Defining Characteristics of National BIM Adoption

Dilan M. Rostam[1], Dawood S. Atrushi[1], Dawa A. A. Masih[2,3]† and Diman N. Abdulqader[4]

[1]College of Engineering, University of Duhok, Duhok, Kurdistan Region – F.R. Iraq

[2]Department of Architectural Engineering, Faculty of Engineering, Koya University, Danielle Mitterrand Boulevard, Koya KOY45, Kurdistan Region – F.R. Iraq

[3]Architectural Engineering and Sustainability Department, School of Science and Engineering, Erbil, University of Kurdistan-Hawler – F.R. Iraq

[4]College of Engineering, University of Zakho, Zakho, Kurdistan Region – F.R. Iraq

Abstract—**Building information modeling (BIM) has become a transformative force in the Architecture, Engineering, and Construction industry, streamlining project coordination, reducing costs, and promoting sustainability. Governments worldwide are mandating BIM to enhance efficiency and digital transformation in public projects. However, a roadmap of national adoption requires clear regulations, standardized frameworks, and skilled professionals. This study critically examines policy frameworks, legal considerations, and workforce readiness, educational strategies, identifying key enablers and barriers to national BIM implementation. Utilising a qualitative methodology, the research reviews global BIM adoption models, educational strategies, and legal challenges that serve the BIM adoption in Kurdistan Region. Findings emphasize the importance of BIM maturity models, structured training programs, and data interoperability. Recommendations include developing national BIM standards, integrating digital permitting systems, and fostering public-private collaboration. The Kurdistan Region faces regulatory gaps that hinder BIM validation and industry-wide adoption. Addressing these challenges through the Kurdistan National BIM Standards, aligned with global benchmarks such as ISO 19650 and BSI PAS 1192, will drive digital transformation, enhance project efficiency, and position Kurdistan as a leader in digital construction.**

***Index Terms*—Architecture and engineering construction industry, Building information modeling adaption, Building code, Building information modeling, Digital construction**

I. Introduction

The global construction industry is undergoing rapid digital transformation, driven by advancements in Building information modeling (BIM) technologies. BIM is a procedure which has converted the construction field from a legacy disciplinary to an integrated digital approach. It is accompanied by different tools, technologies, and contracts that are being used to collect, create, analyze, and manage the digital representation of the project model produced (Othman, et al., 2021). BIM, one of the key digital technologies used in the architecture and engineering construction (AEC) industry, has been integrated into AEC Higher education as an emerging technology topic (Wang, et al., 2020). BIM offers a structured methodology for project planning, execution, and facility management by enabling integrated data environments (BSI, 2013). Before construction begins, BIM facilitates a multidisciplinary 3D virtual model, coordinating design elements across project disciplines. It serves as a centralized data source, preventing information conflicts and redefining team roles. BIM's primary objectives are to resolve bottlenecks in the construction industry and provide a streamlined building process (Roshani, 2019). Evidently, countries like the UK, Singapore, and Finland have successfully incorporated BIM specifications to improve project coordination, reduce lifecycle costs, and enhance sustainability (McCuen, et al., 2012). Even so, different rules and industry readiness continue to pose significant challenges to widespread BIM adoption (Cheng and Lu, 2015). This study carefully investigates the characteristics that motivate BIM adoption on a national scale, examining key drivers and barriers through multidisciplinary policy analysis and industry case studies.

The complexity of BIM implementation requires a multi-faceted approach, including technological advances, regulatory frameworks, and workforce training. The success of BIM at a national scale depends not only on government policies but also on active industry collaboration and the ability and motivation of stakeholders to invest in digital transformation. This paper aims to highlight the interdependent factors that influence the adoption of BIM and propose solutions for its efficient implementation.

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†Corresponding author's e-mail: dawa.azad@koyauniversity.org

II. Research Methodology

This study undertakes a detailed analysis of the main factors affecting the adoption and implementation of BIM, focusing on social, strategic, framework, and organizational aspects. The methodology is structured as follows:

- BIM guidelines: Investigates the influence of public organizations on BIM adoption, global standards, and associated challenges. It covers the development of BIM roadmaps, maturity models, and evaluation metrics, and insights drawn from real-world examples.
- BIM application guides: Reviews global best practices, BIM instructions by region and organization, including level of detail/development (LOD), information requirements, and BIM implementation planning to understand the challenges.
- BIM education: Highlights the importance of training programs and certifications in academic and industrial settings to ensure skilled professionals in BIM, which ensures future workforce marketability in the construction industry.
- Legal, security, and best practices: Addresses legal rights, security concerns, and cost considerations in BIM collaboration. It explores stakeholder responsibilities, project interdependencies, and best practices for successful implementation.

This study is founded on a wide analysis of literature, industry standards, case studies, and educational programs. Data are gathered from scholarly articles, government reports, industry publications, and academic institutions. Qualitative analysis is carried out to identify patterns, themes, and critical insights shaping BIM adoption at the national level.

This study attempts to give a more comprehensive knowledge of the challenges and possible advantages of implementing BIM within the AEC industry by closely analyzing these factors.

III. Literature Review

A. Global BIM Policy Frameworks

National Policies that encourage the utilization of BIM in public-sector projects have a substantial influence on how it is embraced. The UK's BIM Level two Mandates, for instance, establishes guidelines for the integration of BIM and mandates that all centrally purchased government projects adhere to certain BIM protocols (BCA, 2012). As an example of how digital transformation can improve compliance, Singapore's BIM e-Submission System streamlines the regulatory approval process (Sacks, Gurevich and Shrestha, 2016). The lack of standardized BIM implementation methodologies in many nations persists despite these developments, leading to uneven adoption and other inefficiencies (Bernstein, et al., 2010).

Adoption rates are often significantly higher in countries with robust regulatory authority for BIM deployment. On the other hand, localities without a regulated mandate frequently struggle with uneven adoption, which leads to inefficiencies and poor project management. For instance, the Nordic nations have effectively incorporated BIM into their national building regulations, which have resulted in notable enhancements to project completion schedules and cost-effectiveness.

Since its early introduction in the late 2000s, BIM implementations have seen tremendous change. At first, nations like South Korea, the United States, Denmark, Norway, and Finland led the way in requiring BIM for public projects (Fig. 1). Numerous other countries have recognized the benefits of BIM throughout time and have put in place their own rules and regulations to encourage productivity, teamwork, and data management in infrastructure and building projects.

Exploring developments in BIM implementation guidelines

United Kingdom

- UK BIM framework updates: The BIM Framework in the United Kingdom was recently revised to better conform to ISO 19650 standards, specifically Parts 2 (ISO 19650-2, 2018) and 3, which address asset delivery and operational stages. The goal of these improvements is to offer more precise instructions for applying BIM at every stage of a project's lifecycle. The emphasis on integrating digital twins is a key component of the updated framework, which reflects the industry's move toward comprehensive lifecycle asset management and real-time data consumption. Benefits of this integration have been observable; for example, in a recent infrastructure project involving a large healthcare facility in the UK, the use of digital twins and workflows that comply with ISO 19650 led to a 20% decrease in design-phase conflicts. This resulted in significant time and cost savings (GlobalCAD, 2025).

Germany

- BIM mandate for federal trunk roads: Starting with a 2015 directive from the Federal Ministry of Transport and digital infrastructure (BMVI) requiring BIM adoption for all federal infrastructure projects by the end of 2020, Germany has gradually incorporated BIM into its infrastructure projects (BMVI, 2016). Expanding on this initiative, the Federal Trunk Roads BIM Masterplan established that by 2025, BIM will become the standard for constructing federal trunk roads, reinforcing Germany's commitment to digitalizing its infrastructure sector (BMVI, 2022).

Norway

- Norway has been implementing its "One-Five-Fifteen-All" strategy since 2007. Statsbygg introduced the first BIM manual in 2008, mandating industry foundation classes (IFC) format for all public projects by 2010. Norway now follows ISO 19650, integrating BIM in road and infrastructure projects with updated 3D modeling guidelines. The country is advancing toward BIM Level 3, emphasizing real-time collaboration and central data management (buildingSMART International, 2024).

Denmark

- Denmark has been a frontrunner in the adoption of BIM, mandating its use for public sector construction projects exceeding €3 million in 2007, with a requirement to follow

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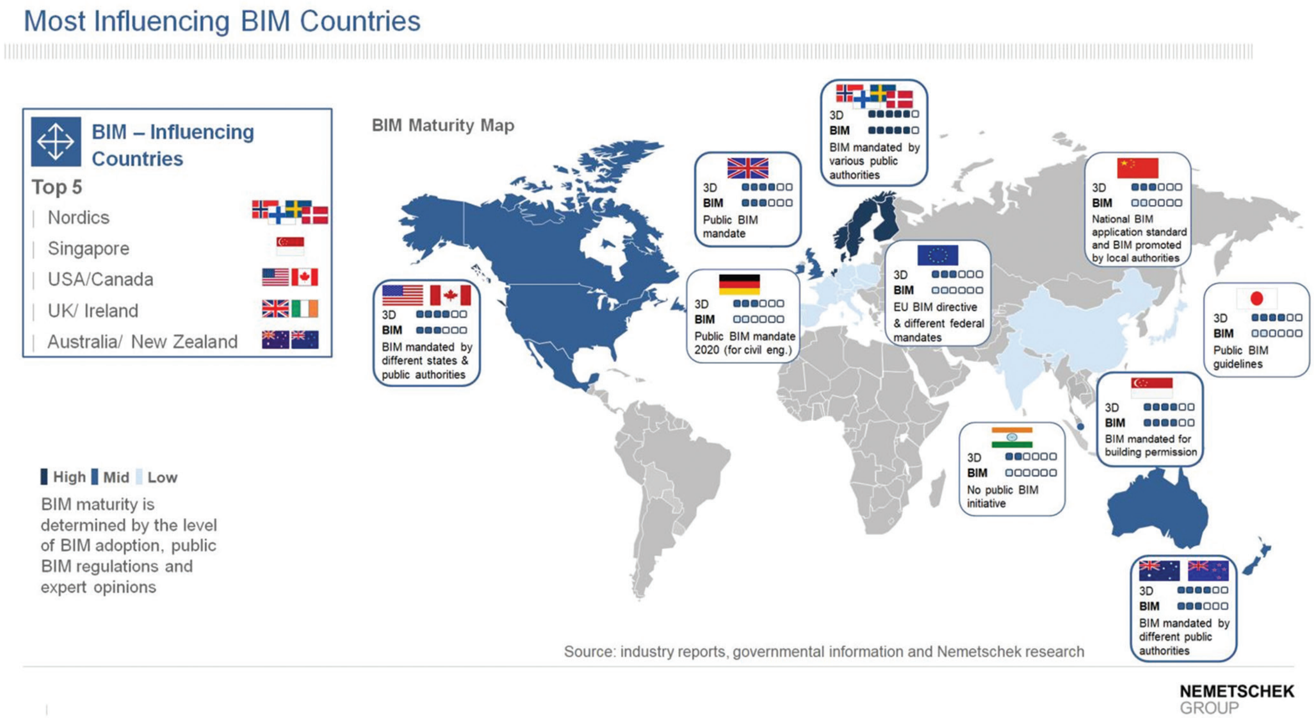

Fig. 1. Most influential Building information modeling (BIM) countries around the world. A map showing the level of BIM technology around the world, with the Nordic countries in first place (BIM Corner, 2020).

IFC standards (Danish Building and Property Agency, 2011). By 2013, this threshold was reduced to €0.7 million, further integrating BIM into public projects. The Danish Building and Property Agency has overseen ICT regulations since 2011, emphasizing the importance of BIM and open-source standards. In addition, Denmark has adopted the ISO 19650 standard, which provides structured guidelines for data management in construction projects (Danish Standards Foundation, n.d.).

Finland

- Finland has been a pioneer in BIM since the late 1980s. In 2007, Senate Properties mandated the use of BIM and IFC standards for all government projects. The Common BIM Requirements (COBIM), introduced in 2012, standardized BIM practices nationwide. The KIRAdigi initiative further integrated BIM into building permit processes. Finland has also adopted the ISO 19650 standard, emphasizing collaborative information management throughout the asset lifecycle. (Global BIM Network, n.d. 2017).

The USA

- The U.S. General Services Administration (GSA) has mandated BIM for major federally funded projects since 2003, requiring model-based design, open-standard facility data, and IFC deliverables. Wisconsin also enforces BIM use, with updated 2022 guidelines ensuring BIM integration in public projects to enhance coordination and lifecycle management. (GSA 2025, Wisconsin, DOA, 2022).

China

- In 2014, the Hong Kong Housing Authority made BIM mandatory for all its projects. This was followed by a government-wide requirement, announced in the 2017 Policy Address, mandating the use of BIM in public works projects exceeding HKD 30 million from January 2018. In mainland China, BIM adoption was emphasized in the 12^{th} 5-year Plan as a key technological development. Hunan Province aimed to implement BIM in public design and construction projects exceeding RMB 60 million or 20,000 square meters by late 2018, targeting 90% adoption in new structures by 2020. Similarly, Fujian introduced BIM for selected projects exceeding RMB 100 million in 2017. At the national level, by 2020, 90% of new construction projects and A-class residential buildings were required to incorporate BIM (Development Bureau, 2020; Construction Industry Council, 2020; Li, 2013).

South Korea

- Ministry of land, infrastructure, and transport and the public procurement service (PPS) have progressively expanded the mandatory use of BIM in public projects since 2010. Initially applied to a limited number of projects, BIM requirements extended to all "total service" projects exceeding 50 billion KRW by 2012 and to all such projects by 2016. A "total service" project is one where PPS oversees the entire procurement and construction process. In 2020, the government introduced a ten-year roadmap to facilitate the gradual adoption of BIM across all project stages, ensuring comprehensive lifecycle integration (IAARC, 2021).

Ireland

- Phased BIM implementation: Ireland's Department of Public Expenditure and Reform released a strategic plan in November 2017 to make it easier for public works projects to integrate digital technology. Starting with bigger, more complicated projects, this plan suggests implementing BIM gradually over four years. The program seeks to promote effectiveness and teamwork in public construction projects. (Department of Public Expenditure and Reform, 2017).

Italy

- Legislative decree No. 50, which outlined a phased implementation of BIM in public bidding processes, was introduced in Italy in April 2016. For the design, construction, and management of public building projects, this order required the progressive implementation of digital techniques and tools, such as BIM. Beginning on January 1, 2019, the implementation schedule mandated the use of BIM for complicated projects worth at least €100 million; in succeeding years, the threshold was lowered. This strategy demonstrates Italy's dedication to boosting innovation and efficiency in public construction projects (Legislative Decree No. 50/, 2016, Ministerial Decree No. 560/, 2017).

Spain

- To implement BIM into public projects, Spain's Ministry of Development formed a commission in 2015. The Panel set a timeline for mandatory adoption of BIM by July 2019 for infrastructure projects and December 2018 for building projects (BIM Community, 2019). The Catalan Municipal Government also established the "Construïm el Futur" (We Build the Future) group in February 2015 to develop a strategy for BIM implementation, with a goal of having it be adopted widely by 2020 (CCF|Comissió Construïm el Futur, 2015, es. BIM Commission, 2015).

France

- France launched Plan BIM 2022, spearheaded by the Association for the Development of Digital in Construction (AND construction) and backed by the digital platform KROQI to further digitize the construction sector in the wake of the building transition digital plan (PTNB). With a €20 million budget, the PTNB was founded in 2014 with the primary objective of encouraging the use of BIM in the construction of 500,000 homes by 2017. By making the program mandatory in 2017, France reaffirmed its commitment to digital transformation in the building industry (European BIM Summit, 2019).

Israel

- The Israeli ministry of defense began a plan in 2016 to require all of its construction projects to use BIM by 2019. The goal of this action was to boost cooperation and efficiency in construction projects related to defense (Sacks, 2019).

Global standards and guidelines

- International BIM implementation guide: The International BIM Implementation Guide, released by the royal institute of chartered surveyors (RICS), provides high-level guidelines for applying and utilizing BIM during the built environment projects' design, construction, and operation stages. The development of regional or national standards for the adoption of BIM can be guided by the comprehensive framework that can be created using this guide (RICS, 2016).

These developments highlight the global tendency toward adopting and expanding BIM practices. As technology advances and the benefits of BIM become increasingly evident, it's estimated that more countries will establish or update their BIM implementation guidelines to stay at the forefront of digital transformation in the construction industry (Fig. 2).

B. Challenges in BIM Adoption

Early BIM mandates primarily required design data submissions in formats like IFC. As BIM adoption progressed, requirements became more detailed. For instance, the Korea Power Exchange headquarters project in 2009 had specific BIM criteria, including automated verification of spatial requirements, design quality assessments (such as clash detection and compliance with safety regulations), and energy performance evaluations. Despite these detailed requirements, a post-tender review revealed that the industry and available software were not fully equipped to meet all demands, leading to the development of South Korea's gradual BIM implementation roadmap (KPX, 2010).

In 2013, Denmark expanded its BIM mandate to include seven key requirements: coordinated use of information and communication technology, management of digital building objects, use of digital communication platforms, utilization of digital building models, digital quantity takeoff and bidding, digital delivery of building documentation, and digital inspection (Karlshøj, 2016).

The UK's BIM mandate, announced in 2011 and effective from April 2016, introduced Level 2 BIM, defined by the PAS 1192 series. PAS 1192–2:2013 specifies requirements for information management during the capital delivery phase, including documents like the master information delivery plan, BIM project execution planning (BEP), and employer's information requirements. Subsequent standards, such as PAS 1192–3 and PAS 1192–5, address information management during the operational phase and security considerations, respectively (BSI, 2013; BSI, 2014).

While national BIM guidelines set minimum standards, project-specific requirements may necessitate additional criteria, such as specific BIM methodologies, a minimum number of BIM professionals, or the use of particular platforms.

Despite its advantages, BIM implementation faces several obstacles. One major challenge is workforce readiness and training deficiencies, as many professionals lack formal BIM education, and academic curricula remain inconsistent (McCallum, 2012). In addition, regulatory and contractual

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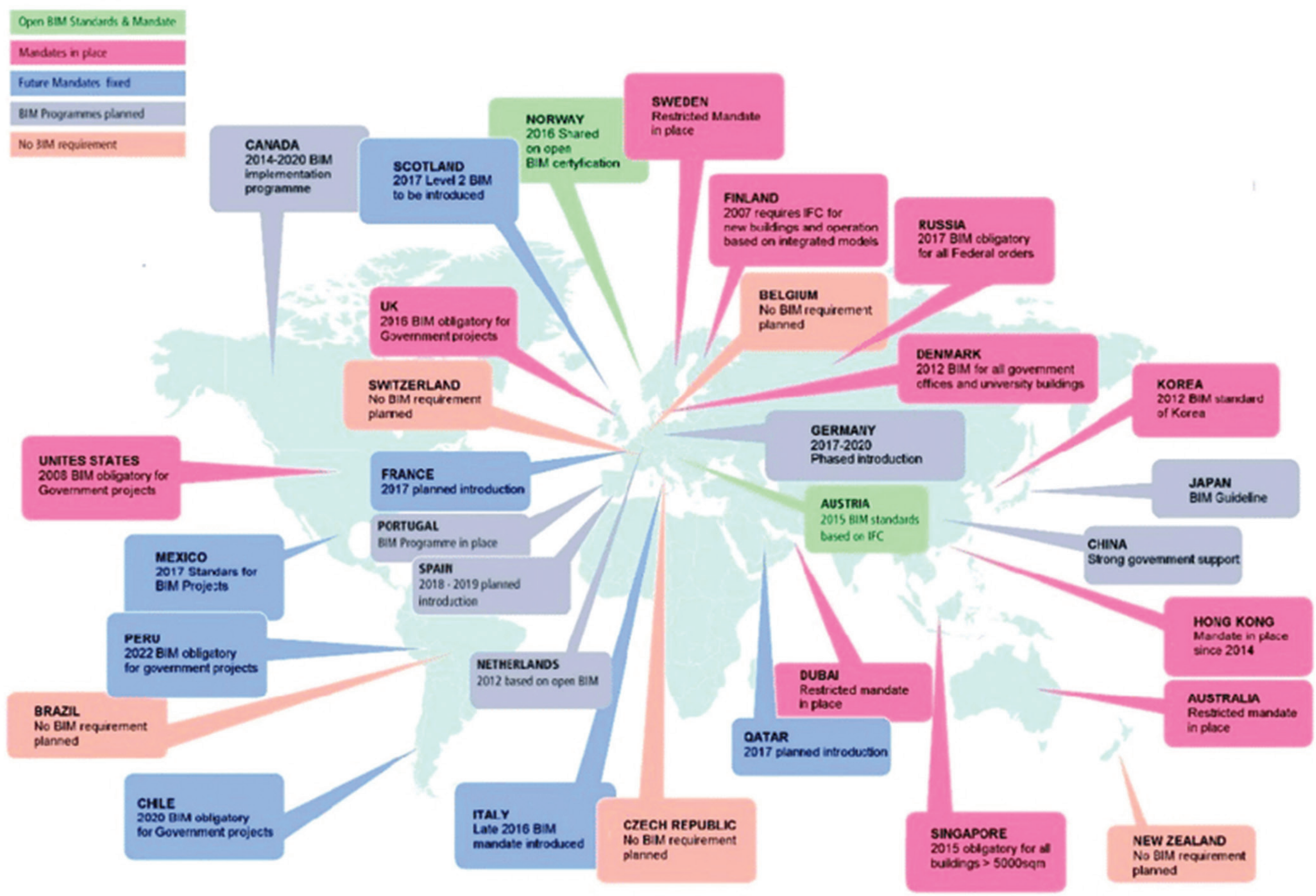

Fig. 2. Overview of global Building information modeling adaptation (Zima, Plebankiewicz and Wieczorek, 2020).

ambiguities create uncertainty, with jurisdictions often failing to define BIM-specific legal frameworks, resulting in disputes over intellectual property rights and project responsibilities (ISO/TS 12911, 2012). Data interoperability issues further complicate adoption, as the absence of universal data exchange standards prevents seamless collaboration across software platforms (Karlshøj, 2016).

Organizational resistance to change is another drawback, as traditional procurement and project delivery models are unable to accommodate BIM's integration workflows (Kam, Song and Senaratna, 2016). BIM studies have documented the advantages of BIM implementation in AEC Advantages for example, better design quality, improved communication, lower construction cost and execution time, lifecycle information management (Saka and Chan, 2023). In addition, technological barriers such as limited access to advanced digital tools and cloud-based collaboration platforms restrict scalability, particularly in developing markets (Teicholz, 2004). These concerns underline the demand for specific policy interventions and initiatives led by the industry to make BIM implementation more seamless.

Government BIM mandates reinforce industry understanding, but their benefits are not immediately visible. Key considerations include:

- Education: Stakeholders must receive professional BIM training to avoid mismanagement.
- Avoiding "BIM Wash": Superficial BIM implementations can be controlled through phased adaptation strategies.
- Clear data definitions: Clearly defining BIM handover data prevents inefficient information exchange.
- Learning curve: Acknowledging the time required to master BIM is crucial. For example, in Denmark, it took seven to eight years after BIM was mandated to fully appreciate its benefits (Karlshøj, 2016).

In summary, while government mandates facilitate BIM integration, achieving meaningful benefits requires educating stakeholders, preventing superficial implementations, clearly defining data requirements, and adopting the progressive learning process.

IV. Research Findings

A. National BIM Roadmaps and Maturity Models

Many nations have developed BIM maturity models to guide implementation (Succar, 2010). A BIM Maturity Model is a structured framework used to assess, measure, and guide the level of BIM adoption and implementation within an organization, project, or industry. These models help track progress, identify gaps, and set strategic goals for improving BIM capabilities. The UK BIM Maturity Model progresses from 2D workflows (Level 1) to fully integrated environments (Level 3) (Sacks, Korb and Barak, 2017). Finland's COBIM Framework emphasizes interoperability, while Singapore's Smart Nation Initiative integrates BIM into broader digital strategies. BIM roadmaps outline steps to achieve maturity, with mandates specifying objectives and guides providing instructions (Fig. 3). Early roadmaps, such as Skanska Finland and the US Army Corps of Engineers, show phased BIM adoption. Modern roadmaps differ in focus, collaboration levels (as seen in CRC's three-phase model), project scope (as exemplified by Singapore's floor area-based roadmap), or phased implementation (as in South Korea's three-stage roadmap). Some, for example, the UK's HS2 roadmap, use descriptive methods, while others apply structured methodologies.

B. Adoption Barriers and Industry Challenges

BIM maturity models assess and quantify BIM capabilities using evaluation criteria and maturity levels. They measure individuals, teams, organizations, or industries. Simple models classify knowledge levels (beginner, intermediate, expert), while advanced models, like the BIM capacity maturity model, evaluate areas such as data diversity, process efficiency, and interoperability (McCuen, et al., 2012). KPIs are crucial for assessing BIM adoption (Fig. 4), covering scheduling, cost impact, return on investment (ROI), request for information (RFIs), and rework reduction. BIM improves ROI by reducing project costs, minimizing errors, and increasing efficiency, and BIM reduces RFIs by improving collaboration, accuracy, and data transparency in the design and planning stages. However, critical metrics such as energy use, risk, and waste reduction remain underutilized.

C. BIM Executive Directives and Implementation Challenges

BIM directives include standards and guides that establish best practices (Cheng and Lu, 2015). These range from global standards (ISO/TS 12911, 2012) to national guidelines and project-specific requirements. Early BIM guides, for instance, the AGC's BIM Guide for Contractors (2006) and GSA's BIM Guide Collection (2007), focused on introducing best practices, but modern directives are more detailed and interconnected. A BIM guide typically includes project planning, technical specifications, implementation, tools, and legal aspects (BSI, 2014a; Keenliside, 2015). Key challenges include the LOD and information requirements. Initially referring to 3D model complexity (Bips, 2007), LOD now represents information detail across project phases (AIA, 2008; 2013; 2022). Despite LOD frameworks, defining precise information requirements remains challenging, as LOD standards vary globally (Bernstein, et al., 2014; BSK, 2016). Clear communication and iterative negotiation are essential for successful BIM implementation.

D. Local Implementation Challenges: Kurdistan Region

Although the United Nations Human Settlements Programme (UN-Habitat) has played a role in reviewing and updating building codes in Iraq, including the Kurdistan Region (UN-Habitat, n.d.), the lack of a unified National Building Regulation remains a major drawback to the implementation of BIM, especially in architectural, structural, and civil engineering. Building structures are designed with a variety of codes in the Kurdistan region and other parts of Iraq. The government does not have control over building design codes (BDC) or building materials used in construction (Abdulqader and Atrushi, 2022).

The Kurdistan Region's lack of a unified National Building Regulation significantly hinders effective BIM implementation, particularly in structural and civil engineering. This regulatory gap creates several interconnected challenges:

1. Lack of standardized BIM requirements: Established building codes often leverage BIM to ensure compliance

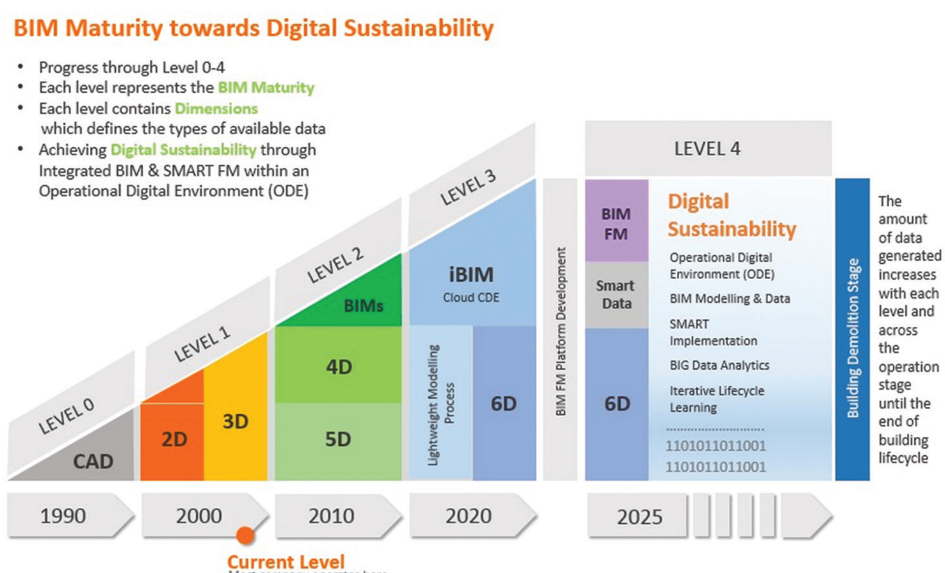

Fig. 3. Building information modeling maturity toward digital sustainability (Prostruct Consulting, 2018).

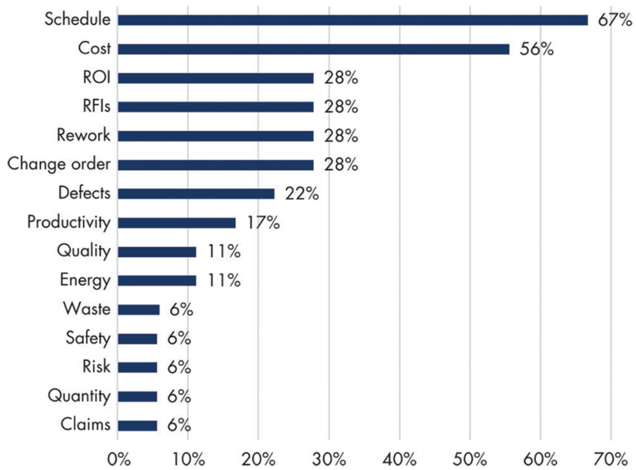

Fig. 4. The most common criteria used to measure Building information modeling status (WON, 2014).

with structural safety standards and design codes (e.g., Eurocodes, ACI). In Kurdistan, the absence of a national code necessitates reliance on multiple, non-unified standards, leading to inconsistent BIM models and design ambiguities. Without government-mandated BIM standards, there's no formal requirement for Level 2 or 3 workflows, slowing adoption and reducing efficiency in large-scale infrastructure projects.

2. Structural and civil engineering design validation issues: Regulated environments require BIM models integrating analysis tools (e.g., finite element analysis) to align with national seismic codes and material guidelines. Kurdistan's lack of binding regulations means no legally enforced validation process exists for BIM-based structural design. This increases risks in load-bearing calculations, earthquake resilience, and infrastructure durability, as models may be developed using varied international standards without local adaptation.
3. Unclear permitting and approval processes: Many regions integrate BIM-based digital permitting systems. In Kurdistan, the lack of digital building permit regulations means manual approval processes, where BIM models are not officially required or reviewed for compliance in structural and civil engineering. This results in delays, inconsistencies, and missed opportunities for using BIM in quality assurance.
4. Construction coordination and clash detection problems: Civil engineering projects benefit from BIM clash detection. Without regional BIM regulations, projects rely on traditional 2D approvals, leading to design conflicts, costly rework, and project delays due to poor coordination.
5. Limited governmental and institutional support for BIM in infrastructure: Countries like the UK mandate BIM for public infrastructure projects. In Kurdistan, public projects lack government-mandated BIM frameworks, meaning civil and structural engineers miss out on the benefits of predictive analytics, digital twins, and asset lifecycle planning.
6. Disunity in education in the Kurdistan Region: The Kurdistan Region's lack of standardized BIM implementation and a unified BDC presents a significant educational challenge. This disunity is evident in university curricula, where diverse and often conflicting BDCs are taught. This inconsistency creates a haphazard educational environment, hindering the development of a cohesive and standardized construction industry.

V. Analysis Of Research Findings

A. Motivations

The adoption of BIM is driven by multiple factors:

- Economic impact: While manufacturing industries have benefited from efficiency improvements, construction lags (Egan, 1998; Teicholz, 2004). BIM enhances productivity and cost-effectiveness.
- Project life cycle optimization: BIM improves design, construction, and facility management throughout a project's lifespan.
- Government initiatives: Many governments integrate BIM standards (IFC, COBie) to enhance public infrastructure planning and regulatory compliance.
- Data-driven decision-making: BIM supports predictive analytics and risk assessment, improving project outcomes.
- Sustainability goals: BIM aligns with global environmental agreements of the UNFCCC Kyoto Protocol (1998) and the Paris Agreement (2015) (UNFCCC Kyoto Protocol, 1998; Paris Agreement, 2015) by optimizing resource efficiency (Bernstein, et al.,2010; Krygiel and Nies, 2008).
- Industrial competitiveness: Countries adopt BIM mandates to maintain global leadership in digital construction.

BIM's ability to deliver faster, cheaper, and safer projects while promoting sustainability underscores its growing significance.

B. BIM Implementation Planning

Early BIM adoption faced challenges due to a lack of standardized implementation strategies. Contractors like DPR, Mortenson, and Beck Group initially developed their own guidelines, but a need for a structured approach emerged.

- Penn State University (PSU) introduced the BIM BEP Guide (CIC, 2011), which remains a widely used framework.
- The BEP process follows four key steps:
  - Define BIM objectives and applications
  - Implement BIM in design
  - Develop methods for data exchange
  - Plan infrastructure for BIM integration.
- The PSU framework provides 14 essential deliverables, including project strategy, stakeholder roles, collaboration protocols, and quality control.

Despite its widespread adoption, various BEP templates pose a challenge in selecting the best fit for projects. In response:

- PSU introduced the BIM Planning Guide for Facility Owners (CIC, 2013; 2019) to support long-term BIM integration.
- The University of Florida's Integrated Green BIM Process Map (Wu and Isa, 2013) was developed for green building projects.

C. Challenges and Considerations

While BIM regulations help streamline adoption, challenges persist:

- Education and training: Project managers and owners must have BIM competency; otherwise, BIM adoption is shallow.
- Steering clear of "BIM Wash": Some companies misuse BIM, implementing it as a basic 3D modeling method rather than an integrated process. A clear implementation plan is necessary to overcome this.
- Data mismanagement: Various stakeholders ask for IFC or COBie models without specifying the necessary data formats and quality requirements.
- Long learning curve: It takes time for BIM adoption. Denmark's experience is that it takes 7–8 years to achieve BIM's full potential (Karlshøj, 2016).

D. Overcoming BIM Challenges in the Kurdistan Region

The lack of national building regulations is a major obstacle to implementing BIM in the Kurdistan Region, particularly in structural and civil engineering. To address this, the Kurdistan Regional Government (KRG) should:

1. Develop and enforce national building codes
   - Formulate Kurdistan National Building Regulations (KNBR) that comply with comply due to proximity to the European market.
   - Integrate BIM-based checks as a compulsory mechanism for structural integrity, load analysis, and seismic safety.
2. Introduce BIM as a mandatory tool for Public Infrastructure
   - Adopt a BIM roadmap for government-funded projects (e.g., roads, bridges, and utilities).
   - Require IFC-based models for long-term asset management and interoperability.
3. Adopt digital permitting and approvals based on BIM
   - Establish a digital permit system that requires BIM submissions before approvals.
   - Ensure BIM compliance standards through collaborative efforts with engineering institutions.
4. BIM training and capacity building
   - Drive BIM certification schemes with international institutions such as ISO 19650–2:2018, BSI PAS 1192, etc.
   - Offer tax allowances or incentives to companies that implement BIM-based processes.

The absence of a unified regulatory framework poses a considerable challenge to the effective implementation of BIM within the Kurdistan Region. To align with global best practices and realize the transformative potential of BIM, the region must prioritize the development and enforcement of standardized BIM policies, matched with robust compliance testing and the adoption of digital workflows. Furthermore, a decisive step toward adopting a singular, nationally recognized BDC is fundamental. Construction authorities must play a leading role in this process, guiding the selection and implementation of the most appropriate design code to ensure consistency and clarity (Abdulqader and Atrushi, 2022).

The establishment of clear BIM standards and the adoption of a national BDC are not minor technical adjustments; they represent a fundamental shift toward a more organized and sustainable construction ecosystem. This unified approach will improve the current discrepancies between educational institutions, private construction firms, and governmental departments, fostering a shared understanding and reducing confusion. Moreover, it will enhance design control, streamline regulatory compliance, and promote fair competition based on quality and price. By embracing a consolidated BDC, the Kurdistan Region of Iraq can establish a common language for building design, facilitating smoother collaboration and ultimately contributing to a more efficient and transparent construction sector.

VI. Summary And Conclusion

BIM achieves successful implementation through skilled professionals and clear regulations, together with educational integration and collaborative frameworks. The worldwide emergence of BIM training and certification programs strengthens its adoption. The expansion of collaborative processes creates a requirement for legal and security frameworks to mitigate risks and establish standardized best practices. BIM achieves continuous improvement through its iterative execution-evaluation-refinement process, which establishes it as a cornerstone of the emerging construction sector.

The Kurdistan Region faces challenges in BIM validation, permitting, and coordination because KNBR do not exist, which restricts government support and limits industry growth. The closing of these deficiencies demands the establishment of transparent BIM regulations, alongside formal training programs and adoption motivation schemes. The implementation of Kurdistan National BIM Standards in accordance with global standards like ISO 19650 and BSI PAS 1192 will improve efficiency and cost-effectiveness while ensuring safety across public and private construction projects.

The KRG needs to create a BIM regulatory institution while investing in digital permitting technologies to embed BIM into infrastructure projects for sustained success. Through this progressive approach, the Kurdistan Region will become a leader in digital construction that drives economic growth while supporting sustainability and industry innovation.

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