

## **ABSTRACT**

### **ENHANCING ROBUST DESIGN WITH AID OF TRIZ AND AXIOMATIC DESIGN**

by

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Design environments that facilitate and support the upfront robustness thinking and robust design must shift the paradigm from reactive problem solving to enhancing the robustness of basic function of product design. Notably, there is significant motivation for research that focuses on improving design robustness from the earliest design stages. One of the most important tasks in robust design is to select an appropriate system output response in study. The quality of this selection will greatly affect the effectiveness of the robust design project. Currently, this selection process is more like art than science. By using TRIZ and Axiomatic Design principle, several new approaches to enhance robust design are developed. These approaches enable us to select the appropriate system output response in a systematic fashion and bridge the gap between conceptual design and parameter design.

This research proposes a methodology based on the blending of TRIZ and Axiomatic Design approaches. Toward this end, a framework for integrated identification of system output response is presented. Two mechanisms are central to the framework definition, including: 1. Design response structural model using substance-field model supporting proper identification of system output response especially energy-related system output response identification, design optimization and capturing system functional behaviors. A four-rule based on substance-field model and mode of action is developed to provide a scientific way of identifying a proper system output response. 2. Design response structural modeling environment through Axiomatic Design supporting concept model analysis, functional breakdown, knowledge capture, capturing design intent, requirements, dependency relationships and feedback for conceptual design improvements, evaluation and encouraging and facilitating the upfront robustness thinking in terms of ideal relationship between system input and system output and preparing for parameter design.

The approach described in this research was successfully applied and verified in numerous case studies at some large automotive companies. Several examples and a case study are provided and demonstrate the methodology for technologically sophisticated system output responses identification and how the gap between conceptual design and parameter design can be bridged and reduced.