Integration of Normative Databases in BIM Projects

Hasmik Hakobyan
NUACA
Yerevan, Armenia
e-mail: mailtohakobyan@gmail.com

Mher Markosyan
YETRI
Yerevan, Armenia
e-mail: mark@yetri.am

Armine Ghulyan
NUACA
Yerevan, Armenia
e-mail: ghulyanarmine@mail.ru

ABSTRACT
The article touches upon the issues of acquiring automated estimates by price for constructing buildings in relation with BIM technology implementation. It is outlined that the automation of work reaches upon the work volume acquisition in various packages used in BIM. For the automation of estimate formation there must be taken some actions of relating two corresponding environments, i.e., the part of work volumes in design package and the bases of normative data. The requiring normative bases and the descriptions of their relations are presented.

Keywords
BIM, normative, cost estimate, database

1. INTRODUCTION
Currently, the implementation of BIM (Building Information Modeling) technologies is of high demand in the construction industry, hence they ensure working control, quality and reduce paperwork enabling to monitor the technical conditions of buildings and constructions. In turn, the latter ensures appropriate decision making.
There are numerous design packages used in BIM. Concurrently, the widely used ones are Revit, ArchiCad, Renga, Tekla. In comparison with AutoCAD, which comprises geometric tools like lines, fragments, the BIM represents object projection [1], which is realized by geometric and non-geometric data. The latter herein has properties and attributes. It is conditioned by the fact that the designer bases on such object-specific terms as wall, pillars, floors, windows, etc., which enable to automatically get work volumes from BIM system for building and construction, which accordingly results in an estimate based on the received data.

2. THE STRUCTURE OF THE RECOMMENDED SYSTEM FOR STARTING AUTOMATED COST ESTIMATES CONSTRUCTION
As shown in Figure 1, for compiling cost estimate a resource base is needed, which represents information on machine- mechanisms, materials, workforce and normative data along with work bases containing information about possible work types.

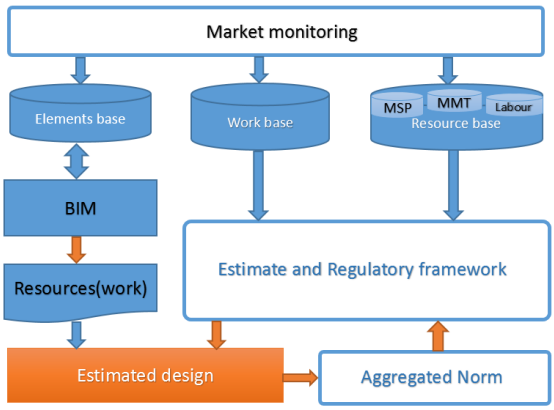

Figure.1

2.1 The formal description of the system logical model
The model has the following logical proceedings:
- A base of elements is started or an appropriate one is downloaded. It can be formed from other projects as a result of monitoring.
- A work volume of appropriate project is started in accordance with the essence of object and the base of applicable elements.
- Cost calculation is performed.

In the existing design packages there are no means for the automation of process in receiving cost estimates [2,3]. For implementing automated creation system of cost estimates, some tools are required, which can provide connection with normative base of cost estimate and, hence, do required calculations.

2.2 The structures of recommended subsystems of the cost estimate normative base
Modernization of cost estimate base is one of the priorities of many countries and is an issue of utmost importance [4,5]. The cost estimate base is formed from work and resource bases. It is worth considering the recommended structures, henceforth:

Workforce Database
Studies have revealed that different countries have different ways of representing workforce data base. In likewise manner, the data bases of Russia [6] and Khazakhstan [7] are principally different from those of Italy and Turkey [8]. Differences are conditioned by both structure and volume.

Basing the study on international expertise and practice, the article highly recommends to limit the workforce description by 40-60 professions and qualifications and if needed, make some additions. The base represents the qualification and an appropriate value of unit time.

Code
Name
Unit (human-hour)
Unit cost

Machine-mechanisms database
According to international expertise [9], the base machine-mechanisms is represented as follows:

Code
Machine type
Unit (machine-hour)
Unit cost

The detailed description of costs is represented in separate subsystems.

Database of materials
The given materials are divided into several groups, which are described by a code.
The base introduces the volume of material unit and an appropriate cost.

Code
Name
Unit
Unit Volume
Unit Cost

The values of work are for both general unit and for detailed description of elementary costs.

First and foremost, all processes of code design apply the technological principle, yet parallely some codes are processed, directed to the field of application (import, element design in BIM, market monitoring and so on).
It is also worth to mention that codes enable to implement bases in different languages.

3. AUTOMATED DESIGN SYSTEM FOR ESTIMATE DOCUMENTATION IN WEB ENVIRONMENT

The platform processed in web-environment ensures the formation of automated estimates, which, in turn, enables designers and estimate designers to apply online automated bases. Figure 2 introduces the structure of platform. The appropriate steps of cost estimation are presented below:

- Work volume upload: the structure corresponds to the given standards. Interim with the design every object receives an appropriate code as well as properties from the base of elements.
- Analysis of data in normative bases by BIM translator with the given codes. Supposedly, the cost of unit is determined according to enclosing an appropriate field.
- Checking and making some changes in accordance with the initial form of the estimate. Yet, changes are to be made by estimate designers concerning norms and parameters.
- Considering the structure of machine-hour or the work of created footnotes.
- Application of some filters on document structure while compiling estimate.
- Finally, data import in an appropriate form (.xls, xml, etc.,) or maintainance for further changes.

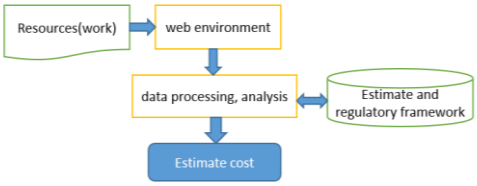

Figure .2

Interim with the design of objects, there may be suchlike projects and in order not to do cost calculation repeatedly, there is an opportunity to receive information about formed estimates.
Estimate designer is entitled to import the estimate document for any work in the project.

3.1 The principle of BIM translator's work

BIM translator is set up to enhance the opportunities of international cooperation as well as to assist in codes agreement and in inter-applicability of entrance data of estimate design. Figure 3 illustrates the aforementioned:

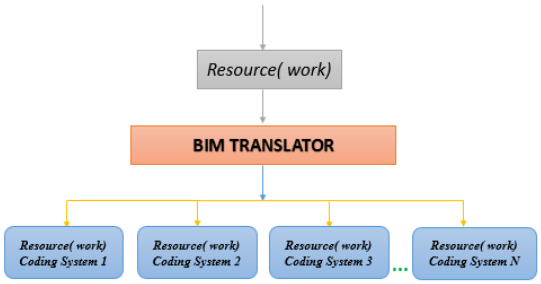

Figure 3

As a result of work volume procession by the assistance of BIM translator, each object receives codes of normative estimates and base work resources. Hence, implemented estimates are available. It is also recommended to search work volume elements according to their names and properties. Correspondingly, the designers should follow the standards processed by BIM translator.

4. CONCLUSION

Lastly, we can state that the recommending platform gives opportunity to:

- Design and encourage automated estimates based on the output data of architectural, engineering projects
- Compare coding systems of work and resources and enlarge international cooperation in the field of deign sphere
- To create and apply joint archival data on designs and estimates

5. ACKNOWLEDGEMENT

The research was carryied out by the scientific and thematic funding of the RA State Budget within the framework of the project "Procession of automated working site of architectural and consturctive design".

REFERENCES

[1] Mr Saeed KIA, Amirkabir University of Technology, "Review of Building Information Modeling (BIM) Software Packages Based on Assets Management", *pp.101-139,2013* [online].Available: *https://www.researchgate.net/publication/253058808_Review_of_Building_Information_Modeling_BIM_Software_Packages_Based_on_Assets_Management*

[2] A.Sattineni, R.Harrison "Bradford II Estimating with BIM: A survey of US construction companies", pp. 564-569 *[online]. Available: https://pdfs.semanticscholar.org/c476/2f36d9154f53b82718ecbaffface0575030d4.pdf*

[3] Ch.Eastman, P. Teicholz, R. Sacks, K. Liston "BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors", 2008 *[online]. Available: https://www.academia.edu/3183272/BIM_handbook_A_guide_to_building_information_modeling_for_owners_managers_designers_engineers_and_contractors*

[4] A.Ghulyan "Some problems of reforming of budget and industrial rationing", *International on contemporary problems in architecture and construction, Volume 2, September 24-27.12, Czestochowa, Poland, pp. 48-49*

[5] A.Ghulyan "Specific features of organizational-technological and appraisal design development for the reconstruction and restoration of historic-cultural buildings in Armenia", *Proceedings of 8th International Conference on contemporary problems of Architecture and Construction, ISSN 1829-4200. pp.101-103, Yerevan-Armenia, 2016*

[6] Сборник текущих средних сметных цен Краснодарского края, on-line https://www.kgexpert.ru/%D0%98%D0%90%D0%9C_%D0%A1%D0%A2%D0%A1%D0%A1%D0%A6_1%D0%BA%D0%B2_2019.pdf

[7] Сборники сметных цен, Республика Казахстан, 2019 *[online]. Available:* https://www.egfntd.kz/rus/page/NTD_KDS_estimate-2019

[8] M.K.Mahallesi "Construction and Installation Unit Prices 2019", The Ministry of Environment and Urbanism, Republic of Turkey, *[online]. Available: https://webdosya.csb.gov.tr/db/yfk/icerikler/insaat-birim-fiyatlari-2019-ingilizce.pdf*

[9] Samphaongoen, Phuwadol, "A Visual Approach to Construction Cost Estimating" (2010). Master's Theses (2009). Paper 28., *[online]. Available:* http://epublications.marquette.edu/theses_open/28