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Need of a BIM-agile Coach to Oversee Architectural Design

From one pedagogical experiment to another

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This paper is part of our research on the digital transition in architecture, and more particularly on the integration of BIM (Building Information Management) technology. Indeed, in the field of AEC in France, this transition is still ongoing and remains difficult for architects. BIM technology changes the way people work and communicate, and remains only a tool without a method behind it. His arrival then raises technical but also human questions. Our research then turns to the social sciences and project management sciences to see if the creation or adaptation of project management methods can facilitate this integration. In other fields such as industry, software engineering, or HMI design, we have seen the emergence of agile methods that focus more on design teams, and therefore communication, than on the process itself. After experimenting with several agile practices, we identified the need for a design team to be mentored by someone in the role of facilitator or coach. This article describes how we can transfer to students an agile practice called BIM-agile Coach that we experimented during a weeklong workshop.

Keywords: *Architectural design, Agile methods, Agile practices, BIM technology, Collaborative design, Project management*

INTRODUCTION

This research takes place in the field of AEC industry in France, and more particulary in collaborative architectural design. Indeed, both in the professional and educational fields, the question of BIM technology is still present, while its integration has not yet been fully achieved. We create and adapt so-called agile methods and collaborative practices to facilitate the adoption and the exploitation of BIM in architectural design. Agility is a term derived from the world of software engineering, and consists of human-centered and customer-oriented methods and practices. This paper describes the path taken to build an experiment designed to transfer agile skills to our students. Indeed, our hypothesis is that the transfer of agile knowledge to our students is an effective way for the digital transition to take place in the professional world.

During a workshop week called Design and Digital Manufacturing, the students put in groups must

have designed a BIM architectural project before making a scale model 1/20 using 3D printers and laser cutters. They applied three agile practices that we have adapted for architectural design: micro poker, design matrix and stand-up meeting.

Experimentation has shown that these practices are compatible, and that they make it possible to improve the coordination of those involved in an architectural project (Gless et al. 2018). However, these three agile practices for designers were framed by a fourth practice for teachers: the BIM-agile coach. He ensures that the workshop runs smoothly, and deals with problems concerning the other practices. We will describe an experiment to improve this practice in this paper.

We will first see in part 2 how BIM technology has led architectural project de-signers to change their business habit. Then, we will see in part 3 that the architec-tural design in France has partly entered into the digital transition, and how agility can help it. Part 4 will concern the experimentation carried out by our students. Part 5 will finally focus on the addition of a fourth agile practice to the workshop process, and on areas for improvement.

THE BIM TECHNOLOGY CHANGES THE WAY DESIGN IS DONE

BIM technology is changing the way we work and communicate. These changes imply adaptations or even creations in the way project management is carried out, and therefore in the way teamwork is done.

BIM technology shifts work and brings complexity

The arrival of BIM technology, according to Patrick MacLeamy's curve (Kensek et al. 2015), shifts the efforts upstream, and consequently increases the amount of work there. By bringing more work and more complexity upstream, BIM technology brings more tasks and more decision-making processes and forces designers to bring more coordination earlier. These changes are transforming the collaborative process, with more information to be shared earlier among stakeholders. BIM poses the problem of the complexity but also creates a need for exchanges between the stakeholders. In addition to changing collaborative digital practices, this can generate misunderstandings, and thus create a climate of non-confidence between actors.

Furthermore, since BIM is presented as a technology, one should expect to find both elements of process and of design tool. Nonetheless, BIM is only a digital model that the designers of a project feed in information depending on the progress, complexity and type of project. BIM stands for Building Information Model, Modeling, or Management. However, it only brings tools and uses (Model and Modeling) and no human coordination practices (Management) (Zignale et al. 2011), which does not necessarily allow good exploitation, and therefore limits its integration with architects and agencies.

These new tools and uses change the way to do project management. The amount of design and modeling work is indeed shifted upstream of the design phase. By passing from a 2D design to a 3D (and more) design, the amount of work is also increased or moved upstream. This is also the case when we add semantic and enriched notions (Halin et al. 2016). It becomes mandatory to think in more detail about object modeling.

This complexity brought about by BIM must be dealt with by appropriate project management methods.

This leads to a need for coordination

In interviews with students or architecture professionals, we found that designers are generally quite well informed about the BIM concept but remain skeptical or worried about its implementation. In addition, we found that collective activities about the tasks to be performed in a BIM environment are complicated or even totally unclear: who does what, to whom I address myself, and especially what this task consists of. It is a question of defining tasks, passing them on to employees or even estimating both complexity and duration. We call that elicitation, refine-

ment and evaluation activities (Gless et al. 2017).

Thus, we have oriented our research towards practices to improve collaboration and consequently exchanges within a group in order to solve these problems: the agile methods.

AGILITY TO HELP THE DIGITAL TRANSITION

While the digital transition is taking place in the AEC industry, other sectors are adapting and creating innovative project management methods.

France in transition

In France, the world of architecture, engineering and construction (AEC) is currently going through an important period of change. Especially in the field of architectural design, digital and collaborative practices are changing in parallel with the advent of BIM technology for both regulatory reasons in public construction and productivity requirements in complex projects.

Nevertheless, there is inertia against BIM which can be explained in several ways. Architectural firms in France are small (90% have 9 employees or fewer and 75% have 4 employees or fewer) [1]. The socio-economic context does not favour large investments either in the short or long term. Finally, any new tool asks questions, and change is never reassuring.

Emerging project management practices

In the field of project management, methods are emerging from continuous improvement or Lean Production, as Lean Construction (Dupin 2014). In order to improve the construction, it is necessary to ask the question of the place of the coordination in the whole process. In software engineering and HCI design fields, agile methods are being applied to answer similar issues (Womack and Jones 2003).

Agility to improve collaborative design

Agile methods are management methods that involve the customer in the design and decision process while following three other fundamental rules: team collaboration, continuous improvement and change acceptance (Beck et al. 2001). By focusing on its aspects, agile methods can address issues of eliciting intentions, refining tasks, and integrating customer needs.

Our hypothesis is that the insertion of agile practices into design activities will improve the quality of the architectural project. Indeed, agile methods and practices focus on building trust between all the design actors (the customer including).

ASSESSMENT OF FULL BIM-AGILE WORKSHOP EXPERIMENT

In order to test agility in collaborative architectural design, we organized a workshop at the end of the semester during which our students put into practice the agile notions they have acquired during our courses. Divided into groups of 3, they experimented with the design matrix, the micro poker, and the stand-up meeting.

The different practices tested

The design matrix. The design matrix is an online table filled collaboratively by the project designers. One can also imagine that a customer or his representative could also intervene in its filling. The incoming elements are found in lines: these are the programmatic elements of the project. In the column are the outputs: these are the graphic or mental or technical supports where the architectural intentions must appear. The boxes at the intersections are then these architectural intentions. This matrix is used to create a mediating object between the designers allowing them to compare their ideas. Moreover, these ideas are then written and no longer said, which makes it possible to refer to them later. This is called the elicitation of architectural intentions.

The micro poker. Micro poker is an evaluation practice based on the use of a card game we have created. Each player has a set of four cards with several rating scales:

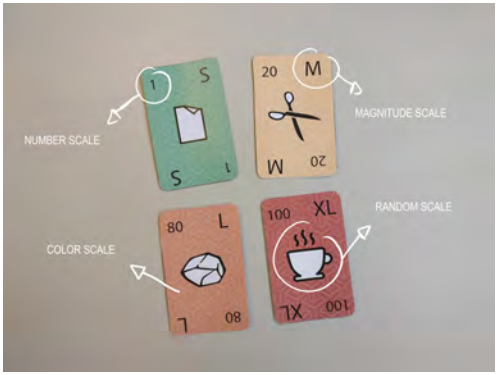

Figure 1
A set of micro poker cards

- Green, with the number 1, the letter S and the symbol of a paper;
- Yellow, with the number 20, the letter M and the scissors symbol;
- Orange, with the number 80, the letter L and the symbol of a stone;
- Red, with the number 100, the letter XL and the symbol of a coffee.

The practice is to evaluate a design task at the same time, so that one player cannot influence others by speaking first, and then debate each player's choices.

The colors represent the scale of the emergency, the numbers a quantity as a percentage of a day or a week, the letters of the sizes, and the symbols allow calling the chance, or a coffee break.

This practice also allows the elicitation of architectural intentions, while allowing designers to refine the perimeter of what they think is the content of a design task. Thus, one can imagine that an actor who played a weak card did not imagine the task in the same way as a player who played a strong card, hence the need to refine them.

The Stand-up meeting. The stand-up meeting is a practice that consists in realizing daily meetings where the actors of a project remain standing and exchange. There are the designers, while a coordinator, or project manager, called facilitator, often leads the meeting. The exchanges consist in quickly knowing what the designers did yesterday, what they will do today, and if they have problems that need to be solved. Standing up helps to keep the meeting fast, as the minimum comfort does not make you want to linger. Moreover, as this meeting is daily and therefore cyclical, the designers must provide at least one binder: a design element (finished or not) whether a model, a plan, a perspective, etc. The aim is to enable all actors to have a global vision of what others are doing, and to solve problems through the collective intelligence or external help of the facilitator, and to produce something to guide or act on things.

The BIM-Agile coach. The BIM-agile coach is the improvement of the facilitator normally present in the stand-up meeting into a full-fledged actor. This practice comes from the scrum method (Kniberg 2015) where we find a scrum master (in charge of the well application of the method) and a product owner (represents the customer needs). This coach has no design mission as such, but aims to solve technical, material and coordination problems instead of designers. In addition, he has a role as the customer's representative. The deliverables expected during the stand-up meeting are then a means for him to check the progress of each group, if the proposals correspond to the ordered program, and if the answers are technically feasible. This role was for us, as a teacher, a simple and effective way to supervise the workshop.

Design and Digital Manufacturing workshop

After a semester of learning about BIM, modeling, and agile project management, Master 2 AME students participated in a workshop called Design and Digital Manufacturing. During this week-long workshop, they must apply what they have learned during the first semester.The students' work topic consisted of the realization of an architectural object of their choice, related to mobile micro architecture. Each group contained an architect, an engineer, and a designer.

The results of the four practices can be summarized as follows, and some observations can be noted:

Agile practices have been well received by students, and properly implemented overall. The majority of students see interest and are considering reusing them in their future projects:

- The matrix is effective at first, and then is used less and less;
- Micro poker is sometimes used as a voting tool and not an elicitation tool but allows players to be on the same page;
- The stand-up had trouble getting started, but it was certainly the practice most requested by the students, in order to be able to validate decisions with the teachers;
- Finally, the BIM-agile coach was able to quickly solve problems of timetable, interpretation of the subject and techniques.

We realized that tools can be used less as time goes on. This is normal: no more need for decision support tools when the project is advanced and only production tasks remain to be carried out.

PERSPECTIVE OF SKILLS TRANSFER TO STUDENTS

The DDM workshop experiment made it possible to verify that the three practices intended for students were compatible and enabled them to communicate better. However, the teachers supported the practice of the BIM-agile coach. It is therefore necessary to rethink another experiment in order to transfer skills of that practice to students in order to achieve a better distinction of roles. A BIM-agile coach within the design directly at the students, and a representative of the customer on the teachers' side.

A new project focusing on management

The new experiment consists of three projects per group of students, constituting several variants of the same typology. Each group is composed of three engineers in architecture initiation and a BIM-agile coach (see Fig. 2). The latter may be an architect or a designer. Teachers will then play the role of customers, and each correction will consist of both a project review and a client needs check. The experi-

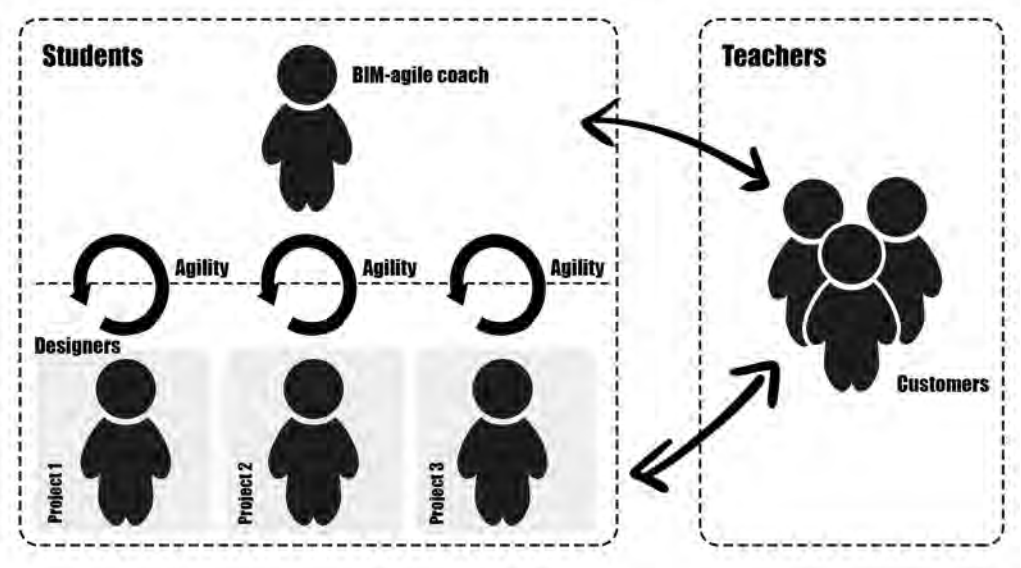

Figure 2
Project organization diagram

ment will last one semester.

Experimental protocol

Before beginning the project, we will give courses and exercises about agility and project management to our students.

We will follow this protocol:

- Theoretical phase: opening course on agility and project management followed by an explanation of the three agile practices;
- Practical phase: one exercise per practice;
- Practical phase: the semester-long BIM collaborative project studio where students will apply the four practices;
- Data gathering: students do a report about the previous collaboration exercise, with comments on practices.

Practice evaluation

Because we are in an educational setting, it is complicated to perform a test on a sample of students and not on others. Furthermore, the final group score cannot be used to assess practice.

Thus, all groups will participate in the experimentation, and the evaluation of the practice of the BIM-agile coach will consist of a report at the end of the semester from the students who played this role. They should first criticize the first three practices and then try to evaluate the influence of a coach on a design team.

Our previous experiments having shown that the first three practices are well received by the students. We expect that the BIM-agile coach will allow each group to have homogeneity in each sub-project thanks to a global vision.

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