#59

ROIDIALOG

# LEAN'S LAST RACE?

*The way to the next evolution stage in Lean Management*

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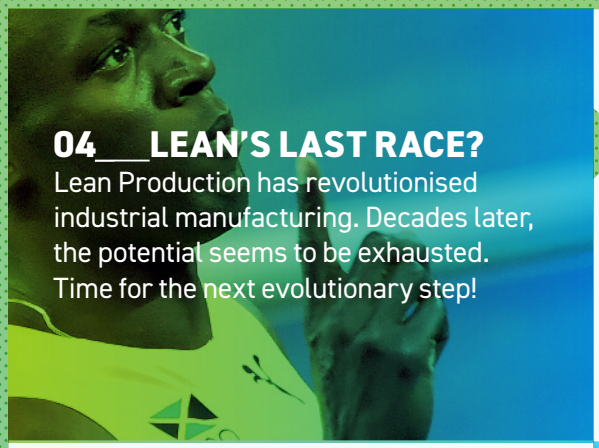


*By Hans-Georg Scheibe, Managing Partner*

# LEAN FUTURE

**ACCORDING TO JAMES P. WOMACK, AUTHOR OF THE STANDARD LEAN WORK „THE MACHINE THAT CHANGED THE WORLD", THERE IS ONLY ONE JAPANESE WORD THAT EVERYONE SHOULD KNOW. IT IS CALLED MUDA AND MEANS WASTE.**

It refers to activities that consume resources but do not create value. For example, mistakes that need to be corrected. The production of things that cannot be sold. Or employees who cannot continue working because they are waiting for a certain workpiece.

The central principle that derives from this and to which all lean approaches, systematics and tools of the last 20 years can be traced is: Avoid everything that does not add value. But what if the understanding of what waste means and how added value is created has radically changed in the last twenty years?

For example, by starting to consciously waste resources instead of rationing them and thereby creating entirely new value creation opportunities: The graphical user interface, the Internet, cloud computing - all these innovations are based on the fact that scarce resources such as computing power or storage space are suddenly so cheaply available that new business models emerge from wasting them. Will this disruptive power of Moore's law become the gravedigger of lean principles? What does it mean, for example, for the design of manufacturing systems when manpower in the form of robots is available so cheaply one day that it makes no difference whether an activity is performed by 5 or 500 machines?

The concept of industrial value creation has also undergone radical change over the past twenty years. Because in the age of digital services and changed business models, the concept of value creation is increasingly decoupled from the production of physical goods. Value creation therefore no longer arises only in the classical manufacturing process, but lies in the networking of people, machines and objects, in the virtualisation of products and processes and in the provision of data and knowledge.

Whether and how these changes affect the principles of lean management is difficult to say from today's perspective. However, it is clear that lean must find answers to these questions of the future. At least it is doubtful whether they are in the guidebooks of twenty years ago.

# LEAN'S LAST RACE?

## THE WAY TO THE NEXT EVOLUTION STAGE IN LEAN MANAGEMENT.

**No management approach has shaped manufacturing systems as much as lean management over the past thirty years. But although lean is now often regarded as a commodity, its true potential has hardly been tapped to date. New advances in technology, psychology and analytics will make the next thirty years even more exciting than the last.**

*When Usain Bolt crossed the finish line of the Beijing Olympic Stadium on the evening of August 16, 2008, he succeeded in doing something that shouldn't have been possible. He had just covered the 100 meters in exactly 9.69 seconds. 0.03 seconds faster than it is physically possible for a human being according to the calculations of leading sports scientists. With his top run, he not only set a new world record, but also questioned the assumptions about the limits of human performance.*

*The question as to how far one can still advance the optimization of one's own performance is also of concern to those responsible for production in industrial manufacturing. For decades, lean production was regarded as the dominant paradigm when it came to shortening throughput times, increasing machine availability or ensuring quality standards. By applying lean principles such as line balancing, pull principle or one-piece flow, they tried to further exploit the efficiency of their manufacturing systems. But in the meantime, other issues have pushed the lean factory off the management agenda. And some believe that Lean has already reached the limits of its capabilities.*

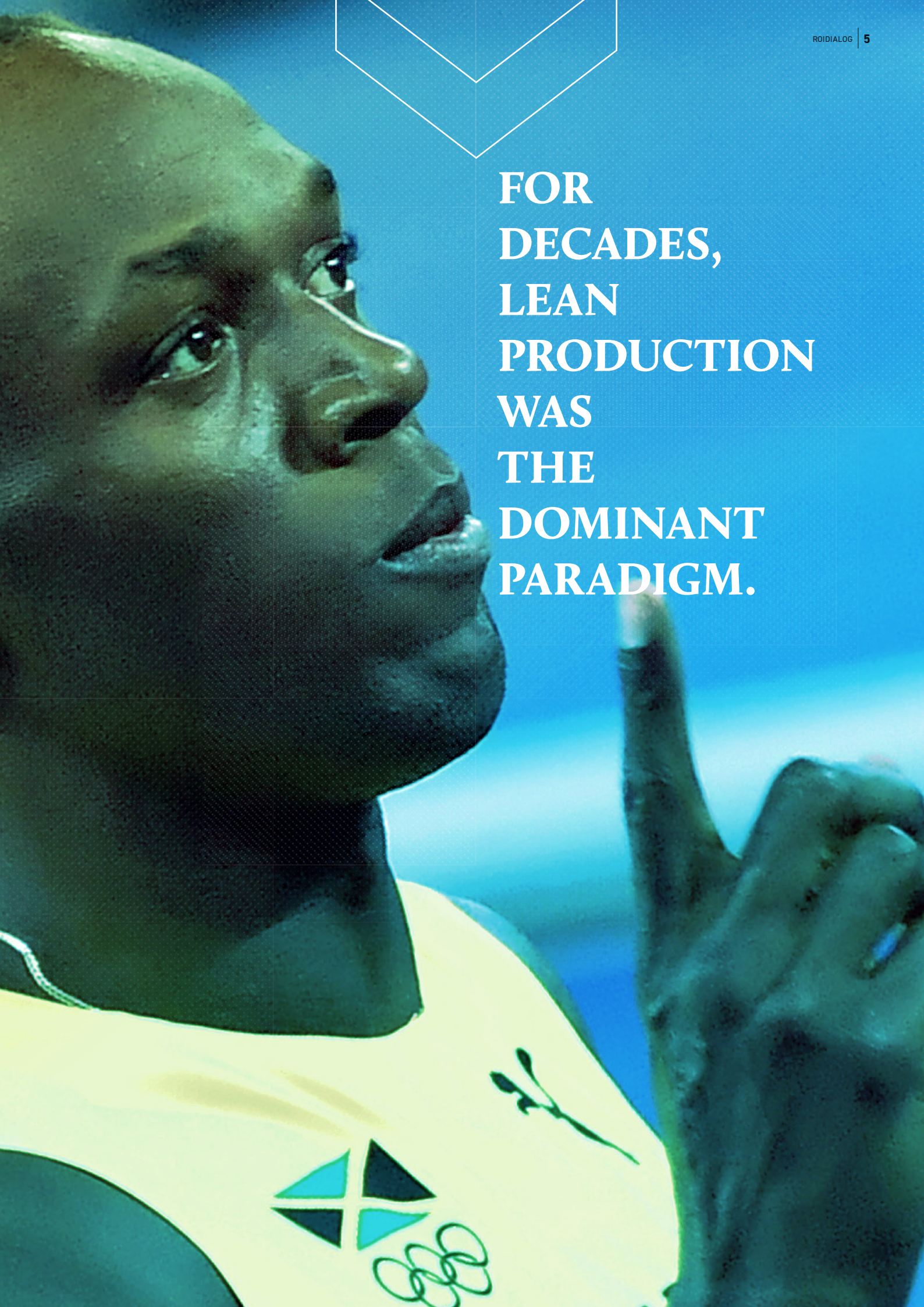
*In fact, however, most companies are only just beginning their lean development. On the one hand, because they often do not yet implement and further develop existing approaches consistently enough. On the other hand, because the integration of new technologies into lean management enables completely new efficiency gains. Together, these two factors create potential that could double the level of productivity achieved to date. Or to put it another way: As if Usain Bolt was running the 100 meters in 4.8 seconds instead of 9.6 seconds. In order for Lean to reach these record levels, it has to go through several evolutionary stages:*

### 9,6 SECONDS
### FROM TOOLBOX TO MANAGEMENT APPROACH

*If you walk through the workshops of German companies today, the traces of Lean Manufacturing are omnipresent. Workplaces are designed according to the 5S principle, posters recall the design principles of lean production and shop floor boards document current events on site. The deeper view into the factories, however, shows a much more heterogeneous picture and still numerous deficit.*

*In theory, manufacturing systems are often very well described. In practice, however, the increases in efficiency achieved so far are mostly the result of isolated improvement projects and point kaizens that are located at the level of classic lean tools such as material control concepts, kanban or teamwork. This is usually due to a wrong understanding of lean as a toolbox that is used for the short-term realization of certain cost or quality goals.*

*The consequence: Lean initiatives often get stuck in the pilot phase or are not consistently further developed after the respective KPI target has been reached. At the same time, however, as the demands of the market continue to develop rapidly, for example in the direction of individualized products or shorter lead times, the effect of these unique and static lean initiatives usually fizzles out without having a lasting effect - especially since they are usually limited to individual lines or work areas such as assembly.*



# FOR DECADES, LEAN PRODUCTION WAS THE DOMINANT PARADIGM.

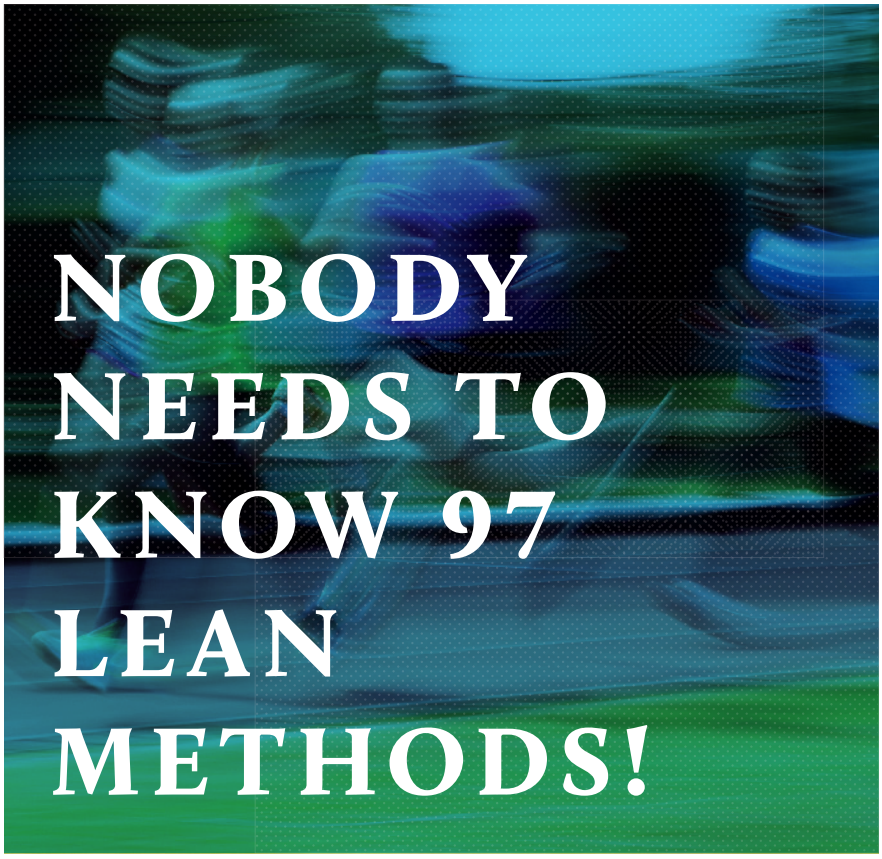
## 8 SECONDS
### FROM VALUE STREAM TO BUSINESS MODEL PERSPECTIVE

*But added value doesn't just begin in manufacturing. And above all, it does not end there. This applies all the more to smart products and components that are able to collect and communicate data throughout their entire lifecycle, from the manufacturing process through to use by the end customer. Lean must take this development into account. On the one hand, it also includes indirect areas such as logistics or maintenance in the value stream design. On the other hand, as value stream analyses are based not only on the material flow but also on the information flow and the IT systems used, in order to identify waste in information technology and to be able to switch it off later.*
*At the same time, this holistic approach must also be reflected in the target image. Instead of starting at the level of key figures, e.g. to reduce throughput times or downtimes, lean initiatives must ask where business processes are heading. Where are the challenges of the market? Do I need to get faster? Do I have to go one step higher in the direction of quality? Is delivery flexibility perhaps more important than productivity? Lean management automatically moves closer to the corporate and production strategy - away from Lean as a tool for KPI optimization and towards a strategic value driver.*

## 7 SECONDS
### FROM TOP FLOOR TO SHOP FLOOR

*The transformation of these overarching target images into concrete actions and behaviors at the point of value creation and their sustainable anchoring continues to be one of the greatest challenges in Lean Management. For the further you dive down the much-quoted "iceberg" towards "Lean Culture" and "Lean Thinking", the more Lean a philosophy often becomes. In fact, however, there are very concrete measures that can help to permanently anchor a culture of continuous improvement in the company.*

*On the one hand, the systematic development of lean know-how in the shop floor: Instead of bundling knowledge in external staff positions or project teams, the training of key users and lean influencers at employee and master level was intended to permanently strengthen lean expertise on site. A decisive factor here is the targeted qualification of employees. Nobody needs to know 97 lean methods. Instead, trainings should be adapted to the actual qualification requirements and should take place at the real object or during ongoing operations. The right qualification of the middle and upper management level is just as central: only if Lean is understood as a management philosophy the managers can also take on the active driving role and ensure sustainability*




*On the other hand, abstract objectives must be translated into concrete key figures and process parameters that are understandable and can actually be influenced by the shop floor employee. The basis for this is formed by cascades of key figures with which target/actual deviations can be recorded clearly and transparently at all company levels. At the same time, they make it possible to initiate problem-solving processes that clearly define a direction for improvement (but not the solution) and thus support employees in their daily improvement routine.*

*The central management instrument is the shop floor management. When implemented correctly, it not only secures and stabilizes the operative control of value-adding processes across all corporate hierarchies, but also promotes continuous process improvement while simultaneously developing employees and their problem-solving skills.*

## 6 SECONDS
### FROM COMPLEXITY REDUCTION TO COMPLEXITY OUTSOURCING

*At this point a caesura takes place. This is where the area of conventional optimizations ends, which can be achieved by exploiting and constantly developing the well-known lean principles. What now follows is the entry into a new phase of lean manufacturing, which is based on the same basic principles, but is making a decisive paradigm shift: Where Lean has so far attempted to reduce or control complexity by dividing complex systems and processes into simple, operationally more manageable units, digital technologies enable this complexity to be outsourced and kept away from the user.*

*As part of digital shop floor management, for example, sensor-supported real-time data and intelligent apps are replacing decentralised Excel solutions, manual lists and handwritten cards. At the same time, the provision of real-time data can significantly improve both the reaction speed and the error rate in the shop floor. Virtually all operations along the value stream can be digitally enhanced in this way: whether predictive maintenance solutions, real-time quality control loops, self-controlling*

**WITH A COST TARGET OF -3%, THE EMPLOYEE CAN'T DO ANYTHING WITH THE MACHINE FOR THE TIME**

*logistics systems or human-machine collaboration in the context of workplace design. The combination of Industry 4.0 and Lean enables optimization potentials that are about as high as what has been realized in thirty years of conventional lean manufacturing.*
*However, these effects only become effective if they are based on the principles of a lean process. Otherwise, digital technologies create new complexity instead of keeping it away from the user. Or as former Telefónica CEO Thorsten Dirks once put it: "If you digitize a shit process, you will have a shit digital process."*

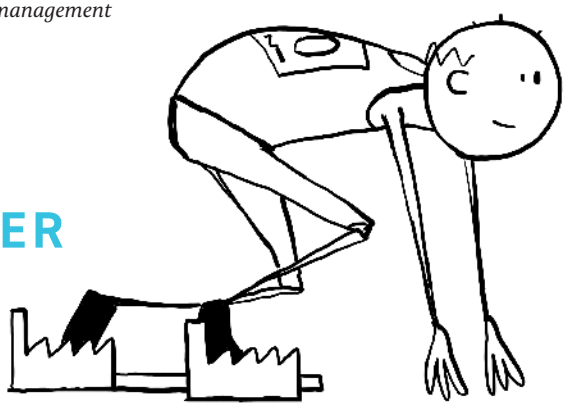
## 5 SECONDS
### FROM LEAN BY EFFORT TO LEAN BY DESIGN

*At the end of this step-by-step lean evolution is the vision of a fully digitized, lean value stream that synchronizes all information and material flows directly or indirectly involved in value creation, from development to manufacturing to logistics, and makes the information contained therein usable. Approaches to this vision can already be seen today in digital process twinning.*

*Along this value stream, the individual process steps will increasingly shift in the direction of autonomous systems that not only recognize process deviations, but also independently find solutions, for example in the sense of prescriptive logic. And this is where it gets exciting. Because where processes increasingly control themselves, Lean must begin to re-evaluate certain basic principles. How meaningful is a pulling system in the age of predictive systems?*

*Against this backdrop, lean experts must remain open to new technologies on the one hand and free themselves from rigid rules and methods on the other. Instead, it is a matter of allowing experiments in the sense of the lean concept and thereby enabling new process optimizations. The starting point is always the customer benefit, which, thanks to smart products and product-related services, is moving ever closer to the development and manufacturing processes. One question for such an experiment could be, for example, how individual customer requirements can be realized without additional planning effort at the workstations. And this is where Lean leaves manufacturing and becomes a cross-company management approach.*

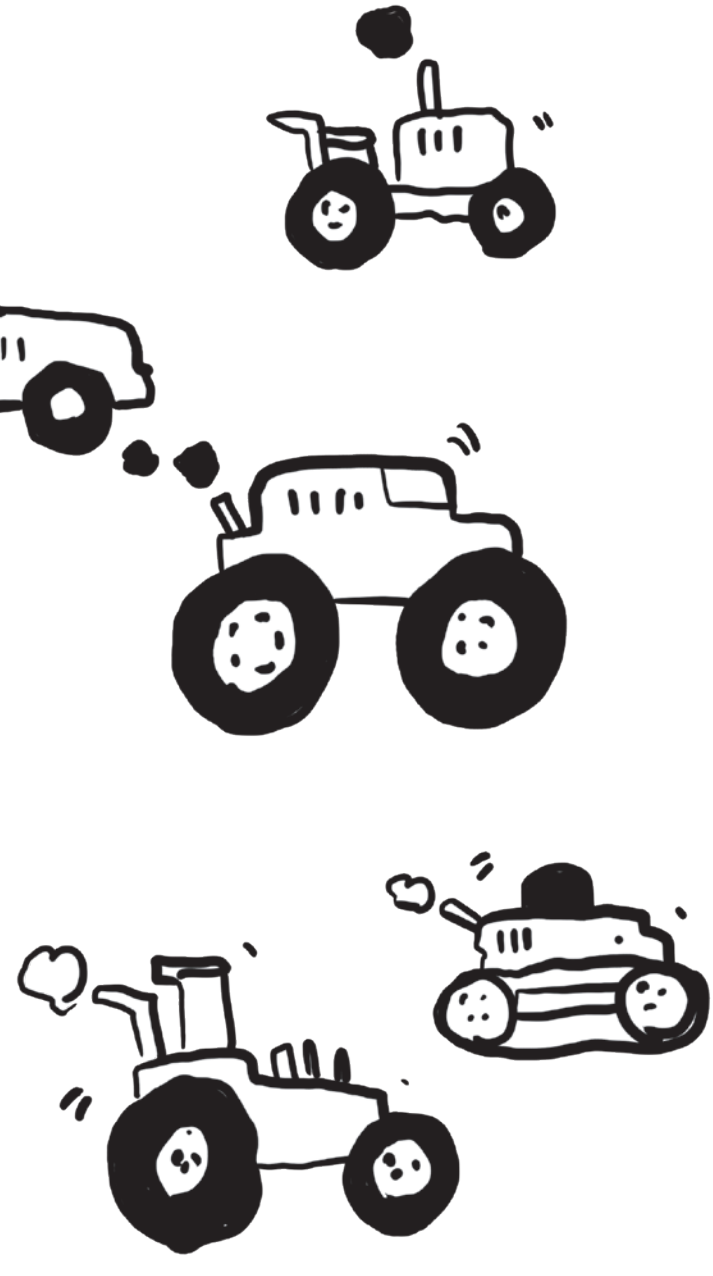
## THE RACE IS NOT OVER YET

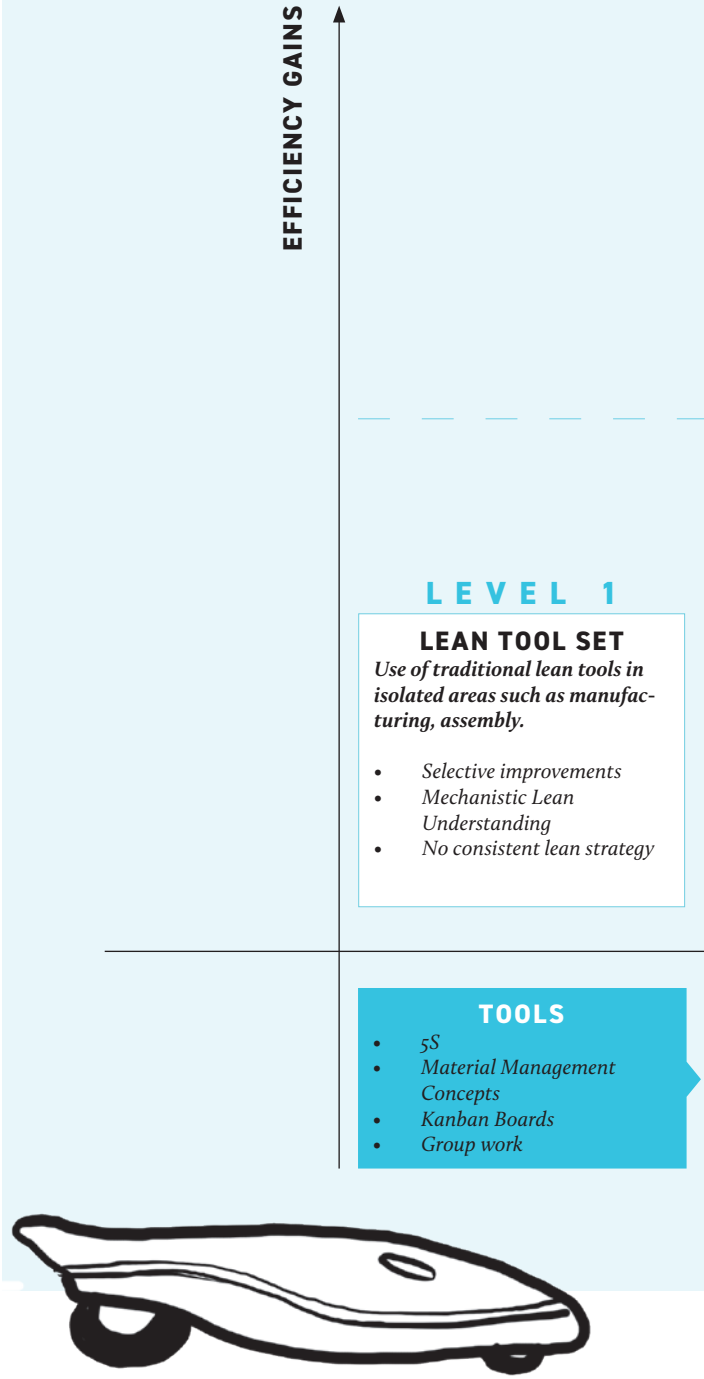


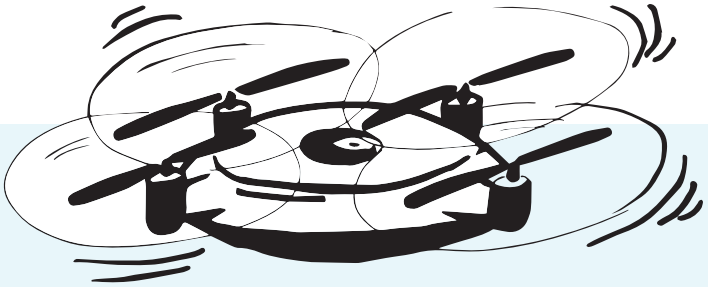
*Of course, Lean hasn't come to the end with this. The fact that a system can no longer be optimized is not impossible. So there will be new development stages and areas in the future in which Lean can advance thanks to new technologies. An end to the records is therefore not in sight.*

***Usain Bolt won´t care.***
***He now gave up the race.***

# JUST BECAUSE TOYOTA ONCE INTRODUCED THE KANBAN PRINCIPLE WITH TWO CONTAINERS DOESN'T MEAN I CAN'T USE A DRONE.







## LEVEL 2

### LEAN VALUE STREAM

***Holistic view and lean optimization along the value stream.***

- *Integration of the indirect areas*
- *Mapping the material and information flow*
- *Linking with strategic corporate goals*

**TOOLS**

- *Value stream mapping and value stream management*
- *Time management and assembly planning (e.g. MTM, ROM)*

## LEVEL 3

### HOLISTIC LEAN

***Enablement of all employees in accordance with the lean philosophy and holistic embedding in the organization.***

- *Development of Lean Knowledge and Influencers in the Company*
- *Holistic target picture development*

**TOOLS**

- *Shop Floor Management*
- *Staff and management trainings, e.g. Gemba workshops*

## LEVEL 4

### LEAN DIGITAL

***Digitally supported lean management outsources complexity instead of reducing it.***

- *Greater transparency through real-time-based metrics*
- *Automatic detection of variances and escalation*

**TOOLS**

- *Digital Shop Floor Management*
- *Digital Twin*
- *Predictive Maintenance*

## LEVEL 5

### LEAN BY DESIGN

***Self-optimizing lean systems that partially overcome old design principles.***

- *Autonomy instead of the pull principle*
- *Prediction instead of reaction*

**TOOLS**

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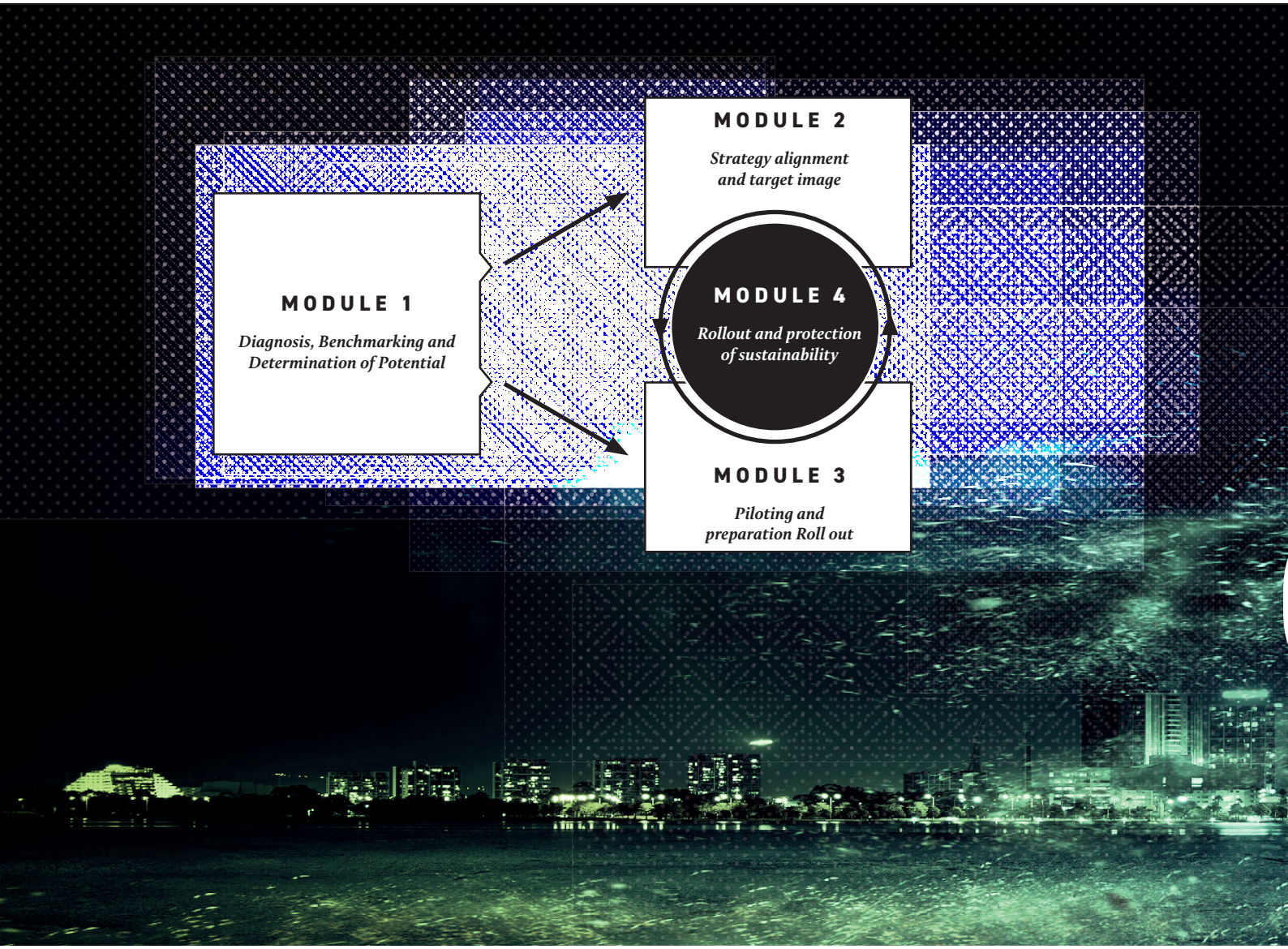
**LIMITATIONS OF TRADITIONAL LEAN MANAGEMENT**

**LEAN MATURITY**

figure 1

# THE ROAD TO LEAN MANUFACTURING



**THE PREREQUISITES FOR LEAN PROJECTS CAN BE EXTREMELY DIVERSE.**
Depending on whether a company has been dealing with the topic for years or has completely neglected the further development of its manufacturing system due to rapid growth. Whether the measures concern individual series of a product or the global manufacturing network of a company. Whether the focus is on increasing flexibility and customer-specific manufacturing or on overall system effectiveness.

However, as different as the framework conditions are in detail, certain success factors usually apply, which can be transferred to all types of lean projects. In addition to a systematic definition of objectives in line with the corporate strategy, these include the targeted qualification of employees and managers as well as the implementation of measures and structures to permanently anchor the lean principles in the overall organization.

Based on these modules, the following sections describe current findings and examples of success for the introduction and global scaling of lean manufacturing.

MODULE

# 1. DIAGNOSIS, BENCHMARKING AND DETERMINATION OF POTENTIAL (CURRENT STATE)

## ISLANDS OF EFFICIENCY

**When the Lean Production approach came to Europe in the 90s, it was closely linked to the instrument of the "Point Kaizens". The idea behind it was simple: Instead of carrying out a complex reconfiguration of the manufacturing system, the first step was to achieve rapid lean successes through isolated optimization measures in clearly defined areas, which then merged to form a complete system. However, the hoped-for effects largely failed to materialize. The optimized areas were successful on a small scale. Without a connection to the remaining value stream, however, these would fizzle out because, for example, upstream workstations did not work in the same cycle and thus caused downtimes at the downstream workstation. Islands of efficiency emerged - in a sea of waste.**

The introduction of lean manufacturing based on point kaizens has therefore largely been replaced today by a more systematic approach that does not focus on working groups but on value stream or organizational levels. If this systematic approach is followed, a lean project begins with a comprehensive analysis of the existing manufacturing system. This comprises three central elements:

### *Determining the Lean Maturity Level*

Standardized assessments and method scans are used to determine an organization's degree of lean maturity. In addition to the classic process design and the methods used in manufacturing, this also evaluates the indirect areas such as purchasing, development, maintenance or shop floor management. In addition, the "Lean Capability", i.e. the ability to make changes at the management level, for example with regard to attention, mindset, target systems and the quality of managers at the lower levels, is also examined. This provides an initial qualitative picture to answer the question: Where do we stand and how far are we from best practice?

### *Quantitative potential derivation*

On the basis of this qualitative examination of the own systems, standardized calculation methods can then be used to derive the technical and business potential of possible lean measures. The latter in particular is crucial in order to generate the necessary attention for the measures at management level and to ensure the necessary support from the management level for the subsequent implementation stages.

### *External benchmarks*

In addition to the internal determination of potential, external benchmarks also help to evaluate the economic potential of lean measures. They also provide important information on the selection and design of the tools used and save time in the design phase by adopting best practices.

# FROM SCAN TO AWARD

## THE PERFORMANCE BUNDESLIGA

**A ROI project at a leading automotive OEM shows how to master the transition from the systematic evaluation of one's own manufacturing systems to a continuous operational excellence program.**

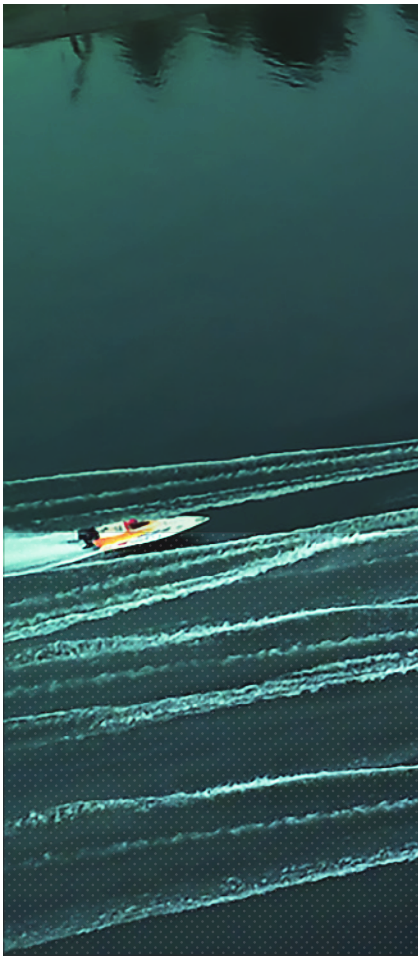
*In order to prepare the component plants of its German manufacturing network for competition from external suppliers, the Group planned to introduce a comprehensive efficiency program aimed at continuously improving productivity and quality in a total of nine German factories. To this end, ROI not only determined the current performance status of the individual locations, but also made it the basis of a unique competition:*

*In a kind of "Performance Bundesliga", the component plants competed in five predefined evaluation categories, such as plant and assembly efficiency. Each plant had to enter a certain number of lines and areas. The absolute and relative improvements on these lines were then measured over six months. The plants with the largest development leaps are the gold, silver and bronze winners within the category.*

*The main prerequisite for this form of internal competition was comparability between the different locations. To this end, a uniform calculation logic for the basic key figures was defined in advance. In addition, a scan specially developed by ROI for each category was used to record the methodological competence.*

*The data obtained in this way was published in all plants as in a Bundesliga table. The employees responded very positively to this competition, so that the idea quickly developed with great dynamism and yielded successes. After only a short time, there were significant improvements in productivity in assembly as well as in logistics and maintenance. In order to promote not only the idea of competition, but also mutual learning, ROI organized additional networking events and introduced a special category "Networking" in the competition, which took into account knowledge transfer and best practice sharing.*

*The translation of the standardized assessments into an internal competition provided for an unprecedented dynamization of the rigid plant structures and work routines. The program is currently being expanded at an international level in the third round with a total of 25 plants. The Performance Bundesliga will thus become the Performance Champion's League.*



MODULE

# 2. STRATEGY ALIGNMENT AND TARGET IMAGE

## THE CHICKEN OR THE EGG?

**Numerous lean initiatives fail even before they have started in the company. The reason: unrealistic target images, a lack of linkage with the corporate strategy or an incomplete picture of the value-adding activities in the company.**

However, how sustainable and holistic Lean Manufacturing is introduced and implemented in a company depends primarily on where the starting point for the planning of Lean measures lies: Is it just a matter of achieving a certain result, such as a cost target, with the help of lean tools?

Or is the focus on the process itself, the improvement of which is intended to achieve sustainable further development of the entire manufacturing system? This chicken-and-egg problem is decisive for whether lean manufacturing is merely seen as an instrument or toolset or whether it is understood as a management approach leading to action.

Three elements are therefore decisive in ensuring optimal target picture development:

### *Strategy alignment*

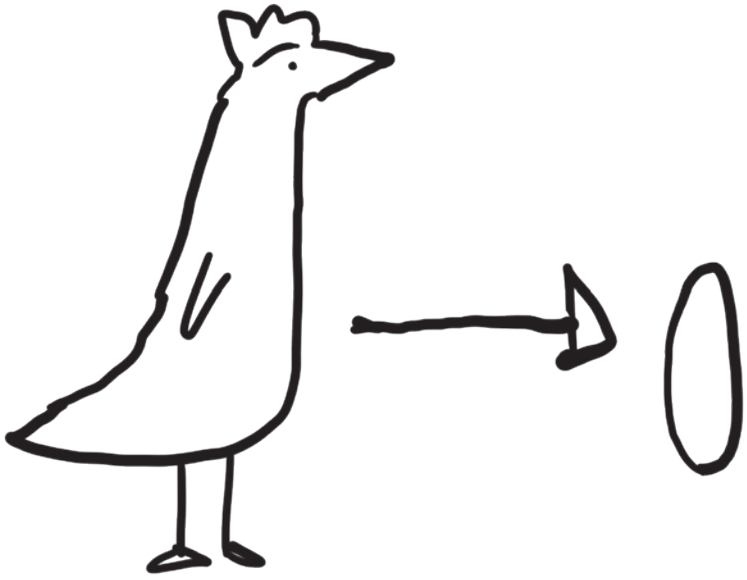
Lean projects should not only be oriented towards short-term key performance indicators, but should also be in line with corporate strategy and market requirements. Goals, requirements and framework conditions must therefore be derived in a systematic strategy comparison from the corporate and manufacturing strategy and translated into concrete lean principles.

### *Target image development*

From these strategic requirements, a target image is then developed in the sense of a future state, which provides information about the structure of the value stream, the lean, technology and digital concepts used, the integration of the indirect areas, organization and management systems as well as qualification requirements. They are derived from the previously defined strategic requirements of the market. If, for example, the company has to move faster towards the market, this means a shortening of throughput times; if the ability to deliver is to be increased, this requires measures in the area of quality.

### *Management attention*

In addition, it is crucial in this phase to create the necessary conditions for the implementation of the Lean project at management level. This involves first of all generating attention for the lean initiative and attracting supporters at decision-maker level. In addition, lean and digital initial training for upper and middle management to ensure the sustainable anchoring of the lean concept across all hierarchical levels in the company.



**LEAN MANAGEMENT RADICALLY QUESTIONS MANY CERTAINTIES OF CLASSIC LEADERSHIP BEHAVIOR.**

*For lean transformation to be successful in the long term, managers must therefore reflect on their leadership role and their behavior in dealing with employees right from the start. It is often necessary to overcome resistance and psychological blockades. Trust thus becomes a core resource in the change process.*

# THE QUESTION OF TRUST

**Actually, everything went according to plan. The manufacturing system was systematically further developed according to lean principles, the employees completed the corresponding method training courses and the first pilot projects were successfully completed. After one year, however, the disillusionment follows. After initial successes, the project stagnates. Targets are not met, causes of errors remain undiscovered and processes are not continuously developed further.**

## BEYOND OPERATIONAL PROCESSES

**This course of the project is prototypical for numerous lean initiatives that focus exclusively on the introduction of methods such as shop floor management or TPM at the process level and thereby neglect essential aspects of leadership behavior. As a result, at many points in the organization, lean practices encounter personal leadership behavior that is incompatible with key principles of lean management. As a result, the internalization of processes according to lean principles does not function properly across the various organizational levels and ensures that frustration or blockade attitudes arise at various points in the organization (see figure 2).**

**A lean transformation process must therefore address not only the optimization of manufacturing systems, but also a change in the roles and behaviors of managers at all levels of the organization. This includes three central dimensions of leadership behavior:**

### *Dealing with errors*

While in other countries, such as the USA, an open approach to dealing with errors prevails, Germany is one of the nations with the lowest fault tolerance. As a result, the willingness to take responsibility for mistakes is hardly pronounced. For fear of sanctions, mistakes are therefore often not openly addressed or even actively covered up. From a lean perspective, however, mistakes are of

elementary importance. Because only on their basis existing processes can effectively be evaluated and optimized. Managers must therefore establish a positive error culture and signal to employees through their behavior that errors are necessary elements of the improvement process.

### *Transfer of problem-solving competence*

In this country, the image of the manager as a problem solver, who "manages" certain grievances or difficulties in areas from above, still prevails. The lean approach, on the other hand, represents the principle of personal responsibility, which enables employees to independently develop solutions to problems in their area. Managers must therefore learn to delegate responsibility for solving problems to their employees and encourage them to take more responsibility through feedback and active communication.

### *Catchball procedure*

While in classical organizations target agreements are usually simply broken down from top to bottom, lean management relies on feedback processes, through which targets must first be discussed with the level below and confirmed by this level. This ensures that objectives are achievable and that the necessary resources are actually made available to achieve the agreed objectives. Managers at all levels must therefore ensure that these feedback loops are adhered to in their area and, in turn, demand this feedback at the next higher level.

## BREAKING OPEN INTERNAL RESISTANCES

**Many of the above-mentioned aspects call into question the traditional attitudes and behaviour of managers over decades, closely linked to the fear of losing influence or status. It is not unusual for attempts to break down these patterns to trigger resistance or blockades that can spread to all levels of the organization and endanger the success of a comprehensive lean transformation in the long term (see figure 2). This makes it all the more important to actively accompany and support this change process from the very beginning. The willingness of managers to change depends on three central factors:**

### *External pressure to change*

The higher the external pressure to transform one's own organization or area is perceived - for example through collapsing margins or new competitors - the higher the willingness to critically question existing role and behavior patterns. Conversely, areas that are in a good economic position usually have a higher resistance to change. This development is fatal above all because the conditions for a change project become more difficult the tighter the economic and temporal leeway becomes. It is therefore important to create a sense of urgency.

### *Internal resistors*

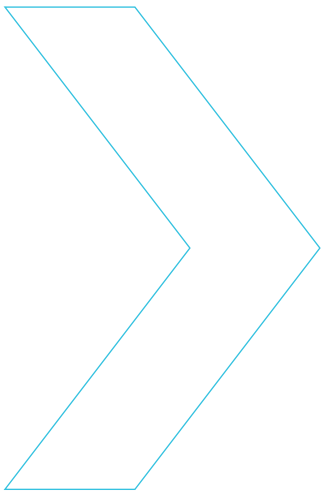
The longer executives in the same position are occupied with the same tasks, the higher their inner resistance to overcome learned behavior patterns is. Starting from certain positions, the probability for role changes decreases thus ever further, since the high-level personnel remain in the same position over ever longer periods. In such situations, methods that enable a change of perspective and give the opportunity to question one's own role and behaviour patterns are particularly important.

### *Time*

The more solid the roles and behaviors in an organization are, the longer it takes to break through them. In such a transformation, people go through different phases before adopting a new behaviour. (cf. Kübler-Ross curve). Time thus becomes a success factor in the transformation project in two respects. On the one hand, managers themselves need time to overcome their own role patterns and behavioural routines. On the other hand, because they should give the change project enough time to unfold, even if the results are not immediately visible.

## ALLOW A CHANGE OF PERSPECTIVE

**In order to win the managers as strategic partners for the project and to promote their personal willingness to change, they should be actively involved at an early stage of the project with the help of training. A particularly promising tool in this context are Gemba workshops in which managers observe the processes on the shop floor level and work out where value creation or waste actually takes place. On the one hand, this change of perspective should help to better recognize waste in the manufacturing process. On the other hand, it increases the visibility of the manager on site and thus creates trust and credibility for new forms of work. However, this only works if the actual behaviour of the local manager is in line with the propagated principles of Lean Management. If this is not the case because, for example, important error analyses are not carried out in favour of manufacturing volumes, this can lead to a loss of trust among the employees.**



## PSYCHOLOGY OF FAILURE

**A lack of willingness to change and adherence to old role models hinder the adaptation of lean principles at all levels of the organization. A lack of consistency and credibility at the management level continues downwards and creates frustration and blockade attitudes.**

figure 2

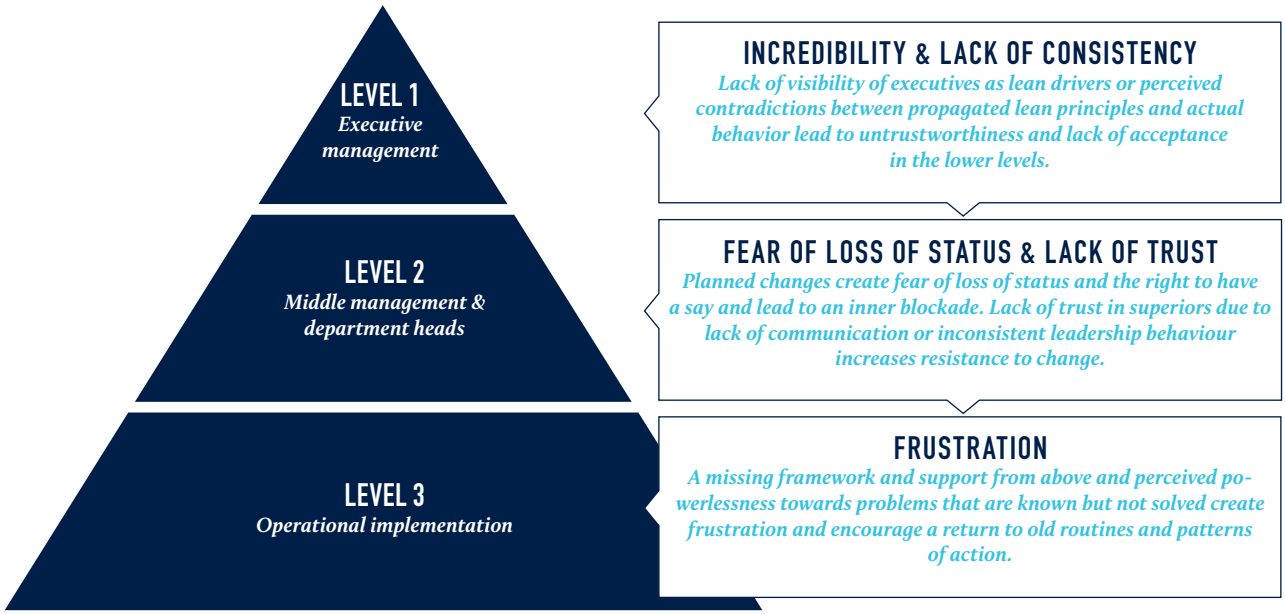
# BREAKING THE COMPLEXITY SOUND BARRIER

**Lean Production is based on the principle of complexity reduction. However, in view of the increasing demands of modern manufacturing systems with regard to the speed, flexibility and variance demanded by customers, classic lean approaches are increasingly reaching their limits. A training simulation of ROI sensitizes employees to the consequences of increasing requirements in the manufacturing process and at the same time shows new ways for a digitally supported lean production approach.**

A tractor manufacturer increases the number of its equipment variants multiple times in one fell swoop. The consequences in manufacturing are immediately noticeable: throughput times increase, the error rate in assembly increases and lean principles that have already been learned are abandoned. As a reaction, the company introduces digital systems, such as Sequenced Material Staging or Intelligent Routing, in assembly - with success: Productivity regains momentum, quality improves. The assembly line is stable despite a greater variety of variants.

## THE LIMITS OF SIMPLIFICATION

What normally takes place within years or even decades takes place here in 2-3 hours. The described scenario is not a real assembly, but part of the ROI-Lean Digital-IoT-Simulation. There the participants experience what happens in many companies in time-lapse mostly creepingly: High customer-specific customization, ever shorter delivery times and more comprehensive product features ensure more complexity and higher control effort. De-




**spite lean-optimized processes, error susceptibility and waste in the system are growing; the proportion of non-value-adding activities is increasing extremely. In short: classic lean approaches are reaching their limits - processes can no longer be controlled by humans.**

**This is exactly where the ROI simulation comes in and supports the transition from classic lean production to a lean digital approach. The assembly process of a tractor manufacturer is simulated using Lego components. In three rounds, up to eight participants take on various tasks, such as assembly activities, logistics and quality control, with the aim of producing as many tractors as possible without defects within a seven-minute shift. The framework conditions for the participants change from round to round in order to sensitize them to the increasing complexity of the assembly process and possible countermeasures:**

## ROUND 1: *CLASSICALLY OPTIMIZED LEAN PRODUCTION WITH ONE VARIANT*

In the first round of simulation, a single product variant of the tractor is manufactured on an assembly line optimized according to lean principles. The participants carry out standardized assembly processes at five assembly workstations. The required components are delivered just-in-sequence from the route train. The participants will experience how a synchronized assembly line, taking into account classic lean principles such as one-piece flow or kanban replenishment systems, enables high productivity and low error rates.

## ROUND 2: *LEAN PRODUCTION WITH GREATLY INCREASED COMPLEXITY (VIA VARIANCE)*

In round two, the number of product variants is increased from one to over 10,000. This increases the complexity of the overall process: In addition to the previous roles, a participant takes over manufacturing control by compiling the parts lists that match the customer orders and integrating them into the assembly process. At the assembly workstations themselves, the complexity increases as the employees there are suddenly confronted with different assembly steps and new work instructions, which they first have to select. These additional work steps quickly lead to paralysis of the entire system. While 14 tractors could still be manufactured in the first round of the game, an average of two were produced in this round. The participants experience how the mostly creeping changes in the manufacturing system can have a massive impact on productivity and how classic lean principles can no longer work on their own in view of increasing complexity.

## ROUND 3: *LEAN PRODUCTION WITH GREATLY INCREASED COMPLEXITY AND SUPPORT FROM INDUSTRY 4.0 ELEMENTS*

In round three, the assembly line is converted from analog to digital control. Instead of written work instructions, production orders and parts lists on paper, the individual assembly stations are equipped with tablets linked to a cloud-based product database. New orders are fed directly into this database via a product configurator. The corresponding order details are stored in an RFID tagged container. By scanning the container at each workstation, the assembly employees receive the appropriate work instructions and visualization on their tablet. In addition, only those parts are delivered just-in-time that are actually required for the respective work step. This and other industry 4.0 elements considerably reduce the search and inspection effort along the assembly line. The participants will thus experience how digitally networked technologies and assistance systems make the increased complexity in the assembly process manageable, ensure process stability and productivity and supplement lean production in a meaningful way.

MODULE

# 3. PILOTING AND PREPARATION ROLL OUT

## THE END OF THE ETERNAL PILOT

**The pilot phase is one of the most sensitive and critical phases of a Lean project. The aim here is to translate the assumptions from the planning phase into concrete measures and to test them in practice. Sensitive, above all, because the involvement of employees in lean activities requires intensive support and a great deal of sensitivity. Critical, because in this phase in particular there is a risk of a number of mistakes that could jeopardize the success of the entire project in the long term.**

**In the 1990s and 2000s, for example, companies preferred to use staff units and project teams to introduce lean in their departments as internal consultants. Despite the high level of expertise of the trainers and teams employed, many of the initiatives failed because the lean know-how and culture could not be sustainably anchored in the divisions. The knowledge also went with the consultants - the projects were forever stuck in the pilot phase.**

**In order to counteract such undesirable developments already in the pilot phase, companies should closely involve the operative specialists and managers on the shop floor from the outset and sensitize them to the planned measures. The following success factors are important:**

### *Making success visible*

Lighthouse projects can help to make the lean changes visible at the shop floor level (e.g. through OEE improvement, workplace standards, inventory reduction) and thus sensitize employees to the planned lean measures. This requires a clear cause-and-effect relationship between the measures taken and the change achieved.

### *User-centered development*

In order to prevent lean measures from being designed to 'bypass' the process or the user, close involvement of employees in the shop floor is crucial. User stories and key users help to adapt the tools used to the requirements of the employees or the process and are the touchstone for the meaningfulness of the planned measures at the same time.

### *Qualify for specific target groups*

A central prerequisite for the successful implementation of the planned measures is the target group-specific qualification of employees across all organizational levels. Depending on the scope of the project, this includes both lean and digital methods. A decisive factor here is, on the one hand, target-oriented qualification geared to the needs of the respective employees and, on the other, practical relevance. By training lean experts and lead users, know-how is anchored in the respective areas for the long term.

### *Define rules*

In addition to the qualification of employees, the appropriate management and control systems must also be provided in this phase, which enable continuous decision-making and problem-solving paths from management to the shop floor. This includes, for exam-

ple, shop-floor management pilots (physical and digital) or the development of KPI systems, cascades of key figures and decentralised problem-solving competence.

## Define roles and responsibilities

An effective leadership and management system requires managers at all levels to have a precise understanding of their own leadership role within the framework of the Lean Project. This includes, for example, actively requesting feedback as part of the goal development process, regularly reviewing the processes on site (Go Gemba) and ensuring an openly lived error culture in its area.

## Accompanying and communicating change

For an effective anchoring of the lean concept in the organization, the introduction of lean projects must go hand in hand with systematic communication measures. A two-stage process is particularly promising, consisting of a cascade of short training sessions and information events that the operational managers themselves carry out and supplementary, centrally controlled communication measures that make the implementation successes visible and tangible.

## Quick start

Lighthouse projects for streamlining processes and introducing lean concepts (process approach) are particularly suitable as starting points for large-scale lean projects: e.g. cycle optimization, flow concepts, pull control. They can be accompanied by digital pilots for the first application of smarter (IoT) technologies (system approach): e.g. predictive maintenance, digital Q-control loops, Smart Logistics, Smart Tooling, real time performance tracking. We recommend precise documentation of the implementation process and recording of lessons learned for use in the later roll-out plan (local to global).

# DIGITAL SHOP FLOOR MANAGEMENT

## THE INDUSTRY 4.0 ENTRY-LEVEL DRUG

*Shopfloor Management is the central management tool in the context of Lean Production. Extended by digital technologies, it not only increases transparency and accelerates on-site problem solving, but also provides the ideal starting point for the transformation of the manufacturing system into a Smart Factory.*

### THE TIME OF EXCEL LISTS IS OVER

Lean is classically an analog culture. It uses notes, handwritten records and employee observations to optimize processes at the shop floor level. But with the increasing networking of machines and the availability of process-relevant data in real time, there are completely new possibilities for process control and accelerated problem solving within the framework of the PDCA cycle. This includes, among other things:

**Improved process control and faster detection of deviations in the process based on real-time data and automatic alerts to employees.**

**Improved target cascading through system-supported and stored KPI pyramids with the ability to provide aggregated metrics in real time and share them with relevant stakeholders at all levels.**

**Detection of micro faults and fault patterns that would not be detectable by manual readout and rigid limit values alone as a prerequisite for predictive fault management, especially in OEE-sensitive areas.**

**Optimized measure management with the help of measure or cause libraries, which support the employee in the elimination of faults or the evaluation of fault patterns or cause analysis in the sense of prescriptive logic.**

**Storage of workflows for adjacent, manufacturing-related areas, such as maintenance or logistics and tracking of measures.**

**Support of the global knowledge management by comparability of the process key figures over common system and sharing of Best Practices and problem solution measures over common digital platform.**

### CREATE ANALOG AND DIGITAL PREREQUISITES

Despite extensive feature sets, Digital Shop Floor Management should not be misunderstood as a turnkey tool. Rather, it is an extension of classic shop floor management with the integration of digital technologies. This has two implications: On the one hand, the prerequisite is an already functioning analog SFM and a correspondingly high degree of lean maturity. Only if key performance indicator systems, measure management and shift plans are defined uniformly, they can be transferred to a digital system. On the other hand, the provision of the required technical infrastructure and architecture, consisting of sensors, retrofit elements, edge elements, gateways, intermediate layer, which collects data, etc., can also be integrated.

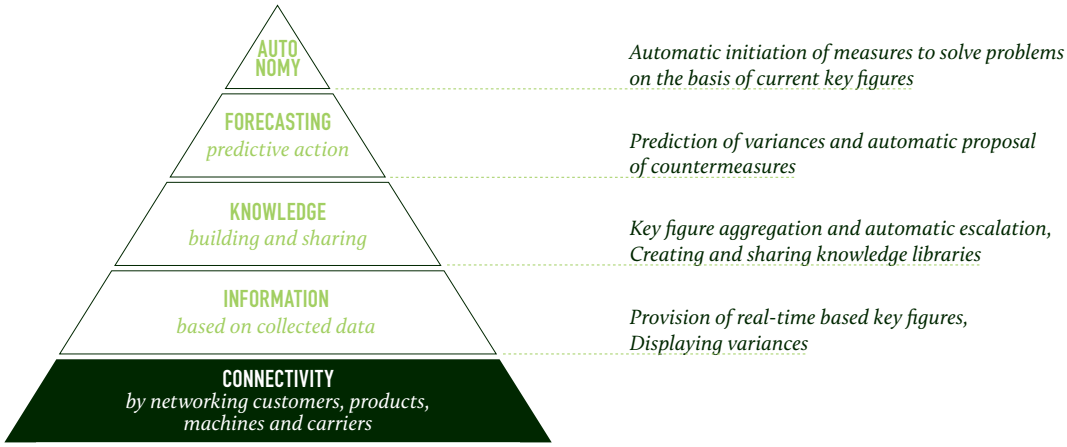
### USER CENTERING AS A SUCCESS FACTOR

A decisive factor for the success of the solution is the close involvement of the users within the framework of an agile development process. For example, user stories can help to optimally adapt the systems used to the requirements and problems of the shop floor employees. This includes, for example, the provision of process-relevant key figures at the right time in the process. An information overload is to be avoided as well as the wrong focusing on target figures that cannot be influenced by the employee on site. However, the system should be flexible enough so that the displayed process data - e.g. via wearables or data glasses - can be adapted ad hoc depending on the current focus of the process optimization (e.g. OEE optimization or quality assurance).

### ENTRY INTO INDUSTRY 4.0

If the prerequisites are met, digital shop floor management offers the ideal framework for the digitization of manufacturing processes in the sense of a Smart Factory. Nowhere else, the path from data acquisition to data use in the sense of process improvement is as short as in shop floor management. In addition, the possible applications within the framework of digital shop floor management are freely scalable and can "grow" with the further development of digital technologies in the company: from the pure provision of data to increase process transparency to the preparation in the form of aggregated key figures to prescriptive solutions for the automation of action management. The special: From the very first stage of digital expansion (see diagram), digital shop floor management can contribute to increasing productivity.

POSSIBLE APPLICATIONS OF DIGITAL SHOPFLOOR MANAGEMENT ON ALL IMPLEMENTATION LEVELS OF THE DIGITAL FACTORY




# EVERYTHING IN TIME

## CONVERSION FROM SHOP FLOOR TO CYCLE ASSEMBLY AT MAPLAN GMBH

**Workshop manufacturing continues to be the method of choice for the production of complex products with a wide variety of variants, such as special-purpose machinery. However, the case of MAPLAN GmbH shows how the introduction of the cycle principle can be made possible even in extremely complex manufacturing environments, thus radically reducing throughput times.**

*When MAPLAN GmbH opened its manufacturing site in Kottingbrunn in 2016, it ventured into unknown territory in two ways. Firstly, because the manufacturer of elastomer injection moulding machines replaced its previous main plant in Ternitz with a completely new factory. On the other hand, because MAPLAN was the first manufacturer in the elastomer sector to implement synchronized flow assembly. Previously, the injection moulding machines and presses were manufactured there exclusively in the stand assembly area, with the majority of the components being brought to the machine at the same time. The changeover to cycle assembly posed an enormous challenge, especially in view of the large number of variants. This is because almost all the systems manufactured at the site are unique, with customer-specific features.*

### LINE BALANCING USING "ROM

*Due to this high variety of variants, the work contents within the line also vary greatly. In order to ensure clocked assembly despite these fluctuations, ROI first developed and evaluated the optimum assembly process with the help of the ROI Tools ROM®.*

*ROM® - the ROI operation sequence method - is a system of predetermined times, with which a very fast and well-founded determination of best-practice times is possible, which simulate an optimized and waste-free assembly and material supply system, on the basis of the parts list. The information obtained in this way formed the basis for the line balancing and a flexible personnel deployment concept in which the employees are no longer deployed exclusively at a fixed workstation, but are in some cases also on the move with the machine. On the other hand, the intensive examination of each individual component also revealed optimization potential, which was implemented together with the designers.*

### SELF-CONTROLLING MATERIAL FLOW THANKS TO INTELLIGENT LOGISTICS CONCEPT

*In addition, ROI supplied a logistics concept adapted to the new form of assembly, with which an optimum material flow can be ensured from goods receipt to dispatch. This included the direct connection of upstream pre-assembly processes as well as the definition of Kanban replenishment processes. The most important deliveries are automatically sorted upwards by the system and usually made available on an hourly or daily basis. As a result, downtimes could be reduced to a minimum.*

### MORE SPACE AND SHORTER LEAD TIMES

*With the help of the new logistics concept, the storage space could be reduced by about half while at the same time doubling the stock turnover. The measures were also effective in assembly. By switching to cycle manufacturing, the lead time from the start of assembly to delivery to the customer was more than halved from just under a month to twelve days. The original plan was to increase the proportion of machines produced in line with the cycle from initially 30 percent to 70 percent within three years. "After only nine months, we already have a 60 percent share," says Wolfgang Meyer. With its innovative assembly and logistics concept, the MAPLAN plant in Kottingbrunn took second place in the overall ranking of "Factory 2018" and won the "Green Factory 2018" category. The event is regarded as the most renowned manufacturing competition in Austria and is jointly awarded by Fraunhofer Austria and WEKA Industrie Medien*

**More at: https://fabrikkonferenz.at/**

MODULE

# 4. ROLLOUT AND PROTECTION OF SUSTAINABILITY

## THE LONG WAY TO THE ENDURANCE RUNNER

**If implemented consistently, Lean Manufacturing is not only a tool for process optimization, but rather a state of continuous improvement. The final vision is a system that combines high process stability with constant experimentation and thus ensures continuous optimization of the manufacturing system. Thus, it is not only a matter of streamlining processes, but also of keeping them "on suspense".**

Achieving this state - and above all securing it in the long term - is a task that extends far beyond the individual areas. In practice, however, responsibility for the continuous further development of processes is often outsourced to the individual employees on the shop floor or in manufacturing-related areas. However, it is impossible for you alone to achieve this.
Instead, the companies themselves are required to create the structural prerequisites for a continuous improvement process. This includes various aspects:

### *Qualification & know-how building*

The central prerequisite for the sustainable anchoring of the lean concept in the organization is the development of the company's own know-how resources. On the one hand, this takes place through the targeted development of junior managers who act as drivers of the topic in the company and anchor the lean concept at management level. On the other hand, by setting up internal qualification infrastructures, for example with the help of train-the-trainer programs .

### *Internalization & Incentive Systems*

In order to promote the anchoring of improvement concepts in the specialist departments and in day-to-day business, additional incentive systems should be created in addition to regular further training programmes in order to motivate employees at all levels to become actively involved in the transformation process. This ranges from individual target agreements to gamification approaches or award concepts.

### *Scaling & global rollout*

Rolling out Lean or OPEX programs in a global plant network requires a centrally controlled, coordinated procedure. Based on a standardized analysis and an internal benchmark of all plants, a framework is set up that the various plants can process in parallel. The use of internal best practices or a control unit approach ensures an agile and flexible procedure and enables rapid optimization of the manufacturing systems in the area. At the same time, the new target systems must be made known to the local operation managers in the local organizations.

### *Standardization & Global Knowledge Management*

In order to ensure an effective exchange between the different locations beyond the roll-out phase, global standards are required that ensure comparability of processes and problem-solving approaches through consolidated key performance indicator systems. The second step is to make the collected process knowledge available globally via appropriate interfaces. Here, too, global knowledge management can be supported by best practice sharing platforms and networking events.

# LARGE SCALE LEAN

**IF YOU WANT TO OPTIMIZE NOT JUST A SINGLE PLANT BUT AN ENTIRE PLANT NETWORK, SPEED IS OFTEN THE DECISIVE FACTOR. In this situation, an agile approach that draws on existing best practices not only promises a rapid roll-out of optimization measures across the site, but also lays the foundation for a continuous improvement process. Networking becomes a decisive success factor.**

**If one tries to optimize a single plant according to the design principles of lean production, the procedure is usually relatively simple: After an inventory has been taken, a pilot project is started in a selected area and then rolled out throughout the entire plant. The findings from the project can then be transferred to other locations.**

**But when it comes to improving processes at over 200 locations worldwide, as in the case of a steel group for which ROI has introduced a global OPEX program, this linear approach reaches its limits. Instead of piloting process improvements individually and rolling them out gradually plant by plant, the project team opted for an agile approach.**

## COPY AND PASTE INSTEAD OF IN-HOUSE DEVELOPMENT

*The first step was to take stock of all global plants using rapid assessments and standardized diagnostic tools. On the one hand, this internal benchmarking served to derive the focal points or the thrust of the improvement measures. On the other hand, it helped to identify existing best practices in the individual plants. On the basis of the knowledge gained in this way, a common framework was then created that contained general quality principles and methods and served as a strategic operational framework for the various measures on site.*

*Instead of developing and piloting their own solutions, the project team decided to fall back on existing best practices, which were adapted for the other locations according to the copy and paste principle. This enabled time and costs for piloting and propagation to be drastically reduced and area-wide improvements to be achieved quickly.*

## CENTRAL CONTROL - LOCAL ANCHORING

*This parallel rolling out of improvement measures across a large number of locations requires a strong central authority in which rollout, guideline and further development competence is anchored. It is responsible for ensuring that projects are effectively implemented on the ground and for ensuring that the defined standards with regard to key figures and processes are adhered to on site.*

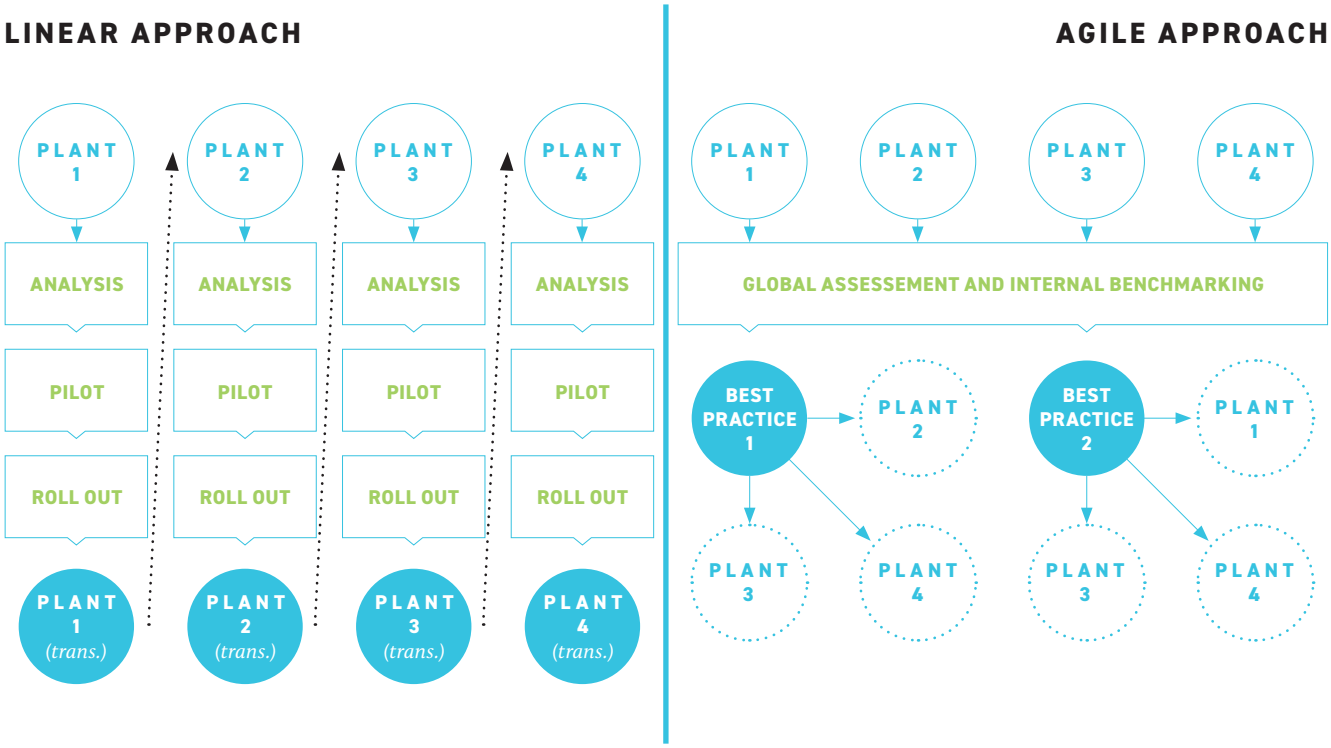
*At the same time, however, it is important to anchor the target systems in the local organizations on site and to build up the appropriate know-how and competencies that will enable them to independently further develop their manufacturing systems or certain methods. The tail unit approach offers a possible model for this: individual plants are selected from the global network in order to further develop certain methods, such as TPM or digital shop floor management at the site, to test them on site and - after they have been declared standard - to bring them into the area via networking and sharing.*

## NETWORKING AS A SUCCESS FACTOR

*Effective best practice sharing thus becomes the central success factor for the global scaling of Lean and OPEX programs. Various methods should therefore be used to promote networking between the plants:*

*Using digital platforms, such as SharePoint, processes can be stored quickly and easily online and shared with the other plants following approval by the central authority. However, the fact that an active exchange actually takes place requires a high degree of discipline and fixed rules, which in turn must be monitored and executed by a central instance.*

*In addition to this, physical networking events should therefore be initiated at which the operative managers meet regularly and deal with different methods from the Lean or OPEX construction kit. One example of this is the "Speed Dating for Best Practices" method set up by ROI for a customer in the automotive industry: Each participant has a quarter of an hour to present his best practice example. Due to the many interactions, interesting interfaces can be quickly identified and deepened in further rounds. In addition to these temporary networking opportunities, it can also make sense to regularly exchange managers and deploy them in other areas or locations. Such a management rotation helps to evaluate existing structures differently from the external perspective, to introduce new ideas and to counteract the Wagenburg mentality.*




# LET'S PLAY LEAN – GAMIFICATION FOR THE INTRODUCTION OF GLOBAL STANDARDS

**German overadministration, American freestyle and service by the rules in China. Cultural differences can be a real challenge when introducing global lean standards in manufacturing. With playful approaches, intercultural teams and local initiatives, ROI succeeded in overcoming these difficulties for a global automotive supplier.**

*The Group, with around 20 successfully operating plants in Asia, Europe and North America, employs around 10,000 people in operations. Cultural differences and extremely heterogeneous operational structures and processes at the plants made performance comparisons and cross-location knowledge transfer more difficult.*

*In order to tap value creation potential and promote exchange, comparable lean standards were to be introduced in the entire operations area. An international OPEX team should motivate those responsible to actively exchange ideas and anchor OPEX thinking processes at all hierarchical levels as early as possible. A key success factor was consistent local stakeholder management.*

*The OPEX measures were adapted to the information and communication conditions in the plants - "Think global, act local". This was intended to dispel reservations about OPEX on the part of local employees.*

*With playful forms of learning and role reversal, ROI ensured rapid development of know-how and structured operating processes that function internationally. Instead of standard presentations, a creative design approach was chosen to visualise OPEX-relevant information, which quickly led to a lively and fruitful dialogue between managers from China, Japan, the USA and Europe.*

*Plant managers, department heads and technical experts from all over the world met several times for operations conferences in order to experience measures to implement the OPEX target image in different roles with different tasks. Participants were able to "play through" various prototypes on the standard assembly line and experienced directly how the product change feels on the line and what concrete changes it would bring. OPEX market stalls illustrated the various main topics and increased the exchange of ideas. In order to sensitize plant managers to how early integration of operations can change the entire value chain, they jointly built a toy car at the OPEX meeting. The clou was that role reversal was mandatory. Colleagues from manufacturing, purchasing, development and sales exchanged roles, as did different nationalities. Practically relevant experiences could be experienced in a playful way, the benefits of OPEX were not an abstract requirement. Commitment at all hierarchical levels and control of the measures ensure lasting success.*

*ROI conducted telephone interviews with randomly selected employees to monitor the success of the measures in practice. Already after completion of the first project phase, it became apparent that the cooperation within the locations as well as the cooperation of all factories could be significantly improved. A monthly newsletter and regular "Town Hall Meetings" ensure the flow of information and accompany the upcoming change processes in the next project phase.*

# *building industrial future*

As an expert in research and development, manufacturing and industry 4.0 with more than 3,000 successful projects, ROI helps industrial companies optimize their products, technologies and production networks and leverage the potential of digitization for more efficient manufacturing and intelligent products. Operational excellence and quantitative, sustainable results are the goals by which ROI can be measured. ROI Management Consulting AG has received several important awards for its highly implementation-oriented projects, such as the "Best Consultant" award from "brand eins" and the "Best of Consulting" award from "WirtschaftsWoche", and has been ranked top in the WGMB study "Hidden Champions of the Consulting Market".

To make the topic of industry 4.0 tangible and more relevant for the corporate sector, WGMB ROI operates an industry 4.0 learning factory in which the technological foundations and principles of digitization can be applied effectively in practice. The course is designed to be combined with the lean production approach and taught in a practical way. ROI also presents the "Industry 4.0 Award" to groundbreaking projects from industry 4.0 practice. The prize has been awarded in Germany since 2013 and in China since 2017. Founded in Munich in 1999, the ROI Group employs more than 150 people worldwide in Munich, Stuttgart, Beijing, Prague, Vienna and Zurich. The spectrum of customers ranges from renowned medium-sized companies to DAX corporations.

**IMPRESSUM**
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