Chapter 1
Motivation and Approach

This book was published because the power of *Virtual Product Creation (VPC)* and its solution elements still are significantly underestimated and hence underutilized within industry. In many companies, significant investments have been made into *PLM (Product Lifecycle Management) technologies*—a term that has been introduced in the second half of the 90s of the last century to designate information applications, which should help to manage the product throughout its entire lifecycle. Nevertheless, no robust working environment has yet been achieved to support digital engineering activities consistently. Today's industrial situation is characterized by a number of factors:

- a clear separation between physical (prototyping and rig) testing and IT-based digital (prototype) simulation,
- difficulties to adopt new digital working practices across all disciplines; enterprise-wide and cross-enterprise,
- pending decisions on core competence in computer-aided design, analysis, validation and verification versus outsourcing digital work packages with the idea of "plug & play" engineering,
- unclear ownership for new digital engineering tasks and opportunities and
- obsolete business models which exclude positive digital value creation (in terms of models, investigations, functional validations and process verifications etc.) and only charge for IT license and server cost as well as for human resource cost.

The role of *Virtual Product Creation* as a fully recognized engineering discipline is to serve as key business enabler for digital value creation synchronized with strategic and operational business plans. In today's best-case scenario, however, *Virtual Product Creation* is still only understood as a joint work stream or project between IT and Engineering departments to launch new digital IT-tools with direct applications and to develop and deploy related IT tool oriented methods for a certain group of digital design engineers and analysts. The dilemma resulting from this limited *Virtual Product Creation* approach is that core-engineering processes remain

mostly untouched. This book aims to address the need, as well as practical and scientific ways to seriously extend today's limited Virtual Product Creation footprint to a full engineering discipline in order to achieve business goals from today and of tomorrow. The future extension of Virtual Product Creation has to take seriously into consideration the interplay between digital product function activities of customers and users in the market as well as maintenance/functional service during the product use lifecycle back with digital activities in product and production engineering.

In silent conviction, even ordinary business managers admit that today's product creation can no longer exist without the engineering discipline *Virtual Product Creation.* However, there still are major misunderstandings in how to use those technology elements consistently, effectively and most efficiently. The biggest dilemma is the question of how to integrate digital activities within the company's business value creation network. Senior business management and operational middle management still regard digital engineering rather as a type of IT technology and a wider spectrum of Virtual Product Creation and PLM processes, methods and solution elements as cost contributors rather than as company competence assets.

The author of this book has spent fourteen years in automotive industry as part of a major global OEM from the first half of the nineties up to the end of the first decade of this century. After having done research in the field of CAD/CAM and Engineering Design in academia, he started in industry to gain substantial experiences as system engineer in body engineering within several global vehicle development projects. During this time, he was responsible for design, test and release of automotive body systems manufactured around the globe. With this product and production development experience he started to build up a new department in the area of C3P (CAD, CAM, CAE and Product Information Management) and PLM. During the last eleven years of his industrial career, he was responsible in various technical expert and manager positions to develop, implement and operationally ensure digital engineering technologies as growing part of the automotive development activities, both in product development and for manufacturing engineering.

Today he holds responsibilities as full-time University professor of the chair *Industrial Information Technology*—belonging to the *Institute of Machine Tools and Factory Management (IWF)* in the faculty *Mechanical Engineering and Transport Systems* at the *Technische Universität Berlin (TU Berlin).* In this position, he is able to enhance digital solutions of the current generation and has excellent opportunities to define and influence next generation Virtual Product Creation solutions. Both R&D activities are accomplished together with his research teams in academia and in industry, with national and international students and in close cooperation with other research institutes, software vendors and industrial companies.

What exactly is this technical book about? Overall, it provides a unique view into the realities of Virtual Product Creation activities in todays' industrial engineering execution. The book's content structure is divided into three major parts. Part one starts with a prologue to lay out the differences in approach in the young technical field of IT supported Engineering and Virtual Product Creation throughout the last 50 years. Part 1 also explains the transition of information technology and its organizational set-up in enterprises as a baseline. The second part of the book (Chaps. 7

through 16) provides refined technical understanding on Virtual Product Creation technologies and methods as well as their practical business use and today's limitations. The third section of the book (Chaps. 17 Through 21) deals predominantly with business integration challenges of IT based digital engineering working practices as part of Virtual Product Creation and with the outlook on future digital engineering approaches, business models and solutions.

At the present time, digital technologies represent an absolute necessity for the creation of new products; however, the day-to-day product development operations have not yet embraced more than forty to fifty percent of the "digital potential". The obvious question is why? This book delivers honest and detailed answers to this question. In addition, it aims at delivering good understanding to industrial managers and technical experts as well as to academia, researchers and students on the weaknesses and strength of digital engineering solutions and the corrective actions which have to be taken in order to make virtual product creation set-ups eligible to solve striking engineering challenges of the future.

Each chapter provides a quick essential guide in the beginning followed by a detailed review with corresponding analysis material. The overall target for the author is:

- to explain the difference between IT/PLM technologies and true digital engineering working solutions,
- to detect and describe best practices and fundamental flaws of today's Virtual Product Creation solutions in industrial practice,
- to motivate the young generation of students and engineers to learn and engage with digital engineering technology appropriately and
- to stimulate industry business leaders to more pro-actively push the full potential of the Virtual Product Creation and to establish new organizational set-ups for the next generation of Virtual Product Creation engineers.

Despite all challenges in making the most effective use of Virtual Product Creation solutions today, as well as likely in the future, there is no other option for modern and future engineering than to rely on appropriate Information and Communication Technologies (ICT). However, it is indispensable to enhance the way these fast evolving technologies are actually integrated into engineering execution processes.