

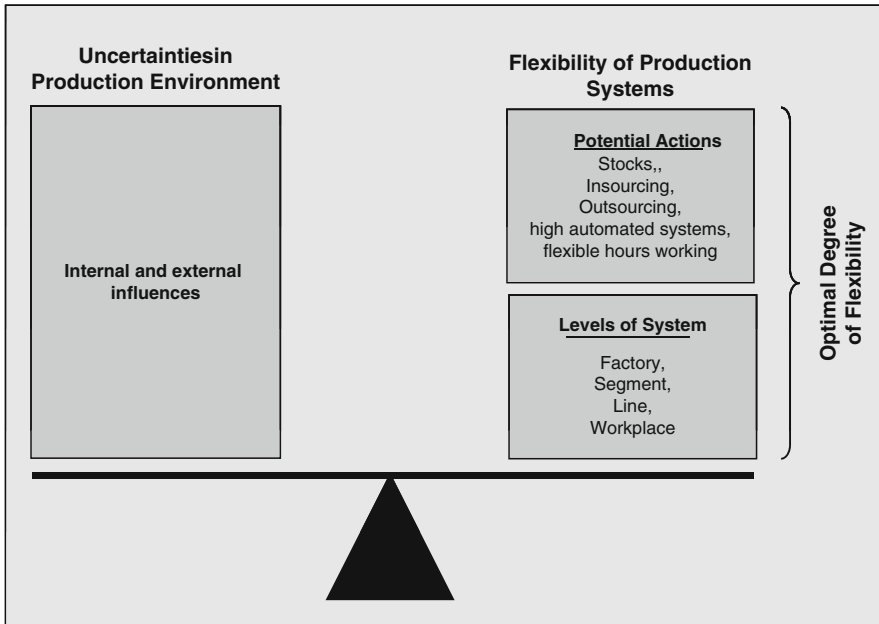


Fig. 1.2 Economic balance between existing uncertainties and flexibility of production systems according to Zäh, Bredow, Möller [ZBM-06]

For this task, industry-accepted evaluation methods are needed that do justice to the multi-dimensional character of flexibility, are based on common evaluation criteria and can be used across many industrial sectors.

1.3 Objective of This Book

Based on the given problem, a comprehensive flexibility evaluation concept is required that allows manufacturing companies to determine an economic balance between the predominating uncertainties and the appropriate degree of flexibility of their production systems. The aim of this book is therefore the introduction of innovative evaluation methodology that, determining characteristic values with interbranch applicability, yields economically reasonable conclusions about production systems' technical and organizational agility. The following types of flexibility need to be analyzed:

- Volume flexibility
- Mix flexibility and
- Expansion flexibility

In order to rate these three distinct types of flexibility, a variety of calculation methods are necessary, also called flexibility metrics. These have to accommodate

the multi-dimensionality of flexibility and follow a common data and evaluation concept, thereby insuring the correct recognition and classification of dependencies between the flexibility types. It has to be possible to specifically attribute flexibility evaluations to chapters of production systems, because environmental turbulences have different impact on the different chapters. The sole focus of the analysis is on production with its direct and indirect processes; construction and development will not be considered.

In order to rate these three distinct types of flexibility, a variety of calculation methods are necessary, also called flexibility metrics. These have to accommodate the multi-dimensionality of flexibility and follow a common data and evaluation concept, thereby insuring the correct recognition and classification of dependencies between the flexibility types. It has to be possible to specifically attribute flexibility evaluations to chapters of production systems, because environmental turbulences have different impact on the different chapters. The sole focus of the analysis is on production with its direct and indirect processes; construction and development will not be considered.

In order to establish evaluation methodology as an efficient tool in production management, the user has to be able to quickly calculate characteristic flexibility values for specific system sectors. Also, the way in which the determined values are incorporated in the complete planned or existing system has to be easily understandable. A so called production system model is needed, which permits abstraction of relevant objects in production systems and their interlinking relations. This will make it possible to perform analyses of flexibility related dependencies between these objects and tracing flexibility deficits back to the responsible parts, thanks to the reciprocal links between the metrics and the production system model.

Finally, the suitability of the methodology as a system solution that can contribute substantially to increasing competitiveness of manufacturing companies in a turbulent market environment will be proven on the basis of a real implementation, which is also applied to a practical example.

The Fig. 1.3 illustrates the approach to tackling the given challenge.

The **guiding research question** in this book to solve the described challenge is as follows:

What criteria must a flexibility evaluation methodology which is accepted in practice follow and how is it possible to make the economically viable technical and organizational scope of production systems with regard to capacitive variations, Product/Variant mix changes and capacitive expansion requirements measurable?

Designed for production planners and managers in production, the book will provide reliable estimates of the flexibility of their production systems, which are vital in order to serve the market in time due to increasing complexity and dynamic as well as shorter reaction time. Thus, the evaluation methodology developed in this work is meant to be a supporting instrument for making decisions in operative and strategic production management that can be used to analyze and compare planned or existing production systems. In this context, the possibility to compare systems in different industrial branches is intended, such that analogies can be spotted and advancements transferred.

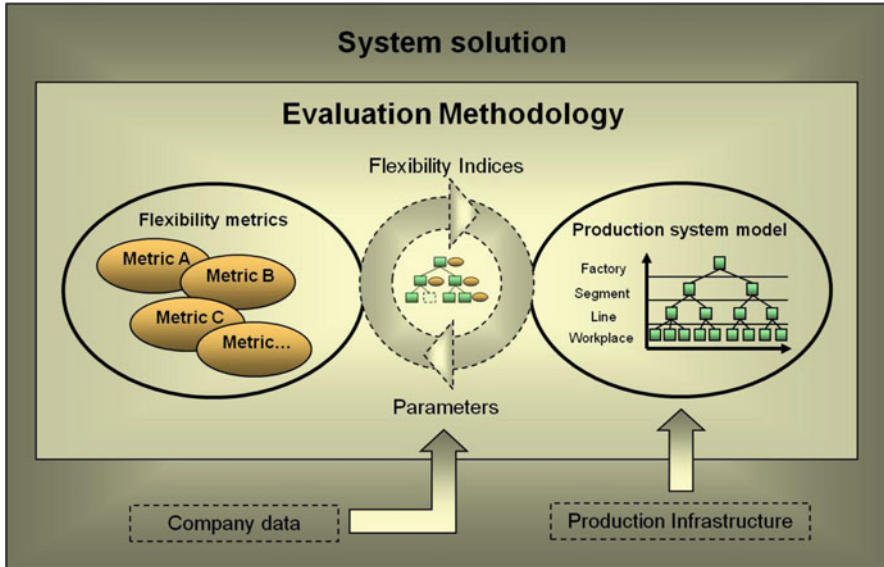


Fig. 1.3 Objective target

The *potential benefits* in case of a successful realisation of the methodology are:

- Unambiguous and transparent flexibility analyses through the use of consistent evaluation criteria
- Identification and containment of flexibility deficits in production systems regarding quantity-related demand fluctuations, changes of the product/variant mix and capacity expansion requirements by quantifying the scope of flexibility
- Support for short-, medium-and long-term security of an economical production by means of scenario considerations for the simultaneous increase in planning security and reduction of flexibility costs during market-related changes
- Reduction in the response time between recognising the need for production-related change and its implementation, due to flexibility analyses focused on various observation levels of a system
- Consideration of the multi-dimensionality of the calculation of production-relevant parameters, such as Break-even volumes or optimal production programmes, to properly classify the identified flexibilities
- Identification of synergies between production systems in different sectors, due to a generalized flexibility calculation approach and the combination of flexibility metrics with a neutrally structured production model.

Flexibility Measurement in Production Systems
Handling Uncertainties in Industrial Production

Rogalski, S.

2011, XI, 186 p., Hardcover

ISBN: 978-3-642-18116-0