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# Real Estate in the Age of the Fourth Industrial Revolution

## INTRODUCTION

BEOS Survey is a series of analyses that periodically discusses issues in the area of corporate real estate as well as in associated areas of logistics, industry, and manufacturing.

In this edition, BEOS Survey provides an overview of current and imminent developments in industrial production ("Industry 4.0"), and outlines the associable ramifications for the value chain of goods, and for the corresponding real estate market segments.

The German Government is aware of the special significance that comprehensive digitalisation and the networking of classic industries has for Germany's mid-market companies, and anchored the "Industry 4.0" topic as future project in its high-tech strategy as early as 2012. In the time since, several excellence clusters have been formed as a result. The German real estate economy has barely taken note of this issue so far even though it will obviously have a considerable impact on future locational requirements and types of use. Especially the classic distinction between the use types management, distribution, production, research, and storage is fading fast in favour of multifunctional areas that combine project-related and thus temporarily mixed uses.

## FROM THE STEAM ENGINE TO INDUSTRY 4.0

As early as 1926, Kondratiev noted that certain major innovations (such as the steam engine) have marked the starting point for fundamental shifts in economy and society. This concerns the production of commodities and goods more than anything else. The perceived process starts with extensive innovation-induced investments in the new technology, thereby triggering an economic boom. Once established during the initial phase, the innovative momentum slows — initiating a downturn. The recessive phase tends to coincide with the emergence of the next major innovation. The hypothesis of long waves was later confirmed by Schumpeter, who suggested naming them Kondratiev waves.[1]

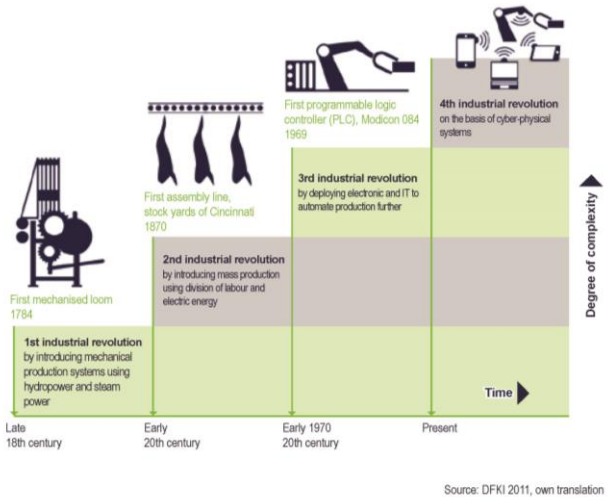


*Figure 1: industrial revolutions*[2]
*(source: DFKI 2011)*

Steam power and its use to drive mechanical processes formed the basis for the first industrial revolution in the late 18th century. The second industrial revolution was marked by the advent of mass production based on the division of labour and using electric power (assembly line). Process automation based on electronics and information technology is referred to as the third industrial revolution. It is considered to be in its final stage at present, which arguably coincides with the onset of the fourth industrial revolution also known as "Industry 4.0." The key source of innovation in this cycle is the mutual integration of physical objects (capital goods) and the exchange of information in networks.[2]

According to Porter, production is only one component in the value chain as a whole, which includes, in addition to research and development, the upstream and downstream logistics processes along with all the services involved in manufacturing and staging a given product.[3] This means that an industrial revolution will not just alter production as such, but will always also have ramifications for the entire value chain, especially for the real properties where the processes may have to be reconfigured to accommodate the innovation.[3]

## WHAT DOES INDUSTRY 4.0 MEAN?

The term “Industry 4.0” was coined in response to the assumption that the advent of the “Internet of Things and Services” will usher in a fourth industrial revolution in the wake of previous such revolutions marked by mechanisation, electrification, and the breakthrough of information technology, respectively. The underlying idea is this: In the future, products will be connected with all systems and players involved in the respective manufacturing process across the entire product life cycle via interactive networks. The scope will range from the sourcing of commodities, to production, distribution, operation, and all the way to the eventual disposal. This means that products will be “smart” and capable of triggering or executing processes on their own. But Industry 4.0 is not limited to smart products. Rather, there is reason to assume moreover that factories and any other unit and system involved in the manufacturing process (smart energy grids, smart mobility, smart logistics, smart buildings) will become “intelligent” and use the Internet to communicate with the product.[2,4] The increasing intelligence as well as the end-to-end integration across the entire value chain form the core elements of the fourth industrial revolution.[2]

The Cyber Physical System (CPS), which is considered its ideal model, virtually connects all processes and units involved in the production (equipment, storage systems, working capital, labour, product, etc.) and facilitates the communication among them. Technologically, the networked communication would use RFID (radio frequency identification) labels integrated into the participating systems and elements. According to Porter this would enable the involved actors and processes to exchange data autonomously and to mutually control each other.[2,4,5]

Each smart product is uniquely identifiable, may be addressed any time, is aware of its production history to date as well as of its current state and its targeted end state. The product remains permanently in touch with its value chain network, and will respond in real time to any change. This permits to take customisation requests regarding design, configuration, order, planning, production, and operation into account on short notice. It would make even a dynamic batch size of 1 production profitable, and could pave the way for customisable mass production.[2,4]

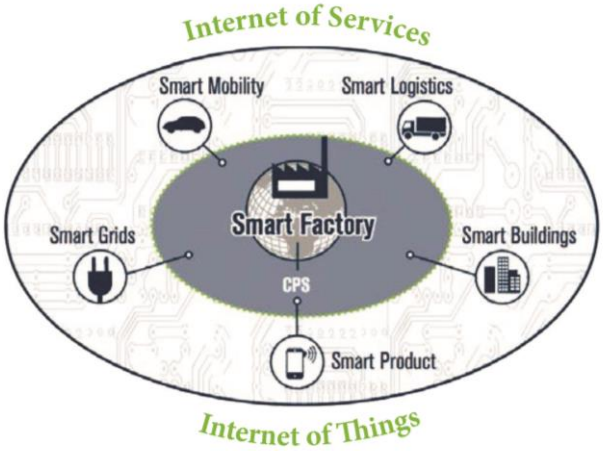


*Figure 2: smart factory as part of the Internet of Things and Services[2] (source: DFKI 2011)*

Take the example of automobile production:

When ordering a certain car model, a customer may request any number of extras (including colour, performance, upholstery, etc.). The custom data could be communicated to the raw car body via the Internet, and to the machinery involved as the production progresses. The coating machine could in turn reconnect to the system to verify that paint of the requested hue is in stock in sufficient quantity, and to have it restocked or reordered as necessary. The smart factory would communicate to the networked smart logistics that more paint is needed. The warehouse system would autonomously organise the purchasing and hauling of the required quantity of paint to the smart factory. Even the tools would be automatically supervised. Each bolt in every car would be logged with the correct torque and the right amount of lubricant, for instance. [2.4.6.7]

While some of these processes are already being implemented, many other remain wishful thinking. The implementation of such a complex interaction of products (“things”), processes, and humans will require a huge research and innovation effort.[2,8]

An example for technical innovation is the much-discussed 3D printing process that was developed in recent years. Now past the lab stage, it has already been rolled out and is available for consumer applications. Small mobile 3D printers are capable of producing small batches of spare parts and models at a client's location.

## RAMIFICATIONS FOR (CORPORATE) REAL ESTATE

Large interconnected industrial and manufacturing complexes were a common phenomenon during the second, and to some extent during the third, industrial revolution. Recent decades were characterised by an accelerating trend, in line with Porter's theory, to outsource sections of the value chain, e. g. by moving production overseas. Research and development as well as management and logistics were progressively unbundled and relocated to geographically separate sites. The general tendency in the context was to downsize the various company locations.[3,9]

The fourth industrial revolution could work a dramatic shift because the value chain components will now be variable and behave intelligently. This will require production staff to have more advanced professional skills, while simple process steps will be less frequently required. Formerly outsourced parts of the production could thus be gradually repatriated, a decision also motivated by other aspects (reduced labour cost benefits, poor product quality, locally adjusted production). In the medium term, the trend could boost the demand for floor space in Germany. The distinction between specific types of uses are becoming increasingly hazy, because there is less and less call for pure production or pure logistics sites. Rather, an integrated value chain marked by upstream and downstream services will take centre stage.[9,10]

Accordingly, the building corpus of the future will have to be increasingly flexible and multifunctional. The more reversible a given floor plan is, the more competitive it will be.[4] The classic office cubicle seems to have outlived its usefulness for good. Its place will be taken by large open-plan units used not just for management but also for other operating activities such as research, distribution, service, and zero-emission pre-fabrication, with all of these smoothly interacting.

Principally speaking, companies will therefore need an adjustable and modular type of property that will accommodate anything from production batches of one to mass production. At the same time, floor plans need to be reversible in order to accommodate even the most diverse elements of the value chain. The required qualities ultimately match those already prevalent in current corporate real estate anyway.[9]

The direct ramifications for each property break down into three aspects:

- Building fit-out and building architecture
- Locational factors
- Building function[9]

*Building Fit-out and Building Architecture*

One of the key prerequisites a building must have to qualify for Industry 4.0 purposes concerns the capacity for digitalisation and networking of the property with all of its internal functions and elements. This means that the actual building will become intelligent so as to autonomously control itself and adjust to changing parameters. A manufacturing plant, for instance, would provide input defining the temperature at which certain products need to be processed. Indeed, any other process could be controlled analogously, including e. g. lighting (natural or electric), ventilation and air quality, or the water and resource management. Gates and doors could similarly interact with products, machines, and people. As raw materials are delivered, the factory could directly determine whether the shipment includes the right material, whether it is waiting at the right gate or whether it needs to be rerouted.[2,6,9]

Analogous processes would work for warehouses. A building's mechanical services and a given commodity would communicate with each other to optimise the indoor temperature.[4]

*Locational Factors:*

A key topic regarding the future in production is the location issue. Full digitalisation of the production including upstream and downstream processes will necessitate the networking of all buildings involved. This in turn presupposes that the infrastructure parameters available at the site are up to standard. Accordingly, high-powered data, energy, and transport networks are a precondition that will factor prominently in any decision for or against a given location. Also, it is safe to assume that clusters will form due to the complex production-related networking of the various functions and buildings. Short distances between a factory's materials handling facility and the finished goods warehouse are desirable

in order to minimise the error susceptibility of the value chain or of the production process.[2,4,9]

The option to customise mass production complements the trend to produce in close proximity to the outlet market because it permits a swifter response to specific customer requests and local demand. The future trend will turn its back on speculative mass production and embrace demand-driven production close to the customer. Rather than having one large factory with a global or cross-continental catchment area, companies are more likely to operate smaller production facilities with regional or local market areas. The increasingly emission-reduced nature of modern production would also let manufacturing facilities move closer to residential areas again. Germany's major conurbations and growth hubs already benefit from the trend.[2,4,9]

*Building Function:*

Especially the building functions will be subject to incisive changes, because multi-purpose buildings are the wave of the future. This goes in particular for storage and logistics properties. Modern technology like the 3D printer could simultaneously turn a storage building into a production plant if the deployment of 3D printers permits the production of goods or production components on demand and on short notice. For the time being, this may not be a paying proposition for bulk goods yet. However, the situation could change quickly as printing technology development advances.[2,4,9,11]

In stock-keeping, it is generally assumed that demand for entrepôt storage will decline. In the case of certain objects, it will no longer be necessary to ship the physical article, but will suffice to send the digital blueprint. The object will be manufactured directly on location using a 3D printer.[1,11] Especially vintage properties in suburban and integrated locations have the potential to be upgraded through appropriate redevelopment measures to serve in new mixed roles. Conversely, demand for pure logistics centres in greenfield locations will probably contract. Buildings of the latter type tend to be too large, too tall, overly specialised, and ineligible for the integrated uses of the sort required in the future.

## CONCLUSION

The fourth industrial revolution, also known as "Industry 4.0," is still in its infancy. It is safe to say, though, that a highly technologised, digitally networked global economy will shift the parameters for real estate, too. Alternative use potential (in the sense of reversibility) and flexibility are issues of mounting importance for the real estate economy. Corporate real estate seem to be well positioned for these challenges by their very nature. The building types likely to be needed in the future open up new perspectives for developers and investors: The trend will shift from owner occupation to renting because companies will want to be able to adjust their processes quicker, and to be more flexible in meeting changing floor space requirements.

## OUTLOOK

Survey 06 will focus on small and medium-sized enterprises (SME) and their significance for the German economy as well as for the asset class of corporate real estate. It will be published in April 2014.


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