Engineering/Industrial Design Collaboration in Capstone Design Projects

Jay R. Goldberg[1], Pascal Malassigne[2] and Mary Beth Privitera[3]
[1]*Marquette University*
[2]*Milwaukee Institute of Art and Design*
[3]*University of Cincinnati*

Engineers and industrial designers place heavy emphasis on identification of customer needs, manufacturing methods, and prototyping. Industrial designers focus on aesthetics, ease of use, and the user's experience. Engineers tend to focus on functionality, analytical modeling, and design validation. Collaboration between the two groups on capstone design courses teaches each to respect and value the unique contributions each brings to the project team and results in improved design solutions. Experiences with engineering/industrial design collaborations in capstone design project teams at Marquette University, the Milwaukee Institute of Art and Design, and University of Cincinnati are presented.

Corresponding Author: Jay Goldberg, jay.goldberg@mu.edu

When engineering students enter the workforce, they will be expected to work on multidisciplinary teams. In industry, these teams typically consist of members of research and development, marketing, production, finance, regulatory affairs, and other departments. Depending upon the type of products being developed, customer needs, and specific design requirements, industrial designers may be assigned to the project team to work with engineers on the design of the new product. Industrial designers are uniquely qualified to assist with specific aspects of product design. However, many engineering students and faculty members are not aware of what industrial designers actually do and the role that they can play in new product development. To prepare engineering and industrial design students for potential future collaborations, it would be helpful for them to understand and appreciate the contributions each can make to the project team. This can be accomplished through the senior capstone design course by forming project teams that include engineering and industrial design students.

To appreciate the role of industrial designers in the design process, it is helpful to understand the three main aspects of product design.[1] First, the technical aspects involve the assembly of parts and systems that allow the device to meet the technical requirements. Second, the human factors aspects deal with how well the user interface enables the user to interact with the device, encourages correct performance, and discourages and prevents incorrect performance. Third, aesthetic form can communicate how to use a device to achieve the intended result, and can make a product easy to use. Although the appearance of a device has little effect on its user interface, it can have a strong psychological influence on the end user. All three aspects of design help create value and enhance the overall perception of quality. A well designed product satisfies all customer needs, meets all required specifications, incorporates basic human factors principles, and is sensitive to aesthetics and market perception.[1]

Engineers and industrial designers tend to emphasize different aspects of design. Engineering students (and practicing engineers) tend to focus on the technical aspects of design such as functionality and performance specifications. For example, engineers developing implantable medical devices are concerned with issues such as corrosion, wear, degradation, strength, and fatigue life. They perform calculations, use a variety of analytical tools (such as finite element analysis), and conduct bench tests to ensure that products are made from materials with the appropriate design characteristics (strength, biocompatibility, biodurability, etc.) and will safely perform as required. Industrial designers focus on usability, safety, quality, and the aesthetics of products. They are concerned with

issues such as the psychological impact of a product's design on the user or potential customer, usability (ease of use, low potential for error), safety (no sharp edges or other potential hazards), quality of the overall product experience, and perceived value of the product. Engineers are also concerned with these issues, but engineering curricula typically do not spend as much time on aesthetics and usability as do industrial design curricula. Both disciplines place heavy emphasis on identification of customer needs, manufacturing methods, and prototyping.

To encourage collaboration between industrial design and engineering students, industrial design students from the Milwaukee Institute of Art and Design (MIAD) and engineering students from Marquette University were encouraged to work together on capstone design projects. Three groups of three MIAD students were assigned to three Marquette projects. The MIAD students functioned as design consultants to the project team and used their model shop to produce prototypes. This collaboration produced professional quality, aesthetically pleasing, functional prototypes. When surveyed about this collaboration, the MIAD and Marquette students said that they had learned about the other's discipline and the role each played on the project team. They developed an appreciation for the other's contributions to the team and felt better prepared to work with each other on product development teams in industry.

At the University of Cincinnati, business, industrial design, and biomedical engineering students are teamed with a physician to study a particular medical device, learn how it is used, and determine how it could be improved. Each student brings his/her unique skills and knowledge to the project team. The business students identify stakeholders and determine regulatory status, the industrial design students conduct task analyses, and the engineering students analyze the device and determine how it functions. This experience provides students with the opportunity to work on multifunctional teams and develop "cross-language skills" needed for careers in new product development. Engineering students complete this course prior to enrolling in the required senior capstone design course. The business and industrial design students are invited to continue their multifunctional team experience via participation in senior capstone design projects. Faculty involved in these collaborative design project experiences at the University of Cincinnati have made some interesting observations concerning transdisciplinary learning among students in different disciplines:[2]

- Engineering students were familiar with the legal and regulatory requirements for detailed record keeping of project activities and decisions. However, industrial design students were unfamiliar with this practice. This presented a challenge as they were encouraged to record and document their activities.
- Engineers are perceived as thinking in a more linear and causally linked form as opposed to the more lateral or free thinking style of industrial designers. An appreciation for the merits of both styles of thinking was necessary for all team members to feel that they were successful contributors.
- The recognition of the value that each discipline brings to the project team was an essential component of effective transdisciplinary learning. During technical design review meetings where design progress was presented to faculty, engineering students learn to value the industrial design student's ability to communicate complex procedural diagrams coupled with new device concept drawings and the industrial design students learned to value the engineering student's ability to conduct, analyze, and present test data to prove the technical and clinical advantages of different designs. Students developed an appreciation of each other's complementary functional strengths.

In summary, collaboration between engineering and industrial design students on senior design project teams provides many benefits. First, students learn how to communicate with people in other functional disciplines. Second, students learn that no individual person has all the skills and knowledge needed to complete a project, and they develop an appreciation for the complementary skills each member brings to the project. Third, students learn that there is more than one way to solve a problem. This helps them develop an appreciation for different approaches to problem solving and ways of thinking. Finally, the overall quality of product design increases when engineering and industrial design students work together.

References:

1. Hyman, W. A., and Privitera, M. B. "Looking Good Matters for Devices, Too", *Medical Device and Diagnostic Industry*, May 2005.

2. Privitera, M. B., and Zirger, B. J. "Letting the Grain Out of the Silo: Transdisciplinary Product Development Education", *Innovation*, Quarterly Publication of the Industrial Designers Society of America, Winter 2006, pgs 49-51.