New technologies in automobile manufacturing are occasionally brought down to earth with a hard thud. If Industry 4.0 projects are to have a chance of success, a close look should be taken especially at the existing hurdles.
RFID, 3-D printing, augmented reality, connected products, and lightweight robots. Engineers, technicians, and physicists from the IT or development departments immediately become excited at the thought of using new, possibly even “disruptive technologies” and start playing through possible use cases. This author finds himself caught up in this kind of excitement as well. After all, the automotive industry, driven as it is by innovation, gets its wings from us creative spirits!

But as so often happens – it is not possible to “tunnel through” the famous hype cycle, and disillusionment sets in at the latest when the new technologies in automotive manufacture come down to earth – production and logistics – with a thud. Detecon is actively involved in shaping recommendations for implementation of the “Platform Industry 4.0” (www.plattform-i40.de), a nationwide initiative of the largest German business associations within the framework of the high-tech strategy of the German government. We have been accompanying “smart” or “digital factory” projects for production in manufacturing industries, above all in the automotive industry and its suppliers, for many years and can, on the basis of this experience, assess what expectations for Industry 4.0 are realistic and where the problems in its implementation appear.

Before we start looking at the problems, however, we should make sure that all of us mean the same thing when we talk about Industry 4.0. Quite often we find this term being used synonymously with “Internet of Things” or “Smart Factory”, but both of these concepts fall short of what is truly meant! The recommendation for the implementation of Industry 4.0 mentions three fundamental prerequisites that differentiate and delineate the subject:

1. Horizontal and cross-company integration of the value chain: from the development of a product to its delivery.
2. Vertical integration with interconnected production systems, bi-directional all the way down to the machine level; commands are issued for product processing, but machines and products can also send data back to the ERP for business management.
3. Digital consistency of the engineering throughout the product life cycle and the related production system; avoidance of technology breaks!

So much for theory – without the least regard for the technology. If we now look at the current state of Industry 4.0 in the automotive industry, however, interested readers will quickly see why shaping the digital future is not as simple as it might have initially appeared.

Hurdle #1: Efficiency pressure in the core added value

Mass production at the assembly line was introduced almost exactly 100 years ago (by Ford) and has since been mercilessly trimmed and optimized for efficiency. Specifically:

- Manufacturing costs and downtimes have been minimized;
- Logistics and sequencing have been optimized;
- Output (number of units built daily) and quality have been maximized.

During mass production, every single minute counts, and the drastic increase in complexity resulting from customers’ individual configuration of their vehicles has definitely turned automobile manufacturing into a challenge. There is substantial reluctance to make any changes in this optimized, yet fragile structure because the pressure to maintain high productivity is immense. Moreover, the increasing number of recalls that are another consequence of the complexity cut into the return on sales, which is thin enough to begin with.

These are the reasons why no one wants to take responsibility for “experiments” that cost a lot of money or could cause disruptions in production. Instead, smaller solutions are tried out in pilot projects here and there – provided there is always a backup solution on hand in the event of failure.

Possible solution: If and when Industry 4.0 has been declared a “top-level issue”, the required breathing room for development or independent “startup” cells that are separate from daily business must be created.

Hurdle #2: Disparate cultures

When IT talks to a plant manager or an automation technician, it is frequently the collision of worlds that are simply measured according to the objectives mentioned under #1. IT goes to the business department with the best of intentions, seeking to determine the department’s needs and to identify possible ways to optimize processes. The business department, in contrast, often prefers to speak about concrete technologies. Perhaps data glasses are procured for testing, or the question arises why a new handling device with IP address cannot simply be added to the network (security requirements). If the look is now extended beyond the immediate horizon to include the production sites scattered all around the world, it quickly becomes obvious that every plant is different – or claims to be different, in any case.
**Possible solution:** The ground for common understanding and goals can be prepared by establishing the required organizational structures with innovation managers, mixed teams, dedicated tasks, and decision-making bodies.

**Hurdle #3: Lack of governance and collaboration models**

Most of the time, the central IT department receives orders from top management to “drive forward” Industry 4.0 and innovation – there is enormous pressure to be able to say something of substance at conferences or during interviews.

So where, then, are the brakes applied? In reality, matrix organizations are ideally structured to nip innovations in the bud and to prevent the establishment of standards:

> Business departments have different targets than the downstream IT and generally only seek consultation when there are issues of the interfaces between MES (manufacturing execution system) and ERP. During the discussions, a lot of energy is generally expended in the efforts to achieve standardization.

> The plants are independent business units and are often actually competitors with one another when they are trying to gain approval for the construction of a new model series.

> The central IT department generally concerns itself with data centers, networks, and globally available applications. Each plant has its own local IT team, however, caught between the central IT department and the plant in the matrix organization (“solid/dotted line”).

> If machines or products are connected, e.g., via so-called localization solutions, yet another layer is added to the traditional “MES pyramid” (see figure). In the case of such genuine Industry 4.0 solutions, however, it is not clear who has final responsibility because they intervene directly in production (the responsibility of the business department), but secure connection to the networks and systems must be guaranteed so that the product (vehicle) is linked to the customer order (responsibility of the IT department).

> Most of the large OEMs have special test factories where they try out new automation technologies. As a rule, however, they are fixed on the hardware side while Industry 4.0, in contrast, includes as well the network, data, and application side!

**Possible solution:** All of the units come together first of all in the central management board – and this is exactly where the command of the subject of Industry 4.0 must be centered so that governance with all of the stakeholders is possible. In the end, the subject is actually a far-reaching business transformation that will create competitive advantages if (and only if) it is set on the right course from the beginning. By the way, the situation is very much the same with respect to the subject of Connected Car; the problem was first recognized and the proposed solution was the creation of the management board position of a chief digital officer (CDO).

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*Figure: Future IT of Production in the Context of Industry 4.0*

**Source:** Detecon
Hurdle #4: Obsolete, monolithic production systems

No one is keen to try “open-heart surgery” – so how can changes otherwise be initiated? As of this moment, there are no indications that there will be any major changes in production methods, which have been following the same sequential pattern of assembly line production for over 100 years, at any time in the next few years.

Almost all manufacturing companies expended a lot of money and effort in the 1990s to connect their production systems to SAP – this was necessary, if for no other reason, because of the increasing complexity of the logistics and the securing of the material flow at the right moment (sequencing). Over the course of time, these large, monolithic production systems have been expanded by the addition of more and more special solutions far removed from any standards. Owing to their right intermeshing with core added value – the manufacture of automobiles – they are at the very heart of operations, and for all practical purposes it is impossible to replace them in existing, active factories.

This has led to most companies taking the so-called green field approach, the construction of new factories – although so far no genuine alternative to the previous systems is available. Only smaller, new component plants can perhaps be operated with a standard MES solution. Legacy factories, owing to their structure of assembly line production with monolithic systems (that also do not fit within the guardrails of modern IT architecture), can be changed only in small, evolutionary steps. Greater efficiency can perhaps be achieved by more extensive replacement of the human workforce with robots. At the moment, however, development in this direction is still in the preliminary stage – the protective fences are just now falling for the so-called lightweight robots such as Kuka LBR; the entire arm is populated with sensors that respond immediately to touch so it can work hand in hand with people or relieve older workers of heavy work.

Possible solution: If a genuine Industry 4.0 revolution is to succeed in the new factories at least, there would have to be an almost radical turning away from (sequential) assembly line production and conversion to so-called station production. After welding, painting, and fitting plus a so-called day for localization in the factory, the vehicle finds its way through the production process on its own! The necessary technologies are already here; there is, for instance, transport using automated guided vehicles (AGV). This would save an enormous amount of floor space because permanently installed assembly lines are no longer needed.

Unfortunately, it makes the problem of material flow even more complicated (just in time, just in sequence, just in location). If, however, we ever actually reach this point, the automobile will presumably no longer be what it once was – more a kind of fully automatic, electrified cabin taxi, assembled from a large number of printed and glued plastic parts, that is booked as needed. Good-bye to car racing.

Hurdle #5: Lack of vision and Industry 4.0 strategy

The result of all of these factors has so far been the lack, by and large, of a holistic, coordinated road map or vision. Besides the lack of mixed teams and coordination among the stakeholders in the appropriate decision-making bodies, there are not even any strategies for partial areas such as plant IT only or automation technology only. This corresponds to a straightforward, technology-driven bottom-up approach. Applications are not developed according to need; instead, there are just trials to see what a technology might be used for.

Possible solution: As tantalizing as this might be – a factory is not a startup garage, and technology must not be allowed to degenerate into an end in itself. What is needed is the agreement of the stakeholders about prioritizing the domains such as production planning in harmony with the corporate strategy; for example, the goal of reducing the time between order and delivery or of being able to produce more flexibly might be set. Only then will it be possible to evaluate technologies for their maturity level and the related applications for their contribution to strategy!

The right approach is a healthy mixture of bottom-up strategy (“trying out” technologies) and top-down strategy (corporate strategy as the “big picture”, cataloging of requirements from the business departments, prioritization of the production domains). Moreover, there must be an iterative process, conducted every year, for recognizing and testing new or more mature technologies and for reviewing possible applications in the prioritized domains.

Hurdle #6: Inadequate architecture without end-to-end security

The legacy of an old MES and its interfaces lacking in consistency and with a lower level of interconnection certainly has one advantage: the heart of the core added value is virtually impervious to attack from the outside. Industry 4.0, however, is based on horizontal (along the entire corporate value chain) and vertical networking (from ERP, MES, and shop floor IT down to the product). The networking through the core value-added process offers opportunities for greater efficiency and synergies, but also heightens risks (example: Stuxnet).
**Possible solution:** IT architects and security experts must be involved in the design of the applications and the entire construction must depend on secure end-to-end architecture. This includes a detailed cataloging of requirements – however, this is standard procedure for these specialists. It is certainly permissible to point out here that Detecon has been conducting training programs in this area for more than ten years!

**Hurdle #7: Technology as an end in itself**

Technology and use case are frequently confused. There are actually examples of a new technology being rejected after a review of its possible use because no one had the imagination to think up further use cases.

A famous example, and one that is ten years old, concerns the operating company of the Frankfurt airport. It originally intended to use RFID for baggage tracking, but then decided against it for cost reasons. The technology was put into use in a completely different way, however: in the legally required fire protection system. About 22,000 doors and smoke alarms make use of it at the Frankfurt airport! The RFID tags were ultimately used for the improvement of the maintenance process: the technicians’ PDAs record the time spent in the vicinity of the door and the digitally documented work can be transmitted directly to SAP.

**Possible solution:** There are standard procedures that can encourage a team to “think outside the box”. Detecon has successfully established the “Design Thinking” methodology in Telekom Group; within only a short time, an agile, iterative process in interdisciplinary teams has led to concrete results (need analysis, idea development, rapid prototyping). Moreover, it is also important that management be willing to accept mistakes. It is not always possible to set out on the right path from the very beginning.

**Conclusion**

These are the seven bridges that must be crossed if the courage is perhaps to be found – after 100 years of sequential assembly line production – to do something fundamentally different. In our opinion, the following elements are absolutely essential:

- Top management buy-in
- Stakeholder management and decision-making bodies for cross-organizational collaboration
- Formation of two-man teams from business department and IT department for concrete issues
- Annual technology radar and continuous assessment of possible applications
- Innovation management with breathing room for creativity and a healthy culture of mistakes
- Cataloging of needs and requirements from the business departments
- An accepted and anchored vision, but one that must still be flexible enough to accommodate rapidly changing technologies

Ultimately, hype also must include a healthy estimation of what appears to be feasible in the specific situation. One product strategy could read like this:

“We are not doing what we have always done in a completely different way, we are simply doing it better.”

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*http://www.computerwoche.de/aftraum-part-450-000-euro-pro-jahr,1051986

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