FORUM ACUSTICUM EURONOISE 2025

BUILDING INFORMATION MODELING: EXAMPLE OF USE IDS FILE AND bSDD DATA BASE FOR ACOUSTIC EVALUATION

Costantino Carlo Mastino[1*] **Antonino Di Bella**[2] **Anna Sygulska**[3]
Raffaello Possidente[1] **Andrea Frattolillo**[1] **Mohsen Zavari**[1] **Valerio Da Pos**[4]
[1] DICAAR, University of Cagliari, Italy
[2] DII, University of Padova, Italy
[3] Poznan University of Technology, Poland
[4] Cadline Software srl, Padova, Italy

ABSTRACT

The obligation of BIM (Building Information Modeling) in Europe is regulated by Directive 2014/24/EU on public procurement, promoting its use to improve efficiency and transparency in public projects. In Italy, the New Procurement Code (Legislative Decree 36/2023) mandates BIM for public works above a specific value starting January 1, 2025. In contrast, Poland does not currently mandate BIM, with its implementation driven by the private sector voluntarily. However, the Ministry of Infrastructure and Construction in Poland is working to integrate BIM into public procurement contracts to achieve significant savings for the State Treasury. The use of BIM is growing, with many technical standards requiring open and interoperable formats like IFC (Industry Foundation Classes) defined by an ISO standard to ensure collaboration among stakeholders. This work analyses the information managed by the IFC format for acoustic purposes with an automated verification approach through an IDS (Information Delivery Specification) file. Additionally, it defines the main variables provided by reference standards and not present by default in the IFC file through the use of the bSDD (building SMART Data Dictionary), where all variables should be described in geometric and physical terms.

Keywords: *BIM, bSDD, IDS, BIM Validation.*

[*] ***Corresponding author***: *mastino@unica.it.*

1. INTRODUCTION

The Building Information Modeling (BIM) is a digital process that involves the creation and management of digital representations of the physical and functional characteristics of buildings. BIM integrates multidisciplinary data to produce a digital model that covers the entire lifecycle of a building, from design and construction to operation [1,2]. This approach enhances collaboration, visualization, and resource management, enabling more informed decision-making and greater efficiency. The integration of BIM with open interoperable formats such as IFC [3], IDS [4], and bSDD [5] provides a powerful tool for managing construction projects, improving collaboration, efficiency, and the quality of information. Specifically, for building acoustic assessments, these tools ensure that acoustic requirements are met, improving the comfort and quality of life for occupants. The Open BIM IFC format (Industry Foundation Classes) [3] is an open and standardized file format for exchanging BIM models. Developed by buildingSMART [6], IFC enables interoperability between different BIM software tools, ensuring that data can be shared without loss or distortion [7–9]. IFC facilitates collaboration among various project stakeholders by allowing them to consistently input, extract, update, or modify model information [10,11]. Checks on the IFC format can be carried out using another data format called IDS (Information Delivery Specification) [4,10]. IDS is a standard that defines the specific data required for a BIM project. An IDS file ensures that all parties involved understand what information must be provided and how it should be structured. In particular, IDS helps standardize data, improve interoperability, and perform automatic compliance checks, reducing errors throughout the different

project phases. All acoustic and non-acoustic parameters, including those not defined within the IFC file, can be included using the bSDD (buildingSMART Data Dictionary) [5]. bSDD is a library of standardized concepts and attributes — for example, a bSDD can be created for all parameters from ISO 12354 [12–17] or ISO 16283 [18–20], which can then be used to manage the acoustic requirements of buildings. Using bSDD, it is possible to clearly define acoustic requirements, classify objects and materials for sound insulation, and integrate this information into BIM models. This approach allows for automatic control and validation of acoustic data, ensuring that the requirements are properly implemented [21–29].

2. MAIN FEATURES OF IDS AND BSDD FORMATS

Below is an overview of the main features of the IDS (Information Delivery Specification) and bSDD (buildingSMART Data Dictionary) formats, which is necessary to introduce the use of these formats in digital processes based on the open BIM IFC data format [21,22,30,31].

2.1 Information Delivery Specification (IDS)

The IDS format is a standard developed by buildingSMART to define information requirements in a form that can be interpreted by both humans and computers. It implements the following key features:

- Clear specifications: Allows for detailing which information must be provided in a BIM model, specifying objects, properties, values, and units of measurement.
- Automated validation: Facilitates the automatic verification of IFC model compliance with defined requirements, improving quality control and data consistency.
- dìIFC integration: Designed to work in synergy with the Industry Foundation Classes (IFC) format, the open standard for BIM model exchange.

In other words, this open data format allows for the definition of requirements and specifications for the project that designers can use to develop their work. The same IDS file will later be used, at the end of the project or during an intermediate or subsequent phase, to verify that the required specifications have been implemented in the model.

2.2 buildingSMART Data Dictionary (bSDD)

The bSDD "database" is a collection of interconnected data dictionaries that provide definitions of terms used to describe the built environment. In practice, within the bSDD it is possible to define all the variables required for acoustic calculations according to ISO 12354, as well as all the variables needed for acoustic classification of buildings according to ISO/TS 19488 [32]. The bSDD includes the following main features:

- Centralized library: Provides an online repository of classes (terms) and properties, including allowed values, units, and translations, promoting terminological consistency.
- Interoperability: Facilitates the integration of existing national and international standards, improving compatibility across different systems and software.
- Open access: Offers a free service accessible by all software solutions, allowing for easy use and integration.

he bSDD is a library based on the IFD ISO 12006-3 standard [33]. The IFD (International Framework for Dictionaries) is a system developed by buildingSMART to facilitate data interoperability in the construction sector. It is a framework that allows the creation, management, and use of standardized data dictionaries to describe the built environment. The IFD focuses on creating an ontology of common concepts and terminologies that can be shared among different software and BIM applications [34].

2.3 IDS and bSDD

In summary, IDS focuses on defining and verifying the information requirements in BIM models, and the same file can be used to communicate to designers which parameters are required within the BIM model. The same IDS file can then be used once a specific project phase is completed to check if it contains all the specified data. bSDD, unlike the IDS format, provides a standardized dictionary of terms and properties to describe the built environment, supporting interoperability and data consistency within the construction sector. Within a bSDD, various rules or variables can be standardized, such as acoustic standards for design and/or on-site verification, to be used automatically by tools. The use of bSDD allows for the implementation of any regulation, technical standard, or requirement in BIM processes without needing to modify the IFC data format. Once defined, the bSDD is published on the buildingSMART International website and, after being validated, is accessible to all operators who request its use.

3. USE OF IDS AND BSDD FORMATS IN BIM PROCESSES FOR ACOUSTICS

The bSDD can be used, either alone or in conjunction with the IDS format, to manage the acoustic requirements of buildings in various ways. Definition of acoustic requirements: The bSDD allows for the clear definition of acoustic requirements using standardized and shared terms. This ensures that all project participants have a uniform understanding of the acoustic specifications. Meanwhile, the IDS file can be used to verify the presence or absence of parameters and/or information regarding acoustic aspects.

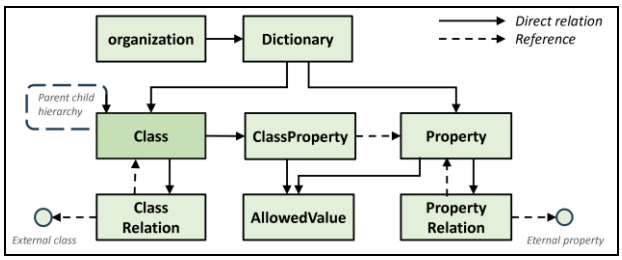

Figure 1. bSDD organization - https://technical.buildingsmart.org/services/bsdd/data-structure

In Figure 1, the following are represented:

- **Classification of objects**
  Objects and materials used for acoustic insulation can be classified in the bSDD. This facilitates the selection of appropriate materials and the verification of their acoustic properties.
- **Integration into BIM models**
  The bSDD can be integrated into BIM (Building Information Modeling) models, allowing acoustic requirements to be directly associated with the elements of the model. This helps ensure that acoustic specifications are met during design and construction.
- **Control and validation**
  By using the bSDD, automatic control and validation of acoustic data can be performed. This reduces communication errors and ensures that acoustic requirements are properly implemented.
- **Extension of property sets or new Psets**
  The bSDD allows the extension of property sets to include specific requirements, such as acoustic ones. This enables the dictionary to be tailored to the particular needs of a project.

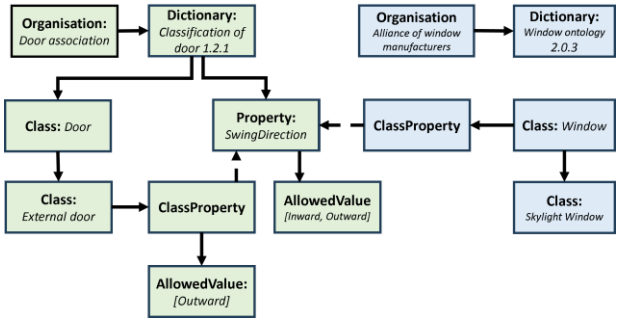

Figure 2. Example demonstrating the usage of the above concepts [4,5]

The bSDD is a service to facilitate the distribution of data dictionaries (read below about what those are) published by independent organisations. The diagram Figure 1 and Figure 2 shows the simplified data model behind the bSDD.

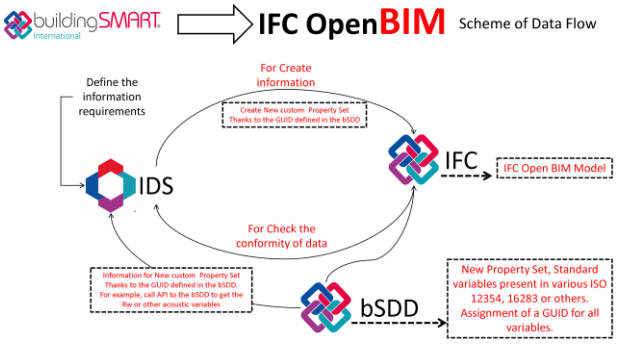

Figure 3. Flow of information for acoustic goals

In Figure 3, the information flow that the various data follow is shown. In particular, it can be observed that the definition and use of one or more bSDD allows, in a standardized way, to define all those variables that are not present in the default property sets provided by the IFC standard. In fact, when a bSDD is created for any purpose, such as project calculation or acoustic tests, a GUID is assigned to the various variables, which allows these to be included in new customized property sets without losing the reference to the standard.

4. CONCLUSIONS

In this work, the procedures that need to be followed for various acoustic issues when using open BIM models have been analyzed. The use of these models created by

buildingSMART International is essential for obtaining standardized calculations and projects within a digital project. The use of the IDS format together with the bSDD dictionary format allows for acoustic issues to fill the information gap that the default IFC open format presented. With the analysis carried out in this work, it has evolved to show how the data flow and various information can be defined within a design or verification process that relies on the use of open BIM models thanks to the open IDS and bSDD formats

5. ACKNOWLEDGMENTS

This work has been developed within the framework of the project e.INS- Ecosystem of Innovation for Next Generation Sardinia (cod. ECS 00000038) funded by the Italian Ministry for Research and Education (MUR) under the National Recovery and Resilience Plan (NRRP) - MISSION 4 COMPONENT 2, "From research to business" INVESTMENT 1.5, "Creation and strengthening of Ecosystems of innovation" and construction of "Territorial R&D Leaders. And The "NEST- Network 4 Energy Sustainable Transition" funded by the Italian Ministry of University and Research under the Next-Generation EU Programme (National Recovery and Resilience Plan)

6. REFERENCES

1. Mastino, C.C.; Baccoli, R.; Frattolillo, A.; Marini, M.; Salaris, C. Acoustic Insulation And Building Information Modeling: A Model Of Calculation For The Code Checking In The Forecast Phase And Of Measurement The Performances.; Rome, Italy; pp. 205–212.
2. Mastino, C.C.; Di Bella, A.; Semprini, G.; Frattolillo, A.; Marini, M.; Da Pos, V. BIM APPLICATION IN DESIGN AND EVALUATION ACOUSTIC PERFORMANCES OF BUILDINGS. In Proceedings of the 25th International Congress on Sound and Vibration; International Institute of Acoustics and Vibration, IIAV: Hiroshima, July 8 2018; Vol. 7, pp. 4241–4248.
3. ISO 16739-1:2018 Industry Foundation Classes (IFC) for Data Sharing in the Construction and Facility Management Industries -- Part 1: Data Schema 2018.
4. BuildingSMART International Information Delivery Specification IDS - Https://Technical.Buildingsmart.Org/Projects/Information-Delivery-Specification-Ids/ 2023.
5. BuildingSMART International buildingSMART Data Dictionary (bSDD) - Https://Www.Buildingsmart.Org/Users/Services/Buildingsmart-Data-Dictionary/.
6. buildingSMART Specification, Http://Www.Buildingsmart-Tech.Org/Specifications.
7. Hernández, J.; Martín Lerones, P.; Bonsma, P.; van Delft, A.; Deighton, R.; Braun, J.-D. An IFC Interoperability Framework for Self-Inspection Process in Buildings. *Buildings* **2018**, *8*, 32, doi:10.3390/buildings8020032.
8. Muller, M.F.; Esmanioto, F.; Huber, N.; Loures, E.R.; Canciglieri, O. A Systematic Literature Review of Interoperability in the Green Building Information Modeling Lifecycle. *Journal of Cleaner Production* **2019**, *223*, 397–412, doi:10.1016/j.jclepro.2019.03.114.
9. Utkucu, D.; Sözer, H. Interoperability and Data Exchange within BIM Platform to Evaluate Building Energy Performance and Indoor Comfort. *Automation in Construction* **2020**, *116*, 103225, doi:10.1016/j.autcon.2020.103225.
10. MASTINO, Costantino Carlo; DI BELLA, Antonino; SYGULSKA, Anna; FRATTOLILLO, Andrea; RICCIU, Roberto; BACCOLI, Roberto; SOLINAS, Elisa On the Use Open BIM Procedures for Acoustic Problems of the Buildings: The New IDS Standard for the Design and Verification Stages.; Institute of Noise Control Engineering: Nantes, 2024; pp. 10068–10074.
11. ISO 19650-4 - Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM) — Information Management Using Building Information modellingPart 4: Information Exchange 2022.
12. ISO 12354-1:2017 Building Acoustics -- Estimation of Acoustic Performance of Buildings from the Performance of Elements -- Part 1: Airborne Sound Insulation between Rooms 2017.
13. ISO 12354-2:2017 Building Acoustics -- Estimation of Acoustic Performance of Buildings from the Performance of Elements -- Part 2: Impact Sound Insulation between Rooms 2017.
14. ISO 12354-3:2017 Building Acoustics -- Estimation of Acoustic Performance of Buildings from the Performance of Elements -- Part 3: Airborne Sound Insulation against Outdoor Sound 2017.
15. ISO 12354-4:2017 Building Acoustics --Estimation of Acoustic Performance of Buildings from the

Performance of Elements — Part 4: Transmission of Indoor Sound to the Outside 2017.
16. EN 12354-5:2009 Building Acoustics - Estimation of Acoustic Performance of Building from the Performance of Elements - Part 5: Sounds Levels Due to the Service Equipment 2009.
17. EN 12354-6:2003 Building Acoustics - Estimation of Acoustic Performance of Buildings from the Performance of Elements - Part 6: Sound Absorption in Enclosed Spaces 2003.
18. ISO 16283-1:2014 Acoustics -- Field Measurement of Sound Insulation in Buildings and of Building Elements -- Part 1: Airborne Sound Insulation 2014.
19. ISO 16283-2:2018 Acoustics -- Field Measurement of Sound Insulation in Buildings and of Building Elements -- Part 2: Impact Sound Insulation 2018.
20. ISO 16283-3:2016 Acoustics -- Field Measurement of Sound Insulation in Buildings and of Building Elements -- Part 3: Façade Sound Insulation 2016.
21. Cooperative Research Centre for Construction *Adopting BIM for Facilities Management: Solutions for Managing the Sydney Opera House*; CRC for Construction Innovation: Brisbane, Qld., 2008; ISBN 978-0-9775282-2-6.
22. Asl, M.R.; Bergin, M.; Menter, A.; Yan, W. BIM-Based Parametric Building Energy Performance Multi-Objective Optimization.; Newcastle upon Tyne, UK, 2014; pp. 455–464.
23. Calquin, D.A.L. Automated Building Data Exchange between BIM and BPS Supporting Building Environmental Assessment Methods (BEAM). **2017**, 5.
24. Czmoch, I.; Pękala, A. Traditional Design versus BIM Based Design. *Procedia Engineering* **2014**, *91*, 210–215, doi:10.1016/j.proeng.2014.12.048.
25. ISO ISO 19650-1 - Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM) — Information Management Using Building Information modellingPart 1: Concepts and Principles 2018.
26. Guignone, G.; Calmon, J.L.; Vieira, D.; Bravo, A. BIM and LCA Integration Methodologies: A Critical Analysis and Proposed Guidelines. *Journal of Building Engineering* **2023**, *73*, 106780, doi:10.1016/j.jobe.2023.106780.
27. Marini, M.; Mastino, C.C.; Baccoli, R.; Frattolillo, A. BIM AND PLANT SYSTEMS: A SPECIFIC ASSESSMENT. *Energy Procedia* **2018**, *148*, 623–630, doi:10.1016/j.egypro.2018.08.150.
28. Mastino, C.C.; Concu, G.; Baccoli, R.; Frattolillo, A.; Di Bella, A. Methods for Acoustic Classification in Buildings: An Example of Application of BIM Procedures on Wooden Buildings. In Proceedings of the INTER-NOISE and NOISE-CON Congress and Conference Proceedings; Institute of Noise Control Engineering: Madrid, Spain, 19/06 2019; pp. 7018-7029 (12).
29. Mastino, C.C.; Di Bella, A.; Semprini, G.; Frattolillo, A.; Marini, M.; Da Pos, V. BIM Application in Design and Evaluation Acoustic Performances of Buildings.; ICSV25 Local Committee in Hiroshima, 2018; Vol. 7, pp. 4241–4248.
30. Abd, A.M.; Khamees, A.S.; Liu, J. As Built Case Studies for BIM as Conflicts Detection and Documentation Tool. *Cogent Engineering* **2017**, *4*, 1411865, doi:10.1080/23311916.2017.1411865.
31. Habibi, S. The Promise of BIM for Improving Building Performance. *Energy and Buildings* **2017**, 24.
32. ISO/TS 19488:2021 Acoustics — Acoustic Classification of Dwellings 2021.
33. ISO ISO 12006-3:2022 Building Construction — Organization of Information about Construction Works 2022.
34. Gerrish, T.; Ruikar, K.; Cook, M.; Johnson, M.; Phillip, M.; Lowry, C. BIM Application to Building Energy Performance Visualisation and Management: Challenges and Potential. *Energy and Buildings* **2017**, *144*, 218–228, doi:10.1016/j.enbuild.2017.03.032.