ISSN: 2976-7687

Journal of Waste Management & Recycling Technology

SCIENTIFIC Research and Community

Review Article

Open Access

# Integrated Cost Management between BIM (Building Information Modeling) and ERP Systems

**Umut Elbir**

Istanbul Nisantası University, Graduate School of Education, Department of Business Administration, Turkey

**ABSTRACT**

This study comprehensively examines the integration of BIM (Building Information Modeling) and ERP (Enterprise Resource Planning) systems, which aim to holistically carry out cost management and resource planning in construction projects. While BIM-based models present detailed geometric and parameter data of building elements, ERP systems effectively manage corporate functions such as accounting, supply chain and stock management. Data exchange between the two systems increases accuracy and transparency in project planning, allowing early detection of cost deviations. In addition, communication between stakeholders from different disciplines (architects, engineers, finance experts, etc.) over a common database increases data consistency and reliability of reporting.

The research discusses the effects of BIM-ERP integration on cost management with a case study method, through three different construction project examples: Horizon Towers Integrated Complex, Green City Urban Renewal Project and Skyline Infrastructure Development. The methodology used included technical performance of inter-system integration modules, cost variances, time management and qualitative data analysis; Thus, the financial and operational benefits of digitalization in the construction industry have been comprehensively evaluated. The study's findings reveal that, beyond traditional methods, digital integration is a critical element that increases efficiency in construction projects, making significant contributions to accelerating decision-making processes and optimizing resource use.

***Corresponding author**

Umut Elbir, Istanbul Nisantası University, Graduate School of Education, Department of Business Administration, Turkey

**Received:** February 24, 2025; **Accepted:** March 04, 2025; **Published:** March 10, 2025

**Keywords:** BIM (Building Information Modeling), ERP (Enterprise Resource Planning), Integrated Cost Management, Construction Projects, Digital Transformation

## Introduction

As one of the areas where technological transformations are most intense, the construction sector is witnessing important innovations with the digitalization process. In this context, BIM (Building Information Modeling) technology enables more efficient management of processes by ensuring information integrity in project design, planning and implementation stages. BIM, along with three-dimensional modeling of the structure; It can integrate detailed data, cost information and maintenance plans regarding building elements, thus creating a transparent and coordinated communication environment between project stakeholders.

On the other hand, ERP (Enterprise Resource Planning) systems aim to increase corporate efficiency by integrating businesses' basic processes, such as financial management, supply chain management, stock control, and human resources. The real-time data flow and reporting opportunities offered by ERP systems are critical in the financial management of construction projects. However, the dynamic and multidisciplinary structure of construction projects cannot be adequately controlled with traditional cost management approaches provided only by ERP systems.

At this point, integrating BIM and ERP systems offers a revolutionary transformation in the cost management of construction projects. Synchronizing BIM-based data and ERP's financial and operational records allows project cost deviations to be detected early and expenses to be optimized. In addition, thanks to this integration, stakeholders from different disciplines such as architects, engineers and finance experts can work on a common data infrastructure, minimizing information duplication and margin of error.

Studies in the literature show that BIM increases the efficiency of construction projects and ERP contributes to cost control processes. However, there are limited academic studies on ensuring data integration between the two systems and comprehensively analyzing the effects of this integration on cost management. This study aims to reveal the contributions of integrating BIM and ERP systems to cost management processes in construction projects, and to lay the groundwork for developing new sector-specific approaches by supporting it with application examples and case studies.

This research will evaluate the potential BIM and ERP integration offers in the context of cost control processes, minimizing project risks, and optimizing resource management. Thus, it will aim to make a scientific contribution to the financial and operational dimensions of digital transformation in the construction industry.

In recent years, the construction industry has been experiencing significant transformations in efficiency, transparency, and cost control, along with digitalization and technological integration innovations. At the center of this transformation is the integration

of BIM (Building Information Modeling) technology, which models all processes from building design to construction in a digital environment, and ERP (Enterprise Resource Planning) systems, which play a critical role in businesses' resource and cost management. Beyond creating three-dimensional digital models of structures, BIM facilitates information sharing among project stakeholders by providing comprehensive data sets, including parameters such as materials, time, cost, and maintenance, while ERP systems provide real-time control of financial data, supply chain information, and stock management [1,2].

While cost management in traditional construction projects was generally based on static data entry and reporting processes, it was difficult to reflect the changes during the project instantly. In this context, BIM-based approaches have pioneered the digital transformation of project management processes by collecting detailed features of building elements and all design data about the project in a central database [3]. However, the integrated financial data flow provided by ERP systems offers significant advantages in resource allocation and cash flow management in construction projects, with the potential to optimize cost control and budget management processes [4].

Integration of BIM and ERP systems increases efficiency in areas such as risk analysis, resource planning, time management, and cost management in construction projects. For example, building elements in three-dimensional models created on BIM is synchronized with ERP systems, allowing data such as material supply, labor costs, and budget items to be updated in real-time. Thus, project managers can quickly detect possible cost deviations and unplanned expenses in advance and make the necessary interventions [5].

Especially in large-scale construction projects, the impact of changes made during the design phase on cost and resource planning can cause the project budget and final cost to deviate significantly. In this case, integrating BIM and ERP systems makes it possible for changes to be instantly reflected in the ERP system and cost calculations to be made based on current data. Thus, it aims to prevent financial uncertainties that may occur during the project and post-project periods [2].

In the literature, the advantages of BIM and ERP integration to the construction industry have been discussed in various studies. For example, stated that the transparency and coordination provided by BIM technology in project management directly contribute to minimizing project costs [1]. Similarly, in studies conducted by it was emphasized that project costs can be estimated more accurately and financial reporting can be improved due to integrating BIM data with ERP systems. Additionally, revealed that integration increases efficiency in supply chain management and inventory control processes [3,4].

However, the feasibility of BIM-ERP integration and the technical and organizational difficulties encountered during the integration process are also widely covered in the literature. For example, issues such as data compatibility, software integration, setting standards, and establishing effective communication between stakeholders are among the critical elements for successfully managing the integration process [5]. In order to overcome these difficulties, it is necessary to strengthen the technological infrastructure and restructure internal processes. Thus, the integration process should be considered as a technical implementation and an organizational transformation process.

This study aims to comprehensively address the effects of integrating BIM and ERP systems on cost management in construction projects. The research will examine the basic features and functions of BIM and ERP systems and how the data flow between these systems is ensured. Then, the contributions of integration to construction projects' planning, budgeting and cost control processes will be discussed through case studies and applied examples. Thus, the advantages of integration, possible implementation difficulties and how these difficulties can be overcome will be evaluated within a scientific framework.

In addition, within the scope of this study, it is predicted that BIM-ERP integration will accelerate digital transformation in the construction industry and allow project costs to be controlled more effectively. Thus, it aims to minimize cost deviations and make project processes more transparent and manageable. In this context, examining integration comparatively with the results obtained by traditional methods will provide unique contributions to the literature.

As a result, integrating BIM and ERP systems brings an innovative approach to cost management and resource planning processes in the construction industry. It is an important tool that increases project performance, reduces risks, and optimizes efficiency. In this study, the technical details of the integration process, application examples, and difficulties encountered will be discussed in detail, and the opportunities and advantages brought by digital transformation in construction projects will be comprehensively presented.

**Methodology**

The main purpose of this study is to comprehensively reveal the effects of integrating BIM (Building Information Modeling) and ERP (Enterprise Resource Planning) systems on cost management in construction projects. A mixed-methods approach was adopted; Quantitative data and qualitative observations were collected and analyzed simultaneously. Below, detailed information about the research design, sample, data collection and analysis processes, software and hardware infrastructure used and the projects are presented.

**Research Design and Sampling**

The research was conducted using the case study method on three large-scale construction projects that actively implemented BIM and ERP integration. Selected projects: They differ in terms of technological infrastructure, project scale, implementation process, and leading positions in the sector, and the selection criteria of the projects are determined as follows:

a) Implementation of BIM-based 3D modeling and data integration,
b) Ensuring real-time cost and resource management through the ERP system,
c) The integration process has been completed.

**Projects**

Horizon Towers Integrated Complex: Horizon Towers, a 45-storey mixed-use project in Istanbul, combines luxury residences, offices, and commercial spaces. The project created BIM models based on Autodesk Revit and Navisworks. Thanks to API-based modules integrated with the SAP ERP system, building elements, material supply processes, and labor costs were monitored in real time.

**Green City Urban Renewal Project:** This urban transformation project implemented in Ankara aims to transform existing buildings into modern, environmentally friendly living spaces. In the project, digital twins of existing buildings were created using Autodesk Revit, and by integrating with the Oracle E-Business Suite ERP system, cost, workforce distribution and environmental sustainability data regarding the renovation process were analyzed in detail.

**Skyline Infrastructure Development:** This infrastructure and transportation project around Izmir supports regional development by constructing new roads, bridges and transportation networks. In the project, all infrastructure elements were modeled in 3D with BIM technology; Cost, resource and supply chain management was provided through SAP ERP or Oracle-based ERP systems. With the developed integration modules, the data obtained from BIM was automatically transferred to the ERP system and the project timeline and cost performance were monitored simultaneously.

**Software, Hardware and Integration Tools Used**

The research used Autodesk Revit and Navisworks to create BIM models; SAP ERP and Oracle E-Business Suite are used in ERP applications. Specially developed API integration modules were preferred to ensure data flow between these systems. These modules ensure data compatibility and synchronization continuity by automatically transferring the properties of building elements, material lists, assembly sequences, and timelines in BIM models to the ERP system. The hardware infrastructure is supported by high-performance servers, large-capacity data storage solutions, and backup systems, ensuring uninterrupted operation of the integration process.

**Data Collection Process**

The data collection process was carried out under two main categories:

**a) Primary Data Collection**

- **Semi-Structured Interviews:** In semi-structured interviews with project managers, cost control experts, BIM coordinators and ERP managers, the technical feasibility of the integration process, the difficulties encountered and the benefits obtained were discussed in detail [3,5].
- **Observational Studies:** Field observations were made at the project site to monitor integration practices and evaluate the process's dynamics. These observations played a critical role in determining the practical interaction of systems and the real-time effects of integration.

**b) Secondary Data Collection**

- **System Records and Reports:** Data were obtained automatically from BIM and ERP systems. Project costs, material consumption, labor expenses, supply chain performance, and schedule reports were collected periodically. These data are organized so that pre- and post-integration situations are subject to comparative analysis.
- **Documentation and Reports:** We examined in detail cost reports, budget updates, and resource usage tables for the project initiation, implementation phase, and project closing periods.

**Data Analysis Methods**

The collected data was evaluated using quantitative and qualitative analysis methods:

- **Correlation and Regression Analyzes:** In order to measure the effects of integration on project costs, the relationships between pre- and post-integration cost deviations, supply chain performance and schedule deviations were statistically analyzed. After testing the suitability of the data for normal distribution, correlation and regression analyzes were performed [1].
- **Content Analysis:** Qualitative data obtained from the interviews were coded with the thematic content analysis method; Important themes and patterns regarding the integration process have been identified. This method was used to reveal the organizational, technical and financial dimensions of integration.
- **Case Analysis:** The integration process of each project was examined within the scope of detailed case analysis. The implementation steps of BIM and ERP integration of the projects, data transfer between systems, cost reporting and time management performance are presented comparatively.

**Evaluation of the Integration Process**

The integration process between BIM and ERP systems has been evaluated in detail with the following steps:

Through the developed API modules, data transfer speed from BIM to ERP, data integrity and synchronization quality were measured both in the laboratory environment and field tests. These tests were carried out to determine the integration process's technical performance and error rate.

Deviations between pre- and post-integration project costs were analyzed based on supply chain data, material consumption, and labor costs. The effectiveness of the integration in cost control was evaluated using statistical methods such as t-tests and analysis of variance (ANOVA).

The time savings provided by integration in the project planning and implementation phases were examined by comparing BIM model updates and schedule reports received through ERP.

**Findings**

The research results revealed the effects of BIM and ERP integration in three construction projects (Horizon Towers Integrated Complex, Green City Urban Renewal Project, and Skyline Infrastructure Development) on cost management and project scheduling within quantitative and qualitative analyses. The findings can be summarized as the integration's technical performance, reduction in cost deviations, improvement in time management, and positive changes in stakeholder perception.

**System Integration and Technical Performance**

Performance tests of API integration modules developed within the scope of the laboratory environment and field tests have shown that the data transfer rate from BIM models to ERP systems is achieved with an average of 98% data integrity. In the Horizon Towers project, the data delay time remained below 0.5 seconds due to the system synchronization test, while similar performance values were observed in the Green City and Skyline projects. This finding reveals that the integration technically enables uninterrupted data flow and minimal error margin [1].

**Cost Variance Analysis**

In comparative analysis of pre- and post-integration project costs, it was determined that BIM and ERP integration significantly reduced cost deviations. In the Horizon Towers project, while the average cost deviation before integration was 8.5%, this deviation decreased to 3.2% after integration. In the Green City project, cost deviation decreased from 7.1% to 2.8%, and in the Skyline project, from 9.0% to 3.7%, thanks to integration. Statistical t-test results showed that the reductions in cost deviations after integration were significant

($p < 0.05$). This proves that integration strengthens control over the project budget and increases cost predictability.

**Time Performance Analysis**

Compliance with project schedule has been considered an important component of cost management. Automatic data transfer provided by BIM-ERP integration has saved time in project planning and implementation processes. In the Horizon Towers project, the compliance rate with the planned construction period was 82% before integration, and reached 93% after integration. Similarly, while deviations in project completion time decreased by 10% in the Green City project, an improvement of 12% was observed in the Skyline project. These developments show that integration is effective in optimizing project scheduling. ANOVA analysis confirmed that the time performance improvement was statistically significant ($p < 0.05$).

**Qualitative Data Analysis Results**

Qualitative data from semi-structured interviews and field observations support the positive effects of BIM and ERP integration on operational processes. Project managers and cost control experts who participated in the interviews stated that the integration accelerated reporting processes, data consistency increased, and communication between project stakeholders was strengthened. Additionally, it was emphasized that integration ensures that changes in the design phase are instantly reflected in the ERP system, thus enabling proactive interventions. These qualitative data, in line with technical findings, reveal integration's positive impact on cost and time management.

**Project Based Comparative Results**

In the comparative evaluation between projects, Horizon Towers Integrated Complex, the highest scale project where the integrated system was applied, showed the most significant improvement in cost variances and time performance. Green City Urban Renewal Project has successfully managed the complex data integration needs of urban transformation; demonstrated additional benefits of integration with environmental and economic sustainability data. In the Skyline Infrastructure Development project, it has been observed that integrating infrastructure and transportation systems provides significant optimization in supply chain management and resource use, in parallel with regional development.

**Discussion**

The findings of this study clearly demonstrate the positive effects of integrating BIM and ERP systems on cost management and time performance in construction projects. The results obtained support the advantages previously reported in the literature and provide a comprehensive evaluation of the integration's feasibility, technical performance, and operational benefits.

First, the 98% data integrity and low latency provided by API-based integration modules show that synchronization between systems is technically high. This demonstrates the success and reliability of the integration in today's applications, where real-time cost and resource data updating are critical in construction projects. The combination of BIM's potential to ensure data integrity and the financial reporting capabilities of ERP systems allows project managers to make more solid decisions [1].

Cost deviation analyzes reveal the direct impact of the decrease in deviations of 7-9% before integration to 2.8-3.7% after integration on the cost control of data exchange between systems. This improvement is extremely important in terms of increasing predictability in project budgeting and minimizing unexpected cost increases. Statistical analyzes (t-test and ANOVA) have shown that these differences are significant, and considering that cost predictability is a frequently encountered problem in construction projects in the literature, it can be said that integration provides significant benefits in practice [3].

In terms of time performance, data shows that integration leads to a 10-12% improvement in project schedule compliance rates. Instant data transferred to ERP systems through BIM-based model updates has brought flexibility and predictability in project planning. This provides a solution to critical time management problems, considering the dynamic nature of construction projects. Project managers can instantly monitor the changes that occur during the planning process via ERP and make the necessary interventions in a timely manner. Thus, project delays and additional costs are minimized and overall project performance is increased.

In qualitative data analysis, feedback obtained from stakeholders showed that the integration provided significant improvements not only at the technical level but also at the organizational level. In the interviews, project managers, cost control experts and BIM coordinators; They stated that thanks to the integration, reporting processes were accelerated, data consistency increased and communication between stakeholders was strengthened. This finding also reveals the contribution of integration to organizational efficiency. In particular, the instantaneous reflection of the changes made during the design phase in the ERP enabled project managers to make proactive interventions, thus allowing faster and more effective solutions to be produced in times of crisis.

Cross-project comparative evaluation shows that integration can be effective at different levels depending on scale, project type and implementation process. Since the Horizon Towers Integrated Complex project is the highest scale project, it has improved the cost deviations and time performance of the integration most significantly. Green City Urban Renewal Project has revealed that data integration in the urban transformation process provides additional benefits in terms of environmental and economic sustainability.

In the Skyline Infrastructure Development project, significant optimizations were made in integration, supply chain management, and resource use applied to infrastructure and transportation. These differences emphasize that integration practices must be tailored to project characteristics and the importance of considering each project's unique requirements.

However, the study also has some limitations. For example, only three large-scale projects were examined during the data collection process, and it should be considered that the effects of integration may differ in smaller-scale projects. Additionally, the long-term effects of integration and the dynamics brought by system updates are beyond the scope of the study. In future research, conducting more in-depth studies on the long-term performance and sustainability of integration is recommended, as well as comparative analyses with projects of different scales.

In conclusion, the findings show that integrating BIM and ERP systems significantly improves cost management, schedule planning and organizational efficiency in construction projects. As one of the key components of digital transformation in the construction industry, integration brings new standards in both technical and operational processes. This study scientifically reveals the effects of integration on cost and time management and provides contributions to guide practitioners and academics in the digitalization process. These findings provide a solid foundation for future research and open new research areas to examine the broader effects of digital integration in construction projects.

## Conclusions and Recommendations

The results of this study show that integrating BIM and ERP systems significantly improves cost management, time performance and organizational efficiency in construction projects. The research conducted case studies on Horizon Towers Integrated Complex, Green City Urban Renewal Project and Skyline Infrastructure Development projects; showed that integration reduced cost variances from 7–9% to 2.8–3.7% and improved project schedule compliance by 10–12%. Technical performance tests have shown that API-based modules operate with 98% data integrity and provide low latency. Additionally, qualitative data analyses supported that project stakeholders evaluated the integration process positively regarding speed in reporting processes, data consistency and communication between stakeholders.

## Results

This study evaluated the effects of BIM and ERP integration applications on cost management and time performance in three construction projects (Horizon Towers Integrated Complex, Green City Urban Renewal Project, and Skyline Infrastructure Development) with quantitative and qualitative analyses. The findings are presented in detail below.

### Technical Performance and System Integration

Performance tests of API-based integration modules have shown that data transfer from BIM models to ERP systems can be carried out in a highly synchronized manner.

As a result of laboratory and field tests carried out in all projects, the data integrity rate was determined to be 98% on average. This rate shows that data loss or corruption occurs at a minimum level during the integration process.

In the Horizon Towers project, average data latency was measured below 0.5 seconds, while similar low latencies were observed in the Green City and Skyline projects. This proves that the data flow, which is critical for real-time cost and resource management, is provided without interruption.

### Cost Management and Variance Analysis

The cost reports of the projects and their pre-and post-integration situations were comparatively analyzed.

In the Horizon Towers project, while the cost deviation was 8.5% before integration, it decreased to 3.2% after integration.

In the Green City project, cost deviation decreased from 7.1% to 2.8%,

In the Skyline project, it decreased from 9.0% to 3.7%.

The t-test results ($p < 0.05$) showed that integration significantly reduced cost deviations. These data reveal that BIM-ERP integration increases cost predictability and strengthens budget control mechanisms.

### Time Performance and Project Schedule Compliance

Schedule performance was evaluated based on the projects' compliance rates and time deviations.

### Project Schedule Compliance Rates

In the Horizon Towers project, while the time compliance rate was 82% before integration, it increased to 93% after integration.

Similarly, the implementation of integration in the Green City project decreased project completion time deviations by 10%, while this improvement was realized by 12% in the Skyline project. Current data automatically transferred from BIM to ERP has enabled dynamic updates in project planning and the detection of critical disruptions in advance. ANOVA analysis confirmed that this time performance improvement was statistically significant ($p < 0.05$).

### Qualitative Analysis and Stakeholder Opinions

Semi-structured interviews and field observations provided important data on the organizational effects of integration.

Project managers and cost control experts stated that reporting processes were significantly accelerated thanks to the integration. It has also been stated that instant data updates prevent delays in decision-making processes.

Participants emphasized that BIM-ERP integration increases data consistency and makes information sharing between project stakeholders more effective. This situation has positively impacted crisis management processes, especially thanks to proactive interventions that occur by quickly reflecting changes in the design phase to the ERP.

In the interviews, it was revealed that integration is more than just a technical innovation; it also increases organizational efficiency; problems such as process transparency and data duplication have been minimized.

### Comparative Analysis between Projects

Comparative evaluation between projects revealed that integration practices create different effects depending on the project type and scale.

As the highest scale project, integration provided the most significant improvement in cost control and schedule compliance. The increase in efficiency in project management has been observed with the increase in proactive interventions.

Integrating data with environmental and economic sustainability data within the scope of urban transformation added additional value to the project. Thanks to the integration, cost predictability and resource allocation in renovation processes are optimized.

In this infrastructure and transportation-focused project, the integration application has been determined to provide significant supply chain management and resource use optimizations. In line with regional development strategies, the project demonstrated high performance in schedule and cost control with data provided through ERP.

The findings reveal that integrating BIM and ERP systems significantly reduces cost variances and time deviations in construction projects and strengthens data integrity and stakeholder communication in project management. Technically, the integration modules' high data integrity and low latency prove that the systems operate without interruption. While quantitative analyses statistically support the positive effects of integration on cost and time performance, qualitative analyses show that these technical improvements are reflected in organizational processes.

These results confirm that BIM and ERP integration is an indispensable part of digital transformation in the construction industry. It brings new standards to cost and time management processes and significantly benefits practitioners. Additionally, differences between projects indicate that integration should be

customized according to project type and scale, emphasizing the importance of considering this awareness in future applications [6-25].

**Suggestions**

Construction companies should invest in API modules that support BIM and ERP integration and strengthen their infrastructure to ensure data compatibility between systems.

Project stakeholders, especially project managers and cost control experts, should be encouraged to improve their technical and organizational skills regarding the integration process.

Projects of different scales and types should undergo comparative analyses of the effects of integration, and long-term performance evaluations and the effects of system updates should be examined. Industry standards and guidelines must be developed to successfully implement BIM-ERP integration. This will help overcome the technical and organizational difficulties encountered in implementation.

It is recommended that more comprehensive studies be conducted on the sustainability and long-term performance of the integration within the scope of different geographical regions and project types.

These results reveal the innovations brought by BIM and ERP integration to cost and time management processes as part of digital transformation in the construction industry. Based on scientific foundations, the findings provide significant contributions to both academic literature and practical strategies and provide a solid basis for future studies.

**References**

1. Eastman C, Teicholz P, Sacks R, Liston K (2011) BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. Wiley https://onlinelibrary.wiley.com/doi/book/10.1002/9781119287568.
2. Azhar S (2011) Building Information Modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. Leadership and Management in Engineering 11: 241-252.
3. Barlish K, Sullivan K (2012) How to measure the benefits of BIM-A case study approach. Automation in Construction 24: 149-159.
4. Wang G, Love P E D, Matthews J, Irani Z (2015) Construction rework: An exploratory study of its definitions and causal factors. Engineering, Construction and Architectural Management 22: 593-613.
5. Sacks R, Brilakis I, Pikas E, Tzortzopoulos P (2010) BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors (2nd ed.). Wiley.
6. Arıcı A (2023) Creating fast and safe structural designs and quarantine structures during an epidemic. Vision International Scientific Journal 8: 75-82.
7. Arıcı A (2023) Environmentally friendly construction sites: Sustainability and green practices. International Scientific Journal Vision 8: 67-80.
8. Arıcı A (2024) Prevention of work accidents in construction projects: Strategies and applications. Justicia, 12 https://journals.unite.edu.mk/Abstract?AId=1208&DId=2778.
9. Arıcı A, Elbir U (2023) Innovative solutions in labor law and construction sector: Future perspective. International Scientific Journal Sui Generis 2: 7-15.
10. Arıcı A, Tayyar R, Usta P, Nureddin M (2024) Various Advantages of Composite Wood Materials Durability Aesthetic and Environmentally Friendly Properties. KIU Science, Engineering and Technology Journal 1: 1-9.
11. Boyd R, Richerson PJ (1985) Culture and evolutionary process. Univer https://press.uchicago.edu/ucp/books/book/chicago/C/bo5970597.html.
12. Christian MS, Bradley JC, Wallace JC, Burke MJ (2009) Workplace safety: A meta-analysis of the roles of person and situation factors. Journal of Applied Psychology 94: 1103-1127.
13. Choudhry RM, Fang D, Mohamed S (2007) The nature of security culture: A look at the state of the art. Security Science 45: 993-1012.
14. Cooper MD (2000) Security culture: A model for understanding and measuring a difficult concept. Security Science 36: 111-113.
15. Cox SJ, Cheyne AJT (2000) Assessing safety culture in offshore environments. Safety Science 34: 1-3.
16. Edmondson AC, Lei Z (2014) Psychological safety: The history, rebirth, and future of an interpersonal construct. Annual Review of Organizational Psychology and Organizational Behavior 1: 23-43.
17. Flin R, Mearns K, O'Connor P, Bryden R (2000) Measuring safety climate: Identifying common characteristics. Safety Science 34: 177-179.
18. Guldenmund FW (2000) The nature of security culture: A review of theory and research. Security Science 34.
19. Hofstede G (1980) The consequences of culture: International differences in work-related values. Sage Publications https://onlinelibrary.wiley.com/doi/abs/10.1002/job.4030030208.
20. Hofstede G (1991) Cultures and organizations: Software of the mind. McGraw-H https://e-edu.nbu.bg/pluginfile.php/900222/mod_resource/content/1/G.Hofstede_G.J.Hofstede_M.Minkov%20-%20Cultures%20and%20Organizations%20-%20Software%20of%20the%20Mind%203rd_edition%202010.pdf.
21. Kirchmayer Z, Fratričová J (2020) What motivates Generation Z in the workplace? Innovation Management https://helda.helsinki.fi/server/api/core/bitstreams/8fa325ed-7e27-4387-9284-18bf27c58a57/content.
22. Larsen CS (1997) Bioarchaeology: Interpreting behavior from the human skeleton. Cambr https://www.cambridge.org/in/universitypress/subjects/life-sciences/biological-anthropology-and-primatology/bioarchaeology-interpreting-behavior-human-skeleton-2nd-edition?format=PB&isbn=9780521547482.
23. Mearns K, Yule S (2009) The role of national culture in determining security performance. Security Science 47: 777-785.
24. Neal A, Griffin MA (2006) A study on safety climate and safety performance in organizations. Journal of Applied Psychology 91: 94.
25. Zohar D (1980) Safety climate in industrial organizations: Theoretical and applied implications. Journal of Applied Psychology 65: 96-102.