

Network-based Customer Preference Modeling

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Engineering systems that involve multi-stakeholder decision-making can be viewed as complex design ecosystems. While there are different techniques for modeling customer preferences, there is a need for modeling customer preferences in engineering systems design to understand the interactions among multiple stakeholders (customers and designers). We present an approach of modeling heterogeneous customer preferences and decision-making behaviors based on social network science by viewing customer-product relationships (customers consider and purchase products) as networks. In this presentation, two case studies on modeling customer preferences in vehicle systems design highlight the steps of network-based customer preference modeling and demonstrate its advantages in visualizing and modeling the complex interdependencies among different entities in a design ecosystem. We first demonstrate the use of a weighted unidimensional network to model car competition relations, identify the key design features, and predict the market changes with exponential random graph models (ERGMs). We then model customers' consideration-then-choice behavior as a bipartite network which consists of nodes of customers and cars, and investigate factors that influence different stages of customers' decision-making using bipartite ERGM and Graph Neural Networks (GNNs). These examples provide insights into various factors considered by customers when purchasing cars and allow us to understand the design ecosystem from a network perspective.