# Geo-Information Technology of 8-Level Responsibility: Concept and Standard of Construction Management for Implementation of The BIM-Technology in Russia

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**Abstract.** Currently, the increase in construction efficiency in the world is associated with the introduction and development of information modelling of construction objects (BIM-technology). The BIM-technology is a process of collective creation and use of information about a structure that forms the basis for all decisions throughout the life cycle of an object. The BIM-technology with the help of a number of software products provides automation of production, it does not provide a methodology for the introduction of these products. The article describes the technology of 8-level responsibility, which is guaranteed to give systematically a new quality of management in construction, related to the requirements of the Russian Government Decree No. 87 of February 16, 2008. The technology of 8-level responsibility (8LR) in the detailed specification of GD No. 87, (territory, construction stage, master plan object, section (part) of the project) extends the number of inseparable levels to 8 (part of the object, element, mark, position), where the "position" is the last indivisible detail of the object. There is reason to argue that the use of the "8LR Technology" in addition to the BIM-technology will provide a synergistic effect and will remove a number of obstacles to the BIM introduction in Russia and system control in the construction and operation of objects of any complexity in Russia.

## 1. Introduction

Life cycle management in construction is a complex and almost very important task. Currently, the increase in construction efficiency in the world is associated with the introduction and development of information modelling of construction objects (BIM-technology). The BIM-technology is a process of collective creation and use of information about the structure that forms the basis for all solutions throughout the life cycle of the facility (from planning to design, production documentation, construction, operation and demolition). At the heart of the BIM there is a three-dimensional information model, on the basis of which the work of the investor, customer, chief designer, chief contractor, operating organization is arranged [1].

At present, in Russia, management at all stages of the construction process is at an unsatisfactory level. That causes errors in the projects, long (compared with foreign analogy) timing of construction of facilities, etc. The most innovative Russian enterprises are actively moving to the BIM and have already felt the benefits of using the technology. Most of those who have not yet switched to the BIM, have

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realized the irreversibility of the changes taking place in the architectural and construction industry, and today they choose the optimal method for implementing information modelling [2, 3].

However, the BIM-technology has a number of significant drawbacks that make it difficult to implement in Russia:

- the BIM is not a means of tracking the life cycle of an object;
- there is a loss of existing work practices when switching to the BIM;
- the BIM does not take into account the specifics of the Russian legislation.

The article proposes to use, in addition to the BIM, the 8-level responsibility of 8LR, which:

- gives a way of structuring and coding construction objects, starting from the territory and ending with an elemental position within the structure, that is why it can be the Russian standard for coding construction objects;
- allows to decompose the task of implementation and clearly define the business processes for each level, so it can be a methodology for implementing the BIM in Russia;
- ideologically consistent with the maturity levels of the BIM;
- does not position itself as a software product that competes or replaces any other product from the AutoDesk or other company line. It is an add-on for building management.

## 2. Maturity levels of the BIM-technologies

The maturity levels of BIM technologies are shown in Fig. 1.

### *2.1. Level 0. "Unmanaged CAD"*

In the UK, they started literally from the zero level, the state where there is no organized interaction between the members of the project team, and the work is in the 2D drawing mode. Finished drawings, mainly through paper carriers or electronic paper, are transferred to subcontractors. Text documentation is also mostly in paper form circulating among the participants of the process, although it is produced on the computer.

### *2.2. Level 1. "Managed CAD"*

At this level, alongside 2D, the 3D graphics appear, and the design data is distributed electronically through a Common Data Environment, specified by the British standard BS 1192: 2007. However, there is no full-fledged interaction between participants belonging to different disciplines.

### *2.2. Level 2. "Federated BIM"*

This level of work implies full interaction and full teamwork of project participants. Each one is developing a three-dimensional model of his own discipline, fully responsible for it, and then there is an interdisciplinary coordination in special environments. Collisions are defined and eliminated, project decisions are verified, etc. A software implementation of such an environment can be Autodesk Navisworks, Solibri Model Checker, Bentley Navigator. The most important condition is the work in accordance with the standard BS 1192: 2007 with the organization of a common data environment. At this level, such an organized interaction can provide up to 50% reduction in non-productive costs of the project.

### *2.3. Level 3. "Integrated BIM"*

Until recently, this level seemed to be something rather "blurred", insufficiently defined, the limit of dreams, when the full interaction between disciplines was realized through the joint use of a single project model stored in a single central repository. All participants can access the model, and the risk of conflict situations is minimized. The development of the methodology of work and life in a digital format on a new qualitative level began. The work on the program BIM level 3 (Digital Built Britain) started. This development was conducted in parallel with two other strategies:

- "Smart" cities, representing "intelligent" systems for transport, energy, health, water supply and waste processing;
- "Information Economy", which deals with high-performance computing, the Internet of things in the form of automatic sensors for the automation of processes, etc. The convergence of the three strategies has allowed us to see the world in which all of us will have to live. These technologies will change our lives and the world in which we live. The strategy of Digital Built Britain eventually presented a vision of a high-performing, transparent economy that effectively serves the needs of its citizens.

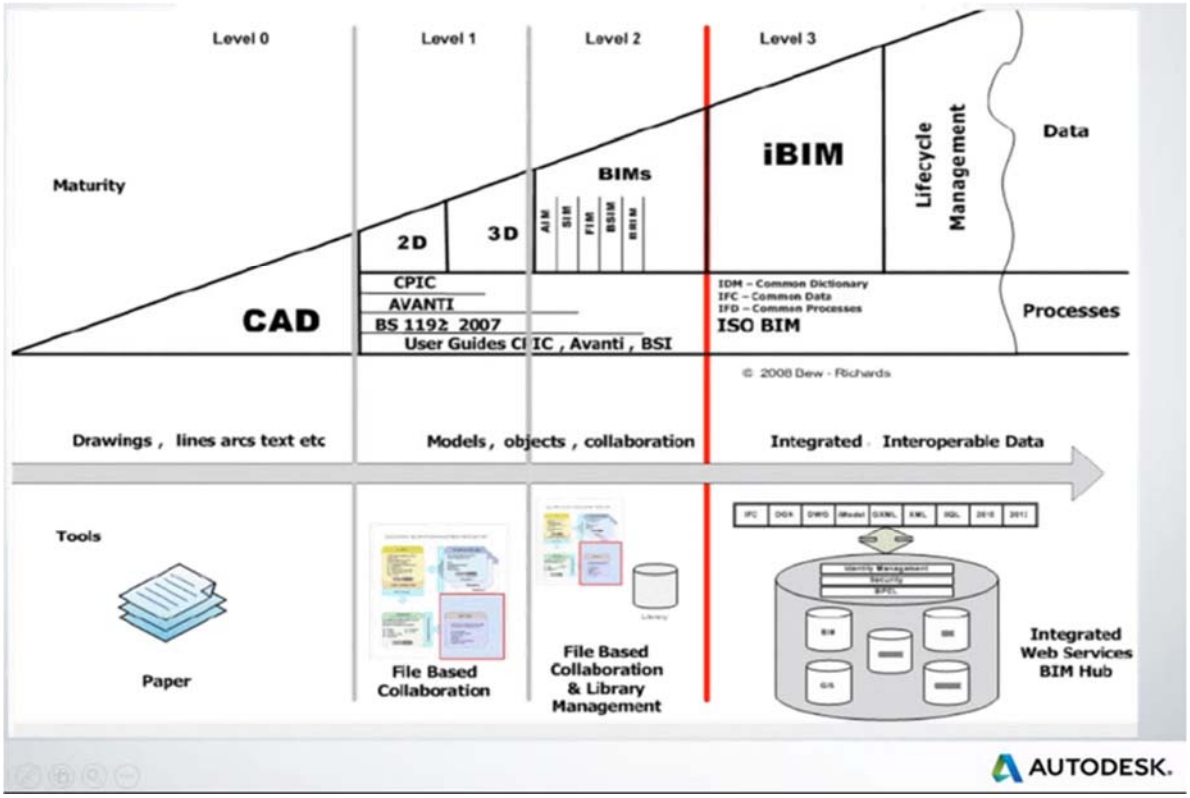



**Figure 1.** BIM maturity levels [4].

The maturity scheme described above is an indispensable component for understanding the British's ambitious approach to the opportunities opening up to construction (in a broad sense) in the digital age that has come.

The BIM is exactly the same technology that symbolizes the arrival of "figures" in the construction industry. In 2011, the UK Government announced that, starting in April 2016, all state purchases in the field of construction will be carried out only for projects implemented in the BIM technology. Thus, the industry was given a powerful impetus for moving forward. Do you want to receive government orders? Learn modern methods of work. And take your projects in BIM Level 2 (the red line in Figure 1).

According to experts, the bulk of designers in Russia in the field of civil engineering is now at level 1: perhaps it is very difficult to find those who work with pure 2D CAD (level 0). In their turn, the most advanced companies are now trying to move from the first level to the second, organizing interaction between the solutions used by internal standards or manually modifying applications, settings,

converters. Some countries even try to spur this process, issuing requirements for the projects being handed over and thus developing the BIM-technologies.

## 3. Geo-information technology of the 8-level responsibility

If the BIM-technology with the help of a number of software products provides automation of production processes, the technology of 8-level responsibility is guaranteed to give systematically a new quality of management in construction, related to the requirements of the Russian Government Decision No. 87 of February 16, 2008 "On the composition of sections of the project Documentation and requirements for their content "(12 sections are simultaneously considered).

The resolution itself is strictly structured according to the general principle of "less in larger" (territory, stage of construction, object of the master plan, section (part) of the project), but in it only control function of state management of the objects of the territory is formed, this is its insufficiency of absolute control.

The technology of 8-level responsibility in detailing Decree No. 87, observing the general principle of "less in larger", extends the number of inseparable levels to 8 (part of the object, element, mark, position), where "position" is the last indivisible part of the object. Thus, the management function of the territory objects (levels 1-4) becomes inextricably linked with the execution function (levels 5-8). In the 8-level geoinformation technology with the use of 4 coordinate systems used in construction: the absolute coordinate system tied to TA in the GLONASS system (levels 1-2), the relative coordinate system (levels 3-5), tied in p. B to the coordinate p. A, the conditional coordinate system (levels 6-7), tied in p. C to coordinate p. B, own coordinate system (level 8), tied in p. D to coordinate p. C. The basic software architecture of the IS *"8LR technology"* is shown in Figure 2.

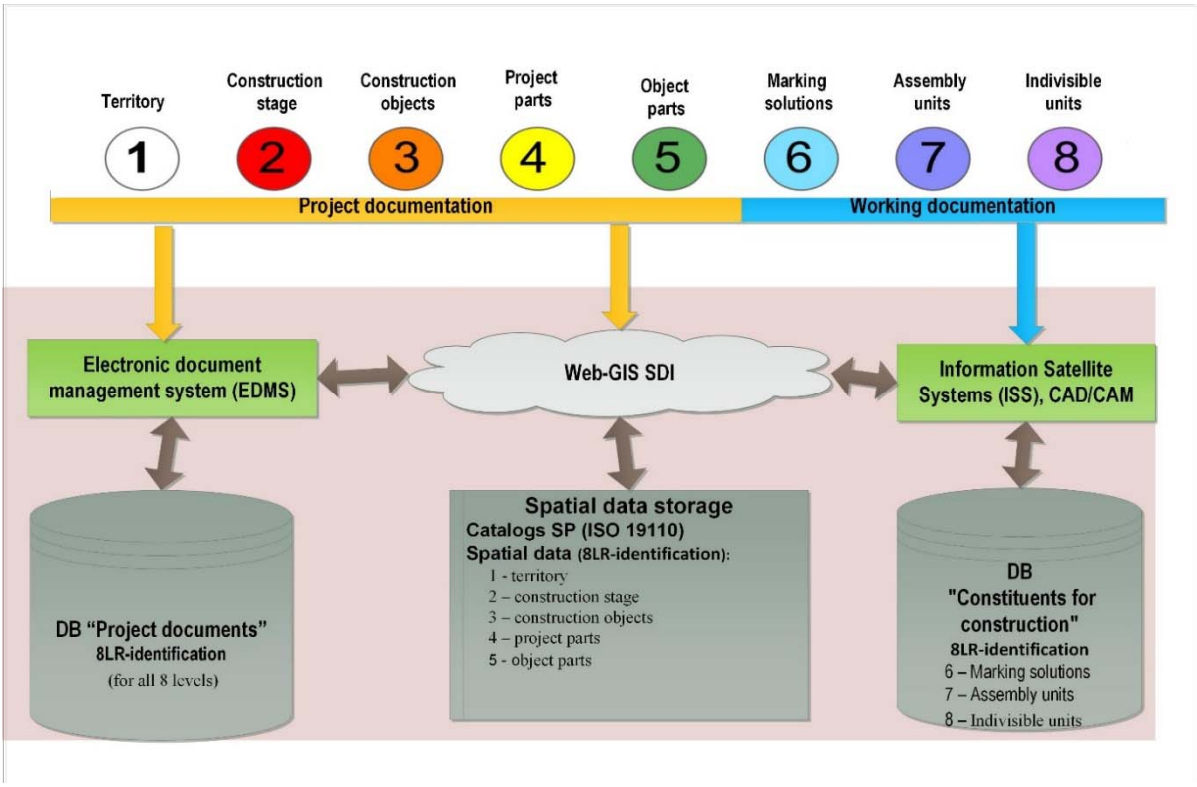



**Figure 2.** Software architecture of the "8LR technology"

Architecturally, the *"8LR technology"* consists of two components of its own design:

- subsystems of electronic document circulation based on 8LR - identification and managing the summary statements of the documentation, issued in full accordance with GOSTs;

- subsystems for visualization of the spatial location of objects on the ground, based on the methodology for constructing spatial data infrastructures [5].

The *"8LR technology"* is not a substitute for the software products of information modeling, for example, firm AutoDesk, which is widespread on the market. It is a control add-in interacting with these products through the use of 8LR-identification in the description of construction objects at levels 6-8 when creating the BIM-model, which allows for a through classification of all elements of construction objects, from the territory and ending with the assembly units.

The software implementation of the *"8LR technology"* is based on several basic principles:

1 *"Forced coding."* Unlike the analogous programs available on the market, codes of documents, construction objects and their components are not formed freely at the discretion of users, but according to a precise procedure, from which it is impossible to retreat. Coding of documents is carried out in strict accordance with the methodology of 8-level responsibility.

2 *"Absolute and relative spatial reference"*. Each object is bound by absolute coordinates to the terrain. The internal elements of the object are bound by relative coordinates to the inner space of the object.

3 *"Storing of ready-made documents"*. In the 8LR program itself there is no means of preparing documents. In the document store, which is the central element of the system, the finished documents are stored each in its cell in accordance with the methodology of 8-level responsibility.

Thus, the 8LR program is not positioned as a competitor to other programs in which there are advanced means of electronic document management.

Documents (project and work) can be prepared by any means and then placed in a repository with forced assignment of the appropriate code.

4 *"Managing the design process from top to bottom."* With the help of the 8LR program, the superior manager distributes the preparation of documents at his own level of responsibility. Further, the subordinate executor operates in strict upper bounds.

5 *"Continuous monitoring of the execution of works"*. With the help of the 8LR program, the manager can at any time see what documents are ready at the moment.

The 8LR program has the following basic capabilities:

1. Creation of the framework of the project according to the methodology of the 8-level responsibility.
2. Gradual filling of this frame with ready-made documents.
3. Visualization of the spatial location of objects on the ground.
4. Viewing the relative position of the internal elements of the object.
5. Automatic generation of summary statements of the documentation in full accordance with GOSTs.
6. Tracking the progress of work with the so-called "dispatching window".
7. Dispatching window allows to see the entire structure of the project on one screen. The elements of the project are coloured in accordance with the degree of their readiness.

The 8LR program can work both in multi-user mode (in small, medium and large organizations) on the basis of a common data store, and in a stand-alone workplace based on a local database.

With the use of software, the system method "geo-information technology of 8-level responsibility" becomes publicly available at all 8 levels of management and execution and does not require special expenses for its adaptation, training of personnel and the population for use, as this is the existing principle of construction management in the Russian Federation.

In fact, when structuring the integrity of the use of the territory, money is created to create a high level of the quality of life of the population in town-planning establishments at the expense of intellectual aids built into highly effective development of land areas.

Integrity is only possible in a structured system. Forming integrity (a variety of factors) we form the quality of life. In the integrity of management (a variety of factors), regulation and control are carried out simultaneously in full, without losing sight of one, even the smallest part of it.

Structuring of integrity in the composition of urban areas solve the main problem - the use of facility management system that provides continuous monitoring of the establishment and support of a high quality standard of living in the area.

Structuring of integrity in the construction of objects of any complexity in the urban planning area, allows using a common master plan, coordinate to combine several types of construction (new construction, maintainability operation, modernization of building) on the same territory with multi-level (multi-layered) objects overlap each other in order to unite the various functions and concentration of management resources of the object, as well as the ability to save and continuous improvement of quality properties in the long duration period of high use.

If use the 8-level information management method for a coordinate objects territory, realized by all parts of the design documentation, it may provide at the expense of reusable industrial production of detailed solutions for the development of working documents (at levels 6-8):

- reduction of the number of different assembly marks and elements;
- automation and robotization of production processes;
- increase in labour productivity;
- reduction of the terms for the production of positions, brands and elements;
- reduction of energy intensity and cost of their manufacture;
- coordinate control of manufacturing, moving and mounting;•
- coordinate control over the use of funds;
- system accounting and regulation at each of the eight levels of management (and between levels) of key technical and economic indicators;

This basis allows:

- to organize the technopark for the additional production of commodity and construction products using technological, power, architectural and construction, and other detailed solutions for wide application among the population;
- to create an online store of open construction technologies.

The developed city planning documentation "The design of the first stage of construction" has a common stable system principle of construction - **less in larger**, divided by levels: **1. Territory, 2. Construction stages. Stage part. 3. Construction objects, 4. Project parts indicated in RF GR No. 87, 5. Parts of the object.**

Example: UTRP-1.20-06-AP-03

1 level: - **"Territory"** - Ural Tube Rolling Plant **(UTRP);**

2 level: **"Stage"** of construction – **(1), "Stage part" - (2);**

3 level: **"Object"** according to the master plan – **(06);**

4 level: **"Project part"** - Section 3 **(AR),** on the Resolution of the Government of the Russian Federation No. 87.

5 level: **"Object part" - (03)**, architectural designation;

Such a systematic way of managing project documentation was applied in practice in 2012 when designing a particularly complex metallurgical facility: "Hot Rolling Sheet Rolling Complex 2250" in Pervouralsk. The following results were achieved.

1. When developing only the architectural and construction part of the project documentation, the cost of design works, using the system design method, was reduced from 25 million rubles down to 10 million rubles;
2. The scope of the project documentation: Section 3 (AR) and Section 4 (CR), implemented in accordance with the requirements of the RF GD No. 87, was systematically performed in 8 volumes, instead of 18 volumes in the traditional version;
3. The positive conclusion of Glavgosexpertiza, the system-executed architectural and construction part of the design documentation, was received a year earlier than the rest of the project.

Due to the use of the structuring system and the repeatability of design solutions in the span of the Kolpakovsky Ovens, during the construction of the Verkh-Iset metallurgical plant, it was possible to shorten the construction period of the underground part of the tunnels for 6 months.

Technology of 8-level responsibility "8LR technology", developed by Strokov V.M., a specialist in the field of construction with almost 50 years of experience, was implemented in cooperation with several private and public organizations: LLC Logosproektstroy TD, INZHGEO LLC, the scientific center of Mathematical Modeling and Applied Programming of South Ural State University.

## 4. "8LR technology" and the BIM-technology

An important step for the introduction of the BIM in Russia was made on March 4, 2014 at the meeting of the Presidium of the Council under the President of the Russian Federation for Economic Modernization and Innovative Development of Russia. Thus, the Ministry of Construction of Russia, Rosstandart, in conjunction with the Expert Council under the Government of the Russian Federation and development institutions, was instructed to "develop and approve a plan for the gradual introduction of information modeling technologies in the field of industrial and civil construction, including the provision of an examination of project documentation prepared using such technologies".

The most innovative Russian enterprises are actively moving to the BIM and have already felt the benefits of using technology. Most of those who have not yet switched to the BIM, have realized the irreversibility of the changes taking place in the architectural and construction industry, and today they choose the optimal method for implementing information modelling.

*1.* First of all, the world (especially American) experience shows that the transition to the BIM is not just the mastery of a new program, it also requires:

- availability of implementation methodology;
- existence of uniform standards for projects;
- training of specialists of the new formation (BIM-manager, BIM-coordinator, BIM-modeller);
- organizational structural changes in construction organizations.

*2.* Before turning to the consideration of "8LR technology" and justifying the possibility of its application in addition to the BIM as a methodology and standard for Russia, let us dwell on some of the shortcomings of the BIM-technology.

*3. The BIM is not a means of tracking the life cycle of an object.* In practice, the BIM is understood not at all as a design concept with an arbitrary number of dimensions in a model and not even supposed support for the life cycle, but a very specific thing is the creation of a three-dimensional model based on intelligent objects, saturated with parametric dependencies and additional information.

*4. Loss of existing working practices during the transition to the BIM.* Not all solutions are suitable for all, which the software vendor implements in its vision of the BIM. Throughout the history of the development of this technology, the most serious claim to it was the inability to include in the integrated process already existing methods of work and tools. The question is whether to abandon the existing effective methods of work, "sharpened" for the tasks performed, for the sake of the planned productivity increase due to the BIM.

*5. The BIM does not take into account the specifics of Russian legislation.* The BIM in no way takes into account the provisions of Resolution of the Government of the Russian Federation No. 87 of 16.02.08. "On the requirements for design documentation ...", which is the fundamental document on the structuring of construction processes. And, in general, the "paper" workflow is for the BIM a by-product.

Perhaps in the near future the BIM-technology will be developed to a comprehensive product of life cycle management in construction. But in order not to waste time and not wait passively when it happens abroad, it is proposed to use "8LR technology" in Russia in addition to the BIM-technology.

*1. "8LR Technology" as an implementation methodology.* The "8LR Technology" offers and implements a systematic approach from general to specific. The introduction of the 8-level classification

allows for the decomposition of the implementation task and clearly defines the business processes for each level.

*2. "8LR technology" and maturity levels of the BIM.* The "8LR technology" is ideologically consistent with the maturity levels of the BIM. Business process management is carried out by rebooting the technology of new construction (NC) in the technology of personal responsibility (PR), technology maintainable exploitation (ME), technology of quality of life (QoL), etc. Moving along this chain, as a result, we come to improve the quality of life of the population, which is the goal of the 3rd level of maturity of the BIM.

*3. "8LR Technology" and other software products.* The "8LR Technology" does not position itself as a software product competing or replacing any other product from the AutoDesk or other company line. It is an add-on for building management, allowing to integrate components of the BIM-technology, if they adhere to the 8-level classification of objects.

## 5. Conclusion

There are reasons to argue that the use of the "8LR technology" in addition to the BIM-technology will provide a synergistic effect and will remove a number of obstacles to the introduction of the BIM in Russia and the system control in the field of construction and operation of objects of any complexity in Russia.

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