Connected Health Care:
Industrial Design and Architecture Connected Solutions

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Introduction

In January 2003, a team of industrial design, architecture and fine arts students from Carleton University and Clemson University were connected across programs of undergraduate and graduate studies, design disciplines, and countries to begin a collaborative process resulting in the design of an improved patient room prototype. It was the beginning of a process and series of studio projects that continues today, and which has now involved over 40 students. Supported by faculty members from both universities, and professionals from the fields of nursing and hospital administration, the student work has garnered awards and has been presented internationally at a range of conferences and exhibits.

The objectives of this paper are to introduce the origins of the collaborative relationship between two universities and disciplines; to outline an overview of the process and experiences of working together; and to present a sample of the design outcomes of the first year of a second project completed together.

Collaboration Origins

The origins of this particular collaboration are rooted in the formation of an international group of educators, architects, and administrators of health care institutions and systems. Global University Programs in Healthcare Architecture (GUPHA) was founded in 2000 by three senior educators who had successful careers in the design and provision of health care facilities: George J. Mann (Texas A&M University, USA), Rosemary Glanville (South Bank University, UK), and Yasushi Nagasawa (University of Tokyo, Japan). They believed that a new range of responses would be required to address the increasingly complex changes that were taking place in the provision of health care environments and particularly hospitals worldwide. They further believed that improvements could be made best though international and multidisciplinary cooperation. Connected to both these founding beliefs was the idea that greater effort should be made to involve students in projects with professionals in order to better prepare them to move into future roles of responsibility.

The GUPHA organization grew quickly and now includes members from over a dozen countries from four continents. It was following the GUPHA3 Forum hosted by Clemson University at facilities in Genoa, Italy, that the project to be presented was formulated by the two authoring professors.

It was recognized that the domain knowledge of industrial design and architecture overlapped in significant ways and that the integration of the two scales of designing for human activity could result in more harmonious overall results. While architects continue to complete successful designs of hospital patient rooms, at times the solutions have been compromised by the later integration of the products of industrial design.

While both professions seek to maximize the experience of the user, the relative scales and proximity of their solutions can conflict. In many scenarios, a person’s experience of hospital architecture may be overshadowed by encounters with machine equipment, examination procedures, and unfamiliar furnishings, and a vast range of intimidating condition specific apparatuses with their attendant wires, tubes, and foreign sounds. Whether the person is comforted, or threatened, by these environments may be a direct result of how well a balance has been established. It is easy then to expect that increased collaboration between architects and industrial designers can contribute significantly to the objective of designing better patient experiences and care environments.

Patient Room Prototype Project (PRPP)

In January 2003, a first test project brought together a team of five graduate architecture and two graduate fine arts students from Clemson University with five undergraduate industrial design and two graduate architecture students from Carleton University. Over the course of one semester the design of a hospital patient room was completed and the relative success of the collaboration was soon apparent. The student work won 1st place in the student category of the 2004 Healthcare Environment Awards Competition sponsored by the US-based *Contract* magazine.

A second Patient Room Prototype Project (PRPP) was then initiated with sponsorship from the Spartanburg Regional Healthcare System (SRHS) of Spartanburg, South Carolina. To be carried out over a three-year period, this collaborative service-learning-research project was to lead to the design and full-scale mock-up of a patient room prototype to be built on the Clemson University campus at the Clinical Learning and Research Center (CLRC) during the first year (academic year 2005-06). The primary goal was to design a universal room platform to accommodate key patient populations and be census adaptable. The room criteria were determined to optimize comfort and control for patients, family and staff by providing a setting that is: functionally efficient and effective; therapeutic and green; supportive of positive patient/family/staff experiences; sufficiently adaptable to accommodate acuity change.

The first year of this second project brought together eight graduate architecture and two graduate fine arts students from Clemson University with three undergraduate industrial design students from Carleton University. The year was completed successfully and is presented in the following sections of this paper. This work again won 1st place in the 2006 Healthcare Environment Awards Competition, this time in the professional conceptual category.

Although not covered in detail in this paper, the second year of the second project (academic year 2006–2007) was dedicated to the evaluation of the mock-up room under simulated use conditions with modifications as necessary for a beta version of the room to be constructed by SRHS on their main campus. In the third year it is anticipated that the concepts and knowledge derived from these studies will eventually lead to the design and construction of a finalized version of the prototype at the SRHS Pelham campus.

Research Travel

During the early phases of the project, visits were made to the health care architectural firms BSA Life Structures in Indiana, and Earl Swenson Associates in Tennessee. Students interacted with and learned from experienced health care design professionals, gaining knowledge of critical design issues. The visit to BSA Life Structures was particularly important as students gathered for the first time to attend interactive presentations that illustrated current health care design issues centering on patient control and comfort, staff and guest experiences, and functional room efficiency.

In order to understand how existing health care environments are cohesively integrated, tours of Indiana health care facilities were given by BSA Life Structures designers. Key aspects of the hospitals and health centers were explained with relationship to the patient rooms and how they fit in with other facility spaces. The health care facilities visited included two hospitals, Clarian West, and Clarian Methodist CCCC, as well as the outpatient cancer treatment Hansen Center. Staff-led discussions and interaction with the environments highlighted critical problem areas for students to focus on in their room development.

Students and supervisors then visited two health care product manufacturers: Hill-Rom located in Indiana, and Wellness LLC located in Tennessee. Presentation of the company design visions and tours of product showrooms allowed students to see the wide range of products developed and possibilities of the future of patient rooms and health care environments. Hill-Rom, for example, has special facilities that designers can use to plan and mock-up full scale sample patient rooms incorporating existing patient room equipment. The facilities allow multiple configurations that provide simultaneous comparisons of different concepts and the teams spent an afternoon experimenting with these facilities.

Figure 1. Presentations at BSA Life Structures.

Figure 2. Mock-up facilities at Hill-Rom.

Virtual Design Reviews and Working Meetings

Working in geographically separate locations required the teams to meet for a number of virtual review checkpoints. These virtual design reviews were scheduled at regular intervals that allowed students and supervisors to bring together all elements of the design and evaluate the development of the patient room as an entire team. Research, design concepts, and results from testing were all shared during these reviews. The collaborative technology used enabled the teams to share ideas through presentations and virtual interaction.

Figure 3. A virtual working meeting.

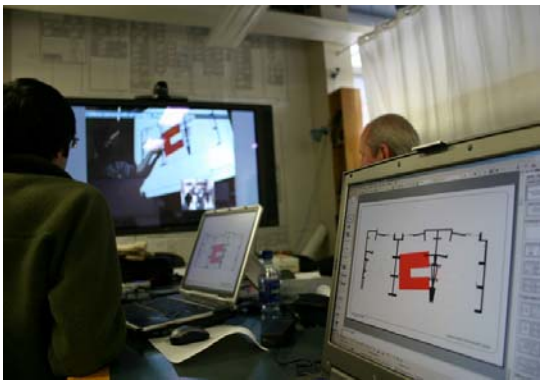

Figure 4. A virtual design review.

During the process everyone continually refined their methods of preparation of information, prior uploading and exchange of files, and how the information was conveyed and presented during the reviews. In addition, between major design reviews, students created opportunities for more specific learning and knowledge transfer through as series of smaller virtual working meetings. Only those members involved in a particular subtopic usually attended these.

Students made use of Clemson's MyCLE (Collaborative Learning Environment) to allow for the transfer of documents, design specifications, and presentation material throughout the course of the project. Having the ability to transfer large files or other digital media enabled students to share working data through a central location rather than person-to-person transfers. The students also created a working flash website as an online information package communicating the collaborative process as well as the design highlights of the patient room project.

Design Charrettes

The design teams traveled three times to meet and conduct multiple day intense design charrettes at strategic points in the process when it was most beneficial to have everyone together in one place.

The first charrette was at Carleton University in early February following the research tours in Indiana. The process began with teams from the same university presenting work previously prepared in anticipation of the charrette. Following the presentations, the entire group first discussed the concepts before breaking into two teams based on interest in the ideas presented to develop possible future directions of the patient room design. This resulted in changing team compositions with members collaborating in different combinations through the various activities of sketching, model making, and early CAD work. The project based teams then made separate presentations and the entire group prioritized the most promising concepts and elements to develop and integrate into the eventual room design.

As teams returned then to their respective institutions the necessity of more virtual meetings was apparent and served to forge strong links between members of the two institutions. Students at both schools then advanced their work prior to meeting for a second charrette a month later at Clemson University in early March. Both teams met for a brief overview session outlining room goals and specifications, with assistance and presentations from experts from the health care architectural firms TRO and HKS. Students then presented project directions and outlined areas that would be further developed. Certain room layout issues had to be resolved, resulting the construction of room mock-ups to determine the locations of key architectural elements.

Figure 5. The Carleton design charrette.

Figure 6. The Clemson construction charrette.

The third and final construction charrette also took place at Clemson University for a full week at the end of April 2006. While the design was developing since the last charrette, preparations to construct the full-scale prototype at the CLRC were made. This charrette was characterized by a variety of dynamic collaborative teams and energetic activities in a range of working locations on and off campus. Around the clock construction by students was required to be ready for the final presentation to the client sponsors and project contributors.

PRPP Final Design

Throughout the course of the project, the design of the overall room was developed on the idea of the successful integration of a variety of room elements. Thus the process was characterized by a continual shifting of scale, a zooming in and out, from elements to overall room and back again until a balance was achieved that met the primary goal and initial criteria. In this way the strengths and expertise of the different students were incorporated with great success. It was also apparent in the end that the final design was informed by the experiences and understanding obtained during the tours of architectural firms, health care facilities, and product manufacturers.

Bathroom: In an effort to make the patient room bathroom a functional yet relaxing environment, the design incorporated a number of user-oriented features:

- Increased patient assistance areas for caregivers

- Automated element controls to increase hygiene
- Use of natural and hygienic materials
- Easily cleanable surfaces
- Introduction of natural light into the bathroom.

Headwall: The room's headwall element was developed as a focal point in the room both in terms of functional and aesthetic criteria. Features include the following:
- Modular side utility panel elements
- Integration with overall room lighting, making it a lighting element
- Recession of cable connections to reduce visual clutter
- Aesthetic recession of cable connectors
- Patient centered lighting control
- Close proximity to bedside staff area

Footwall: A patient centered footwall gives patients and their guests an activity and rest center, providing elements that allow both interaction and increased comfort. Features include the following:
- Integrated Murphy bed for guest overnight stay
- Patient facing seating benches
- Integrated bench storage units for linen storage or guest use
- User controlled LCD panel

Figure 7. The headwall design.

Figure 8. The footwall design.

Staff Work Areas: The staff work areas were specifically located and structured to increase efficiency and the comfort of both patients and their caregivers. Features include the following:
- Organization wall units for staff work equipment
- Non-obtrusive chart display and computer control methods
- Equipment and washable storage at strategic locations
- Cleanable work surfaces located at key hygiene points
- Overhead task lighting

Room Lighting: Room lighting was seen as a critical way to enhance patient, staff, and guest experiences within the patient room. Strategic lighting elements were placed throughout the room. Features include the following:
- Dynamically controlled ambient phase lighting element above patient bed
- Integrated ambient lighting element within headwall
- Recessed pot lights above bench seating along footwall

- Recessed task spotlights at staff work areas

Overbed Table: Critical to the comfort of the patient was an over-bed table that would provide a functional work surface for patients and their guests. Features include the following:
- Swing-out secondary table surface for extra patient use or guest usage
- Modular shelving units, designed for easy cleaning and customization
- Universal storage unit pins for modular elements
- Adjustable patient trash unit with removable and washable bag

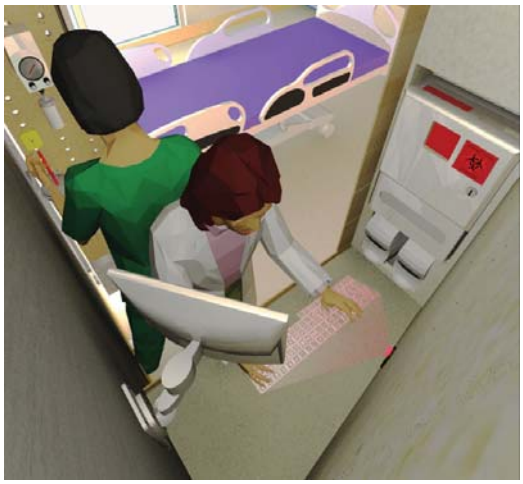

Figure 9. The staff work area.

Figure 10. The room lighting.

Final Design Presentation

The project team made a final design presentation to guests from the sponsoring Spartanburg Regional Health System and other supporting stakeholders on May 1, 2006. The faculty supervisors introduced the project goals and an overview of the project research and early concept studies. The students then presented the room design and how the elements were designed to meet the original goal and criteria. The presentation was followed by a brief question and answer session before a room walk-through and in-situ discussion of use scenarios.

Following the organized walk-through, an extremely valuable period of continued discussion provided an opportunity to exchange ideas on the design at a time when directions for the subsequent work on the room were being determined. In particular, the fluid interactions that students had with faculty supervisors, sponsors and stakeholders were later reported by students to be some of the most meaningful parts of their overall experience.

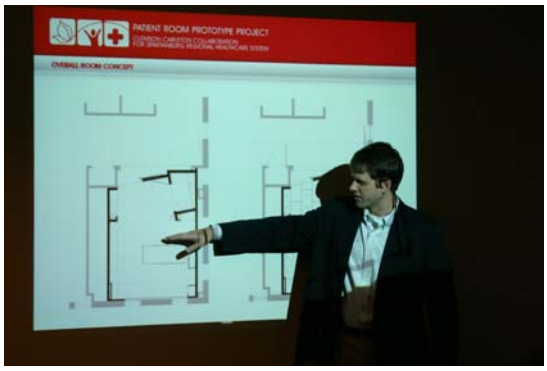

Figure 11. The final design presentation.

Figure 12. The room walk-through of use scenarios

Conclusions

The most obvious conclusions stemming from the experiences of these collaborative projects center on affirming from a number of points of view that they can be successful and produce positive results. From the point of view of multidisciplinary collaboration in design it is clear that results can be achieved by combining working scales, domain knowledge, and educational backgrounds. Further, the unique contributions that individuals from different disciplines bring to the team can work to dissolve some of the differences across levels of study, undergraduate and graduate, that might be more apparent with students only from the same discipline. By extension, this points to the value that organizations like GUPHA represent in promoting networking opportunities across disciplines and countries, and providing a forum for discussion of the merits of multidisciplinary work. Further, one can conclude that widening the network of participants to regions of the world not yet represented in GUPHA can enhance the potential.

More particular to this current project, the process that was followed of combining physical and virtual meetings and conducting focused charrettes as milestones along a path of more individually conducted project work can at least be determined to be a good one in this case. The way in which the process at times dissolved the institutional boundaries when students formed interim teams based on interest in particular room elements or room concepts also fostered good results despite the additional effort required to work virtually across distance. The success that the work has had in competitions is also an important indicator.

In the end, it seems important to recognize how each student was able to benefit from the experience, particularly from the interactions with expert professionals, of working in ways that closely emulate the kind of situations they will be expected to perform in once they’ve completed their studies.

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The following students have participated in the projects described.

2003	Carleton University	Sadia Akhter Isabel Estan Alexandra McDonald Matthew Menard Nasim Sarir Chantal Trudel Alvin Yung
	Clemson University	Katie Brock Ellen Cathey Cullen Keen Ruka Kosuge Chad Plunkett Scott Radcliff Lora Schwartz
2005–2006	Carleton University	Gianluca Camarda Sunmee Kim Arjun Mehta
	Clemson University	Allen Buie Brenna Costello Damien Linnen Akiko Matsumoto Marie McFaddin Anindita Mukherjee Eileen Powell Dave Ruthven Scott Weinhoff Cody Weston
2006–2007	Carleton University	Phillip Benson Albert Kwon Hamid Mohammadi
	Clemson University	Josh Boltinhouse Scott Weinhoff