

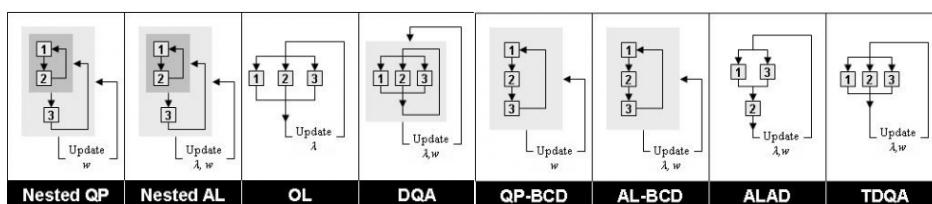
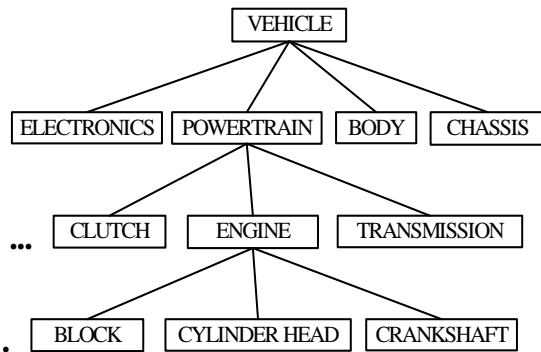
# Carnegie Mellon DESIGN DECISIONS LABORATORY

The Design Decisions Laboratory develops theories and tools to understand and assist decision-making in design and product development. The group is interested in the preferences and economics that drive design tradeoff decisions as well as the impact of those decisions on public and private stakeholders. Drawing upon research in economics, marketing, psychology, and public policy as well as engineering and design optimization, the lab pursues three primary thrust areas:

1. **Systems Optimization:** Develop fundamental knowledge and new methods for multidisciplinary design and complex systems optimization;
2. **Design for Market Systems:** Measure and predict consumer choice and firm behavior in the marketplace to optimize engineering systems for profitability; and
3. **Green Design & Environmental Policy:** Study the effects of economics and public policy on design decisions and the resulting environmental impact of those decisions.

## Systems Optimization:

The design and optimization of complex systems pose unique challenges: Subsystems and components must be designed such that they are compatible and consistent with one another while delivering properties that, in combination, achieve targets for the overall system. The Design Decisions Laboratory develops mathematical and computational tools for decomposing complex design tasks into smaller subsystem design tasks and coordinating design of these subsystems to achieve optimal system solutions. Research includes theoretical and empirical analysis of existing methods as well as development of new methods to improve performance, enable parallelization, and expand the class of problems that can be solved. Such algorithms have been applied to structural optimization, product family optimization, layout optimization, and multidisciplinary design optimization for product development.



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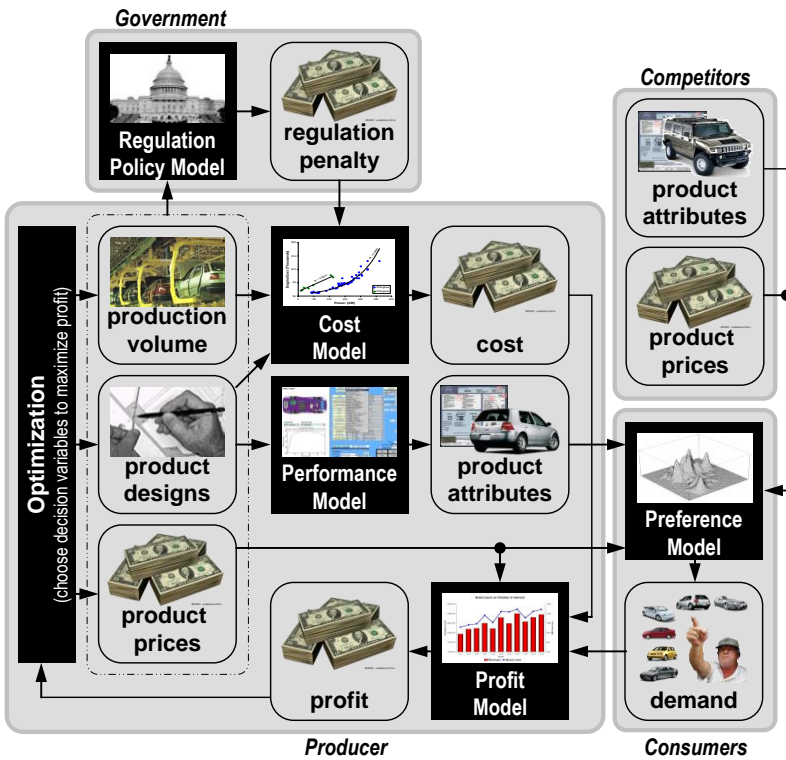
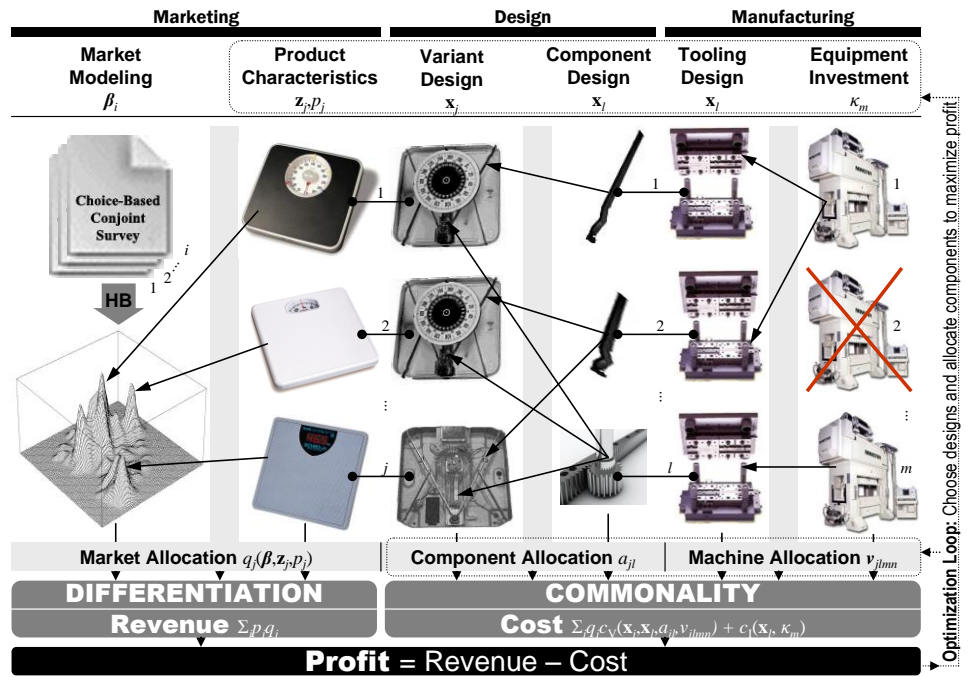
In 2006, the lab established the Design Decisions Wiki, intended for researchers, educators, students and practitioners to serve as a central resource and community portal for sharing information about design and tools to analyze and support decision-making. Visitors are encouraged to contribute to adding and editing content, especially to share information about their research group and research topics about which they have expertise. As of 2009, DDWiki had over 450 articles, 500,000 page views and 300 registered users and has been used actively in graduate and undergraduate courses as well as by researchers at other universities.

<http://ddl.me.cmu.edu>

DDWiki is intended to serve as a central information resource similar to Wikipedia; however, because DDWiki has a specific focus, entries can be made with content specific to the needs and interests of our community. For example, information on relevant theories, methods, people, research groups, organizations, conferences, journals, publications, textbooks, courses, job postings, news and events, new research results, data, algorithms and community debates are included.

## Design for Market Systems:

Technical tradeoffs are difficult to resolve without knowledge of preferences. Whether interested in profit or in social welfare, designers are concerned with the preferences people have and the choices they make. DDL works to measure preferences in the marketplace by observing past consumer purchasing patterns or conducting controlled experiments with choice-based conjoint survey designs. Econometric analysis and estimation are used to extract the relative importance of product attributes to consumers and predict choice behavior. These models are integrated with cost, revenue, pricing, and manufacturing models, to guide enterprise-wide design optimization using firm objectives (such as profitability). For example, a particular challenge is how best to design a family of products when consumer preferences are heterogeneous: Product families must balance differentiation in the marketplace (to attract a range of market segments) against commonality at the engineering level (to save costs through economies of scale). Quantification of both aspects can support design.



## Green Design & Environmental Policy:

Environmental regulations attempt to correct for market failures by altering incentive structures or restricting the space of options available to designers. Such regulations have direct impact on the decisions made by designers, and the success of any such policy depends upon the product designs that result under regulated market conditions. DDL builds models to understand and predict the effects of policy on the incentives that drive design decisions and the resulting impact on producers, users, society and the environment.

For example, a particular challenge is to understand how legislation passed by Congress to reduce greenhouse gasses and dependency on foreign oil in the transportation sector will affect the types of vehicles produced by manufacturers. A switch to hybrid or alternative fuels is one important effect, but the size, weight and performance of these vehicles, as well as the infrastructure to acquire, produce and distribute their fuels, will ultimately affect market success

as well as environmental implications. DDL simulates, analyzes and optimizes conventional and alternative vehicle designs to assess life cycle economic and environmental implications.

For more information, visit the lab website:

[www.cmu.edu/me/ddl](http://www.cmu.edu/me/ddl)