

A Model for BIM Adoption in the Government Sector of Bulgaria [†]

Alexander Petkov ^{1,2} 

¹ Informatics Department, Faculty of Applied Mathematics and Informatics, Technical University of Sofia, 1000 Sofia, Bulgaria; alexpetkov@tu-sofia.bg or alex@acstre.com

² Research and Development Sector, Technical University of Sofia, 1000 Sofia, Bulgaria

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Abstract

Building Information Modelling (BIM) is a key component of the digital transformation of the construction industry. The government of Bulgaria has accepted a National Strategy for The Digital Transformation of the Construction Industry which defines a set of goals and measures to achieve these goals. In this paper, we examine the goals and measures of the strategy related to adoption of BIM in the government sector and propose a model for the adoption, emphasizing the use of existing standards and open-source solutions.

Keywords: BIM; GIS; e-governance

1. Introduction

Building Information Modelling (BIM) is defined as the *use of a shared digital representation of a built asset to facilitate design, construction and operation processes to form a reliable basis for decisions* [1].

For the public sector, BIM can be thought of as ‘digital construction’. It combines the use of 3D computer modelling with whole-life asset and project information to improve collaboration, coordination and decision-making when delivering and operating public assets [2].

Among policymakers, BIM is expected to improve the performance of the construction sector. For built assets, this translates to 10% savings on time delivery, lower operational costs, less site waste, higher standards for health and safety. For the construction sector, the benefits of BIM are improved sector competitiveness, growth of the export capabilities, resource efficiency, and cleaner and safer jobs in construction, among others. Given those benefits, one would expect that BIM would swiftly become a standard practice across the industry. However, the adoption of BIM has encountered several obstacles that hinder its widespread implementation. One significant challenge is the fragmentation of the construction sector which is dominated by small and medium enterprises. With nearly 95% of the construction sector being SMEs, it is difficult for the sector to align in one direction. At the same time, governments are the largest procurers of construction, accounting for nearly 30% of all procurements. This means that governments are in a position to significantly influence the market. Thus, government incentive can be a driving force for BIM adoption. In Europe, we can see a trend of governments taking a leading role in encouraging and creating a demand for BIM [2]. Table 1 shows an overview of the adoption of BIM by country, until 2021 [3].



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Table 1. Overview of BIM adoption in Europe by country, until 2021.

Country	Year	BIM Program/Mandate
Finland	2007	Open-BIM mandate for new buildings
Norway	2008	Open-BIM mandate
Denmark	2011	BIM mandate for all government buildings
Netherlands	2012	Open-BIM mandate for infrastructure
Austria	2015	Introduction of Open-BIM standards
Sweden	2015	BIM mandatory for transportation
United Kingdom	2016	BIM compulsory for government contracts
France	2017	Announcement of BIM roadmap
Germany	2017	Phased BIM implementation for infrastructure
Czech Republic	2017	Launch of BIM program
European Union	2017	Handbook for the introduction of BIM
Spain	2018	BIM mandatory for all the public construction tenders.
Italy	2019	BIM mandate for large public projects
Russia	2021	BIM mandatory for federal contracts

As we can see, most of the large European economies have already introduced BIM at the government level. This puts a significant pressure on all other countries to also introduce BIM to improve their competitiveness.

The government of Bulgaria has taken steps in that direction. In 2020, a “National Workgroup for the Introduction of BIM for the Entire Lifecycle of Constructions” was created by the Ministry of Regional Development and Public Works. The workgroup had the following tasks:

1. To create a draft of a long-term strategy for the introduction of BIM in the design, delivery and operation of built assets, as a foundation for the digital transformation of the construction sector.
2. To create a draft of an action plan for the execution of the long-term strategy, that details the execution of the strategy and organizes and plans its execution, monitoring, evaluation and needs for updates.

In 2023, a “National Strategy for the Digital Transformation of the Construction Sector 2030” and a roadmap for it were approved by the Ministry of Councils. It is a relatively short-term strategy—until 2030—with the goal of creating the conditions that enable the digital transformation of the construction sector [4].

In this paper, we examine the goals and measures of the strategy related to adoption of BIM in the government sector and the propose a model for its adoption, using the existing infrastructure and international open standards.

2. Relevant Goals and Measures

The strategy sets the following strategic and operational goals regarding BIM:

- Creation of regulatory conditions and IT infrastructure for the implementation of BIM;
- Provision of material resources for the introduction of electronic administrative services related to BIM in investment design;
- Development of digital capacity and skills of public administration engaged in investment design;
- Preparation of the educational system to provide quality training in the application of BIM in vocational high schools for secondary technical education in the field of construction;
- Preparation of the educational system to provide quality training in the application of BIM in higher education institutions;
- Increasing the capacity of participants in design and construction;

- Development of activities related to innovation in the construction sector;
- Ensuring awareness and active participation of the construction sector in the process of digital transformation.

Of these, we focus on the goals that particularly affect the government sector: creation of regulatory conditions and IT infrastructure for the implementation of BIM, provision of material resources for the introduction of electronic administrative services related to BIM in investment design and development of digital capacity and skills of public administration engaged in investment design.

2.1. Creation of Regulatory Conditions and IT Infrastructure for the Implementation of BIM

This aspect is important because the act that governs the construction process in Bulgaria in its current form requires that the investment projects are submitted on paper [5]. Creating the conditions for effective electronic administrative services in the investment process is at the heart of the digital transformation for the government sector and has the potential to be a huge driving force for the wider adoption of BIM, because it will allow the participants in the process to use BIM data in their interactions with the administration.

The measures in the strategy are:

- Analysis and development of a legislative framework;
- Development of a national BIM model, templates, and procedures for collecting, managing, and sharing information, security, and access control based on BDS EN ISO 19650 [6] and CEN standards;
- Development of BIM object libraries that reflect construction products and materials in infrastructure construction;
- Creation of software infrastructure for working with BIM projects in the process of approving and coordinating investment projects;
- Introduction of requirements for the application of BIM in public procurement;
- Analysis of the application of BIM and the readiness of the sector to determine the scope of public procurement for construction projects in the third phase of BIM implementation.

2.2. Provision of Material Resources for the Introduction of Electronic Administrative Services Related to BIM in Investment Design

The hardware requirements for BIM are an important consideration when it comes to the approval of large BIM projects, as regular workstations may struggle with such large models. Another very important aspect is the availability of viewing software for the public administration because, unlike paper and 2D schematics, BIM models require specialized software to view and collaborate. Thus, there is going to be a large circle of experts who used paper and 2D PDFs who now need easy-to-use specialized software. Of course, this will require training and the availability of online resources. The measures for this goal are:

- Provision of hardware and software for experts from municipal, district, and state administrations involved in the process of coordinating and approving investment projects;
- Development of a web-based platform with published online training, an interactive guide (manual) for the national BIM model, design and approval processes for BIM projects, and resources for download such as libraries, templates, and forms, as well as applications for checking digital maturity for enterprises in the construction sector;
- Pilot development of a module for automated conflict detection between all engineering networks, structural and architectural elements within the BIM model, and for automated coordination.

2.3. Development of Digital Capacity and Skills of Public Administration Engaged in Investment Design

As already mentioned, specialized training is required if the experts in the public administration are going to move from paper to digital models. The measures in the strategy are:

- Conduct specialized training aligned with the general framework standards for the implementation of BIM and European best practices in administration;
- Prepare an online training format for the subsequent training of personnel from all interested administrations through the Institute of Public Administration;
- Conduct annual training for experts from public administrations.

3. Relevant Local and International Standards

The strategy calls for the introduction of BIM Level 2 and openBIM in the construction sector in Bulgaria. Level 2 BIM promotes collaborative working by giving each of the stakeholders its own 3D CAD model. Collaborative working is the distinguishing aspect of this level and Level 2 requires streamlined information exchange related to a project and seamless coordination between all the systems and the stakeholders. All the parties work on their local 3D CAD models and information is exchanged through a common file format. Such a system allows organizations to combine external data with their own model to create a federated BIM model [7].

To achieve this goal, vendor-neutral open standards that promote collaboration are crucial. Here we examine some of the most well-known international standards that fulfil these criteria. To make the introduction of BIM more natural and seamless, we examine the existing national standards and infrastructure. We will later present our adoption model where we blend the local and international standards together.

3.1. International BIM Standards

buildingSMART (Kings Langley, United Kingdom) is the worldwide industry body driving the digital transformation of the built environment [8]. It is responsible for the development of many international BIM standards and the concept of openBIM—a collaborative process that is vendor-neutral. In this paper we will base our adoption model on the principles of openBIM [9]:

1. Interoperability is key to the digital transformation in the built asset industry;
2. Open and neutral standards should be developed to facilitate interoperability;
3. Reliable data exchanges depend on independent quality benchmarks;
4. Collaboration workflows are enhanced by open and agile data formats;
5. Flexibility of choice of technology creates more value to all stakeholders;
6. Sustainability is safeguarded by long-term interoperable data standards.

3.1.1. Industry Foundation Classes (IFC)

The Industry Foundation Classes (IFC) format, developed by buildingSMART, is the leading international standard for BIM. IFC provides a standardized, digital representation of the built environment, covering buildings and civil infrastructure. As an open, international standard (ISO 16739-1:2018 [10]), IFC is vendor-neutral and compatible with various hardware, software, and interfaces, supporting numerous use cases. The IFC schema specification is buildingSMART International's main technical output to advance openBIM [11].

3.1.2. Information Delivery Specification (IDS)

An Information Delivery Specification (IDS) is a machine-readable document defining the Exchange Requirements for model-based exchange. It specifies how objects, classifications, properties, and values and units should be delivered and exchanged, potentially integrating Industry Foundation Classes (IFC), Domain Extensions, and additional classifications and properties [12].

3.1.3. BIM Collaboration Format (BCF)

The BIM Collaboration Format (BCF) facilitates communication of model-based issues and topics between different BIM applications, using previously shared IFC models [13]. It is a key component for an open, structured collaboration model where issues are semantically connected to model data.

3.1.4. Documents API

The Documents API simplifies the downloading and uploading of files to a common data environment (CDE). Its specification defines the processes for file selection, discovery, download, and upload. When both client and server support it, the API offers a straightforward and integrated method for syncing cloud-stored documents with local applications [14].

3.1.5. Dictionary API

The Dictionary API is the primary way to access the buildingSMART Data Dictionary (bSDD) service [15]. The service itself is a collection of interconnected data dictionaries with definitions of terms to describe the built environment. The service is provided by buildingSMART for free, to enable easy access from all software solutions. Each data dictionary in bSDD contains definitions of classes and properties to describe the built environment. bSDD serves as a library for referencing shared definitions in IDS specifications and IFC data [16].

3.2. Bulgarian Standards and e-Government Infrastructure

3.2.1. Regulation on Document Exchange in the Administration

All government administrations in Bulgaria have **Administrative Information Systems (AIS)**, as required by Article 4 of [17].

The AIS ensures the maintenance and processing of data for the circulation of electronic documents and paper documents in the provision of administrative services and the execution of administrative procedures. As per the regulation, AISs must be used to store e-documents, must accept e-documents for e-administrative services, must manage tasks and more, essentially requiring that **AISs are true eDMSs which can exchange documents between each other.**

3.2.2. Environment for Electronic Exchange of Messages

The Environment for Electronic Exchange of Messages is a technical protocol, approved initially by the chairman of the State Agency “Electronic Government” and later by the Minister of Electronic Governance. Since 2018, all administrations must exchange documents **only in electronic form** through this technical protocol. The public administrations in Bulgaria must use only AISs that support the protocol [18].

3.2.3. Horizontal e-Government Systems

The Ministry of Electronic Governance supports a number of horizontal e-government systems, among which are:

- RegiX;
- e-Authentication;
- e-Delivery;
- e-Payment;
- Unified Portal for Electronic Administrative Services.

RegiX is a system that allows government registries to publish automatic internal administrative services that provide information stored in the registry. The purpose of the system is to reduce administrative burden on citizens and businesses [19].

e-Delivery is an electronic registered mail service. It provides legally binding delivery of electronic documents between government administrations, businesses and people.

e-Authentication is a Single Sign-On service that uses several options for electronic identification, such as a qualified digital signature, personal identification codes issued by trusted government parties and others.

e-Payment is a payment system for administrative services and the Unified Portal for Electronic Administrative Services is where public administrations publish the electronic administrative services that they provide.

4. A Model for BIM Adoption

4.1. Key Software Components of the BIM Infrastructure

We have identified the following software components that are required for a functioning BIM infrastructure:

- Common Data Environment (CDE);
- Electronic Document Management Systems (eDMSs);
- BIM Authoring Software;
- BIM Viewing and Collaboration Software;
- Data Dictionary Service.

The purpose of the CDE is to provide a single source of truth about the built assets. The eDMSs manage the exchange of documents between participants and the internal business processes of every participant.

The BIM Authoring software is what the architects, constructors, facility managers and others use to create and update the digital models.

The BIM Viewing and Collaboration Software is the equivalent of a PDF viewer or sheet of paper for schematics—a simple tool that allows all participants to collaborate on a digital model.

The Data Dictionary Service is an extensible semantic ontology that enhances the base definitions in IFC with national-level detailed definitions.

4.2. Model for BIM Adoption

Here we propose a model for BIM adoption by the government sector of Bulgaria, based on the international standards and the openBIM workflow, the existing e-governance infrastructure of Bulgaria, and the National Strategy for the Digital Transformation of the Construction Sector 2030. The model is illustrated in Figure 1.

In our model, a lot of existing software infrastructure is reused. Only two software modules need to be developed: a Central BIM Registry and a BIM Viewing and Collaboration Software. The government also needs to codify its national definitions and requirements; this is the National Model for BIM.

to the requirements through integration with the Documents API. Using the same API, administrations can update their IDS requirements as they change over time.

4.2.3. BIM Viewing and Collaboration Software

As discussed earlier, many participants in construction will have to use specialized software to do what they used to do on paper and PDFs. This software does not need to be the same for everyone. Through the use of openBIM, organizations and users are free to use a BIM viewing and collaboration software of their choice. The software is expected to provide the following functionalities (not all users will need all functions):

1. Support for the IFC file format;
2. Simultaneous work with more than one information container (federated BIM model);
3. 3D visualization tools—rotation, translation, zoom, cutting planes, viewing modes with different level of detail, isolation of chosen elements;
4. Measurement tools;
5. BCF viewing and authoring;
6. IDS validation and authoring;
7. Documents API integration.

4.3. The Government BIM Process

The intended usage pattern of the proposed model is as follows:

1. A set of common requirements and templates developed by the government (a National BIM Model) is available in the Central BIM Registry;
2. Architects, builders, facility managers and others use the requirements and templates to create and update BIM models using an authoring tool of their choice;
3. Investors upload the BIM models to the registry and submit applications for administrative services to the government bodies with identifiers/links to the BIM models in the registry;
4. Administrations use a BIM viewing and collaboration software of their choice to create BCF requests for information or raise issues;
5. Approving administrations request internal administrative services from other administrations through EEEM or e-Delivery using their AIS, requests include the identifier/link to the BIM model in the registry;
6. All issues and requests for information are linked to the original model uploaded in the Central BIM Registry;
7. All documents sent between administrations and between them and the investor contain identifiers/links to the information container in the Central BIM Registry which allows the receiver to view the issue/model;
8. The Central BIM Registry is the single source of truth about the latest data but access to the data is restricted by requiring official document exchange between the parties that contains the identifiers/links that allow access.

5. Conclusions

The presented model integrates the principles of openBIM and incorporates the BIM workflows into the existing software infrastructure of Bulgaria to allow a swift and effective adoption of BIM in the government sector.

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Abbreviations

The following abbreviations are used in this manuscript:

AIS	Administrative Information Systems
API	Application Programming Interface
BCF	BIM Collaboration Format
BDS	Bulgarian State Standard
BIM	Building Information Modelling
bSDD	buildingSMART Data Dictionary
CAD	Computer-Aided Design
CDE	Common Data Environment
CEN	European Committee for Standardization
DCM	Decree of the Council of Ministers
eDMS	Electronic Document Management System
EEEM	Environment for Electronic Exchange of Messages
EU	European Union
GIS	Geographic Information Systems
IDS	Information Delivery Specification
IFC	Industry Foundation Classes
ISO	International Organization for Standardization
IT	Information Technology
PDF	Portable Document Format
SMEs	Small and Medium Enterprises

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