A Design Science Approach for Automotive Design: Implications for Engineering Design Education

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Research Motivation

Engineers are generally trained on the use of analytical methods for quantifying functional product attributes they desire to design. However, it is well known that consumers often make decisions about the products they purchase based on subjective or perception based attributes of a product. We demonstrate the use of a design science approach based on methods primarily from psychology and engineering for quantifying subjective attributes that can inform engineering design decisions.

What is Design Science?

Design Science studies the creation of artifacts and their embedding in our physical, psychological, economic, and social environment. Traditional science studies the world as we found it; design science studies the world as we make it.

Limitations of Using One Discipline

It is well known that the problems engineers of tomorrow will have to solve are increasingly interdisciplinary in nature. Approaching design problems from the perspective of one discipline limits the richness of their solutions. Table 1 shows 3 disciplines of interest to this research along with the benefits and limitations of each one on their own.

<table>
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<tr>
<th>The Psychology Discipline:</th>
<th>The Engineering Discipline:</th>
<th>The Field of Industrial Design:</th>
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<tr>
<td>Benefits</td>
<td>Limitations</td>
<td>Benefits</td>
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<tr>
<td>- Has methods and tools for predicting and understanding human behavior</td>
<td>- Has few techniques that can directly incorporate analysis for the direct evaluation of physical products and artifacts.</td>
<td>- Embedded scientific method.</td>
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<td>- Uses quantitative models.</td>
<td>- Uses the scientific method.</td>
<td>- Provides insight into the aspects of design.</td>
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<td>Important to the &quot;making&quot; needs of the consumer.</td>
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<tr>
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<td>Uses the scientific method.</td>
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<td>Table 1: The benefits and limitations of knowledge from engineering, psychology, and industrial design as applied to design problems</td>
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General Approach

The general approach is shown in Figure 1 below and consists of key steps from: Stimuli creation, data collection and analysis to engineering optimization methods (Reid et al., 2009).

Automotive Case Study

The general approach was used to quantify preference for positive "green" styling cues in an experimental survey format.

Summary

The case study briefly demonstrates a tool developed from methods of psychology and engineering to provide designers with insight to aid engineering decision making. In this case, we assess people’s perceptions about the “green” styling features of vehicle silhouettes that can be used at the conceptual stage of product design.

Implications on Design Education

The design issues of the present and future increasingly require engineering students to understand quantitative methods outside of their discipline. The case study above is based on doctoral research however, there is opportunity for undergraduates to learn such methods. The Analytical Product Design course (ME 455/DESCI 501), offered in the Fall is an exemplar to design science (Frischknecht et al., 2009) and provides engineering, business, industrial design, and information science students with an interdisciplinary design experience.

About the Authors

Tahira Reid is a PhD Candidate in the Design Science Program. She is co-advised by Richard Gonzalez in the Psychology Department and Panos Papalambros in the Mechanical Engineering Department. For more information about the Design Science program, please visit our website at http://designscience.umich.edu.

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References