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## Preface

The 1990s saw the rapid development of both the Internet and business logistics. Less than two decades later, the globalized economy was a reality. Nowadays, sustainability and resource efficiency are guiding principles to run a factory. The digital communication of orders, processes, and resources is the next foreseeable development step in manufacturing.

Enterprises now frequently distribute their productions over several sites in a number of countries, and their productions are usually subject to strong fluctuations. Individual sites thus have to be highly reactive and changeable. This in turn necessitates a paradigm change; generally speaking, we need to invert the way we have traditionally considered a factory. Whereas previously, the primary task of a parent company was seen as developing a product, producing it and processing orders, while procuring and distributing finished goods to customers were secondary, today's priority is reliably supplying globally distributed markets from the most advantageous sites. Instead of central factories with a broad manufacturing depth, transformable or even temporary production sites located near the individual markets are now essential.

With this in mind, we realized that a critical look at factory planning up until now had to be undertaken. In gathering information from numerous research projects and industrial-based projects conducted in various branches, it became clear that in addition to the customary primary goal of being as efficient as possible, additional demands have arisen:

- Depending on the impulse for change, a factory needs to be able to adjust itself within a suitable time period with regard to both production technology and spatial demands on each of the impacted factory levels.
- Manufacturing and assembly systems need to take into consideration local perspectives concerning know-how, wage costs, and required value-adding (i.e., local content).
- Production facilities and buildings need to be designed so that they conserve resources and are energy efficient.
- The external appearance of the factory needs to represent the corporate identity of the enterprise, while the internal appearance needs to meet the claim of the product.
- The spatial design of production sites needs to provide comfortable workplaces, thereby expressing the company's high regard for its employees.

In consideration of all this and over a number of years, we have developed the tri-fold structure of this book. It is based on the second edition of the German “Handbuch Fabrikplanung” (Handbook Factory Planning), published in 2014 by Hanser Verlag Munich.

The first part of the book consists of five chapters and begins by developing a deeper understanding of the drivers behind factory changes and the resulting planning basis including future demands. Following that, we review existing production concepts and conclude by deriving various characteristics of what we refer to as a ‘site’s changeability’.

In the second part of the book, we describe the planning and design process of a production site from the level of individual workstations to the level of various sections, up to the levels of the building and location itself. Depending on the level, we discuss strategic and functional planning aspects as well as aspects pertaining to the actual organization of work—all with a special emphasis on changeability. Describing the spatial specifications of these levels plays a central role in directing the factory planner’s view to the notion that form not only follows function, but also follows the performance of the buildings and the building services they are equipped with.

With three chapters in the third part of the book, we focus on the systematic factory planning process with respect to these new requirements. The center of our discussion is the synergetic factory planning model. In seven stages, it describes the creative interplay between production planning and spatial planning based on a continuous 3-D-modeling starting with the goal-setting right up to the ramp-up. The second chapter takes a look at project management, including the aspects of forming a project team, the responsibilities or team tasks, as well as a brief overview of digital tools for planning a factory. In view of the frequent changes of use, it becomes all the more important to efficiently use real estate properties; the last chapter of the book is therefore dedicated to facility management.

Our goal with this handbook is first and foremost to provide a comprehensive, methodical, and practical support for the management of production enterprises as well as for planners and designers of production sites. The same applies to architects and construction planners who design and realize industrial buildings. Moreover, this handbook is also intended for those studying production technology and industrial logistics from the perspectives of both engineering and management, and for architecture and building construction students.

Before delving into our subject matter, we would like to thank first of all Mrs. Rett Rossi, our most valued translator, who went deep into the complex subject and delivered a perfect performance. Next to thank is Jens Lübke-mann from the IFA Institute of Production Systems and Logistics Leibniz University, Hannover, for coordinating the work between the authors, our reviewers, and Mrs. Rossi as well as the preparation of the correct format of text and figures. Mr. Gerhard Hoffmann, CEO of IFES GmbH in Cologne, has contributed Sect. 11.3 and Detlef Gerst Chap. 7; to both, we have to express our sincere thanks. In addition, we are much indebted to Indranil Bhattacharya, from the architectural firm Reichardt–Maas and Associates (Essen/Bangalore), for energetically supporting Chaps. 11–14 on spatial

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Hans-Peter Wiendahl  
Jürgen Reichardt  
Peter Nyhuis



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Wiendahl, H.-P.; Reichardt, J.; Nyhuis, P.

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