CHANGE MANAGEMENT IN AN ARCHITECTURE AGENCY: THE APPLICATION OF "SHARELAB" FOR BIM IMPLEMENTATION

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Abstract: The linear and fragmented nature of the construction process no longer meets the demands that are imposed by the growing complexity and scope of construction projects. Furthermore, it is now harder to keep up with the increasing number of stakeholders that are involved in the decision making process. Building Information Modeling (BIM) is seen as a solution to involve and connect all the project's stakeholders via a virtual platform. However, the integration of this platform in the traditional structure poses major problems on the levels of communication, design, execution, etc. Therefore, the challenges in implementing this solution are not technological, but social. How do we re-organise the work process in order to maximise the impact of BIM in a firm? This paper presents the first results of applying a new approach that aims to assist organisational change around implementing BIM in the workflow of an architectural firm. The study has adopted a participative approach called "ShareLab", which is based on a three intervention stages: creation of a common ground; construction of a shared vision; and concretization of a collective dedicated strategy. The first two stages were workshops involving several participants from the firm that represents the operational and decisional levels. The results of this study demonstrate the importance of a participative approach to foster the creation of a strategy for BIM implementation that addresses situations specific to the firm. The next step will be to expand the field of the application to include a larger context where different actors from the industry are involved.

1 INTRODUCTION

Construction projects are increasingly complex and multidisciplinary. They involve a large number of players that are geographically dispersed with a tight deadlines and budgets. In order to confront these difficulties, and to avoid the growing gap between the design phase and the results obtained during the construction and operation phases, it seems essential to guarantee a constant and, practically simultaneous, exchange of information, and to ensure a better coordination between of the different involved players. However, traditional practices and procedures intra- and inter organisational of production, and information exchange prevent the acquisition of this fluidity required. This results in projects that rarely respect budgets and deadlines due to divergences or contradictions, which arise from the different decisions made by the various players involved in the project (Winch 2010). The implementation of Building Information Modeling (BIM) technologies and processes in the industry is perceived as a response to these issues and a promising development that could establish, encourage and facilitate collaborative approaches in a project. BIM technologies and methods allow all project stakeholders to work, in an integrated way, on the entire life cycle of a building - from the design phase to the commissioning and operation phase. BIM deals with the design and modeling of data that describe, through digital models, the building, its restrictions and its performance objectives. This information needs

to be managed and coordinated through a collaborative process, the integration of which is yet to be devised (Celnik 2014). However, BIM integration requires a reconfiguration of business practices of the companies involved in the entire life cycle of a project (Mihindu and Arayici 2008). Therefore, this new process implicates an organisational change within the company, which requires an in-depth understanding of its impacts on current practices. However, today's challenge is that there exists a lack of understanding as to what BIM is - a technology, a process or a part of a particular software? (Forgues et al. 2014). Design and construction practitioners see the BIM as a tool and not as an organisational approach based on a concurrent process, thus different from the linear process used in current practice. This lack of clarity makes it difficult to establish BIM processes and protocol, and use it in integrated way (Forgues et al., 2014). Therefore, the challenge for design professionals is to plan and organise the transformation of their practices. This paper is a part of a broader approach that targets the development of a framework for the BIM deployment in the Architecture, Engineering, Construction and Operation (AECO) sector. Its originality lies both in its methodology, an interventionist approach based on Collaborative Action Research (CAR), and in the nature of its intervention, a radical transformation of the practices of an architectural firm toward collaborative interdisciplinary design that uses BIM deployment as a vector for change. To that end, the section 2 of this paper will discuss the guidelines and the importance of BIM implementation; in section 3, the context for the study will be highlighted and the justification for the application of a participative approach; the methodological framework of study will be presented in section 4; and in section 5, the results of our approach will be exposed. The conclusion will concern the evaluation of the adopted approach and its limitations.

2   BIM FOR DURABILITY USES

The creation, exchange, management and consumption of information throughout the life cycle of property assets present a major challenge in the field of construction. New Information and Communication Technologies (NICT) are part of the solution as they facilitate the collaboration and the exchange of information. Nevertheless, contrary to other industries, the AECO sector is yet to apply NICT to increase its performance. BIM, like NICT, is a technological solution that promises to bring the performance of the AECO sector to the level of other industries. BIM is concurrently a technology, a production management tool and a process. According to the National BIM Standard (National Institute of Building Science 2007): "A basic premise of BIM is collaboration by different stakeholders at different phases of the lifecycle of a facility to insert, extract, update, or modify information in the BIM to support and reflect the roles of that stakeholder." BIM could, therefore, solve the problem of information exchange by offering a unique and centralised information platform that is based on a digital representation of the building. Several studies suggest that during the life cycle of a project, BIM offers a number of possibilities for improving the efficiency of its delivery process (Becerik-Gerber and Kensek 2010; Bryde, Broquetas and Volm 2013, Eastman et al. 2011). BIM is also considered by many to be as a disruptive technology or innovation (Crotty 2011; Eastman et al. 2011), its integration calls for change in intra and inter organisational dimensions, namely the resolution of the obstacles in the management of the flow of information at the project and at the firm level. It is, therefore, important to implement BIM in a strategic and coherent way, so that clients and project team can derive the maximum benefits during the entire life cycle of a project (Becerik-Gerber and Kensek 2010; Bryde, Broquetas and Volm 2013; Eastman et al. 2011). However, its adoption and implementation at the organisational and project level implicate numerous challenges. If they are not met, BIM runs the risk of not yielding all of its benefits, and it may even damage project performance. As Bernstein and Pittman (2004) observed: *"new modeling technology is not in itself our biggest challenge. Rather, that challenge is institutional, more a matter of how we reorganize business practices and legal relationships to fully exploit the value of this form of documentation."* Other industries have applied different methods and approaches of change in their NICT adoption with similar characteristics. However, their efforts were fruitless as a result of the temporal and fragmented nature of the supply chain and the specialty-centred organisation of their work. Some researchers in the field of organisational learning (Engeström and Blackler 2005; Carlile 2004) have studied the factors limiting collaboration and innovation in specialty-based work, and they have proposed various solutions. However, to our knowledge, there does not exist any research that studies the particularities of this issue inside a coalition of specialists temporarily united in the realisation of a specific AECO project. Our preliminary research intends to offer a contribution to remedy this issue.

3   CONTEXT OF THE STUDY

The research presented in this paper is part of an ongoing study that aims to optimize the information processing using BIM and to develop design rules for data production and exchanges in the design process aiming at continuous optimization. It also promotes collaboration between two research labs: Groupe de Recherche en Intégration et Développement Durable (GRIDD) of the École Technologie Supérieure (ÉTS) de Montréal and the Lab for User Cognition and Innovative Design (LUCID) of the University of Liège. This collaboration focuses on the challenges of BIM implementation that face architectural firms in order to understand the assistance needed for such an implementation in different firms across Canada and Europe. The research that is presented in this paper aims to accompany an architectural firm in its BIM implementation. The study's overall goal is threefold: 1) to help professionals and their companies develop the agility needed to adapt to an ever-changing business environment; 2) to aid in the management of this temporality in perpetual mutation; 3) to prepare a governance plan to oversee the different types of work and divergent methods of data and structure organisation.

3.1   Context of implementation

The architectural firm that participated in this study is composed of 170 specialists on four sites: Montreal, New York, St. Louis and Haiti. This multidisciplinary agency has five departments: Architecture and Sustainable Design, Engineering, Corporate (the work environment), Retail and Design Studio. For the past few years, this firm has attempted to initiate the deployment of BIM through projects that lend themselves well to this type of exercise. However, BIM implementation remains embryonic, isolated and limited to the use of a 3D modeling software. The majority of these types of projects are carried out in its architecture department, and some of its retail department's projects have to use BIM in order to answer to client demands. This firm had attempted to encourage transdisciplinary collaboration by facilitating interdepartmental partnership, notably through the use of NICT; however, a few years ago, it concluded that its efforts were met with limited success. This motivated them to engage in this study.

The collaboration with the research team and this firm began with the application of the Change Lab approach developed by the Centre for Research on Activity, Development and Learning (CRADLE) research group (Engestrom et al. 1996). The objective of that study was to identify and become aware, to the main actors in the agency, the inherent contradictions in the organisation of their work and the consequences that these contradictions could have on the adoption of NICT (Aksenova, Tahrani and Forgues 2014). The results from this first stage led the firm to engage in the proposed study by the two labs. This study is the result of the consolidation of work conducted by GRIDD on change management in BIM projects and that of LUCID on the development of the "ShareLab" method (Ben Rajeb et al. 2015). It is composed two stages. The methodology used in the first stage is based on the theory of organisational maturity (Crosby 1979). In this stage, the intervention had used the BIM maturity matrix, proposed by Computer Integrated Construction Research Group (CIC) in 2012 for the BIM implementation for owners (Computer Integrated Construction Research Group 2012). This phase consists of the evaluation of the current BIM use within the firm in order to define the desired outcome. This helps target the problems linked to organisational change that results from such implementation. It also involves the assessment of fundamental elements that help in the preparation of a roadmap for the BIM implementation. This paper examines the second stage in greater detail. In this study, the first stage was limited to the firm's architecture department and the researcher evaluated the current situation from his own point of view without the contribution of the main firm actors. Nevertheless, since the end of the first stage of the study, any action has been taken to change the practices of the firm and encourage a concurrent approach that would integrate BIM in a concrete and structured way in the company's various departments. This is why, in the second stage, we put forth a more participative approach between the stakeholders and the researchers. We achieved this by implicating all the departments of the firm, thereby expanding our field of intervention. This paper discusses this second stage of our study, where we promoted collaboration between firm's actors and our research team. Our goal was to help the firm better evaluate the current (real) situation of its BIM activity in order to help identify, together, the desired situation and timelines for BIM implementation. This was done through the construction of a common dedicated strategy. This approach called for a transition from the traditional method of intervention to one that is based on a CAR approach, called "ShareLab", which uses the BIM maturity matrix as a basis for evaluation.

3.2 Toward a participative approach

The originality of the second stage of our research lies in the application of a CAR approach in the world of design and construction in order to facilitate the implementation of BIM (Ben Rajeb et al. 2015). In fact, the management of organisational change, accelerated by the obligation of BIM use, is reliant on the ability of a group to understand, together, the entire scope of the current situation and its vision for the future (Heifetz, Grashow & Linsky 2009). The goal of this shared understanding is to allow the group to adapt to its new reality and to participate in its own future implementation strategy of these new tools. In this sense, CAR is useful in providing support in all aspects of this type of change: technological, socio-cognitive and organisational. This participative approach differentiates our study from classic scientific research (Reason et al. 2001) as action is at its heart, and it aims to understand and transform practices. The individuals involved in the process are actors, as well as collaborators in the study. They participate as much in the definition of the problem as they do in the collect, treatment and data analysis (Monceau 2015).

Commonly used in the field of human and social sciences (to support academic learning, to develop leadership or to integrate a social perimeter in an urban project), this novel interventionist approach promises to be of great interest in this new context. In the short-term, CAR fosters the development of a greater understanding of organisational tools and evolving technologies. This awareness will aid players to be better informed and to improve their mastery in their specific domain (Bourassa et al. 2007). In the long-term, its goal is "teaching how to learn" through a dedicated approach that accompanies less and less companies who are progressively developing their own processes and workshops that foster sharing and reflection among different project protagonists.

Within the scope of this CAR approach, we seek to introduce a new method called ShareLab; its objective is to allow groups to elaborate a common knowledge of their BIM method and work. It also aims to promote the sharing and/ or transfer of certain privileges and the optimisation of certain processes when their deficiencies are detected by the main actors (project's stakeholders or researchers) (McCall 2004). The ShareLab method was developed by the LUCID laboratory, and it takes its inspiration from the activity theory suggested by Engeström (1987). It promotes a participative and iterative approach that facilitates change result from BIM implementation. In this approach, the researcher takes the role of facilitator or mediator and leaves room for the players to have an active role in the activity studied. The goal is to foster awareness of the situation surrounding the BIM implementation. This way the participants are able to create a common synchronised understanding that will facilitate the construction of individual strategies (Ben Rajeb et al. 2015).

In this study, it deals with gathering players from different levels and departments to collectively, with the help of the researcher, establish a shared understanding of the issue at hand (Figure 1). This common point of view *(common ground)* helps them evolve together in their shared thinking *(cognitive synchronisation)* in order to jointly build a shared vision, which doubles as a short- and long-term strategy for BIM implementation within the organisation. All this must be completed before moving on to the simple distribution of tasks dedicated to each player *(synchronisation of operations)*. However, in order to foster such a common understanding, it is primordial to first create an environment of trust and to establish the methodological tools *(sharing)* around which the actors will collectively react and construct a common sense and a mutual understanding of the situation *(awareness)*.
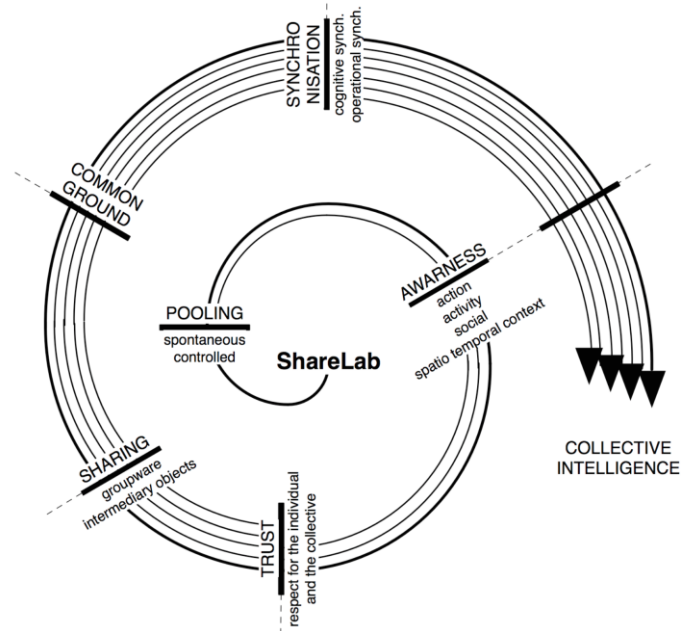
Figure 1: ShareLab Steps (according to Ben Rajeb et al. 2015)

This immersive approach equally involves researchers and design industry players in the different stages of the study. This gives our team access to information that is useful to understanding complex situations. This paper presents one of the applications that were carried out in different types of pluridisciplinary and multi-site design and building construction agencies and companies.

4 "SHARELAB" FOR ASSISTING IN CHANGE

The ShareLab approach contains three steps of intervention: the first is the establishment of a common ground by describing the real situation through BIM maturity matrix (used as a tool to support the reflection that can be shared by all of the participants); the second step is the building of a common vision through collectively defining the desired and the targeted level of maturity; and lastly it is the synchronisation and the creation of a common strategy. In the context of this study, the first two steps took the form of a workshop, while the third dealt with result analysis (Figure 2).

The main methodological tool used in the study was the BIM maturity matrix, which has been adjusted to best suit the context of a design professional phase 1 of the current research (cf. section 3.1). It was then reused, in collaborative et participative way with supervision of the researcher. It was not used as a tool for evaluation, but as a pretext for sharing each of the participants' individual experiences in order to construct a common goal. In fact, ours is an incremental approach wherein we base our work on actions that have already been used at the heart of the firm in order to gradually adapt these actions to new tools and to their inherent jargon. This incremental approach is necessary to guarantee the success of ShareLab and to guide the process of change.
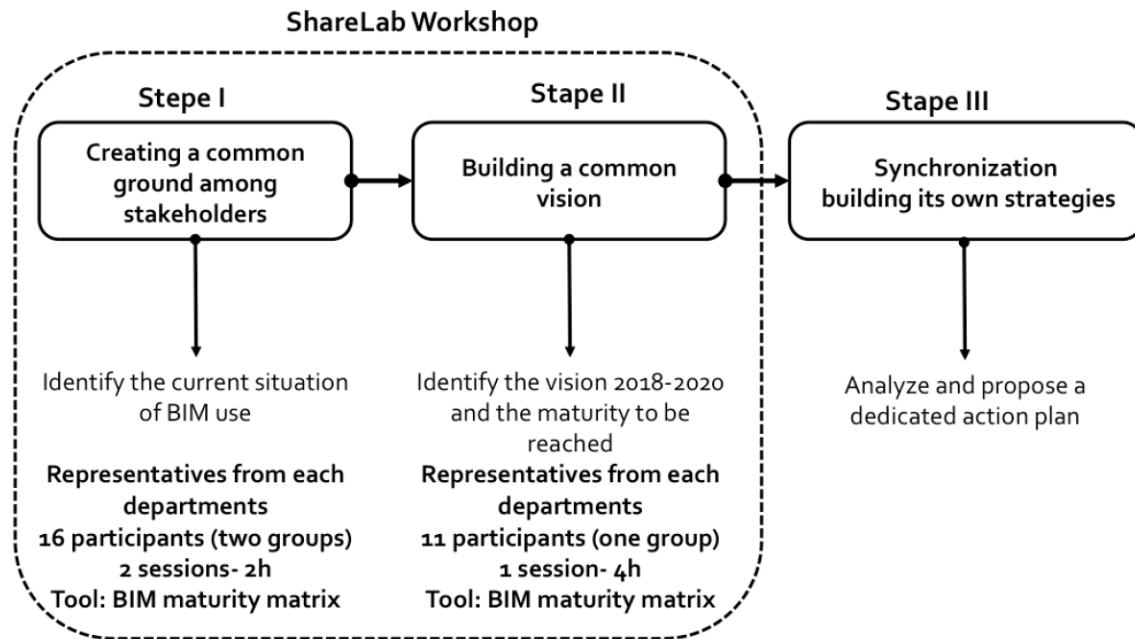
Figure 2: Adopted Methodology for Research

Step 1 - *Create a common ground between participants*: the goal of this stage is to gather representatives from each department in the firm (Architecture, Retail, Engineering, Design, Corporate). These delegates are encouraged to exchange their different perspectives in order to identify the current situation regarding BIM's use at the heart of the firm. In this study, sixteen people (who represented the following roles: vice-president, director, architect, project manager, technician, designer) participated in the first ShareLab workshop; they represented 10% of the firm's employees. For this first step, we divided the sixteen people into one group of six and one group of ten people, and we held two distinct discussion groups (two sessions each for a duration of two hours).

Step 2 - *Build a common vision*: the aim of this stage was to identify a concrete and common vision for the firm for 2018 (a short-term vision for the two years of installation) and for 2020 (a more long-term vision). This second ShareLab workshop gathered all the participants in the previous step for a four-hour session. During the four hours, the results from the first workshops were presented. Two sub-groups were then formed to identify the desired outcome. Once they reflected on the vision for 2018 and 2020, we allotted time for a common understanding to be reached by all participants.

Step 3 - *Allow for synchronisation*: the goal of this step is to analyse and identify the elements necessary for the introduction of internally dedicated BIM strategies.

These three steps, in addition to the integration of an incremental approach, broach the subject through a concurrent and socializing viewpoint. They attempt to establish common points of view with the aim of unitedly constructing a sense of change and mutually managing it. This is achieved through the involvement of players at each level of the firm and the collaboration of all of its departments in BIM implementation.

5   EVIDENCES REGARDING THE ADOPTION OF BIM WITHIN THE FIRM

5.1   Toward a shared understanding of BIM

During the first ShareLab workshop, the participants were asked to answer the following question via an anonymous survey so to express their understanding of BIM's term: "What does BIM mean to you?". The

research team was able to observe a discrepancy between the answers of the two working groups. The first group saw BIM as a tool, while the second perceived it as an organisation. The participants then answered the same question during the second ShareLab workshop. The researchers recorded an improvement in the participants' understanding of BIM from the first survey. Knowing that 40% did not understand BIM's principles and did not even use BIM-enabled software in their projects. The second time that they were asked the question; the participants used terms such as organisation, process and technology to define BIM. The words they used encompassed BIM's entire scope. Moreover, the participants emphasised on collaboration and information sharing when discussing BIM. Given the aforementioned results, there is a strong correlation between ShareLab workshops and the creation of a shared language and a common definition of BIM by players who do not have the same level of exposure to it. This shared definition contributes to the cognitive synchronisation between participants, which is the underlying and necessary condition to subsequently bring about a common vision.

5.2   The common perception of reality

Our analysis of participants' perception of the current level of maturity revealed a gap between the two groups that were created during the first workshop our study (

Figure 3). Many factors explain this gap, here we shall identify the most important: 1) The departments concerned by the BIM implementation; 2) The level of involvement of each person in the firm (senior, direction, BIM-enabled software users, etc.); 3) The context of BIM integration (client maturity and their demands, the scope of the project, etc.); 4) The type of contract (consortium, whether BIM was imposed by the client or not, etc.).
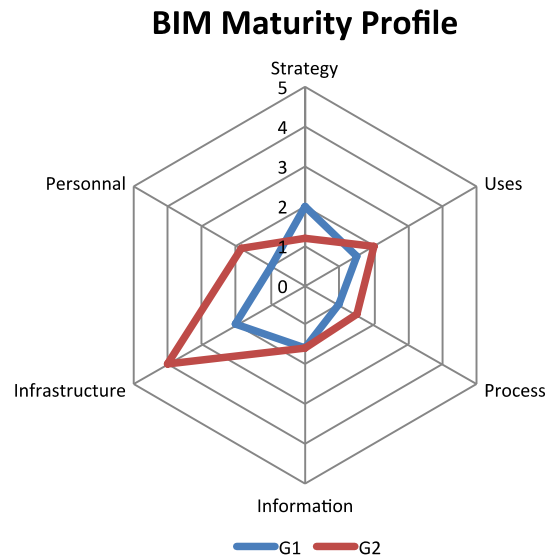

Figure 3: The discrepancy in the maturity of the groups formed

In order to deepen the analysis, our team looked at the level of maturity in each department. This was done in consequence to our research team's conclusion that departmental maturity was the determining factor for the discrepancy between the first and the second group of ShareLab participants (

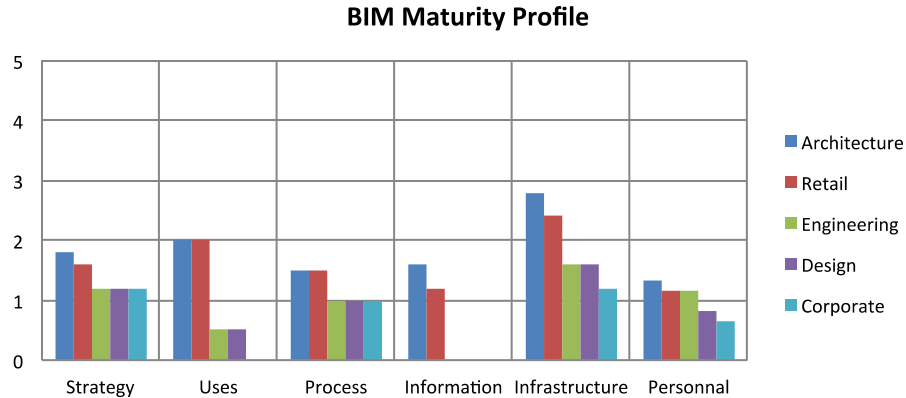Figure 4).

BIM Maturity Profile

Figure 4: BIM maturity according to the departments in the firm

Despite the diversity and the number of departments in the firm (five departments in total), our team could only observe two different levels of maturity: the Architecture and Retail Departments differed greatly from the firm's other departments. This difference is directly linked to amount of projects in which BIM has been implemented. This situation allowed to guide the reflection toward the goal of creating a two-tier action plan in order to better manage change: 1) *Macro level* – the establishment of a governance strategy that encompasses all the departments and that focuses on the long-term goals; 2) *Micro level* - the establishment of a local and adjustable short-term plan that answers to the evolution of each department in a way that encourages their conformance for the 2018 deadline.

5.3   Concretising the adoption of BIM within the firm

The development of an action plan requires the organisation of a Bottom/Up and Top/Down strategy. Such a plan needs to include not only upper management (the decision makers), but also all operational levels. It is crucial to guarantee dialogue between the two spheres for the proper management of change at the heart of the firm and between different departments. The proposed action plan is comprised of the following elements:

1. *Internal mobilisation*: the creation of internal working groups led by the BIM champions and supported by upper management. These working groups need to consist of at least one representative per department and one person from upper management. The champions are volunteers who have become acquainted with BIM during their participation in ShareLab workshops.

2. *Development of strategies*: the role of these working groups is to develop, investigate and experiment the different directions for BIM internal development. These directions for development take the following into consideration: 1) The two different levels of strategy (macro and micro), by adopting a vertical thematic approach and/or a horizontal departmental method; 2) The factors that influence the success of BIM implementation, more specifically the investment of time and resources. All this is done with the approval and the participation of upper management.

The firm that participated in our study settled up a solid and well-structured approach, and its upper management expressed an interest in pursuing our proposed action plan. They considered the implementation of BIM as a project in itself that affects the firm at all its levels by means of schedules, objectives and participants. The project is composed of three phases. The first phase lasts six months (June to December, 2016). It deals with the creation of a collection of knowledge, processes and tools for BIM implementation. The second phase spans over a year (2017) and aims to establish new practices through target pilot projects. The last phase, in 2018, proposes to enlarge the installation and to optimise practices. Our team has defined an organisational structure to support this progressive approach. This structure revolves around four entities: 1) "BIM Core" that unites representative from each department under the guidance of the researcher. The role of this core is to frame and define the scope of the approach in terms of needs and resources; 2) "Steering Committee" that gathers members from upper management who ensure that the development process is in line with the firm's strategies; 3)

"Development Cells" unites players on the basis of voluntary participation for the realisation and the development of the needs identified by the BIM Core; and 4) a unit that brings together researchers to fuel and support the process. In order to organise these committees for development, the BIM Core began by identifying the needs of each department. These requirements were then categorised and prioritised so to discern the scope of intervention.

6   CONCLUSION AND PROSPECTS

This paper presents the first results of an ongoing study. It demonstrates the value of adopting a participative approach to ensure the most effective management of organisational change. In an effort to evaluate the experiences of the participants and to comment on the improvement of the "ShareLab" method, our team distributed an anonymous questionnaire to each participant at the conclusion of the two workshops presented in this paper. The answers that we collected allowed us to observe a real desire to participate in this type of activity. 90% of the ShareLab workshop participants said that they would like to take part in and contribute to working groups that were put forward in the action plan. *"... Yes, I have every intention to continue the workshop and to take part in the committee"; "I am definitely looking forward to participating and to being involved in future workshops"; "Yes to developing a plan and to putting it into practice"; "The prospect of taking part in a small workshop inspires the sharing of concrete ideas that have been tested in the field"; "Absolutely! This is exactly the type of project in which I like to invest myself"; "Yes, ShareLab motivates me to move forward with the hope that I will have the support of my superiors …" (Participant Testimonials)*.

The adoption of a collaborative approach between researchers and practitioners helps partners better identify current issues in the firm and facilitates the suggestion of potential future solutions. The researcher's role of facilitator allows for the associates to establish a common language and to adapt the process according to their actual needs and experiences. It also encourages their continued use of this approach in their Internal BIM development. This method showed upper management the importance of the contribution of players from all operational levels in the firm; it is this type of a participation that allows for the development of a common strategy that best meets the needs of all stakeholders. Moreover, upper management recognised the importance of their own involvement and interest in all the business approaches undertaken by their associates.

Despite the fact that the ShareLab method aims to reinforce collective emerging activity, to focus on common goals and to minimise the influence of the researcher, it is important to remember that its actual role is to frame the process. In the context of ShareLab, it is important to understand the place that the researcher needs to take and the position that he or she needs to adopt in a structure where different actors share in the responsibilities and where individual goals may differ. How can the various players arrive at a consensus? How can one maintain one's intellectual autonomy in the face of pressure from upper management? How can the freedom of expression of each participant be ensured, while his or her anonymity respected? The researcher needs to be mindful of all these questions in order to be a *" socially responsible researcher who seeks to define, unveil and shed light on the stakes and to contribute to their transformation*" (Beaujolin-Bellet 2008, p. 91).

In our approach, the researcher was faced with two challenges. On the one hand, he needed to encourage and convince upper management to implement perimeters for the process without imposing them. On the other hand, he needed to stimulate the process by teaching the firm how to learn in order for it to be able to appropriate the considered solutions and to establish a coherent process that best suits the context in which the firm is evolving. This study focussed on organisational change in an architectural firm through the creation of a common internal dialogue. Yet, in order to resolve the temporal issues in a construction project, it is crucial to build dialogue between the different stakeholders involved, particularly, between owners, design professionals and contractors. The next step will be to expand the field of application of the ShareLab method and to use it in a context that assembles these players. The goal is to use the BIM process to collectively create a common vision that allows for the optimisation of time, cost and the quality of the project.

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