enterprise Information Systems, 11(8), 1243–1261.
[55] Leyh, C. (2014, September). Critical Success Factors for ERP Projects in Small and Medium-Sized Enterprises: The Perspective of Selected German SMEs. In 2014 Federated Conference on Computer Science and Information Systems (pp. 1181–1190). IEEE.
[56] Reel, J.S. (1999). Critical Success Factors in Software Projects. IEEE Software, 16(3), 18–23.
[57] Remus, U., & Wiener, M. (2010). A Multi-Method, Holistic Strategy for Researching Critical Success Factors in IT Projects. Information Systems Journal, 20(1), 25–52.
[58] Salmeron, J.L., & Lopez, C. (2011). Forecasting Risk Impact on ERP Maintenance with Augmented Fuzzy Cognitive Maps. IEEE Transactions on Software Engineering, 38(2), 439–452.
[59] Shaul, L., & Tauber, D. (2013). Critical Success Factors in Enterprise Resource Planning Systems: Review of the Last Decade. ACM Computing Surveys (CSUR), 45(4), 1–39.
[60] Shehab, E.M., Sharp, M.W., Supramaniam, L., & Spedding, T.A. (2004). Enterprise Resource Planning: An Integrative Review. Business Process Management Journal, 10(4), 359–386.
[61] Somers, T.M., & Nelson, K. (2001, January). The Impact of Critical Success Factors Across the Stages of Enterprise Resource Planning Implementations. Proceedings of the 34th Annual Hawaii International Conference on System Sciences (pp. 10–pp). IEEE.
[62] Sumner, M. (1999, April). Critical Success Factors in Enterprise-Wide Information Management Systems Projects. Proceedings of the 1999 ACM SIGCPR Conference on Computer Personnel Research (pp. 297–303).
[63] Sumner, M. (2000, April). Risk Factors in Enterprise-Wide Information Management Systems Projects. Proceedings of the 2000 ACM SIGCPR Conference on Computer Personnel Research (pp. 180–187).
[64] Sun, H., Ni, W., & Lam, R. (2015). A Step-by-Step Performance Assessment and Improvement Method for ERP Implementation: Action Case Studies in Chinese Companies. Computers in Industry, 68, 40–52.
[65] Tobie, A.M., Etoundi, R.A., & Zoa, J. (2016). A Literature Review of ERP Implementation in African Countries. The Electronic Journal of Information Systems in Developing Countries, 76(1), 1–20.
[66] Trąbka, J., & Soja, P. (2013). ERP in Project-Driven Organizations: A Case Study from the IT Industry in Poland. Information Systems: Development, Learning, Security: 6th SIGSAND/PLAIS EuroSymposium (pp. 27–38). Springer Berlin Heidelberg.
[67] Urquhart, C., Lehmann, H., & Myers, M.D. (2010). Putting the 'Theory' Back into Grounded Theory: Guidelines for Grounded Theory Studies in Information Systems. Information Systems Journal, 20(4), 357–381.
[68] Bansal, V. (2013). Identifying Critical Success Factors for ERP in SMEs Through a Case Study. International Journal of Future Computer and Communication, 2(5), 471.
[69] Velcu, O. (2007). Exploring the Effects of ERP Systems on Organizational Performance: Evidence from Finnish Companies. Industrial Management & Data Systems, 107(9), 1316–1334.
[70] Venkatesh, V., Brown, S.A., & Bala, H. (2013). Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems. MIS Quarterly, 21–54.
[71] Da Silva, R.V., & Rahimi, I. (2007). A Critical Success Factor Model for CRM Implementation.

International Journal of Electronic Customer Relationship Management, 1(1), 3–15.
[72] Weill, P., & Olson, M.H. (1989). An Assessment of the Contingency Theory of Management Information Systems. Journal of Management Information Systems, 6(1), 59–86.
[73] Wong, K.Y. (2005). Critical Success Factors for Implementing Knowledge Management in Small and Medium Enterprises. Industrial Management & Data Systems, 105(3), 261–279.
[74] Yeoh, W., & Koronios, A. (2010). Critical Success Factors for Business Intelligence Systems. Journal of Computer Information Systems, 50(3), 23–32.
[75] Ziemba, E., & Kolasa, I. (2015, September). Risk Factors Framework for Information Systems Projects in Public Organizations: Insight from Poland. 2015 Federated Conference on Computer Science and Information Systems (FedCSIS) (pp. 1575–1583). IEEE.
[76] Kunkulagunta, M. (2024). ERP Based on Machine Learning for SAP HANA Analytics.
[77] Kunkulagunta, M. (2024). Automated Device for Data Anomaly Detection in SAP HANA.
[78] Kunkulagunta, M. (2024). Study on Connection Between ERP and Artificial Intelligence Through the Application of ML Techniques in ERP Industrial Processes. Processing, 3(2), 91–101.
[79] Kunkulagunta, M. (2024). Evolution of Integrated Management Information Systems on the ERP Process System. Processing, 2(1), 29–39.
[80] Kunkulagunta, M. (2024). Study of Internet of Things Applications Supporting Technologies That Are Used in the IT Sector. Processing, 1(2), 1–15.
[81] Kunkulagunta, M. (2024). Cloud Computing Applications for ERP Implementation. International Journal of Computer Engineering Technology (IJCET), 15(2).
[82] Kunkulagunta, M. (2024). Role of Machine Learning, Data Mining, and Analytics. International Journal of Computer Engineering Technology (IJCET), 15(2).
[83] Kunkulagunta, M. (2024). Studying of Exploring Based on Impacts of Artificial Intelligence & Machine Learning on Enterprise Resource Planning. International Journal of Artificial Intelligence & Machine Learning (IJAIML).
[84] Kunkulagunta, M. (2024). IoT-Based Enterprise Resource Planning: Challenges, Open Issues, Applications, and Architecture Analysis. International Journal of Artificial Intelligence & Machine Learning (IJAIML).
[85] Kunkulagunta, M. (2024). An Analysis of Adoption Factors and Attitudes Based on Cloud-Based ERP Systems. International Journal of Data Analysis Research & Development (IJDARD), 2.
[86] Kunkulagunta, M. (2024). A Self-Organized Multi-Agent System with Industry 4.0 Coordination and Big Data-Based Feedback. International Journal of Data Analysis Research & Development (IJDARD), 2.
[87] Kunkulagunta, M. (2024). New Rains Research Excellence Award 2024. New Rains.
[88] Kunkulagunta, M. (2024). Analysis on Multi-Dimensional Model of Enterprise Resource Planning Critical Success Factors. International Journal of System Design Information Processing (IJSDIP), 12(2), 149–160.
[89] Raghunath, V. (2024). Predictive Analytics on SAP Database (HANA) by Using Artificial Intelligence (AI) and Automated Machine Learning Capabilities. International Journal of Computer Engineering Technology (IJCET), 15(3), 65–78.
[90] Raghunath, V. (2024). Investigating the Adaptive Supply Chain Module for the Integration of Google Cloud and SAP HANA Technologies. European Journal of Advanced Engineering Technology, 11(9), 103–110.