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Evidence-based design in practice: a thematic analysis

El diseño basado en la evidencia: un análisis temático

| ABSTRACT |
This paper presents an observational study of the activities of an interdisciplinary design team tasked with designing a healthcare facility in a developing country. The intent of the team was to implement «evidence-based design». Tracking the disciplinary interactions of the participants, we investigate emerging issues concerning integration of evidence coming from different sources into the architectural design delivered. The study adopts a data-driven thematic approach in the analysis of the qualitative data collected. We discuss three themes –textures of evidence, operationalizing evidence and tools of integration– that emerge out of our qualitative analysis of evidence-based design practice.

| RESUMEN |
En este artículo se presenta un estudio de observación de las actividades de un equipo de diseño interdisciplinario encargado de diseñar un centro de salud en un país en desarrollo. La intención del equipo fue la implementación de «diseño basado en la evidencia». Se realizó un seguimiento de las interacciones disciplinarias de los participantes, investigando las nuevas cuestiones relativas a la integración de la evidencia proveniente de diferentes fuentes en el diseño arquitectónico. El estudio adopta un enfoque temático basado en el análisis de los datos cualitativos recogidos. Se discuten tres temas –evidencia de textura, evidencias operacionales y herramientas de integración– que surgen de nuestro análisis cualitativo de la práctica del diseño basada en la evidencia.

INTRODUCTION

The term «Evidence-based Design» (EBD hereafter) denotes a recent approach in the field of design. Making use of multiple forms of evidence and integrating recent scientific research findings into design work is of course not completely novel. However, evidence oriented practice is becoming de rigueur in healthcare design circles. The most important constituent of EBD practice suggests a two-way relationship between scientific research and architectural design. While the evidence crosses the boundary of the discipline in which it was produced to act as a driver throughout the design process, the design output creates a fertile ground for testing hypotheses and benchmarking for future scientific research.

Our observational study tracks the activities of an interdisciplinary team tasked with designing a clinic for a non-governmental organization in a developing nation. Besides other important design issues at stake, the implementation of EBD was very much on the agenda of the team. Focusing on introduction, interpretation and integration of evidence throughout the process, our larger research project involved addressing focal areas concerning the actors in the process, the actual sources and the representational forms of evidence, and the mechanisms for integrating evidence into the architectural design delivered. Within the scope of this paper, we will present only a limited set of emerging themes that relate to the focal areas mentioned above.

EBD OVERVIEW

The EBD approach was deliberately «modeled on evidence-based medicine» (Zimring & Bosch, 2008: 147) which was described as «the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients» by Sackett et al. (1996: 71). The main idea behind evidence-based medicine practice is to prioritize clinical research findings (evidence) over intuition and clinical experience, which are associated with the traditional methods in medicine.

The EBD framework emerged in the early 2000s, and has since been propagated significantly

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throughout multiple building typologies (Hamilton & Watkins, 2009; Lippman, 2010). The evidence-oriented framework has quickly become a dominant approach within healthcare design practice, particularly in the U.S. The Center for Health Design, a leading advocate institution of EBD, defined the design approach as «the process of basing decisions about the built environment on credible research to achieve the best possible outcomes» (Malone et al., 2008: 3). The argument is that the improved physical design of healthcare environments, fueled by the evidence coming from the growing body of environment and behavior research, helps to increase safety, quality and satisfaction levels significantly (Ulrich et al., 2008; Zimring & Bosch, 2008).

It is not unusual for designers to move beyond the boundaries of existing guidelines or schemas and scrutinize existing examples and relevant research findings. Occasionally, the extended set of information considered by designers can end up being implemented in ongoing projects. It has been argued recently that EBD differs from the customary use of evidence in design in that EBD drives innovation by ensuring careful analysis, evaluation and implementation of the evidence coming out of relevant research efforts (Chong et al., 2010). However, there is an important implicit question within this approach that reveals itself in practice: How is the evidence derived from multiple sources selected, evaluated and prioritized as design drivers of physical environments?

RESEARCH DESIGN AND METHODS

We had the opportunity to conduct an observational study of a graduate level design studio project that took place at a school of architecture in a leading university in the U.S. The task was to design an actual healthcare facility in a collective manner involving individuals coming from a variety of disciplines. The intention to incorporate the concept of EBD into the design process was very clearly stated in the course description document and disseminated prior to the start.

THE TEAM AND THE TASK

The team consisted of 14 individuals-studio facilitator (P1); 2 graduate students from a health systems department with industrial and systems engineering background (H1, H2); a graduate student from school of architecture with expertise in environmental psychology (E1); 9 architecture students (a mix of grads and undergrads) and a graduate student from industrial design department (D1-D10). The team also had the opportunity to benefit from the expertise of five external consultants/reviewers (R1-R5), when key issues, including specifics of healthcare design and management, environment and behavior related concerns, sustainable design, structural engineering and waste management, were at stake.

The design task was to generate a design proposal for a small rural hospital of a remote region in a developing country. The client was a physician leading a non-governmental organization that currently owns a small clinic on the edge of the rain forest. Specifically, the organization's vision was to build a facility including an inpatient wing (12 beds), an outpatient wing (16 examination rooms), diagnostics and emergency room, administration section, and auxiliary spaces to support the extensive goals of the hospital which are healing, education, conservation of the rain forest and implementing sustainability concepts.

DATA COLLECTION AND ANALYSIS

Our data collection relied on in-vivo observations of individual and collective activities within the group, the drawing set produced over the course of the semester, online group interactions including document transfers, e-mails and memos, and interviews which were audio-recorded, fully transcribed, and analyzed.

The analysis adopted a data-driven thematic approach in the analysis of the qualitative data collected (Boyatzis, 1998; Braun & Clarke, 2006). Generally, thematic analysis is described as the «method for identifying, analyzing and reporting patterns (themes) within data» (Braun & Clarke, 2006: 79). A theme is defined as a pattern «found in the information that at minimum describes and organizes possible observations and at maximum interprets aspects of phenomenon» (Boyatzis, 1998: 4). The first step of analysis involved subjecting the qualitative data to open coding. After an initial set of codes was generated, the next step involved collating the relevant codes into categories with the building blocks of each theme emerging out of the data at hand. Subsequently, the codes and the categories were collated under sub-themes and themes according to what they individually capture. The themes were then reviewed, refined and presented in parallel with the focal areas of the study (Table 1).

Table 1

Elements of the analysis: focal points, themes, and sub-themes

Focal point 1	Focal point 2	Focal point 3
Actors around the process	The evidence base	Integration of evidence
Theme 1:	Theme 2:	Theme 3:
Acknowledging disciplinary casting	The textures of evidence	Patterns of collaboration
Sub-themes:	Sub-themes:	Theme 4:
Casting in estudio	Considering scientific evidence	Operational evidence
Expectations	Making use of precedents	Sub-themes:
	Considering local/cultural evidence	Prioritizing evidence
	Combining evidence	Theme 5:
		Tools of integration

EMERGING THEMES AND SUB-THEMES

Within the scope of this paper, we present three critical themes, out of five (Table 1), that possess the content to provide valuable insights for evidence-oriented design practice and potential venues for further research.

TEXTURES OF EVIDENCE

We use «textures of evidence»[1] to refer to the multiple sources of evidence that were developed as a theme across the entire set of interviews conducted. This section elaborates on the theme by three sub-themes which emerged from post-process interviews, many field notes, and online communications that occurred throughout design process.

Scientific research as evidence

The first sub-theme emerging under textures of evidence is that scientific research was one of the major sources of evidence driving the design process. The overarching concept of EBD, which was deliberately adopted by the studio facilitator, was observed to be influencing and enhancing the ways that the participants interact with scientific research in a number of ways. As it had been anticipated by the studio facilitator (P1), the body of evidence emerging out of scientific research was mostly introduced by internal and external consultants. The presented research findings were gathered from three different sources. First, evidence deriving from academic research papers was brought to the designers' attention. Secondly, the consultants presented evidence that had been digested into institutional guides prepared to aid or regulate the design of healthcare facilities owned by particular organizational bodies, governmental and non-governmental. The evidence was also introduced through checklists, which is an acknowledged way of implementing evidence into actual healthcare design practice. One of the consultants (E1) had put together a checklist by collating different resources. The checklist document introduced a range of potential issues, supporting evidence, and suggested solutions to be considered throughout the process.

Making use of precedents

The evidence base brought to studio also included the precedent healthcare architecture works which were regarded as successful design exemplars in the field. Across the recorded interviews, the sub-theme, making use of precedents, was developed for both the consultants and the designers. The precedent design work was introduced in two ways. First, published exemplars were collectively pulled together by the participants. Since it is typical, especially in studios within schools of architecture, to consider precedent work in early phases of architectural design, the designers were the main ones to bring specific examples to table. Second, some precedents were introduced through lecture-type presentations by external consultants. Both of their presentations provided examples of the most recent evidence-based designed health environments with specific emphasis on improved health outcomes correlated to features of the physical environment. These presentations frequently emerged as one of the sub-themes closely tied with the discussions around what successful evidence-based precedents suggested versus what local culture suggested.

Considering local/cultural evidence

The critical pieces of information which were considered by participants as the main drivers of the design emerged out of local culture in the form of anecdotes. The sub-theme, considering local/cultural evidence, was developed for all participants in post-process interviews. There were two predominant pieces of local/cultural information which were observed to be heavily influential throughout the design process. First, the team was informed about the culture-specific issue of an extended number of family members accompanying or visiting while the patient is in the care process. Considering the potential number of visitors and their activity patterns, which were also conveyed in the form of anecdotes, the team reconsidered the area of public spaces.

The second piece of anecdotal evidence introduced to the group was that people in the host country feel very depressed and abandoned if they are the only person in the room. Multiple sources confirmed the patients within that particular culture feel as they are left to die if they are the only person in the patient room. As reflected in the design, this information was translated into a design strategy of multiple-bed inpatient rooms supported by family areas instead of single-bed rooms which is the industry standard for newly constructed hospitals in the U.S.

The culture-based evidence mentioned above was transmitted and maintained orally within the group. The major source of the anecdotal evidence was the client and the local team around her, who were anticipated to be the end users of the facility. Also, other individuals whom the designers interacted with during a visit to the site corroborated what the local healthcare team had asserted. In a post-process interview, one of the designers (D2) mentioned the anecdotal evidence emerging out of team's interactions on site;

> …the evidence that people actually in [host country] feel like they are on their death bed if they are the only person in the room.

The strong demand pressed by the client who is the physician leading the organization and staff members was that the design, except tuberculosis isolation rooms, should not include single-bed units which is a norm in mainstream EBD approach. In addition to multi-bed units, the anecdotal evidence strongly suggested the need to incorporate extra spaces to accommodate a number of family members accompanying patients in the room. Eventually, the conflict

[1] The name «textures of evidence» is adopted from an in vivo code extracted from D2's post process interview. Strauss and Corbin (1990: 69) define an in vivo code as «words and phrases used by informants themselves, catchy ones that immediately draw your attention to them».

between scientific evidence imposing single-bed bedroom and the anecdotal evidence emerging from local culture suggesting multi-bed units became one of the hot topics debated throughout the design process.

OPERATIONALIZING EVIDENCE

Under the theme operationalizing evidence, we discuss two emerging sub-themes: prioritizing and combining evidence.

Prioritizing evidence

During the design process of inpatient units in which the group was exposed to conflicting evidence, the designers and the consultants were observed to assign different priorities to evidence emerging from different sources. Early in the design, the healthcare systems consultants (H1, H2) pushed to have single-bed units which was strongly supported by research literature. However, the designers' inclination was towards anecdotal (local/cultural) evidence that encouraged adoption of multi-bed inpatient rooms. This conflict developed as a thorny topic within the group since it concerned the weighting of different evidence, potentially prioritizing non-scientific evidence.

The different prioritizations around the issue of single versus multi-bed room seem to arise from different attitudes towards the status of evidence held by designers and consultants. The consultants' approach to evidence was exemplified in the statements of H1;

> All facilities being built here (in the U.S.) are single-patient rooms. For privacy, prevents spread of infection and disease. It's quieter. Patients get better sleep. There's a lot of logical benefits of single patient rooms. Um, so that's something I wanted to see from the beginning. I think [H2] thought the same way.

The implicit assumption within this statement is that the scientific evidence is universal manifestation of facts that will not differ irrespective of other factors within a given environment, whether it is in the U.S. or anywhere else. The consultants' intention was to implement what the scientific evidence specifically suggested; namely providing single-bed patient rooms. The designers were also observed to agree with the validity of the evidence from the research that was conducted in healthcare environments in the U.S. No instance of arguing against the benefits of single-bed units (e.g. reduction of infection rates, fewer interruptions in patient sleep due to noise) was observed on the designers' side. However, that was a difference between consultants and designers in the «applicability of the evidence» within a given case. The designers disagreed with the notion that scientific evidence has to apply at any place at any time, and they consistently maintained the possibility of other confounding factors in a given setting that can potentially be prioritized over relevant scientific evidence. The designers' orientation was towards seeing each design case as situated and unique in itself. As one of the designers (D7) mentioned;

> …what they (consultants) have given us is what is used here, in the States. We cannot go on and implement everything programmed there.

Similarly, a comment by another designer (D2) in a recorded interview, exemplified the designers' attitude towards evidence;

> This is actually what an architect, this is one of the big things that is all about architecture and what architects do, is they gather evidence from a lot of different textures. And then based up… Of their previous experience, um, their expertise, evaluating a specific event in a specific need from a specific quality at that one time. They have to shift through all this evidence, all of times contradicts each other and, they choose which evidence to go with at that time.

According to D2, «architects choose which evidence to go with» which does not necessarily assign higher priority to evidence stemming from scientific literature. Conflicts around the scientific evidence at hand, in particular, whether it applies or not in any given situation, were observed to be a critical process that entailed negotiations and compromises.

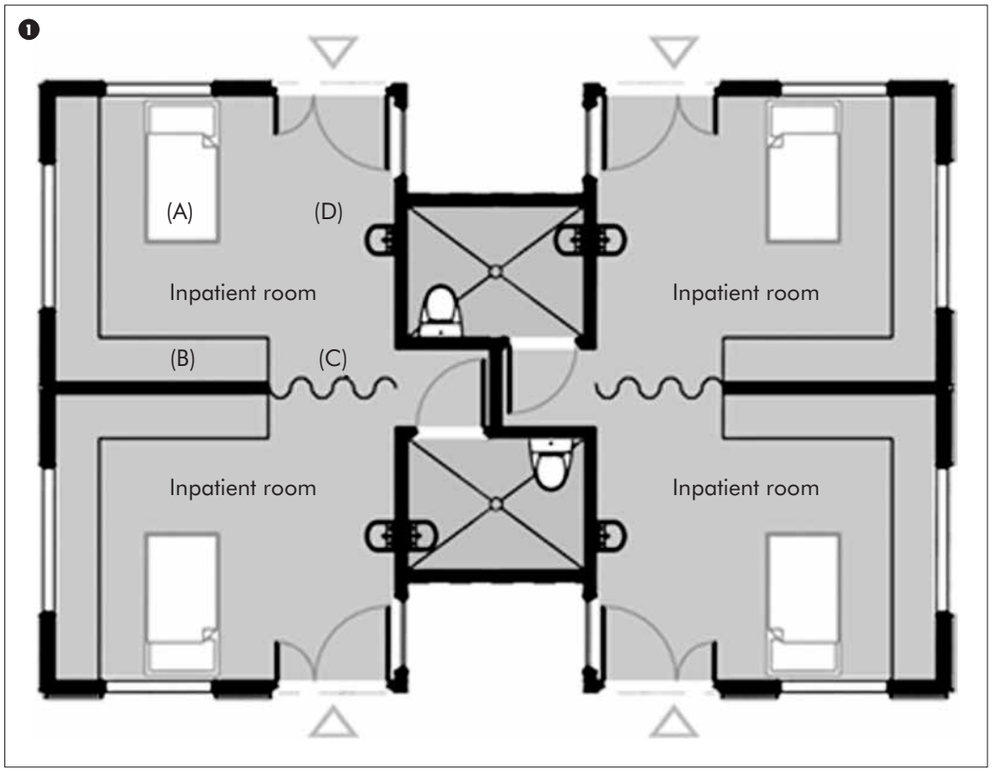
Combining evidence

Early in the process, alongside the discussions of programmatic content, the actual design work started off with multiple areas of focus, one of which was the design for inpatient rooms. An initial design alternative included two-bed units by conjoining two single-bed rooms, which, then, was combined into a four-bed cluster (Figure 1). The team tried to integrate several features suggested by different resources into the design, e.g. (a) multi-bed units, (b) accommodate family, (c) curtains providing privacy, (d) providing sinks promoting hand-washing (Figure 1). D2 described the design as follows;

> …it is a mirror of a single patient room, and, we were… We did that to allow for two-patient room while focusing on these privacy issues and security issues that the healthcare experts were bringing up... So, this was a compromise between the people from healthcare and the architects.

Alternative design proposals for the inpatient units circulated among the team members alongside the discussions of managing the set of evidence emerging out of different resources. Early in the process, the team's major struggle was addressing all issues around the patient rooms. As it is exemplified in Figure 1, the strategy was to integrate the physical features of both single-bed and multi-bed units, which can hardly be reconciled. The initial designs, which were created through mirroring and duplication of single-bed units, were to have the solid wall with a curtained passage between spaces allowing a degree of segregation within the space. Through internal discussions and reviews, the team did not reach agreement on the layout as a satisficing solution. Similar in-between (single and multi-bed) designs, such as the layout illustrated above, remained undecided as the focus shifted to other areas within design.

1. An intermediate step in the design of the inpatient unit pavilion.



The decisive moment in the team members' approach to the design of rooms occurred during the site visit, which took place around mid-point of the design process. The dichotomy of single-versus-multiple beds was observed to dissolve soon after the group «went out there and saw the reality» as mentioned by P1. After the site visit, the option of single-bed units was totally off the agenda. Although skepticism still existed on the consultants' side, even after the final public review in which the group presented double-bed units, «seeing the reality» elevated the anecdotal evidence above that piece of scientific evidence while still allowing other research-based evidence to be incorporated into the design. The trip notes, which were taken daily during the visit by E1, reveal how the team members experienced «the reality» which was conveyed previously in the form of anecdotes;

> Individuality is not a desired commodity here. Relationships, family, and community are all at the heart of [host country] life. Walking around town you feel as though you have entered someone's home, and there is a certain seamlessness and familiarity at the interface between public and private.

Visiting the site, interacting with the client and users of the future hospital, and experiencing local healthcare facilities during the trip dissolved the tension between single versus multi-bed room units. The decision was to adopt two-bed patient rooms as local-cultural evidence suggested, and to integrate certain physical environment features suggested by EBD oriented research literature. In the remaining period after the site visit, the team followed the strategy of combining evidence from different sources. Apart from merely identifying, critiquing, and operationalizing scientific evidence, the group collaborated in a way that integrated multiple kinds of evidence into the design of inpatient units. This happened through sessions of negotiations over the set of features, emerging out of diverse evidence textures, to be implemented in the design.

TOOLS OF INTEGRATION

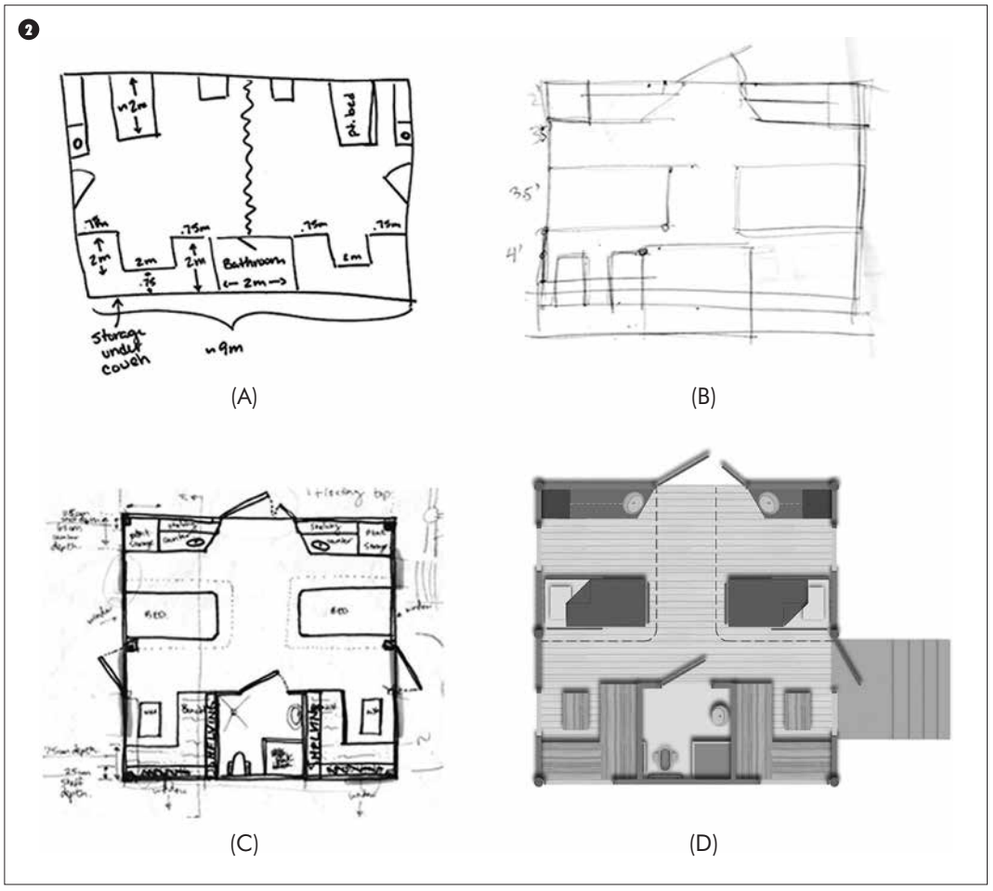
The last theme to discuss in this paper, namely the tools of integration, concerned the synthesis of evidence emerging from various resources. An explicit category, namely plan drawings which was mentioned by all participants, was observed to be the major tool of integrative action. The theme was developed across entire set of post-process interviews.

The utilization of plan drawings during meetings facilitated a more intense exchange of information among team members with different disciplinary backgrounds. As designers became versed in health systems issues, in a similar fashion, the consultants were observed to increase their awareness in what had been envisaged and put on paper by designers. H2 mentioned in a post-process interview;

> We mostly discussed on layouts which I think, first time you see it, you cannot really see anything on it. But once you actually start looking at it, you know, «here is the pharmacy, here is the bathroom», sort of you, kind of, get easier to see… But I think now, working with them I am fine, looking at layouts, we even look at the AutoCAD drawings, just fine.

Following the inpatient unit design episode, the relevant evidence from various resources, such as utilizing multi-bed units, installing sinks in each unit, and accommodating family within each patient room, was fused and integrated into the design through the medium of plan drawings. In the traditional sense, producing drawings is assumed to be the domain of architects, however, within the studio, both consultant and the designer groups were observed to be contributing to the generation of ideas in the form of plan drawings. Figure 2a, drawn by H1, is an instance captured within the process exemplifying how non-designer members of the

2. The piecemeal evolution of the multi-bed inpatient room.



team introduce and communicate ideas through sketching the layout of the specific areas of the future facility.

The team members also utilized plan drawings as predominant tools of integration through one-on-one type (a consultant and a designer) of interactions. One example of that intense cross-disciplinary interaction was the sketches (Figure 2b and 2c) which were collaboratively produced by a designer (D1) and a consultant (E1). In a piecemeal manner, D1 and E1 had developed the features of the physical environment of the room across different representations and over time. The output of this productive interaction provided the basics of the patient room of the final schematic design (Figure 2d). The two participants took the previously agreed design decisions (utilizing multi-bed rooms, accommodating family in the room, providing sinks for care givers, etc…) further by discussing and negotiating the details of the inpatient room design which were initially visualized in the form of sketches, and, eventually, translated into CAD drawings.

DISCUSSION

The design team was exposed to a range of evidence, sometimes conflicting, emerging from various sources; scientific research study findings, successful patterns from precedent design work, and anecdotes communicated by individuals embedded in the local/cultural context in which the future hospital would dwell in. Thus, rather than limited to scientific research, the term «evidence» was used to indicate an extended set of information, including context-based information, which occasionally challenged design decisions throughout the process The limited case we presented points to the need for a comprehensive framework to account for evidence emerging within the architectural design process.

Although the EBD literature acknowledges the fact that the evidence might stem from different methodological paradigms (Quan et al., 2009), there is not much emphasis, if any, on potential evidence-bearing studies addressing the socio-cultural context of the future inhabitants. Evidence-based practice has been criticized for devaluation of the status of non-quantitative research (Cartwright & Efstathiou, 2008) that can account for cultural variations from one institution to another, from one country to another. The current EBD approach does not provide methodological tools for practitioners to deal with the tensions between the array of evidence emerging from different sources, nor does it guide practitioners to evaluate/prioritize/negotiate conflicting evidence to be integrated into a design. Hence, it can be projected that, currently, each EBD oriented team is unique in the way the members shift through the textures of evidence and make a decision what and how to apply evidence at hand.

ACHIEVING INTEGRATION

The term «integration» is the building block of interdisciplinary team work. According to O'Donnell and Derry (2005: 54), «interdisciplinary groups are ones that consciously try to integrate knowledge from the different disciplines included». Being inherently interdisciplinary, the EBD approach requires practitioners to gather, interpret, cross-check, differentiate, weight, and translate emerging evidence to achieve a level of integration. Obviously, the subject of these activities is the evidence which can be regarded as a «boundary object» between various disciplines involved in the design venture. Star and Griesemer (1989: 393) describe boundary objects as abstract or concrete entities having «different

meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation». Star and Griesemer argue that boundary objects (together with standardized methods) can fill the cracks between allies by facilitating a platform of common interest and discourse. This ability is a feature of evidence observed within our study. The collaborators negotiated through evidence emerging out of different textures as it was being embodied in design drawings (layouts). Eventually, the layouts inherited the boundary properties of the evidence discussed within the studio, as the drawings became the subject of cross-disciplinary communication. Beyond facilitating communication, the layouts also provided the venue for fusing the evidence and the expertise of individuals participating in the process.

The interdisciplinary EBD approach requires a certain level of research literacy for designers and of visual literacy in architectural representations for participating consultants without architecture background. Considering the case presented in this paper, the critical skills were partly acquired within the studio through intense interactions between individuals coming from different disciplinary backgrounds. Mutual scaffolding, assuring access to evidence and to drawings, enabled a higher level access to both EBD oriented research literature and architectural drawings through which evidence was combined and integrated.

Since the knowledge base is so vast for both research studies and architectural representations, the post-process interviews with participants revealed that there were still gaps (poor use of terminology on designers' side and difficulty in reading section drawings as expressed by consultants) in the necessary skills to achieve integration. The introductory texts of EBD (Malone et al., 2008; Quan et al., 2009) focus solely on the disciplinary expertise of individuals to be brought into the process. The necessary cross-disciplinary skills (e.g. designers' ability to criticize a research methodology, or subject matter experts' comprehension of technical drawings) of individuals which might hinder or facilitate instances of interdisciplinary integration, is also an unexplored sub-area within literature on EBD practice.

CONCLUSION

EBD has increasingly been drawing attention in the field of healthcare environments design. According to a survey conducted with the top forty healthcare interior design firms with projects in the U.S., thirty-seven of those design firms (92.5%) engage in EBD and thirty of them (75%) engage in Level One EBD (Hamilton, 2003) which requires using peer-reviewed scientific journals as a way to inform design concepts. Given that the industry is widely embracing the EBD approach, there is a need for longitudinal research investigating how and to what extent professionals run EBD or how EBD practice differs from traditional approach to design work.

The limited study presented in this paper raises critical questions around the practice of EBD, which require further research in a variety of settings. The study provided insights on its own, while underscoring the current research efforts to evaluate the outcomes of the EBD approach, occurring through post-occupancy evaluations, should be complemented by longitudinal research on evidence-oriented design processes during which evidence is gathered, evaluated, prioritized and translated into the design work.

REFERENCES

Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Thousand Oaks, CA: Sage Publications.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.

Cartwright, N., & Efstathiou, S. (2008). Evidence-based policy and its ranking schemes: so, where's ethnography? Paper presented at the Association of Anthropologists 'The Pitch of Ethnography'.

Chong, G., Brandt, R. M., & Martin, W. M. (2010). Design informed: driving innovation with evidence-based design. Hoboken, NJ: John Wiley & Sons.

Hamilton, K. (2003). The four levels of evidence-based practice. Healthcare Design, 3(4), 18-26.

Hamilton, K., & Watkins, D. H. (2009). Evidence-based design for multiple building types. Hoboken, N.J.: John Wiley & Sons, Inc.

Malone, E., Harmsen, C., Reno, K., Edelstein, E., Hamilton, D. K., Salvatore, A., et al. (2008). An introduction to evidence based design: exploring healthcare and design (EDAC Study Guide Series, Vol: 1). Concord, CA: The Center for Health Design.

O'Donnell, A. M., & Derry, S. J. (2005). Cognitive processes in interdisciplinary groups: problems and possibilities. In S. J. Derry, C. D. Schunn & M. Gernsbacher (Eds.), Interdisciplinary collaboration: An emerging cognitive science (pp. 51-82). Mahwah, NJ: Lawrence Erlbaum.

Quan, X., Geboy, L., Ginsberg, R., Bosch, S., Joseph, A., & Keller, A. (2009). Building the evidence-base: understanding research in healthcare design (EDAC Study Guide Series, Vol: 2). Concord, CA: The Center for Health Design.

Sackett, D. L., Rosenberg, W., Gray, J. A. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: what it is and what it is not. British Medical Journal, 312, 71-72.

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, `translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. Social Studies of Science, 19(3), 387-420.

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H., Choi, Y., et al. (2008). A review of scientific literature on evidence-based healthcare design. Healthcare Environments Research & Design Journal, 1(3), 61-125.

Zimring, C., & Bosch, S. (2008). Building the evidence base for evidence-based design: editors' introduction. Environment and Behavior, 40(2), 147-150.