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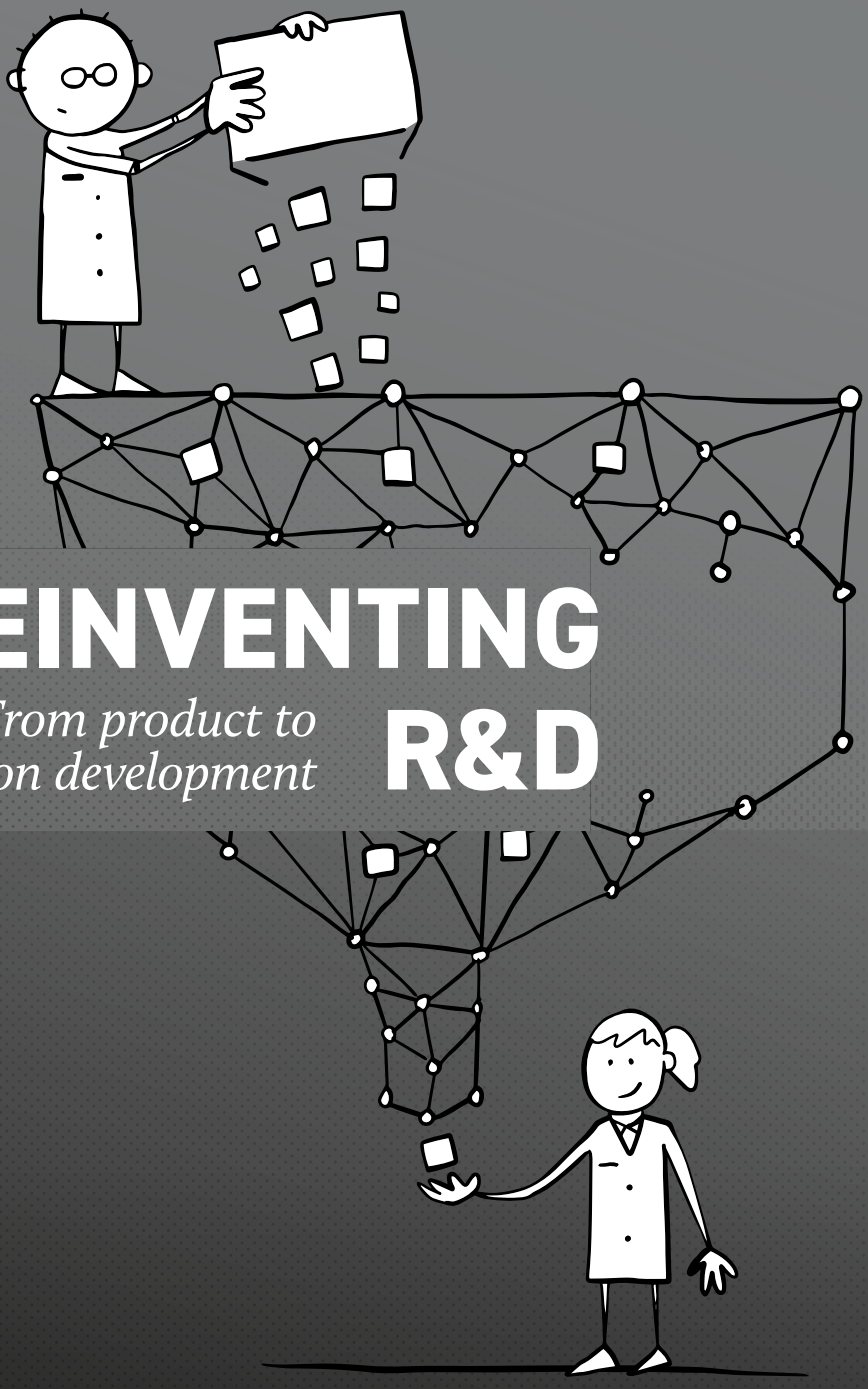
ROIDIALOG



# REINVENTING R&D

*From product to solution development*

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MANAGEMENT CONSULTANTS

CONTENT
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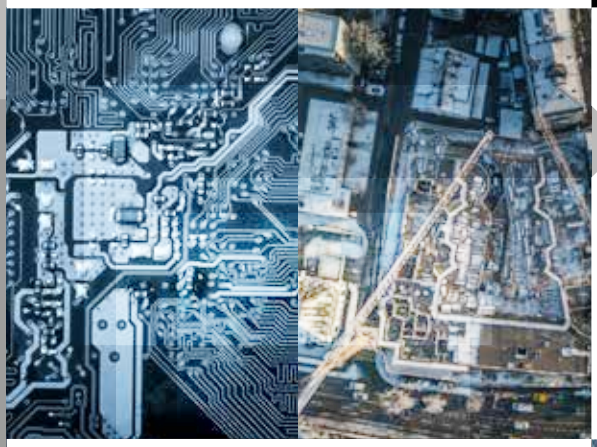
Over the next 10 years, 90% of industrial products will have a software component. Most development departments are not prepared for this today.



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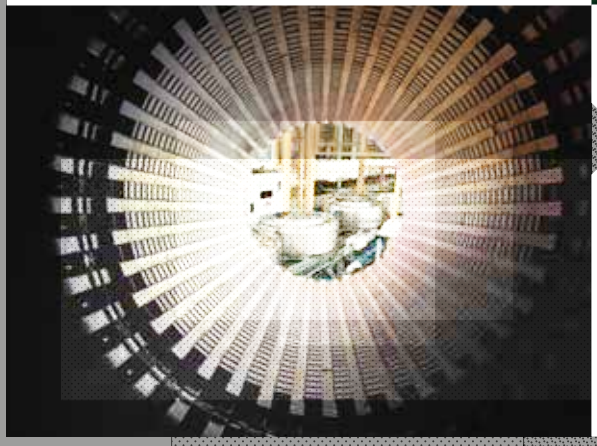


## 30___A JOB FOR THE I-TEAM

Toasters and refrigerators are transformed into "smart products" that will be controlled by Alexa and Siri in the future. A manufacturer of household appliances realizes: Three years from the first idea to the finished product are too long for that. He consistently upgrades his development team with ROI.

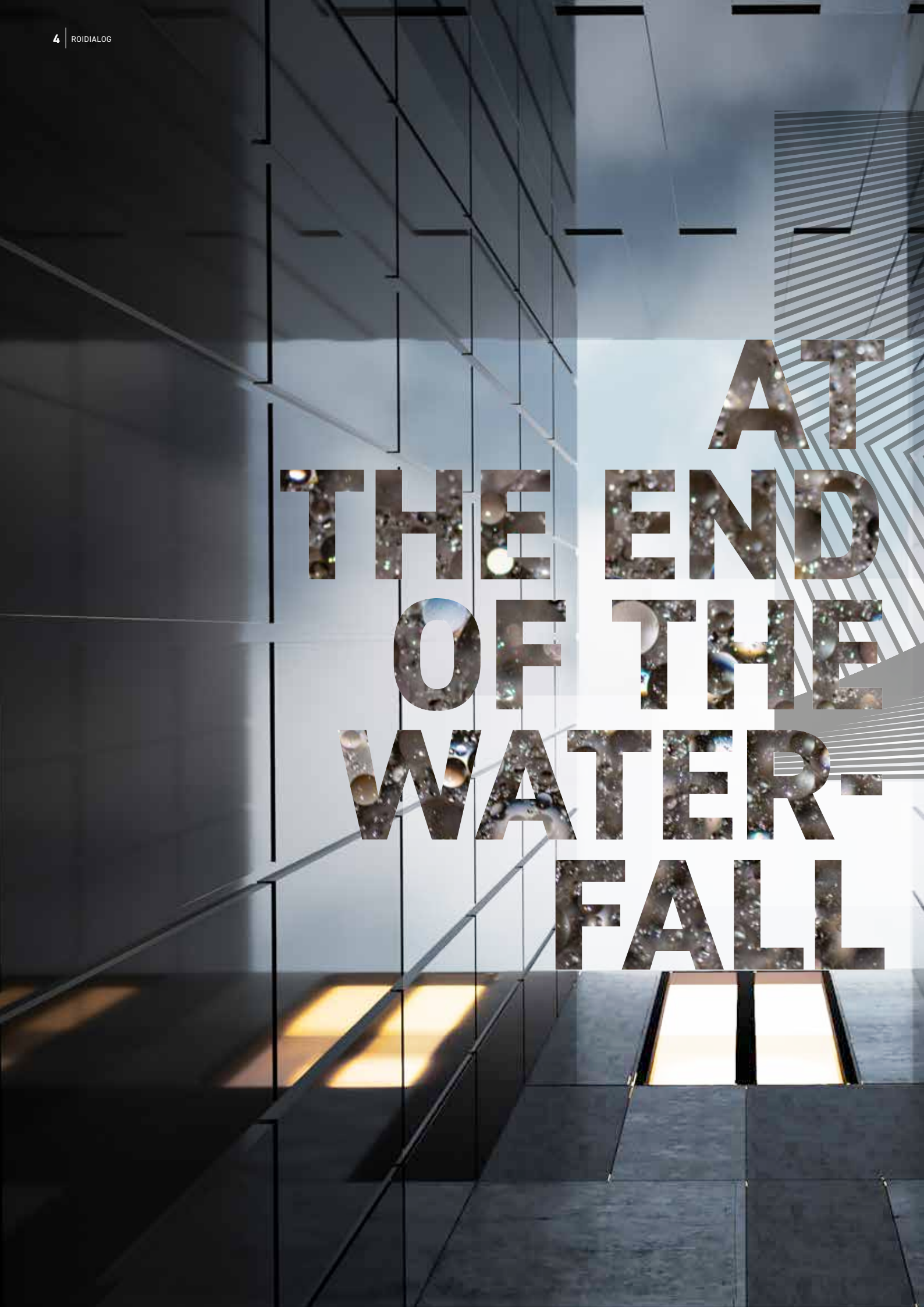
*By Hans-Georg Scheibe,*
*Managing Partner, ROI*

# THE ENGINEER WILL SOON HAVE A HARD TIME

**THERE IS AN ANECDOTE ACCORDING TO WHICH THE FORMER VW BOARD MEMBER FERDINAND PIËCH, IN ORDER TO DETERMINE WHETHER AN EIGHTCYLINDER WAS PERFECTLY ADJUSTED, PLACED A COIN IN THE CAR ON ITS EDGE. IF IT STAYED IN PLACE WITH THE ENGINE RUNNING, EVERYTHING WAS FINE.**

More must probably not be said about the quality standards of German engineering. For a long time it was regarded as the epitome of industrial superiority in the own country and abroad, as an irrevocable quality feature and source of innovation.

And this is where the problem lies. For a long time now, innovation has been taking place for the most part not in the hardware but in the software sector. In the automotive sector alone, 70 to 90 percent of all innovations now concern electronics and the associated software. Experts are already forecasting a market volume of around 160 billion euros for embedded systems. This poses enormous challenges for most manufacturers of classic industrial products. Their R&D processes, which are focused on the development of hardware components, are not designed for the high complexity and dynamics of software development. Where prototyping in the hardware sector can take several weeks, up to 100 releases per day are made in the software environment. Synchronizing these development streams with their different speeds is one of the central challenges of the development organization in the smart products age. However, this requires skills that go beyond classical German engineering. Namely a rethinking in a number of areas: From waterfall to agile methods, from German over-engineering to continuous short-cycle product updates, and from Fire-and-Forget mentality to looking at products throughout their lifecycle.



# AT THE END OF THE WATER-FALL

*Author: Susanne Drexl-Wittbecker, ROI Management Consulting AG*

**OVER THE NEXT FIVE YEARS, 90% OF ALL INDUSTRIAL COMPANIES WILL OFFER PRODUCTS THAT HAVE A SOFTWARE COMPONENT AND ARE NETWORKED IN THE IOT.**

They form the basis for product-related services and pave the way for new, digital business models. Only the development departments are not prepared for this.

**When Hurricane Irma hit the Florida coast in September 2017 and hundreds of thousands of people left their homes to flee inland, electric car manufacturer Tesla responded immediately with a software update. With it, the manufacturer deactivated the power limitation of the battery used in some models and thus released additional battery capacities. A simple download increased the range of the vehicles by around 20% in one fell swoop and enabled thousands of Tesla drivers to safely escape hurricanes.**

## REACH AS A SERVICE

Tesla's example symbolizes a new product world in which classic industrial goods are increasingly defined by elements beyond hardware. The combination of electromechanical components, computing power and connectivity forms the basis for a range of complementary solutions and services for the core product, such as predictive maintenance or the leasing of machine capacities. These smart products enable manufacturers to stay in contact with their customers beyond the point of sale, add functions and thus adapt their products to current trends - and monetize them. This not only changes the functional scope of individual products, but also the entire product portfolio of a company. Instead of a product that is sold once and used in the same way by the customer for 20, 30 or even 40 years, a hybrid bundle of physical components and complementary applications that can be offered to the customer throughout the life of the product occurs. Tesla's example makes it clear how this works in practice: because

the limitation of battery performance is not primarily for technical reasons, but is part of the price model: customers can purchase a cheaper vehicle variant that does not differ from the other models in terms of hardware, but can only access 60 kWh of the built-in 75 kWh battery power. So it is no longer the hardware that forms the distinguishing feature between the variants of a model series, but the software setting. Range, engine power or pollutant emissions are no longer characteristics acquired with the product, but additional services. Welcome to the age of Smart Services!

## SERVITIZATION OF THE INDUSTRY

This development does not only affect the automotive sector, but covers almost all industries, from consumer-oriented electronics manufacturers to automotive OEMs to mechanical and plant engineering. According to a recent ROI survey, 83% of companies believe that their products can be digitally enhanced (cf. DIALOG 50 and 57). The increasing shift in revenue potential in the direction of digital additional services is putting manufacturers of classic industrial goods under considerable pressure. On the one hand, because so far their organizations, processes and methods have generally not been designed for the dynamics and changed cycles of digital products and services. On the other hand, because more and more new competitors are appearing that do not originate in the manufacturing of hardware, but try to roll up the market of traditional manufacturers via software or business model features.

## WELCOME TO THE AGE OF SERVITIZATION


Fig. 1

The development department is at the centre of these market dynamics: on the one hand as a driving force in the identification of product-related services for changing customer requirements. On the other hand as enabler for new services and business models in terms of a fast and efficient implementation "from idea to market". In practice, however, most development departments are not at all geared to these requirements in terms of personnel, processes and organization. To prevent the development organization from becoming a bottleneck on the way to becoming a smart products provider, companies must adapt their processes to the logic of digital products and services. This requires a new, smart development approach, or in short: Smart R&D.

## THE SMART R&D ORGANIZATION

This development approach is characterized above all by the fact that it is radically oriented towards the customer and his product requirements, which can be incorporated into the development in all phases of the product development process. The entire organization, the processes, the employees and their mindset must be designed in such a way that customer requirements can be incorporated or changed at any time. This requires high flexibility and agility in the processes and structures on the one hand and the ability and appropriate methodology on the other to quickly and efficiently convert such requirements into functional and testable solutions. To achieve this, essential aspects of the development organization must be rethought:

### REQUIREMENTS-ENGINEERING

*FROM PRODUCT TO ECOSYSTEM PERSPECTIVE*

Henry Ford's much quoted aphorism that people, when asked what they wanted most, answered with "faster horses", summarizes well the challenges of modern requirements management. Especially in the context of smart products, the question of what a product should be able to do has to be viewed differently than it has long been the case with classic, industrially manufactured products. Digitization will considerably broaden the range of potential product functionalities. However, many of them do not result directly from the core product itself, but from the way it interacts with other products or infrastructures in a complex ecosystem. For example, when vehicles communicate with each other or with the traffic infrastructure in order to reduce the risk of accidents.

The essential task of requirements engineering is to identify these (mostly implicit) customer requirements, to evaluate them and to convert them into concrete functional scopes. On the one hand, it is important to consider the entire product life cycle and to consider where additional innovations can be introduced meaningfully in the form of a software solution or a service. And on the other hand, to take into account the external conditions, such as platforms or operating systems, which they access. The development organization must therefore not only keep an eye on its own customers, but also on other providers and their systems. To break down this complexity into concrete requirements, to synchronize the different life cycles of the individual partial solutions and to define interfaces are activities that require considerably more attention than in the past and are hardly sufficiently mapped in the classical development models so far (see Fig. 1).

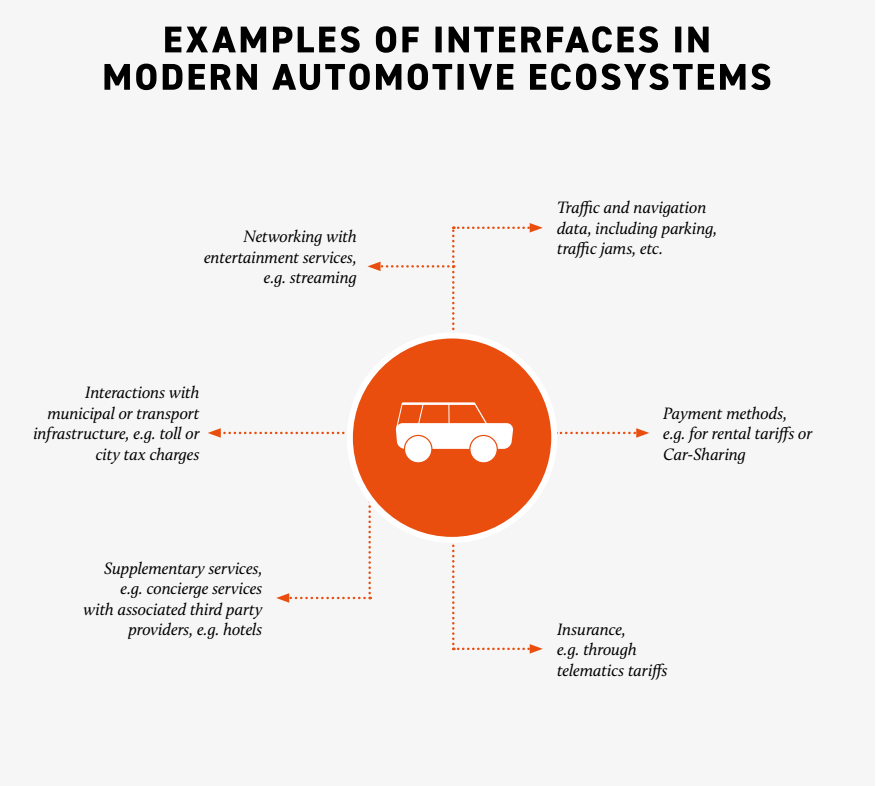



Fig. 2

In order to do justice to this, smart development models therefore rely on an early and continuous dialogue with the customer. Methods such as Design Thinking are used to attempt to take into account the perspective of the design from the outset in the development process. Early and regular testing via MVPs and rapid prototyping also ensure continuous customer feedback throughout the entire development process. Allignment with corporate management also represents a key success factor in the development of smart product solutions. Beacuse the question of which revenues are to be generated in the future with the core product and which with product-related services directly affects the long-term strategic orientation of the company and should therefore be integrated into an overarching portfolio strategy that is also supported and consistently supported by the company management.

### PROCESSES

*FROM WATERFALL TO HYBRID DEVELOPMENT MODEL*

Additional product functionalities, especially in the software area, not only increase the development effort, but also create completely new roles and tasks in the development process that must be integrated into the overall process. In particular, the synchronization of the various functions in hardware and software development, which each have very different development cycles and working methods [see info box], poses a particular challenge in the development of smart products for which most development departments do not have suitable control models. Hybrid development models such as ROI's (see article on page 12) provide an approach for integrating agile methods with the classic Stage-Gate approach, creating regular points of interaction with customers (see Fig. 2).

In addition to controlling at the project level, it is also important to build up digital solutions and supplementary service offerings across various product groups in a modular manner within the framework of systematic portfolio management so that the internal value chains can be streamlined.

### ORGANIZATION

*FROM PROJECT TO PRODUCT THINKING*

Hardly any other organizational unit in a company is exposed to such massive changes as the development department. The expansion of the product portfolio to include smart products and services not only leads to a high demand for new specialists, but

also changes the type of cooperation within the development organization.

Whereas the development process used to end with the start of production, smart products are now being continuously further developed with the help of updates and functional enhancements. This shift in the product development process well into the market phase means for the development organization that its capacities are tied to a product for longer than before. The classic project organization, with a defined start and end point, can no longer be applied to this. Instead, development departments will have to think more in terms of products or product groups and releases, similar to software manufacturers.

This also includes networking the development department with other indirect areas such as product management, maintenance or customer service in order to accompany a product throughout its entire service life and to incorporate the findings from the other areas in its further development.

## IS SOFTWARE EATING THE R&D?

The increasing proportion of software in numerous industrial products is already changing the processes, organizations and working methods in the development organization. Many of these adaptations have their origin in the agile working methods of software development, which are now increasingly finding their way into hardware development. With their high transparency of results and flexibility, they offer the ideal set-up for smart product development in many respects. Nevertheless, an approach aimed exclusively at adopting agile methods does not go far enough.

On the one hand, because a smart development process cannot be reduced to individual methods such as SCRUM or Kanban, which can never completely map its complexity. Rather, it is about the entire organization, the processes, the employees and their mindset being aligned in such a way that customer requirements can be incorporated or changed at any time. On the other hand, because certain elements from the classic hardware development process, such as checks and validations, will continue to be necessary. These security levels in particular are aspects in which software development can learn from hardware development. Compared to pure software products, compliance with norms and standards plays a much greater role in combined smart products - for example when it comes to combining hardware and software in the field of autonomous driving (see Fig. 3).

And finally, companies must be careful not to overburden their employees. Often hardware developers are not used to the high frequency and transparency of results. These "cultural differences" often lead to a frightened defensive or blockade posture. Managers are therefore challenged to shape this transformation process in the development department ... and to accompany it consistently by coaching and reducing fears on the one hand, but also by allowing more autonomy in the teams on the other (see page 24).

### DIFFERENCES IN HARDWARE AND SOFTWARE DEVELOPMENT

| HARDWARE | | SOFTWARE |
|---|---|---|
| STAGE-GATE APPROACH | VS | AGILE PROCEDURE |
| LONG-CYCLE DEVELOPMENT TIMES (WEEKS/MONTHS) | VS | SHORT CYCLE DEVELOPMENT TIMES (DAYS) |
| LOW COMPLEXITY | VS | HIGH COMPLEXITY |
| GOAL: ERROR-FREE DELIVERY | VS | GOAL: FAST DELIVERY |
| RIGID STRUCTURE | VS | FLEXIBLE STRUCTURE |

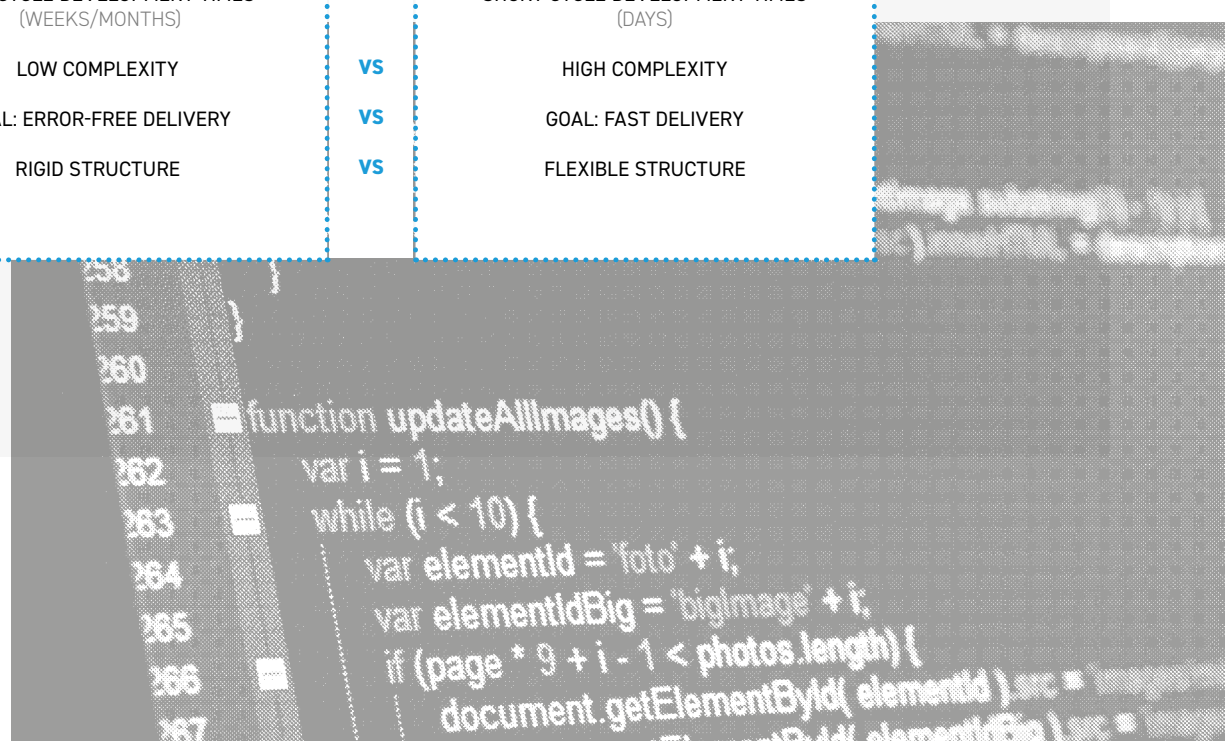
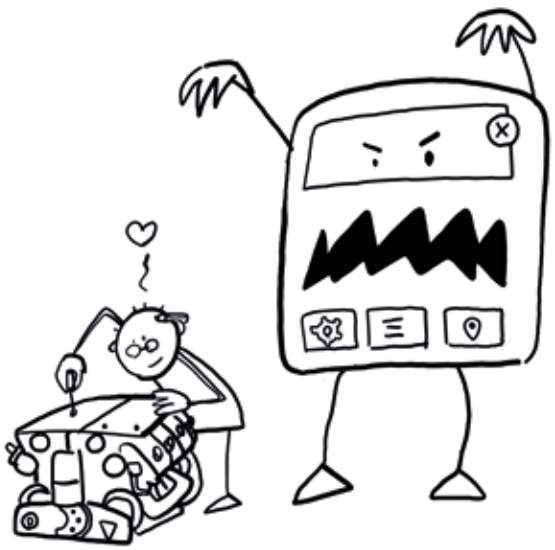
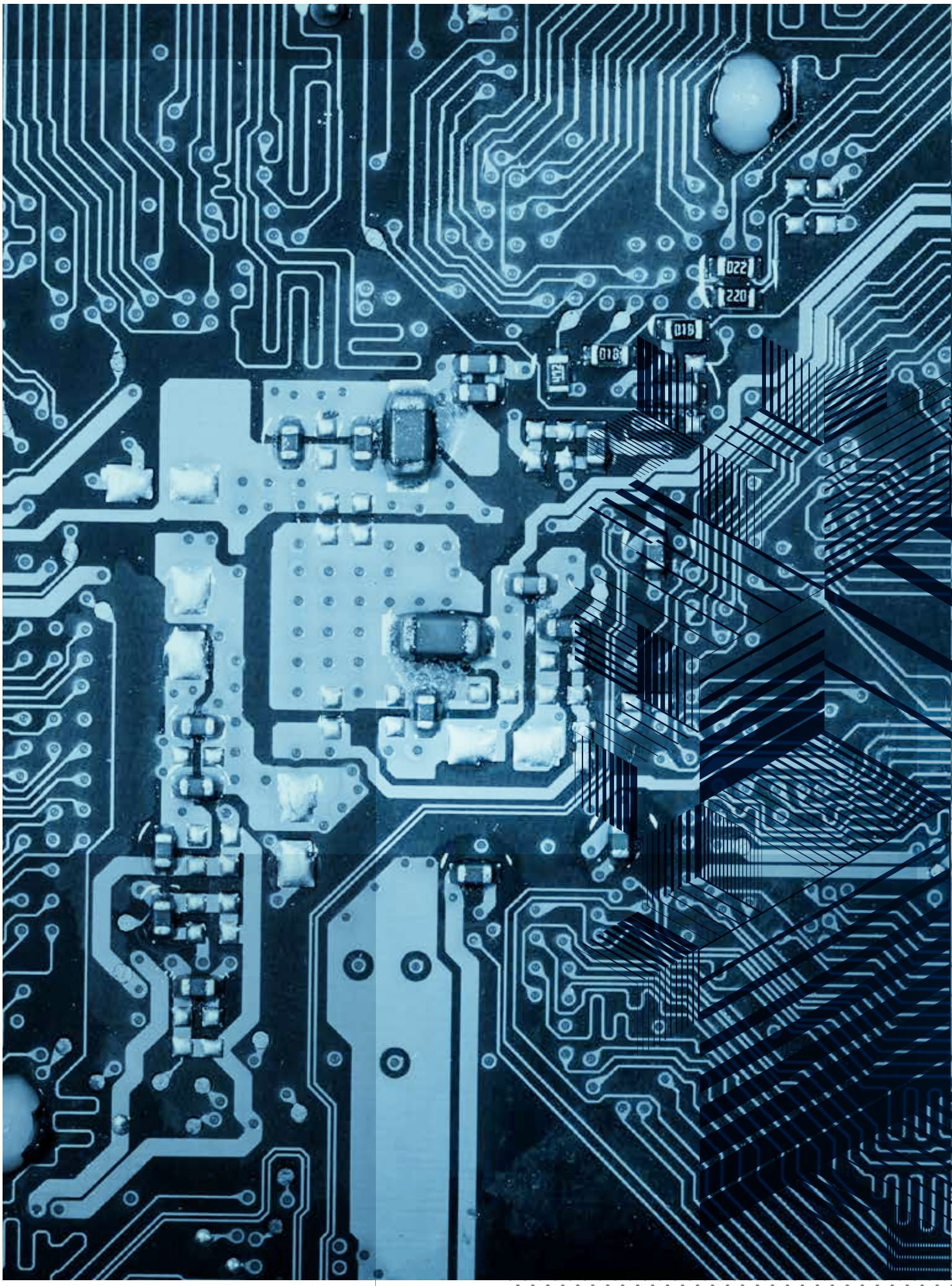



Fig. 3

## BOTTOM LINE

**Companies that manage to overcome these tensions between the old and new R&D worlds and to combine the competencies from the hardware and software sectors in the best possible way certainly have considerable competitive advantages here. In the age of smart products, an agile development organization that is able to react quickly and flexibly to dynamic customer requirements becomes a strategic success factor for entering digital business models. The example of Tesla shows once again how difficult this process can be sometimes. This is because Californians regularly fail to transfer their "digital-centered mindsets" to the supposedly outdated structures of physical vehicle construction, as is evidenced by delayed deliveries and constant quality problems.**

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# CONTROL MODEL FOR SMART PRODUCT DEVELOPMENT

*Author: Dr. Bernhard Burger,*
*ROI Management Consulting GmbH*

# THE DEVELOPMENT OF SMART NETWORKED PRODUCTS REQUIRES A HIGHLY INTEGRATIVE CONTROL MODEL - BUT HOW CAN DIFFERENT RELEASE CYCLES BETWEEN A FEW DAYS AND SEVERAL MONTHS BE MERGED?

For a device with a high proportion of electronics and software, a new functionality is to be enabled during operation. In order to maintain the necessary memory capacity of the device, the product developers decide to delete lines of code for functions that are no longer required. Hours later, the entire work comes to a standstill. The reason: Although the deleted functionalities were not relevant for the operation of the device, they were required for the EOL test.

The example shows how closely hardware and software components interact in smart products. For product development, this means that the various components must not only be closely coordinated in design and development, but also tested in an integrated manner. It also shows what effects software-centric function development has on hardware planning and component selection. In development practice, however, this is often not the case: Since hardware components are often made available later, software tests are often carried out with the help of simulations, but normally not even with them. A number of fine tunings can only be made in the integrated system. An integrated development model is therefore urgently needed. But what can this look like if the components involved work according to completely different methods and development phases (see Fig. 1)?

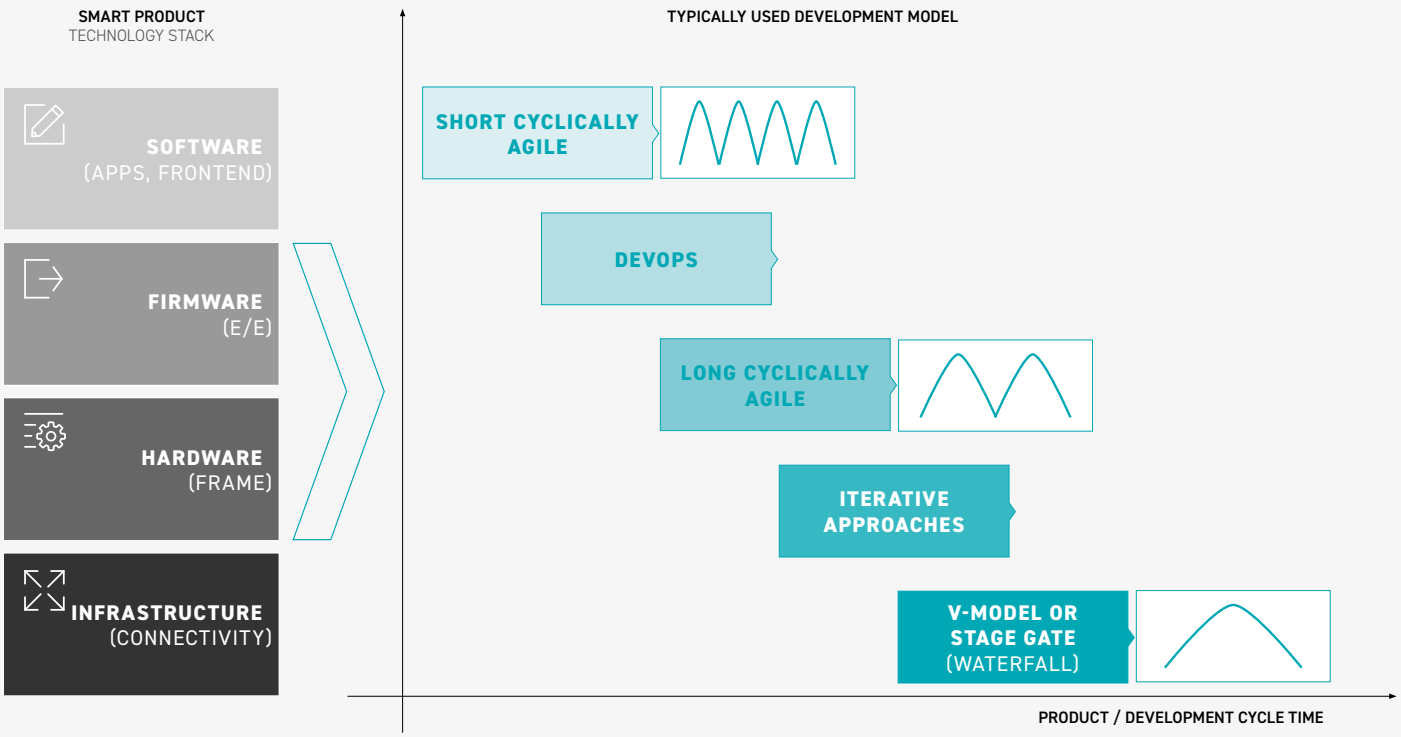



Fig. 1

## INTEGRATION INSTEAD OF ADAPTATION

A pure transfer of methods from software to hardware development and vice versa is not very promising. The working methods and development cycles in the respective areas are too different. While, for example, a software and application team can complete a new version daily or even more short-term, the production of a testable hardware component often takes several weeks or even months. This does not mean that we cannot work more short-cyclically in HW development than it is often the case today. Clever cutting of functionalities and early development spikes of individual modules ensure shorter cycle times here as well. Nevertheless, it is necessary to adapt the optimal methodology for each of the various components and to ensure interaction between the individual development streams via an overarching control model. The following premises should be taken into account:

- ***HIGHLY INTEGRATED DEVELOPMENT***
  *Regular, defined synchronization points, which are much shorter cyclical than typical stage gates, must ensure early and frequent integration of hardware and software development as well as other streams.*

- ***PERMANENT FEEDBACK***
  *An incremental approach and early and regular testing should make it possible to obtain and control customer feedback at any time.*

- ***FAST INCREMENTS***
  *The control model should support closely timed releases of new increments.*

- ***FULL TRANSPARENCY***
  *The development model should ensure full transparency for all persons involved in the development process regarding development scope, deadlines and dependencies.*

Based on these premises, ROI has designed a development model that provides an integrative framework for the development of smart products (see Fig. 2 on next page).

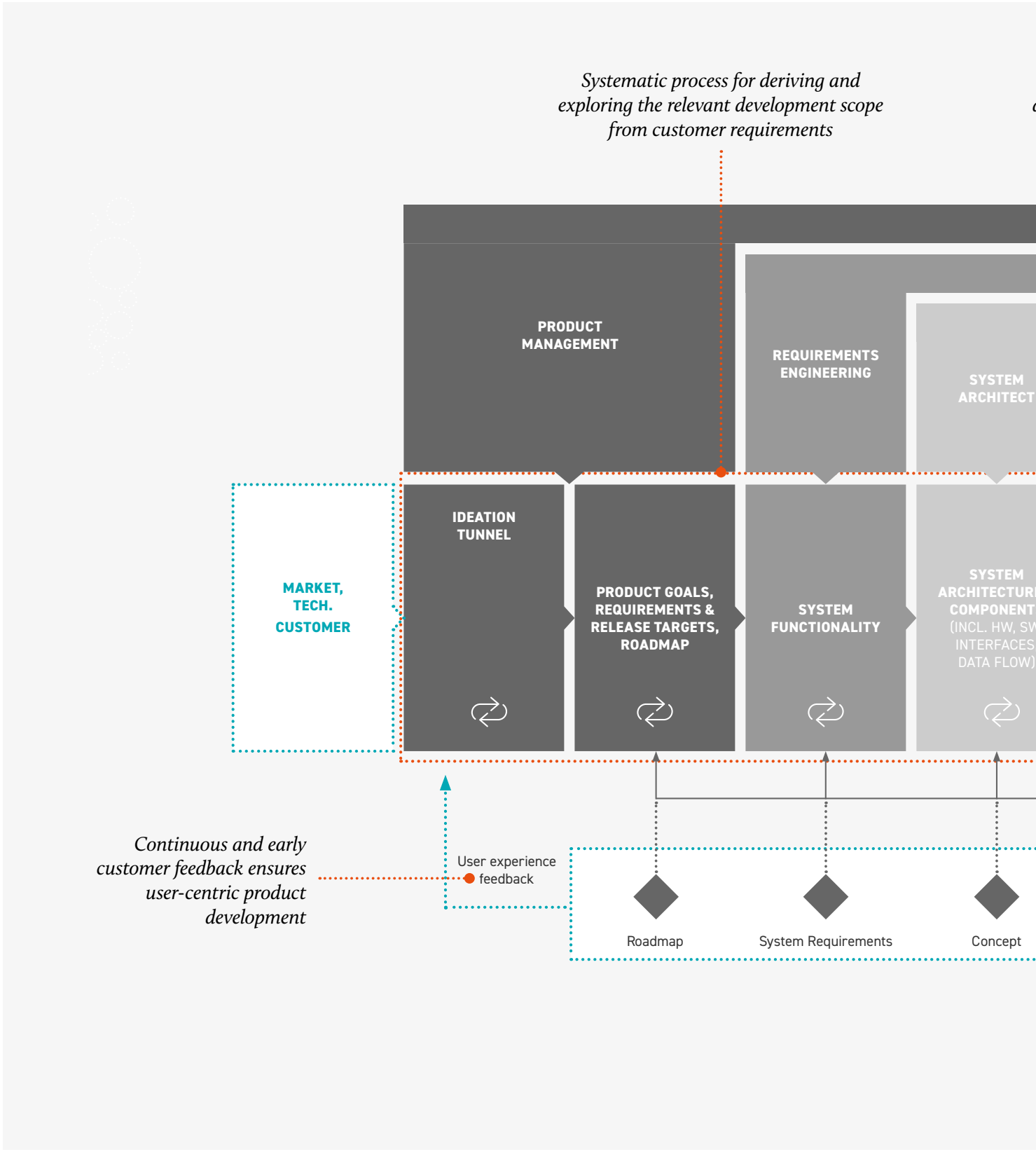
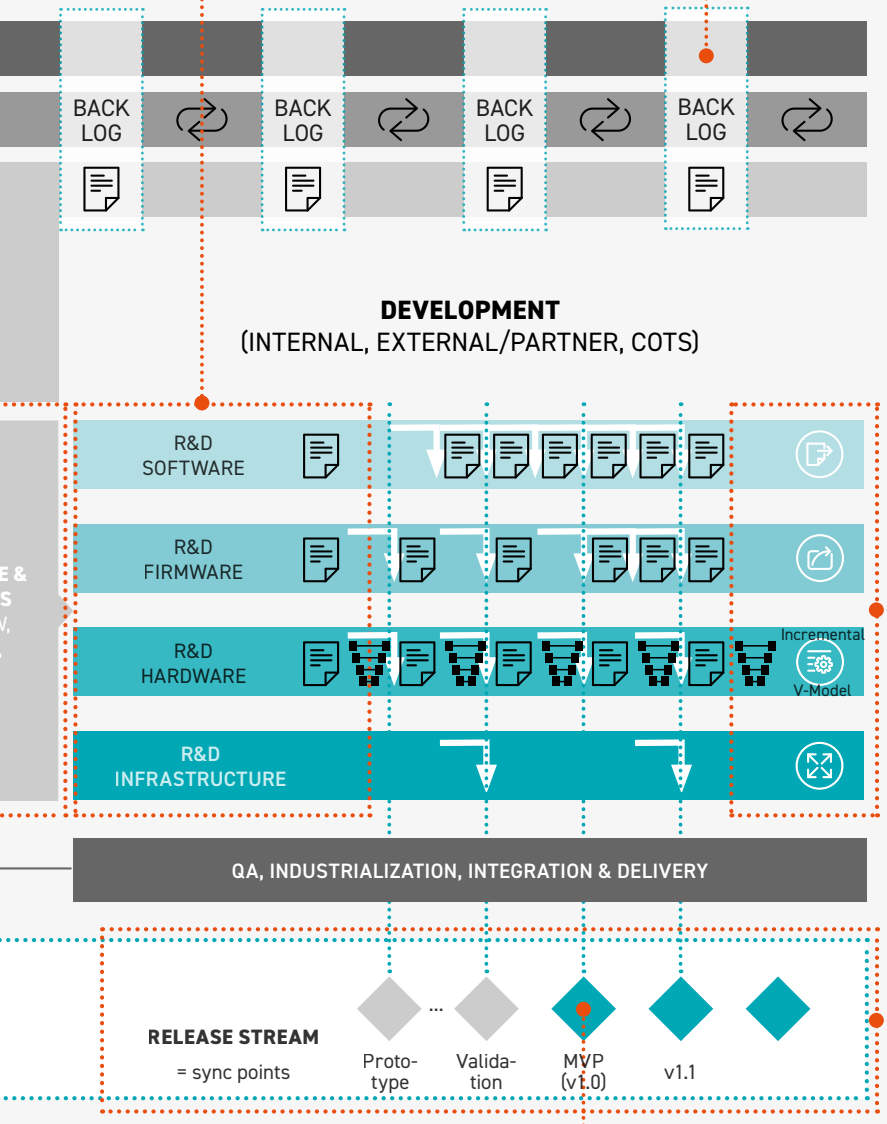

Systematic process for deriving and exploring the relevant development scope from customer requirements
PRODUCT MANAGEMENT
REQUIREMENTS ENGINEERING
SYSTEM ARCHITECT
MARKET, TECH. CUSTOMER
IDEATION TUNNEL
PRODUCT GOALS, REQUIREMENTS & RELEASE TARGETS, ROADMAP
SYSTEM FUNCTIONALITY
SYSTEM ARCHITECTUR COMPONENT (INCL. HW, SV INTERFACES DATA FLOW)
Continuous and early customer feedback ensures user-centric product development
User experience feedback
Roadmap
System Requirements
Concept

Fig. 2

*Separate consideration of the different development streams in the smart product*

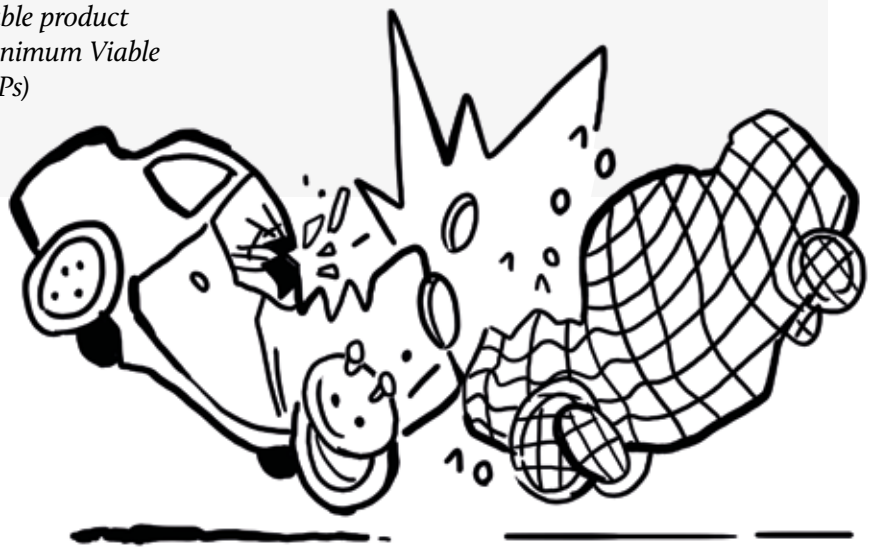
*Full transparency about the coordinated development scope in the overall development backlogs*




*Consideration of different control methods depending on product/development cycle duration*

*Regular synchronization points for early and frequent integration of different development streams*

*Early provision of testable product versions in the form of Minimum Viable Products (MVPs)*



# LOOKING FOR THE „DEEP BLUE“ MOMENT

*Author: Dr. Robert Schrobenhauser,*
*ROI Management Consulting AG*

GROWING FUNCTIONAL RANGES AND AN INCREASING NUMBER OF VARIANTS HAVE MADE THE DEVELOPMENT OF NEW PRODUCTS MORE COMPLEX AND TIME-CONSUMING.

At the same time, new technologies and tools promise radical leaps in efficiency. But are these sufficient to make the increasing complexity in smart product development manageable? And where does product development currently stand when it comes to AI-enabled R&D?

***In pharmacology it is assumed that there are about 1060 molecules with a biological effect. More and more pharmaceutical companies are using smart data analytics and intelligent algorithms to independently compare billions of possible molecule variants in order to determine the chemical compounds that could be used as active ingredients in the treatment of diseases such as cancer or Alzheimer's disease. This reduces the time required to identify potential active ingredients from years to hours. In view of this development, experts are already talking about the "deep blue" moment in pharmaceutical research.***

***The search for efficiency gains is particularly important in an industry that otherwise suffers from poor research statistics. It still takes an average of twelve years and costs two billion dollars to bring a new medication to the market. On the way there, the failure rate in the preclinical phase is 99%. According to a 2017 study, projected returns on investment in research and development fell to their lowest level in eight years at that time, while spending increased.***

## SMART PRODUCTS AS COMPLEXITY DRIVERS

Also in other industries, such as the automotive industry or mechanical engineering, the costs for the development of new products have been rising constantly for years. The main reasons for this are the increasing range of functions and the increasing variety of digitally enriched products. But also more complex dependencies with external requirements, e.g. regulations, globally distributed competition and customers with frequently changing offers and needs. As a result, the pressure on companies in the manufacturing industry to bring product updates to the market in ever shorter cycles is increasing considerably.

In order to make the resulting complexity manageable, companies in these sectors are more and more using new technologies and methods in their product development (cf. Fig. 1 on page 22). They start where cost- and time-intensive cost drivers have arisen due to the changed requirements and processes in the context of digital product development, for example at the interfaces between the various departments involved in the development process or the different release timing in hardware and software development.

## ANALYTICS FOR BETTER DECISIONS

This begins with the conception of a new product portfolio. Companies face the challenge that the evaluation of customer requirements and business cases based on these has become considerably more complex. On the one hand, because "smart products" have additional components (software, electronics, connectivity, etc.) whose development efforts and manufacturing costs must be included in the overall view and coordinated across departments. On the other hand, because digitally enhanced products no longer have to be considered only up to the start of production (SOP), but over almost their entire life cycle, e.g. the total sales potential. New features and revenue opportunities that are added to the product during operation must also be taken into account. In addition, product-related services generally follow other revenue mechanisms for which model calculations do not yet exist in many industries. This results in a complex system of multiple cross-dependencies.

As a result, the exploration period for industrial products, such as vehicles, is now two to three years. Big Data Analytics or Decision Analytics (cf. Fig. 2) can make an important contribution to achieving better and above all faster decisions in this interface

management with the aid of artificial intelligence. The prerequisite for this is that the entire process is standardized and backed up with well-founded data and models. This includes a variety of different data sources, such as social media analytics, current usage or forecast data, which must be integrated into a data model. In this way, the time required to calculate a total business case can be reduced to one year or less.

## COMPUTER-AIDED DEVELOPEMENT

In addition to the loss of time at the interfaces, the different pulsing in hardware and software development represents a further challenge in the development of smart products. To avoid delays, such as when hardware components on which a software function is to be tested are not available in time, various design and construction methods can be used to significantly reduce the time required to provide testable prototypes.

A particularly promising approach, which is becoming more and more important, is the so-called generative design. This is a design method for constructions in which a software program independently generates designs using algorithms and logical calculations. The designer simply enters the planning goals and constraints into a CAD program and defines parameters such as material type, load capacity and costs. The program then calculates thousands of different variants with which the specified parameters are met and performs an independent performance analysis. This shortens the construction time many times over, since designs no longer have to be carried out manually and simulations and tests are already integrated into the design process. In addition, this process enables the creation of completely new geometries with improved properties, which partly seem to contradict the designer's intuition.

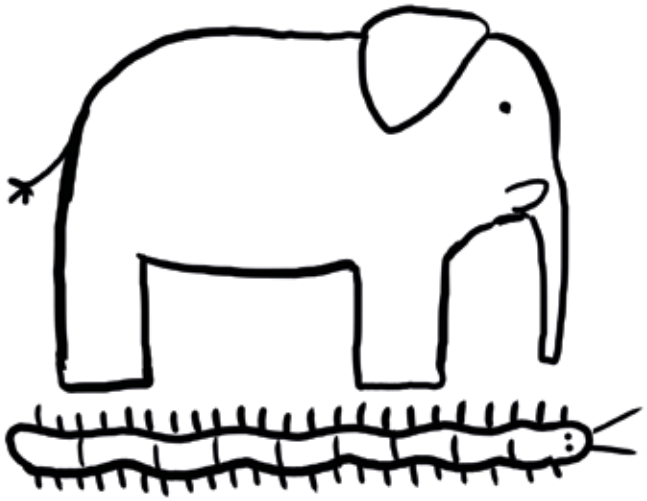
## ELIMINATE DEVELOPMENT LOOPS WITH LEARNING SYSTEMS

Another way to shorten the development time for hardware components is to use self-learning systems. They can significantly reduce expensive and time-consuming optimization loops in the subsequent adaptation of components. This is where high costs and time losses often occur in practice, for example when special tools are required. To minimize this type of waste, companies use a combination of simulation and 3D printing techniques, for example. The latter enables rapid prototyping of the components. Instead of manufacturing completely new components for each optimization loop, additive manufacturing is used to create prototypes whose properties are in turn fed back to the digital model. From the comparison between the prototype and the digital model, the system learns in each loop how the best model must be designed in order to map, so to speak, the real production in comparison to how it is digitally available. With the help of this semi-intelligent, learning system, the development time of corresponding components could be considerably reduced, sometimes more than halved.

## INTELLIGENT MANAGEMENT OF THE SYSTEM LIFE CYCLE

In addition to the optimizations in the individual phases, the greatest challenge in the development of smart products is to map the various interfaces, functional and process-related dependencies in an overall model. This is precisely where approaches such as Model based Systems Engineering (MBSE) or System Lifecycle Management (SysLM) come in by providing a development platform that is able to demonstrate the effects of individual parameters, such as a software feature, in the overall system. Due to the large number of possible variations and interfaces in the hardware and software, this cannot usually be achieved by humans. For this reason, the use of artificial intelligence holds enormous potential here. Only if development systems are able not only to map this complexity but also to make it manageable, continuous product development, which goes beyond the SOP and, for example, incorporates user data from digital twins into the continuous further development of products in ongoing use, can be implemented. Currently this vision fails in many cases due to the IT infrastructure and the continuity of the various, networked and dependent tools and systems (e.g. PDM/PLM and ERP). In particular, the harmonisation of interfaces is a necessary basis, which in turn requires an intelligent, coordinated design of the associated processes, but which is anything but trivial.

In other words,
**INDUSTRIAL PRODUCT DEVELOPMENT IS WAITING FOR ITS "DEEP BLUE" MOMENT.**



## TECHNOLOGY INNOVATIONS ALONG THE R&D PROCESS

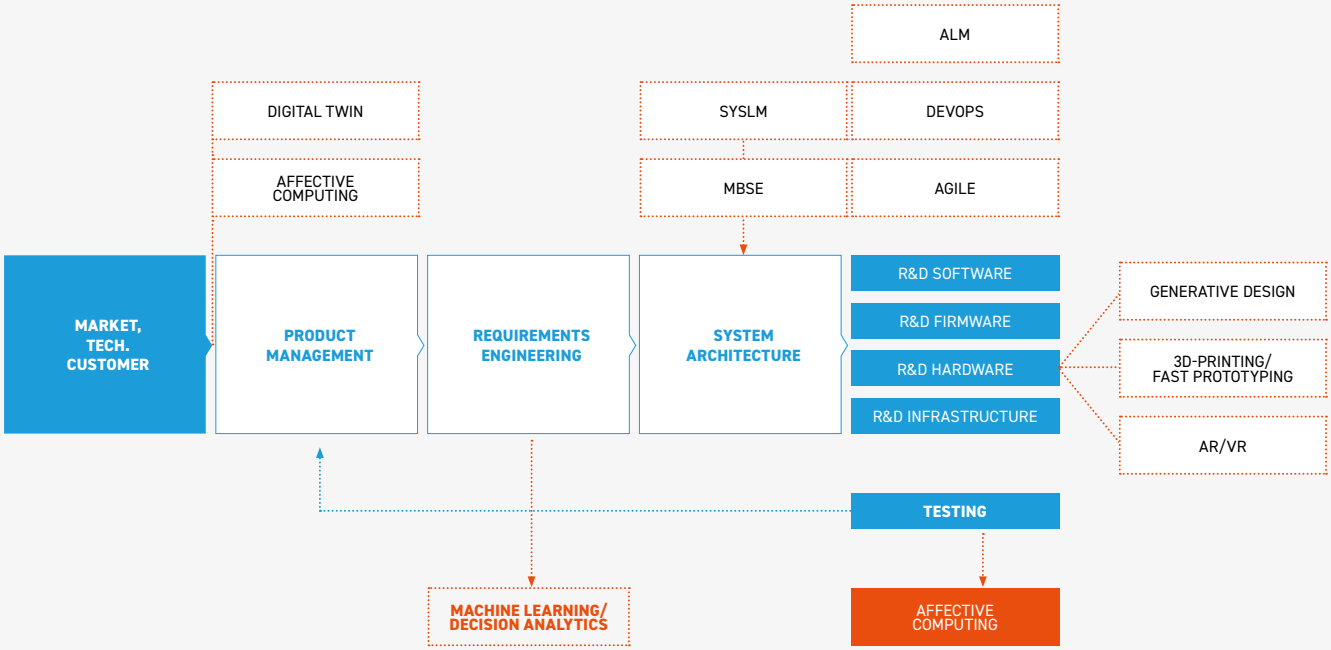
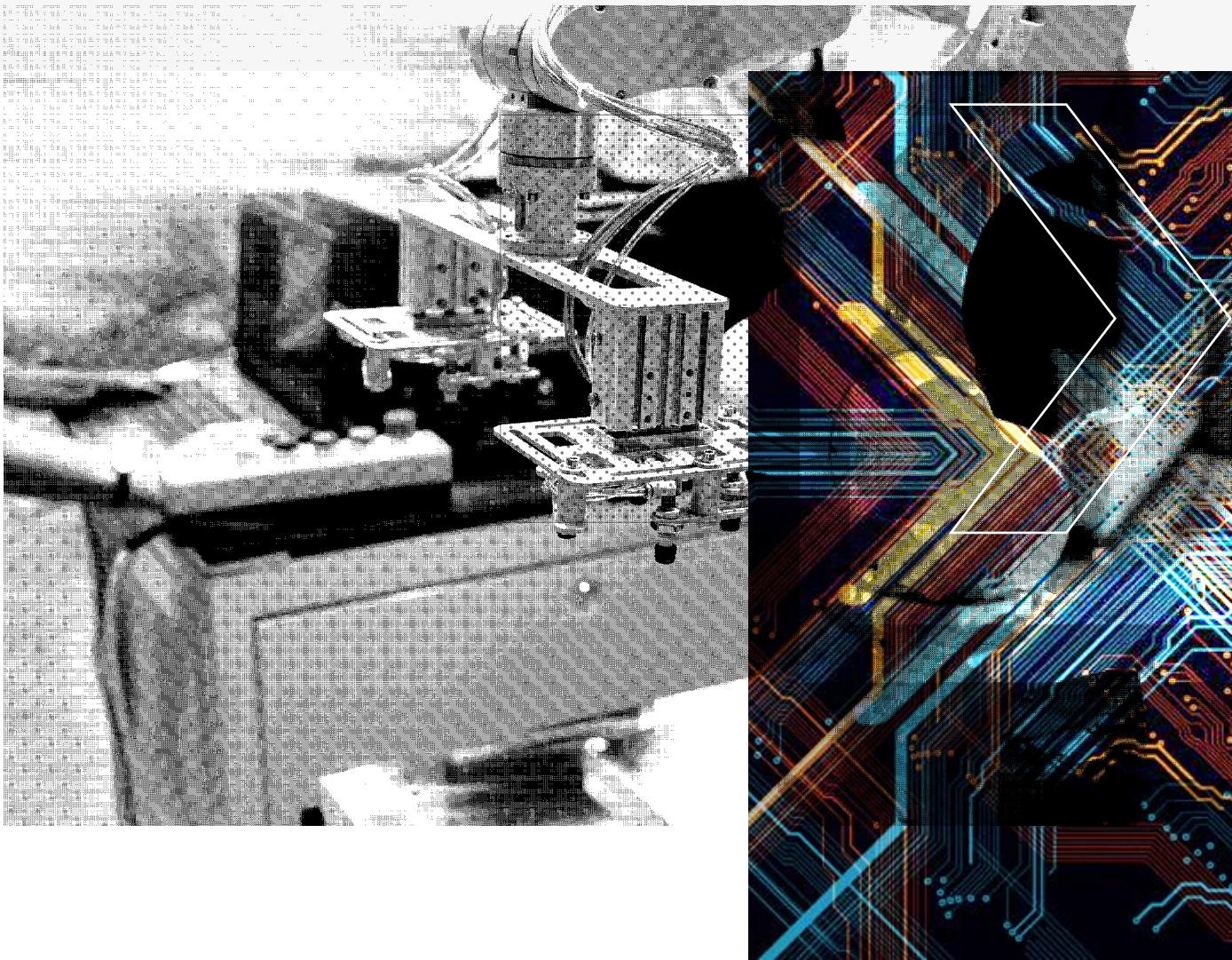
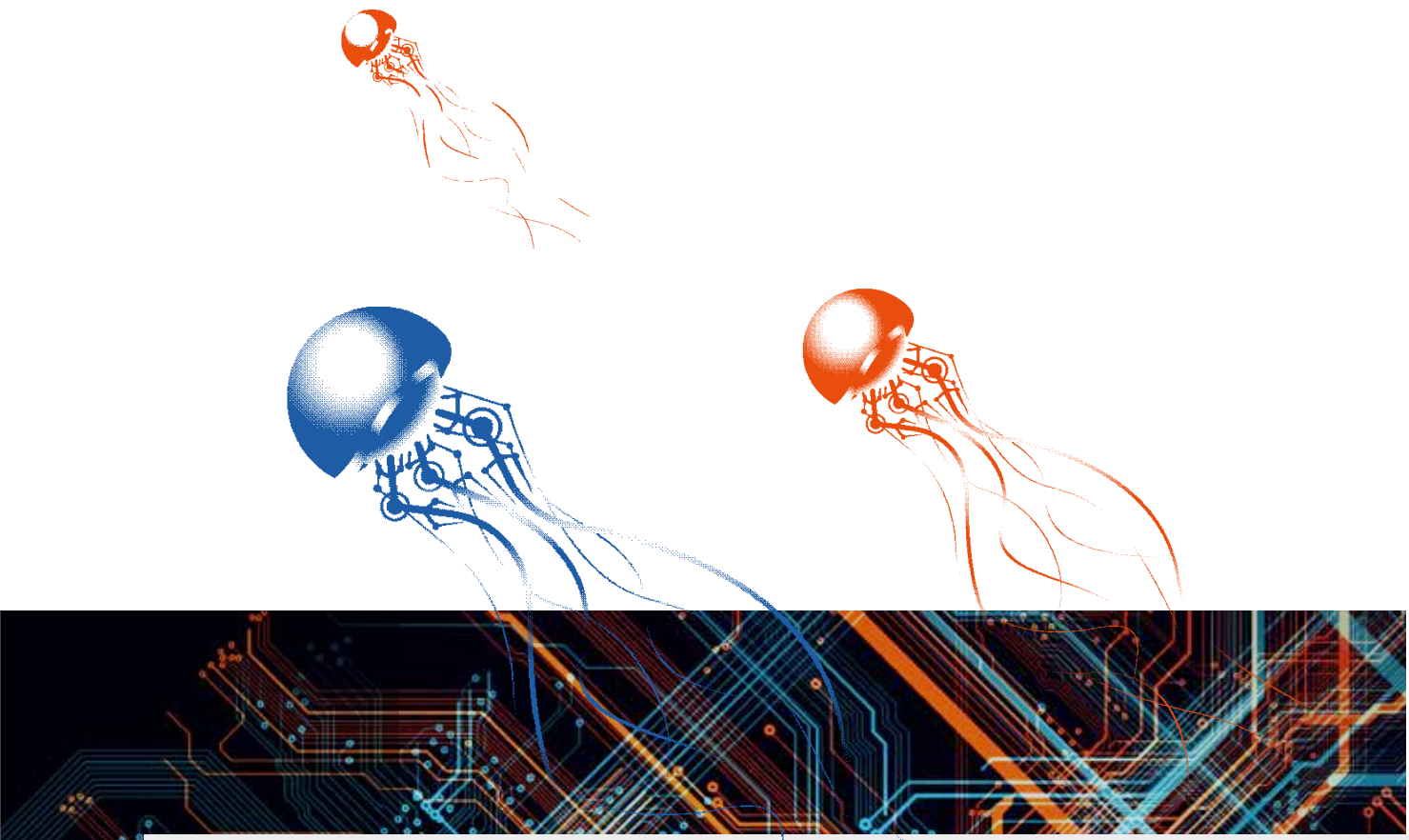



Fig. 1





## DECISION ANALYTICS

| | |
|---|---|
| **DESCRIPTION** | • *Intelligent techniques for processing multiple data from multiple sources along the development process using advanced analytics to analyze complex cross-dependencies and accelerate decision making* |
| **APPLICATION AREA** | • *Requirements Engineering*<br>• *System Architecture* |
| **BENEFITS** | • *Faster and better decisions in complex decision making processes*<br>• *Shortening of the exploration phase by >50%* |

## GENERATIVE DESIGN

| | |
|---|---|
| **DESCRIPTION** | • *Design or construction method in which design drafts are independently developed and automatically tested by software using algorithms and on the basis of defined parameters* |
| **APPLICATION AREA** | • *Engineering*<br>• *Hardware development* |
| **BENEFITS** | • *Shortening of the design phase*<br>• *Avoidance of subsequent optimization loops through integrated testing*<br>• *Development of new solutions for known design challenges* |

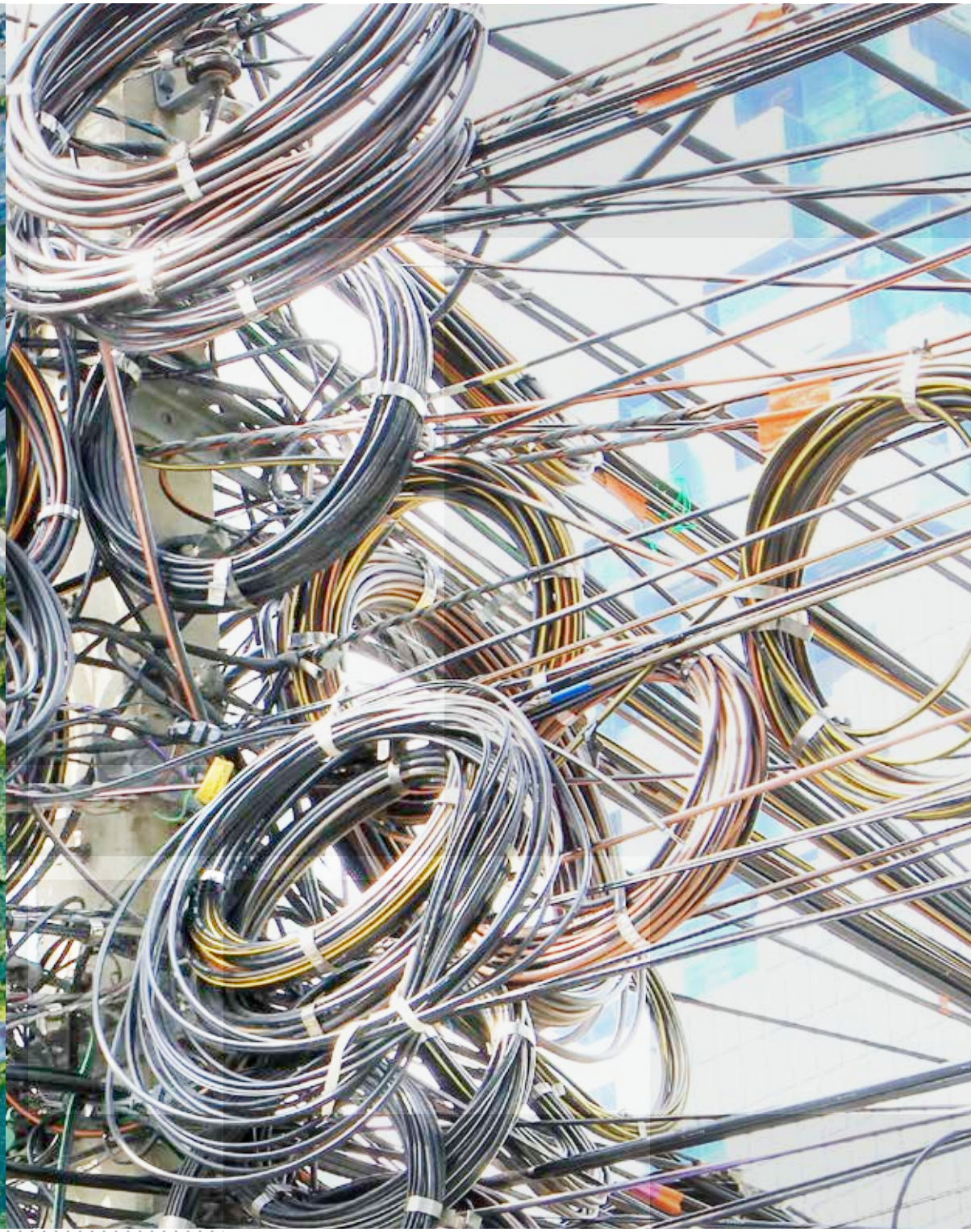
## SYSTEMS ENGINEERING

| | |
|---|---|
| **DESCRIPTION** | • *Engineering backbone concept for product development and lifecycle management within the framework of the Industrial Internet and for integrated and interdisciplinary Model-Based Systems Engineering (MBSE), Product Line Engineering (PLE) and Service Lifecycle Engineering (SLE)* |
| **APPLICATION AREA** | • *Comprehensive development process* |
| **APPLICATION EXAMPLE** | • *Greater transparency and controllability of complex development lifecycles* |

Fig. 2

# ALL EYES ON AGILE...?

*Author: Dr. Bernhard Burger,*
*ROI Management Consulting GmbH*



# YOUNGER, FASTER, MORE DIGITAL. THE DEVELOPMENT OF SMART PRODUCTS CHANGES TEAMS AND PROCESSES IN THE R&D ORGANIZATION.

In search for suitable cooperation models, companies often resort to standard methods from the textbook on agile product development - and fail to do so. Because methods & tools alone are not enough. If you want to successfully transform your R&D team, you must first empower the organization itself.

In order to understand which phase of upheaval the R&D department is currently going through, it is worth first taking a look at another corporate function: For example, a VDI survey of HR managers shows that the proportion of classic engineers should fall from currently just under two-thirds to below 50 percent within the next five years - while at the same time the demand for IT specialists and IT engineers is rising massively. In the battle for the coveted IT experts, this initially means a special challenge for classic industrial companies. But building new skills alone is not enough. Efficient processes are only possible if companies manage to integrate them successfully into the existing development organization. The new requirements of a smart product development have to be considered:

- *NEW COMPETENCIES & METHODS*
  As the proportion of software in products increases, so does the need for new competencies in R&D: software developers and similar functions introduce new ways of working and change the composition of teams and the culture in the development organization.

- *HIGHER COMPLEXITY OF THE SYSTEMS*
  Smart products consist of a large number of physical and non-physical components, some of which have very different development times. This increases the complexity and coordination effort in the overall system.

- *SHORTER INNOVATION CYCLES*
  Particularly in B2C-related industries, product updates take place at ever shorter intervals and thus place new demands on development speed.

- *CONSIDERATION OF THE ENTIRE PRODUCT LIFE CYCLE*
  The software component in the products extends the development phase into ongoing operation. Resources in the development organization are thus tied to a product for much longer.

The pressure on companies to adapt their processes to these changed conditions of digital product development often promotes the adaptation of new tools and methods. Under the buzzword of "agile product development", many of them rely on well-known frameworks from software development, such as Scrum, SAFe, LeSS or Nexus. However, the introduction of agile methods alone does not usually lead to better collaboration, as they are not transferable to most organizations one-to-one. Rather, the understanding of the cooperation between the individual roles in the development department must first be sharpened and the processes and organizational structures aligned accordingly.

## DEVELOPMENT UNDER LABORATORY CONDITIONS

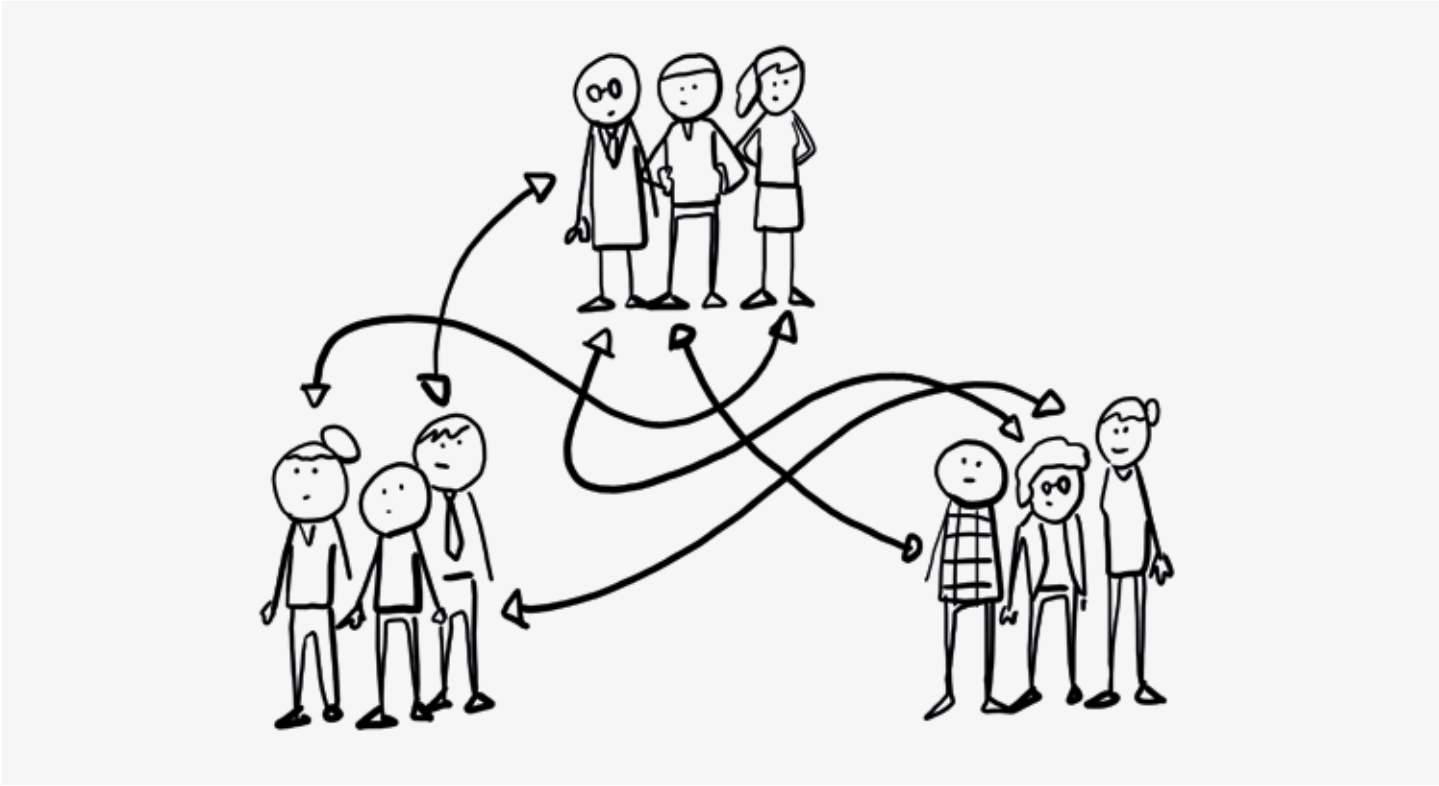
This begins with the organizational structure of development teams and their location within the company. Depending on the nature of the innovation project, it may make sense, for example, to outsource it from the existing organization and, for example, in the form of spin-offs of the core company. This is particularly the case if it is a fundamentally new technology, its development and the methods used could overtax the existing organization and thereby slow down the speed of development. Conversely, the functioning existing business can thus be protected against the risks of new developments. However, the central challenge with this type of approach is the re-integration of the outsourced area into the core organization after completion of the development and the achievement of synergy effects between the existing and the new development organization.

## WITH COMMUNICATION AGAINST SILO FORMATION

In the case of the expansion of existing products by a software component, however, the main objective is to synchronize the development flows, which are synchronized in different ways, and to prevent the creation of silos within the development department. This requires a highly integrated approach with regular synchronization points between the individual disciplines. In development departments that are organized according to separate specialist teams, such as hardware, software or electronics development, this requires a high level of planning and communication effort. Cross-functional teams made up of specialists from the various disciplines provide a counter-draft to this and are thus able to fully implement smart components from start to finish. This not only increases transparency with regard to mutual dependencies in the development process - the development speed can also be substantially increased through parallel interdisciplinary work on individual components.

## THE ORGANIZATION CHART FOLLOWS THE TASK

For most companies, this means a real paradigm shift: In smart product development, instead of a fixed development organization structured according to specialist terminology, a flexible organization of changing and interdisciplinary microgroups is used, which work together on a specific task for a limited period of time before they reassemble themselves. Therefore, it is no longer the technical orientation that is decisive for the team membership of an employee, but the task he or she is currently working on. This increases the dynamics of the development organization in two ways. On the one



hand, team members switch between teams more frequently and faster. On the other hand, the individual development packages or increments are generally smaller in size, thus enabling more closely timed release cycles. Irrespective of the choice of individual methods, this flexibility is at the heart of agile product development.

## ACCOMPANYING THE TRANSFORMATION SUCCESSFULLY

Not only for the organization as a whole, but also for the individual employees, this agile approach represents a radical break with familiar ways of working. In order not to lose them on the way to a new form of agile cooperation, companies and their managers must intensively accompany this transformation process. Five premises apply:

1. *THE RIGHT WORKING METHOD FOR THE RIGHT PROCESS*
   Smart products consist of different components with sometimes very different development cycles. This makes it all the more important to find and adapt the appropriate method for each process type and each project. The motto "one does fit all" does not apply. While SCRUM, for example, provides a high added value for the software sector, it can be a hindrance in mechanical development.

2. *DESCRIBE OBJECTIVES AND JUSTIFY METHODOLOGY*
   Agile methods must not only create added value for the company, for example in the form of shorter increments or release cycles - this added value must also be clearly communicated and justified to the employees. It must become clear that this is not just a change of method, but a new understanding of the product life cycle.

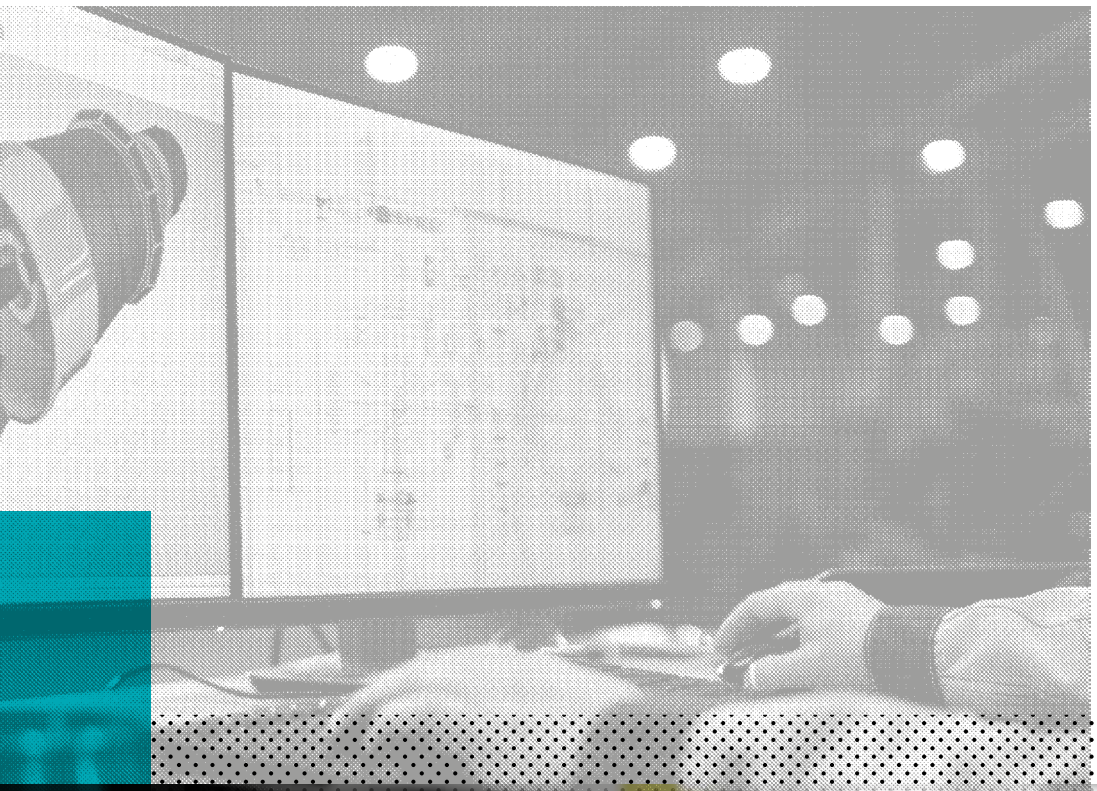
3. *FIRST ADAPT - THEN QUALIFY*
   Training and qualification play a central role in this context. However, you can only train effectively if you know what. Because standard training courses work just as little as standard methods. Therefore, the following applies: first find the method, then adapt it and finally qualify it in a targeted manner. Individual training plans and department-specific training are key success factors.

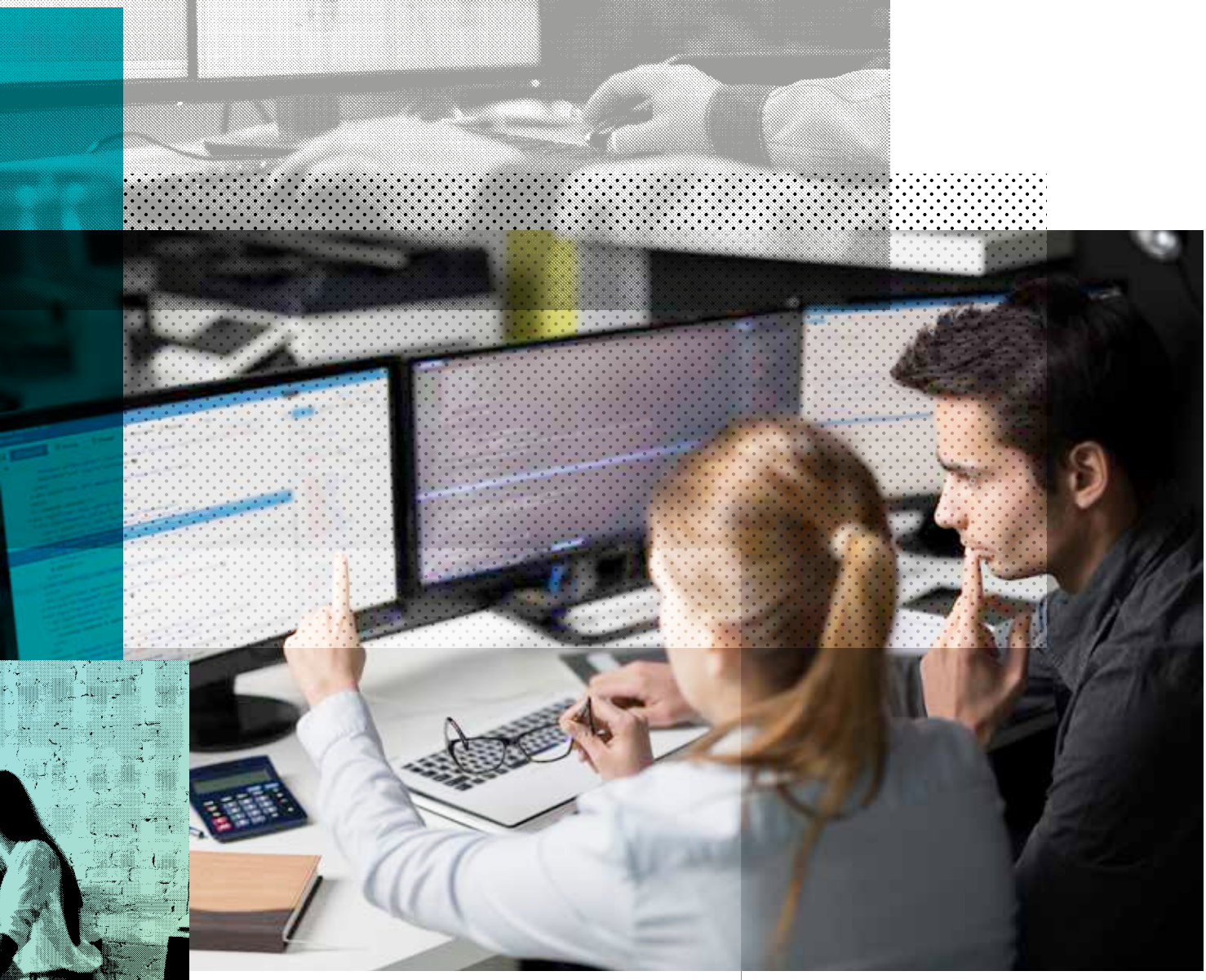
4. *STEP-BY-STEP INTRODUCTION*
   In order not to overtax the organization and its employees, it is advisable to gradually introduce new working methods in selected pilot teams. The experience gained there can then be used to transfer it to the other areas.

5. *SHOW SUCCESS*
   At the same time, the pilot phase also creates visibility for the new methods in the organization and thus helps to reduce resistance and demonstrate the effectiveness of the processes used.

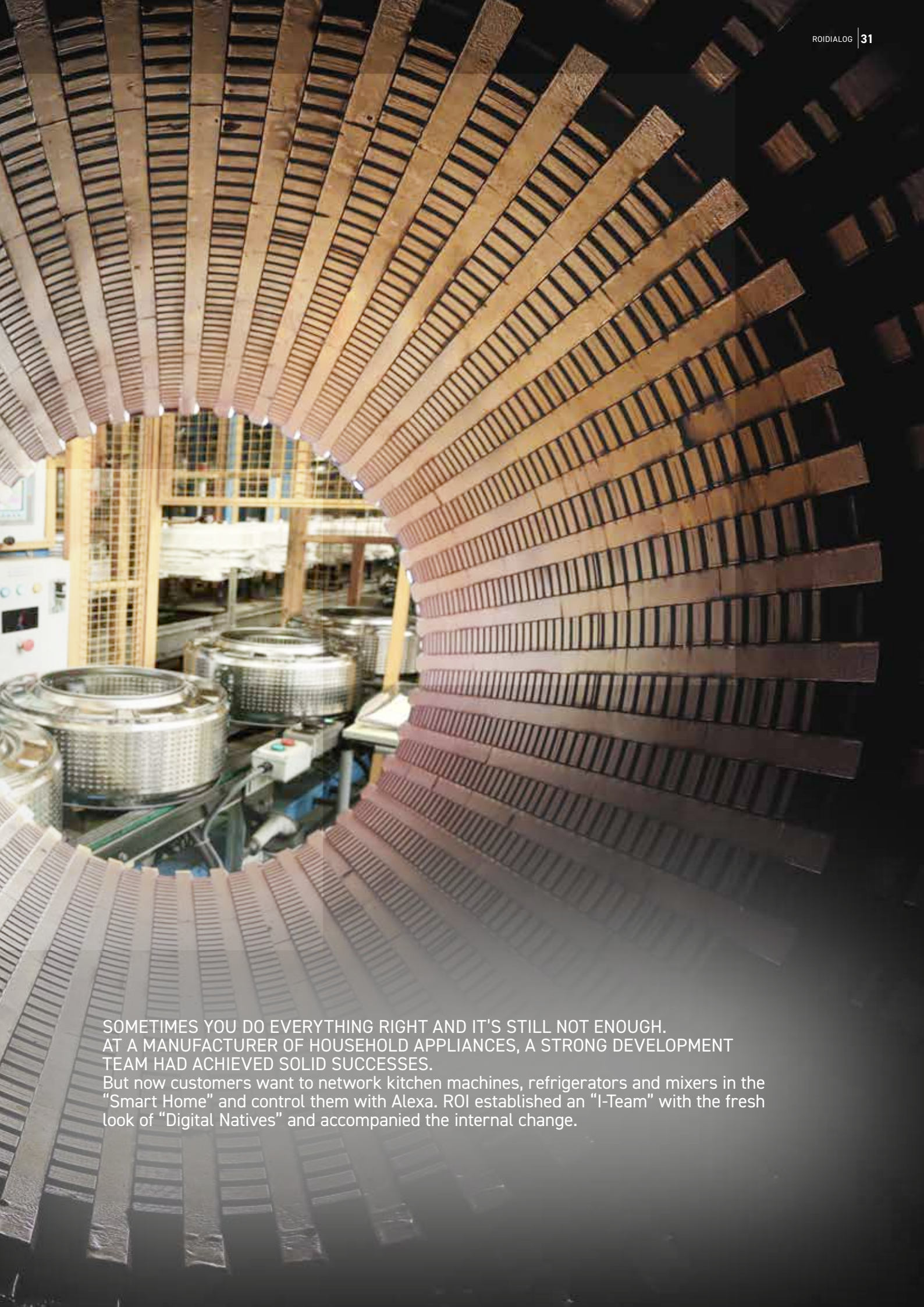
## BOTTOM LINE

**This systematic approach makes it clear that agile product development involves more than the introduction of individual working methods. Rather, it is a matter of a holistic transformation of the R&D area. It includes structural and procedural changes, such as composition and communication within and between development teams, as well as the sensitization and qualification of individual employees.**





# A JOB FOR THE I-TEAM



SOMETIMES YOU DO EVERYTHING RIGHT AND IT'S STILL NOT ENOUGH.
AT A MANUFACTURER OF HOUSEHOLD APPLIANCES, A STRONG DEVELOPMENT TEAM HAD ACHIEVED SOLID SUCCESSES.
But now customers want to network kitchen machines, refrigerators and mixers in the "Smart Home" and control them with Alexa. ROI established an "I-Team" with the fresh look of "Digital Natives" and accompanied the internal change.

*The company had actually opted for a good, proven strategy in order to defend its competitive position with new product ideas: constant availability of development resources - secured by the bundling of all development teams at one location. High quality standards in development for series production of large quantities - ensured by experienced teams and established processes.*

*But: Routines do not manage disruption. Especially not when digitization is creating a completely new market around the networked "smart home" at enormously short intervals, where imagination and agility are the leitmotifs. If the customer wants a stove that sends pictures and cooking times of his next Christmas roast to his smartphone, a three-year cycle from the first idea to the finished product is simply too long.*

*In this case, the developers were well aware of this. But as experienced series developers they are more "digital immigrants": they are open to new technologies, but at the same time they know that the scope for new ideas must always be brought into line with the clearly timed cycles of production. So why not combine this many years of experience with the joy of experimenting and the working methods of "digital natives"? That was exactly the starting point of ROI's solution approach. A generation of developers who always play with the latest iPhone thinks and works short-cyclically and iteratively. It follows a maker mentality, i.e. it constantly wants to look beyond the existing system boundaries and does not shy away from the risk that a project can go wrong. Especially in the context of the "Smart Home", these are important success criteria because a large number of different product groups are networked with software tools and thus reinvented.*

## TEAMWORK FOR SMART PROTOTYPES

However, a German group is not a Californian start-up either. And of course nobody can and should misunderstand the digital transformation to the extent that the current production can be improved with garage experiments in development. Therefore, the project pursued a "bridge approach": In addition to the first group, the core team of electronics developers, the so-called I-Team (Ideation Team) of newly hired "Digital Natives" works in parallel. As a "bridge", we established a third group in pre-development, in which members of both teams concentrate on creating new prototypes.

## QUALITY AND COSTS AT A GLANCE

The most important "clash" in the working cultures of all team members was to integrate their different work cycles: While the "Natives" act short-cyclically and fabricate and discard tons of new ideas in 30 minutes with methods like Design Thinking, the development professionals of serial production know that every change, every quality defect and every standstill in the two to three year production cycle means enormous time and therefore financial losses. The principle of "two-handed leadership" was therefore important when establishing the „I-Team" in the development team: the younger team members also had to learn to appreciate the value of a structure in the line in terms of quality and costs.

## COMBINING DEVELOPMENT COMPETENCIES

The ROI approach was now to bring the competencies together in the pre-development group in such a way that valid prototypes for series production are created in two to three months. Once the prototype has been developed and approved, the "combi-team" dissolves again - and is reassembled according to competencies and product groups during the next prototype development. A procedure that at first glance does not fit in with the classic line management at all, but makes a significant contribution to keeping the flow of ideas, motivation and quality of results at a constantly high level. This anchors step-by-step changes in working methods without jeopardising business stability.

## CULTURE EATS STRATEGY FOR BREAKFAST

In this way, however, not only "smart" products are created, but also smart organizations. The ROI approach for digital transformation in this case also aims to lead employees and teams more consensually and to dissolve silo mentalities between departments by networking know-how. In addition, external partners in the project proved to be an important success factor: on the one hand, in order to obtain the specialist knowledge needed at short notice. And on the other hand, to have an impartial advisor as a process companion, who permanently reminds of a relapse into old behavior patterns and demands a clear commitment from the executive board to the team member for the fulfillment of once defined goals.

## SUCCESSES AS CONFLICT SOLVERS

This project for digital transformation with smart products differs from other change projects in that the networking skills, flexibility and knowledge of the employees in the development department of the company are now weighted much higher than the length of service with the company. At the beginning, the project team was confronted with an absolute change-typical conflict: Some employees reacted to the new colleagues and the approach of the "I-Team" with the attitude "Let the young savages run into a brick wall - something like this won't work for us".

ROI follows the principle of "culture eats strategy for breakfast" in order to resolve such a pattern in the long term. This means that we identify and strengthen the most willing to change in both groups in order to quickly demonstrate with pilot projects that it does work after all. With every successful project, the motivation of those involved increases to prove that "there is no such thing as no such thing". In addition, after some successful - and also failed - projects, the curiosity and motivation of the skeptics to become an active part of change increased.

## SUCCESS MADE BY ROI

Our change approach is aimed at precisely this overall dynamic. In order to integrate old views and new ideas, tangible results have to emerge that take skeptics and observers with them. This can be ideally achieved, for example, by "splitting" development and production into two tracks, so that the new world can compete against the old.

So now quickly start a few Google Sprints and Design Thinking workshops in development and form an „I-Team" with the most dedicated employees? Well, it's not that simple, of course. Above all, a fixation on methods can turn out to be a killer for transformation projects: new as well as old change methods create freedom and creation in certain areas. However, they do not solve the basic challenge of "switching" a large organization to a new way of working. This requires long-term support and consistent implementation, in which the choice and design of methods are based on the corporate culture.

No matter whether the goal is a talking stove or ergonomic workstations in the line: **IT IS FIRST NECESSARY TO UNDERSTAND THE CULTURE, THEN TO BUILD THE METHOD(S), THEN TO ADAPT THEM CONTINUOUSLY.**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