

# Preface

The commercial success of companies is closely related to their capability to develop innovative products. With regard to global markets and competition, product development needs to take a step forward in order to not just fulfill a set of product or customer requirements but to create products which are optimized with regard to their whole product life cycle. This task is becoming more and more demanding not only due to the fact that the complexity of products is growing but also due to the progress in technological know-how of the manufacturing processes that are involved. Regarding products for structural lightweight applications for instance, there is a variety of manufacturing processes available. Each of these processes has its individual potentials and restrictions, some of them being invariant whereas others keep changing in the course of research and development in manufacturing technology. Furthermore, most manufacturing processes for lightweight structures also affect the material properties, which might have a significant impact not only on the product performance but also on processes at later stages of the manufacturing chain, leading either to restrictions or to new potentials.

Keeping an overview of all these aspects and interactions in all their complexity requires expert level knowledge in a variety of fields, thus making product development a challenge with highly interdisciplinary character. To meet this challenge, a methodology and corresponding development tools are needed to help processing the continuously growing amount of technological knowledge. This becomes even more important when considering that new manufacturing technologies, which might unlock a new level of product performance, can also act as a trigger for product innovation.

A prime example for the complex interaction between manufacturing process innovation and product development is the technologies that were developed within a collaborative research center (CRC) on integral sheet metal design, which was established at Technische Universität Darmstadt in 2005. The aim of the CRC666 “Integral Sheet Metal Design with Higher Order Bifurcations” was not only the development of manufacturing processes for sheet metal products but also the beneficial use of process innovation for optimized products.

This book is based on the research activities within the CRC666 and aims at providing an integrated view on product and process development. While putting an emphasis on sheet metal products, the new design paradigm in which this book concludes is not limited to a specific product range but can be applied to a wide range of applications. The first two chapters of this book have an introductory character. They focus on the role of production technologies in current product development approaches and provide a motivation for a new approach that exploits the potentials provided by technological innovation to realize optimized solutions. In the third chapter, manufacturing technologies and process chains for branched sheet metal products are introduced which exhibit a high innovation potential and provide the technological basis for the new product development approach throughout the following chapters. The fourth chapter discusses the impact of manufacturing technologies on local material properties and their beneficial use to improve product performance. The aspect of optimization within the new development approach is addressed in the fifth chapter, from fundamental requirements and challenges for the formulation of optimization problems to application examples for the optimization of production sequences and process controls. The sixth chapter focuses on virtual product development methods and tools such as the information model, CAD modeling, and the numerical simulation of manufacturing processes and product properties. In the seventh and eighth chapter, two different scenarios for product innovation are discussed, being technological advances driven by marked demands and new product ideas that arise from manufacturing process innovation. Finally, the ninth chapter presents the new *Integrated Algorithm-Based Product and Process Development Approach* and illustrates its application and benefits based on case studies.

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