# Abstract

Engineer-to-Order (ETO) is a special product development strategy, where openly defined solution spaces and generally defined concepts and principles govern design and production. This kind of business typically organizes itself around customer order specifics, where one-of-a-kind products are developed in customer-targeted development projects. Developing complex engineering systems in this manner is characterized by high engineering effort, long lead times, low production volumes, and complex process and product structures.

Variety is important to the market, but internal variation can clutter the portfolio with one-off information and solutions. The repetition of projects and the organization around projects offers great potential for reuse of product variants. However, lack of strategic planning to reuse can inhibit this. The industry looks to Mass Customization strategies for systematic reuse, but experience reveals that most of these tools are too rigid and would force the business to sacrifice much-needed adaptability and˛ exibility. One way of achieving strategic reuse is by creating and using properly defined and aligned process and product platforms. The platforms are governed by strict architectures, which determine the fundamental structures of processes and products as well as their interplays. Another important tool for complex engineering involves a coherent use of systems nomenclature and decomposition of tasks, responsibilities, processes, and sub-solutions. Systems supply common organizational structure and understanding.

To support the ETO industry in shaping their platforms toward strategic reuse, this research project undertakes an industrial case study via an exploratory abductive reasoning approach. The aim is to create a reference of platform design efforts for ETO businesses faced with similar challenges. The project constructs experience-and fact-based models of processes, products, and data of the business organization to enable investigation of variation. It uncovers financial and managerial problems stemming from variation and lack of strategic reuse. These problems initiate a series of focused analyses targeted at specific process and product definitions to reveal the underlying causes of variation and reuse inability. To address the revealed sources and causes for variation, solution proposals are presented as a set of levers for variation management.

The research concludes that the fundamental design of the business, namely the business platform, must be systematically designed with reuse in mind. When a business is designed to accept and, indeed, encourage unmanaged process and product customization, comparisons between entities and solutions become increasingly difficult. Such a design will hinder reuse for the next project, resulting in even more unique solutions. Thus, organizational definitions and nomenclature must be established to allow comparison. Following this, efforts should be undertaken to target high-level design reuse and detailed design reproduction. Suggestions to this include front-end project screening tools and component detail configuration systems. Moreover, the results show that the separation of customer-specific solutions from customer-independent solutions must be strictly practiced. To achieve this objective, introduction of a portfolio management unit responsible for gathering portfolio information, understanding portfolio variety, and comparing solutions to guide development is recommended.