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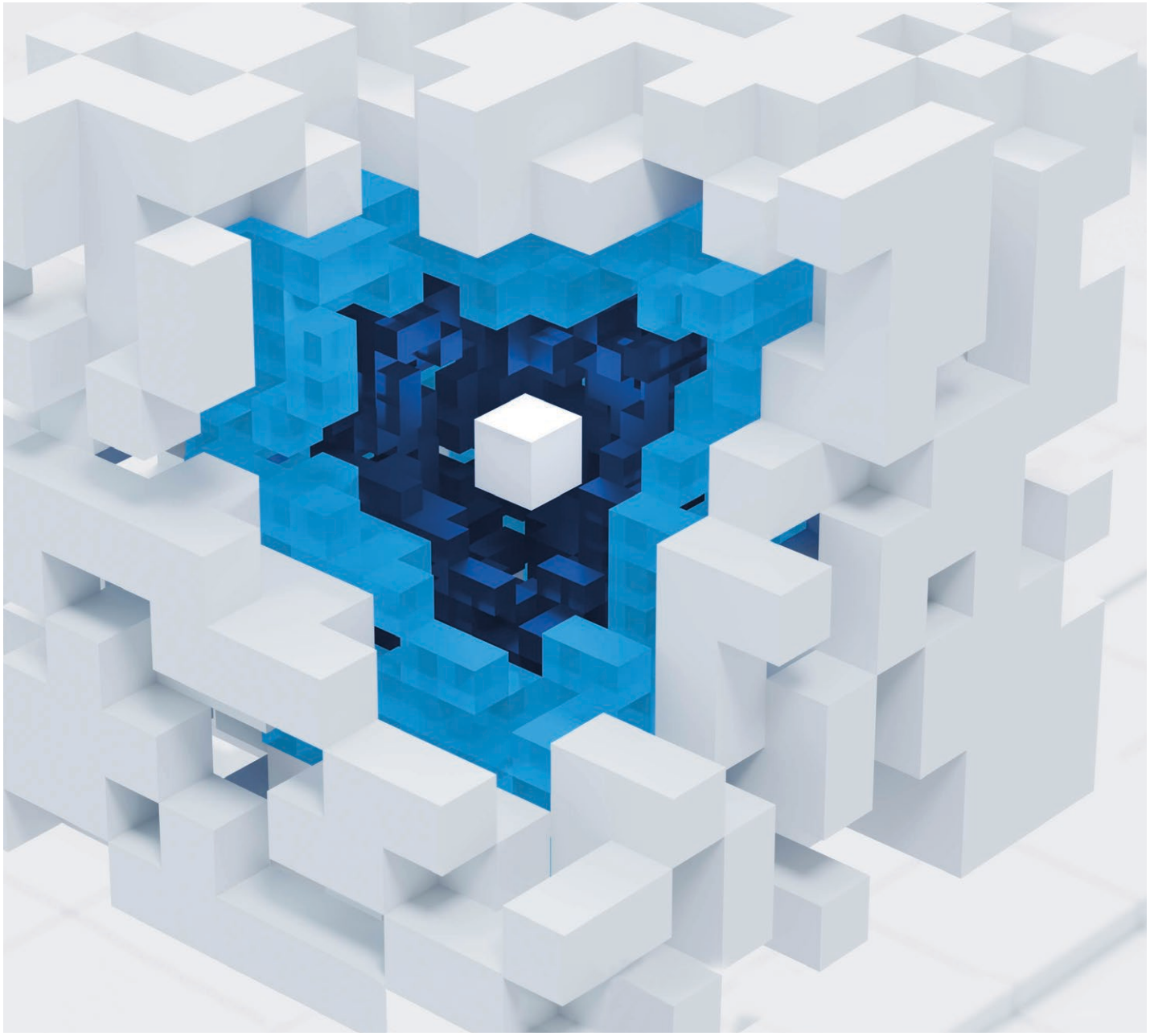

WHITE PAPER

# Flexibility and Changeability in Production

## Evaluating production strategies for enhanced flexibility and changeability

# Flexibility and changeability assessment

## November 2025

Flexibility and changeability are becoming increasingly important within the manufacturing landscape. These capabilities are key success factors for efficiently adapting to unpredictable production events and ensuring the longevity of manufacturing systems. Measuring them practically has proven challenging because of the complex and multidimensional nature of flexibility and changeability. For this reason, Dürr Consulting developed an approach that bridges the gap between theory and practice. The approach can be applied to both greenfield plant planning and existing production facilities.

### FLEXIBILITY AND CHANGEABILITY – ADAPTING TO CHANGING ENVIRONMENTAL CONDITIONS

Manufacturing companies operate in an increasingly complex and rapidly changing environment. Shifts in customer demands and growing global competition necessitate even shorter product innovation cycles. At the same time, social, environmental, and political conditions remain uncertain. Introducing new production technologies, materials, product designs, and information systems can accelerate the need for even shorter product and process life cycles.[1]
These factors represent significant challenges that companies must address as quickly and specifically as possible. One way to mitigate risks and respond to unexpected events is to incorporate flexible, changeable structures within the production environment. These structures should integrate into new plant planning and be regularly reviewed and modified in existing plants.

Flexibility is the ability of a system to perform various tasks and meet changing requirements within predefined task boundaries (see Figure 1). This hinges on a range of services collectively forming the "flexibility corridor."[3] As a pivotal success factor, flexibility significantly contributes to a manufacturing company's competitiveness.[2] For instance, it facilitates production of an existing product in different colors or with additional features in response to shifting demands. However, if the planned flexibility cannot accommodate market turbulence, the concept of changeability is essential.[2]

Changeability, in contrast to flexibility, provides an increased ability to adapt, but is typically accompanied by a capital expenditure.[1] An example of changeable production processes appeared at the onset of the COVID-19 pandemic when companies produced disinfectant instead of perfume or face masks instead of clothes. The drastic shift in demand prompted the conversion of individual processes through capital expenditures, enabling their transition to a new flexibility corridor.

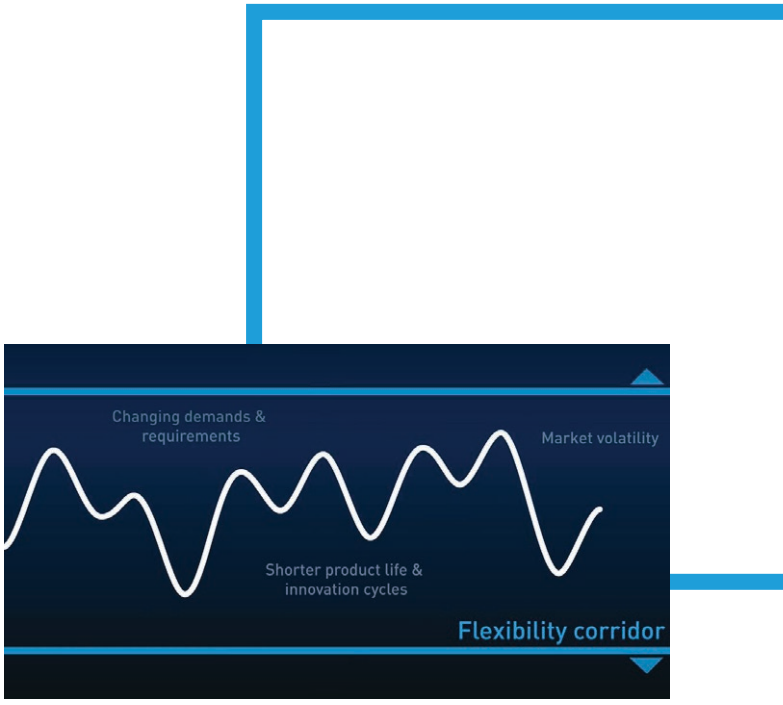


Figure 1: Flexibility corridor and influences on flexibility [4]

# Flexibility and changeability assessment

## Gauging your maturity level

Returning production to its original state or increasing the flexibility corridor's size can also serve as a response to and a preventative measure against possible internal and external changes. Flexibility and changeability in production require meticulous design for specific requirements and purposeful improvement to meet the need for a flexible and changeable response.[2]

One key challenge lies in the systematic evaluation of the current production status. Furthermore, it is unclear what specific level of flexibility and changeability production departments should work toward. Strategic drivers of change must be systematically identified to determine the ideal production target status.[5] Therefore, the two key questions are "How well prepared is your production facility currently for various and unexpected changes?" and "How flexible and changeable should your production department be in the future?" Dürr's flexibility and changeability assessment is precisely tailored to these questions. Dürr Consulting, in collaboration with Aalen University, developed a science-based methodology validated and quantified through multiple projects.

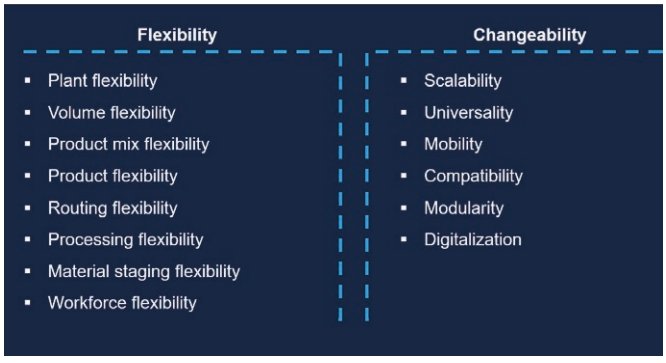


Figure 2: Summary of flexibility and changeability criteria

Both flexibility and changeability are multidimensional constructs that are difficult to measure and cannot be quantified by a single key performance indicator (KPI). Dürr Consulting employs a methodology that assesses your flexibility based on distinct flexibility types. The same applies to changeability, where the changeable structures are evaluated as sub-elements that determine changeability using individual criteria and sub-criteria. These sub-criteria encompass the characteristixccs of the criteria along with considerations of time and cost factors (see Figure 2). It is important to include all relevant design elements within your organization when evaluating flexibility and changeability. The methodology examines all the potential aspects of flexibility and changeability, rather than a limited selection, ensuring a comprehensive picture.

An evaluation of your company's production-related environment occurs once the necessary assessment criteria are chosen. Both flexibility and changeability are gauged on a four-stage scale. Stage I represents a rigid and inflexible system on the flexibility scale, while Stage IV is a highly flexible system operating within the specified parameters. The changeability scale operates according to the same principle, with Stage I being a low level of changeability and Stage IV representing a system with an extremely high level of flexibility, typically associated with minimal capital expenditure.

These scales assess the chosen criteria individually, assigning a distinct rating to each criterion. Stage IV represents a system with an extremely high level of flexibility with estimated low capital expenditure.

**The criteria that have already been selected are assessed with the help of these scales. Each criterion is given a separate rating.**

## WORKSHOP CONCEPT

Dürr Consulting assesses your organization's flexibility and changeability in a workshop. Our consultants draw upon their extensive experience and knowledge gained from several projects. The workshop consists of five phases.

### Phase 1: Kick-off

During the initial phase, we introduce Dürr Consulting's assessment tool and provide a foundational explanation of flexibility and changeability. Afterwards, we structure your organization's configuration and capture your production process. We collaboratively define the scope of assessment and identify key contacts within both Dürr Consulting and your organization.

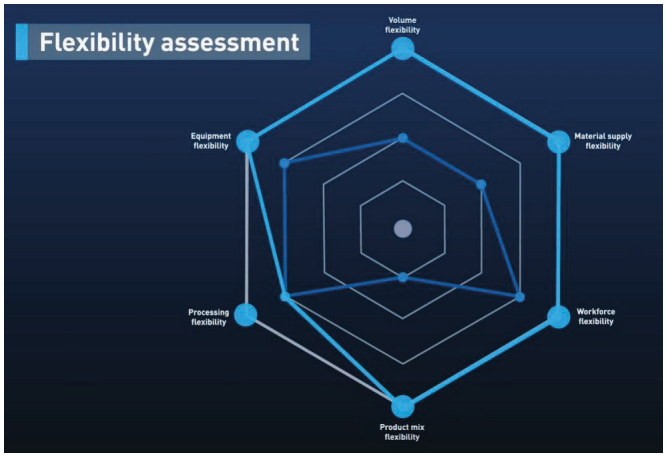


Figure 4: Target/current comparison of flexibility and changeability

### Phase 2: Preparatory work

In the preparation phase, we conduct workshops utilizing different methods to assign weight to individual criteria. Factors considered during this process include, among others, strategic requirements, company specifics, and the market environment.

### Phase 3: Analysis of the current situation

This phase consists of a tour of the factory floor by Dürr Consulting experts, during which we identify the production process state and the various interfaces and restrictions for the product, process, logistics, organization, and production planning. Experts from your company provide additional input. Subsequently, our experts carry out an impartial assessment of your company's current flexibility and changeability. Your specialists actively participate in a balanced assessment.

### Phase 4: Target definition

The fourth phase consists of a combined workshop to define the target state. In addition, any relevant drivers of change are identified and analyzed. This analysis is the basis for determining the desired level of flexibility.

### Phase 5: Follow-up

In the final phase, Dürr Consulting presents areas for action identified by comparing current and target states. We also outline potential measures to bridge the gap between the two. Partnering with your team of experts, we prioritize these measures based on their impact and relevance, creating a roadmap for implementation (For examples, see Figure 3).

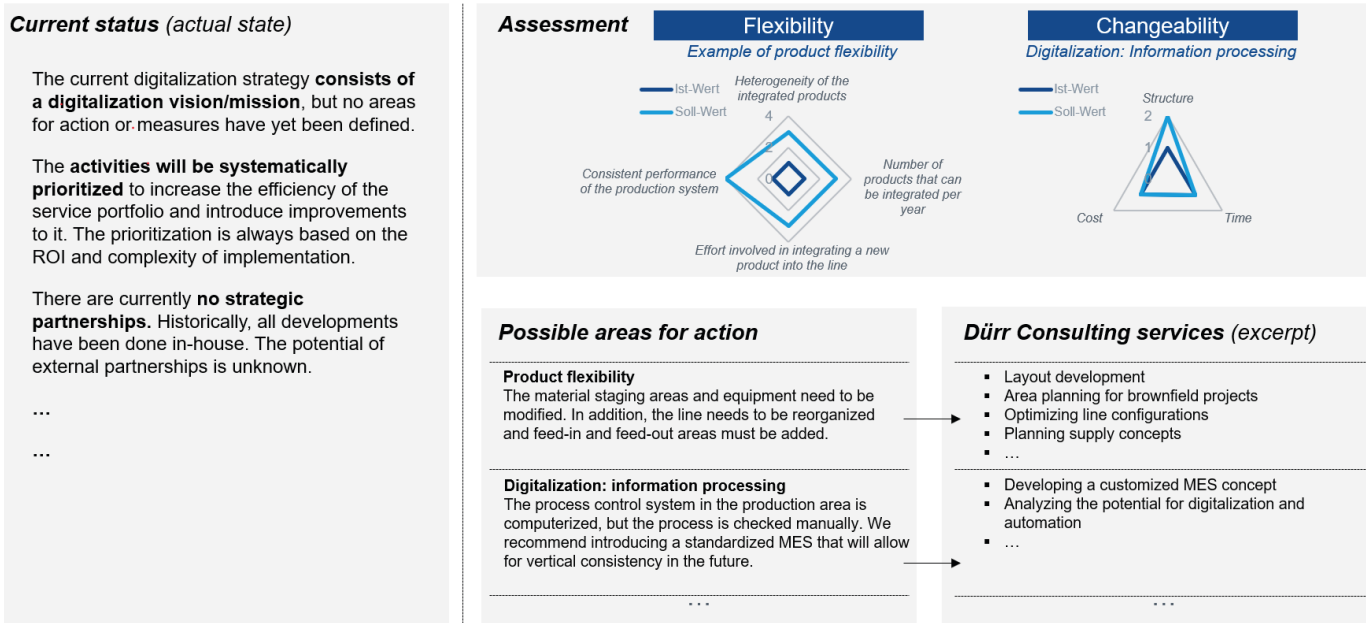


Figure 3: Example of possible analysis results

# Flexibility and changeability assessment

## Gauging your maturity level

**SUMMARY**
Flexibility describes the ability to adapt effortlessly within a predefined framework known as the 'flexibility corridor', whereas changeability refers to a system's ability to adapt beyond the boundaries of the flexibility corridor. Changeability, offers an improved ability to change compared to flexibility, but typically entails capital expenditure. Both flexibility and changeability are multidimensional constructs that are difficult to measure and cannot be quantified by a single key performance indicator (KPI). Dürr Consulting developed a science-based methodology to assist in assessing and evaluating the flexibility and changeability of your production structures.

This method addresses the multidimensional nature of flexibility and changeability by investigating different flexibility types and enablers. Moreover, we ensure a holistic examination of the entire assessment area. Cooperation between internal and external experts guarantees the assessment's objectivity. The assessment scale, with specific stages for each criterion, ensures result transparency and traceability. This method, which applies to a range of industries, makes it possible to comprehensively analyze an organization's current flexibility and changeability while identifying future needs in these areas. It facilitates the easy identification of deficiencies, allowing for optimization within the assessment area. Have we sparked your interest?

## Bibliography

[1] P. Nyhuis, G. Reinhart, E. Abele (Hrsg.) Wandlungsfähige Produktionssysteme. Heute die Industrie von morgen gestalten, PZH Produktionstechnisches Zentrum, Garbsen, 2008.

[2] B. Kaluza (Hrsg.) Technological economics, Vol. 60, Schmidt, Berlin, 2005.

[3] P. Nyhuis (Hrsg.) Schriftenreihe der Hochschulgruppe für Arbeits- und Betriebsorganisation e.V. (HAB), GITO-Verl., Berlin, 2010.

[4] H.-P. Wiendahl, J. Reichardt, P. Nyhuis, Handbuch Fabrikplanung. Konzept, Gestaltung und Umsetzung wandlungsfähiger Produktionsstätten, 2. Aufl., Hanser, München, Wien, 2014.

[5] H.-P. Wiendahl, D. Nofen, J. H. Klußmann, F. Breitenbach, Planung modularer Fabriken. Vorgehen und Beispiele aus der Praxis, Hanser, München, Wien, 2005.

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