Sharing Knowledge and Information within BIM Life Cycle Processes

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Abstract. Building Information Modeling begins to be perceived as the concept of "covering all stages of the life cycle of a building". A major flaw in this view is the fact that BIM is not actually perceived by all stakeholders as identical, and there is no single vocabulary, either in the form of a structured lexicon or in purely semantic understanding of many names and concepts used. Based on research findings BIM's focus on Building Information Management has proven to be a key part of BIM's success. As a result, it seeks to design a knowledge management system throughout the whole life cycle of the building as well as in the management of knowledge through partial projects. An essential part of BIM framework has identified the need to visualize knowledge and information. Based on other literature searches, ways of identifying knowledge, by deriving knowledge from information from experts, using shared models, are proposed. This derivation is directly driven by ontological identification and knowledge models based on taxonomy have been proposed. It leads to proposal of intelligent environment for team collaboration on projects or programs that probably require a suitable mix of different technology tools.

1 Introduction

An intelligent environment for team collaboration on projects or programs will probably require a suitable mix of different technology tools, some of which have been outlined in [1]. On the other hand, it will also depend on a shared culture of cooperation and knowledge sharing without which all technological tools will remain unused. In case of the current state of development of intelligent agents Vytlačil [2] brings the third dimension of a design knowledge system, which is, in particular, a quick and effective search for context not only within the framework of the project's own knowledge, but can also combine "best practices" with the right practices where appropriate.

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2 Designing Procedures Based on Knowledge Systems and Principles of BIM Knowledge Management

An important dimension of knowledge work will be "visualization of knowledge". Under this deadline, we present a knowledge presentation in such a way as to help the professionals involved in the project to better navigate, or navigate them directly in the knowledge bases and in their own activities above that basis. It is a technique that facilitates understanding of shared experience and expertise and conducts actions based on this understanding. Visualization of knowledge is particularly important in today's world, where it is becoming more and more difficult to recognize knowledge formulas, because knowledge is becoming more and more complex and mainly interconnected.

Visualizations will be achieved in particular as described by Vytlačil [2]

- Creating a "Rich Picture" of all that is already known to make the knowledge link understandable and visible
- Better communication of complex relationships
- Presentation of time, space and activities in multidimensional settings (time-space orientation)
- Presentation of multi-level relationships, causes and consequences
- Stimulating the emergence of new knowledge - Visualization of where knowledge supports the creation of new knowledge, so it is not only the output of the processes but also valuable input into
- A sample of what is not known
- Show schemas of everything that was not previously known
- Creating common symbols to emphasize group belonging

The basic advantage of visualizing knowledge in project, program, and company management is to bring workers into the knowledge sharing process, which leads to increased productivity by reducing the costs of searching, understanding, accepting and applying knowledge.

Based on previous literature analyzes and available resources, we will attempt to map forest structures that allow participants throughout the life cycle of a building to understand basic knowledge structures while helping to negotiate BIM implementation requirements (or relevant areas within the BIM).

2.1 BIM Framework

Looking at BIM, as knowledge sharing platform from systems point of view, we can understand BIM as a Framework that can be simplistically depicted in an overall ontological model containing all communication flows and knowledge flows as shown in Figure 1. BIM Framework can be recorded in a way of three mutually permeating knowledge nodes (BIM Technology, BIM processes and BIM procedures). Here is a description of the three BIM Knowledge Kits as derived from the literature e.g. [3] as well as discussions with experts, especially within the czBIM Working Group. The essence of BIM will be communication, storage and sharing of knowledge. Fig. 1 in a simplified form demonstrates the distribution of basic knowledge that can be digitally stored in models (blue rectangles) and their interdependence with the knowledge of people, depending on their competencies, skills and characteristics, which will always be stored in their heads (white rectangles).

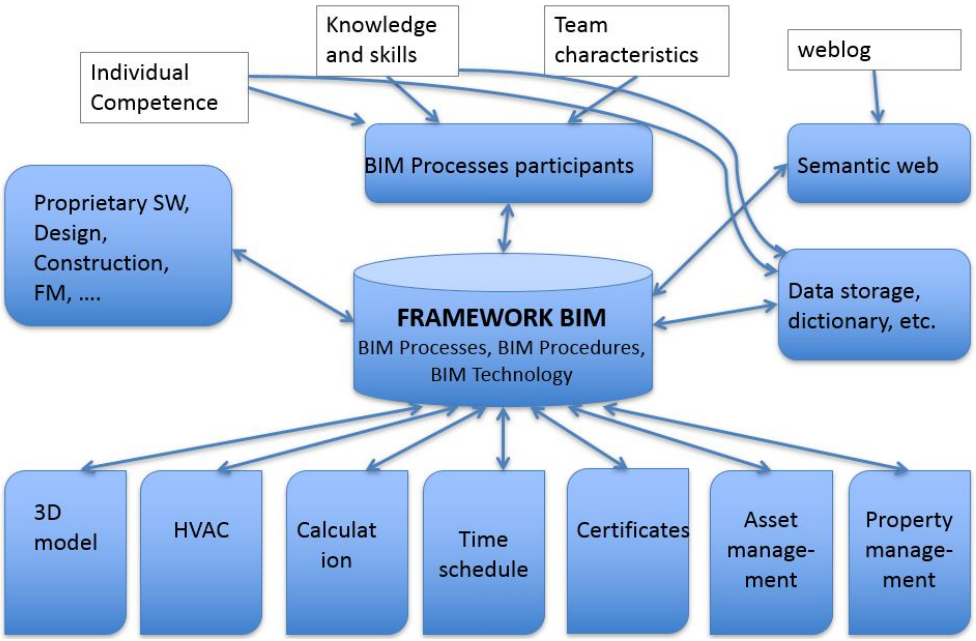

Fig. 1 Proposal of BIM Framework and Communication Flows with Knowledge Holders in the Whole Ontology Model. (Own Design)

It is also proposed a description of mutual relations between these subspaces and specific mutual overlaps.

a) BIM technology

Technology is "Application of Scientific Knowledge to Practical Use" [4]. The technology space is used to cluster BIM participants who specialize in SW, HW and other devices, including social networks and systems necessary to increase the efficiency, productivity and profitability of the entire investment sector. This includes organizations involved in the creation of SW solutions and tools that are both directly and indirectly applicable to architects' processes, designing, calculations (static, budgeting, etc.), the creation of components of BIM libraries, project realization, construction and facility management.

b) BIM processes

The process is a "specific organization of work activities in time and space, with the beginning and end and clearly defined inputs and outputs: the structure for action" [5]. BIM processes will collect BIM groups of participants who design, manufacture, build, manage and maintain constructions. This includes developers, architects, property owners, designers, construction engineers, construction contractors, building component manufacturers, facility managers, and many others who play a part in investment development processes.

c) BIM strategy - principles and procedures

Principles are "written principles or rules for decision-making management" [6]. BIM Principles will bind BIM participants to focus on training professionals, further research in the field, sharing benefits, allocating risks and minimizing conflicts among participants in the construction process. These participants do not create any real product (construction), but they are mostly special purpose organizations - insurance companies, research centers, education organizations, regulators, state organizations and state administration - who play initial, preparatory, regulatory and contractual tasks in the whole spectrum of investment construction.

d) BIM - Interactions within BIM Systems

BIM interrelationships are push and pull knowledge-based transactions that occur within or between BIM Framework and knowledge nodes (see Figure 2). The pressure mechanism [7] "transfers knowledge to another space or node while the stroke mechanism transfers knowledge to satisfy the need for knowledge required by another space or node." Pattern transactions cover data transfers, team dynamics, and contractual relationships between spaces and nodes. Identifying and depicting such links and relationships is an important part of what the BIM framework can bring.

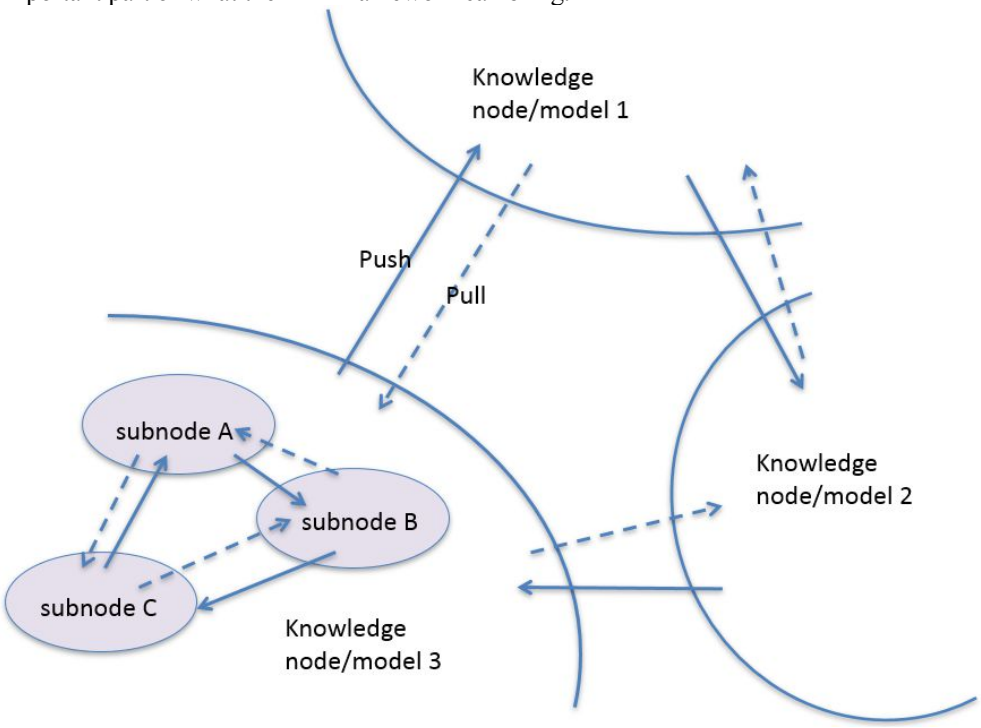

Fig. 2 Mutual "BIM relationships" both inside and between the knowledge models / nodes. Relationships are both push-pressure and pull-pull types, (Own Design)

e) BIM mutual overlaps between knowledge nodes

The three basic BIM knowledge nodes mutually overlap each other as they share both BIM participants and implementation outputs. Such overlap between subnets occurs when:

1) Implementation output requires BIM participants to join more than one node. The development, application, and sharing of a shared and collaboration-supporting scheme (eg. IFC) requires a concerted effort by both BIM Policies and Regulators (Researchers, Standards Makers, Legislators) and BIM Technologies (SW Developers).

2) Participants belonging to one node create outputs classified in the second. E.g. czBIM is a company whose members are part of the BIM Processes (eg. architects). However, this company generates outputs for the BIM subspace Standards within the BIM node Procedures (Best Practices), rather than the outputs of BIM Processes (architectural designs, constructional details).

2.2 BIM Levels

BIM Maturity Levels, as described in [8] have become the "standard" of describing the achievement of BIM goals, but also a tactical aid for the gradual development and implementation of BIM tools.

BIM Levels as the next subsystem of the proposed BIM Framework identify the state prior to the beginnings of the BIM-Level 0 implementation, and then derive 3 levels describing the partial achievement of the BIM implementation stage to the final level where full integration of BIM-iBIM will be achieved.

We use the concepts that will be presented here with a brief explanation of their importance for the design of the necessary actions to implement the BIM methodology.

The basic concept is the level of documentation, modeling and information transfer in the building process. Graphically, we can illustrate it using the image known as the "BIM Maturity Level" created and published in 2008 by Mervyn Richards and Mark Bew [8]. Subsequently, the BIM Industry Working Group [9] established these levels of BIM adoption as a standard for the UK, and they are becoming an international standard.

3 Recording and displaying BIM Framewriting

Recognition of knowledge and depictions of activities involves the identification and the intrinsic contribution of knowledge within the environment by exploration that facilitates the representation in a way appropriate to generalization and enlargement.

Know-how transactions are essentially multiple and complex in nature, especially because they are driven by the vast amount of knowledge domains that are contained in the BIM framework. Such a wide and varied range of interrelations requires "to use visualizations to cover both their size and complexity. The presentation and visualization of these interrelations offers a systematic way to transfer knowledge to others" [7].

3.1 Design of a methodology for identifying, recording and displaying knowledge within BIM Framework

Adequate methodology for defining, identifying and capturing BIM linkages through understanding BIM knowledge, looking through a BIM domain specific ontology to displaying knowledge models - see below:

a) Preparation - In this step we will do
- creating a BIM proposal for the knowledge framework (for further research)
- the design of BIM ontology fundamentals
- theoretical support for proposals
- definition of model visualization for analysis
- definition of graphical language visualization for expert knowledge modeling
- identification of expert selection criteria
- identification of knowledge logging protocols

b) Identification of knowledge and selection of appropriate tools:
- goal identification
- selection of tools and methods for recording knowledge and its depiction
- expanding the creation of knowledge (graphic) models

c) Knowledge acquisition and visualization in the BIM domain:
- creation (design) of knowledge models obtained from experts
- collection of text data from collaborating experts

d) Organization of knowledge in appropriate structures:

- organizing the acquired knowledge to a certain degree of uniformity, uniformity, usability and connectivity with graphically representative knowledge models

e) Control and feedback

- the knowledge recorded during the recovery cycle is either:

Acceptable (then we can start a new cycle, get more knowledge)

o Rejected (cycle repeated with modifications)

o Suggested for further expansion (suggestions for their use will be prepared), which will be created as follows:

• direct recommendations

• methodology and evaluation

f) Summary and final recommendations for further action

Conclusion

The term BIM Framework was introduced as a working name for the overall *knowledge management framework across all levels or BIM model dimensions in the whole BIM Life Cycle process.* In view of the development of the BIM implementation as proposed by Bew & Richards [9] in the form of "3 levels" - 3 levels, a superstructure has been proposed where the level model becomes one of the building blocks - a knowledge node - of the entire BIM Framework. The next two knowledge nodes are BIM Space (consisting of subsystems – Processes and Technologies) and BIM Focus, representing the different needs of data, information and knowledge of various participants in the investment construction. This provides a sufficient basis for the design of knowledge structures.

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