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Analyzing Challenges in Enterprise Resource Planning (ERP) Implementation in a Safety Inspection Company: An IVT2IF DEMATEL Approach

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Abstract

Implementing Enterprise Resource Planning (ERP) systems is crucial for modern businesses, offering integrated solutions that streamline operations and enhance decision-making. However, in specialized sectors such as safety inspection within the Readymade Garment (RMG) industry, ERP implementation presents unique challenges due to the complexity and scope of operations. This research addresses the critical need to understand and systematically address these challenges, particularly in a safety inspection company focused on fire, electrical, structural, and boiler safety. Despite extensive research on ERP implementation in various industries, there is a significant gap in understanding the specific challenges faced by safety inspection companies in the RMG sector. To fill this gap, this study employs the Interval-Valued Type-2 Intuitionistic Fuzzy (IVT2IF) Decision-Making Trial And Evaluation Laboratory (DEMATEL) method to identify, rank, and analyze the interrelationships between ERP implementation challenges. The research identifies fifteen major obstacles, including "Vendor Selection and Management" (D+R = 11.347, D-R = -1.223), "Data Migration" (D+R = 10.194, D-R = -1.891), and "Customization Requirements" (D+R = 11.137, D-R = -0.458). The results highlight "Change Management" (D+R = 8.866, D-R = 1.772) and "Scalability and Future-Proofing" (D+R = 7.370, D-R = 1.753) as the primary causal factors influencing the implementation process. In contrast, "Data Migration" and "Compliance and Security" are significant effect challenges, dependent on successfully managing other factors. By understanding the causal relationships between challenges, companies can prioritize their efforts in key areas to mitigate the most impactful risks during ERP implementation. This approach not only enhances the efficiency and effectiveness of ERP systems but also ensures regulatory compliance and improved decision-making, ultimately contributing to safer working environments in the garment industry.

Keywords: Enterprise resource planning, Readymade garment, Safety inspection, Decision making trial and evaluation laboratory, Interval-valued type-2 intuitionistic fuzzy.

1 | Introduction

Enterprise Resource Planning (ERP) is a software system that integrates various business processes and functions into a single, cohesive system, streamlining operations and improving the flow of information within an organization [1]. By covering areas such as finance, human resources, supply chain management,

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and production, ERP systems enhance efficiency by automating and integrating core business processes, reducing manual effort and errors. This data centralization ensures accuracy and consistency, providing a single source of truth that enhances decision-making capabilities.

Additionally, ERP systems help reduce costs by streamlining operations and improving resource management, leading to significant savings [2]. They also offer scalability, supporting business growth by adapting to changing needs without requiring multiple systems. Furthermore, ERP systems facilitate regulatory compliance and simplify reporting through standardized processes and data management, making them essential for modern businesses aiming to remain competitive and efficient.

Our research focuses on ERP implementation in a company that specializes in conducting safety inspections specifically for the Readymade Garment (RMG) industry, focusing on key areas such as fire safety, electrical safety, structural safety, and boiler safety. Additionally, the company monitors remediation programs and assigns safety ratings, ensuring that garment factories meet the required safety standards. Beyond inspections, the company also enhances worker safety through regular safety training programs. This combination of thorough inspections and proactive training highlights the company's dedication to creating a safe working environment in the RMG industry, which is crucial for protecting workers and maintaining the industry's reputation.

Implementing an ERP system in this company is of paramount importance due to the multifaceted nature of its operations. An ERP system will integrate all the critical functions, from inspection scheduling and data collection to remediation monitoring and training management, into a single unified platform. This integration will significantly enhance operational efficiency by automating routine tasks, reducing manual errors, and ensuring that all data is consistently updated and accessible across departments. Furthermore, the ERP system will facilitate better decision-making by providing real-time insights and comprehensive reports on safety compliance and training effectiveness. This centralized data management will also streamline regulatory reporting and improve stakeholder transparency.

However, implementing an ERP system can be challenging for the company due to the complexity and scope of its operations, which involve various safety inspections and training programs. Integrating these diverse functions into a single system requires careful planning, customization, and data migration [2]. Additionally, the company must ensure that employees are adequately trained to use the new system, which can be time-consuming and resource-intensive. Resistance to change and the need for continuous support and maintenance further complicate the implementation process, making it a demanding yet essential endeavor for improving overall efficiency and data management.

Amid this situation, several research questions (RQ) arise:

RQ1. What are the major challenges of ERP implementation in a safety inspection company?

RQ2. How are these challenges ranked so that they can be addressed sequentially?

RQ3. How are these challenges interconnected and influencing each other?

Several studies previously addressed various ERP implementation techniques, performance enhancement, and challenges in different types of companies and work areas. For example, Kulikov et al. [3] explored the challenges and prospects of ERP implementation in the agricultural sector. They identified key barriers such as a lack of skilled personnel, insufficient knowledge among top managers, funding shortages, and inadequate infrastructure. Despite these challenges, ERP systems can significantly enhance business performance, cost management, and agricultural decision-making, with the findings useful for government programs aimed at the industry's innovative development and technical upgrading.

Malik and Khan [4] developed a strategy to overcome ERP implementation failures in developing countries. Key success factors identified include top management commitment, project management, change management, and business process reengineering, while training and vendor management were found to be less significant.

Christiansen et al. [5] reviewed the adoption of cloud ERP systems in SMEs and large enterprises using the Diffusion of Innovation (DOI) and Technology, Organization, and Environment (TOE) frameworks, identifying 13 key influencing factors. These factors include innovation characteristics like perceived relative advantage, compatibility, and complexity, along with technological, organizational, and environmental factors such as system quality, security, financial advantage, and competitive pressures.

With a descriptive study, Pandey et al. [6] determined how ERP systems can enhance business operations. They identified the issues and challenges related to their implementation, providing recommendations to address them.

Pandey and Kumar [7] emphasized the importance of ERP implementation for sustaining Small and Medium-sized Enterprises (SMEs). They highlighted the challenges Indian SMEs face, such as the required structural changes and the difficulty in reaping ERP benefits, aiming to identify and prioritize these challenges for successful ERP adoption.

However, none of the previous studies have addressed the challenges of ERP implementation in a safety inspection company within the RMG industry. Therefore, this research aims to fill this gap by determining the following Research Objectives (RO):

RO1. Identify the major challenges of ERP implementation in a safety inspection company.

RO2. Systematically rank these challenges to address them sequentially in a competitive business environment with various resource constraints.

RO3. Determine the relationships between the challenges to understand their dynamics and support decision-making.

As empirical real data is not available for identifying and interrelating the challenges, we will rely on a literature review and an expert-opinion-based Multi-Criteria Decision-Making (MCDM) approach suitable for such situations [8]. Recent studies have used various MCDM techniques for ranking and analyzing variables in complex decision-making environments [9–11]. These studies prefer fuzzy numbers over crisp numbers because they can handle human decision ambiguity. We will utilize the Interval-Valued Type-2 Intuitionistic Fuzzy (IVT2IF) DEMATEL approach for our study. DEMATEL is chosen over other MCDM methods because it can directly rank and find correlations among factors without predefined ranking criteria [12]. Integrating DEMATEL with different variations of fuzzy numbers makes it more effective than other MCDM techniques [13].

The rest of the article is structured as follows. Section 2 presents a generalized ERP implementation framework for a company or business; Section 3 conceptualizes the challenges of ERP implementation for a safety inspection company; Section 4 describes the methodology; Section 5 discusses the obtained results and implications; and Section 6 concludes the paper, highlighting unique findings, limitations, and future research scopes.

2 | Generalized ERP Implementation Framework for Businesses

Previous studies have provided frameworks for ERP implementation in different types of businesses [1–3]. Based on these studies, we can generalize an ERP implementation framework.

The ERP implementation process begins with a thorough needs assessment, in which interviews are conducted, current processes are analyzed, and specific requirements are defined. This is followed by vendor selection, involving researching potential vendors, requesting proposals, conducting demos, and evaluating bids to find the best fit for the company's needs. Project planning comes next, defining the scope, setting timelines, allocating resources, and establishing milestones to ensure a structured approach.

System design is then undertaken, where modules are configured, workflows are designed, and user roles are set up to meet the company's specific requirements. Data migration planning involves mapping, cleaning,

preparing, and developing a comprehensive migration strategy. The system configuration phase includes installing the software, configuring necessary settings, and customizing reports to suit the company's operations.

Data migration is executed, focusing on validating data accuracy and resolving any issues. Integration with existing systems is crucial, requiring the development of integration protocols, rigorous testing, and troubleshooting to ensure seamless operation. User training is conducted by developing training materials, training sessions, and ongoing support to ensure employees are well-equipped to use the new system.

The testing phase involves conducting unit tests, performing integration tests, and executing user acceptance tests to ensure the system functions correctly. Go-live preparation includes finalizing configurations, conducting final training sessions, and communicating the go-live plan to all stakeholders. During the go-live phase, system performance is closely monitored, immediate support is provided, and any issues are promptly addressed.

Post-implementation support ensures ongoing system monitoring, issue resolution, and additional training as needed. Evaluation and feedback are critical for continuous improvement, involving reviews, collecting user feedback, and identifying areas for enhancement. Finally, continuous improvement is pursued by implementing updates, optimizing processes, and expanding functionalities to ensure the ERP system remains effective and efficient in meeting the company's evolving needs.

A summarized flow diagram is depicted in *Fig. 1*, detailing specific steps, step descriptions, and the responsible parties or people in the organizational organogram. The diagram is prepared following the 5 key steps of the project life cycle: initiation, planning, execution, monitoring and controlling, and closing.

3 | Conceptualizing ERP Implementation Challenges for a Safety Inspection Company

Our study focuses on a safety inspection company that conducts safety inspections for RMG factories, focusing on four critical areas: fire safety, electrical safety, structural safety, and boiler safety. It is funded by a coalition of international apparel brands, international labor unions, and factory owners' associations. As the company prepares to implement an ERP system for the first time, it faces several unique challenges that must be addressed to ensure a successful implementation.

One of the primary challenges is the need for customization [14]. The ERP system must be tailored to meet the specific requirements of safety inspections across multiple departments. This involves developing custom modules and integrating the ERP system with existing inspection tools. Without adequate customization, the system may not effectively support the unique operational needs of the company.

Data migration presents another significant hurdle [15]. Migrating historical data from current systems to the new ERP system is complex and requires meticulous attention to ensure data accuracy and integrity. Any errors during this process could lead to operational disruptions and affect the system's reliability. Ensuring a smooth data transition is crucial for maintaining continuous and effective operations.

User training and adoption are also critical areas of concern [16]. Employees accustomed to manual processes or different software may find adapting to the new ERP system challenging. Comprehensive training programs and ongoing support are necessary to facilitate smooth adoption and ensure all users are comfortable and proficient with the new system. Without proper training, the full potential of the ERP system may not be realized.

Integration with existing systems is another major challenge [3]. The ERP system must seamlessly integrate with other tools and software for inspections, reporting, and financial management. Ensuring that the new system works harmoniously with existing technologies is essential to prevent data silos and operational inefficiencies.

Compliance and security are paramount, particularly given the sensitive nature of safety inspection data. The ERP system must comply with international safety standards and data security regulations, ensuring the secure handling of all information [17]. Any breaches or non-compliance could have severe implications for the company.

Effective change management is crucial as implementing an ERP system represents a significant organizational change [15]. Strategies for managing this change, including communication, training, and support, are essential to address resistance and ensure a smooth transition. Engaging stakeholders and demonstrating the new system's benefits can help overcome resistance.

Vendor selection and management also play a critical role. Choosing the right ERP vendor who understands the company's specific needs and provides reliable support is vital [18]. Managing the relationship with the vendor throughout the implementation process is equally important to ensure the timely and effective delivery of services.

Cost and resource allocation are significant considerations. Proper budgeting and resource allocation are necessary to avoid cost overruns and ensure the project is adequately funded and staffed. Efficient management of financial and human resources will be crucial for the project's success [6].

Workflow reengineering is often required to align existing processes with the new ERP system [19]. This requires a thorough understanding of current workflows and the ability to redesign them to fit within the ERP framework. Reengineering workflows can lead to more efficient and effective operations.

The ERP system must also be scalable and future-proof. It should be capable of accommodating future growth and changes within the organization, ensuring it remains relevant and effective over time. Planning for scalability and future needs is essential for the system's long-term success [20].

Maintaining data accuracy and integrity throughout implementation is critical to ensure reliable operations and reporting. Any compromises in data quality can affect decision-making and operational efficiency. Robust data management practices are necessary to uphold data standards [20].

The system's robust reporting and analytics capabilities must generate valuable insights and support decision-making [21]. Analyzing data effectively can significantly enhance the company's operations and strategic planning.

Minimizing system downtime during implementation is crucial to avoid disrupting critical activities [22]. Effective planning and execution can help maintain continuous operations and reduce the impact of any necessary downtime.

Post-implementation support is essential to address issues, provide additional training, and make necessary adjustments after the system goes live [23]. Ongoing support ensures that the system meets the company's needs and adapts to any changes.

Resistance to change is a common challenge in ERP implementations [24]. Addressing this through effective communication, involving key stakeholders, and demonstrating the new system's benefits is essential. Overcoming resistance can facilitate a smoother transition and more successful implementation.

Based on the above discussion, several critical challenges to implementing ERP in an organization are mentioned in the existing literature, especially when focusing on a safety inspection company. For our research, we searched renowned databases such as Scopus, DOAJ, Web of Science, ScienceDirect, and Google Scholar to find relevant literature on ERP implementation challenges. By examining the most relevant and closely related studies published between 2015 and 2024, we identified 15 challenges for ERP implementation in a safety inspection company. These challenges are listed in *Table 1*, along with their source papers.

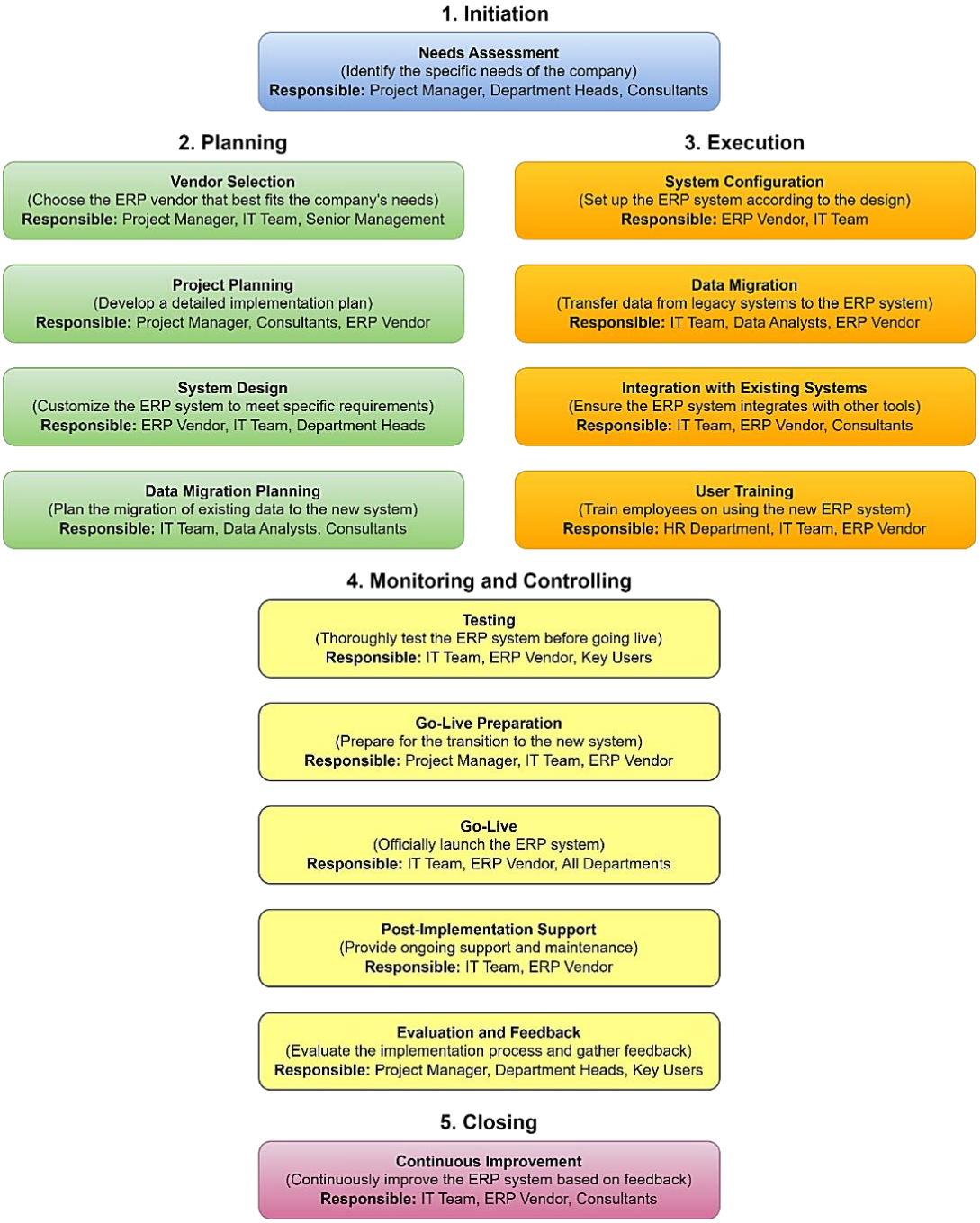

Fig. 1. Flow diagram of ERP implementation.

Table 1. ERP implementation challenges for a safety inspection company.

Code	Challenges	Source
C1	System downtime during implementation	[22]
C2	Data accuracy and integrity	[20]
C3	Vendor selection and management	[18]
C4	Compliance and security	[17]
C5	Resistance to change	[24]
C6	User training and adoption	[16]
C7	Post-implementation support	[23]
C8	Data migration	[15]
C9	Scalability and future-proofing	[20]
C10	Customization requirements	[14]
C11	Workflow reengineering	[19]
C12	Cost and resource allocation	[6]
C13	Change management	[15]
C14	Reporting and analytics	[21]
C15	Integration with existing systems	[3]

4 | Theoretical and Methodological Approach

4.1 | Data Collection

The paper draws on a literature review and qualitative interviews conducted with business leaders, ERP consultants, and project managers who have implemented ERP systems in their organizations. The experts were selected purposively based on their experience and willingness to participate in this study. Such selection is important when conducting a study with limited data, as expertise is mandatory to effectively participate in the semi-structured interview questionnaire [25], [26]. The profiles of the 9 experts are depicted in *Table 2*.

Table 2. Profiles of the experts interviewed.

Designation	Year of Experience
Chief operating officer (E1)	22
Head of operations (E2)	17
General manager- procurement (E3)	13
General manager- production (E4)	12
Manager- maintenance (E5)	13
General manager- export (E6)	11
ERP consultant 1 (E7)	8
ERP consultant 2 (E8)	9
Project manager (E9)	10

The experts evaluated each challenge using a linguistic scale, as shown in *Table 3*, which was taken from the study by Debnath et al. [27]. For example, the questions included, "How much influence does challenge 1 (C1) have over challenge 2 (C2)?" After gathering responses from all 9 experts, the collected data on the linguistic scale was converted to numeric values according to *Table 3*. Subsequently, the Interval-Valued Type 2 Intuitionistic Fuzzy (IVT2IF) DEMATEL method was applied to analyze the gathered data for our study.

Table 3. Linguistic scale for evaluating the influence between challenges.

Linguistic	IVT2IF
No	([0.060, 0.260], [0.700, 0.900])
Very low	([0.220, 0.420], [0.540, 0.740])
Low	([0.380, 0.580], [0.380, 0.580])
High	([0.540, 0.740], [0.220, 0.200])
Very high	([0.700, 0.900], [0.060, 0.260])

4.2 | IVT2IF Theory

The Fuzzy Set Theory (FST) was developed to address vagueness and uncertainty in information analysis [11]. While Type-1 fuzzy systems have a fixed membership function, Type-2 fuzzy systems feature a fluctuating membership function [27]. Although all fuzzy numbers indicate a single membership grade, they provide a precise value within the interval [0,1]. However, Type-2 fuzzy numbers can capture degrees of uncertainty that Type-1 fuzzy numbers cannot. This additional dimension gives Type-2 fuzzy numbers more flexibility to better represent uncertainty compared to Type-1 fuzzy sets.

Suppose we have a finite, non-empty set M. W is a standard fuzzy set where each element m in M has a membership function αw(m) that assigns a value between 0 and 1, indicating the degree of membership. Based on this, a fuzzy relation is,

$$R = \{m, \alpha w(m) : m \in M, \alpha w(m) \in [0,1]\}. \quad (1)$$

Let $\tilde{P}i = ([\alpha i-, \alpha i+], [\beta i-, \beta i+])$ (here, i=1, 2, …, n) is a set of Interval-Valued Type 2 Intuitionistic Fuzzy Numbers (IVT2IFNs). The weight vector w= (w1, w2, …, wn) is associated with $\tilde{P}i$ where, $\sum_{i=1}^{n} wi=1$. The Interval-Valued Type 2 Intuitionistic Fuzzy Weighted Geometric (IVT2IFWG) operator is defined as,

$$IVT2IFWG(\tilde{P}1, \tilde{P}2, \dots, \tilde{P}n) = ([\prod_{i=1}^{n} (\alpha_i^-) wi, \prod_{i=1}^{n} (\alpha_i^+) wi], [\prod_{i=1}^{n} (\beta_i^-) wi, \prod_{i=1}^{n} (\beta_i^+) wi]). \quad (2)$$

The linguistic term is converted into a precise value using *Eq. (4)*, which involves the fuzzy numbers α and β. Here, αu and αL are the upper and lower values of the fuzzy number α, respectively. Similarly, βu and βL are the upper and lower values of the fuzzy number β. The resulting crisp value is calculated as follows,

$$P = \frac{\alpha L + \alpha u + \sqrt{1-\beta L^2} + \sqrt{1-\beta u^2}}{4} + \frac{\alpha L \alpha u - \sqrt{\sqrt{1-\beta L^2}\sqrt{1-\beta u^2}}}{4}. \quad (3)$$

4.3 | DEMATEL Method

The Decision-Making Trial and Evaluation Laboratory (DEMATEL) is a renowned method used to determine the ranking of multiple factors while simultaneously identifying the cause-effect relationships among those factors in a complex decision-making environment. The steps of DEMATEL are as follows [26], [27]:

I. Construct a Direct Relation Matrix (DRM) through pairwise comparisons of all factors based on each expert's opinion collected using a linguistic scale.

Mathematically, the matrix is as follows for the kth expert.

$$Z = [z_{ij}^k]. \quad (4)$$

II. Convert the linguistic scale-based DRM into a numeric scale (see *Table 3* for the conversion).

III. Aggregate all the experts' opinions and form an aggregated DRM.

IV. Normalize the aggregated DRM.

V. Construct a Total Relation Matrix (TRM).

The total-relation matrix (I) is as follows.

$$T = X \times (I - X)^{-1}. \quad (5)$$

Where I stand for the identity matrix.

VI. Determine prominence ranking and cause-effect relationship from the TRM.

$$D_i = \left[\sum_{j=1}^{n} T_{ij}\right], \text{for all i.} \quad (6)$$

$$R_j = \left[\sum_{i=1}^{n} T_{ij}\right], \text{for all j.} \quad (7)$$

$$\text{Prominence, } P_i = [D_i + R_j], \text{for all } i = j. \quad (8)$$

$$\text{Net effect, } E_i = [D_i - R_j], \text{for all } i = j. \quad (9)$$

4.4 | Calculations

A sample DRM from an expert is shown in *Table 4*.

Table 4. A sample DRM.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1	0	VL	L	L	N	N	N	H	N	L	N	N	N	N	VL
C2	N	0	L	VL	N	L	N	L	N	N	N	VL	N	N	N
C3	VL	VL	0	H	N	H	N	L	N	VL	L	H	L	N	N
C4	L	H	N	0	N	VL	N	VL	N	VL	N	N	N	N	VL
C5	L	N	H	N	0	N	N	N	N	H	N	N	N	N	L
C6	N	L	L	L	N	0	N	N	N	L	VL	N	L	N	L
C7	N	L	H	H	N	N	0	L	N	L	VL	L	N	N	VL
C8	N	N	VH	L	N	L	N	0	N	L	N	L	N	N	N
C9	L	VL	L	L	N	VL	N	VL	0	H	N	VL	N	N	L
C10	H	VH	H	H	N	H	N	L	N	0	N	L	N	N	VH
C11	N	N	L	N	N	L	N	L	N	VL	0	VL	L	N	H
C12	N	N	H	L	N	N	N	H	N	H	L	0	N	N	VL
C13	N	N	VL	L	N	H	N	H	N	L	L	L	0	H	L
C14	N	N	N	N	N	N	N	H	N	L	H	H	N	0	VL
C15	H	H	L	L	N	L	N	H	N	H	VL	N	N	N	0

The calculated TRM after completing all the steps is shown in *Table 5*.

Table 5. Total relation matrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
C1	0.200	0.278	0.361	0.328	0.162	0.272	0.162	0.368	0.162	0.336	0.233	0.263	0.196	0.174	0.285
C2	0.213	0.204	0.335	0.287	0.151	0.286	0.151	0.323	0.151	0.277	0.218	0.262	0.184	0.162	0.246
C3	0.299	0.333	0.368	0.412	0.197	0.388	0.197	0.423	0.197	0.389	0.327	0.380	0.279	0.214	0.332
C4	0.255	0.300	0.304	0.240	0.154	0.272	0.154	0.312	0.154	0.299	0.219	0.245	0.185	0.165	0.270
C5	0.282	0.271	0.396	0.304	0.137	0.283	0.169	0.328	0.169	0.370	0.246	0.276	0.205	0.181	0.319
C6	0.245	0.310	0.375	0.343	0.170	0.255	0.170	0.330	0.170	0.351	0.266	0.276	0.245	0.185	0.320
C7	0.259	0.325	0.418	0.382	0.180	0.303	0.147	0.385	0.180	0.370	0.279	0.331	0.219	0.193	0.316
C8	0.239	0.267	0.408	0.339	0.167	0.317	0.167	0.288	0.167	0.346	0.243	0.309	0.205	0.180	0.277
C9	0.299	0.311	0.401	0.364	0.181	0.322	0.181	0.370	0.148	0.394	0.262	0.312	0.219	0.194	0.339
C10	0.356	0.410	0.475	0.434	0.206	0.406	0.206	0.441	0.206	0.355	0.300	0.372	0.252	0.221	0.417
C11	0.246	0.274	0.381	0.310	0.172	0.327	0.172	0.369	0.172	0.339	0.218	0.298	0.248	0.187	0.342
C12	0.257	0.286	0.416	0.359	0.178	0.302	0.178	0.402	0.178	0.388	0.296	0.260	0.218	0.191	0.317
C13	0.295	0.330	0.437	0.408	0.205	0.403	0.205	0.461	0.205	0.426	0.342	0.377	0.219	0.279	0.384
C14	0.253	0.280	0.362	0.318	0.178	0.297	0.178	0.404	0.178	0.370	0.318	0.349	0.216	0.158	0.317
C15	0.330	0.363	0.420	0.381	0.189	0.357	0.189	0.424	0.189	0.408	0.291	0.308	0.231	0.203	0.283

5 | Results Discussion

5.1 | Results

According to this study, two separate rankings of the challenges were obtained, prominence ranking and cause-effect ranking. *Tables 6* and *7* consecutively show these two rankings from this study.

Table 6. Prominence ranking of the challenges.

Code	Factors	D+R	Prominence Ranking
C1	System downtime during implementation	8.293	11
C2	Data accuracy and integrity	8.491	10
C3	Vendor selection and management	11.347	1
C4	Compliance and security	9.271	7
C5	Resistance to change	7.015	15
C6	User training and adoption	9.348	6
C7	Post-implementation support	7.342	14
C8	Data migration	10.194	3
C9	Scalability and future-proofing	7.370	13
C10	Customization requirements	11.137	2
C11	Workflow reengineering	8.675	9
C12	Cost and resource allocation	9.469	5
C13	Change management	8.866	8
C14	Reporting and analytics	7.562	12
C15	Integration with existing systems	9.932	4

Table 7. Cause-effect ranking of the challenges.

Code	Factors	D-R	Causal Ranking	Cause/Effect
C1	System downtime during implementation	-0.288	8	Effect
C2	Data accuracy and integrity	-1.173	12	Effect
C3	Vendor selection and management	-1.223	13	Effect
C4	Compliance and security	-1.801	14	Effect
C5	Resistance to change	1.397	4	Cause
C6	User training and adoption	-0.851	11	Effect
C7	Post-implementation support	1.725	3	Cause
C8	Data migration	-1.891	15	Effect
C9	Scalability and future-proofing	1.753	2	Cause
C10	Customization requirements	-0.458	9	Effect
C11	Workflow reengineering	-0.092	6	Effect
C12	Cost and resource allocation	-0.485	10	Effect
C13	Change management	1.772	1	Cause
C14	Reporting and analytics	1.394	5	Cause
C15	Integration with existing systems	-0.282	7	Effect

5.2 | Discussion on Prominence Ranking

The results, as presented in *Table 6*, provide a prominence ranking of these challenges based on the D+R values, which reflect each factor's degree of influence and importance (see *Fig. 2*).

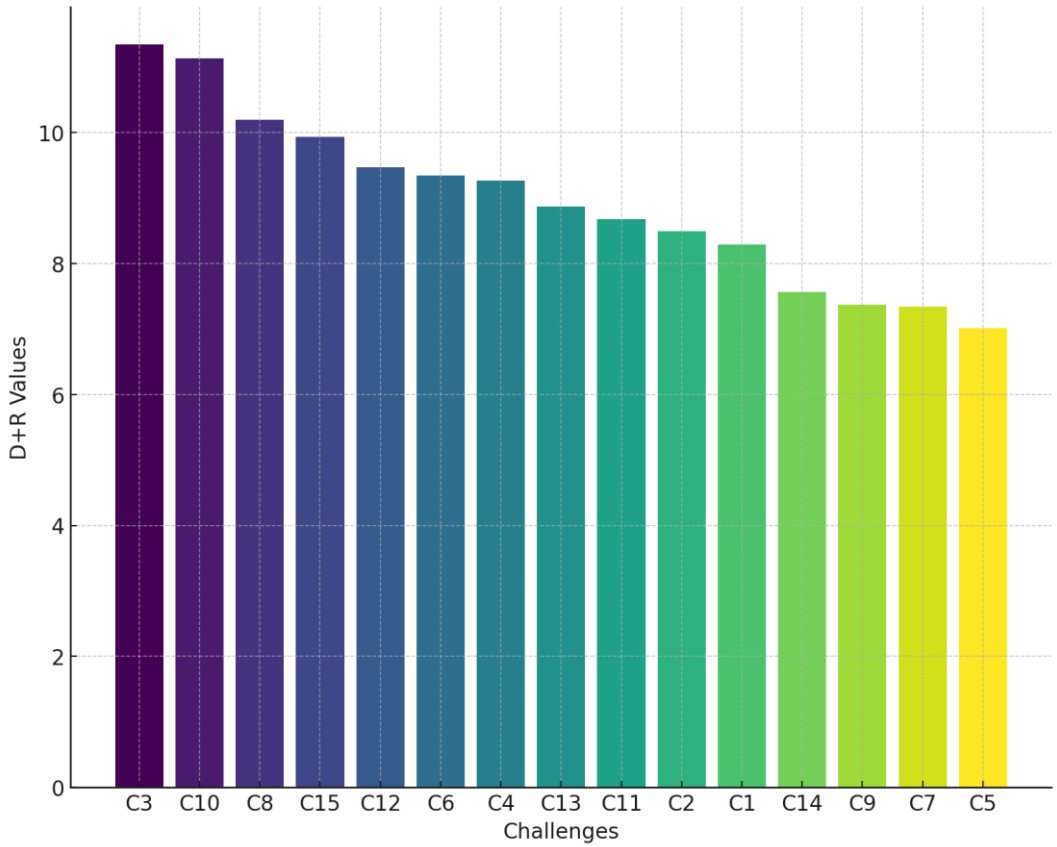

Fig. 2. Prominence ranking obtained from this study.

Top-ranked challenges

Vendor selection and management (C3) stands as the most critical challenge, with a D+R value of 11.347. This ranking is well justified given that the vendor choice is foundational in the entire ERP implementation process. A vendor must not only understand the specific operational needs of a safety inspection company but also provide ongoing support and customization. Poor vendor selection can lead to cascading failures across multiple project areas, from inadequate customization to poor integration and support, ultimately jeopardizing the success of the ERP implementation.

Customization requirements (C10) ranks second with a D+R value of 11.137. Given the specialized nature of the company's operations—focusing on fire safety, electrical safety, structural safety, and boiler safety—the ERP system must be tailored to these needs. Early and accurate customization is crucial to ensure that the ERP system effectively supports all critical business functions. This high ranking underscores the importance of addressing customization from the outset to prevent disruptions and inefficiencies later in the implementation process.

Data migration (C8), with a D+R value of 10.194, is the third most significant challenge. Data migration is a critical step that involves transferring historical data from legacy systems to the new ERP system. The accuracy and integrity of this data transfer are paramount, as any errors can have far-reaching consequences, affecting everything from operational efficiency to strategic decision-making. The prominence of this challenge highlights the need for meticulous planning and execution during the data migration phase.

Mid-ranked challenges

Integration with existing systems (C15) ranks fourth with a D+R value 9.932. Seamless integration ensures the new ERP system works harmoniously with existing tools and processes. This challenge is particularly relevant in a safety inspection company, where specialized systems may already be used. The relatively high ranking reflects the importance of addressing integration early in the implementation process to avoid operational disruptions.

Cost and resource allocation (C12), with a D+R value of 9.469, is another significant challenge, ranked fifth. Proper budgeting and resource allocation are essential to avoid cost overruns and ensure the project has sufficient resources. The prominence of this challenge indicates that financial and human resource management is crucial for maintaining the momentum and success of the ERP implementation.

User training and adoption (C6), ranked sixth with a D+R value of 9.348, emphasizes the importance of preparing the workforce for the new ERP system. Effective user training ensures employees are comfortable and proficient with the new system, reducing resistance and minimizing errors. This challenge's prominence reflects the critical role of training in successfully adopting the ERP system.

Compliance and security (C4) is ranked seventh with a D+R value of 9.271. Compliance with regulatory standards and ensuring data security are vital, particularly in a company dealing with sensitive safety inspection data. The prominence of this challenge highlights the need for the ERP system to adhere to strict security protocols and regulatory requirements, ensuring the protection of critical data and avoiding legal issues.

Lower-ranked challenges

Change management (C13) ranks eighth with a D+R value of 8.866. Effective change management addresses resistance to the new system and ensures a smooth transition. This includes clear communication, ongoing support, and the involvement of key stakeholders throughout the implementation process. The ranking of this challenge indicates its importance but suggests that it is less critical compared to vendor selection, customization, and data migration.

Workflow reengineering (C11), ranked ninth with a D+R value of 8.675, involves redesigning existing workflows to align with the new ERP system. While this is an important implementation aspect, the ranking

suggests it is a secondary concern relative to the more immediate challenges of customization and data migration.

Data accuracy and integrity (C2), with a D+R value of 8.491, is ranked tenth. Maintaining accurate and reliable data is essential for the smooth operation of the ERP system. Although critical, the lower ranking indicates it is somewhat less pressing than the challenges ranked higher on the list.

System downtime during implementation (C1), ranked eleventh with a D+R value of 8.293, underscores the need to minimize disruptions during the transition to the new system. While important, this challenge is ranked lower, suggesting that while downtime must be managed, it is less of a concern compared to the foundational challenges like vendor selection and data migration.

Reporting and analytics (C14), ranked twelfth with a D+R value of 7.562, highlights the importance of setting up effective reporting and analytics capabilities in the ERP system. Although this is essential for generating insights and supporting decision-making, it is considered less critical compared to the immediate operational challenges.

Scalability and future-proofing (C9), with a D+R value of 7.370, is ranked thirteenth. Ensuring that the ERP system can scale and adapt to future needs is important for long-term success, but it is considered a less immediate concern during the initial implementation phases.

Post-implementation support (C7), ranked fourteenth with a D+R value of 7.342, is crucial for addressing any issues that arise after the system goes live. However, its lower ranking indicates that while necessary, it is less critical during the initial implementation compared to challenges like vendor selection and customization.

Resistance to change (C5), ranked fifteenth with a D+R value of 7.015, reflects a common challenge in ERP implementations. The low ranking suggests that, with effective change management strategies, resistance to change can be managed effectively, making it less of a priority compared to other challenges.

The prominence ranking of challenges in the ERP implementation process for a safety inspection company highlights the critical areas that require attention to ensure a successful project. Vendor selection and management, customization requirements, and data migration are identified as the most pressing challenges, underscoring the importance of careful planning, resource allocation, and strategic decision-making in these areas. By addressing these challenges in order of prominence, the company can effectively navigate the complexities of ERP implementation and achieve its desired outcomes.

5.3 | Discussion on Cause-Effect Ranking

In analyzing ERP implementation challenges within a safety inspection company (see *Table 7*), the cause-effect ranking provides insight into the underlying dynamics between various challenges. The D-R (difference between the degrees of influence and the degrees of dependence) values help identify whether a challenge acts as a cause, driving other challenges, or as an effect resulting from other challenges (see *Fig. 3*).

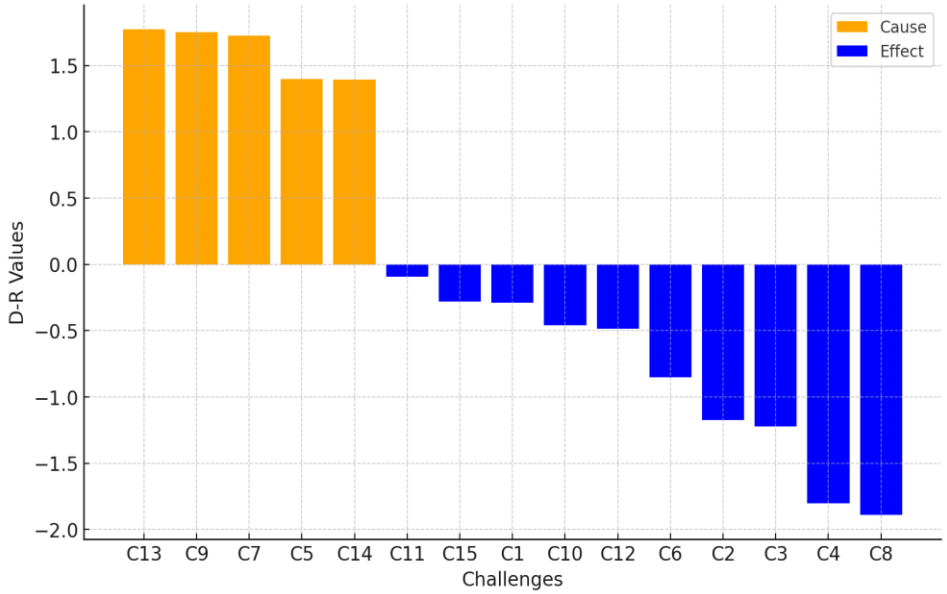

Fig. 3. Cause-effect ranking.

Causes: the driving challenges

Change management (C13), with the highest D-R value of 1.772, is identified as the most significant cause in this study. Change management is critical in ERP implementation because it directly influences how the organization adapts to new systems and processes. Effective change management can mitigate resistance, encourage user adoption, and ensure a smooth transition to the new ERP system. The high causal ranking indicates that poor change management can lead to multiple downstream effects, including resistance to change (C5), challenges in user training and adoption (C6), and even issues in system downtime (C1).

Scalability and future-proofing (C9), with a D-R value of 1.753, is another key cause. This factor represents the organization's ability to scale the ERP system to meet future needs and challenges. When not adequately addressed, scalability can lead to long-term operational inefficiencies and increased costs. Moreover, failing to future-proof the system can create a ripple effect, where customization requirements (C10) and integration with existing systems (C15) become more complex and challenging.

Post-implementation support (C7), ranked third with a D-R value of 1.725, is also a significant cause. Adequate support following the implementation phase is crucial to address issues that arise as the system is put into real-world use. Lack of support can exacerbate challenges such as system downtime (C1) and data accuracy and integrity (C2), as unresolved issues can lead to operational disruptions and decreased trust in the system.

Resistance to change (C5) and reporting and analytics (C14), with D-R values of 1.397 and 1.394 respectively, are additional causes. Resistance to change is a common hurdle in ERP implementations, often driven by fear of the unknown or discomfort with new technologies. This resistance can slow down user training and adoption (C6) and increase system downtime (C1). Meanwhile, the effectiveness of reporting and analytics is foundational for decision-making processes. If reporting systems are poorly implemented or not user-friendly, it can impact the broader utility of the ERP system, leading to further customization needs (C10) and workflow reengineering (C11).

Effects: the resulting challenges

Data migration (C8), with the lowest D-R value of -1.891, is identified as a significant effect. Data migration is highly dependent on other factors, particularly the quality of pre-implementation planning, change management, and the success of vendor selection (C3). If these causal factors are not managed effectively, data migration can become error-prone, leading to inaccuracies and inefficiencies in the new system.

Compliance and security (C4) is another key effect, with a D-R value of -1.801. Compliance and security issues often arise from inadequate planning and poor change management. For instance, if the ERP system is not adequately future-proofed (C9), it may struggle to comply with evolving regulatory requirements, thereby compromising data security.

Vendor selection and management (C3) and data accuracy and integrity (C2), with D-R values of -1.223 and -1.173 respectively, are also considered effects. The effectiveness of vendor selection is influenced by the clarity of the organization's needs, which are often shaped by change management and scalability considerations. Similarly, data accuracy and integrity depend on successful migration (C8) and post-implementation support (C7).

Other challenges, such as system downtime during implementation (C1), user training and adoption (C6), customization requirements (C10), workflow reengineering (C11), and cost and resource allocation (C12), are also identified as effects. These challenges are the outcomes of how well the causal factors are managed. For example, insufficient post-implementation support (C7) or ineffective change management (C13) can lead to extended system downtime (C1) or hinder the training and adoption process (C6).

Interactions between causes and effects

The relationship between causes and effects in this ranking highlights the importance of addressing root causes to mitigate the impact on effect challenges. For instance, robust change management (C13) and effective post-implementation support (C7) can significantly reduce resistance to change (C5) and ensure that the system operates smoothly with minimal downtime (C1). Similarly, focusing on scalability and future-proofing (C9) can alleviate long-term issues such as excessive customization needs (C10) and difficulties in system integration (C15). *Fig. 4* depicts all such relationships.

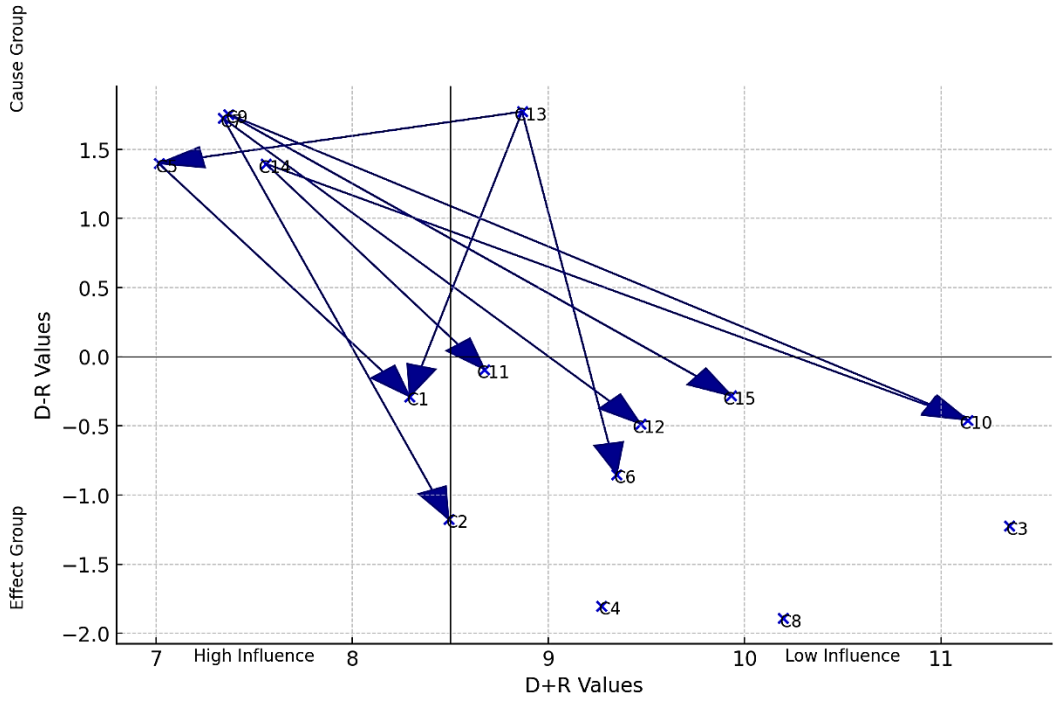

Fig. 4. Interrelationship between causes and effects.

Organizations can proactively manage the effects by addressing the causes identified in this study, leading to a more successful ERP implementation. This approach emphasizes the need for strategic planning, comprehensive change management, and robust post-implementation support to ensure that the ERP system meets the organization's current and future needs.

5.4 | Comparison with Existing Literature

The results of our study align with existing literature in highlighting the critical importance of factors such as "Vendor Selection and Management" and "Data Migration" in ERP implementation. Similar to the findings by Kulikov et al. [3], which identified the lack of skilled personnel and inadequate infrastructure as major challenges in the agricultural sector, our study underscores the complexities of vendor selection and data migration as central to successful ERP integration in safety inspection companies. Additionally, like Malik and Khan's [4] emphasis on top management commitment and project management as key to overcoming ERP implementation failures in developing countries, our research also identifies "Change Management" as a primary causal factor that drives the success of other implementation areas.

However, our study diverges from previous research by specifically focusing on the safety inspection sector within the RMG industry, an area that has not been extensively explored. Unlike Christiansen et al. [5], who reviewed ERP adoption in SMEs and large enterprises without a sector-specific focus, our research uniquely addresses the specialized challenges posed by safety inspections, such as compliance with safety standards and integration with remediation monitoring systems. This sector-specific focus not only fills a significant research gap but also introduces new insights into the dynamics of ERP implementation in a highly regulated and safety-critical environment, thereby contributing to the novelty of our findings.

5.5 | Managerial Implications

The findings of this study have significant implications for managers overseeing ERP implementation in safety inspection companies within the RMG industry. Understanding the causal relationships between key challenges such as "Change Management" and "Scalability and Future-Proofing" enables managers to prioritize their resources and efforts in these high-impact areas. By focusing on effective change management strategies, managers can mitigate resistance to change, ensure smoother transitions, and foster higher levels of user adoption. Additionally, emphasizing scalability and future-proofing during the ERP design phase can prevent costly reconfigurations and ensure that the system remains adaptable to evolving business needs.

Moreover, identifying "Data Migration" and "Compliance and Security" as critical effect challenges underscores the need for meticulous planning and execution in these areas. Managers must ensure that data migration processes are well-supported by vendor expertise and robust post-implementation support, as any errors can have far-reaching consequences on the system's reliability and compliance with safety regulations. By addressing these managerial implications, companies can not only enhance the efficiency and effectiveness of their ERP systems but also improve their overall operational safety and regulatory compliance, ultimately leading to better decision-making and safer working environments.

6 | Conclusion

This study was motivated by the critical need to understand and address the unique challenges of ERP implementation in safety inspection companies within the RMG industry. Given the multifaceted nature of such organizations, which handle essential functions like fire safety, electrical safety, structural safety, and boiler safety inspections, integrating these processes through an ERP system is paramount for improving operational efficiency, ensuring regulatory compliance, and enhancing overall decision-making. However, despite extensive research on ERP systems in various sectors, there was a notable gap in the literature regarding the specific challenges faced by safety inspection companies in the RMG industry.

The primary objectives of this research were to identify and systematically rank the major challenges of ERP implementation in a safety inspection company and to analyze the interrelationships between these challenges to provide actionable insights for managers. These objectives were addressed using a robust methodological approach involving the IVT2IF DEMATEL method, which is well-suited for handling the complexities of decision-making in this context.

Key findings from the study include the identification of "Vendor Selection and Management", "Customization Requirements", and "Data Migration" as the top challenges based on prominence ranking. The cause-effect analysis further revealed that "Change Management", "Scalability and Future-Proofing", and "Post-Implementation Support" are the primary causal factors driving the success of ERP implementation. In contrast, challenges like "Data Migration" and "Compliance and Security" were identified as significant effect challenges, heavily influenced by how well the causal factors are managed.

Despite these contributions, the study has certain limitations. While suitable for this research, the reliance on expert opinion and literature review for data collection suggests that future studies could benefit from empirical data gathered through case studies or real-world ERP implementations. Additionally, the study was focused on safety inspection companies within the RMG industry, which may limit the generalizability of the findings to other sectors.

Future research could explore applying the findings to other industries or develop more refined models that integrate empirical data. The implications of this study are significant for managers in the RMG industry, providing them with a clear understanding of the critical challenges they need to address for successful ERP implementation. By prioritizing key areas like change management and scalability, companies can enhance the effectiveness of their ERP systems, leading to improved operational safety, better decision-making, and sustained competitive advantage in the industry.

Author Contributions

Md. Tanvir Siraj designed the research framework and led the application of the IVT2IF DEMATEL approach to analyze ERP implementation challenges. Md. Rashedul Haque and Md. Saimon Chowdhury contributed to data collection and analysis, focusing on identifying the key challenges. Nazrul Islam and Basudeb Biswas provided expert knowledge on ERP systems and safety inspection requirements. Md Kamrul Hasan Chowdhury supervised the overall research process and contributed to writing the manuscript. All authors reviewed and approved the final version of the paper.

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Data Availability

The data supporting the findings of this study are available upon reasonable request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this publication.

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