Building Information Modeling for Existing Residential Buildings in Armenia

Marine Ghazaryan
National University of Architecture and
Construction of Armenia
Yerevan, Armenia
e-mail: mghazaryan@nuaca.am

ABSTRACT

This article is an overview of the ways of introduction and operation of Building Information Modeling (BIM) in Industrial countries with big heritage of old multi-apartment residential buildings needing systematic and capital maintenance. Particular attention is being paid to the experience of the former Soviet States that have similar background, but different paths of development followed by the collapse of the Soviet Union. The issue is particularly critical for the Republic of Armenia that has a big heritage of residential buildings necessitating management and enhancement of seismic resilience. Six main components of the issue were introduced that are critical for the development of the institute of residential building management and may be sustained and developed by the means of information technologies and introduction of BIM.

Keywords

Building Information modeling, residential building, building management.

1. INTRODUCTION

Many industrial countries in the world have huge inventory of buildings built in mid decades of the 20th century. There is a common problem for these countries to maintain safe operations of these buildings and infrastructure [1] and at the same time save public funds. This article focuses on the use of Information Technologies and management mechanisms for resolving maintenance issues of the old residential buildings. This problem is particularly important for the Republic of Armenia (RA), where earthquake resilience is a critical requirement. This concern is significant for RA and from the urban development point of view, and from the national security.

After independence the Government of RA has privatized significant part of state owned residential building. However, it was not clarified whether the State or private owners should carry out the current and capital repairs of the buildings (basement, roofs, commonly used spaces and technologies). In accordance with current urban development standards (which were set up after the 1988 Spitak earthquake), the old residential buildings have to be reinforced to comply the requirements of the new standards; the repair regularity and priority have to be set up based on Life Cycle (LC) studies; responsibility for the reinforcement should be clarified; etc. Of course this list could go on expanding, covering all the aspects of the old building Facility Management (FM).

We see introduction of BIM-Building Information Modeling as a necessary component for facilitating process of FM for storing and communicating easily big amount of data on constructions in general and old residential buildings in particular. Digitalization and applications of information and communication technologies (ICT) are now in almost every aspects of our life. ICT as means of assisting the FM processes, enhancing the efficiency in communication between stakeholders and reducing costs is in the core of multi-direction measures forming the field. We propose the following six components (Figure 1) as the above mentioned vital measures that constitute aspects of the old residential building issue.

Figure 1. Six constituents of Residential Building Management

2. METHODOLOGY

As mentioned, the problem is common for many countries, and some countries have found very educational, smart and interesting solutions. As a first step we present the overview of international experience of old residential building management in former three Soviet states (Latvia, Lithuania and Russia) for: (a) adapting the best solution in RA, and / or (b) developing new ways and solutions.

Second part will be devoted to the introduction of BIM as an application to construction business in general.

3. OVERVIEW OF INTERNATIONAL EXPERIENCE

The issues connected with the management of the old multi-apartment residential buildings as: (1) planning and implementation of capital and periodic repairs, (2) data collection and registration of technical condition of the buildings, (3) management of the residential buildings, and other issues are common for the former Soviet republics as inheritors of the former practice and understanding of FM.

Here we present the experience of three former soviet states: Latvia, Lithuania and Russia, their approaches and solutions to the Residential Building Management (RBM).

3.1 Latvia -Sandra Geypelen in her research paper devoted to the Republic of Latvia has accurately presented that the understanding of ownership is not being perceived only by the transfer of the certificate verifying ownership, but by the understanding of the great responsibility, which in realty the real estate ownership includes. [2] "Taking into account the fact that during the Soviet times, there was no ownership of the apartment, and then quickly offering apartments to a planned privatization, in the society there did not develop an understanding and responsibility for the property, especially for the property in multi-storey apartment buildings. Similarly, the understanding of the property ownership did not facilitate the transfer of the ownership rights of residential property using privatization certificates, without explaining the potential owner the burden of responsibility of having the property in the ownership." This statement is true and for the case of the RA as the adoption of ownership doesn't assume acceptance and perception of the entire spectrum of its responsibilities arising from the ownership. The authors of the article highlight the importance of the institute of management for the residential buildings under the laws and regulations of the State. This institute in Latvia has a considerable influence on initiating the repair and reconstruction work [3], but it is still a matter of discussion, the method of assessment and evaluation of the repair works and sustainable development of the emerging residential buildings' managers market [4]. Iveta Pukiten and Geypelen articles [5] point out that the problem of residential buildings has a major impact on the whole society. Latvia developed chaotic management of this building process [3] and had a great impact on the economic and social spheres, and thus clarifies that the issue should take into account not only the interests of private owners, but the entire society to ensure healthy and safe accommodation requirement.

3.2 Lithuania- In the Republic of Lithuania the issues of management, maintenance, repair and reconstruction of residential buildings are included into the program of energy efficiency improvement for the buildings, which [6] were implemented in three phases. In the first phase (1996-2004) [7], the World Bank and the donor community conducted $ 28.6 million US dollars investment for the energy efficiency improvement pilot project. In addition, technical assistance was provided for the formation and development of energy audit markets, establishment of owners' unions, for bank officials training and the formation of the so-called development housing agency officials. The goal of the latter was the promotion of energy efficiency investments in housing. Thus, the elements of infrastructure were created for management of residential building in Lithuania.

The second phase [7] (2005-2010) began with adoption of the State strategic plan on repairs of multi-apartment buildings in 2004 after the adoption of the Lithuanian Housing Strategy Project. The project includes commercial banks for investments in the sector of engagement and in support of subsidies provided by the State. The subsidies rose from 15 percent to 30 percent and then reached the 50% threshold. Dramatic increase in the State subsidies was conditioned by the outbreak of the financial crisis. At this stage, banks were reluctant to invest own resources and taking risks for providing credit facility.

In the third stage [7] (2010-2013), Joint European Support for Sustainable Investment in City Area- JESSICA program was introduced, which provided € 227 million of EU structural funds and the state budget. Initially, the project was developing slowly. Implementation of the new program EnerVizija model accelerated introduction of launching a large-scale repairs: (i) by municipalities and (ii) by managers/administrators of residential buildings who initiated repairs and became borrowers of loans, instead of apartment owners. The project was supported by state subsidies of up to 15 percent. Further accelerating the process of promotion, new tools were introduced, including additional 25 percent subsidized by the Climate Change Fund and 3% fixed interest rate of JESSICA funds. These changes accelerated the process of modernizing buildings in Lithuania. Prior to the third phase, 70 building were annually renovated in Lithuania. The taken measures increased up to 490 renovated buildings annually. In May 2013, the subsidy procedure for low-income homeowners was revised. All this simplifies the process of decision making for repairs, especially low-income homeowners. Summarizing the experience of the Republic of Lithuania should be noted that mechanisms and institutions have been developed with the combination of public, private and business resources. 97 percent of Lithuanian residential buildings are privatized and only 3% is of the municipal property. [7] Only 4 percent of the 35,000 residential buildings built before 1993, were repaired within the framework of this reform

3.3 Russia-The European Bank for Reconstruction and Development and the International Finance Corporation conducted a study on capital repairs of residential buildings of Russian Federation (RF) [8] titled as Financing Capital Repairs and Energy Efficiency Improvements in Russia (1), where is stated that capital repairs are urgent priority for residential buildings in Russia. About 60 percent of residential buildings of RF need urgent repairs according to the regulations of the country on urban planning. International experience shows that the sustainable housing renovation and modernization policy of Government depends on the precise definition of goals and objectives, long-term strategic plan. And concluded that "the problems of maintenance and repairs of apartment buildings should be settled based on the principles of private property and the rule of law." [8]

This brief review allowed us to conclude that in financial support can be serious measure for solving residential building issues along with innovative management methods.

4. INTRODUCTION OF BIM

The modern urban development has the trend of transition from industrial development of the cities, which is recognized as non-sustainable development phase, to the smart and green cities as sustainable development stage [9]. This assumes modernization of urban development functions, restructuring and reorganization of the complete cycle: design, construction, operations, maintenance and demolition, with the applications of ICT.

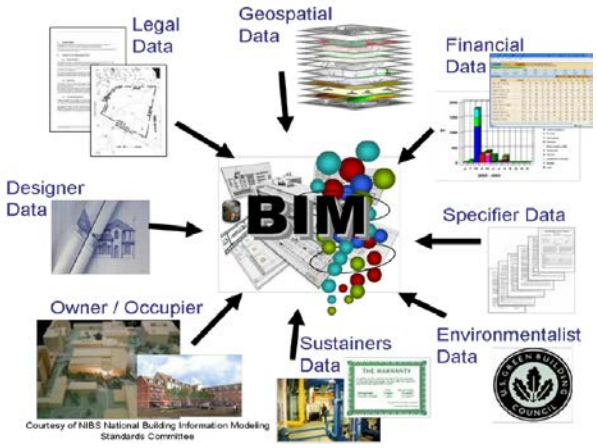
This development trend of the industry has been adopted to some extent by 60-70 countries and was titled BIM (Building Information Management/ Modeling). BIM is the innovation in the urban development concepts by introducing new technologies, polices and regulations, which changes the results of the work, the relationships in the industry and beyond. Building Information Modeling (BIM) is the process that creates and manages buildings' physical and functional characteristics by ICT. BIM are files, which can be exchanged into the network, putted into circulation, as support for decision-making. It involves the dissemination of information at different levels and sectors. There are many definitions of BIM. Here is a number of them:

"Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a

facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition". *National BIM Standard - United States* [10].

"BIM describes the means by which everyone can understand a building through the use of a digital model which draws on a range of data assembled collaboratively, before during and after construction. Creating a digital Building Information Model enables those who interact with the building to optimize their actions, resulting in a greater whole life value for the asset." *National Building Specifications, UK* [11]

Besides these two [10,11] official definitions, there are many other definitions of BIM. Some definitions pay great attention to the environmental impact of the buildings or the buildings' owners or inhabitants needs in information during the whole life cycle. BIM is defined as a way of ensuring a smooth process throughout the LC of the building with the use of information technology. As a result the residents will have more effective and safer management with less environmental impact [12]. In other words BIM is the informational infrastructure for buildings, which may be available to interested parties linked to the structure. BIM is a methodology which integrates a digital description of the building components and their relationships. Accurate and complete information about the buildings will help the users to execute queries, electronic experimental simulations, calculations and other activities, examining the effects on the facility during life cycle. Consequently, BIM can provide, building owners and residents with valuable information for decision making, for increasing LC and operational stability.



Pic. 2. Communication, collaboration and Visualization with BIM model (NIBS, 2008) [13]

BIM can be seen from a narrow and a broader perspective. BIM in a narrow sense comprises solely the digital building model itself in the sense of a central information management hub or repository and its model creation issues [14]. From the broader perspective organizational and legal issues, functional and LC issues, informational issues are included in the BIM. Commercial BIM platforms offer integrated data management, component libraries and general functionalities [15]. Widespread differentiations of BIM are 3D (spatial model with quantity takeoff), 4D (plus construction scheduling) and 5D (plus cost calculation) BIM [15].

5. CONCLUSION

BIM adoption in the Construction Industry is seen as an important step and facilitating tool for resolving the particular, but vital and huge issue existing in Armenia on residential building management. Due to the big number of buildings that were built before the modernization of the seismic standards, and based on the recent programs developed by the Urban Development Committee on passporting the residential buildings we see BIM implementation as an important and inevitable constituent of the industry developments. The BIM usage and implementation in new structures (without even titling it as BIM) is still limited, but exists to some extent. However, the structured BIM implementation in new buildings is still missing, as after construction stakeholders access to information is still limited. Owners, facility managers and related consultants are hardly involved in BIM functionality development [16] worldwide.

Although on the one hand, implementation of BIM both in new and existing buildings induces profound changes of processes and information flows, on the other hand it accrues considerable advantages [14]. Potential BIM functionalities and benefits in existing buildings are numerous. Calculation of alternatives and optimizations seem promising to enhance the project management and risk mitigation or to limit costs and duration of FM or deconstruction measures, e.g., in complex buildings or infrastructures [14].

It has to be mentioned that to our knowledge there isn't research on comprehensive cost-benefit analysis of BIM implementation for the existing buildings.

REFERENCES

[1] K. L. M. Z. P. S. Andre Barrmann, "BIM- Based Life-Cycle Management for Reinforced Concrete Buildings," *International Journal of 3-D Information Modeling, January- March,* pp. 1-24, 2012.

[2] I. G. D. S. I. S. Sandra Gaipele, "Social, Economic and Leagal Problems of Housing Management in Latvia," in *Business and Management*, Vilnius, 2012.

[3] V. G. E. Gara, "Refurbishing Apartments and Houses in Latvia and Bulgria: Levers and Breaks," in *ECEEE 2011 Summer study*, 2011.

[4] S. G. B. P. Ineta Geipele, "Pricing Principles of Apartment House Management in Latvia," in *International Conference on E-Business, Management and Economics*, Singapore, 2011.

[5] I. G. Iveta Pukite, "Residential Building Managemet System Features and Underlying Factors," *Baltic Journal of Real Estate Economcs and Construction Management,* pp. 45-55, 2015.

[6] E. Maldonado, 2016-Implementing the Energy Performance of Buildings Directive (EPBD) Featuring Country Reports, Lisbon: Adene, 2015, pp. 383-399.

[7] V. Sirvydis, "The Residential Energy Efficiancy program in Lithuania," World Bank Group, 2014.

[8] "Financing Capital Repairs and Energy Efficiency Improvements in Russian Multi-family Apartment," Alex Publishers, Moscow, 2012.

[9] Y. Arayici, "Towards building information modeling for existing structures," *Structural Survey, vol 26 Iss 3*, pp. 210-222, 2008.

[10] U. National BIM Standard.

[11] N. B. S. U. NBS.

[12] A. G. Arayici Y, Building Information Modeling (BIM) for Construction Lifecycle Management, NY: Nova Science Publisher, 2010.

[13] R. C. C. P. Arayici Y., "Building information modelling (BIM) implementation and remote construction projects: Issues, Challenges and Critiques," *Journal of Information Technology in Construction*, pp. 75-92, 2012.

[14] Rebekka Volk, Julian Stengeluilding information Modeling (BIM) for Existing Buildings, A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. Article in Automation in Construction March 2014.

[15] Eastman, Teicholz, Sacks, Liston. BIM Handbook - A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. 2. Aufl. Hoboken: Wiley; 2011.

[16] Becerik-Gerber B, Rice S. The perceived value of building information modeling in the U.S. building industry. ITcon 2010;15:185–201.