PREFERENCE COORDINATION
IN ENGINEERING DESIGN DECISION-MAKING

by

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ABSTRACT

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Whether interested in profit or in social welfare, designers are concerned with the preferences people have and the choices they make. Tools such as Quality Function Deployment have been developed to help designers organize thinking about the relationship between design decisions and stakeholder preferences; however, work incorporating explicit quantitative models of stakeholder preferences into engineering design decision making is still sparse.

Preference coordination draws on theory and methods from the marketing, economics, and psychology literatures to model preference structures and to coordinate them effectively with design models of engineering feasibility and performance for achieving jointly optimal solutions with both technical and market feasibility. This process resolves tradeoffs among competing technical objectives while ensuring that product targets based on market preferences are physically realizable.

Specifically, theory is reviewed and developed for analytical target cascading (ATC), a methodology for decomposing a system into a hierarchy of subsystems and coordinating optimization of each subsystem so as to achieve the joint solution. The ATC methodology is then applied to coordinate marketing and engineering design decision models in a profit-seeking firm. It is demonstrated with a case study that the joint solution obtained through coordination is superior to the solution obtained by treating each discipline independently. The modularity of the framework facilitates extensions, and two

such extensions are pursued: First, the methodology is extended for product line design by coordinating preference models that capture heterogeneity with a set of engineering design models. Second, manufacturing decisions are incorporated by adding a module to coordinate machine investment and allocation decisions. Finally, the scope of preferences is expanded to explore social preferences as expressed through regulation: Game theory is used to predict the design decisions made by profit-seeking producers in a competitive marketplace, and the effects of different regulation scenarios on the resulting decisions are examined.

It is the hope that the methods developed in this dissertation for modeling stakeholder preferences and coordinating with engineering design decision-making will help design engineers and managers to understand the relationship between their decisions and the interests upon which they have impact so that better, more informed decision-making can be realized.