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FUSING COMPETENCY AND RISK MANAGEMENT IN ENGINEERING PROJECTS: THE IRMMHR FRAMEWORK FOR HUMAN RESOURCES

Abstract. *Organizations in engineering sectors face critical workforce challenges, including high turnover and skill mismatches, which impede efficient project delivery. The Integral Risk Management Method for Human Resources (IRMMHR) was introduced to mitigate these issues by integrating competency assessments with risk management approaches. This study aimed to evaluate the effectiveness of IRMMHR in reducing personnel risks and enhancing employee competencies at Mastergaz, a company specializing in engineering projects. A mixed-methods design was employed, incorporating quantitative surveys of 150 employees and semi-structured interviews with 20 participants. Data were analyzed to measure changes in turnover rates, task completion rates, and overall job satisfaction pre- and post-implementation. The implementation of IRMMHR led to a 20 percent reduction in turnover rates and a 30 percent increase in task completion rates. These improvements were attributed to targeted training programs and better alignment of employee skills with project requirements. IRMMHR demonstrates promise as a structured framework that strategically integrates competency building with risk assessment. By enhancing workforce stability and adaptability, it offers a viable pathway for organizations seeking to optimize human resources in competitive environments.*

Keywords: integral risk management; competency assessment; human resources; engineering projects; employee turnover; project management; performance metrics; customer satisfaction

Introduction

In today's competitive business environment, effective human resource management (HRM) is increasingly recognized as a key determinant of organizational success, especially in sectors characterized by rapid technological advancements and evolving workforce dynamics [1]. Recent scholarship suggests that aligning HRM practices with risk management strategies can bolster organizational resilience and sustainability, as many industries grapple with multifaceted challenges such as supply chain disruptions and the complexity of engineering projects [2]. Within this context, competency assessments have emerged as a vital tool for addressing prevalent HR concerns – such as high turnover and skills mismatches – in ways that more traditional, siloed methods often fail to capture [3; 4].

Organizations involved in engineering projects, for instance, must maintain a workforce equipped with diverse competencies that match specialized project requirements [5]. Yet many firms continue to face critical personnel risks, notably workforce attrition and inadequate skill sets, which underscores the urgency of strategic HR interventions in the digital era [6]. These issues become even more pressing with the growing need to integrate digital competencies and advanced technologies such as artificial intelligence and big data into daily operations [7]. If left unaddressed, deficits in employee expertise or stability can lead to significant repercussions, including project delays, increased operational costs, and diminished service quality [4].

Against this backdrop, the Integral Risk Management Method for Human Resources (IRMMHR) has emerged as a potential solution, offering a structured framework to identify and mitigate personnel risks through integrated assessments of workforce

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competencies [8]. Building on previous work in competency-based HR and risk mitigation, the IRMMHR seeks to better align employee capabilities with organizational needs, thereby fostering adaptability and resilience in engineering contexts. This paper centers on Mastergaz, a company specializing in engineering projects, to examine how IRMMHR might address the dual challenges of employee turnover and skill gaps.

Guided by a comprehensive review of recent studies [9-11], this research posits that systematically embedding risk management principles within HRM practices could offer a powerful mechanism to enhance workforce stability and project outcomes. Specifically, it hypothesizes that an integrated, competency-driven risk management approach not only reduces turnover intentions but also improves overall organizational performance. The central questions revolve around whether applying a risk-focused competency assessment methodology effectively lowers employee turnover in an engineering-focused organization and how integrating competency-based HRM and risk management influences project execution and employee satisfaction in the face of rapid technological change. By empirically examining these questions through a mixed-methods study at Mastergaz, this paper seeks to advance the broader understanding of how integrated human resource strategies can mitigate workforce vulnerabilities in competitive and technologically dynamic industries [12].

Purpose of the article

The objective of this study is to evaluate the effectiveness of the Integral Risk Management Method for Human Resources in reducing personnel risks and enhancing employee competencies in engineering projects.

Analysis of latest research

This study employed a mixed-methods design to evaluate the effectiveness of the Integral Risk Management Method for Human Resources at Mastergaz, a company specializing in engineering projects. The research protocol adhered to established guidelines for comprehensive HR investigations and aimed to ensure methodological rigor [13]. Following recommendations in human resource research, both quantitative and qualitative approaches were combined in order to capture a holistic view of the IRMMHR's influence on competency development and turnover risks. A total of 150 employees from various departments participated in an online survey designed to measure individual competencies, job satisfaction, and perceived turnover intentions, using Likert-scale items that allowed for nuanced yet readily analyzable responses [14]. This sample size provided statistically robust insights and represented a meaningful cross-section of the workforce, as it accounted for a substantial portion of the organization's total employees, thereby aligning with widely accepted practices in HR-related research [12]. In addition, 20 semi-structured qualitative interviews were conducted with selected participants who varied in roles and seniority, offering deeper perspectives on job stability and competency requirements, and yielding a richer understanding of how IRMMHR interventions influenced individual experiences [15].

All data were initially screened in Microsoft Excel to remove incomplete entries, ensuring that the final dataset accurately reflected participants' views. Descriptive analyses generated measures of central tendency and dispersion, including means, medians, and standard deviations. Subsequently, inferential techniques such as t-tests and ANOVA were used to compare metrics captured before and after the IRMMHR implementation, thereby facilitating an evaluation of changes in employee performance and turnover rates [16]. Correlation analysis further clarified the relationships between competency levels and turnover intentions, helping identify key factors that affect workforce stability [17]. Throughout these steps, data quality was verified by combining the objective metrics provided by the ERP-BPMS BOS CIS system with human oversight, whereby specialists cross-checked system-generated results against established checklists and protocols. The system, in turn, flagged anomalies or discrepancies for further review by these same specialists. This reciprocal validation minimized errors and underscored the importance of expert judgment in conjunction with automated data-capture procedures.

To quantitatively evaluate IRMMHR efficacy, a Competency-Risk Profile (CRP) was created. The profile computes

$$rp = \left(sum\ of\ \left(cj \cdot wj \right) \right) / \left(\left(t + 1 \right) \cdot fr \right),$$

where *rp* – represents personnel risk; *cj* –indicates the employee's competency level; *wj* – denotes the weight assigned to each competency; *t* – reflects the time required to complete tasks; and *fr* – is the turnover rate.

The choice of variables in this formula drew on recognized concepts in risk management, and the resulting numeric output was cross-verified through the dual-check procedures noted above. Workshops and training sessions supported this implementation, aiming to reduce employee resistance and demonstrate how targeted competency assessments enhance job satisfaction [18]. Data accuracy was maintained through periodic audits of the ERP-BPMS BOS CIS system, in which system outputs were regularly reviewed by operational managers, and managers' observations were likewise validated against automated records. This closed-loop mechanism fortified consistency between digital data and human judgments.

During IRMMHR implementation, efforts were made to maintain adequate resources for training and skill development. Budget planning, additional time allocation, and a dedicated reporting structure for discrepancies contributed to the smooth adoption of new practices. Emphasis on methodological rigor, together with adherence to clear protocols in data collection and analysis, helped ensure reliable findings [19]. Moreover, the mixed-methods strategy offered a comprehensive viewpoint: quantitative measures provided a statistically grounded assessment of IRMMHR's impact, while qualitative interviews contextualized these findings by illustrating how risk-focused competency initiatives influenced daily work processes. This layered methodology reinforced the study's internal validity, and the detailed documentation of each stage, combined with the active participation of specialists within the ERP-BPMS BOS CIS system, demonstrated the method's potential for replicability in other organizational contexts seeking to integrate competency management with risk assessment.

The main material of the article

The implementation of the Integral Risk Management Method for Human Resources at Mastergaz provided substantial insights into workforce competency optimization and the mitigation of personnel risks over the 2022–2024 period. Three representative projects, each valued at under 100,000 USD and aligned with the company's engineering and IT services for residential needs, were selected to observe the method's impact. These projects included residential water meter installation, heating systems servicing, and routine building maintenance. Initial assessments using the Competency-Risk Profile (CRP) indicated that employee turnover and insufficient skill sets posed particular concerns. Targeted training initiatives and mentorship programs were subsequently introduced to address these issues, with a focus on developing both technical and soft skills.

Table 1 shows that pre- and post-implementation CRP values declined notably across the Installation, Servicing, and Maintenance departments, suggesting improved competencies and lower turnover risks.

Table 2 illustrates a steady rise in task completion rates over three months following the IRMMHR rollout, pointing to greater efficiency in project execution.

Table 3 reveals lower turnover rates in all three focal projects, indicating that enhanced competencies and clearer role alignment positively influenced employee retention. These trends collectively affirm the IRMMHR's capacity to bolster both operational performance and workforce stability at Mastergaz [4; 8].

Economic impact analyses reinforce the method's benefits, as the average 25 percent reduction in turnover yielded an estimated 50,000 USD in saved recruitment and onboarding costs. Improved competencies contributed to approximately a 20 percent increase in productivity, which translated into an additional 100,000 USD in revenue across the three projects.

These figures underscore the tangible value of addressing skill gaps and mitigating turnover risks through an integrated HR and risk management framework. Statistical validation involved descriptive and inferential analyses of 24 months of data from the ERP-BPMS BOS CIS system, which provided real-time metrics on project progress and employee performance.

Table 1 – ***Comparison of CRP Before and After Implementation***

Department	Pre-Implementation CRP	Post-Implementation CRP	Change (%)
Installation	0.75	0.50	-33.33
Servicing	0.65	0.45	-30.77
Maintenance	0.80	0.55	-31.25

*Table 2 –****Task Completion Rates Over Time***

Project Type	Month 1 (%)	Month 2 (%)	Month 3 (%)
Water Meter Installation	70	80	90
Heating Systems Servicing	75	85	95
Routine Maintenance	65	75	85

Table 3 – ***Employee Turnover Rates Pre- and Post-Implementation***

Project Name	Pre-Implementation Turnover Rate (%)	Post-Implementation Turnover Rate (%)
Water Meter Installation	12	8
Heating Systems Servicing	10	6
Routine Maintenance	11	7

Descriptive statistics indicated sustained improvements in workforce competencies, while tests for statistical significance showed strong differences in pre- and post-implementation metrics. Correlation analysis similarly revealed a negative association between competency levels and turnover intentions, consistent with research linking effective HRM practices to enhanced employee retention [17, 12]. Overall, the results demonstrate that the IRMMHR promotes both workforce optimization and organizational resilience, underlining its effectiveness in managing personnel risks and improving project outcomes.

Additional project-level evaluations at Mastergaz further illustrate how the IRMMHR approach can be adapted to different service lines and operational contexts. In a follow-up pilot on water meter installations in 12 residential buildings, where the average time per installation had previously been high, the CRP analysis revealed that targeted training and adjustments to scheduling significantly reduced completion times and the incidence of rework visits.

Specifically, average installation time decreased by 15 percent, while the number of return appointments fell by 25 percent, correlating with a measurable decline in the CRP score. Customer satisfaction rose by 10 percent, reflecting a more efficient and transparent process that was facilitated by the close integration of BOS CIS system data with expert oversight.

A similarly structured approach was tested in an emergency repair context, focusing on sudden bursts in heating pipelines. Prior to IRMMHR, dispatch delays and mismatches in technical expertise often led to repeated calls for additional interventions. Once the IRMMHR framework had been implemented, along with the updated BOS CIS routing system, response times improved by an average of 20 percent, and the number of emergency revisits per 100 incidents dropped by 42 percent. Personnel risk, captured by the CRP formula:

$$rp = \left(sum\ of\ \left(cj \cdot wj \right) \right) / \left(\left(t+1 \right) \cdot fr \right),$$

declined because faster, more accurate technician assignment reduced the likelihood of repeated breakdowns and turnover due to work overload.

Table 4 illustrates these outcomes in greater detail, underscoring how a clearer alignment between employee competencies, automated scheduling, and risk assessments can significantly enhance performance in high-pressure scenarios.

To illustrate how IRMMHR scales across multiple business processes at Mastergaz, an expanded set of key performance indicators was tracked to compare metrics before and after IRMMHR adoption.

Table 5 highlights data from both routine and critical projects, emphasizing changes in productivity, resource utilization, and customer engagement. While not all indicators improved at the same pace, the consistent downward shift in risk scores and increase in positive feedback demonstrate the reproducibility of IRMMHR principles across diverse operational frameworks.

These extended findings reinforce the idea that IRMMHR can be implemented systematically within a company that processes a broad spectrum of service requests, relies on complex logistics, and draws on both automated and manual oversight. By integrating competency-driven risk assessment into existing processes and technologies such as the ERP-BPMS BOS CIS system, Mastergaz has demonstrated that significant gains in efficiency, customer satisfaction, and personnel stability can be achieved even in high-volume, technically demanding environments.

The reproducibility and scalability of these outcomes suggest that other organizations operating in similarly dynamic or risk-prone contexts could adopt IRMMHR to realize comparable benefits, further validating the method's potential as a robust framework for contemporary HR management. The results from implementing the Integral Risk Management Method for Human Resources at Mastergaz underscore the dynamic relationship between employee competencies and workforce risks.

A 20 percent reduction in turnover and a 30 percent increase in task completion rates highlight IRMMHR's emphasis on targeted competency development, which extends beyond traditional human resource approaches that often lack explicit risk-management components [20].

The reliance on the competency-risk profile (CRP) provides a more holistic perspective that addresses both performance improvement and retention challenges, contrasting with conventional competency-based approaches, where skill-gap analyses frequently fail to capture turnover metrics and leave an organization vulnerable to attrition [20].

Table 4 – ***Sample Emergency Repair Indicators***

Indicator	Pre-IRMMHR	Post-IRMMHR	Change (%)
Average repair time (hours)	4.0	3.2	-20
Emergency revisits per 100 incidents	12	7	-42
CRP score (unitless)	0.65	0.48	-26
Customer satisfaction (% feedback)	78	85	9

Table 5 – ***Selected Mastergaz KPI Comparisons***

KPI	Pre-IRMMHR	Post-IRMMHR	Change (%)	Target
Number of daily service orders	200	250	25	300
Average completion time (hours)	2.0	1.5	-25	1.0
Customer satisfaction (% positive feedback)	70	90	20	95
Average emergency response time (minutes)	60	30	-50	20
Turnover rate (% per year)	15	10	-33	5
CRP score (unitless) across depts	0.72	0.52	-28	0.40

By integrating risk assessment into a single data-driven framework, IRMMHR complements other HR strategies that prioritize cultural alignment and job satisfaction. The quantitative measures afforded by IRMMHR offer organizations objective indicators for timely interventions aimed at optimizing competencies [21]. This aligns with emerging research on predictive analytics, which stresses the importance of systematic data integration for enhancing workforce stability [22]. The CRP's numerical format supports immediate decision-making and also paves the way for advanced predictive tools that anticipate gaps and mitigate risks, thereby aligning employee skill sets with evolving organizational objectives [23].

Compared to standalone competency-based training, IRMMHR's structure enables the simultaneous evaluation of both skill development and retention risks. This integrated perspective appears particularly relevant in engineering and IT contexts, where rapid changes in market demand require continuous role adaptation. The Mastergaz experience shows that sustained application of IRMMHR can stimulate employee engagement because it actively aligns training priorities with emerging project requirements and individual career aspirations [24], a finding that resonates with [30] research demonstrating that training matters significantly for workforce retention in decentralized systems. Regularly updated risk parameters keep the approach agile, allowing IRMMHR to function as a versatile model in the face of ongoing technological and market shifts [25].

The study's findings also reinforce the idea that leveraging advanced analytics can amplify IRMMHR's effectiveness, particularly in sectors driven by innovation and rapid technological growth [26]. Incorporating machine learning or Internet of Things (IoT)-based HR analytics could optimize real-time competency assessments, facilitating swift corrective actions and allocation of resources [27]. This data-oriented strategy resonates with broader movements in strategic HR management that stress proactive interventions and continuous monitoring as essential components of competitiveness [28].

Overall, the observed gains in employee retention, task completion, and workforce adaptability support the initial research hypotheses. Embedding risk management within HR practices appears to reduce turnover intentions and improve project performance in engineering-driven operations, affirming that IRMMHR's competency-centered risk assessments are not only practical but strategically valuable. The rise in employee engagement likewise supports the notion that robust skill alignment leads to job satisfaction and greater organizational resilience [17]. Certain limitations must be acknowledged, however, including the reliance on self-reported survey data and semi-structured interviews, which, although informative, can introduce biases and limit the accuracy of some metrics. Future research should incorporate objective performance indicators and long-term data to validate changes in competency levels and turnover rates over an extended period. While Mastergaz served as a useful case, comparative studies across multiple industries and regions could further test the scalability and adaptability of IRMMHR [29]. Research into more advanced predictive tools, including machine learning algorithms for real-time risk monitoring, could also refine this method's ability to anticipate and address emerging workforce challenges.

Conclusion

The implementation of the Integral Risk Management Method for Human Resources at Mastergaz has demonstrated that integrating risk assessment with strategic competency management can decrease turnover and enhance operational performance. By focusing on specific skill gaps, this approach aligns workforce capabilities with project demands, a synergy that culminated in a 20 percent drop in turnover and a 30 percent rise in task completion rates. These outcomes suggest that IRMMHR can serve as a powerful means of bolstering employee engagement and ensuring that organizations remain resilient amid fluctuating market and technological pressures. Managerial implications stem from interventions that target the root causes of attrition, including insufficient competency development, aligning with recent evidence that training initiatives are crucial determinants of retention success [30]. By systematically identifying these gaps and integrating training into a broader risk management strategy, managers can optimize human resources and reduce the likelihood of costly disruptions.

The Mastergaz experience also underscores the value of continuous evaluation, wherein risk parameters are revised as roles evolve to foster a culture of ongoing improvement and adaptability. This flexibility is especially important in fast-paced environments such as engineering and IT services, where effective talent management and proactive skill alignment can be decisive factors in meeting organizational objectives.

The theoretical significance of IRMMHR lies in its capacity to unify two traditionally distinct areas of HR research: competency-based frameworks and risk management models. This approach highlights the potential for a quantitative tool, such as the CRP, to establish a transparent connection between workforce competencies and turnover tendencies, thereby responding to calls for more integrated, data-driven methodologies that capture the complexities of modern workforce dynamics. Although further comparative studies may broaden its applicability to diverse organizational contexts, IRMMHR remains a valuable contribution to the growing literature on sustainable HR strategies.

In conclusion, the Mastergaz case emphasizes IRMMHR's effectiveness in environments experiencing rapid change, affirming that structured, risk-based interventions combined with competency-centered initiatives can yield tangible improvements in both employee retention and operational performance. While the reliance on self-reported data highlights the need for more objective, longitudinal metrics, this study illustrates how embedding risk management principles within HR practices helps develop a capable and engaged workforce. Future research that expands the method's scope – whether geographically, sectorally, or technologically – will further confirm the adaptability and scalability of this integrative, data-driven framework for contemporary HR management.

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ПОЄДНАННЯ КОМПЕТЕНЦІЙ ТА УПРАВЛІННЯ РИЗИКАМИ В ІНЖЕНЕРНИХ ПРОЄКТАХ: СТРУКТУРА МІУРЛР УПРАВЛІННЯ ЛЮДСЬКИМИ РЕСУРСАМИ

Анотація. *Проведено аналіз критичних проблем, пов'язаних із робочою силою в інженерному секторі, включаючи високу плинність кадрів та невідповідність навичок, які перешкоджають ефективному виконанню проєктів. Виділено дві ключові особливості сучасних інженерних компаній: потреба в інтеграції оцінки компетенцій та підходів до управління ризиками для забезпечення стабільності проєктної діяльності. Запропоновано Метод інтегрального управління ризиками людських ресурсів (МІУРЛР) – структуровану систему, яка стратегічно поєднує розвиток*

компетенцій з оцінкою ризиків. У контексті розробки елементів моделі наведено її ефективність на прикладі компанії Mastergaz, яка спеціалізується на інженерних проєктах. Матричне представлення ефективності засноване на вимірюванні змін у коефіцієнтах плинності кадрів та коефіцієнтах виконання завдань до та після впровадження МІУРЛР. Впровадження моделі продемонструвало 20-відсоткове зниження коефіцієнта плинності кадрів та 30-відсоткове збільшення коефіцієнта виконання завдань, що було пояснено цільовими навчальними програмами та кращим узгодженням навичок співробітників з вимогами проєкту. Входами моделі МІУРЛР є кадрові ризики та рівень компетенцій, а виходами – підвищена стабільність та адаптивність робочої сили, оптимізація людських ресурсів у конкурентному середовищі. Методологічним підґрунтям моделі є підхід, який інтегрує оцінку компетенцій з управлінням ризиками. Зроблено висновок щодо потенційної ефективності запропонованого МІУРЛР як життєздатного шляху для оптимізації людських ресурсів. Сформульовано галузі подальших досліджень у обраному напрямі, серед яких: формалізація процесу інтеграції МІУРЛР у різні типи інженерних проєктів; адаптація моделі до умов високої конкуренції та швидких технологічних змін; розроблення додаткових показників ефективності для вимірювання задоволеності клієнтів та підвищення загальної задоволеності роботою співробітників; впровадження моделі у практичну діяльність інженерно-проєктних організацій. Сформульовано висновки з проведених досліджень.

Ключові слова: інтегральне управління ризиками; оцінка компетенцій; людські ресурси; інженерні проєкти; плинність кадрів; управління проєктами; показники ефективності; задоволеність клієнтів

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