

# *Production Level 4*

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*The Upgrade for Industrie 4.0*

*Production*  
**Level4**

First introduced in Kaiserslautern in 2005, the term Industrie 4.0 has since radiated around the world. The general understanding of the term is that it refers to digitalization and networking. Originally, the 4.0 referred to the revolution in industrial manufacturing, yet over time, many nuances have been coined like Vacation 4.0, Administration 4.0 and Labor Law 4.0. For scientists, Industrie 4.0 still describes a period of development, an era.

It began with the advances in digitalization and the networking of cyber-physical production stations. It continues with the current period of cognition, in which communication between man and machine is improved and made more transparent, for example, via speech recognition and the visualization of data. In our view, the years of agile, autonomous production structures are still ahead.

However, the term autonomous has a bitter aftertaste, because it connotes automated functions without human interaction. In the context of industrial production, it is often associated with deserted factory operations. That is precisely the direction of development that we do not see. We needed a new term to describe a vision of what the next advance in the future of production will look like. We settled for the term ***Production Level 4.***

We present the key elements of our vision in this brochure.

Sincerely,



**Prof. Dr. Martin Ruskowski,**  
Chairman of the Board at *SmartFactory*<sup>KL</sup>



## Why is it called *Production Level 4*?



The term *Production Level 4*, with the number 4, is a continuation of Industrie 4.0. Extraordinary technical advances have been made in recent years. The concepts of Industrie 4.0 must also be upgraded to keep pace. This is the exact goal of *Production Level 4*. In the age of digitalization and networked machines, we describe the important role of software – specifically, the various advances in artificial intelligence – and the role of humans in the factory. *Production Level 4* is seen as an upgrade of Industrie 4.0 concepts.

The number 4 also refers to a level of autonomy. In autonomous driving and manufacturing, Level 5 is defined as the absence of human involvement. The vehicles no longer need a steering wheel and factories operate without

people. But that's not exactly what we see. In our vision, people play the role of the decision maker, the final authority. The person on site understands every production process and can follow every machine-made decision at all times. The operator has the option to intervene and question any decision made by the software. Factory agility is increased as there is no need to reprogram machines or to change work processes at great expense. People have the keen sense of perception and can take such steps faster and more error-free than software or machines. People will always have abilities that robots can never have, for example, empathy, creativity, or the concepts of space and time. To this extent, *Production Level 4* corresponds to Level 4 autonomy and holds a place for humans in production.



## What is the aim of *Production Level 4*?

*Production Level 4* means using Artificial Intelligence to gain the ability to make agile responses to external influences and to increase the reliability of production. Our goal is the automated preparation of data for the operator to increase the transparency of decisions made by the machines so they can be understood by the operator at any time. As a result, the operator is able to change or optimize the processes.

*Production Level 4* assumes that machines will be designed, built, and programmed to „know,“ on the basis of cumulative and analyzed experience, how to best perform the production step under

any given circumstances while having an „awareness“ of the product. Machines will be networked to enable them to exchange data among themselves as well as with the product about the next production step. We also envision a higher order system that recognizes and monitors the overall system.

The operational transparency permits status queries and shows the reasons for decisions. The mostly unstructured measurement and analysis data from the machines are processed in a form that is understandable to humans. We call this the semantic form.

## *What does the future of manufacturing look like?*

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Flexible production only produces those goods that have been ordered. The production of tomorrow will resemble an online marketplace, where smart machines, equipped with simple intelligence, offer services and make decisions. These machines will use AI systems, for example, to check product quality directly at the production stations or while in transit on an autonomous transport system. Higher order systems take care of large and small problems, and bots, which are small software programs, take care of the machine, the product, and the logistics.

In the smart factory, the individual product independently finds its way through the manufacturing process. Lot size 1 ensures conservation of resources and production adapted to the markets. The integrated system orchestrates the independent and autonomous work units that are capable of learning as it optimizes processes and production methods. Keywords such as cooperativeness, resource adaptation, self-learning, decision-making ability or explanatory skills become a matter of routine.

## *What roles will humans play?*

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At **Production Level 4** in the future, fully automated production stations perform more and more of the routine and repetitive tasks on the factory floors. Yet, even robots quickly reach limits in terms of the mechanical activities and the flexible adjustments to work stations required to setup for new products. These activities demand human abilities and agility.

People will concentrate on their strengths in the factories of the future: Complex

operations, strategic choices, and, in particular, the search for continuous product and process improvement remain in the realm of human beings with their extraordinary abilities. Autonomy means allowing work units to be assigned more flexibly, to increase their (technical) versatility, to communicate, and to independently make some decisions. People remain sovereign at all times and bear the responsibility, and ability, to intervene.

## *Corporate declaration of Production Level 4*

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- **Production Level 4** increases robustness through agile reactions to external influences.
- **Production Level 4** requires people as decision makers in the production process.
- **Production Level 4** increases transparency through automated data processing.
- **Production Level 4** networks and automates production scheduling.
- **Production Level 4** enables flexible plant reconfiguration / retooling.
- **Production Level 4** implies a self-learning ability as an enabler of continuous improvement.

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