# A survey on BIM information management: the approach of producers and consumers of model information in Brazil

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**Abstract**. BIM Information Management, namely how information is introduced in and consumed from building information models, have an impact on the efficacy and efficiency of BIM workflows. Implicit reliance on all the information contained in a model may result in non-value-adding work from model authors. The recommended alternative is creation and use of information according to the Project BIM Execution Plan specifications. Regardless the adopted approach, model asseveration is demanded from authors (i.e., the verification that all required information is reliable and is available on a released model). International standards, such as ISO 19650, require clear and rigorous specification of information need, but anecdotal evidence indicates that the current practices in local markets are far from those recommended by these standards. An extensive online survey was conducted to assess current practices of professionals from the Brazilian market. Results showed that about half of the respondents adopt document-based (MEA/MET) recommended practices when dealing with model information, while the other half kept a behaviour more akin to the older CAD workflows. The implicit reliance (without checking MEA/MET documents) on model information varies according to professional role, being lower for design professionals and coordinators and higher for construction managers. As standards evolve and introduce new concepts for deeper and more granular information management, such as the Level of Information Need, it is necessary that professionals adapt their practices for increased efficiency on their BIM workflows.

## 1. Introduction

Brazil is a continental-size country with a wide range of variations when it comes to the level of maturity of BIM implementations. Among the fundamental causes of this variability, we can highlight the differences in distribution of educational centres between the main metropolitan cities and smaller ones, regional variations on average project size etc.

The Brazilian construction market is large (US$ 57bi GDP and employing almost 2 million people) and also very fragmented in many levels – from small, family-owned companies, run by a few to none person with technical skills up to large companies that expanded overseas and have support of a specific department to identify, manage and implement innovations and new technologies to improve the efficiency on their processes [1] [2]. Being only in a medium BIM maturity stage [3], best practices and efficient workflows related to BIM are not yet fully widespread in Brazil. The national versions of ISO19650, parts 1 and 2, have just been published and it is expected that compliance with these standards will be demanded both by public and private clients, triggering further maturing of professional practices related to information management in the Brazilian market.

One aspect of information management with BIM that has particular importance is the use of a document which specifies when (milestone) and who (element author) is responsible for modelling each element/system at a given Level of Development (LOD). This document is known as MEA (Model Element Author), MET (Model Element Table) or MPDT (Model Production and Delivery Table), among other denominations. In recent standards [4] [5] [6] (ISO 19650-2:2018 and BS EN 17412:2020 / ISO-DIS 7817:2022), LOD has been replaced by the Level of Information Need, for further specifying the required information at a given project milestone, and more detailed information is gathered with the task information delivery plan (TIDP).

Although these newer international standards, which are being adopted as-is or translated at a very quick pace worldwide [7], have increased the demands for proper information management, anecdotal evidence indicates the current practices are far from the recommended.

The main goal of this work is to assess at what extent some BIM information management practices are known and adopted by professionals in the Brazilian market. In particular, we are interested on examining how professionals create and rely on information in BIM models, as information reliability, at a given milestone, is supposed to be limited to that specified on MEA-type documents [8]. Although literature about this issue is very scarce, some recent work [9] reinforces our perception that, even in more developed markets, "consulting before consuming" is not the general practice regarding model information.

### *1.1. Motivation*

The shift in designing a building from the old paper-based to a CAD-based method, despite all its benefits, hasn't changed one core concept: all information consumed by any agent during the asset lifecycle has been asserted by its author, i.e., was intently inputted (represented) on the supporting media (paper or digital drawing).

Considering the impact on the whole construction chain, although valuable, the migration from paper to CAD should be only considered as the digitization of the design process since it didn't change fundamentally the way other stakeholders consume design information.

On the other hand, BIM is considered the vector of the digital transformation of construction – its digitalization - with a much deeper impact on the overall workflow by creating new concepts, processes, demands and opportunities.

The "BIM object" is one of these new concepts. It created the possibility for suppliers of construction components to provide information about their products through a virtual representation, with semantic meaning for both humans and machines. Differently from other predecessors (e.g., CAD blocks/cells), BIM objects may carry information that are not readily perceived (i.e., are not visual in nature) as they are stored as (alphanumeric) properties. During model creation, when the designer instantiates objects from BIM libraries, a lot of non-geometric information may be unknowingly inserted into the model.

As we are still in a transition from CAD processes to a BIM-based workflow, with the majority of current professionals trained and experienced with the visual-information-only style of CAD-based design documentation (graphics or text on drawing sheets), it is common the built-in data on BIM objects sometimes be neglected by both designers using third party objects and consumers visualizing models. Some may consider that all the information in the building information model is reliable as they do for CAD files and also because BIM models usually tend to appear precise and certain [9].

Along the evolution of BIM, information reliability has been a concern and one way of addressing it was the LOD (Level of Development) definition by the BIM Forum (2021) that expands the previous concept of geometrical detailing progression of BIM objects (Level of Detail) to embrace their information and reliability. The Level of Development concept, along with a MEA table, allow the author to "limit reliance to only what he/she specifically states" [8].

Best practices, expressed on relevant BIM Protocols (e.g., CIC BIM Protocol 2018, BIM Forum LOD Spec 2021, etc.) and Standards (ISO 19650:2018, EN 17412-1:2020, etc.), advise to establish needed information requirements for each project milestone. This may be done using a Model Production and

Delivery Table (MPDT) [10] or a similar document. Also, supplying more information than requested at a given milestone is discouraged by those international standards. These protocols and standards refer to valid/verified/reliable information, and states that their reliability shall be considered to be managed through metadata. A valid building model may contain unverified information that is not needed at a given project milestone. Therefore, when instantiating a BIM object into the model, its unrequired information at the time does not have to be purged nor verified, as these actions take time but do not add any value to the model. That fact implies that a consumer of model information is required to verify, beforehand, if a desired piece of information is to be supplied by the agreed author at the current milestone.

Conversely, all the required information at a given project milestone must be in the model and fully validated as agreed in the project's BIM Execution Plan, before its release to other parties. To that end, the model author not only has to make sure the needed information is present in the model, but also has to validate it. This process was identified and named: BIM Model Asseveration [11]. Asseverating a BIM model is the process by which the model author communicates his/her awareness (through metadata or other means) about the presence of required information in the model and explicitly states that it can be consumed by others.

The survey reported here aims to identify current BIM information management practices, establishing if the asseveration process is currently performed and, if not, what are the reasons why it is not and which are the alternative procedures adopted. For a broader understanding of the process and the perception of the implied stakeholders, the investigation tried to cover all phases, from the requirements definition (BIM uses, MEA/MET adoption, etc.), model authoring and model information consuming by professionals with several profiles.

These results will determine the need for such computer tool, justifying the research, and promote best practices in the AEC market [12].

## 2. Research Method

Before deciding on performing our own survey, a literature review on our particular topic of interest was conducted but no relevant results were found neither for the Brazilian marked nor for the international one. This is because the specific procedure on the information management workflow we are focusing on (Asseveration) is usually neglected or not considered due to oversight.

The subsequent research steps consisted on a preliminary interview with representative design and project coordination professionals which guided the development of a survey afterwards, followed by an analysis of the collected data.

A questionnaire was prepared and made available on Google Forms and an invitation to respond it was shared in groups with related topics on social networks (e.g., LinkedIn, WhatsApp). Also, participation on the survey was requested through an e-mail sent to an extensive list (n=5063) of contacts publicly available at the section "BIM Professionals" (Profissionais BIM, in Portuguese) of the Plataforma BIM BR [13] as well as to a mailing-list from a Brazilian National Project Coordination Association (n=1069) and to authors' professional contacts. There is some data overlap among these databases. No identification data was collected.

The survey started on March 13th, 2021 and reached a partial result of 539 responses until April 14th, 2021, forming the database used for the analysis reported here. The data collected from the Google Form was exported, cleaned, normalized and analysed in an Excel spreadsheet. Additional data was collected after the analysis deadline and was not considered in this report. The collected data is publicly available at: https://docs.google.com/spreadsheets/d/1IikkaFZpzmyIsB4bn33i-jGHV7VKIUitmDN2JWr5pM4/edit?usp=sharing.

### *2.1. Questionnaire structure*

The survey questions were grouped in eight sections that aim to extract the following information: i. What is the respondent's location, professional role, skills, level of education and knowledge about BIM ii. Their understanding and level of experience on BIM; iii. How they handle BIM models; iv. Are they

authors and/or consumers of BIM information?; v. What are the primary BIM uses and disciplines they have worked on; vi. Other BIM uses they have had experience with; vii. Work methods and model information management tools used; viii) Their understanding on MEA (Model Element Author) / MET (Model Element Table);

The adopted education level scale ranged from the Brazilian equivalent to ISCED11 level 4 (post-secondary non-tertiary education) to PhD (ISCED11 level 8 – Doctoral or equivalent level) [14].

Some decision gateways were established for ensuring correct data collection according to given answers: a) for the only one respondent that stated "I don't know BIM" (0.19%) in section I, the questionnaire finished at that point; b) to respondents that reported no experience on BIM, the survey ended after section II; c) the ones that only consume information from BIM models skipped the questions related to model authoring; d) respondents that don't know about MEA/MET haven't been asked about their perception on using it;

## 3. Results and Discussion

### *3.1. Demographics*

The distribution of respondents by country region is shown in Figure 2. This distribution correlates well with other demographic parameters (total population, regional development, HDI, GDP, etc.). The most developed region in Brazil is SE, followed by S, NE, CW and N.

The results for the first question (Which is your main training area?) are shown in Figure 1. It shows the predominance of Civil Engineers and Architects among respondents.

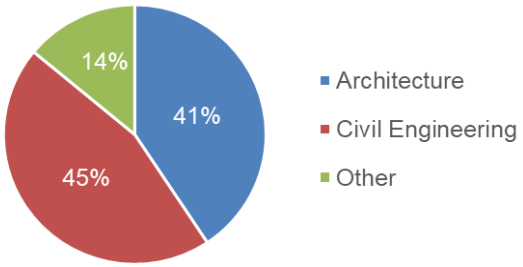



**Figure 1.** Respondents' training area.

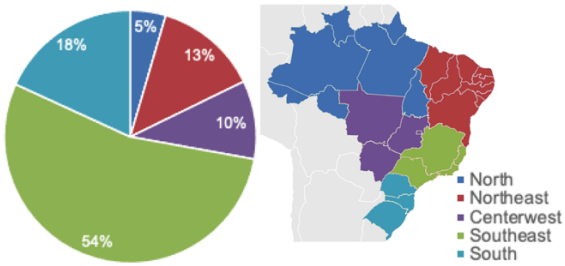



**Figure 2.** Respondents by region.

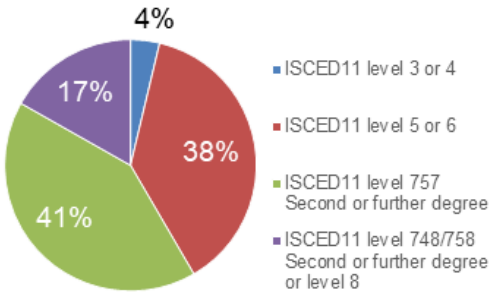



**Figure 3.** Respondents' educational level.

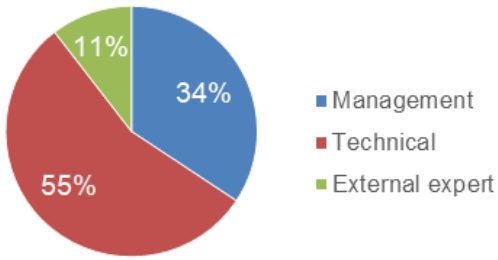



**Figure 4.** Professional function.

The answers to the next question show that 41% have a post-graduate level, 38% a college degree and 17% hold a MSc or PhD degree (see Figure 3), i.e., respondents are very well qualified. Figure 4 shows respondent's professional function. Most of them, working on technical functions, directly produce and/or consume information from BIM models.

Figure 5 shows respondents professional roles, indicating most of them are model authors.

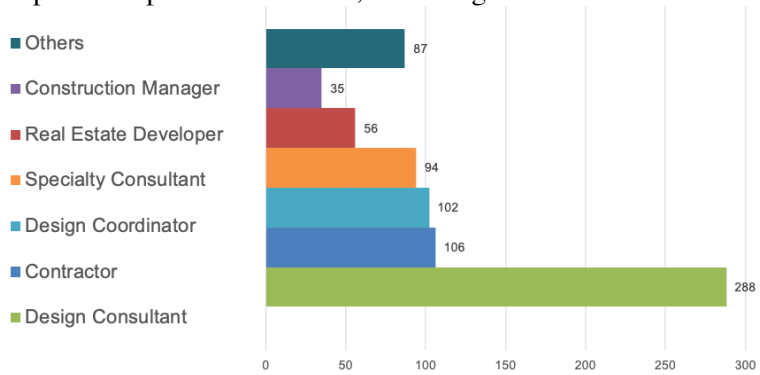



**Figure 5.** Respondents' professional role.

Figure 6 and Figure 7 show respondents diverse level of knowledge about BIM and their understanding about what BIM is. The majority of respondents have formal training in BIM and are well informed about it.

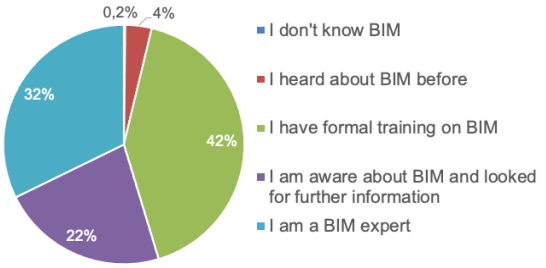



**Figure 6.** BIM knowledge level.

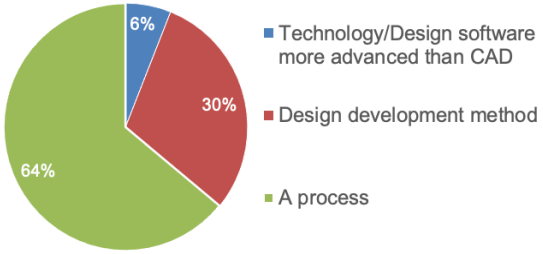



**Figure 7.** BIM concept understanding.

Most of the respondents (87%) have already used BIM and 63% are currently using it in their projects (Figure 8).

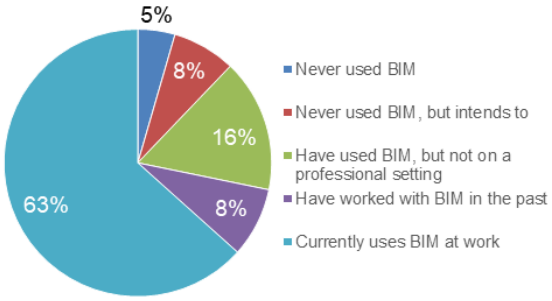



**Figure 8.** BIM experience level.

The analysis of the demographic data of the collected sample shows it is very representative of the target population and that most of respondents are knowledgeable about BIM. Therefore, analyses from this sample can be considered faithful regarding the current players and their professional practices in the Brazilian market.

*3.2. BIM information producers*

62 out of the total 539 respondents do not create BIM models ("I'm not a designer"). Figure 9 shows the selections (one or more) for the remaining 477 respondents regarding the methods used when preparing a BIM model. 186 (39%) of the designers reported replacing BIM objects for more specific ones as the design evolves, but 36 out of these (19.4%) also marked the option that states these objects are not checked nor edited afterwards.

Regarding the use of external BIM objects (excluding responses that states: "BIM object provider is the selected construction component supplier"), the ones that "Check and adjust properties" are 36 (28%), while the ones that "Don't edit them" are 91 (72%).

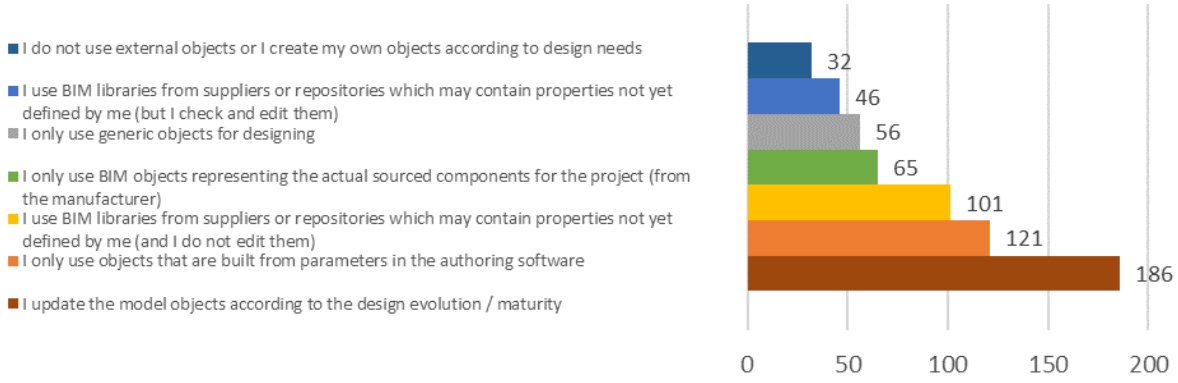



**Figure 9.** Model production methods.

Table 1 shows the relationship between modelling practices, their reported frequency on the survey and necessity for asseverating the model if that practice is adopted. Only practices where the object is created by the designer or supplied by third parties matching the actual sourced components for the project do not require later asseveration. In the former case, object data is intently inserted when creating the object; in the later, data is already correct as it matches the manufacturer's specifications (but, in the other hand, there may be data beyond project's requirements). All other practices require asseveration to assure model information is present and correct.

**Table 1.** Analysis of modelling practices x asseveration need x frequency.

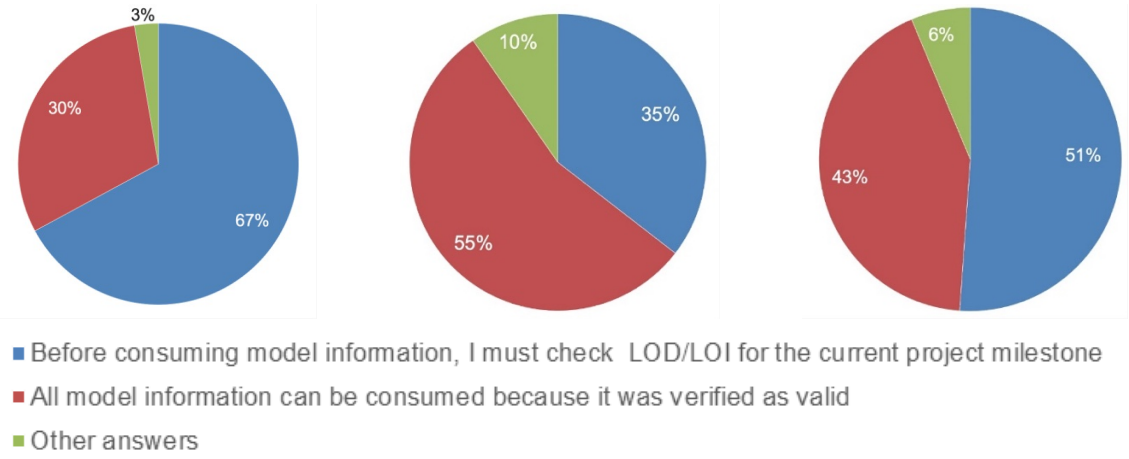
| Modelling practice | Need asseveration? | Freq. |
|---|---|---|
| **I do not use external objects or I create my own objects according to design needs** | No | 6.7% |
| **I use BIM libraries from suppliers or repositories which may contain properties not yet defined by me (but I check and edit them as needed)** | Yes | 9.6% |
| **I only use generic objects for designing** | Yes | 11.7% |
| **I only use BIM objects representing the actual sourced components for the project (from the manufacturer)** | No | 13.6% |
| **I use BIM libraries from suppliers or repositories which may contain properties not yet defined by me (and I do not edit them)** | Yes | 21.2% |
| **I only use objects that are built "on the fly" by the authoring software based on parameters I previously inserted** | No | 25.4% |
| **I update the model objects according to the design evolution / maturity** | Maybe | 39.0% |

Some frequent modelling practices are not efficient, as they imply work which does not add value (e.g., inputting or checking parameters not required at a given milestone, zeroing or blanking parameters not required at a given milestone, replacing objects according to model maturity) and are performed because best practices are not observed on the project information workflow.

These data show that workflows which require model asseveration practices, either implicitly or explicitly, are relatively common, but not yet the most frequent. Adoption of BIM protocols which includes preparation of a Model Production and Delivery Table and subsequent use of it for model asseveration and model information consumption may improve design efficiency.

### *3.3. BIM information consumers*

On the information consumption side, Figure 10 shows how different professionals manage model information.

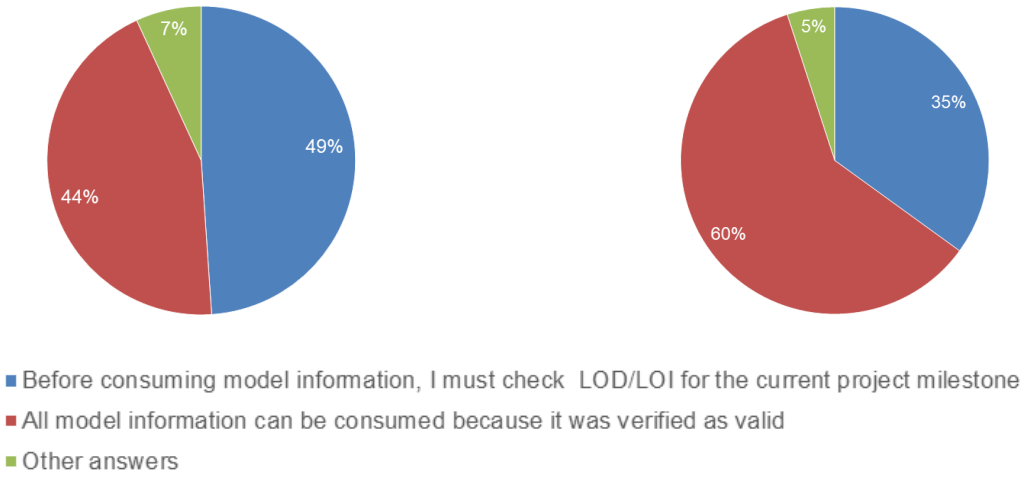



(a) Design Coordinator (b) Construction Manager (c)Architect/Design Consultants

**Figure 10.** Information consuming behaviour by respondent role.

Both of these two behaviours are very frequent: i. to consider all model information as valid and; ii. to check information available on the model against a MPDT or similar document. The first one is more frequent among Construction Managers, probably because they usually interact with models only after design is finished. The second approach is favoured by Design Coordinators, who manage the MPDT and enforces it. Architects and Design Consultants are divided between the two approaches.

Figure 11 compares the results of the two most disparate regional scenarios: a) Southeast and b) North. This analysis indicates that, in the most developed region (Southeast), the recommended practice is significantly more frequent (49%) than in the less developed North region (35%), although, in both areas, a greater diffusion of best practices is still needed.




(a) Southeast region (b) North region

**Figure 11.** Information consuming behaviour by respondent region.

Out of all respondents that stated "Before consuming information, I must query another source about its reliability" (221), only 24% (52) reported having previous experience with Model Element Table (MET), Model Element Author (MEA) or equivalent tables (Figure 12) and 56% (124) of them didn't know what this is about (Figure 13). These results clearly indicate that the recommended workflows are not widely known or adopted in Brazil.

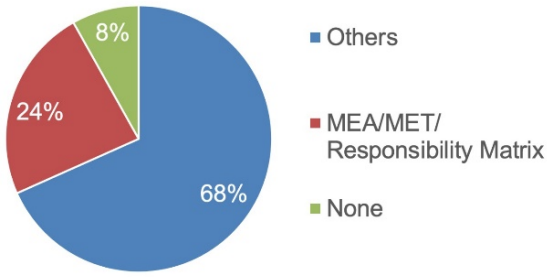



**Figure 12.** BIM standards, guides and best-practices.

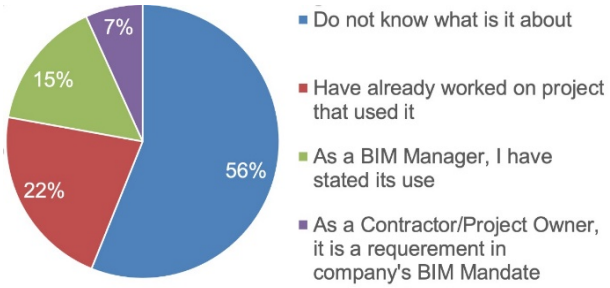



**Figure 13.** Respondents experience with MEA/MET tables.

## 4. Conclusions and Further Research

The survey developed for this research got a representative sample of professionals working with BIM in Brazil (although not a statistically controlled one). Respondents are well qualified and from all regions of the country. Most of them were working with BIM at the time the survey was conducted. Therefore, some aspects of the current professional practice regarding BIM information management have been successfully documented.

When consuming model information, about half of respondents consider all the information on a building information model as valid and therefore, do not consult a MPDT (or similar table) or are not aware of this kind of document or workflows which include it.

Considering model authoring, about half of respondents only keep valid information in the model, even if this behaviour requires additional, non-value-adding work (blanking not-yet-defined values from object parameters, replacing generic objects according to design evolution, etc.). This is probably due to keeping previous CAD-related behaviour when working with the new BIM processes.

The other half adopts best practices adding and/or checking model information before delivering it as required at each project milestone and works according to an agreed MPDT and follows (strictly or loosely) international standards. A similarly sized group checks the validity of model information at current milestone before consuming it. Besides international literature, there are national guides [15] [16] that explain and recommend these practices.

For these later groups, model asseveration is already an intrinsic process, performed by model authors and expected by other designers, design coordinators and consultants and may benefit from a computer-assisted model asseveration tool. The groups mentioned first also may benefit from such tool, however, they initially require an update on their BIM practices and adoption of an improved workflow.

BIM coordinators and managers (more knowledgeable) and professionals from more developed areas in the country are more aware of and aligned to best practices.

Results from the analysis of the conducted survey showed that a computer tool for aiding in model asseveration may be a useful resource also for improving BIM workflows. This conclusion is furthered by research [17] that suggests that a fully integrated and collaborative BIM process can be achieved by automating BIM-related standards in friendly interfaces.

The authors could not identify similar surveys developed in other countries. This is probably due to the fact that the concept of asseveration, previously proposed by the authors, is still new and not the focus of broad research yet. In countries which lack a widely adopted BIM Protocol recommending the use of a Model Production and Delivery Table or similar tool, an analogous situation to the one reported here is to be expected, as the migration from CAD to BIM usually follows the same path everywhere. However, as a future work, this survey could be applied to international markets as well, to assess if the same professional practices are in place and, consequently, the need for a tool for aiding the asseveration process.

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