“Field Guide” as a Catalyst for Student-Initiated Design-Build Research

This process account demonstrates how a student-led, peer-to-peer learning Design-Build initiative is transforming the academic experience at Waterloo Architecture. The paper outlines how F_RMlab—a collective founded by a core group of graduate students in Waterloo’s self-directed masters program—is acquiring agency and resources for advanced computational design through the analysis of *Field Guide*–a responsive ceiling canopy–as a catalyst for student-initiated Design-Build research.

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1.0 INTRODUCTION

F_RMlab is a graduate student initiated research collective engaged in advanced computational design tools and fabrication methods at the University of Waterloo School of Architecture. The group was formed in support of architectural paradigms where dynamic interaction, social responsiveness, regenerative materials and systemic resilience play an integral part in the building process. The collective develops resources and expertise for computing and advanced technology in design that contribute to a renewed vision of architecture. By creating this resource library, participants within the collective have access to knowledge created and documented by other members. This allows for opportunities to learn from other group members and apply this learning to new projects while having access to previous project data and not having to start from scratch.

1.1 EDUCATIONAL CONTEXT

The goal of F_RMlab is to operate at the periphery of an architectural core course curriculum while being critical of current architectural paradigms in relation to digital tools and computational discourse. It is intended to operate as a self-sustaining collective that archives knowledge and rigorously documents its projects such that the material is made available to future students and can help to both provide learning frameworks and further iterate prototypes. The origins of the collective stem from *Field Guide*, a collaborative, Design-Build project that allows speculative design research to operate simultaneously across multiple streams. The project covers responsive computation, hardware design, and digital fabrication. *Field Guide* played a catalytic role in evolving student led design research, technical workshops and future projects in F_RMlab.

As Architectural design research differentiates itself from the "classic" research of the sciences and other academic disciplines, the development of its own values and processes is needed in order to formally contribute to the particular knowledge base. The structure of F_RMlab allows for explorations that supplement current methods of learning and working within an architectural design education. Space is provided for students to develop skills applicable to course work and to pursue independent projects.

F_RMlab actively seeks out opportunities to contribute to academic design research and participate in professional exhibitions of work. Design research is still a moderately young method and is often under great scrutiny and controversy due to its inherent deviation from "epistemological traditions, methodological guidelines, and academic standards,"[1] usually used as the standard for traditional research. However, the architectural importance of design research is constantly growing due to the evolving relationships between technology, the sciences and architecture.

Knowledge itself is found in creation and then a critical analysis of the results. The method established and then applied in Field Guide enacts both sides of Charles Owen's diagram as seen in Figure 1, which depicts the relationship in knowledge creation, balancing the processes between theory and practice. In the execution of Field Guide, technique, theory and workflow were constantly under critical analysis in order for the best possibilities for improvement to be logged and explored. The integration of both inquiry and application into a single collective relates to the criticism of previous architectural working methods and limitations, and explores the possibilities of faster workflow or innovative experiences in design. Subsequently, "Child projects" come out of the critical assessment and a parent project.

While the School of Architecture at the University of Waterloo has undergone many changes in the past year with regards to goals, objectives and curriculum, F_RMlab has continued to function and adapt to these evolving circumstances. As the group is democratic in its approach, the technical skills development workshops always lean towards teaching the interest of the majority. This choice is often affected by expressed interest or need in areas concerning the members' current educational experience. F_RMlab differentiates itself from the curriculum in its agenda for the development of full scale Design-Build projects.

Operating in this manner is imperative for the success of knowledge transfer, resource acquisition and ultimately corporate partnership and sponsorship within a student-run group that will inevitably experience influx in the core members responsible for F_RMlab's continuity. Within the University of Waterloo community, the independent pursuits of Graduate research and Undergraduate professional experience leads to varied types of accumulated knowledge. F_RMlab is focused on creating opportunities to encourage the cross-pollination between years. Traditional design studios evaluate students' individual achievements and only facilitate peer-to-peer learning in select group projects.

1.2 F_RMLAB METHODS AND STRATEGIES

The following highlights two of the main methods that F_RMlab has adopted in order to formulate a student-led Design-Build that investigates the idea of research through making. The first strategy that will be outlined in this paper is adaptability, which emphasizes F_RMlab's ability to address shifting paradigms and evolving interests. Secondly, F_RMlab's strategy of inclusivity allows for outreach, collaboration, building of community networks and diversifying interests to be explored. These methods outline the importance of The incorporation of computational design with

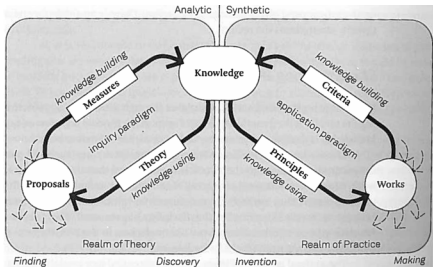

Figure 1: Using and accumulating knowledge in the two realms. *Building the Knowledge Base,* Charles Owen.

2

Figure 2: *Field Guide*, May Wu

Design-Build work takes cues from the cultural importance of the craftsman, as outlined by Richard Sennett, as well as the importance of cybernetic theory in relation to architectural design practice, as expressed by Gordon Pask. As Richard Sennett states in *The Craftsman*, "the Enlightenment believed that everyone possesses the ability to do good work of some kind, that there is an intelligent craftsman in most of us; that faith still makes sense."[2] F_RMlab follows a similar approach and recognizes that all members have unique technical skills to contribute, an idea fostered in the current format of co-op work placements included throughout the undergraduate architectural education at the University of Waterloo. This, paired with the fundamental belief that knowledge can be enriched through the process of engaging physically with touch and movement, is what frames the positioning for peer-to-peer learning in a Design-Build format. The focus on computational design and architecture is a deliberate response to the growing role of technology in the daily experiences of the human life and, in this manner, F_RMlab identifies the differences that exist between the constant acceleration of technological innovation and the evolution of academic curricula.

The Homeric *Hymn to Hephaestus* appears to be one of the original celebrations of the craftsman—a member of society whose value and contribution has oscillated under scrutiny throughout history. This hymn celebrated the man who worked with hand and head, the man who was able to move beyond the uses of tools for technical production and was able to harness them for the development of a collective good. Much like what Richard Sennett describes as an insinuated value in the composition of the *Hymn to Hephaestus*, *Field Guide* is an example of how F_RMlab strives to have individuals "identify with other craftsmen as fellow citizens" and how "[s]kill would bind them to their ancestors as to their fellows."[3] The group creates a community that shares in the cultivation of architectural craft while practicing the mastery of the technical skills that can contribute to a collective good. The identification of the ancestral bond is strengthened by envisioning projects as if members of a lineage or family tree. Craft is improved and perfected through the evolution of projects in a generational manner.

F_RMlab aims to partner the instructive nature of craft with the technologically attuned discipline of Cybernetics, defined by Gordon Pask as,

> "transdisciplinary domain, permeating such disparate fields as engineering, biology, sociology, economics and design, institutes a paradigm for thinking which emphasizes the circular reasoning, interrelating output, adaptation and self-organization."[4]

The relevance of cybernetic theory lies in the explicit recognition that architecture itself is a complex set of relational systems. This is compounded in the relation of an individual project to its greater context. By advocating for a holistic design education, including the process of physical creation, F_RMlab promotes processes that see architecture "as an environmental, social and cultural device, and proposes the fundamental components of design processes which may calculate, determine and predict such systems."[5]

The development of architectural design and the implied relationships between cybernetic thought is already ubiquitous in the form of CAD computing. What is arguably considered to be a "typical" design workflow is now being subverted by BIM systems, parametric modeling and the integration of computationally embedded technologies such as Arduino. With this diverse ecology taking shape, different skills are taught in different capacities within architectural education. F_RMlab

embraces innovative cybernetic work systems and provides a platform where hands-on learning can occur and where individuals with different skill levels learn about different technical systems in parallel. This allows for knowledge to flow freely between groups and impact the knowledge base of each member. Additionally, the framework operates as a bottom-up strategy—individual members are invited to participate and immediately encouraged to actively pursue leadership roles within the collective. This cross-pollination is not limited to peer-to-peer learning and seeks assistance from community, institutional, interdisciplinary and faculty partnerships whenever possible.[6]

Therefore, all projects created by F_RMlab are implemented with these core values in mind. Implying that many systems and disciplines are related, and that each member is a fellow craftsman. The collaborative nature allows for participants to seek understanding and knowledge by looking to their fellow explorers, whereas the relationship is openly reciprocal; as one seeks it is also their responsibility to teach others.

2.0 F_RMLAB METHODS AND STRATEGIES: ADAPTABILITY IN "FIELD GUIDE"

When dealing with rapidly shifting paradigms and new technologies within architecture, the speed at which the learning environment and complementary resources can adapt is crucial. F_RMlab facilitates learning through necessity and demand within a structured curriculum at the School of Architecture. This is executed by enabling the student-body to share interests, experiences and expertise within design collaborations in order to directly affect the structure of their education. The immediacy of experimenting with a topic of interest and the informality of the process that a student-led Design-Build offers creates a momentum that can influence and change curriculums.

Field Guide is designated as the "Parent project" for this informal research-through-making-process. Workshops, skills development and prototyping become integral to the design development of the project. The transfer of knowledge between sources and participants is considered highly valuable in the realization of a design idea. This shared practice and communication in turn garners a higher awareness and criticality when creating "Child projects" as further developments of previous ideas. The combination of "design research" and "Design-Build" effectively brings students with different types of experience together on a single project. *Field Guide* as the "Parent project," included a group of graduate students involved in differing research interests. *Field Guide* began as an opportunity to engage the development of skill-sets in three categories;"textile fabrication", "responsive systems" and "installation/structural implementation"that apply to the majority of the groups core interests while simultaneously addressing technical development outside the academic courses available. In subsequent child projects, the collaboration has spanned across groups that include first year Undergraduates increasing to Masters students, often still working in similar clusters established in the parent project. These child projects are accompanied by skills workshops addressing strategies implemented in the responsive architecture projects.

Field Guide, evolved through many iterations, sought dynamic relations between a synthetic ceiling textile and the behavioral responses of individuals experiencing it. By operating with dynamic systems and working in spatial systems that are still maturing in implementation, the testing of possibilities, and subsequent reflections are embedded in the single project. The built work is not a final result but an index of possibilities. New questions emerge from each subsequent exploration, and these moments are of great value.

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4

Figure 3: *Field Guide II*, CivicAction Metropolis

Figure 4: *Field Guide III*, Photo by Author

Field Guide II and *Field Guide III* acted as iterative translations of the parent project. *Field Guide II* re-evaluated the capacities of the responsive system and revisited the original structure design to suit the site conditions. *Field Guide III* was a portion of the original project size in order to better focus on the atmospheric conditions of the textile system. The smaller dimensions of the location allowed for closer scrutiny of human-synthetic relationships created in the sensor based system while also considering lighting as an ingredient of the responsive experience.

2.1 STRATEGIES FOR ADAPTABILITY IN A STUDENT-LED DESIGN-BUILD:

Adaptability coupled with student agency and a desire to learn results in a more flexible accountability that encourages experimentation, risk-taking and growth. *Field Guide II* and *Field Guide III* are examples of an iterative process and the ease by which new attempts can be deployed within a short period of time. The original project division into three clusters privileged the possibility to iterate single portions of the project, focusing on the critical analysis of portions of the work. Adaptability, responding to student agency and the emphasis on knowledge acquisition through necessity have made the continual functioning of F_RMlab possible. It is due to the bottom-up structure of F_RMlab that fluctuating dynamics can be accommodated for according to changing interests and evolving skill sets. This Design-Build learning structure can easily respond to the agency within the student-body and adapt to their needs. This framework then becomes a platform upon which students can gauge interest and respond through project and resource acquisition. In this way, adapting their learning initiatives in real-time and from one project to another. This adaptability, driven from urgency and the light footedness of the framework, can ensure the sustainability of the organization over time.

2.2 CHALLENGES OF ADAPTABILITY AS A STRATEGY

The lack of accountability and limited methods for the evaluation of strategies create many challenges in the structure of a student-led Design-Build such as F_RMlab. The main challenge within F_RMlab is how to successfully build up parent projects that can then have iterative child projects. The successful start of a series of projects becomes a challenge in order to attract new participants and thereafter manage resources in an effective way. Enabling a student-led Design-Build initiative to be effective and sustainable in terms of resource acquisition, management, dissemination, effectiveness and productivity are all crucial in the success of the envisioned project ecology. F_RMlab has struggled to establish itself as a group, similar to the MIT Media Lab amongst others example, while maintaining itself as an entity affiliated with the university rather than being integral to the institution. The method of faculty directors who lead open ended clusters is quite successful at MIT, as it develops work within the cluster, while also allowing new clusters to form when certain work gains traction and sophistication. An example of this is the spawning of Skylar Tibbits and Neri Oxman's clusters in the research group, after developing the work within the pre-existing structure. The forming of research pathways and design projects, funding, resources and attracting required expertise becomes difficult when this faculty support is deliberately absent and the students are left to their own devices.[7]

3.0 F_RMLAB METHODS AND STRATEGIES: INCLUSIVITY AND AGENCY

F_RMlab is able to function in itself as a student-led Design-Build in part due to its emphasis on inclusivity. Inclusivity as discussed in this context implies the willingness to participate, the agency to learn and the eagerness to investigate challenging territories. F_RMlab's constitution clearly outlines the roles of a F_RMlab member in terms of their engagement within the learning process of the

Design-Build, their participation in the advancement of the knowledge base and project experimentation. The ability and desire of any of the student-body to contribute to the experimental projects and advancement of knowledge of the larger group clearly defines the inclusivity. The initiative relies heavily on the openness of members to contribute new ideas, demonstrate a commitment to the greater good of the group, and exhibit a willingness to share skill sets with peers. As a horizontal student-led initiative, participation is not limited to skill sets and the importance is on the process and the experience. With this mindset, the idea of iterations and the parent-child projects explained earlier allow for the development and experimentation of concepts that can be pushed by each individual's unique contribution.

Ways in which F_RMlab tries to promote and exercise its inclusivity policy is through regular workshops and the open-door sessions—a large portion of peer-to-peer learning—that provide support offered for personal projects and graduate research. Initiating, hosting and participating within regular work sessions is an important way to promote the inclusivity and ability of any member to take charge of knowledge transfer collectively. F_RMlab uses the workshops as a way of communicating with the larger student body and tries to cater to the more general needs of students—in this way gauging more interest and increasing the number of younger members who are eager to learn and to investigate concepts through future Design-Builds. F_RMlab's acquired knowledge and resources are easily accessible to the student body through the promoted open-door sessions, in which members make themselves available for hours every week in order to answer any questions or to help work on, initiate or discuss new ideas and future projects. Lastly, F_RMlab has been offering its knowledge base and resources in order to attract funding as well to acquire support for personal projects and Graduate research. In promoting various smaller projects and independent thesis research to collaborate with F_RMlab members, F_RMlab has been able to gauge more interest through this diversity in interests and focuses for initiating Design-Build projects.

3.1 IMPORTANCE OF INCLUSIVITY FOR A STUDENT-LED DESIGN-BUILD:

Inclusivity has been a crucial part in sustaining and developing F_RMlab's Design-Build initiative. It has been influential, allowing the formulation of an expansive knowledge base and continuously attracting new members. Inclusion is merited on passion and interest rather than initial skill. All interested students are openly welcomed by F_RMlab, building a sense of community within the group. One that has been able to extend to the larger community of Cambridge and the main campus of University of Waterloo. As the F_RMlab constitution states, members are encouraged to dedicated their efforts to the dissemination of knowledge through peer-to-peer learning sessions, conference papers, posters and publications based on Design-Build projects and explorations. In this manner, the aim is to publicize and gauge the trajectory of F_RMlab beside industry standards and current pursuits in academic research. This spirit of inclusivity was demonstrated in the development of *The Cube*. A project that attempted to iterate earlier developments in the *Field Guide* series. The installation was created for the 2013 ACADIA Adaptive Architecture Conference, and strived to accentuate the range of motion of the responsive motor system while simultaneously fabricating a more robust, reflective plexiglass textile.

3.2 CHALLENGES OF INCLUSIVITY AS A STRATEGY

The primary challenge of a holistically inclusive student led, peer-peer

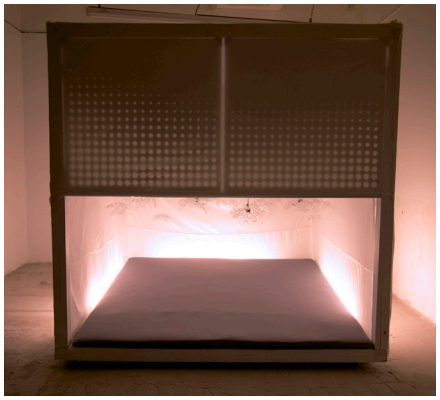

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Figure 5: *The Cube*, Andrew Cole

Design-Build is to maintain commitment and accountability. It is a system that relies heavily on developing a balance between students who are interested in teaching and students who are interested in learning. If no one feels comfortable teaching then the group effort is stifled, lacking in direction. The ambiguous identity and structure can cause volatility when this balance shifts. An open ended system thrives in the circumstances where students are able to bring their own problems and piggyback off existing resources and design teams in order to expedite the learning process. Collaboration opens members to new possibilities, which exponentially increase the vibrancy and richness that can be achieved in a single project.

Project circumstances can be compromised by the placement of individuals within roles they are not able to fulfill effectively. Establishing a degree of accountability enforces the importance of responsibility and contribution that lies within the strengths of each individual. F_RMlab projects do not carry personal consequence such as grades or financial investment, and therefore the risk of lackadaisical contribution increases. To date, F_RMlab has had to compromise in project completion and on particular administrative tasks. The group remains dynamic, and committed members contribute in both independent and collaborative efforts related to design as well as administration. F_RMlab focuses on the implementation of support infrastructures that limit redundant tasks, keeping members as free as possible to focus on the design projects. In addition, it is important to identify a project manager within a team. As projects scale up in size with respect to financial costs, notoriety, or dimension, team members experience a larger fallout if a project goes unfinished. This transition between F_RMlab as a student group to F_RMlab as a small experimental design studio shifts the mindset of the participants and allows for an increased level of accountability. This method of working enforces the value of teamwork and participation in realizing a built work that brings pride, a value echoed by Richard Sennet, “The emotional rewards craftsmanship holds out for attaining skill are twofold: people are anchored in tangible reality, and they can take pride in their work.”[8]

Individual dependability and accountability within a group project can falter when a design team grows beyond a critical mass. In regards to The Cube, it can be said that this project suffered from lack of mentoring due to time constraints. This in turn did not allow for fluid knowledge transfer between student generations, which was further aggravated by the over-saturation of participants in relation to project scale. The project also suffered from trying to iterate too many components without properly evaluating the existing resources and communicating between team clusters, creating workflow disruptions. Strong communication and members who fit management roles is crucial to the success. Project organization becomes essential in the success of any Design-Build project. Not only that, communication between veteran F_RMlab members and newer participants, providing mentorship in the establishment of an evolutionary project is essential in order for the system to work to its potential.

4.0 CONCLUSION

The exploratory learning environment that F_RMlab has provided is a safe, resourceful, and experimental atmosphere—an alternative to traditionally structured, grade-based, lecture-driven education. By allowing students of all class years to teach peers of higher and lower years, the implied hierarchy of knowledge that exists within an institutional setting is deconstructed. By humbly insinuating that anyone can teach and that anyone can learn, self-empowerment is paired with creative opportunity and in this way the group celebrates the contributions of

every individual. This allows for implicit mentoring connections, for opportunities outside of class time to continue learning and to work collectively on personal projects.

In the future of F_RMlab, this system can grow to the local community, assembling public workshops in order to provide creative workshops for kids, or technical design sessions for local artists or hobbyists. This could be done in partnership with Art Galleries, and Cultural Centres such as the Library and Maker Space. F_RMlab has already taken steps to form collaborative relationships between other university faculties and is a leader in developing entrepreneurial resources for students in architecture through partnership with a regional startup incubator, Velocity.

Student-led learning through making recognizes the design possibilities in the digital age and enables students to take on built works on their own while still in school. The freedom and agency empowers students while allowing opportunities to physically test and make mistakes in order to learn. The deliberate agenda is focused on resource acquisition and learning ecologies; allowing for increased accessibility, mentoring and information database. In this way, Field Guide exposes students involved, to Arduino-Processing computation skills, the craft of material studies, hardware assembly, and the basic strategies of structural assembly. The collaborative nature of projects leads to an increased sophistication; a holistic method that can be learned from and compounded in further project generations. The Design-Build projects allow for immediate feedback between computational ideas and the constraints of physical implementation. This expands the region of possibility, allowing for greater leaps in design knowledge and providing alternative methods of learning that feedback into the school's architectural curriculum.

The mentoring framework is loose, but exists in order to guide the entrepreneurial spirit of the group, rather than command it. The working model favours horizontal learning ecologies rather than vertical, single stream learning practices often found in a traditional academic design studio. By drawing on knowledge gained outside of the academic curriculum, F_RMlab aims to act as an incubator for innovation and exploration in the school. The implementation of Field Guide has started a series of projects and allows precedent for new "Parent projects" to push the F_RMlab clusters in new directions. The supplement of informal workshops continually allows for students to take agency of their architectural education.

ENDNOTES

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