THINK ACT

BEYOND MAINSTREAM

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The Industrie 4.0 transition quantified

How the fourth industrial revolution is reshuffling the economic, social and industrial model

Roland Berger

SPECIAL
DEVELOPMENT PATHS OF MAJOR INDUSTRIALIZED COUNTRIES
→ P. 9

THE BIG 3

+25 PPTS

is the gross increase in ROCE (return on capital employed) that an industrial business can expect through 2035 following the transition to Industrie 4.0.

Page 6

EUR 420 bn

is the potential amount of capital employed and net profits that becomes available through the introduction of Industrie 4.0 in Western Europe's industrial sector.

Page 17

~10 m

is the number of jobs that could potentially be recreated or shifted – triggered by Industrie 4.0. The net effect is positive.

Page 16

Beyond technologies: Industrie 4.0 means a paradigm shift in companies' manufacturing strategies.

There is more to Industrie 4.0 than its technical dimension. Technologies like factory virtualization, smart and intelligent machines, the IoT, the cyber production system, 3D technology, cobots determine the debate. Many are available already or emerging. Companies have launched pilot projects in which they try to embed these technologies in their current manufacturing process. Few, however, have genuinely exploited their potential to the full and implemented new models.

The forth industrial revolution will transform the economic paradigm and the mechanisms for creating value that underpin it. Manufacturing has, in effect, switched from a mindset of mass production to one of mass customization. No longer is it based on scale and volume effects but on flexible and localized production situated close to centers of demand. It manufactures "on demand" and no longer creates inventory, instead dynamically adapting itself to demand. It is more predictive and auto-corrective and it involves less trial and error. Its logic is now focused not on the product but on usage, and it has also switched from a rigid form of labor organization, inherited from Taylorism, to a flexible form – enhancing the appeal of work as a result. It potentially represents a complete overhaul of the economic rationale behind business.

A NEW ECONOMIC RATIONALE

The industrial model today is still based on the principle of decreasing product costs through the volume of products manufactured: the higher the volume produced, the lower unit costs become. As a result of this, industry has been primarily concerned with optimizing the costs and price of products and less so with optimizing the capital required to make them. This industrial paradigm is now being questioned because there is only so far it can go. Given the climate of uncertainty with regard to volumes – a climate generated by the economic crisis – and the increasing diversity of customers and their expectations, the investments required to manufacture products at the lowest cost and in large numbers have created an inflationary trend in capital employed caused by a lack of flexibility or the under-use of the manufacturing base. We have developed an innovative approach to analyze the effects of Industrie 4.0: We explore its effects on return on capital employed (ROCE). It became clear from this analysis that a company makes far better use of its physical

Cover photo: Getty Images /DigitalVision; Fotolia

A

FUTURE PATH OR DEAD END? THREE OPTIONS FOR DEVELOPMENT

We analyze industry development at firm and country level. By using return on capital employed we can calculate effects and draw conclusions

1 AUTOMATION

Products with high added value and high margins

CAPEX intensive production

High level of automation/ modern machine parc

2 OBSOLESCENCE

Medium or low added value, low margins

Labor intensive production

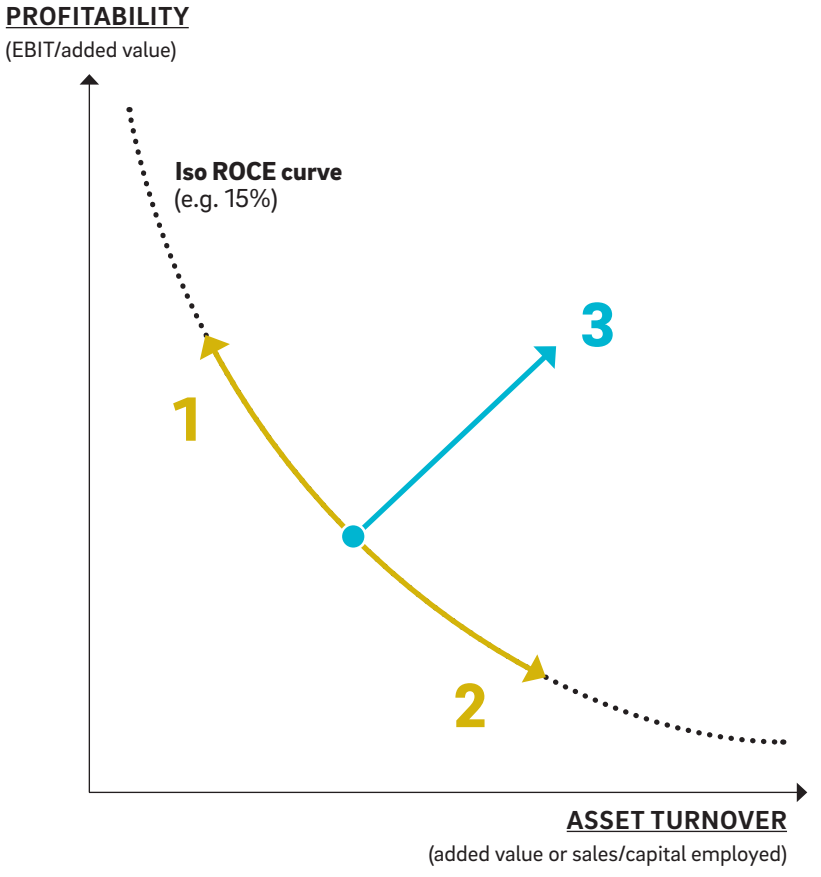
Amortized or obsolete means of production

3 INDUSTRIE 4.0

High added value products, high margins

Flexible production

High ROCE



Source: Brokers, Roland Berger

Profitability is improved within Industrie 4.0 by means of a reduction in labor costs and an enhanced asset utilization rate, which compensates for the increase in automation-related depreciation. Margins are also improved thanks to the increased value of products and by customization and flexibility.

Asset turnover indicates the sales generated for every euro of capital employed (fixed assets and working capital requirement). Industrie 4.0 allows better asset use (reduction of product changeover time; reduced machine downtime, inventory and maintenance times; etc.). It is also an indicator of capital intensity: the lower the asset turnover, the greater the capital intensity in the industry.

An industry with low asset turnover and a high margin (automation) can offer the same ROCE as an industry with high asset turnover and a low margin (obsolescence).

asset in an Industrie 4.0 environment. It reduces the cost of complexity, which is borne by the digital aspect of a product or a machine that is essentially standardized. One example is the 3D printer, which is a standard machine manufacturing an infinite variety of products, but this is the spirit of Industrie 4.0 as a whole. → A

Does Industrie 4.0 require more capital than before? There are several reasons to believe this is not the case. For instance, a cobot is considerably less expensive than a conventional robotic cell; the price of sensors is but a fraction of what it once was; and RFID and connectivity solutions are relatively cheaper than their equivalent in a Kanban system, and their price is falling, as is the case with electronics. Furthermore, digital continuity requires more unified IT systems, which is clearly cheaper than the plethora of IT systems found at companies, with all their associated interfaces. So overall, the additional investments in extra equipment and software will be offset by enhanced utilization of the manufacturing asset as a whole.

KEY TAKEAWAYS

Roland Berger has simulated the overall impact of the transformation to Industrie 4.0 at a typical factory in the automotive parts industry. This shift is based on five main drivers:

Virtual factories will enable new products to be industrialized virtually before disrupting the physical system, thereby enhancing the ability to launch new products quickly by drastically reducing development times in production. This will also offer managers a new way of overseeing operations and intervening in them.

Automated flows (via autonomous vehicles or cobots) provide a relatively low ROCE impact, because savings on logistics costs are partly offset by investments in automation solutions (vehicles, equipment and software). However, the issue here is not automation, but making the whole system more flexible and responsive and cutting inventory levels and throughput, which impact on ROCE. Such an automated system will be able to perform tasks that are beyond human capabilities with a huge combination of flows and parts diversity required by customization.

Smart machines need much fewer operators than traditional ones and are able to correct themselves and can operate both separately to and in connection with each other, through the night, for example. Given their ability to operate for far longer on their own, the operator adopts a very different approach of problem solving or correction. Instead of doing it, they make the machine do it.

Predictive maintenance systems enable improved planning of machine downtime, since it becomes foreseeable. This ensures that tools are used in a more efficient way. The impact on the job performed by the operator is considerable. From a logic of manual and visual inspection, they will adopt a logic of diagnosis and problem solving.

The cyber-production system is the upper layer of command of the factory and its suppliers: It enables mass customization and the readjusting of production planning in line with demand variations. It will also allow switching from a switch from push production – make and build up inventory – to pull-production – make to order. A yield management approach can be applied for the product pricing, with discounts according to lead time. All of this brings planning and logistics jobs and management practices into question and ultimately leads to their transformation.

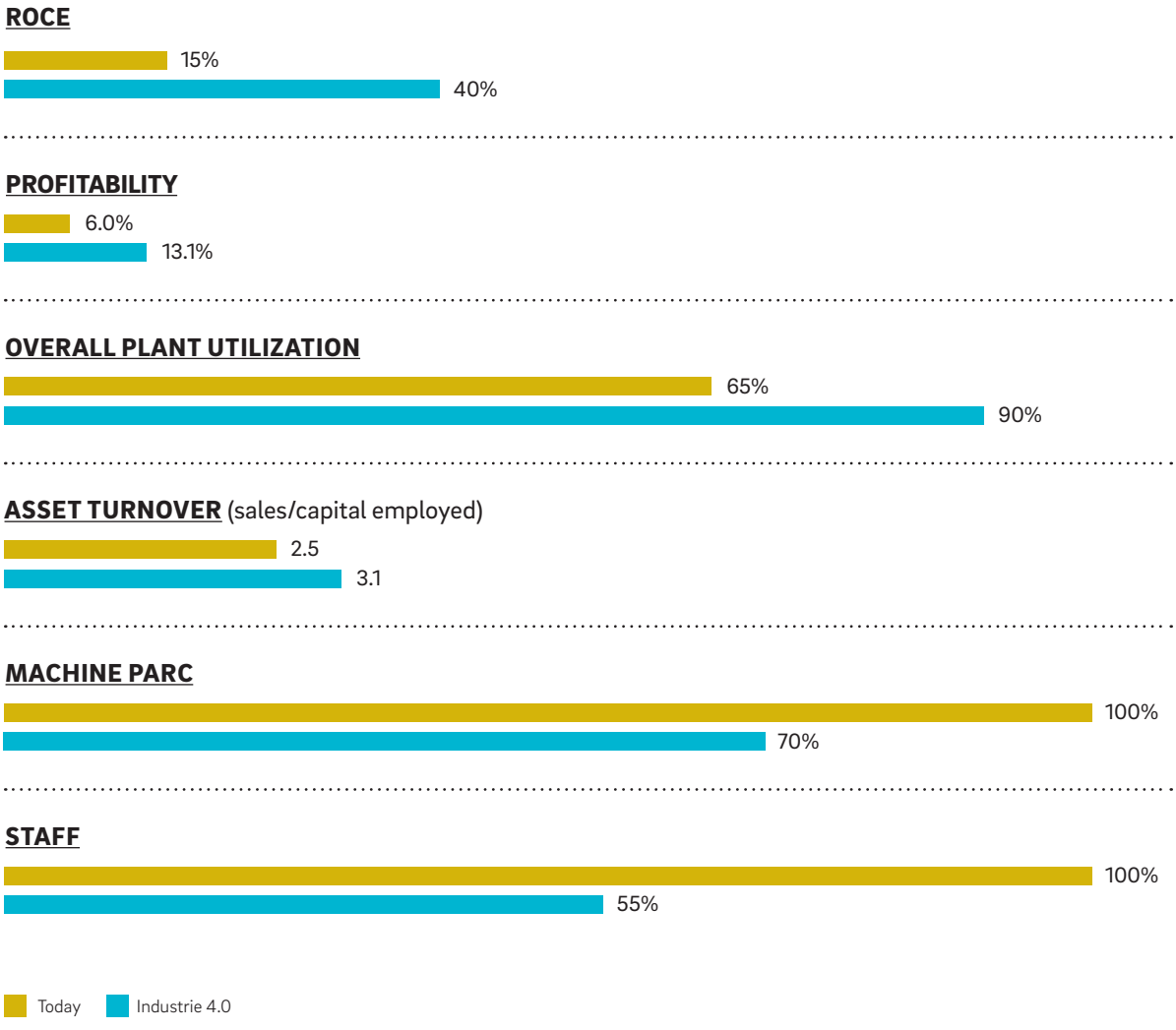
We calculated the effects for the example of an automotive supplier. They result in an ROCE increasing from 15 to 40% and the margin growing from 6 to 12%, while plant utilization rises from 65 to 90%. → B At first sight the human workforce needed to operate the plant is reduced by around half, but people still are at the heart of the system. Firstly, the factory of the future will offer jobs for all qualification levels. For example, operating a cobot is much easier than programming an industrial robot and requires far fewer qualifications. Secondly, responsibilities in areas such as quality, maintenance and security will remain. Additionally, relationships with the internal client and the understanding of needs and problem solving will become more important. Thirdly, new jobs will appear (in systems, cyber-security, big data, analytics and other areas) in the form of local and non-local skills. Work modes will change too: teams of learners pooling local, internal and external skills at the company will be headed up by coaches. Finally, the quality of work life will improve. Tiresome and repetitive tasks will be automated, leaving people free to focus on the operating process and engage far more as part of a team. These improvements can lend a whole new image to industry, that is more appealing to young people and more rewarding. → C

B

HOW CAN FIRMS MAKE MORE OF THEIR CAPITAL?

We simulated Industrie 4.0 effects for a typical automotive supplier. ROCE increased by 25 percentage points. We also observed better plant utilization, higher profits and asset turnover, lower machine parc and staff investment

Selected effects of Industrie 4.0:



Source: Roland Berger

C

THE GLOBAL WORKBENCH OF INDUSTRIE 4.0

Three examples illustrate the progress the new paradigm brings to companies applying Industrie 4.0 principles

GERMANY

Adidas – production sites with maximum agility

Sportswear specialist Adidas is aiming to manufacture bespoke sports shoes at closer proximity to consumers. Its "speed factory" concept will begin in summer 2016. Outsourcing of sports shoe manufacturing to Asia has become increasingly unappealing for Adidas due to the 18-month time lapse between the design of new models and their arrival in stores, which increases labor costs and creates a large carbon footprint. The new type of factory manufactures seamless footwear thanks to an innovative automated procedure. Developed as part of a project embarked on with other manufacturers and research institutes (Johnson Controls, KSL Keilmann, Fortis Institute and the textile institute ITA RWTH), the "speed factory" significantly develops the modular approach by making man and machine work together side by side, with one or the other being able to perform certain tasks. The result is a production site that can fit into a cargo container and uses an automated process to manufacture individual running shoes, thus taking local labor costs out of the equation and eliminating transport costs. The innovative process also allows new collections to be brought out in less than 45 days in order to meet demand and requirements, a move towards fast fashion, a business model invented by Zara and H&M. The first "speed factory" will open in Ansbach, Germany.

USA

Local Motors – made to order car manufacturing

In much the same way as fab labs, Local Motors (LM) asks prospective car buyers a simple question: why go to car manufacturers when there is another choice available? In making that alternative available, this young start-up has created a community of members, engineers, researchers, designers and amateur mechanics and car enthusiasts, giving them the opportunity to share their experiences and skills in specific projects, in particular the development of open-source cars. Complementing the initiative are microfactories, fully equipped workshops where prototypes can be developed and mechanized and products assembled in short runs. The adventure began with an all-terrain vehicle project by the name of Rally Fighter. Employing 107 people and backed up by a community of 51,700 members working on 81 projects, the company runs three microfactories and is planning to set up 100 in all over the next ten years, with all these sites set to offer small but highly customized production runs. The company originally made its name with the LM3D, a 3D-printed car due to be launched on the market in 2016. It also recently teamed up with American giant General Electric to create the FirstBuild network, which pursues the same philosophy as LM itself but focuses on the development of the home appliances of tomorrow. Ideas are shared in a social network, while manufacturing takes place at a dedicated microfactory.

JAPAN

Okuma – a best practice smart factory

The Japanese machine tool manufacturer has developed a complete milling process capable of operating autonomously 24 hours a day, seven days a week, without human intervention. The process can automatically select cutting tools and change them when necessary. Materials are supplied automatically, with the system collecting any discarded metal. Every operation is displayed on iPad-type tablets. Even the continuous improvement system (Kaizen, so beloved of the Japanese) is automated, thanks to software based on warning reports generated by the machine during production. Operators are merely on hand to supervise the line and carry out high value-added tasks. Complete automation of the process leads to productivity being doubled, with the automatic Kaizen system doubling it again.

Rethinking politics: How Industrie 4.0 makes an impact on industrialized nations' development routes.

The transformation brought about by the switch to Industrie 4.0 is not limited to its micro-economic impact, though this transformation first manifests itself at an individual company level. This switch also represents a major macro-economic challenge faced by all major industrialized nations. What are the routes that the world's major industrial powers pursue? ROCE is relevant both at the scale of a factory and at the scale of an entire country. Its development reflects the development routes taken by nations in terms of their industrial policy. → A → D

The first of them is automation, not to be confused with Industrie 4.0. It merely increases capital employed through the effects of investment, with companies becoming more capital intensive as a result. Profits increase thanks to automated activities replacing manual ones. Ultimately, the two phenomena tend to balance each other out, with ROCE remaining unchanged. Conversely, when a country heads to industrial obsolescence profits are decreasing, causing investment to drop to a level below depreciation. In turn, capital employed falls, while asset turnover (sales/capital employed) rises artificially, which compensates for the drop in profits and enables ROCE to remain constant. However, neither of these two development routes pertains to Industrie 4.0, which is characterized by an increase in both asset turnover and profit. Roland Berger has calculated the ROCE of the industries of leading nations and their development during the period 2000–2014, and revealed some enlightening variations in the process.

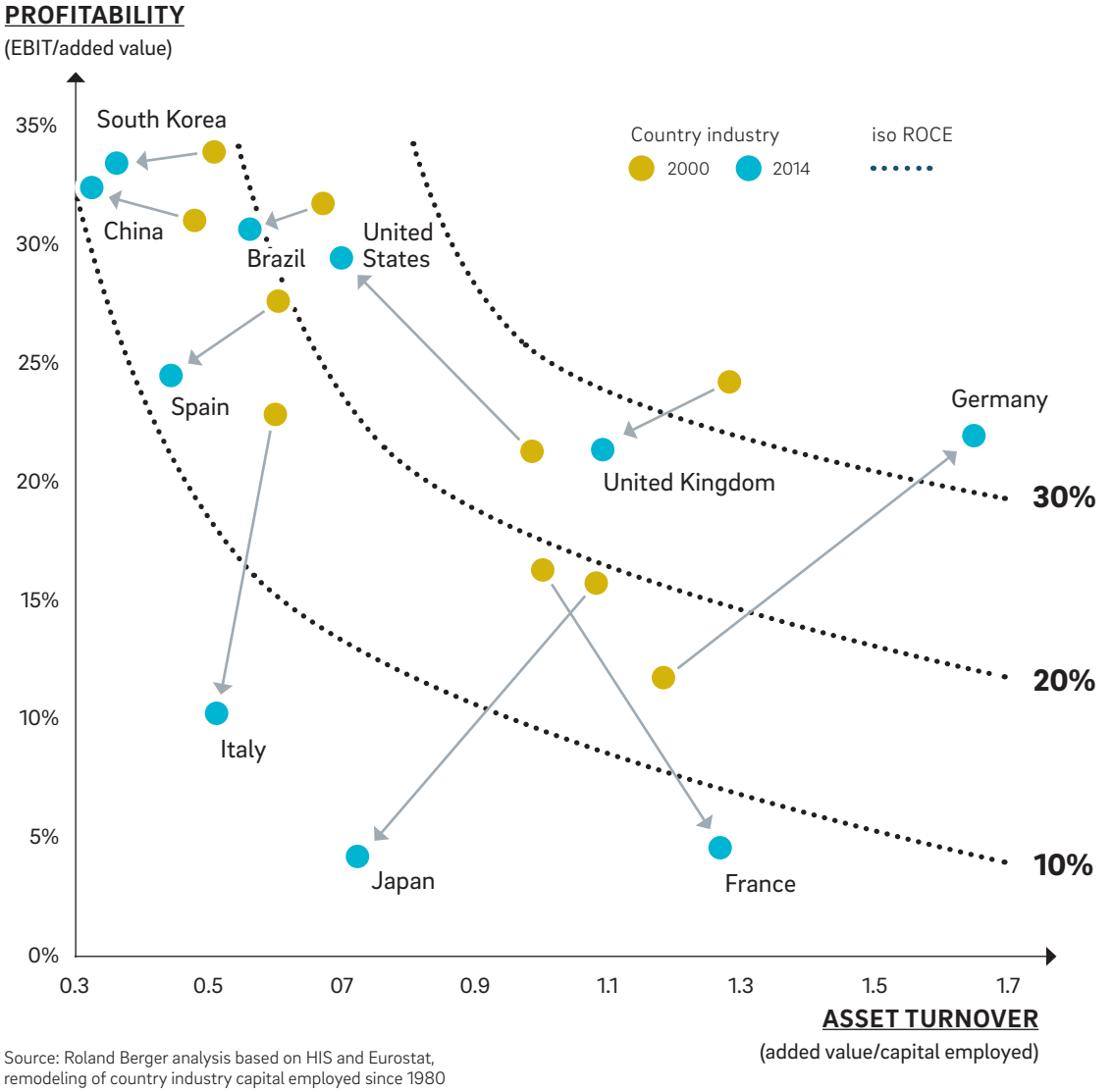
Industrial policies implemented across the world often pursue the same objectives: increased competitiveness and relocation or preservation of activities. However, the means of achieving these objectives and the stakes involved for each country vary according to the strength of their industries and economies, the level of automation they have attained and the size of their local markets, among other factors. Every nation thus invests in Industrie 4.0 as a levered response to specific challenges, which is why the growth in manufacturing value added through increased competitiveness is at the heart of German, Chinese and American strategies, while France and Japan focus more on the relocalization of manufacturing by neutralizing the effects of high labor costs. The issue of remaining a global market leader in industrial solutions is vitally important in Germany, and also to a degree in China. In

D

DIFFERENT STRATEGIES – DIFFERENT RESULTS

A world of deindustrialization: The US increased profits by investing in automation. France, Japan and Italy underinvested while profits shrank. Germany alone managed to increase profits and asset turnover at the same time

Evolution of countries' return on capital employed (manufacturing, mining & utilities sectors; 2000 to 2014)



Source: Roland Berger analysis based on HIS and Eurostat, remodeling of country industry capital employed since 1980

E

A GLOBAL BUZZ

Industrie 4.0 is a concept originating in Germany in 2010 and introduced to the public by the German Engineering Federation at the 2011 Hannover Messe. Today it is known all over the world

International rollout: Initiatives launched per country

2015

JAPAN
Revitalization/robotics strategy:
Increase the productivity of service industries, significantly raise the deployment of robotics by 2020

SOUTH KOREA
Manufacturing Innovation 3.0:
Create a manufacturing ecosystem based on new technologies/encourage smart factory development

FRANCE
Industry of the future:
Support the development of specific products (efficient car, electric airplane, etc.)

2014

BELGIUM
Intelligent factories clusters:
Suport the development of "Factories of the future"

CHINA
Made in China 2025:
Turn China into a strong manufacturing nation with priority on digitization and modernization of 10 sectors

What is Industrie 4.0? It symbolizes the advent of the fourth global industrial revolution, which makes use of three technological innovations – automation, the Internet of Things and artificial intelligence – to create groundbreaking industrial and economic models. What might have been perceived as a marketing initiative by industrial equipment suppliers became, in the space of just a few years, a global concern shared by the industrialized world.

2012

ITALY
Intelligent factories clusters:
Structure Italian manufacturing community to develop and leverage research, with 4 projects

2011

UNITED STATES
Advanced Manufacturing Partnership 2.0:
Create high quality manufacturing jobs and enhance US global competitiveness

UNITED KINGDOM
Catapult centers:
Double manufacturing contribution to GDP

2010

GERMANY
Industrie 4.0 platform:
Common approach BITKOM, VDMA & ZVEI

Source: Roland Berger

France and Japan, meanwhile, more significance is attached to raising job satisfaction levels, making manufacturing more sustainable and harnessing Industrie 4.0 to improve the image of industry. → E → F

GERMANY: A DEFENSIVE/OFFENSIVE STATEGY

Germany is the only country whose industry has significantly improved its ROCE over the last 15 years. It has been following the route of Industrie 4.0. Despite a slight drop in employment (9%), German industry has seen its value added rise 80% between 2000 and 2014 and its profits jump 158%. Investments and depreciation have remained more or less unchanged over the same period, while far better use has been made of assets, and the rate of use of production equipment rose from 85% in 1998 to 95% in 2014. As a result, Germany's ROCE climbed from 12% in 2000 to over 30% in 2014. Capital employed, which has remained constant, produces far more today than it did 15 years ago, helping to give rise to the so-called "German miracle".

About a decade ago Germany was facing several challenges: rising labor costs; rising energy costs in the future; the need to renew infrastructure, and a shortfall in skilled employees. Industrie 4.0 can help the country combat the risk of the competitive potential of the existing model being compromised. Germany is also a producer of Industrie 4.0 solutions, thanks to giants such as Siemens and Bosch and a number of medium-sized enterprises specializing in manufacturing equipment, a sector that accounts for more than 3% of national GDP. Germany is thus putting its faith in the development of 4.0 solutions as a means of sustaining its dominance in the global market and keeping production volumes steady. Consequently, Germany's 4.0 strategy is both defensive in nature (maintaining its production at home, being more flexible in response to crises in international markets) and offensive (ensuring skills and know-how stay in Germany in order to support the export model).

FRANCE: A STRATEGY FOR INDUSTRIAL RESURGENCE

French manufacturing is not particularly strong. It accounts – the energy sector included – for only 12% of national GDP and 3.7 million jobs. The country has been pursuing the route of industrial obsolescence for some time now. With an ageing manufacturing machine base – estimated in 2014 at 19 years old on average, significant manufacturing job losses (- 20% between 2000 and 2014), a fall in value added (-4%) over the same period, and a drop in profitability (-70%), French industry is sharply decreasing. In 2014, French industry suffered a shortfall of EUR 40 bn on its investments in relation to its depreciation. As a result, French industry has become less capital intensive, but not for good reasons. The machine use rate fell from 85 to 81% between 2000 and 2014, with the country's ROCE dropping from 20% in 2000 to around 8% in 2014.

Does industry of the future represent a golden opportunity to re-emerge as an industrial power? Despite the weaknesses of its machinery sector, the digitization of the production system can help France to reposition itself, thanks to its digital and virtualization expertise and also to its newly developed and growing start-up ecosystem. Furthermore, the industry of the future can present a unique opportunity to create a new manufacturing base, one that is able to avoid or bypass the constraints of labor costs and related social issues. Industrie 4.0 can also boost the sector's image with the general public. Provided that the conditions are favorable, France could well nurture a degree of industrial relocation and manufacture products that are currently delocalized (textiles, parts, etc.), while also creating skilled jobs.

UNITED STATES: AN INDUSTRIAL RELOCATION STRATEGY

As a result of significant relocation to China and Mexico, the rate of industrialization in the US is relatively low (17% in 2014). In absolute terms, however, American industry was worth EUR 2.160 bn in 2014, nearly three times more than German industry and a figure bettered only by China's EUR 2.750 bn in manufacturing value added. The downside is that with "only" 13.4 million employees (as opposed to China's 160 million), American industry's employment rate fell nearly 30% between 2000 and 2014, with more than five million jobs being destroyed. For instance, Ford, GM and Chrysler have alone shed more than 100,000 jobs, with that figure rising to nearly half a million if their suppliers are included. In the meantime, the US has invested heavily in its industrial sector, with capital employed doubling between 2000 and 2014. The modernization, automation, the use of robotics in factories and high labor productivity (around 40%) have helped profits jump 54%.

F

AN OVERVIEW OF DIFFERENT RATIONALES

The motivation to implement initiatives in favor of the industry sector and the measures applied depend on the challenges that are most urgent

WHAT?	HOW?	WHO?
Added value and competitiveness	Aim for lower labor sensitivity, improve competitiveness, create entry barriers	Germany Japan United States China
Footprint and new business models	Produce personalized products at mass production cost	France Japan United States
Global leadership in 4.0 solutions	Develop technologies and standards, create export solutions	Germany China South Korea
Internationalization and risk management	Build flexible production lines to balance demand volatility, decrease capital cost of geographical expansion	Germany Japan China South Korea
Digital start-ups and ecosystems	Create platform to enable ecosystems, accelerate innovation via incubators and clusters	France China United States
Employee satisfaction at work	Reduce convenience at work, make work more meaningful for life	France Germany Japan
Sustainability and image	Reduce use of natural resources, improve image of industry	France Japan

Source: Roland Berger

The US has, to some extent, followed the route of automation, with modernization and productivity increasing, albeit with a level of investment that is too high in relation to the value added generated, and, as a result, with no improvement in ROCE. As far as the Americans are concerned, the challenge with regard to Industrie 4.0 is a simple one: to increase value added and make better use of modernized assets. That is the objective of President Obama's policies, in particular the Advanced Manufacturing Partnership, which aims to promote Industrie 4.0 in factories, increase value added, enable the relocation of industrial activities and create high-quality skilled jobs across the country.

JAPAN: A STRATEGY TO RENEW INDUSTRIAL GROWTH

Japan's manufacturing value added shrank by 40% over a ten-year period, and the country lost two million industrial jobs between 2000 and 2014, with industrial profits falling 80% over the same period. In the meantime, it has "underinvested" to the tune of EUR 160 bn. Its inevitable deindustrialization is the result of its proximity to China (where a number of Japanese manufacturers have relocated), a strong yen dragging down exports and an overall drop in competitiveness, exacerbated by the impact of the country's population decline and the disastrous economic effects of the March 2011 tsunami. It is on the obsolescence route.

Reliant on a weak yen, Prime Minister Shinzo Abe's economic policies (Abenomics) has also revealed its shortcomings, giving rise to more expensive imports – which are very important to Japan – but without stimulating exports, with the fall in the yen mainly being used by manufacturers to create margin rather than volume.

Not surprisingly, these developments have led to a sharp fall in ROCE, followed by very weak asset turnover and low profitability. In order to halt deindustrialization, Japan has belatedly committed itself to Industrie 4.0, launching a raft of programs in the middle of 2015. Bearing in mind its current level of automation, Industrie 4.0 should allow it to regain competitiveness and flexibility. Industrie 4.0 also has a crucial role to play in addressing young people's lack of interest in industry and in offsetting population decline by reviving investment in the quality of work in factories. Finally, it is essential for Japanese companies with a high international profile that the country should provide them with a competitive industrial base.

CHINA: THE INDUSTRIAL EXCEPTION

A world leader in "low-cost exports", China has evidently taken good note of the threats to this model. It has also understood that the only way it can safeguard its industry is to upscale and go premium, especially given the fact that there are two major obstacles to the growth of its manufacturing value add: falling demand for low-cost products and, above all, the growing problem it faces in terms of competitiveness, with blue- and white-collar wages rising all along the east coast, energy and land costs rising, and difficulties in attracting workers to the center of the country, among other issues.

China thus sees Industrie 4.0 as the solution to the challenges it faces in terms of competitiveness and upscaling, and also views it as a means for developing a portfolio of industrial solutions that will allow it to compete, in time, with Germany. Will China's industrialization, which like Korea and Japan has followed the conventional blueprint of a low-cost exporter that then upscales – prove to be the exception at the end of the industrial miracle?

A NEW GROWTH MODEL FOR EMERGING COUNTRIES

Industrie 4.0 does indeed result in a profound upheaval of the development model in emerging countries by depriving them of access to the model of conventional industrialization and the exporting of low-cost products. Emerging nations have a need for industrial goods and products that are produced locally. Thanks to far more flexible means of production, lower capital employed and the increasing customization of products, Industrie 4.0 is well able to adapt to unstable markets by mitigating risk of the kind that occurs in emerging countries. The Industrie 4.0 model can help emerging nations industrialize at a local level by enabling more win-win cooperation between themselves and the industrialized world through the principle of co-localization, which is not new in itself but which has the potential for far greater development.

Foreign partners can thus provide the production means and the technology to develop products and are paid for the use of industrial assets. As a result, the "host" country creates added value around a raft of design, marketing, sales and product distribution activities.

An opportunity for social change: Industrie 4.0 can set new impulses for growth and employment.

One of the most delicate questions regarding the fourth industrial revolution concerns the impact it will have on jobs. Will the quantity of employment destroyed by digitization and automation be compensated for or not by the creation of activity linked to the benefits they bring? The fact of the matter is that Industrie 4.0 involves a large number of jobs, and the impact in terms of the reduction in the quantity of work in the factories of the future, compared to those of today, is potentially significant.

In the next industrial transition, however, it is not volumes, the scale effect or the labor cost factor that will create value, but product customization, and, in economic terms, the reduction of capital employed to obtain them. These new value drivers possess considerable potential for creating new activities and jobs.

With Taylorization, the specialization of tasks and the standardization of the product, Ford was able to cut the time it took to make one of his cars from 12.5 hours to just 1.33. In ordinary circumstances, this would have led to a 90-percent drop in employment, but given that mass-produced cars were considerably cheaper to make, ultimately a much wider section of the population could afford them. This drove demand, which increased much faster than the rate of production, hence generating jobs in numbers that exceed the employment fall caused by the reduction in labor per unit. This mechanism for converting productivity into purchasing power, which then drove production, was also the cornerstone of Les Trente Glorieuses (as the 30-year period between 1945 and 1975 was known in France).

THE TRADITIONAL ACTIVITY RECREATION DRIVERS ARE AT A HALT

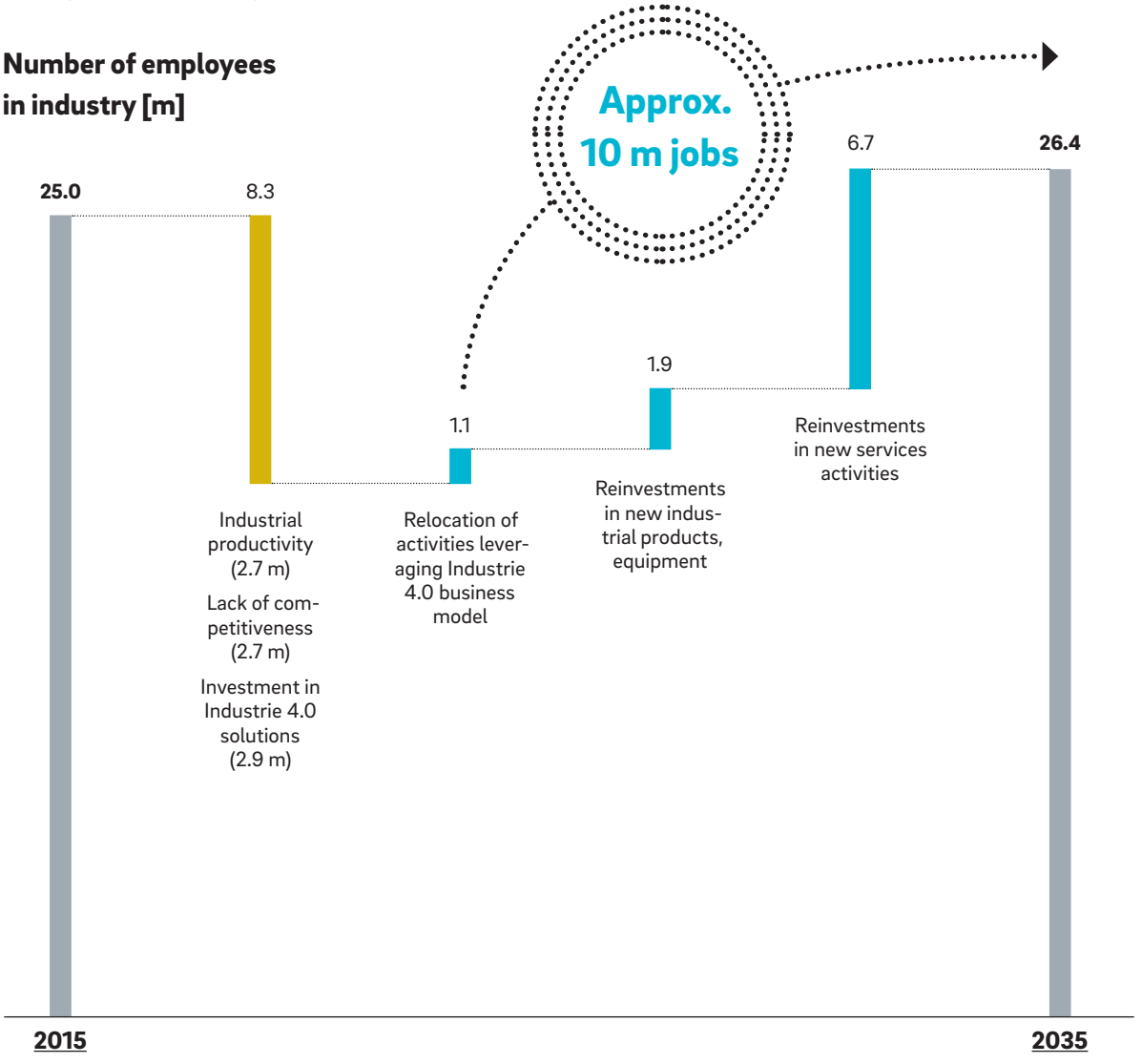
During the successive waves of automation, manufacturing volumes offset the increase in productivity in jobs. More recently, industrial productivity gradually translated into reduced costs instead of increased volumes that led to a growth in services triggered by increased customer spending power. At the same time, the productivity of the industrialized nations was the catalyst for a boom in emerging countries, which benefited from work being transferred to them.

In the four decades that have followed the era of automation, industrial job losses have been compensated for by three drivers of alternative economic activity, which have now ground to a halt. In the last 15 years, five

G

POSITIVE PROSPECTS FOR TALENT AND EMPLOYMENT

In our model we assume an adoption rate of 50% for Industrie 4.0 solutions until 2035. We observe where jobs are disappearing, being replaced and where completely new ones are being created in Western Europe. The net effect is expected to be positive



Source: Roland Berger

million industry jobs have been lost in Western Europe, with industrial jobs now accounting for only 15% of total jobs in the zone. While such falls were always offset in the past, this is not the case anymore:

1. Outsourcing to services (which accounted for around 35% of the fall in industrial jobs before 2000) has directly contributed to the growth of industry-related services: logistics, maintenance, security, industrial subcontracting, etc. Over the last 15 years, this particular driver represents less than 10% of the fall in employment and no longer generates employment.

2. Industrial productivity (which accounts for around 45% of the fall in industrial jobs), through cost cutting, translates into customer spending power, which has directly contributed to the growth of services and has created jobs in number. A turning point has been reached here: with the development of digital technologies services productivity is increasing to a degree that is no longer capable of offsetting industrial job losses.

3. Lack of competitiveness in industry, which accounts for 45% of lost jobs, has had the effect of transferring activities to more competitive countries, often at low cost, either through delocalization, non-replacement or reinvestment in the activity, creating millions of jobs there. In enabling countries with high costs to become competitive again (protecting them from labor costs, in particular), Industrie 4.0 has brought an end to the low-cost model. As a driver of job creation in emerging countries, the low-cost model is destined to decline in emerging countries, which will have to find an alternative growth model.

The loss of momentum of these three employment transfer drivers has already had visible effects that have hit the global middle classes notably through a rise in inequality. This also feeds a sense of pessimism as to the future of work and society as a whole, where enforced inactivity will be the fate of most of the population, while an overqualified minority will enjoy all the benefits of the digital economy. The fact is, though, that every time some jobs – or occasionally a great number of them – disappear, others crop up in their place, while the employment figures generated by industrial revolutions have always been largely positive. Why should things be any different this time? Like every industrial revolution before it, Industrie 4.0 has considerable potential to create value, and this will be converted into new activities. The new element is that the value-creation mechanisms are fundamentally different in nature to those that have emerged in previous industrial revolutions.

THE NEW PARAMETERS OF THE EMPLOYMENT EQUATION

In the future, Industrie 4.0 will allow products to be manufactured locally with optimized industrial assets and relatively little labor. The concern now is to increase flexibility, customization and quality, among other factors. It is no longer a question of improving prices or volumes. The issue at stake is knowing how to generate alternative economic activity and employment as part of this new deal, by means of mechanisms that are very different to those we have seen to date.

During the third industrial revolution, automation, mass production in factories and delocalization had the principal effect of optimizing cost prices, by raising volumes to a level at which investment was justified. In the next industrial transition, it is not volumes, the scale effect or the labor-cost factor that will create value, but the customization of products and services, and, in economic terms, the reduction of capital employed. This ROCE economy has considerable potential to create value, and thereby activity and jobs, albeit in ways that differ to those we are familiar with. → G

Deindustrialization of European industry will continue to a certain extent until 2035. Based on historical data we estimate than 2.7 million jobs will be destroyed by the effects of productivity and 2.7 million by the loss of competitiveness in relation to other regions. The next factor mirrors the impact of the gradual introduction of Industrie 4.0 before 2035, by envisaging that only 50% of industrial companies will have chosen to harness the full potential that Industrie 4.0 has to offer, and that the remaining 50% will only use certain technological building blocks with a view to becoming more competitive. Industrie 4.0 will accelerate the rate of job losses, with around an additional 2.9 million being destroyed, thereby doubling conventional industrial productivity. Only 16.7 million jobs would be left in an industrial sector that has become largely 4.0 and, at the very least, competitive once more.

RECREATION OF EMPLOYMENT OUTPACES DESTRUCTION

At the same time, the manufacturing base will have been modernized by 4.0 solutions, allowing capital

employed to be used more gainfully. In making better use of its base, industry will draw less on capital employed. Profitability and ROCE will rise and create new investment opportunities – a key aspect in the funding of new projects and in creating new jobs. We have assumed that most of those jobs will be created in Europe[1]. In the model, the creation of value linked to the growth of ROCE, which rises from 18% in 2015 to an average of 28%[2], will potentially generate EUR 420 bn, in the form of excess profit (after tax) and savings in capital employed. Provided that most of it is reinvested in the European economy, this investment capacity should generate added value of EUR 850 bn[3].

What does this mean for the labor market? In this model, manufacturing jobs account for 12% of the total number of jobs, while manufacturing value added represents 15% of the total value added – figures that are not dissimilar to the current ones. However, it is also estimated that other jobs will be created as a result of the value generated by Industrie 4.0, in services as well as manufacturing. We estimate that this development represents the creation of potentially upwards of ten million new jobs. That would be enough to offset the overall fall. Around three million of these jobs would be created in manufacturing, with the remaining seven million coming in new services[4]. Out of the three million new manufacturing jobs, we estimate that 1.1 million would come from the industrial relocalization of activity formerly based in Europe (for example, from textile 4.0, the manufacture of parts, toys, furniture, etc., or in other sectors that have long since been delocalized) or from activities that are on the verge of being delocalized. Though a moderate estimate, this figure conveys the idea that relocalization requires new, ultra-optimized and automated solutions with low numbers of employees to be as competitive as other low cost countries. The jobs that are created by new industrial activities bear little resemblance to old ones and are based on an entirely different business model. Assets take the form of a product platform and a services ecosystem that are highly standardized and are used extremely efficiently,ioffering customization, user-oriented services and management of the customer-community interface. → H

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KEY FIGURES

How Industrie 4.0 initiatives could contribute to more value contribution and recreation of jobs

28%

is the potential return on capital employed in Western Europe until 2035 – compared to 18% today.

420 bn

net profits and savings in capital employed would be the value effect of Industrie 4.0.

6.7 m

new jobs could be created in the service sector alone.

12%

would be the share of manufacturing jobs on total jobs in 2035.

1 It was assumed that the jobs created abroad from foreign investments are offset by the jobs created by foreign countries investing in Europe.
2 18% for the half of industry that remains conventional and 38% for Industrie 4.0.
3 Based on asset turnover of 1.3 for manufacturing and 2.5 for services.
4 We have envisaged that 35% of the reinvestment would come in manufacturing (double the national average) and 65% in services, as this value creation would come from industrial companies, which are more inclined to reinvest in their sector than the economy as a whole (20-80).

A WORLD OF NEW SERVICES

Another characteristic of Industrie 4.0, as with digitization, is that it puts a premium on usage rather than the possession of goods (e.g. matching services, pay-as-you-go). As a result, even though the price of the product remains the same, the customer's total outlay is significantly lower because they pay for usage only, thus freeing up spending power. This virtuous circle is radically different to the core concept of our development to date. Price per unit and production volumes will no longer be of concern. Instead, it is the volume of use that increases and the cost of use that decreases, while assets and products remain constant or diminish.

We estimate that the creation of value has the potential to generate nearly seven million jobs in services, thereby satisfying the additional spending power freed up by reduced cost of use for consumers. By considering how basic needs are fulfilled, we can understand the huge potential to create new services, in the field of education and training, health, leisure, access to knowledge, mobility, food and human contact, which are continually developing and far from being satisfied for all Europeans, in terms of either quality or cost. We will thus see digital for solutions to various aspects of mobility and access to accommodation, health or education emerging.

What these figures reveal above all is the scale of the shift in employment that is about to take place. Nine million of the 25 million people employed in manufacturing will change activity, moving primarily, to services, while the remaining 16 million will see their jobs change significantly. This signals an urgent need for us to prepare the ground for training the population for such a transformation, at every level.

CALL FOR ACTION

Industrie 4.0 provides us with the means to rethink our industry as part of this new environment and ensure that it remains strong in industrialized nations. It responds to four key issues: the increased competitiveness of assets, flexibility, the ability to respond to changes and shifts in demand, and the regionalization of production. It also responds to humanity's aspirations, which occupy a more central place in industry than ever before. Finally, it also paves the way for some sort of renaissance in cottage industries, by making it viable to have small structures situated closer to population centers.

Industrie 4.0 also provides an economic rationale founded on the creation of new value. New industry generates its value by increasing the use of an asset or product – which translates into a lower cost of use for the customer – and by reducing capital employed for the producer. This shift in the economic paradigm, which is what creates new industry's value, is the factor that will create alternative economic activity and jobs in the years to come.

There is an urgent need to gain a better understanding of this transformation, to comprehend and explain it in more detail. Only then will we be able to plan for a transitional phase that is already largely under way, and brings concomitant problems: unemployment, deindustrialization, the disintegration of large groups, social tensions, unsuitable skills, etc. With a view to keeping this phase as short as possible, we must start anticipating the imminent restructuring of the social, employment and investment model. There is a new world waiting to be built. ◆

ABOUT US

Roland Berger, founded in 1967, is the only leading global consultancy of German heritage and European origin. With 2,400 employees working from 36 countries, we have successful operations in all major international markets. Our 50 offices are located in the key global business hubs. The consultancy is an independent partnership owned exclusively by 220 Partners.

FURTHER READING

Of Robots and Men

Automated solutions for logistics are making very fast progress. Now, they allow human operators and machines to work within the same warehouse. The impact will be twofold: Within companies automation will dramatically reduce logistics costs; on the labor market unemployment will be the consequence.

Nouvelle donne industrielle, nouveau modèle économique

This books explores the impact of the transition towards Industrie 4.0. It looks into industrial strategies, industrial policy, developed and emerging countries, skills shift and the recreation of activities. It aims at developing a vision of the end game, to better prepare the upcoming transition.

Les classes moyennes face à la transformation digitale

Since 1990 the manufacturing sector in France has been facing major challenges. The country still has not found a shared vision of how to adapt to the digital transformation of industry. We are looking for a strategy to protect the industrial base and the nations' industrial employees.

Additive manufacturing

As industrial digitization proceeds apace, fully automated 3D factories are realizable and anticipated. The market for additive manufacturing/3D printing has grown 20 percent on average every year since 2004. We expect a wide variety of technological innovations to considerably broaden the scope of applications and support further growth.

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