PING Projects: distributed networks of design

Learning and Teaching Investment Fund 2010
Final Project Report

**Project Information:**

**Project Title:** PING Projects: Distributed Networks of Design

**Theme:** Primary: Virtual Mobility, Secondary: Multi-disciplinary project based learning

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**Table of Contents:**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive summary</td>
<td>pg 03</td>
</tr>
<tr>
<td>List of outcomes</td>
<td>pg 04</td>
</tr>
<tr>
<td>Detailed Project Description and Rationale</td>
<td>pg 04</td>
</tr>
<tr>
<td>Project Outcomes and Impact</td>
<td>pg 06</td>
</tr>
<tr>
<td>Dissemination Strategies and Outputs</td>
<td>pg 06</td>
</tr>
<tr>
<td>Linkages</td>
<td>pg 06</td>
</tr>
<tr>
<td>Evaluation of project outcomes</td>
<td>pg 06</td>
</tr>
<tr>
<td>References</td>
<td>pg 07</td>
</tr>
<tr>
<td>Appendix (Visual supplement)</td>
<td>attached</td>
</tr>
<tr>
<td>Financial Acquittal</td>
<td>attached</td>
</tr>
</tbody>
</table>
PING Projects: distributed networks of design

**Executive Summary**

The PING Project was an industry-linked, virtual mobility studio in the RMIT School of Architecture and Design focused on the design and fabrication of flat-packable architectural assemblies for urban sites. Entitled One-TWO-One, (i.e. full-scale on twin sites) the students combined the use of laminate sheet material with advanced digital fabrication techniques to produce a series of full-scale flat-packable structures for sites in London and Melbourne. The studio consisted of 24 Master of Architecture students working in seven groups, led by Gretchen Wilkins, Leanne Zilka and John Cherrey, in collaboration with The Laminex Group in Melbourne and several London-based organizations, described below. Key pedagogical ambitions for this project were to: provide experience with advanced digital fabrication techniques and programs, encourage collaborative work and project-based research - especially across international networks in a virtual mobility studio format, and consider alternative design opportunities and environmentally sustainable practices of building construction through industry partnerships.

The studio was structured in three phases beginning with site and materials research, then to a schematic design “competition,” and finally designs development and fabrication of the work – phases which roughly follow conventions of architectural professional practice. The project was coordinated in conjunction with the London Metropolitan University’s “Make Do and Mend” brief for the London Festival of Architecture International Student Exhibition, which proposed full-scale architectural installations for a series of sites in London using recycled or reclaimed material. Using discarded laminate sheet optimized through digital fabrication processes, RMIT students produced four full-scale architectural installations which were shipped to London for the festival and subsequently exhibited in Melbourne (State of Design Festival), Shanghai (Cumulus Conference for the Shanghai Expo) and Beijing (Beijing Architecture Biennial). In London the installations were received and assembled by architecture students from London Metropolitan University and the University College London at the Bartlett.

The collaborative, international, and industry-linked structure to this studio enabled several teaching and learning outcomes. Foremost was the opportunity for students to experiment in an open-ended manner with materials and fabrication, testing a variety of methods for bridging the gap between thinking and making. The nature of the problem – requiring full-scale assembly by others on remote sites using reclaimed material – foregrounded an imperative for optimization and efficiency in design and construction across many facets: in terms of how the work is designed, how pieces are composed on flat sheet material, how the work is physically assembled and compacted for economic shipping, and how it might be quickly installed by third-party students. The relationship between controlled and uncontrolled aspects of design work, such as the combination of precise digital tolerances and inconsistent material supply, or specific local conditions and unpredictable remote sites, defined the design and learning process, placing utmost importance on the development of skills for negotiation and communication between group members (of varying levels of experience and cultural background).

The combination of these factors further revealed boundaries between the processes of design and execution, especially as related to the collective expertise and experiences of architectural students. The skill and craftsmanship typically required in full-scale construction, that which takes place in the ‘field’ or job site, was shifted to the tasks further ‘upstream,’ such as digital design, documentation, and scripting, processes with which students quickly develop with a high degree of skill. As such this became a specific focus of the studio work, not in making full-scale constructions or learning to script form per se, but in developing a material intelligence which could bridge between the processes of input and output, between digital and material systems, and be of use in future experiments or alternate scales of work. In this context the studio operated somewhere between a research lab, a professional office and an artist apprenticeship, where students were both guiding the work and following where it led.
PING Projects: distributed networks of design

Outcomes

Work from the One-TWO-One studio work were exhibited at four international design expositions in 2010:

- The London Festival of Architecture (theme: Make Do and Mend)
- The Beijing Architecture Biennial (theme: Machinic Processes)
- The Cumulus Conference at the Shanghai Expo
- The State of Design Festival in Melbourne (theme: Design for Everyone)

The projects were also presented at the “Material Connexion” conference curated by Leanne Zilka and hosted by the Design Research Institute, RMIT University, and published in associated conference proceedings. Students have continued this work independently, in collaboration with The Laminex Group, Craft Victoria and VISY. Two conference papers were prepared for submission to the Fabricate conference in London (University College of London – the Bartlett) and ACADIA (Association for Computer Aided Design in Architecture).

Project Description and Rationale

The overall ambition of the PING project, demonstrated through the One-TWO-One design studio, was to engage students in project-based learning through a virtual mobility structure, and to research architectural fabrication techniques through collaborative, industry-partnered work. These ambitions will be elaborated specifically, below.

Project-based learning:

The studio course consisted of 24 Master of Architecture students roughly split between male and female, local and international and across four academic levels (studio levels 6-9). It was coordinated and taught by 3 lecturers each bringing a specific focus and expertise. Gretchen Wilkins (LTIF project leader) with experience in design-build studio teaching and collaborator in the Urban Architecture Laboratory, Leanne Zilka, architect researching material systems, and John Cherrey, director of workshops for RMIT School of Architecture and Design. The students were split into two groups initially, one group documenting the Melbourne and London urban sites and the other producing iterative design tests with laminate material, while both would come together once a week in the workshop to discuss the relationship between these ideas. The students were then reformed into seven teams, within which they developed a single design proposal that needed to work across both sites. They also had to demonstrate the method of assembly (undertaken by themselves locally and by others internationally), the logistics and flat-packability for shipping, outline the costs and material needs and what each member of the group contributed. Based on a formal assessment by the studio leaders and outside critics, as well as peer-review, four projects were selected to move forward. All students were redistributed among these four projects to work collaboratively on design development, full and half-scale mock-ups, costing, material testing, sample detailing, and ultimately final production, fabrication and installation. A final review at the end of the semester was scheduled and the work was publically exhibited as described above.

In this way the teaching and learning objectives were channeled through a specified project with clear limitations, benchmarks and methods of assessment. This criteria included design process, (demonstrated by a project folio), design development (demonstration of iterations and tests), efficiency and transportability (flat-pack and shipping logistics), mechanisms for remote assembly and ultimately the final work itself, sited, installed with appropriate local and administrative clearances and permissions, useable by the public. Students had were accountable within their groups for specific tasks, and had to consistently register their work against and across that of their team, adjusting where needed, driving certain aspects at appropriate times and taking a secondary role at others. The project itself, measurable incrementally throughout the semester, was the ultimate venue for the teaching and learning objectives.
PING Projects: distributed networks of design

**Industry-partnerships:**
The studio worked in collaboration The Laminex Group, Grant Lindsay and Andrew Hripko. Their interest was in searching for alternative uses for laminate sheet in architectural applications, ours in combating the increasingly growing problem of building construction waste. They agreed to provide an almost endless supply of material for students to use free of charge which would both their waste output and encourage experimentation with alternative architectural applications in return.

Each year nearly 500 tons of industrial sheet materials are sent to the local landfills in Victoria alone. The eccentric nature of building construction waste is often the most limiting factor in considering its potential reuse. Most has not lost its original use-value from degradation or substantial defects, but is merely impossible to sell, resupply, or exists in odd shapes which defy standard manufacturing techniques. While some materials may be crushed, melted or chipped for remanufacturing into a product of lesser quality, reuse of the existing material for new architectural systems (as opposed to customized, single objects) without employing these energy-consuming processes is rare. How to standardize a re-manufacturing process when the nature and properties of the material itself are unknown is the most obvious difficulty. Given the wealth of intelligence in digital design processes and increasingly widespread availability of advanced fabrication tools, the One-TWO-One studio sought to develop a method of mass-customizing reclaimed waste material which did not substantially increase the embodied energy nor substantially decrease the quality or formal possibilities. In short, we endeavored to develop a ‘smart’ architectural product that might embody the systems of information used to reprocess it.

Students were given the task of reprocessing this material with their own digital tools, and then to design architectural systems that can be easily built with a minimal amount of waste and without the need for highly skilled labor, locally or remotely. They began by working directly with laminate sheet material to test the strengths and weaknesses, pliability, structural capacity, and architectural and formal possibilities. They were then asked to develop a structure that combines a variety of digital input values, such as laminate dimensions, scripting processes, rapid prototyping specifications and international shipping dimensions. By reordering conventional design processes to begin with (reclaimed) material constraints we sought to narrow the gap between material manufacturing and building waste. We reclaimed nearly 900 cubic meters of disused material for use in the studio.

**Global Passport** *(virtual mobility learning)*
The international collaboration with London-based organizations allowed for students to be connected to, and collaborate with, international partners without actually traveling to them. While two of the students chose to travel overseas to assist with the installation of the work in London, the studio was structure in a way in which actual travel was not necessary. The projects thoroughly researched international shipping logistics in order to maximize their design for ease of assembly by their international partners, and to stay within range of transportability. Communication took place largely over the web, as well as being heavily reliant on Google programs: Maps, Streetview, Earth and SketchUP. The virtual mobility aspect of the work was key in promoting the integration of physical and digital components of design process, such as coupling weight and volume ratios into the layout of pieces on a CNC-router bed-sized sheet, or ensuring designs could flat-pack into an efficiently sized size, even as carry-on luggage, or scripting the production and assembly process it could be easily assembled by others, internationally.

The imperative for the design, rather than the designers, to ‘travel’ created a strong imperative on keenly understanding how to translate between two and three-dimensional aspects of architectural design, both physically and digitally. Students quickly began to explore architectural programs for digital unfolding and physical re-folding. Programs like Grasshopper help to accelerate the learning curve for design-based scripting, while many other ‘unfolding’ tools, such as Pepakura, Rhino unroll, Waybe and Lamina, were tested. Meanwhile the material implications of these programs were tested on various fabrication tools, such as the CNC router, water jet cutter, digital paper cutter, plastic welder, vacu-former, Objet printer and laser cutters. It was the combination of these digital and physical skills along with repeated, iterative testing that ultimately revealed the
PING Projects: distributed networks of design

capacity of design tools in use together and furthered the student’s designs. In this way the virtual mobility structure of the studio encouraged the use of experimental, open-source programs and design platforms, as well as new forms of architectural representation, notation, drawing, modeling and architectural execution.

The other aspect of the global passport was in the international dissemination of the work through exhibition, conferences and publication, as well as newly formed partnerships between students and universities in Melbourne and London. Finally, the nature of the studio brief, both learning advanced digital and physical fabrication methods as well as confronting issues of building construction waste in design, are aspects of architectural practice which are highly relevant locally and globally. Students from the One-TWO-One studio will have directly experienced and presented a broader, general understanding of some of the issues, limitations, tools and questions it presents for their own future work locally or in collaboration internationally.

**Project Outcomes and Impact**
The PING Project was designed to achieve a series of outcomes including:
1) International collaborative design research:
The studio collaborated with the London Metropolitan University, the University College of London – the Bartlett school, and Genesis Cinema, London, where the project were sited and stored.

2. A studio to conduct design research through advanced material fabrications:
The One-TWO-One studio, as described above, was successfully implemented in Semester 1, 2010. A second version of the studio is planned for Semester 2, 2011.

3. Exhibition of the design research:
The projects were exhibited at the London Festival of Architecture – International Student Exhibition, Beijing Architecture Biennial, Cumulus Conference at the Shanghai Expo, and the Melbourne State of Design Conference.

4. A conference paper:
The work was presented to the ACADIA conference (IN-Formation), Fabricate (Bartlett school of Architecture), and Material Connexion (DRI, RMIT)

Further, this work formed a pilot project for a future LTIF grant, the Project Office (G. Wilkins, L. Zilka, J. Cherrey and Mel Dodd) in 2010. The industry-based structure to the studio, virtual mobility format and full-scale fabrication aspects as well as community-design partnerships frame the future work of the Project Office, which has commenced in 2011. Testing the learning and teaching objectives, assessment and implementation through the PING project allowed for this type of work to be tested within a semester-based time frame and studio environment. The Project Office will build on from the PING project and pick up where this work leaves off.

**Dissemination Strategies and Outputs**
The PING Project outcomes and dissemination strategies are listed above. Attached is a PDF document to further describe the process and outcomes.

**Linkages**
The PING Project outcomes and dissemination strategies are listed above. Attached is a PDF document to further describe the process and outcomes.

**Evaluation of project outcomes**
The broad ranging interest in this work locally and internationally, as well as the feedback from industry partners, students and related staff has been overwhelmingly positive. This encouragement has motivated continuation of these efforts, and further research into teaching and learning strategies and resources in architecture by the author in collaboration with others, as described in the Project Office LTIF proposal mentioned above and granted in 2011. Specifically
that work proposes to initiate an organizational unit within RMIT School of Architecture and Design aimed to facilitate ongoing linkages between academic and community or industry practices, continuing the focus on 'live' projects and practices of teaching and learning that operate through collaborations outside of the university. Having evaluated several models of practice-based research and teaching within the university, such as embedded practice, the academic practitioner, research units or centers and other models of our proposal, the project office, we are proposing to create a space within the School for studio-based projects with a community design practice emphasis on 'service learning' as a pedagogical framework. As such the next phase of this work through the Project Office will encourage an active involvement by a wider collective of academic design staff to this type of teaching and learning activity.

References
Please see attached document.

Appendix
Please see attached document.

Final Financial Acquittal
Please see attached document.