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Developing BIM Objects Libraries for Provision of BIM Services: An Action Research

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Abstract

Except for the development and operation of a Common Data Environment, BIM applications in projects start with 3D BIM modelling. As one important part of the BIM implementation, 3D BIM modelling is a time consuming task and has a great impact on design accuracy, stakeholder collaboration, then the efficiency of BIM model uses etc. This paper presents an action research in developing BIM objects libraries in an organisation providing BIM services in Vietnam. This research study examined the creation of BIM object libraries for a BIM consultant in Vietnam, emphasizing the challenges encountered during various cycles of the action research conducted. Three cycles of the action research have been completed, resulting in five lessons learned. The findings illustrate the methodology for creating well-organized BIM libraries, which are anticipated to enhance design workflows, increase data consistency, and facilitate seamless information exchange among stakeholders. The insights gained can serve as a valuable reference for both other BIM consultants and the Government in formulating rules, processes, and guidelines to facilitate the adoption of BIM within the Vietnamese construction industry.

1. Introduction

Building Information Modelling (BIM) has revolutionized the construction industry all over the world in general and in Vietnam in particular [1] by enabling a collaborative, data-driven approach to project delivery. Except for the development and operation of a Common Data Environment, BIM applications in projects start with 3D BIM modelling. As one important part of the BIM implementation, 3D BIM modelling is a time consuming task and has a great impact on design accuracy, stakeholder collaboration, then the efficiency of BIM model uses etc. BIM objects, which represent the functional and physical attributes of construction features like doors, windows, HVAC systems, and more, are the fundamental units of digital models [2]. These items can cause misunderstandings, design problems, and expensive mistakes throughout the building process if they are badly made or lack important details. Therefore, the availability and quality of BIM object libraries – the digital repositories of standardized, parametric models representing physical and functional characteristics of building components [3] play a critical role in the services provision of any BIM consultants.

Nomenclature is included if necessary

BIM	Building Information Modelling
UK	United Kingdom

In a rapidly evolving BIM market, the ability to develop and manage comprehensive BIM objects libraries is essential for staying competitive and meeting the demands of increasingly complex projects. As Vietnam is still at its embryonic stage of BIM adoption [4], the country has not developed any standards or guidelines for BIM objects development. Therefore, organisations in the construction industry do not have any uniform standards when creating/developing BIM objects libraries. That is why they experienced inefficiencies with BIM objects libraries development, which constraint their competitiveness. One of the reasons is that there is a lack of best practices for developing BIM object libraries in markets that are lagging behind in BIM adoption, such as Vietnam. This gap not only hinders the productivity and accuracy benefits of BIM but also slows the digital transformation of the construction industry in these regions.

Aiming to assist the BIM consultants to avoid inefficiencies in developing their good BIM objects libraries, this paper explores the practice of a BIM consultant organization regarding their BIM objects libraries development for provision of BIM services in the market. The insights gained from action research can serve as valuable references for both other BIM consultants and local government in formulating BIM object standards and guidelines. This paper, showing the results of the action research is structured in five sections, excluding the introduction. The background section succinctly outlines pertinent subjects that inform this research study, encompassing action research, BIM object libraries, BIM model uses, and subsequently, the Levels of Development (LOD) alongside the correlation between the integrated data of BIM objects and their applications. The literature review section encapsulates the findings from prior publications about the development of BIM object libraries. The methodology section describes the initial framework for delivering action research in this context. The next section examines the outcomes of action research conducted with a BIM consultant in Vietnam. The discussion and conclusion section synthesizes the findings, then proposes future research directions.

2. Background

2.1 Action Research

When research involves a practitioner, it can be classified as action research. Having its roots in the works of John Dewey since 1910, the term "action research" came to use firstly by Kurt Levin in 1946 [5]. Since then, action research has gradually become more popular [6]. McNiff and Whitehead [7] define action research as "a process of learning from experience, a dialectical interplay between practice, reflection and learning." At the same time, these authors argue that this type of research is most suitable for practitioners doing research by themselves, or together with other researcher(s). Though it was claimed to be particularly attractive to educators as researchers [8], it has become more popular in the domains other than education, namely construction management [6].

Action research is not a method or a technique, but an approach for conducting research [8]. It must be differentiated from experimental research and positivist scientific research. In action research, the research is conducted while the action is on going (concurrent), the action itself is not the subject of the research. It is a sequence of problem-solving activities in which the researchers participate [9]. The activities include planning, acting, observing, and reflecting making a cyclical process of steps (Figure 1). Planning involves developing a plan of critically informed action to improve what is already happening. Acting is implemented with an action conducted to deliver the plan. In the observing step, the effects of the critically informed action in the context in which it occurs are monitored. In the last step of a cycle, the main job is to reflect on these effects as a foundation for the following additional planning and critically informed action through a succession of cycles [10].

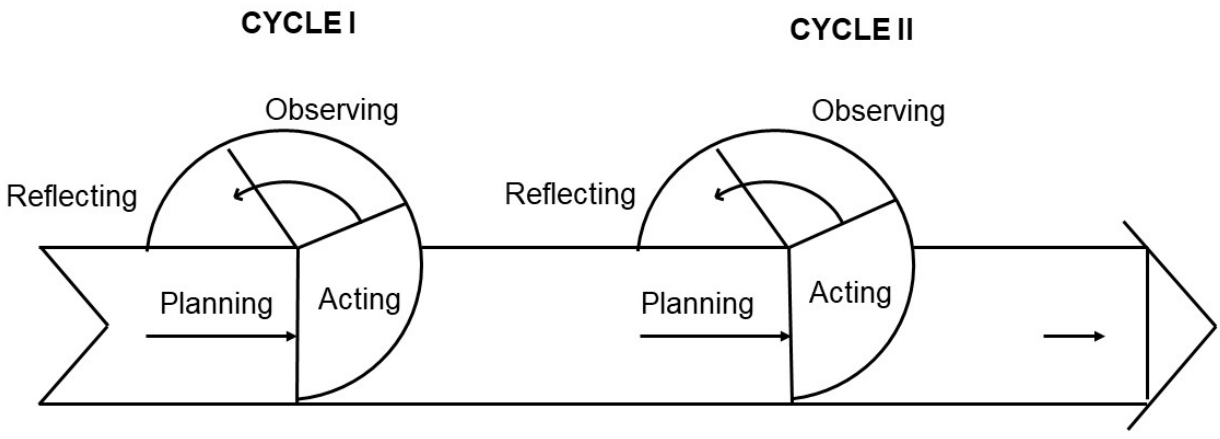

Fig. 1 *The cyclical process of action research (adapted from [10], [11] and [7])*

2.2 BIM Objects Library

Recently, Building Information Modelling (BIM) has been considered as an advanced methodology leveraging Industry 4.0 in the built environment. It has been widely adopted in many countries and started to be mandated in Vietnam in 2023 [12, 13]. The core part of the methodology is to develop a BIM model as the digital representation of the construction works, then make uses of the model throughout the project life cycle. BIM models are composed of intelligent objects that contains three-dimensional geometry and non-geometric data at a specific level of detail (Figure 2). These are named BIM objects and can be defined as the representation of building components, physical or spatial entities, with the geometric and non-geometric properties integrated [3]. There are two groups of BIM objects, generic and specific objects. Generally speaking, generic objects lack explicit details on certain attributes related to their function or performance. In subsequent phases of the project, they serve as stand-ins for the real object. Manufacturer objects make up the group of "specific objects" and contain all of the parameters, data, and information related to the real product [3].

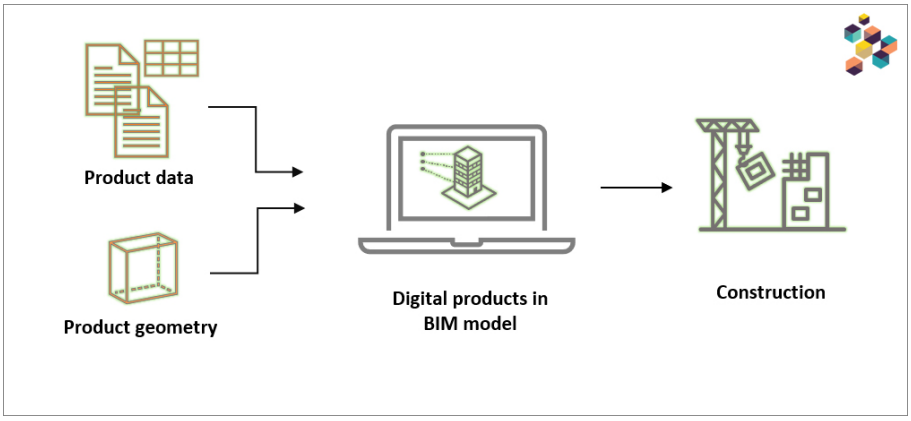

Fig. 2 *BIM objects and BIM model (source: [2])*

Textbooks on BIM suggest that developing quality objects libraries can be very beneficial, since the libraries can be used again and again [14]. Not only enhancing the productivity of the modelling process, the usage of BIM objects libraries can facilitate the interoperability in information exchange among the project stakeholders [3]. However, there are several definitions for BIM objects libraries found in the literature. As Barbini, et al. [3] summarised, they can be defined as "source for building product model organized synthetically and systematically" [15] or "an organized group of BIM objects where the building information is stored" [16]. The number of BIM objects libraries has increased greatly in recent years. Selected countries, such as the United Kingdom and Italy, have promoted the development of national BIM libraries [3]. Lots of commercial libraries have also been developed making this type of library the dominated group [17]. However, commercial BIM objects libraries of often perform poorly [17].

Vietnam, as a lagging country in terms of BIM adoption, until now, has no national BIM objects library. BIM consultants started to develop BIM objects libraries for facilitate the delivery of their BIM services. The essential part of developing the libraries is to have BIM objects on hand. BIM practitioners in Vietnam get the BIM objects by the following ways: (i) create BIM objects using object editor functions of 3D modelling software (e.g. Family Editor of Autodesk Revit) [18], (ii) utilise the BIM objects from the libraries that the software vendors supply [19], and (iii) collect BIM objects shared by the government or organisations (manufacturers), individuals, including objects uploaded onto websites or online forums, etc. [20]. The objects are then being processed and sorted to develop the libraries.

2.3 BIM Model Uses

BIM model uses (often name shortly as BIM uses), therefore, become significantly important in BIM-adopted projects. Though there is no widely accepted definition for BIM uses [21], BIM uses can be understood as the uses of information extracted from the BIM models to serve the delivery and/or the management of a facility throughout its lifecycle. BIM uses can be classified into essential and enhanced groups [22], or basic and advanced BIM groups [23]. BIM uses can be delivered solely or with other digital technologies [23]. Penn State University has proposed a list of BIM uses, which can be considered as the baseline for selection (Table 1). In Vietnam, only the following BIM uses are introduced officially in the Government's BIM guide: Capture Existing Conditions, BIM Design Authoring (3D), Analyse Energy Performance, Analyse Structural Performance, Analyse Lighting Performance, Design Review, Cost Estimation, 3D Coordination and BIM-based Scheduling [24]. Such BIM model

uses can be implemented at different stages of a typical project, ranging from preliminary design, basic design, technical design, detailed (or construction drawing) design, construction and operation, as regulated by the country's laws and regulations. In public projects in Vietnam, the decision makers for the investment policy will decide if the projects adopt BIM, while the owners decide the BIM uses to be implemented [25].

Table 1 *Common BIM uses throughout the project lifecycle as presented by Penn State University*

BIM uses	Plan	Design	Construction	Operation
Capture Existing Conditions	v	v		
Author Design Model	v	v	v	
Analyse Program Requirements	v	v	v	
Author Cost Estimate	v	v	v	v
Author 4D Model	v	v	v	
Analyse Energy Performance		v	v	
Analyse Structural Performance		v	v	
Analyse Lighting Performance		v	v	
Coordinate Design Model(s)		v	v	
Review Design Model(s)		v	v	
Analyse Sustainability Performance		v	v	v
Draw Construction Documents		v	v	
Author Construction Site Logistics Model		v	v	
Author Temporary Construction System Model(s)		v	v	
Fabricate Products			v	
Layout Construction Works			v	
Compile Record Model			v	v
Monitor Maintenance				v
Monitor Assets				v
Monitor Space Utilisation				v
Monitor System Performance				v

Source: [22]

It is noted that the BIM model uses in the list may be delivered partly. For example, only quantity take-off from the BIM model may be implemented, not the cost estimation. Also, the same BIM use can be named differently from territory to territory, e.g. BIM Design Authoring (3D) in Vietnam can be understood as Author Design Model in the Penn State' approach.

2.4 LOD and the Relationship Between BIM Objects' Integrated Data and BIM Uses

In order to provide information for implementation of any BIM uses, the relevant data must be integrated into the BIM models beforehand to be extracted later on. As the construction projects progress from preliminary designs, to basic designs, technical designs, then more detailed designs before being constructed on sites [26] (the names of the design stages may be different from country to country), different types and levels of detail, levels of development of information may be required in different project stages. Therefore, BIM models and BIM objects require different levels of development to better serve the provision of different BIM uses, which are implemented in different stages of the project life cycle.

Good BIM guides of nations all over the world define the levels of development for both geometric and non-geometric information. Regarding the geometric information, levels of development of BIM models can be differentiated among the popular levels of LOD 100, LOD 200, LOD 300, LOD 350, LOD 400 and LOD 500 (Figure 2). Non-geometric information can be integrated into BIM objects with LOD from 200.

Fig. 3 *Level of development (source: [27])*

3. Literature Review

Numerous preceding articles exist about the development of BIM objects, showcasing findings from earlier research on the subject. Barbini, et al. [3] examine a case study about the development of a BIM objects library for a public organization in Italy. The findings demonstrate that both proprietary and open formats serve as effective alternatives for constructing a BIM library for a public institutions. Nonetheless, its efficacy is contingent upon how the public entity elects to structure its BIM adoption. Another research study conducted in the context of Italy is the INNOVance, which tries to classify and standardise BIM objects and define the object requirements for developing BIM library [28]. To assist the classification of BIM objects to develop the libraries, Afsari and Eastman [15] proposed the way to categorize building product models in an earlier research, while Shin, et al. [16] highlighted the significance of managing BIM property information. Pavan, et al. [17] introduced BIMReL, an innovative BIM object library, proposing the incorporation of Construction Product Regulation features in the object production process. To rectify the inadequacy of existing BIM objects, which lack comprehensiveness and contextual relevance, Lu, et al. [29] proposed to develop an open access BIM objects library for using in Hong Kong market. Other research studies emphasize the role of BIM object library development in sustainable development, proposing solutions to enhance building thermal energy simulation [30], or methods to incorporate life cycle data into BIM object libraries to facilitate green and digital public procurements [31]. Smart BIM objects have been discussed in relation to promoting design intelligence [32]. Sun and Kim [33] proposed an automated checking system for modular BIM objects while Wu, et al. [34] have used natural-language-based intelligent retrieval engine for exploiting data from BIM object database.

In Vietnam, there are no research projects addressing the development of BIM objects or BIM object libraries. Only a few websites provide guidance on producing or acquiring BIM objects for library development or direct use. This research study, therefore, have achieved its novelty by providing best practices in developing BIM objects libraries within the construction industry in Vietnam.

4. Research Methodology

This research study applied action research approach. The BIM object library development is planned (planning step), then the plan is implemented leading to the development of the current BIM objects libraries (acting step). Feedback is collected not only for the process of developing the libraries, but also for the quality of objects in the libraries (observing step). Lastly, the feedback is analysed and reflected to update the BIM object libraries (reflecting step). The detailed initial process of the action research is illustrated in Figure 4.

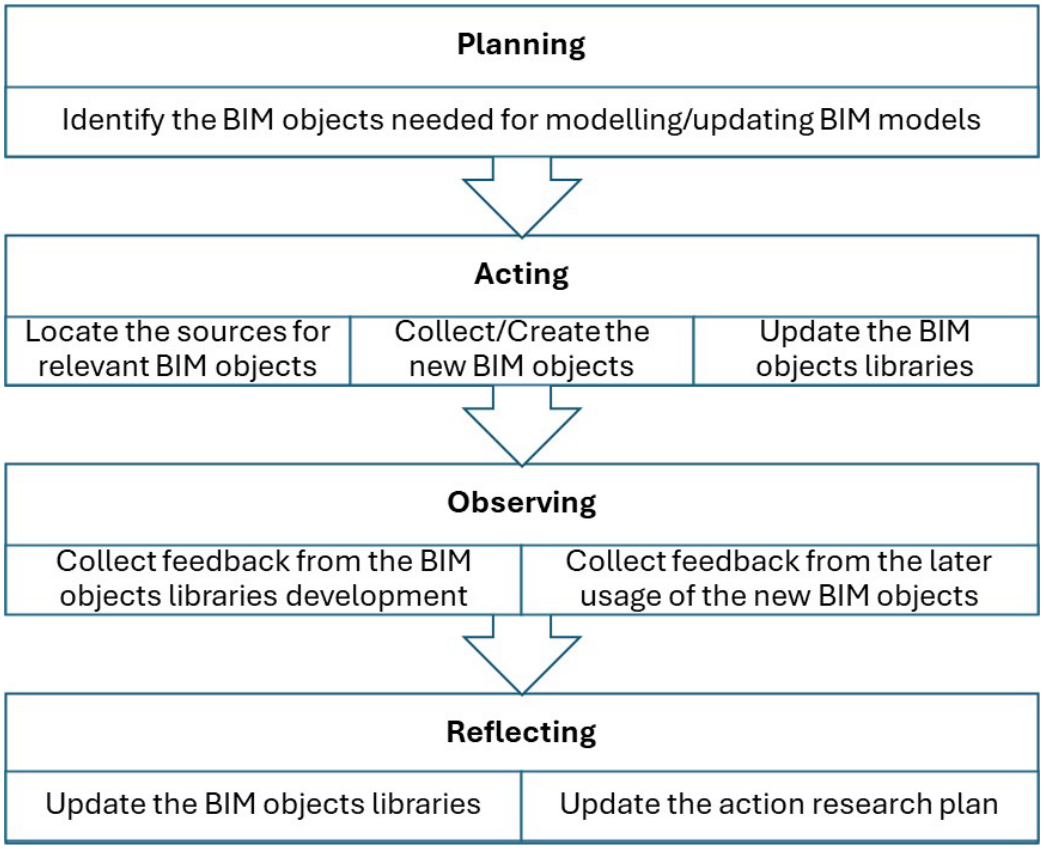

Fig. 4 *The initial process of the action research (Cycle 1)*

5. Results

As a BIM consultant, the organization participated in this research study is a small-sized organization providing BIM services to their clients (hereafter named Consultant A for anonymous purposes). They started their BIM services provision in the building sector by providing 3D modelling as a main service. The BIM models developed are often used to provide their clients with selected 3D functions, including walkthrough for better visualisation of the projects and clash detection for checking the design/model quality. The models can be updated/revised throughout the stages of the projects by using objects with higher LOD. Together with the creation of new BIM families, they started developing their BIM objects libraries to facilitate the development and update of BIM models.

Before the first cycle of this action research study, Consultant A has only a library of about 60 objects, mostly for structural and architectural BIM models in building projects for using with Autodesk Revit. After the first cycle of the action research, several initial issues have been discovered, including:

- The creation of BIM objects is a time-consuming and error-prone process, while there are lots of sources for acquiring BIM objects on the internet.
- Different BIM platforms (software) require different types of BIM objects. The modelling software was used is Autodesk Revit, therefore, only the BIM families for Autodesk Revit are concerned about. However, Consultant A started to use other software for modelling other types of projects, then families for other software need to be collected.
- Software developers often produce and update their BIM objects library, also producers of building services systems.
- The BIM objects collected may have similar shape, but they may not be used properly for several reasons; they need to be checked before putting in the libraries.
- The BIM objects collected may not be compatible with selected BIM model uses which require more information, either geometric or nongeometric. Depending on the stage that the BIM uses are implemented, different LODs will be required.

To reflect these issues, the research team implemented some changes in the action research process, as illustrated in Table 2.

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Table 2 *The first revised process of the action research (Cycle 2)*

Steps	Substeps
Planning	• Develop a list of sources for collecting BIM objects • Develop a set of acceptance criteria to assess the BIM objects collected/created • Develop a list of BIM objects to be acquired with specific LOD that facilitate the BIM uses implementation
Acting	• Locate the sources for relevant BIM objects • Collect/Create the new BIM objects • Assess the BIM objects collected against the acceptance criteria • Update the BIM objects libraries with the accepted objects
Observing	• Collect feedback from the BIM objects libraries development • Collect feedback from the later usage of the new BIM objects
Reflecting	• Update the BIM objects libraries • Update the action research plan

In the planning step, the sources for collecting BIM objects can be categorized by BIM authoring software and types of components/systems represented by the objects. It is noted that several sources can provide objects for multiple popular software. With suggestion from some BIM/Revit experts, Consultant A has identified more than twenty sources to collect the objects. Table 3 shows eight most popular sources.

Table 3 *Identified sources for acquiring BIM objects (8 most popular sources)*

No	Sources	Remarks
1	Autodesk Seek http://help.autodesk.com/cloudhelp/2017/ENU/Revit-GetStarted/files/GUID-6E4358A4-EE17-4418-B996-F8D807DB3AEE.htm	Revit libraries from Autodesk include families from manufacturers and general libraries. Many family libraries comply with CSI standards such as Uniformat, Masterformat and the Omniclass classification system.
2	NBS National BIM Library https://source.thenbs.com/bimlibrary	This is one of the most professional sources for downloading families in Revit with a variety of components from manufacturers to families created by users. It also provides add-ins to support managing and downloading families directly from the Revit environment.
3	BIM Store https://www.bimstore.co/	A library resource from the UK BIM community. All Revit families contain IFC and COBie variables, with a wide range of manufacturer specifications.
4	BIM Object https://www.bimobject.com/	A commercial site providing services to the construction industry, similar to Autodesk Seek. Users can easily search the BIM library based on brand, type, material, building type, classification system, functional space and many other attributes.
5	RubySketch https://3dlibrary.rubysketch.com/specific_search/5	A service provider from the US. Like many other sites, RubySketch links with many different partners and provides libraries of Sketchup and Revit, with many mechanical and electrical components.
6	SpecifiedBY https://www.specifiedby.com/	This is the largest Family Revit library source in the UK. All library sets are provided by the manufacturer.
7	RevitCity https://www.revitcity.com/	All family libraries do not follow any specific standards. This is also a good choice for Reviter.
8	SmartBIM Library https://smartbim-library.software.informer.com/	A community library. It contains many libraries from manufacturers and other general families.

Nearly 1,000 objects have been downloaded from such sources. The objects are then classified in groups according to the types and subtypes (if any), LOD, and stored to relevant folders in the shared drive.

Regarding the compatibility of the BIM objects, by collecting lessons from the internet, the research team has identified a set of criteria for assessing BIM objects. The criteria are presented in Table 4.

Table 4 *Criteria for assessing an object's quality*

Criteria	Aspect to assess
Geometric dimensions	If the object has three dimension
Parameters' editability	If the parameters can be edited to fit in another project
The shape of the object	If the shape can visually reflect the real-world physical product/system
Presence of different LODs	If there are several versions of the object with different levels of detail
File size (should never exceed 1500 KB)	Large objects may cause the software to slow down
Contain relevant data	Depending on the types of objects, data include material properties in general, and performance data for the MEPF systems

Recognising the market opportunity of BIM services due to the BIM mandate by the Government in construction work of from grade II, Consultant A starts targeting to not only the building sector but also infrastructure sector. They did a quick survey in their targeting markets of building and infrastructure sectors to determine the BIM services demand and information requirements for each stage of the project life cycle, which are the basis for developing their BIM object libraries. The results revealed that BIM uses are not required in the preliminary design stage and less required in the basic design stage. The current demand for popular BIM services is presented in Table 5.

Table 5 *The current demand for BIM services*

BIM uses in the sectors	Basic design	Technical Design	Detailed Design	Construction	Operation
BIM uses demand for both sectors					
Author Design Model (BIM Design Authoring)	v	v	v	v	v
Quantity take-off for main components and systems		v	v	v	
Simulating the construction progress (part of BIM 4D)			v	v	
Coordinate Design Model(s)		v	v	v	
Construction Process Model(s)				v	
Author Construction Site Logistics Model				v	
Building sector					
Review Design Model(s)	v	v	v		
Layout Construction Works				v	
Infrastructure sector					
Capture Existing Conditions (either stage)	v	v	v	v	

After running one more cycle of action research with the revised process, the following issues have been identified:

- The set of quality criteria is not sufficient to ensure the compatibility of the BIM objects. Only about 60% of the BIM objects collected could be used.
- Some sources of BIM objects have more low-quality objects than others, namely Revitcity and some local sources. Some sources are not updated frequently, namely SmartBIM Library and some local sources.
- Not all the information required need to be included in the BIM objects, since they are required for some projects but may not be needed for others. Therefore, the team have learned that some information will be input later during the project progress, in relation to the task information delivery plans.
- The objects are arranged in folder structure designed by the team, not to be compatible with any object classification system. Therefore, sometimes it is hard to find a particular object to use later on.

- The information integrated in the objects are all in English. This practice is OK for the time being but may be an issue in long-term when clients want BIM models in other languages such as Vietnamese or Japanese.
- In the action research process, there are two action with the name "update the libraries", resulting confusion.

Reasons for irrelevant or low-quality objects include:

- The objects collected are not in correct shapes or are not with correct relative dimensions.
- The object parameters structure and parameter names are not consistent with others, making it difficult when extracting information for future usage.
- The objects, especially MEPF systems, cannot connect to other objects of the same project due to the difference in specifications (i.e. number or type of connectors).
- The objects were created in outdated versions of software.

In order to reflect the issues above, the research team proposed and applied some amendments to the action research process. Table 6 shows the revised process.

Table 6 *The second revised process of the action research (Cycle 3)*

Steps	Substeps
Planning	• Develop/***Update*** a list of sources for collecting BIM objects • Develop/***Update*** a set of acceptance criteria to assess the BIM objects collected/created • ***Identify the BIM uses and related information requirements to be served with BIM objects libraries*** • Develop a list of BIM objects to be acquired with specific LOD that facilitate the BIM uses implementation
Acting	• ***Structure the object folders according to a specific object classification which is most rationale*** • Locate the sources for relevant BIM objects • Collect/Create the new BIM objects • Assess the BIM objects collected against the acceptance criteria • Update the BIM objects libraries with the accepted objects
Observing	• Collect feedback from the BIM objects libraries development • Collect feedback from the later usage of the new BIM objects
Reflecting	• ***Rearrange the misplacing objects to the most relevant folder*** • ***Remove irrelevant and low-quality objects from the BIM objects libraries*** • Develop/update BIM objects libraries dictionary • Update the action research plan

The list of sources for obtaining BIM objects is updated regularly by removing low quality and irrelevant sources, together with adding the new sources found. However, the removed sources are still kept in a separate database in order to keep track, to avoid being suggested again. Regarding the quality of the BIM objects, new criteria are added leading to an updated set as presented in Table 7.

Table 7 *Updated criteria for assessing an object's quality*

Criteria	Aspect to assess
Geometric dimensions	If the object has three dimension
Parameters' editability	If the parameters can be edited to fit in another project
Software version	***If the object file created with the recent software to be compatible with the current version of modelling software***
The shape of the object	If the shape can visually reflect the real-world physical product/system
The object's structure	***If the architecture of a BIM object can be clearly understandable to experienced practitioners***
Presence of different LODs	If there are several versions of the object with different levels of detail

File size (should never exceed 1500 KB)	Large objects may cause the software to slow down
Contain relevant data	Depending on the types of objects, data include material properties in general, and performance data for the MEPF systems
Sufficient data	***A BIM object should not include too much information that is difficult to interpret***
Functional usability	***If an object is convenient and easy to insert and use in a project to serve a specific and clearly-defined function***

The folders for BIM objects libraries, storing on the local drive of the organization, was restructured using Omniclass structure. Omniclass was selected since it is widely used in BIM; also, it integrates various currently used systems, including Electronic Product Information Cooperation (EPIC) for product structuring, MasterFormat for work outputs, and UniFormat for elements [35].

As presented in Table 6, the task "Develop/update BIM objects libraries dictionary" has been added to the action research process in the reflecting step. The dictionary will provide glossary and information of the libraries structure, define object functions, and provide other necessary information.

After running one more cycle of action research with the second revised process, the following issues have been identified:

- The folder structure following Omniclass classification cannot differentiate between similar objects with different LODs
- Since the MEPF systems and premanufactured components are provided by different manufacturers and may not be replaceable, in the later stages of the project, different BIM objects may need to be collected
- There was no rule for naming convention, therefore, the object files are not named in a properly way, leading to challenges in locating the objects later.

In order to solve the issues, folder and file naming standards must be in place for governing the file names of objects collected. The information containers structure applied was adopted from the structure of Omniclass classification system, while the naming convention applied for BIM objects was adopted from BS8541-1:2012 standard, as in Table 8.

Table 8 *Naming convention for BIM objects in the BIM objects libraries*

Field	Type	Description
1	Software	Used to identify the software to use with; for objects in openBIM format, use "Open" for this field
2	Type	Used to identify the type of the object
3	Subtype/ product code	Used to communicate extra details that help characterize the construction product, like the product range
4	Source	Used to identify the manufacturer of the library object. For a generic object, this field shows the website to collect the objects, or "internal" if an object is created by a member of staff
5	LOD	Used to identify the LOD of the library object
6	Differentiator	Used to differentiate specialized characteristics for classifying the objects

Using a field in the name of the objects for differentiation of the relevant software can simplify the structure of the libraries folder structure. We can store different objects for the same project components/systems but with different software in the same folder, which can facilitate the object locating. It can also provide users with options of getting use of objects files in native format and openBIM format storing in the same folder. The new naming conventions must be applied to the existing objects and also integrated into the action research plans for future use.

6. Discussion and Conclusion

After running three cycles of the action research, the job of BIM objects libraries development of Consultant A has been improved significantly. Several lessons have been drawn out, as follows:

- The use of an object classification system is a must. This can facilitate the structure of the information containers to store BIM objects libraries.

- There should be a rule for creating BIM objects if the job is done with in-house forces. This can ensure the quality and compatibility of the BIM objects created for future use.
- There should be a good set of criteria for assessing the quality and compatibility of BIM objects collected ready beforehand to avoid using low-quality or irrelevant objects in projects, which can influence the project delivery.
- There should be a naming convention adopted for governing the file names of objects collected.
- The level of information integrated into the BIM objects depends on the purposes of utilizing the BIM models, in other words, depending on the BIM model uses. Therefore, the determination of popular BIM model uses will decide the strategy for BIM objects libraries development.
- The BIM object libraries need to be updated frequently due to that software developers produce new BIM objects regularly for community uses. Also, the development of software versions will quickly outdate selected BIM objects, then removal need to be taken into account.
- Vietnam currently does not have a national standard or an official guide for BIM object development; this is one of the cause for the issues emerged in the action research.

This research study examined the creation of BIM object libraries for a BIM consultant in Vietnam, emphasizing the challenges encountered during various cycles of the action research conducted. The findings illustrate the methodology for creating well-organized BIM libraries, which are anticipated to enhance design workflows, increase data consistency, and facilitate seamless information exchange among stakeholders. The insights gained can serve as a valuable reference for both other BIM consultants and the Government in formulating rules, processes, and guidelines to facilitate the adoption of BIM within the Vietnamese construction industry.

In long-term, Vietnam should develop their own national standard or official guide for BIM object development. This can be considered as a future research project at the national level. Also, in order to promote interoperability across platforms, making the BIM objects libraries simpler but more efficient, there is a need for developing BIM objects in openBIM format and with Vietnamese language. Then the BIM models developed can be exploited for more purposes in line with the BIM model uses agreed by project stakeholders.

Future studies should focus on expanding the scope of BIM objects libraries to include advanced functionalities such as real-time data integration, sustainability analysis, development of BIM objects in open format and enhancement of the automation in BIM objects development and exploitation. These enhancements can propel the use of BIM libraries to a higher level, ensuring their adaptability and relevance in an increasingly digital and sustainable construction landscape.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *QN, HBN;* ***data collection:*** *QN, HBN;* ***analysis and interpretation of results:*** *QN, HBN, VM;* ***draft manuscript preparation:*** *QN, HBN, VM. All authors reviewed the results and approved the final version of the manuscript.*

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