



Science fiction or oncoming reality?

Joachim Miebach

Inventions like the steam engine or internet were revolutionary and have changed the world. Today, experts talk about the beginning of a further revolution Industry 4.0. This goes along with concepts and catchwords such as internet of things or “big data”. The impact of this progress, especially on the applicable principles of the value chain, are difficult to predict.

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Of all technological trends, which will undoubtedly revolutionize the world we live in, there are three (besides IT) that have a major impact on supply chains: 3D printing, robots and drones.

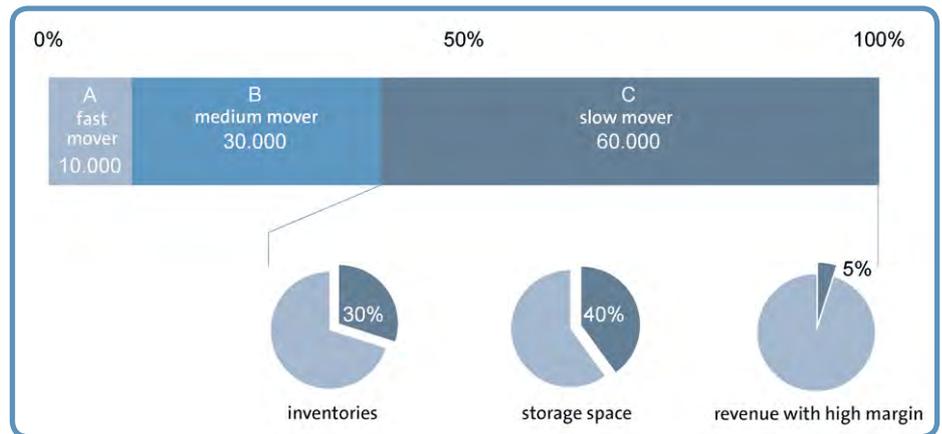
3D printers with high quality standards that work with different materials are already in use and can replace inventories in the future. Robots are increasingly being integrated into the supply chain processes and can support the order picking in warehouses.

Furthermore, companies like Amazon, Google or DHL are already testing the use of drones (driven by remote control) for package deliveries, which could take charge of the “last mile” transport in the future.

3D printing process – more than prototyping

3D printing or additive manufacturing is an increasingly relevant technology (for the production), although it has to evolve a lot further to use its full potential. Currently it is already possible to create products of different sizes and materials (plastic, metal, paper, ceramics, etc.) with simple or complex structures through various methods of “printing” (FDM Fused Deposition Modelling and SLS Selective Laser Sintering). The price of printers is very variable, the scope of application ranges from personal to industrial use. Another cost factor is the time of manufacturing of the 3D products, which basically depends on the size of the piece.

Today, many industries, including the automotive and aviation industry, are experimenting with 3D printers in the production, using the printers for those parts which are easy to print and assemble due to their low complexity and simple shape.



01 Inventories, storage space and revenue of spare parts

Large multinational companies such as HP are already investing in the 3D printing technology.

In the logistics field of automotive companies, 20% of the low rotation spare-parts of a car are already 3D printable. In this sector, a large number of spare parts (approx. 60%) occupies significant space in the warehouse (approx. 40%) and repre-

sents a significant percentage of the inventory level (approx. 30%) but generate only 5% of the sales (**Image 01**).

As an example, we compare a conventional supply chain in which a supplier of spare parts orders plastic cogwheels (used for car windows) and a supply chain in which the product is ordered as 3D-print by the same supplier.



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02 The four main benefits of 3D printing

It becomes clear through the comparison (table on this page) that the complexity levels of both options are very different.

The printing costs of this spare part are currently very high (ranging between 15 and 20 USD if it is made out of plastic and up to 100 USD if it is made out of metal). However, the costs for manufacturing, storage, handling, transport, and the risk of obsolescence and transport damages are, for the most part, not existent. These costs summed up for all spare parts around the world lead to a significant number of costs. Moreover, the high delivery rates should also be taken into account.

3D technology will develop a lot in the future: printing will become faster, cheaper, more universal and of higher quality; the

material will become more suitable for 3D printing and the print shops will be located inside the distribution centers or in large industrial cities (**Image 02**).

and print designs of pieces are available on the internet (electronic format). On the other hand, new opportunities and new business models will arise, such as 3D

Use of robots in warehouses will not only replace some jobs, but also create new ones

The major challenge in the future in this area is the issue of quality guarantee: Who takes over the responsibility for any damages or the costs if, for example, the product is defect. Another aspect is the intellectual property, which borders are blurred more easily if 3D printing is widespread

printing centers, which are certified by the manufacturers to print their pieces.

Will robots take over the material handling in the warehouses?

The non-humanoid robots are already an established part of our industrial environment. They build an inherent component in our automotive production where they weld together the different pieces of a vehicle body. Together with the artificial intelligence, new progress is created, for example computers win chess games against humans since many years.

However, in distribution centers we still see a large number of machines handling goods, or complex transportation and storage systems for pallets and boxes that do not look like robots but are replacing the humans. The automatic and semiautomatic systems are used for picking boxes or units, but they are also very complex solutions that require a large financial investment.

These high-end technologies to automate warehousing, handling and internal

Conventional supply chain vs 3D supply chain	
Conventional supply chain	3D supply chain
Manufacturing in India	Printing in Printing Service Center in Rio de Janeiro
Transport to central warehouse in Germany	Packing and shipping to dealer in Rio de Janeiro
Picking and transport to Latin American warehouse in São Paulo – unpacking & put away	
Picking and packing to dealer’s order	
Shipping to dealer in Rio de Janeiro	

Source: Miebach

Calculation example for the economic profitability of robots in warehouses

Performance	Human workforce	Robot
Picks per hour	500	700
Working hours per day	7,5	16
Working days per year	200	250
Total picks per year	= 750,000	= 2,800,000
Cost calculation		
Investment	–	210,000 US-Dollar
Depreciation	–	70,000 US-Dollar
Labor cost / maintenance / energy	40,000 US-Dollar	20,000 US-Dollar
Total cost per year	40,000 US-Dollar	90,000 US-Dollar
Cost per pick	≈ 5.4 cents	≈ 3.2 cents

Source: Miebach

transport as well as order preparation will be partially replaced by robots very soon. According to various sources, more than 50 % of the staff of warehouses will be replaced by robots in the next 10 years.

Instead of having a humanoid form, these robots will have a much more specialized design depending on its particular function. The key elements will be the grabbing and recognition systems (“hands and eyes”).

The implementation of specialized robots in warehouses mainly depends on the economic profitability with working hours, labor costs and other necessary investment for the robots taken into account (table on this page).

Therefore the robotics industry should reduce investment through standardization and mass production of robots.

The use of robots in warehouses will cause the elimination of some jobs but will also generate other jobs related to manufacturing, commissioning and maintenance.

Delivery by drones – limited to specific areas of use

Military or civilian use of drones (surveillance, photography, toys) is already widespread in the world but its use in logistics is still very limited. A drone is a mixture of an aircraft and an unmanned helicopter, and we all know that transporting goods by air is the most expensive form of transportation today.

However, companies like Amazon and Google are already experimenting with drones that perform customer deliveries, mainly of purchases made via e-commerce. There are other companies such as Deutsche Post DHL, Matternet or VertiKUL, which are also working on this kind of service, and who already established cases in which a fixed trade route for deliveries via drones, for instance the delivery of drugs to pharmacies in remote areas.

A restricting factor in the operating method of these drones is that all of them have to be operated manually (with a joystick) from the warehouse and none of them is flying to their destination “alone”. There are other constraints that have to be considered in the future: economic, legislative and safety aspects. Furthermore, it is necessary to solve several logistical challenges before the implementation of delivery drones: Definition of flightways on highways, landing sites and returns.

In the short term, the delivery through drones is developed to supply remote areas and also the production facilities (through internal transport).

The short-term distribution by drones will be developed to supply remote areas and like an internal transport system inside the factories. In the long term, the drones will be used for the delivery of e-commerce orders (delivery in 30 minutes) and courier premium services. It is unlikely that drones will be used for mass

transportation purposes or that it will replace other means of transport, but they could become a valuable alternative solution for delivering goods when it comes to speed.

The use of drones may even lead to a reduction of urban traffic, if the air traffic by drones can be regulated through circular routes and highways.

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