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Looking for virtuous architecture

Learning collaboration through experimentation and patent development

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Abstract. What is the best way to teach collaborative design to students in architecture within an interdisciplinary environment? How does one extend traditional architectural methods to serve environmental design? How does one generate new collaborative practices in the architecture profession in particular with contractors and industrial partners? These questions are founding concerns of an educational program conducted from September to December 2015 at the ENSAL – Lyon’s national school of architecture. The studio was called “looking for virtuous architecture” and was directed by three architect-teachers Paul Vincent, Estelle Morlé and Emmanuel Ritz. To address these issues the team used collaborative experimentations through prototyping in order to create synergy between architects and their partners – technical engineers, public contracting authorities, industrial partners. This paper covers the method used in this educational program. As an illustration of this process, we will describe two projects that led the ENSAL and industrial partners to register co-ownership patents at the end of the studio.

Résumé. Comment enseigner aux étudiants architectes à concevoir en collaboration au sein d’un environnement interdisciplinaire ? Comment élargir le périmètre traditionnel des moyens de l’architecture pour servir la conception environnementale ? Comment ouvrir le métier d’architecte à de nouvelles pratiques collaboratives notamment avec des partenaires entrepreneurs et industriels ? Tels sont les questionnements fondateurs de l’enseignement de master « à la recherche d’une architecture vertueuse », mené à l’ENSAL - Ecole Nationale Supérieure d’Architecture de Lyon – de septembre à décembre 2015 par trois enseignants architectes Paul Vincent, Estelle Morlé et Emmanuel Ritz. Pour explorer ces problématiques, l’équipe a utilisé l’expérimentation collaborative par prototypage à échelle pour générer une synergie entre les architectes – étudiants et enseignants - et leurs partenaires – industriels, maîtres d’ouvrage, ingénieurs techniques. Cet article s’attache à expliciter et discuter la méthode mise en place dans le cas particulier de deux projets aboutissant au dépôt de brevet en copropriété entre l’ENSAL et le partenaire industriel.

Keywords: Cooperate, collaborate, prototype, innovate, R&D for architecture

Introduction and context

Architecture is a combination of art, technical and social matters. Several different fields of knowledge are involved in the design process and they overstep the unique skills of an architect. The first principle of architecture is that it is collective, and requires collaboration between different actors involved in a project. Thus, the efficiency of the collaboration is conditional to performance in the architectural process.

In the present day, a stronger demand of normalization, ecological pressure and economical stress limits the flexibility of architecture. Architectural production has to engage in a more and more complex reality in order to meet today’s expectations.

This appeal for architecture to change both the process and the production refers to the necessity for architects to innovate. A distinction is made between invention, innovation and diffusion (Schumpeter, 1912). Invention comes first with an idea of something new and useful for progress. On the other hand innovation makes production usable and used. Diffusion comes last and makes innovation accessible to the general public.

The education program *Looking for virtuous architecture* is a design-built studio created by Paul Vincent, Estelle Morlé and Emmanuel Ritz at the ENSAL in September 2015. The studio questions innovation moving from invention for architecture in both result and process.

The pedagogical outcomes can be described in three main points:

- Collaborate with experts and integrate their knowledge for the benefit of a project
- Cooperate in teams all along the design process using management tools
- Experiment the design with partners using prototypes and experimental protocols.

Firstly we will observe the implementation method in this education program, then we will evaluate the role the prototype played in reaching the results.

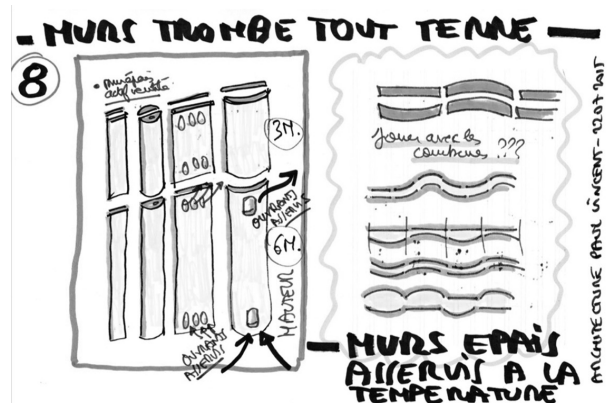
Teaching method

Start with an invention

At the beginning of the studio, several topics are jointly defined by the three architect-teachers. Each subject arises from current issues of society and outlines their new approach through architecture.

In September 2015, 4 topics were proposed to 16 students among which Paul Vincent introduced two of them more specifically. They were projects he had previously conducted with an industrial partner in terra cotta. The first one called *virtuous wall* was gathering traditional and environmental functions into a thick piece of prefabricated wall. The second one called *planted tile* offered a renewal in traditional terra cotta tiles in a large format designed for contemporary architecture with environmental qualities.

Before entering the studio, students have to choose one of the topics and justify their interest by writing a short text and looking for attached references.



Starting base: reference on existing and draft idea from Paul Vincent

Work in team using management tools

One of the basis of the design-build studio is to allocate 50% of the learning outcomes to social and interpersonal skills. As a consequence, half of the final evaluation for student certification is founded on collective work. We use two different terms for collective work: collaborative and cooperative (Baudrit, 2007). Collaborative means work with external people like partners or teachers, cooperative means work with peers inside the team.

The teaching method implements a specific process with formative evaluations all along the semester to assist students in the team management. It aims at increasing solidarity between members by taking action on self-regulation (Villeneuve et Motoi, 2009).

Work with professional partners

The team teacher calls upon different kinds of partners to create a collaborative ecosystem around each project. Some of them help define the orientation of projects whereas others only step in during the design process. The teaching method implements different working tools for students to practice collaboration.

Each partner has a different role regarding his skills and knowledge. Industrial and supplier partners share their expertise on the technical properties and production processes of the materials. They also supply economical support and provide materials for experimentations.

During the design process, collaboration workshops are organized with experts – professionals and engineers - to focus on one specific aspect of the project. These could be social, environmental or technical matters such as *diversity of uses*, *natural ventilation* or *planted buildings*. During work sessions, several iterations are arranged between students and experts in order to increase knowledge sharing. Experts start by exposing theoretical knowledge in a conference. Then students work in teams for a short time to analyse a case study or specific literature on the topic. Right after they display their work to experts and teachers. These learning steps open the possibility for immediate feedback on thought processes and make learning easier. In the last working phase, students go back to the studio project and work on one short proposition that integrates what they learnt.

Apart from workshops, students can ask for technical support from other partners such as contractors or technical engineers. In order to share a project's documents, each team creates an e-portfolio with a weekly update. This online support works also as a formative evaluation for students to get feedback from teachers. Every week they sent back comments and guidelines to help students further their work.

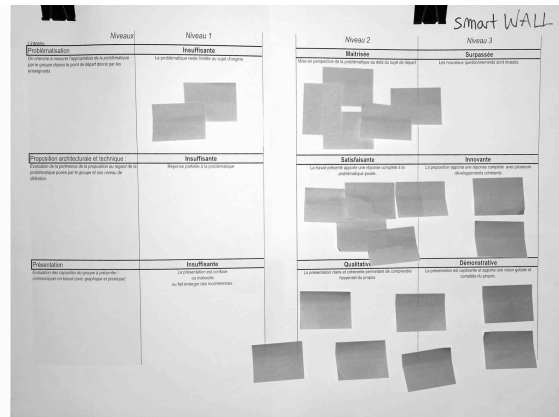


e-portfolio (Boulangier A., Fournier B., Jadaud A., Padilla M., Lezais F., Pose L., Cervero F. Neuburger Y.)

In mid-term and at the end, most partners are invited to a jury to contribute to the evaluation process. Students get 3 kinds of feedback from the jury:

- Oral comments after presentation,
- Assessment grid with criterion and levels with evaluation from all members,
- Written comments which summarize the jury's debate.

Critères	Niveau 1	Niveau 2	Niveau 3
Problématisation On cherche à mesurer l'appropriation de la problématique par le groupe depuis le point de départ donné par les enseignants	Insuffisante La problématique reste limitée au sujet d'origine	Maitrisée Mise en perspective de la problématique au delà du sujet de départ	Surpassée Les nouveaux questionnements sont investis.
Proposition architecturale et technique : Evaluation de la pertinence de la proposition au regard de la problématique posée par le groupe et son niveau de définition.	Insuffisante Réponse partielle à la problématique	Satisfaisante La travail présenté apporte une réponse complète à la problématique posée.	Innovante La proposition apporte une réponse complète avec plusieurs développements cohérents
Présentation Evaluation des capacités du groupe à présenter / communiquer un travail (oral, graphique et plastique).	Insuffisante La présentation est confuse ou inaboutie ou fait émerger des incohérences.	Qualitative La présentation claire et cohérente permettant de comprendre l'essentiel du propos.	Démonstrative La présentation est captivante et apporte une vision globale et complète du propos.



Evaluation grid and result through jury's votes

Prototyping and experimentation process

The design production of students for the studio is divided in 2 parts: project and prototype. One is feeding the other in such a way that students go from one to the other following an iterative process all along the semester.

For the projects virtuous wall and planted tile, the prototype design and construction hold a special place in the collaboration process with engineers and industrial partners. The main steps of this collaboration are summarized in the following table.

		Virtuous wall	Planted tile	Actors
1	Project draft	Look for architectural references. Sketch design and functioning principles. Experiment through scale models.		Students
2	Workshop with partners	Factory tour. Define outlines for prototype and global dimensions. Functions to integrate: ventilation through earth cooling tubes, warming tubes, inside and outside surfacing, insulation.	Rainwater drainage. Main structure. Tile fixing system.	Students Partners
3	Prototype design	Execution drawings 1:10. Main dimensions from existing product.	Adaptation of original student design with existing products.	Students
4	Materials order	Existing prefabricated wall	Existing prefabricated lintels and sun shading louvers. Sedum mat.	Students Partners
5	Prototyping	Intensive workshop for 3 days in les Grands Ateliers		Students
6	Physical experimentations	Airflow. Cooling tube.	Rainwater drainage. Fixing system.	Students Partners
7	Feedback in the project	Change the final design.		Students
8	Register patent	Register documents based on prototype.		Partners Ensal

Table 1 Main steps for prototyping

Results and discussion

Prototyping: a demonstrator and a collaborative vector

For this first experience of the education program, we observed two functions for prototyping and physical experimentations. First, it held a catalyst function for collaborative work between interdisciplinary actors.

Describing the role of prototyping in the framework of construction history - a practice known as experimental archeology - F. Fleury and R. Mouterde (2016) write:

"[...] To design, build, and operate the experimental setup requires at least coordination [of various expertise], and often the simultaneous presence of the [different] actors. Since each discipline must step-in upstream in the design of the apparatus, the specific objectives change, and disciplinary perspectives are no longer the driving force : the necessity to concentrate on the fabrication of the object shifts the traditional disciplinary posture which is usually dedicated to description, explanation, understanding, but not directly to action. The reproduction if only a part of the object's reality engages various actors and funnels disciplinary energy towards a common goal. There is then no point in focalizing on the specific phenomena of one's discipline, which is henceforth neither first nor last, but simply necessary as the others."

Although interdisciplinarity is but one facet of the collaboration process, and because of its heterotopic position at the edge of socio-professional issues, we believe that prototyping also enhances complicity between professionals.

The second function of prototyping was an indicator of innovation. If we go back to Schumpeter's definition (1912), we can say that a prototype is the first step to make an invention usable. The next step is to make it used.

This usable characteristic of the innovation [demonstrated by the prototype] is one of the conditions to register the patent. The national public agency of intellectual property defines as patentable criteria the new technical solution to a technical problem and the practical use for industry¹.



Prototyping of planted tiles and virtuous wall – Credit photo Bernadette Forest ENSAL

¹ <https://www.inpi.fr/fr/comprendre-la-propriete-intellectuelle/le-brevet/les-criteres-de-brevetabilite>

Assessment of student learning

We assessed student learning at the end of the studio through the following question *what did you learn the most during this education program?* Most of the comments refer to collective work (22 comments) including collaboration with partners and teachers (11) and cooperation with peers (11). Other comments refer to architecture and design methodology (10), importance of motivation (3) and to build at real scale (3).

Conclusion

Patent is the first step to develop innovation for industry. By using collaborative prototyping for architectural research, we can say that the studio looking for virtuous architecture achieved two innovations. But how can we talk about innovation for architecture?

Architecture and industry used to maintain close relations through history. Despite their links, we can notice major differences. One is the handcraft character of architecture that always belongs to a different context. What kind of innovation can share industry and architecture? What does innovation for architecture could mean?

The educational program at ENSAL explores ways to answer rather than finding a unique and true solution. It opened two different tracks to answer.

Innovation for production

Rather than enclosing architecture in mechanics of industrial patents, the studio aims at reconsidering the limits of architecture as a discipline. Architecture relies on economical and industrial systems. What about reassessing architects' action so as to address these concerns and to serve environmental and human design?

Innovation for design process

Rather more than simply production, student-learning assessment reveals the main target of the studio: to practice a shared design through a cooperative and collaborative process. While complexity is increasing, the current challenge we have to face is to build a collective and cross-disciplinary society. This is an increasing demand and dismantling segmented studies in university education will be a necessity. Improving social and interpersonal skills for students is necessary to create new working methods at school in order to reach then professional sphere.

Acknowledgments

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