

International Conference on Applied Research in Business, Management and Economics

14 - 16 November 2025

London , United Kingdom

A Dsm-based Approach for Modularizing Collaborative Design Tasks of Complex Products

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Abstract

In response to the challenges of quantifying inter-task relationships in collaborative design of complex products, this study addresses the modularization of design tasks to enhance efficiency and reduce development costs. A Design Structure Matrix (DSM)-based model is constructed to quantify task correlations across functional, physical, geometric, and feature dimensions. By integrating an analytic hierarchy process for weight assignment, a numerical DSM is established to represent task interdependencies. A genetic algorithm is then applied to perform clustering analysis, optimizing the module partitioning of design tasks. The proposed method is validated through a case study involving the collaborative design of an automobile model. Results demonstrate that the proposed approach effectively identifies module structures with strong intra-module cohesion and minimal inter-module coupling. The derived modular scheme not only simplifies design complexity but also significantly reduces iterative interactions across teams, thereby shortening development cycles and lowering coordination costs. This research provides a systematic and computationally efficient approach to task modularization in complex product development, offering both theoretical insights and practical utility.

Keywords: Complex Product; Design Task; Module Partitioning; Design Structure Matrix (DSM); Genetic Algorithm