

Abstract

The basic premise of this dissertation was that a link existed between the question-asking behavior of engineers and design performance in industry. The work explores several aspects of the question-asking behavior of designers and demonstrates four experimental design strategies to cope with the complex nature of the research. First, experiments were conducted in the context of a less complex environment, that of a design class, ME210. This is a graduate-level project-based class at Stanford University where the curriculum, resources, and duration result in design behavior and products similar to those observed in industry. Second, experiments were problem focused, the initial focus being development time reduction. Third, multiple solutions were generated, and fourth, problems and solutions were elaborated in a parallel fashion.

Early experimental results showed that automated "question" analysis is very problematic but that noun phrases are workable surrogates of questions. The work was revised to test the association between noun phrases in design documents and the project grade in ME210. Thirty reports (averaging forty pages a piece) representing ten projects in the class were analyzed with the aid of a parts-of-speech tagger. The key observations from this analysis were: 1) reports assigned the letter grade B or B+ had lower numbers of distinct noun phrases than those assigned the letter grade A or A+ ($\gamma=0.7$); 2) it was not possible to make this level of differentiation based on the number of words in the documents ($\gamma=0.5$), or the readability of the documents ($\gamma=0.3$).

The results show that the incidence of noun phrases is strongly associated with design team performance. This is significant because it demonstrates the possibility that an objective design document metric can predict design process performance. It raises several issues such as the significance of verb phrases, and the possibility that quasi-real time noun phrase assessment may someday provide design teams and design managers with something akin to a design "speedometer". In conclusion, a number of alternative lines of future research are described.