SOCIAL BIM PERSPECTIVES

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ABSTRACT

Ongoing change in digitalization of built environment process has been greatly influenced by diverse use of information and communication technology. Built environments today are developed with a more user- and customer-oriented approach. The forerunners of construction industry are implementing new processes based on building information modeling (BIM) for enhanced productivity. Unfortunately these tools focus on planning, and their social dimension, are not thoroughly developed to support planning process. One of the recent developments in strengthening social perspective is an active use of social media tools and applications, which are usually built on web 2.0 technologies.

This paper presents conceptualization of "Social BIM 2.0" that builds on core concept to link BIM and social media. Free easy-to-use social applications are already a commonly accepted way to share different kinds of media. Integrating these to model-based applications with social plugin to share 3D models is an interesting way to collect opinions, comments and feedback from audiences. The empirical part of the paper presents current way of work with model-based tools and the use of social media for built environment projects highlighting end-user participation and social interaction. Besides, we also present critical scenarios for the uptake of such technologies in real project environment.

Keywords: social BIM, social Media, BIM, social interaction, suilt environment, snd user participation.

1. INTRODUCTION

Construction industry has high expectations for model-based applications. The industry is one of the world's largest economical activities and projects are usually complex and diverse involving various subsectors. Project Management Body of Knowledge (PMBOK) guide defines a project as "*a temporary endeavor undertaken to create unique product, service, or result*" (PMI, 2012). Successful project management, from its early conception to execution, requires collaboration, integration and application of knowledge from numerous stakeholders. Since the amount of information is extensive, this integrated approach also requires good tools and techniques to work. The industry is inclining towards the increased use of model-based applications like Building Information Modeling (BIM). These applications are expected to assist and support in achieving the expected productivity gains and success in projects.

Construction industry is important; not only because of the sector's size but also because of its output – the built environment - that provides us with necessary physical structures and infrastructures for various productive activities and other industries (House of commons, 2008). Built environment projects involve many participants, and therefore, are collaborative undertakings. Today, these projects are increasingly more user and customer oriented and clients are demanding socially acceptable, sustainable solutions. User participation and activation have been recognized as topics where industry needs more development. Implementation of digital tools and technologies, in particular social media (some) provides a promise towards customer orientation. However, the industry is still struggling for achieving the full benefits of some applications and tools.

This paper explains the social perspectives of Building Information Modeling (BIM) and presents a conceptualization of its social extension. "Social BIM 2.0" includes the core concept of linking BIM technology and social media together. The empirical part presents a current scenario and use of social media applications in built environment projects to enhance end user participation and social interaction. Besides, the paper draws critical conclusions and recommendations on the use of social media. We discuss about the current and future perspectives of social media utilization in built environment projects.

2. BUILDINGN INFORMATION MODELING AND SOCIAL MEDIA

Technologically disruptive technologies like BIM and some are altering the basic foundations of AEC industry. Model based applications are widely used in professional collaboration between different stakeholders; where as social media is a commonly accepted collaborative platform for user-generated content. In fact, the core of both technologies lies in communication but their focus has differences. While BIM aims at professional collaboration the some tools are manifesting user participation. In the future these technologies may be joined together in a meaningful way, for better and socially accepted innovative built environment solutions.

2.1 Building information modeling

There are various definitions for building information modeling. First, the technology is commonly considered as an activity and process for generating different information models (US-NBIMS, 2007; Eastman et. al., 2008). On the other hand, US-NBIMS (2007) also states BIM as system -building information management - business structures of work and communication that increase quality and efficiency. Access to the global Internet and its services, communications standards, various building classifications, and new ICT tools and services are considered as main driving forces in the development of BIM (Christiansson et. al., 2011). The core concept of modeling is to build a digital model, prior to its physical construction in a way that enables different simulations and analyses. Today BIM is considered as an integrated process for product development. The approach provides benefits like automatic fabrication/shop drawing, cost and material procurement, construction sequencing, conflict or collision detection, forensic analysis and facility management (Azhar, 2011).

Through implementing BIM technology the companies are aiming for efficiency in work, optimized design solutions for limited waste of resources, reduced energy usage, and enhanced passive design strategies (Bynum et al. 2012). It holds promises to become the facilitator of integration, interoperability and collaboration in the construction industry (Isikdag & Underwood 2010). BIM has proven benefits for different phases of built environment projects and "*perhaps most important is that BIM creates significant opportunity for society at large to achieve more sustainable building construction processes*" (Eastman et al., 2008). Despite the benefits of its implementation, the industry is still looking for adhering its full potential. The adoption rate of technology is growing rapidly (SmartMarket Report, 2010, 2012). BIM is a "sociotechnical system" and cycles for its improved use and new business areas are rising along the line (Harty et. al., 2010). The technological improvements have provided us not only with new business solutions but also with improved dimensions for generating innovative solutions.

2.2 . Social Media

The fast pace of Internet penetration shows that the world will be even more connected in upcoming years. Information and communication technologies and web-based solutions are interesting opportunities for advanced communication. Earlier expensive and insufficient Internet infrastructure and low bandwidth connectivity resulted in a halt in advanced use. Currently, we have easy access to Internet and the global population using it continues to grow rapidly. International telecommunication union estimated that 2.7 billion (39%) of the world's population will use Internet and 41% of the world's households will be connected to the Internet by the end of 2013 (ITU, 2013). The first principle of European Charter on Sustainable Design and Construction, which suggested every key sector in society to make transition towards a "person-centered" and "socially inclusive" approach. Same was also proposed for built environment planning, design and construction.

The use of social media has grown in construction industry. The term social media is widely used in 21st century for internet-based applications triggered to a social interaction (Porkka et. al., 2012). Social media has different forms and are built on three progressively tied key elements of content, communities and web 2.0 technologies (Ahlqvist et. al., 2010). The first generation of social media includes tools such as blogging, podcasting, video sharing, wikis, RSS feeds, micro-blogging, social networking, social bookmarking, and social aggregation (Hopkins, 2009). The second generation of social media provides a new dimension of three-dimensional (3D) virtual worlds to web 2.0 applications that provides a potential linkage to the construction industry (Porkka et. al., 2012). Frontrunner actors in construction industry, in private as well as public sectors, are implementing new modeling-based processes. Advantages in technology and software have provided more feasible solutions.

3. ENHANCING SOCIAL DIMENSIONS IN BUILDING INFORMATION MODELING

3.1 From lonely BIM to social BIM

The word lonely in BIM refers to an observation that designers may share models but are in fact acting alone (Benson and Hartzog, 2009; Sinclair, 2012). In relation to earlier, only one party utilizes the benefits of the model and models are not leveraging their fully collaboration potential. Adopting from RIBA BIM overlay (2012), lonely BIM is used in reference to level 1 BIM and early level 2 BIM projects (See Figure 1). The academia has claimed that a successful project lies in an intensive collaboration between stakeholders, as early as possible. Models support collaboration through an integrated approach where all the stakeholders come together to successfully plan, design, built and operate built environment products. These kind of collaborative approaches to working are often termed as “Social BIM”, “Collaborative BIM” and “integrated BIM (iBIM)”.

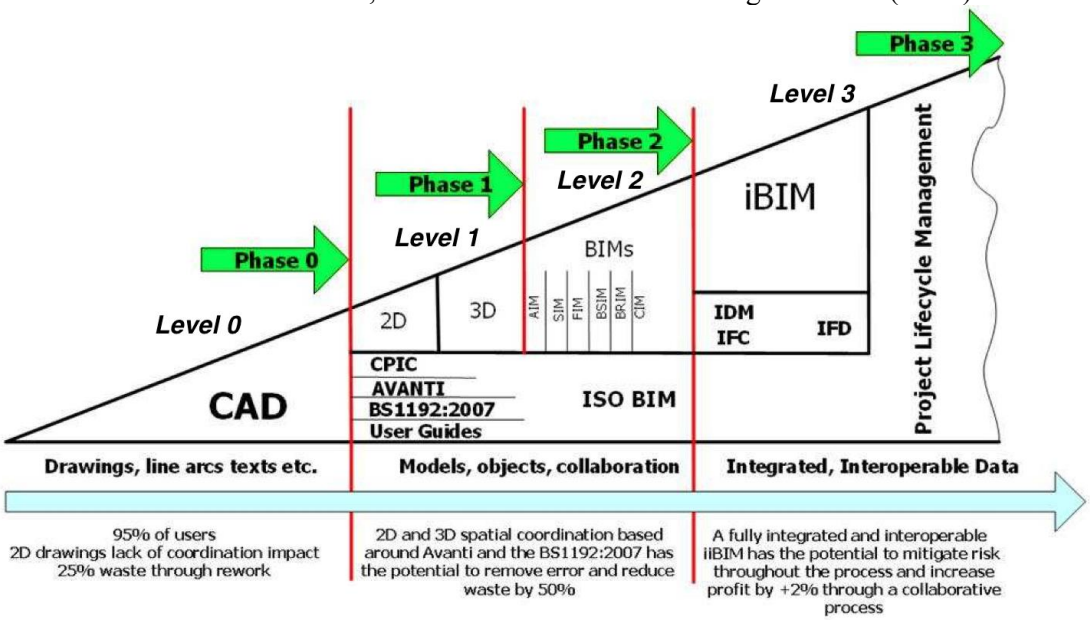

Figure 1: BIM maturity diagram, (Bew and Richanrds, 2008 as in Snook, 2009)

Another interesting perspective to BIM flavors include lonely BIM and social BIM . Banks (2013a and 2013b) explains that there has been various debate about what is BIM and what does or does not qualify as BIM. Shown in Figure 2, the transition from traditional CAD based workflow to the full utilization of BIM is represented by shift from quadrant I to IV and the possible approaches currently underlying in the industry are represented by the arrows. Quadrant I “lonely little BIM”, is the starting phase of BIM adoption in an organization. This adoption generally focuses in deploying BIM for enhanced productivity and better workflow within an organization to achieve various frontend BIM benefits like automated documentation, easy visualizations that CAD technology

does not provide. With varying degree of BIM implementation and usage, lonely quadrants (I and III) focuses towards the use of BIM for internal benefits and social quadrants (II and IV) defines the social aspects of collaboration. Quadrant IV "social BIG BIM" addresses real BIM with the integrated collaborative approach between all the stakeholders at almost all the project phases with a smooth workflow between various disciplines of authoring tools. The main constituents of these various flavors are shortly presented as follows:

I. lonely little BIM – The different BIM authoring tools in the lonely little BIM are used to create the project model and traditional printed set of documents. BIM is primarily used for enhancing the workflow in individual organization, because of its primary benefits like reducing errors and time through coordinated documentation, quick 3d visualization of the project and so on. The BIM created largely aims for the production benefits within the organization and is not shared with other disciplines. BIM authoring tools are mostly utilized as a fancy tool for virtual model creation which is transferred into different other visualization applications for further manipulation of the objects to produce different visualization media like realistic photo-renderings and walkthroughs.

I-II-IV social little BIM – In addition to lonely BIM, social little BIM approach shares BIM data with other collaborators and between different BIM authoring tools through little or one-time 3D data exchange primarily within design and merely for construction phase. BIM data required for the purposes of operation and maintenance phase or facility management phase is not included in this process. Moreover, various aspects of collaborative BIM and nD features are not taken into consideration.

I-III- IV lonely BIG BIM – Lonely BIG BIM goes beyond visual utilization however the BIM data is shared with basic 2d traditional formats and printed set. Its major advantage is to build efficiency and effectiveness in the design process. Comparative alternative solutions are produced and analyzed through use of BIM for informed design decisions. This approach leverages lonely little BIM with utilization of features like energy analyses, quantity takeoffs, cost calculations and so on, but are largely focused for its use for individual purposes (Banks, 2013).

I-II-III-IV social BIG BIM – This approach is considered as the real BIM with the integrated collaborative approach between all the stakeholders and various disciplines of authoring tools. Full benefits and advantages of BIM deployment in almost all the phases in an integrated manner throughout the project lifecycle is actively considered and used. It also involves nD models that are shared between collaborators and clients for different types of analyses like detailed energy analysis. Various features like clash detection, detailed energy analyses, constructability analyses are actively used during design and construction phases as well as data communication with other non-building related applications for building lifecycle is also carried out. This process defines and exposes the maximum benefits what BIM could give today.

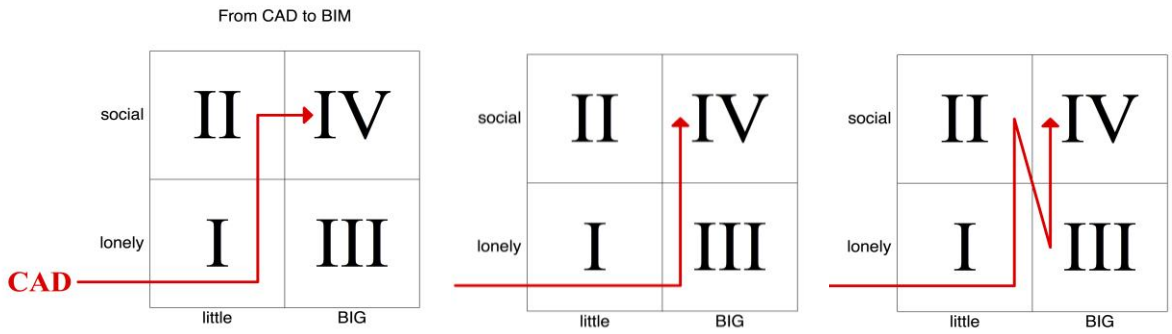

Figure 2: Various transitions of BIM from CAD to social little BIM on left I-II-IV, lonely BIG BIM in the middle I-III-IV, and social BIG BIM at right I-II-III-IV (Banks, 2013a)

Different social aspects of BIM can be generalized under a common title of Social BIM where the degree of socialization varies. The social aspects in lonely BIM focuses to internal organizational BIM usage for providing better outputs in short time and social BIG BIM governs the full benefits of social BIM which lies in the integrated collaborative approach and process of product information modeling where all the stakeholders work

together to attain the full benefits of BIM technology solution. These different BIM flavors of socialization are still growing today and will encompass new perspectives as a result of technological innovations for the construction industry.

3.2 Social BIM 2.0

One of the major problems in construction projects is lack of communication. The problems in communication are normally resulting from not involving the right people at the right time or even from withholding the information for company's or personals gain (Brown, 2012). BIM supports the concept of integrated project delivery and implementation from the very earliest project initiation phase helps in maximizing BIM benefits (Eastman et. al, 2008, Azhar, 2011). Social BIM has been uprising as the collaborative domain for socializing project data between the stakeholders and different domains through adaptive use of technological innovations. Successful construction projects meet users' need. Users have unique knowledge and consistent designs require a systematic and coherent approach to user involvement (Christiansson et. al., 2011) and are most appreciated in the early stages of planning (Jäväjä et. al, 2012). Projects today are more and more user and customer oriented. However, innovative tools actively be used for user participation in projects are still at early stages. Including users early enough in multidisciplinary team provides the team with an opportunity to discover the real goal of the project and solutions on how it can best be achieved. (Baars, 2006). "Social BIM 2.0" is defined here as the collaborative approach of working where end users of the construction product or the residents of the project location participate to generate and develop socially accepted innovative construction solutions through use of tools developed by Web 2.0 technologies and has the possibilities of BIM integration. Users are allowed to participate in these type of collaboration after accepting to the user agreement terms and conditions defined by the implementing organization. Users log in to these collaborative workspace through verified and unique log in credentials generated through creation of authentic new user account or linking their existing social media account. The users are able to share, post, comment and recommend various types of ideas and solutions through different types of social medias and are provided with incentives for active participation. These type of user generated solutions when integrated with BIM applications acts as a base and aids professionals to quickly refine and develop better outputs. End user participation in generating best if not good solutions is the key to the concept of social BIM 2.0.

Open innovation, with a key technique as "crowdsourcing" is a concept from innovation literatures that largely deals with the social media and may stand as the approach. Crowdsourcing means to leverage the power of the crowd in a job that is traditionally performed by a closed group of people like employees and contractors. Crowdsourcing is a means of internet based citizen participation, where planners can get new visions for their work from large and diverse group, crowdsourcing is also defined as distributed problem solving approach (Seltzer & Mahmoudi, 2012). In a review of citizen participation in planning, Lane (2005) presents motives of crowdsourcing; requirement for active citizen involvement and the pluralistic view of society. Healey (2003, 2006) notes that communicative planning is collaboration between all participants in the process, citizens, planners, and decision makers. Howe (2006) and Brabham (2009) expect that crowdsourcing examples would include at least; a diverse crowd, a well- defined call or problem. The crowd needs to be provided with a clear task and with some notion of the desired product, and the crowd should submit their innovations or ideas so that other crowd members may see them. The process should utilize an easily accessible and broadly understood internet platform. It is evident, that a Social BIM 2.0 platform can live up to those expectations .

One other way to enhance social dimension of BIM is BIM Collaboration Format (BCF), which introduces a workflow communication capability connected to IFC models. The idea is to separate the communication from the actual model. Instead of adding comments and information directly into an IFC model as a property set, the comments are described using BCF with direct links to objects in the model. In addition to text, comments and the list of objects, each issue can also have a snapshot of how the model looked in the application where the issue was last addressed. The standard specifies means by which designers and other stakeholders are able to relate messages, action items, viewpoints and snapshots to specific components in a model and transmit them to others. The planner as receiving party then uses the information in its own BIM authoring tool to identify and locate the component and see the same view the sender established. The OpenBIM Collaboration process enables an

effective method of communication which is fully traceable. BCF format is currently a prerelease submitted to buildingSMART under the new "Affiliation Scheme" to become later an official buildingSMART specification (buildingSMART, 2012). Many companies, such as Tekla Corporation, Solibri, Autodesk, DDS, Eurostep, Kymdata, are committed to include collaboration tools in their software. The possible open standard enhances the social properties of BIM. Hopefully residents, users, citizens, and other stakeholders are able to comment, discuss, give feedback during design phase, but still the final changes in BIM model are managed by the designer.

4. SOCIAL MEDIA ACCEPTANCE IN CONSTRUCTION INDUSTRY

Results show an increase in the use of social media. A national survey for construction professionals conducted by Illinois based Construction Marketing Association in September 2012 showed that 90% of professionals use social media in their businesses and 91.3% is internally managed (CMA, 2012). Another survey for members of The Building Centre in UK showed that 66.5% of the companies use social media tools and amongst them, 79.8% tell people about product and services, and 78.6% to engage with customers (Hopkins, 2013). These results show an increase in social media use with a focus on digital business and obtaining new customers. Similar results are also gained from mapping social media acceptance of construction industry professionals in Finland. A qualitative survey in April 2013 (RYM, 2013) was distributed to 700 newsletter subscribers. The results of 157 respondents indicate that four out of 5 are interested to use social media. However, at the moment it appears that social media is primarily used for personal contacts and actual work related utilization is at early stage.

Social media usage in construction industry is uprising as an easy and efficient two-way communication tool for business activities. Its development and integration with construction processes and activities may give rise to new business innovations like development of integrated social BIM platforms. Introduction of these types of platforms will not only act as easy to use and quickly accessible tool for enhancing collaborative projects but also may completely enhance the traditional construction. Furthermore these platforms with possible BIM tools integration will act as a common place for all the project stakeholders to easily upload BIM models and generate reports of the model like model quality, energy efficiency of the proposed product. With integration of social media, users will be able to easily share their views and propose new discussion forums that could act as the repository of tacit knowledge. However, these future developments still need wide area of research and acceptance from the industry. Hypothetical scenarios defining the benefits of BIM and social media integration and are presented through two approaches: 1. A person using social media channels to plan and construct a house (developed from Porkka et. al., 2012) and 2. A hypothetical neighborhood design by crowdsourcing (Brabham, 2009) focusing integrative benefits of BIM integration.

4.1 Scenario 1 – house construction with social application

A fictive story explains how an individual is able to discuss and comment about the house designs with the help of social application. A citizen quickly searches for different house suppliers from web with his hand held device. With the help of social media applications, he finds out about list of construction companies. The application leads him to company page, where different house prototypes matching to requirements are presented. The information also includes energy efficiency and average costs. There is also a possibility to navigate alternatives in virtual environment to experience their characteristics. Designers have created plans with model-based application. The company has an incorporated social media site where potential customer can quickly view and make minor changes to the plan. Later, when the building layout is ready, the selected house can be published to public discussion and commenting to friends and relatives. The page informs about downloading an application optimized for specific devices. After downloading the application, friends and relatives may use social media credentials to log in and propose comments and change initiatives.

The integrated 2D and 3D workspace lets all quickly make modifications and adjustments. The plan is made of objects where desired objects are selected. All objects form an object library, which is a combination of various manufacturer products. The software explains to all how they can modify plan or if they are only allowed to post their comments for design alternatives. The platform also integrates directly to video and audio calls if they have something to discuss about the project. If changes are being proposed, everyone sees the proposals in 3D view to

assist collaboration. The proposal is saved to his account and application communicates with the construction company professionals when needed. When the proposal is agreed by the client, professionals continue the plan development and generate required documentation.

When the plan is agreed by both client and professionals, the tool helps to find suitable meeting time with the help of linkage to calendars. In the meeting, the plan is reviewed and preliminary design work is conducted together with the client. Upon agreement, they decide to proceed further. The link of materials created together with the client is sent to architect. The architect imports the building into his native BIM application and develop the plan further and performs accurate design analyses and verifies that energy consumption meets the regulations. After the design is finalized by the architect, the updates are sent to the client through social media platform where the user provides feedback and agrees the solutions. The housing company uses simple BIM based web environment to apply building permit. When the permit is obtained, the proposal is updated into the 3d repository of buildings in city. They execute the work as planned and update changes made during the construction into the plans. This as-built model is finally updated to the city repository of buildings.

4.2 Scenario 2 – activate masses of people for neighborhood development

A crowdsourcing platform as hypothesized by Brabham (2009) is set up for hypothetical neighborhood development by the city commission. The information is communicated to the mass of city residents through various social media channels. Different types of social media based surveys are conducted to preliminary gather information about the acceptance of the project from the residents. Interested community and users sign up for participation by creating new account or using their existing social media network credentials.

The city offers points for active participation as a bounty for activating the users which can be utilized for exchanging with different kind of city services and activities. The residents may propose different types of requirements and solutions through various media types for the area by creating new threads. Online galleries with the possibilities of commenting in online bulletin boards and vote on the best proposals by other users are made possible. Regular updates and main project highlights are regularly notified to the users through auto-generated notifications and emails to make the platform and activate user participation. Different top solutions generated by user are used as an advisory element in design of the actual plan. A social media platform is integrated with crowdsourcing platform for individual users to plan and design the neighborhood. The platform consists of preliminary space designs and building blocks that users can easily drag and drop to the ones they intend to create.

Moreover, the users are provided with a possibility to build their own designs from the scratch. The guidelines explains use of different elements over the provided project template. The proposed design solutions are open for public voting where both active and passive users can provide their views and comments for the proposals. The winning design proposals are then reviewed and these user-generated solutions are referenced for the development of detailed designed proposals by the professionals in their applications. This process integration of crowdsourcing and social media platforms help both the planners in citizens to generate new, creative ideas and solutions together.

5. DISCUSSIONS AND CONCLUSIONS

Digitalization of processes is changing work culture in construction industry. Web 2.0 technologies, in particular social media tools have changed the way people work and communicate both in private as well as business life. Service oriented businesses are rapidly including these tools to enhance communication towards their customers, whereas market oriented businesses widely adopt its use for finding new customers. Social media is a promising opportunity for communication between the professionals and audiences. The second generation of social media, 3d virtual environment, may be utilized for easy commenting features to collect opinions, comments and feedback from customers. BIM applications can be provided with a social plugin to share models automatically to social media tools. This will result in a strengthened social perspective of BIM based tools. The new "Social BIM 2.0" platform is socially triggered way to improve work methods. Market oriented businesses are able to provide better solutions for customers that will also aid in their traditional workflow, as we described in scenario 1. Service

oriented businesses will be able to generate more socially accepted solutions through the active user participation and contribution as highlighted in scenario 2. Altogether, the platform has potential to provide customer-friendly services that activate audiences in planning, designing and building better environments.

The development of new generation platform with visual 3D integration is a promising field and could be considered as a social dimension of BIM. Free easy-to-use social applications are already commonly accepted way to share different kinds of media. The development of digital era has enabled mutual flow of information and communication is easier between various devices and locations. The construction industry has now an opportunity to utilize customer-driven work practices through visual social applications in projects to communicate with experts and audiences (Jäväjä et al, 2013). Integration of Internet as a distribution channel to share 3D plans in social applications is a step towards more participatory practices. There are already few web-based modeling platforms available in the market. Perhaps these tools are able to provide this integration in near future. With the help of visual 3D presentation, the complex plans are effectively communicated to audiences. A platform with crowdsourcing capabilities for individual users to plan and design the neighborhood can be the next 'killer app' in city development. Social applications provide audiences with visual plans that are effortless to improve and share with friends and larges audiences with similar interests. Social BIM 2.0 is still at the stage of theoretical development and we hope to see integrated practices combining BIM to social media applications actively used in projects in the future.

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