Methods of knowing: grounded theory in the study of future-use architecture

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ABSTRACT: Unlike disciplines defined by well-established methodologies, no single method characterizes architectural research. Instead, scholars and practitioners adapt approaches from across disciplines in the humanities, natural, and social sciences to answer the questions at hand. Questions in, of, and about contemporary practice demand the systematic creation of new knowledge; but design inquiry necessarily yields knowledge highly-situated in specific projects, and struggles to integrate qualitative and quantitative data, to address uncertainty, and to demonstrate validity. While the discipline produces and consumes research, the study and dissemination of research methods in education and practice remain rare, ad hoc, and anecdotal. This paper traces the methodology of a multi-year research project bridging research and practice conducted by a team of academics in response to a call from the profession for research advancing adaptive and regenerative buildings. The work builds on years of speculative design research and historical-theoretical scholarship in the context of the academy and was awarded a significant research prize to support a two-year program of research seeking significant advances in the profession. The resulting knowledge addresses both scholars and practitioners, supporting application in practice and scholarly discourse about the built environment. The team adopted a grounded theory approach: seeking not to test a specific hypothesis but to develop an organizing theory. Through a mix of methods, architectural practice and architectural products became both the subject and object of research. The team conducted dozens of structured interviews with selected designers, clients, and building occupants, which were recorded, transcribed, coded and synthesized. Nearly one-hundred building projects were identified as possibly valuable case studies, and documented through analytical design drawings, and compared using graphic matrices. This paper describes and evaluates the methodological choices and their implications for research in the built environment.

KEYWORDS: grounded theory; research methods;

INTRODUCTION

Like all systematic efforts to identify new knowledge, architectural research depends on the paradigm, or system of inquiry, in which research is conducted. Beyond the ontological consequences on *what* questions are asked; paradigms' epistemological stance inevitably shapes the forms and methods of inquiry, dictating *how* a study is conceived and executed (Groat and Wang 2013, 65). As a multidisciplinary practice, architecture encompasses a great breadth of paradigms, engenders diverse research topics, and thus offers a great many methods from which to choose. This paper traces the application of one method—grounded theory—for a specific inquiry situated in a particular locus of research and practice.

1.0 BACKGROUND: THE CALL AND THE PROPOSAL

1.1 Proposed research program

The project described here addressed a call for a two-year program of research leading to significant advances in the profession of architecture and focused on research about buildings that change and adapt over time. Under the banner of *Adaptive Reuse and Regenerative Buildings*, the call emphasized responses to new uses and to dynamic environmental conditions. In response, the proposed project, titled *Future Use Architecture: Design for Persistent Change* expressed the goal of designing today to allow a building to support human

occupancy in many possible but unknown futures. By questioning design based on programmatic determinism, the proposal suggested buildings organized around the inherent logics of building systems, their architectural arrangement, and the resulting cultural value. This idea wove together numerous threads of prior individual and group inquiries about the balance between flexible and fixed building systems; buildings' response to dynamic and unforeseeable contingencies; and the conservation of essential architectural design and performance. Furthermore, the proposed work built on a long-standing approach using the lenses of r*esilience* and *future change* to helps students enrolled in the Comprehensive Design Studio at Northeastern University develop integrated, comprehensive design.

For years before embarking on this project, the research team had been developing and co-teaching the *Comprehensive Design Studio* and the associated lecture course *Integrated Building Systems*, which together challenge teams of students to integrate architectonic, environmental, and structural systems into high-performing, long-lasting buildings that adapt to unknown future environmental, spatial, and human conditions. The technical rigor and theoretical grounding in precedent buildings discussed in the lecture course, coupled with the speculative, open-ended inquiry of design studio helps students develop fully-integrated environments that engage building and landscape systems at multiple scales. Thus the students engage in *design research*, a projective form of inquiry examining the modifications of places, spaces and practices over time (Leatherbarrow 2012). This example suggested that unconscious knowledge from practice may be discovered by subjecting practice to similarly provocative questions.

1.2 Proposed research plan

To build a rigorous research study from this existing speculative framework, the proposal outlined an empirical approach based on investigating selected case-study buildings to identify physical, and non-physical attributes associated with buildings that have successfully changed use over time. Those attributes would form the criteria to select illustrative precedents that demonstrate and explicate the principles through scholarly and professional publications and exhibitions. The practical focus of the investigation precluded purely speculative, or theoretical approaches in favour of ones based on real buildings. While experimental methods like a randomized controlled trial set the standard for rigor, they are often impractical for building-scale questions, whereas empirical can rigorously observe variations that exist in the world. Empirical methods do have limitations. One—described by the *cum hoc* fallacy—lies in mistakenly attributing each building's survival to its unique features although the features are present and the building survived, the correlation does not prove one caused the other. So expanding the sample to include *negative* examples of projects that had *failed* to successfully adapt can test whether the *absence* of specific attributes limited or precluded future-use. More importantly, mixed methods that incorporate other forms of evidence that cannot be gleaned from analysing the artefact itself—for example personal accounts of the social context and history of buildings—can explicitly connect building attributes with decisions to preserve or not. As with all case studies, collecting, documentation, and analysing multiple examples constituted the bulk of the proposed effort, and highlights a second challenge: selecting the right buildings to ensure they represent the breadth of relevant conditions, comprehensively cover the investigation space, but do not bias the findings with preconceptions. Fortunately, a decade of teaching, sharing, and collaborating with a diverse studio faculty had produced a geographically, typologically, and chronologically diverse list of example buildings. The proposal described these lists, and the method itself as a starting point which would expand and evolve as the project progressed.

2.0 METHODOLOGY: GROUNDED THEORY

Existing research methods can quantify the costs and benefits of long-lasting buildings, for example life cycle cost assessment can test Alex Gordon's ideal of "long life, loose fit, low energy" by measuring durability (long life), adaptability (loose fit) and sustainability (low energy); by quantifying the tangible and intangible costs and benefits of buildings over time (Langston 2018). However, many aspects of Future-Use Architecture specifically—like architecture generally—defy quantitative analysis: design processes; human motivations for

or against preservation; and socio-cultural factors make it impossible to measure or predict the long-term reuse of buildings. Furthermore, the attributes that allow (or cause) buildings to endure are inherently project-specific and context-dependent cases of broader general phenomena. These types of complex, multivariate problems can only be understood through observation and analysis of projects, practices, and people, operating in different contexts: in other words, through qualitative research. Quantitative methods are considered top-down (from theory to hypothesis to data), while qualitative methods are considered bottom-up (Bollo and Collins 2017). In this case observing phenomena or studying examples leads to patterns and themes which in turn coalesce into a theory. Grounded theory is a *systematic* method of analysis to make research based on qualitative data rigorous and validated. The bottom-up research method used in this project is illustrated in **Error! Reference source not found.**,
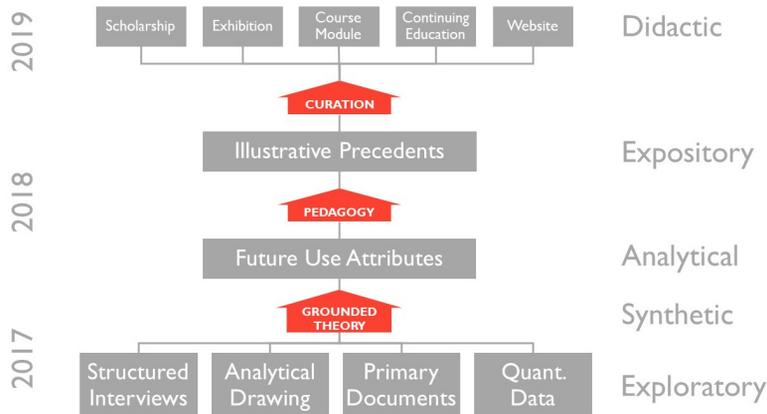
Figure 5: Simplified, linear concept diagram of the research process, grounded in multiple data sources (bottom), which are synthesized and analysed to identify the attributes, which are in turn explained and ultimately disseminated (top). Dates on the left indicate a rough timeline, while the words at right characterize the dominant mode of enquiry**.**

2.1 Interviews

A major form of data for this project consists of *structured interviews* which ask architects, clients and users a set of identical and pre-planned questions (while allowing varied follow-up questions as each interview progresses). This method allows the researchers to understand the many aspects of projects not visible in the drawn or built work, including ways architects learn from older buildings, the challenges of working with historic structures, and the lessons from witnessing projects evolve. Interviews can trace the intersection of design theories with the complexities of practice, and outline the role of clients, users and other stakeholders in future adaptability. In short, these personal accounts fill in the context of design decisions otherwise inaccessible through the work itself.

As mentioned above, the quality of interviews depends on the selection of subjects, and the years of teaching provided a list of people and practices doing relevant work, starting with those who designed, occupied or managed the case study buildings. The team cast a broad net, inviting architects, engineers, developers, financiers, lawyers, contractors, construction managers, property owners, facilities managers and researchers based on their connection to specific buildings or the topic in general. Research that involves people carries an ethical imperative to protect human subjects, even when, as in this case, the work is far removed from the biomedical research that gave rise to the Belmont report (1979). The team prepared a complete human subjects protocol, anticipating a designation as *exempt* human subjects research based on the interviews presenting "no more than minimal risk of harm" (*45 CFR: Public Welfare* 2018, §46.101(b)(2)). In this instance, the project was determined *not* to be human subjects research, on the basis that *buildings* rather than *people* were the subject of the study, and any people we interviewed were acting only in their *professional* rather than

personal capacity. The compliance staff at our institution suggested the helpful analogy of an *oral history* project: the information needed was not written in books, it was remembered by people, and interviews were the only way to get it. Even though the protocol was ultimately not needed, the process of preparing it helped develop the interview questions, systematize the research procedures, and produce documents such as standard outreach letter.

**Table 1:** List of questions for the structured Interview

WHEN and **WHERE** has your work considered change over time? Can you suggest specific projects should we talk about?
WHY are the buildings you've worked on—whether new, renovated, or in general—worth keeping?
HOW does the design process change when considering long-term future change?
WHAT design strategies and project attributes enable long-term future change, and which preclude or challenge it?
WHO prompts considerations of future change, who benefits, and who pays?
WOULD you be willing to share documentation with us to support our research? Is it okay if we contact you with any follow up questions?

Interviews—particularly *structured* interviews—depend on good questions, with sufficient specificity to elicit useful responses about a consistent set of issues and to afford structured analysis. On the other hand, open-ended questions often yield unexpected, and therefore uniquely valuable insights. Naturally, good questions avoid leading the subject to preordained responses that simply reinforce the interviewer's initial bias. To develop the questions for this project, the researchers first individually brainstormed open-ended and specific questions. Working together in several meetings, the principal investigators merged, sorted, and categorized these questions into a set of overarching root questions, shown in Table 1. We sent the questions to the interview subjects in advance, so they could prepare, and explained the methodology as a sort of informed consent for use the information. With the first draft in hand, we conducted an initial interview with a highly sympathetic (and patient) subject as a pilot of the questions, the logistics, and the method of analysis. Reviewing the transcript (with time stamps, see below) revealed that the researchers spoke too much, both in length and content; resulting in a thoughtful but wandering conversation rather than the rigor of a structured interview. In response, the team organized follow-up questions by topic in an interview reference guide to keep the researchers focused, and the interviews consistent.

Once the questions and structure were established, the effort switched to logistical rather than intellectual aspects of the method, for example scheduling fixed blocks of time each week, and coordinating travel to maximize in-person (rather than telephone) interviews. The team found a simple voice-memo app on a smart phone produced adequate audio quality if the microphone was centrally placed and background noise kept to a minimum. A large external battery ensured the phone did not power off mid-interview. Audio recordings raise numerous privacy and legal issues. During in-person interviews, researchers could simply ask permission prior to starting a recording device, and leave the device visible as a reminder. Remote interviews must consider legal restrictions on wiretapping, and several technologies were considered for conducting and recording phone interviews, including online-meeting platforms. Ultimately the team adopted the free application Google Voice, which can record calls and save files to a Google Drive with reasonable quality, and also announces the start and end of recording. For both in-person and phone interviews, recording was mentioned first in the invitation letter or email soliciting the interview, and the structured interview protocol includes confirming consent before starting the recording. In person, the subject can see the researcher turn on the device, while on phone calls, the Google Voice announcement creates a record of consent directly in the recording and transcript. Both recording methods produced acceptable quality and file sizes, with only minor hiccups in playback. In only one case the interviewee declined to be recorded but agreed to review the detailed notes of the investigators and offered corrections and even additions to the notes, which were then coded like any other transcript. Initially, we hired undergraduate students to transcribe the recordings, hoping to benefit from their subject-matter knowledge and modest cost while offering a research experience and the opportunity to hear these conversations. The students were trained to use a standard syntax

indicating who was speaking, and to tag with square brackets passages when the quality of recording or complexity of accents made the speech inaudible. A similar notation indicated non-speech sounds, and identified the occasional words the transcriber did not know or other points that required following up with the interview subject. To aid with navigating the transcript (and connecting text with audio) transcribers were instructed to put a time stamp in the transcript every five minutes, and at each [inaudible] tag. Our analysis of timesheets indicated students needed about five hours to produce a first-draft transcript of a one-hour conversation. Unfortunately, a typical first also draft required a complete review by another student reading the transcript while listening to the audio, which demanded at least another one-and-a-half times the interview length. In the last step before coding, one of the principal investigators who had conducted the interview reviewed the written second draft for quality and to clarify any remaining tags, and occasionally spot-checked against the audio. In all, this process required about seven to ten times the length of the interview to yield a document ready for coding. Students worked part time, so the process was very slow: delaying the research. Additionally, the quality varied significantly, it proved impossible to predict which students would be most effective; and the large team required extensive supervision and coordination by the PIs. The PIs turned to an external, online transcription service that, while limiting students' opportunity to participate in research, was much faster and comparably or slightly less expensive. After comparing multiple vendors, the team selected Rev (*Rev.Com* 2018). Transcripts were typically produced within two days, and the quality was good, except some names (Le Corbusier was a constant problem) and some specifically-architectural terms. To address these problems, the team retained the best student research assistants to complete the second-draft quality assurance, and the PI's continued to review transcripts of their interviews before coding. In an additional benefit, the transcription service provides an on-line editing interface, which allowed the quality assurance and PI review to occur in the cloud, easing coordination. The online transcript automatically links to the correct time stamp in the audio recording; so inaudible, tricky, or interesting passages in the text can be selected and played back with a single click. With better transcripts and fewer students, the QA process was faster and easier.

The coding process is the hallmark of grounded theory, and requires close and careful reading of the transcribed text, and a way to mark or "tag" sections of text with additional information, for example their relationship to another topic. Once texts are embellished in this way, researchers can aggregate and synthesize the tags to interpret and understand the text. While all this can be done manually on paper, or using word-processing software, dedicated software for text analysis streamlines the process, and offers additional benefits of searching and filtering codes, and quantifying frequency, proximity, and so on. The team reviewed many software tools, some open-source, some free, and some fully paid. Many of the open-source tools demanded significant programming and/or lacked a graphic interface. Cloud-based software promised excellent collaboration across researchers and interoperability across platforms however, the limitations of browser-based workflows meant the cloud-based tools required many steps to load and process information. On the other hand, some of the high-end applications offered quantitative analysis features that were not relevant to the proposed work. In the end, ease of use, strong support documentation, and support for both Windows and MacOS led us to select F4analyse software (Dresing and Pehl 2019). To keep consistent tags and links across multiple texts, F4analyse works with a single database file for each project and does not support simultaneous editing of that file. Collaboration across multiple researchers requires external version control, such as scheduling work time. F4analyse does have an effective merge feature, allowing team members to work in parallel on separate documents, and then merge them back together, albeit with enough nail-biting that this remained a less-desirable option.
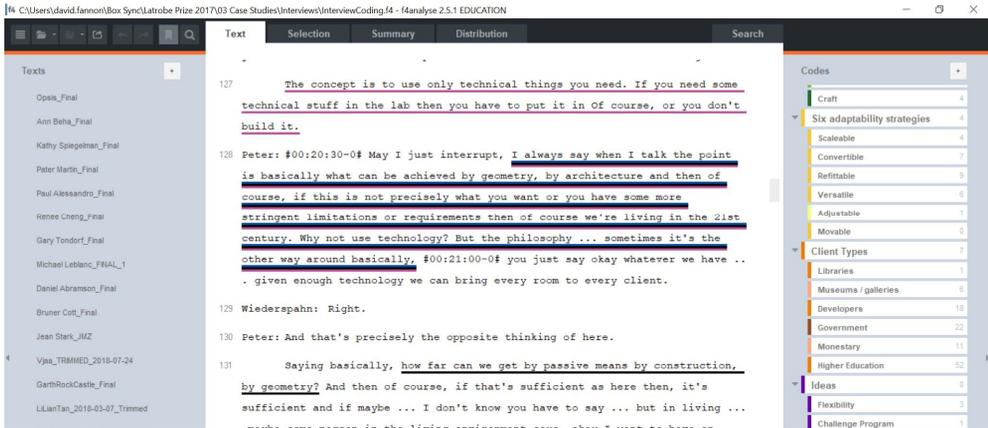
Figure 6: Screenshot of F4analyse software interface. The corpus of texts is on the left, the selected text in the center, and project codes listed on the fight. Note the color-coded underlining tagging the text by code.
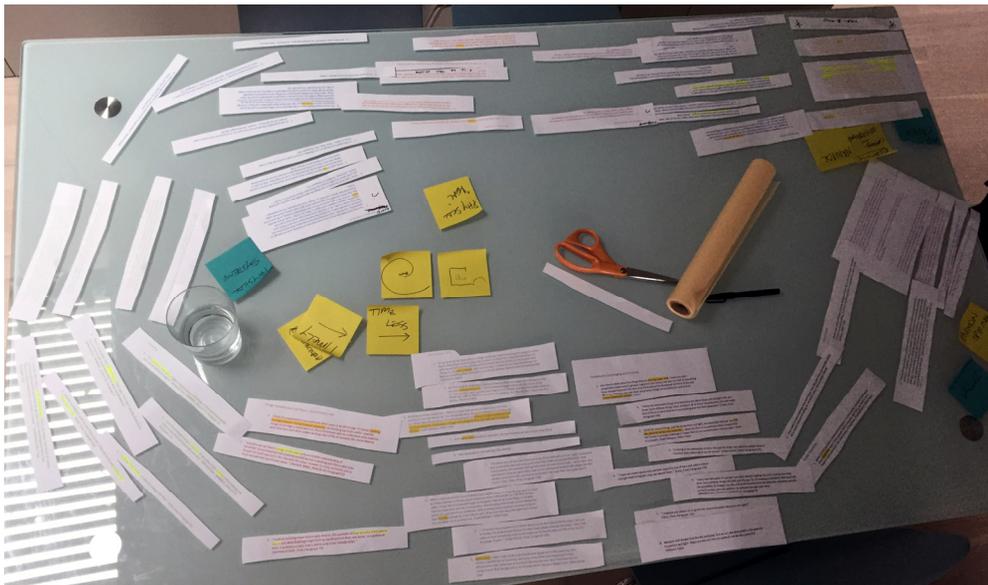

Figure 7: Photograph of the table during a work session, showing code categorization as a manual process.

Coding is time consuming: it requires several hours to code a single-hour interview. The team prepared some codes in advance based on prior literature review, and others were added on the fly. With multiple researchers working, and multiple interviews, codes tended to proliferate alarmingly, occasionally with only slight differences in meaning or based on misunderstanding or simple oversight. As shown in Figure 6, F4analyse underlines text with different colors for each code, and the team tried to group and categorize codes as sub codes of larger ideas using related colors. If coding itself is difficult, the synthesis and consolidation of ideas is even more challenging, particularly with a team of three researchers each approaching the problem with unique perspective and expertise. In the end, our team found it most effective to collaborate by printing key coded ideas to work through them manually and collectively as shown in **Error! Reference source not found.**. Using paper and white boards, with tape and scissors and sticky notes the team could discuss and rearrange our thinking, often arriving at new organizations and insights not possible in the coding environment itself, perhaps because of the limitations of the software. These sessions represent some of the most productive time

for advancing the grounded theory work. As such, the team learned to schedule and safeguard long blocks of time in a comfortable off-site location with few distractions to have a focused and productive session.

2.2 Design drawings

While the interviews capture the human perspective and history, the architectural nature of this study emerges from case-study buildings. The team initially compiled a list of nearly two-hundred buildings from the prior instructional use; selecting a first-pass of about two-dozen buildings to begin; and then expanding to over forty projects as the interviews progressed. Fortunately, grounded theory allows for and structures *iterative* selection of case-studies as the project evolves, relieving the pressure to identify a perfect sample at the inception of the project. As shown in Table 1, each interview solicited other buildings and people to study, continuously expanding the study. Some buildings are well documented and previously published, and in some cases designers or owners shared additional documentation. Other cases required extensive archival work to obtain background information, and then knowledge and judgement to interpret multiple sources and bridge gaps while preparing drawings. For example, some wall assemblies are described in written articles, but available section or detail drawings do not illustrate them. Just as writing uses citations in the text, the team developed a system of tags and labels (on non-plotting layers) in drawings and models to track the source of information. That said, accurately recording the process of interpretation and judgement inherent to producing drawings remains a significant challenge.
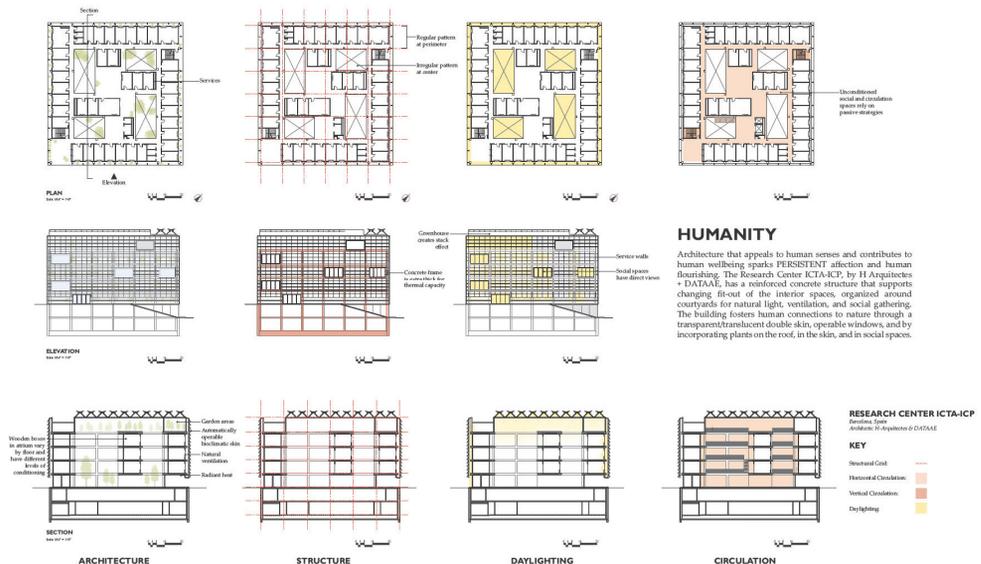

Figure 8: Example of Analytical Diagrams in plan (top) elevation (middle) and section (bottom) analysing the (from left to right) spatial, structural, luminous and circulation patterns of the ICTA-ICP Building in Spain. Note the dimensional information on the structural plan. This image was created as a panel from an exhibit curated by the research team.

The production of drawings began with the idea of basic documentation in plan, section, and elevation. The team established a set of drawing standards and conventions for level of detail, layer naming, and so on based on initial hunches about the questions this graphic dataset might help answer. However, some questions could only be known once the drawings were made, and this uncertainty proved challenging for the PIs to describe, and a difficult drawing assignment for graduate research assistants accustomed to drawing for a more-or-less intended deliverable. A typical building required ten to twenty hours to assemble documents and draw the three base drawings, although that naturally varied with size, complexity and availability of information. Making the consistent body of drawings is only a prerequisite: the

research work lies in analysis. In this project, analytical drawings are the graphic analog to the coding process, and each building was evaluated and "tagged" using a consistent diagramming language to interpret specific building features, like aspect ratio, window to wall ratio, structural pattern and dimension, and the arrangement and size of programmatic and circulation space, among others. Some of these analytical diagrams formed the basis for an exhibit, one panel of which is shown in Figure 8, to illustrate the graphic relationships possible.

Drawing each case study building reveals how it works, however, identifying attributes common to many (or all) long-lasting buildings demands a *comparative* graphic approach. To that end, the team constructed a series of comparative matrixes to sort an arrange buildings based on characteristics, for example sorting plans by latitude, or elevations by window to wall ratio to evaluate climatic correlations. More interesting are use-related patterns, especially between programmed space, circulation space (for both people and services) and unprogrammed space. If the drawings are like interviews, the analytical diagramming added to those base drawings is akin to the coding process. Like the integration of codes, analysis and synthesis of diagrams represents the most intellectually-demanding (and rewarding) aspect of the work. We found it was best to print the drawings at the same scale and lay them out on the floor to arrange, compare, trace and annotate (Fig. 5). Initial sorting by obvious attributes—such as aspect ratio—sometimes revealed unexpected affinities, and prompted more sophisticated organizations, such as relating the distance between vertical circulation and the façade to the shape of the building and its height. Working in this way became clear that certain distances between core and exterior wall seem to support long-term adaptability to multiple uses. Even more interesting: identifying buildings that had a significant change in use, revealed that when buildings did not have those advantageous dimensions but were preserved for other reasons (e.g. cultural or economic value) they were often modified to more closely follow those patterns.
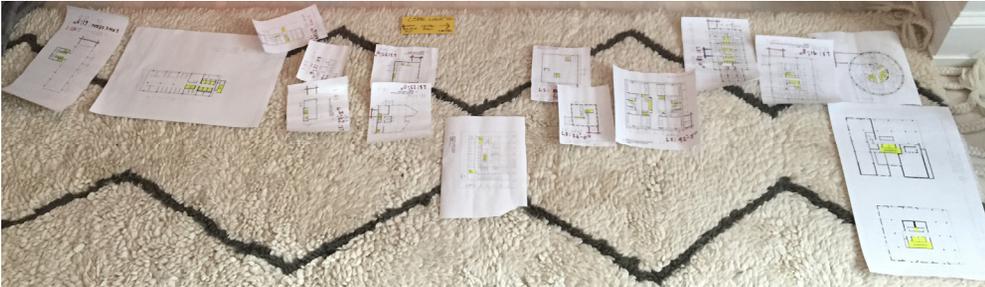
Figure 5: Prints of case studies' plans during a work session, beginning sorting by patterns of circulation.

3.0 RESULTS

An interview on June 26, 2018 with the Austrian firm Baumschlager Eberle illustrates how discussing the case study projects feeds and fosters the development of the theory. The designers of the innovative project *Haus 2226* in Lustenau contextualized the work by describing the project through theory, technique, and experience. In response to the research questions, the architects explained their philosophy for durable and sustainable buildings, refining Stewart Brand's theory of shearing layers (Brand 1995) with specific criteria for the life of the project, saying "the plot of building is 200 years normally, the structure 100, the façade 50". They described the scientific and technical developments in controls and insulating masonry that capture internal gains from people, lights and equipment and allow the building to remain comfortable without mechanical heating. One of the business leaders emphasized the role of architect as both designer and developer on this project, describing their ambition to deploy and test this model as an experiment and international prototype. Similarly, the drawn analysis of that building became a part of the larger set of patterns, its massive walls, square aspect ratio, and centrifugal circulation cores consistent with other case study buildings we studied.

To date, the team conducted over thirty interviews in the United States and Europe, and graphically analyzed over forty projects around the world. The interviews were coded by each of the three principal investigators, leveraging their unique expertise and perspective and giving rise to a dozen primary codes and one hundred and sixteen sub-codes, which continue to evolve with the project. So far, roughly a dozen themes emerged from the relationships and categorization of codes. The themes range from the physical attributes of buildings (the artifacts) to the human dimensions of reuse (the buildings' affect on people and communities), and on to the social and philosophical implications of long-lasting architecture (cultural value). Most important—and gratifying—the themes emerging from the interviews and drawings do not align with, and occasionally even contradict, the team's initial speculations. The fundamental test of a good research method lies in its ability to produce new knowledge, and while conducting interviews and making analytical drawings has the appearance and form of research, the rigorous structure of grounded theory means this project has the *substance* of research, rather than simply reflecting the researchers' preconceived notions.

CONCLUSION

The choice of method for architectural research depends on the nature of the investigation. This paper provides future researchers an example of applying Grounded Theory methods to systematically examine and extract theoretical principles from the knowledge accumulated in practice. We outline collaborative research that provides structure for closely reading multiple media, from multiple perspectives, with multiple expertise. The process of analyzing and the individual coding resembles the creative process of design, including iterative cycles of analysis, interpretation, ideation, and critique. As in creative work, the logistical demands can mask the intellectual activity with a great deal of sometimes-tedious work: tasks like transcribing interviews and preparing base drawings can seem far removed from scholarly inquiry, or the research goals, and the rigors of grounded theory demand a lot of slogging through the weeds. However, the experience of this research team on this project shows it is through—and *only* through—deep and constant engagement with the material that truly new insights and new knowledge are possible.

ACKNOWLEDGEMENTS

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