

# China – Industry 4.0 Index 2015



Industry 4.0 and Lean

A study by Staufen AG

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In Germany, the „Industry 4.0 Index“ was conducted for the second time after 2014 and shows the speed at which digitalisation is driving the economy forward. However, for all three surveyed countries the following holds true: Many employees and managers risk losing touch with this dynamic development.

To ensure that this does not happen, it is worth taking a look at the 4.0 pioneers. Do the networked forerunners have something in common? Yes, it is called Lean Management. The

study revealed that a higher-than-average number of them have already streamlined their entire organisation. Moreover, they develop their processes and procedures at the point of value creation so that technological progress and the further development of the leadership culture are always in step.

This shows that the proven impulse generator Lean Management creates the optimal foundation for the smart factory – also for companies that do not yet or only partially consider themselves capable of transitioning to smart factories.







## ABOUT THIS SURVEY

For the “Industry 4.0 index”, consulting firm Staufen surveyed a total of 329 industrial enterprises in Germany, Switzerland and China. One hundred of the participating companies were based in China, of which 40 percent were active in the machinery and engineering sector and the automotive industry.

The surveys were conducted between late April and mid-July 2015.

## BACKGROUND AND SCOPE OF THE STUDY

China continues to be seen as the “workbench of the world”. Yet the Middle Kingdom is looking to shed its image of being the land of rapid and cheap production. The programme “Made in China 2025” announced this year by the government is the first step towards achieving this.

The aim of the 10-year plan is to bring China on an equal footing with the Western industrial nations with respect to Industry 4.0. In the long term, the government has more in mind. Its ambition is for the People’s Republic to become the world’s leading industrial power by the time it turns 100 in 2049. “Made in China” is therefore meant to represent innovation, quality and efficiency, something the Mercator Institute for China Studies considers a “challenge to the established industrial nations that is to be taken seriously”.

The Fraunhofer-Institut für Arbeitswirtschaft und Organisation (Fraunhofer IAO) already sees China as being “on the fast track”. Why? From 2013 to 2015, Chinese inventors registered more than 2,500 patents for Industry 4.0-enabling technologies. In the USA, this number was 1,065 and in Germany 441. Also with respect to patent quality, researchers believe that China has outperformed the USA and Germany.

Nevertheless, China is still in the early days with respect to the implementation of Industry 4.0 – 35 percent of companies have not yet concerned themselves with the subject. However, it must not be forgotten: China is becoming a breeding ground for innovation. Owing to the digitalisation of the industry, companies are doing everything in their power to skip ahead a step in terms of economic development. Even if this will not be entirely successful – production and the Internet grow together and the Internet of Things is finding its way into factories. All too soon, very few production companies will be able to get by without networked production, in which machines and parts are engaged in an ongoing exchange of information.

The smart factory is based on the foundation of efficient processes in production, development and administration. In other words: Lean Management. In this respect, China is a considerable step behind Germany. Nevertheless, firms in China are well aware of the methods they must use in order to catch up. An important aspect of this is the behaviour of its managers – many of China’s top managers are already re-interpreting their role and in doing so creating a suitable environment for intelligent production.

The “Industry 4.0 index” to be conducted for China for the first time also shows that companies in China are looking to seize the opportunities presented by digitalisation and networking. Most important: **The subject of the smart factory is on the agenda for at least half of Chinese industrial companies, although German businesses are one step ahead of them.** The investigation has also shed light on the technological and organisational challenges faced by China in an era of digital transformation.

<sup>1</sup> ZEIT ONLINE GmbH, 27th May 2015: <http://www.zeit.de/wirtschaft/2015-05/china-industrie-technologie-innovation>

<sup>2</sup> Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO, 24 June 2015: <https://www.iao.fraunhofer.de/lang-de/ueber-uns/presse-und-medien/1606-top-50-chinesischer-industrie-4-0-patente.html>

## THE SURVEY

### More and more companies becoming “smart factories”

Chinese companies are still at an early stage with respect to Industry 4.0: Just one in ten firms already started to make the transition towards the web-based, real-time networking of objects, machines and people by way of operative projects. Businesses are lying in wait. For 37 percent of them, the smart factory is in the observation and analysis phase and for a further nine percent, it is already in the planning and testing phase.

However, 35 percent of Chinese firms are yet to concern themselves with Industry 4.0, this despite the fact that smart production will need to be adopted very soon by companies if China is to shed its image as the “work-bench of the world”. For this reason, the Chinese government announced this year the programme “Made in China 2025”. The aim of the 10-year plan is to bring China on an equal footing with the Western industrial nations with respect to Industry 4.0 – with Germany acting as a shining example.

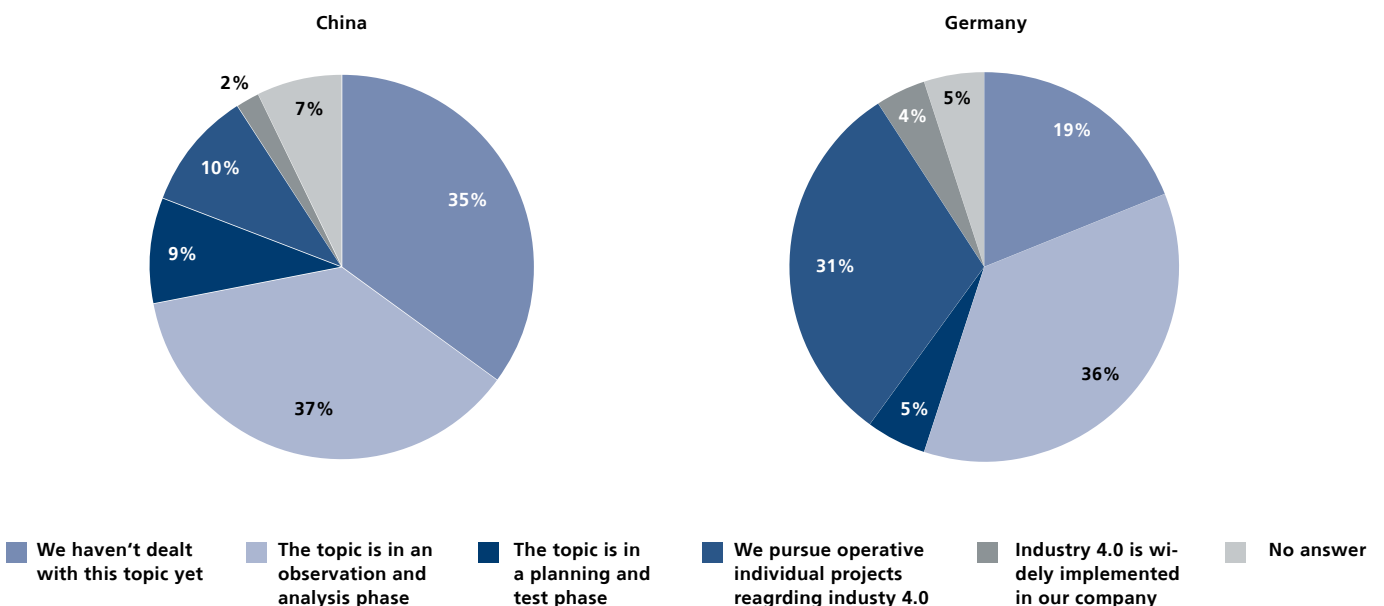
As the country comparison shows, Germany is already considerably ahead of China with respect to Industry 4.0. One in three German

businesses have started to make the transition to smart factories by way of individual projects. If we compare the results for China in summer 2015 with those for Germany from the previous year’s study, we see that at present, Chinese companies are roughly in the same position German firms were one year ago.

As it stands, 76 percent of German firms are already getting to grips with smart production. This comparably high figure is hardly surprising. After all, the subject has been energetically pursued as a future project since 2012 as part of the high-tech strategy of the German government and the industry.

By way of comparison: In China, 58 percent of companies currently have Industry 4.0 on their agenda. The programme “Made in China 2025” will play a considerable role in increasing this share over the coming years.

**Industry 4.0, web-based network of objects, machines and people in real time, is currently the top topic. How far is your company on the way to „Smart Factory“? How well-prepared is your company for „Smart Factory“?**





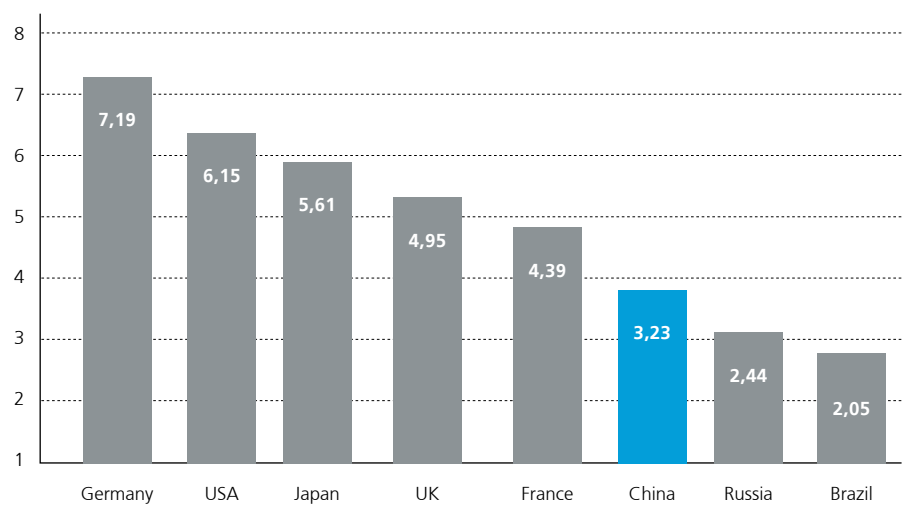
## China already with the pack – Germany remains ahead

Which country has made the most progress in implementing smart production? The Chinese companies surveyed place the Middle Kingdom in sixth position in the international “Industry 4.0 comparison”, ahead of Russia and Brazil and behind France.

In the long-term, however, China will not be satisfied with this ranking. This is attested to not only by the 10-year plan “Made in China 2025” but also by the fact that China is ahead of the USA and Germany according to the Fraunhofer IAO with respect to Industry 4.0-enabling technologies, with more than 2,500 patent registrations filed compared to 1,065 and 441, respectively.

The majority of Chinese study participants believe Germany is the world’s leading nation in the development of a digitalised and networked industry, followed by the USA and Japan.

**From your point of view, which country is most advanced in Industry 4.0?**  
(average rating, 8 = most advanced)



<sup>3</sup> Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO, 30 March 2015:  
<http://www.iao.fraunhofer.de/lang-de/ueber-uns/presse-und-medien/1585-industrie-4-0-china-auf-der-ueberholspur.html>

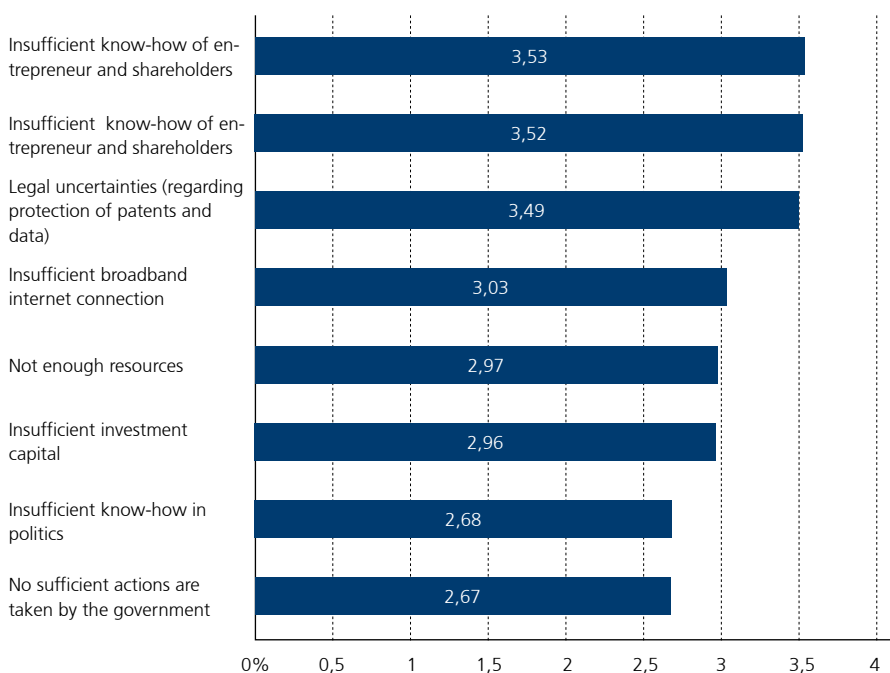
## Missing norms, insufficient know-how and legal uncertainties are thwarting Industry 4.0

The companies believe that there are three obstacles in particular that China must overcome if it is to become an Industry 4.0 nation: Nearly two in three firms complain of missing norms and standards. They alone are considered a prerequisite if China is to join the digitalised and networked industrial world. However, as part of the digitisation of industrial manufacturing, production parts have indeed been fitted with sensors and chips and as such are able to send and receive information to and from machines and suppliers. The standards are, as it were, the language the chips and machines use to communicate. Where they are missing, the smart factory remains incomplete.

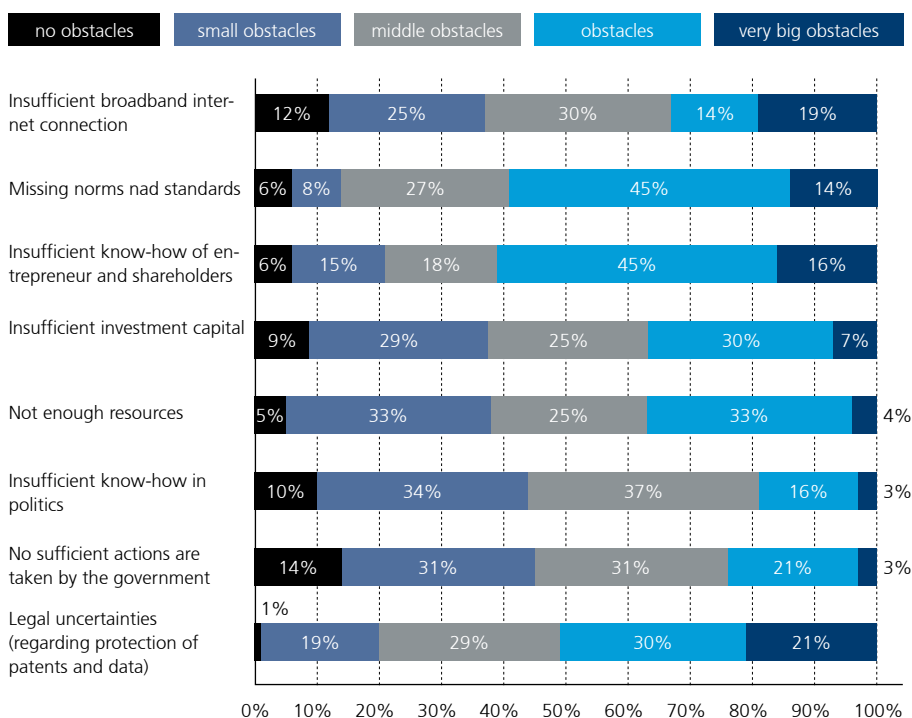
In addition, nearly two in three companies criticise the insufficient know-how of founders and shareholders in China. The third biggest obstacle at 51 percent is legal insecurities relating to patent and data protection.

The issue of broadband expansion ranks fourth: For 63 percent of Chinese companies, insufficient broadband connections represent a big to very big obstacle. This is hardly surprising: The average connection speed in China in the first quarter of 2015 was 3.7 megabits per second (Mbit/s). By way of comparison: In Germany, it was 10.2 Mbit/s for the same period – there, too, seven out of ten companies consider insufficient broadband connections to be a major obstacle. In Switzerland, on the other hand, the average connection speed in the first quarter of 2015 was 14.9 Mbit/s. Thus it comes as no surprise that broadband expansion represents next to no obstacle for a third of Swiss companies (34 percent) and at best a small obstacle for a further 28 percent.

**Which are possible obstacles on the way to Industry 4.0 in China?**  
(Average rating: 1 = no obstacles – 5 = very big obstacles)



**Which are possible obstacles on the way to Industry 4.0 in China?**



<sup>4</sup> Heise Online, 15 February 2015: <http://www.heise.de/newsticker/meldung/Industrie-4-0-Bosch-will-Standards-vorantreiben-2549645.html>

<sup>5</sup> Akamai Technologies 2015: <https://www.stateoftheinternet.com/downloads/pdfs/2015-q1-state-of-the-internet-report-infographic-asia.pdf>

<sup>6</sup> Akamai Technologies 2015: <https://www.stateoftheinternet.com/downloads/pdfs/2015-q1-state-of-the-internet-report-infographic-emea.pdf>



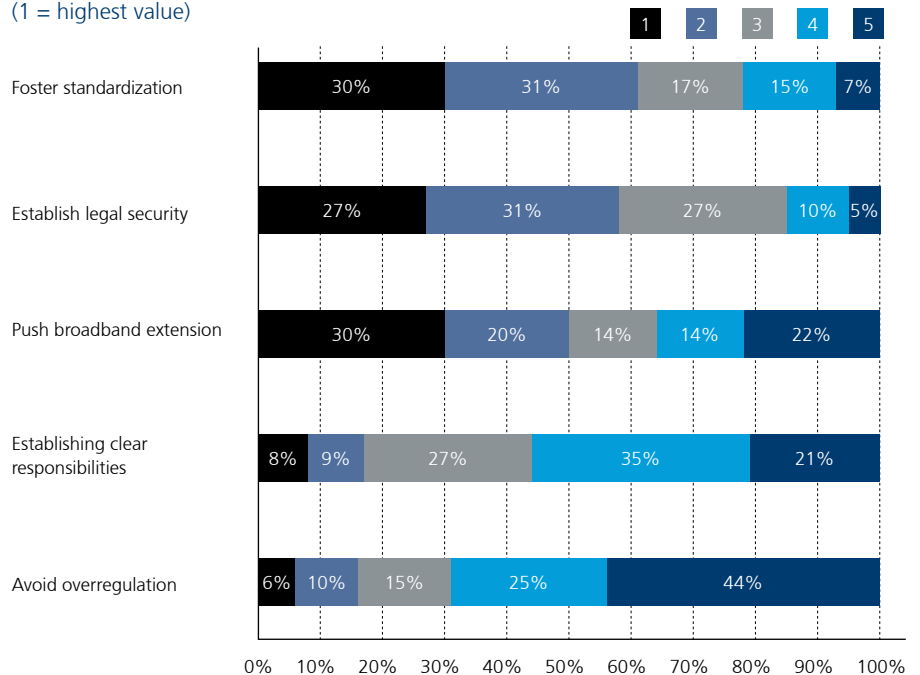
## The government should press ahead with standardisation and broadband expansion

Demands on the government come as a direct consequence of the obstacles blocking the development of Industry 4.0 in China. For a large number of companies, it is imperative to foster standardisation and to push broadband expansion. This is followed by the establishment of legal security with respect to patents and data protection. At least one in two companies describe all three points as being a top or high priority.

A parallel to Germany can be drawn from the country comparison, where the three key demands on the government are identical – right down to their order. In Germany, too, companies are demanding broadband expansion be a top priority, followed by the establishment of legal security and the fostering of standards.

### What do you expect from the government regarding Industry 4.0? Please order you responses.

(1 = highest value)

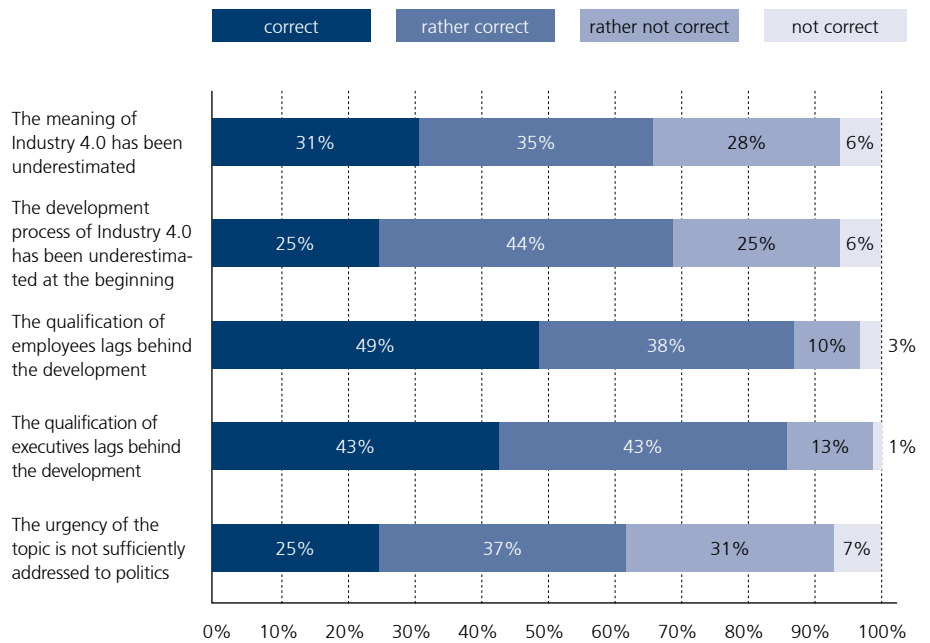


## Industrial know-how still missing

The Chinese industry is by all means self-critical when it comes to smart production. Almost nine in ten companies say the Chinese economy is lagging behind with respect to the qualification of its employees and executives.

Furthermore, two in three firms admit that the industry has underestimated first the significance of Industry 4.0 and also the pace with which the digitalised and networked production world is developing.

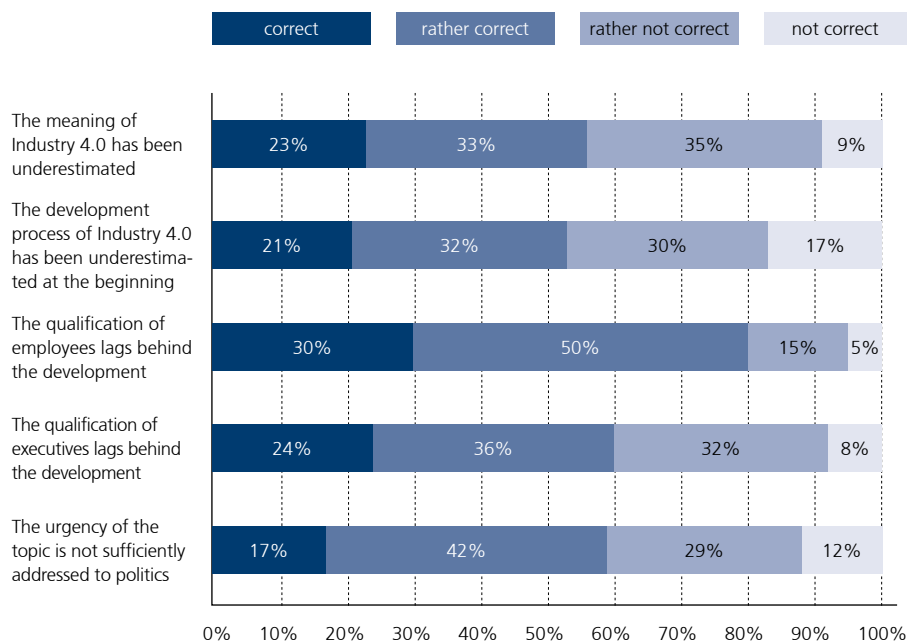
### What is the position of the Chinese industry regarding Industry 4.0?



In general, the overall economy or the specific industry are more poorly regarded than one's own company. This also applies, albeit in diluted form, for Chinese businesses. While they judge their own internal situation less pessimistically than that of the industry, they also believe that they have a lot of catching up to do. Eight in ten companies concede that the qualification of their employees lags behind technological development. A further six in ten companies have identified the same shortcoming among their executives.

On this last point, despite all the self-criticism, companies in China are interestingly more sure of themselves than their German counterparts. Nearly eight in 10 German businesses responded that the qualification of their managers is lagging behind the Industry 4.0 development. The same applies with respect to a further self-assessment of the firms: While in China just 53 percent of companies believe they have underestimated the pace of development of Industry 4.0, 62 percent of German firms state that this is the case.

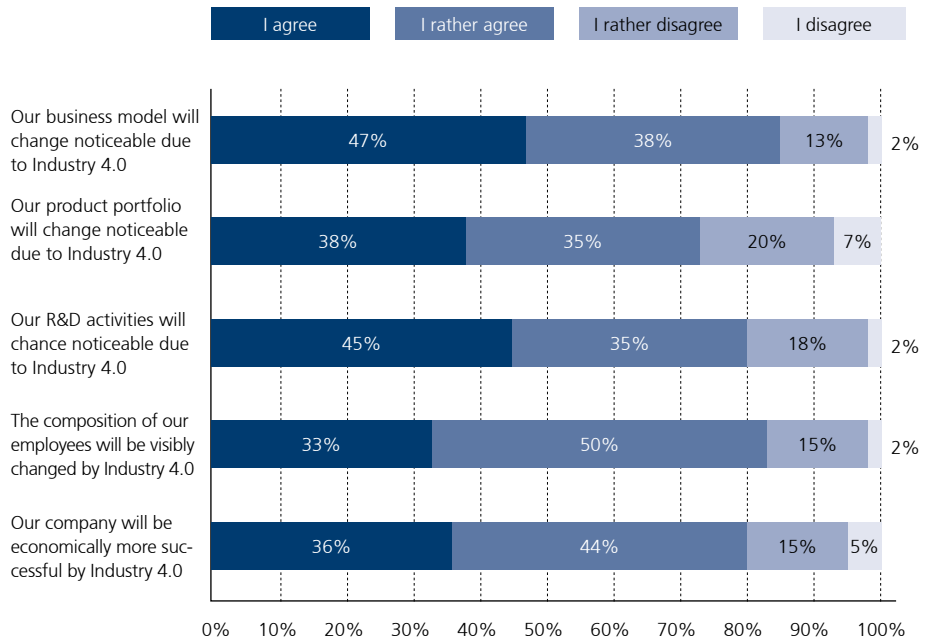
### And how has your company positioned itself regarding Industry 4.0 so far?



## Revolutionary development in the industry

Chinese companies see a need to catch up in terms of their becoming smart factories. Yet over the coming five years the industry in China will face major changes. Around eight in ten companies are convinced that their business model and the composition of their workforce will change considerably as a result of Industry 4.0. Roughly the same number expect economic success to follow from smart production as well as a shift in their research in development activities. It is hardly surprising, therefore, that more than seven in ten companies anticipate a significant change in their product portfolio.

### Which impact will Industry 4.0 have in your company in the next 5 years?



The country comparison with Germany shows clear differences. In Germany, only one in ten companies expect their own business model and the composition of their workforce to change considerably as a result of Industry 4.0 over the coming five years.

Moreover, just 48 percent of German companies are anticipating radical changes to their product ranges.

The differences allow several interpretations. First, the pace of development of Industry 4.0 in the Middle Kingdom is higher than in Germany due to China's prevailing economic momentum and starting position – the "student of China" is therefore in store for a revolution, while evolution is imminent for its shining role model Germany.

Second, the Chinese businesses clearly view the for-them-still-new subject somewhat more euphorically than the German companies, who are already well on their way to becoming smart factories.



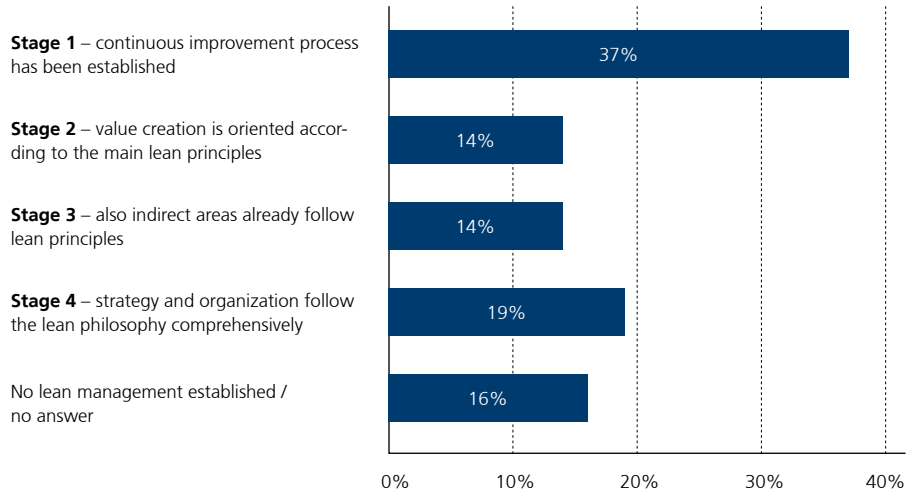
## Lean processes form the foundation for Industry 4.0

The smart factory and the thus hoped-for economic success are based on the foundation of efficient processes in production, development and administration. For this reason, the study asked how far Chinese companies have come with respect to the introduction and implementation of Lean Management.

Nearly four in 10 companies in China (37 percent) have established a continuous improvement process. Furthermore, 14 percent of their entire value creation is orientated according to the main lean principles and a further 14 percent have also expanded these to indirect areas. One in five companies have already completed the next step, i.e. the comprehensive implementation of the lean philosophy with respect to strategy and organisation.

Thus Chinese businesses are doing it the German way, which can be summed up as "lean first, then smart". Not the worst decision: As the Staufen study shows, Germany's lead with respect to Industry 4.0 correlates stron-

### How far have you already established lean management methods in your company? Please select the response which best describes your status.



gly with the maturity level of the Lean Management that has been established within the companies. As such, the German economy is on average a full step ahead of the Chinese economy. At 41 percent, the propor-

tion of companies in Germany who have orientated their value creation chain according to the lean principles is approximately three times greater than in China.



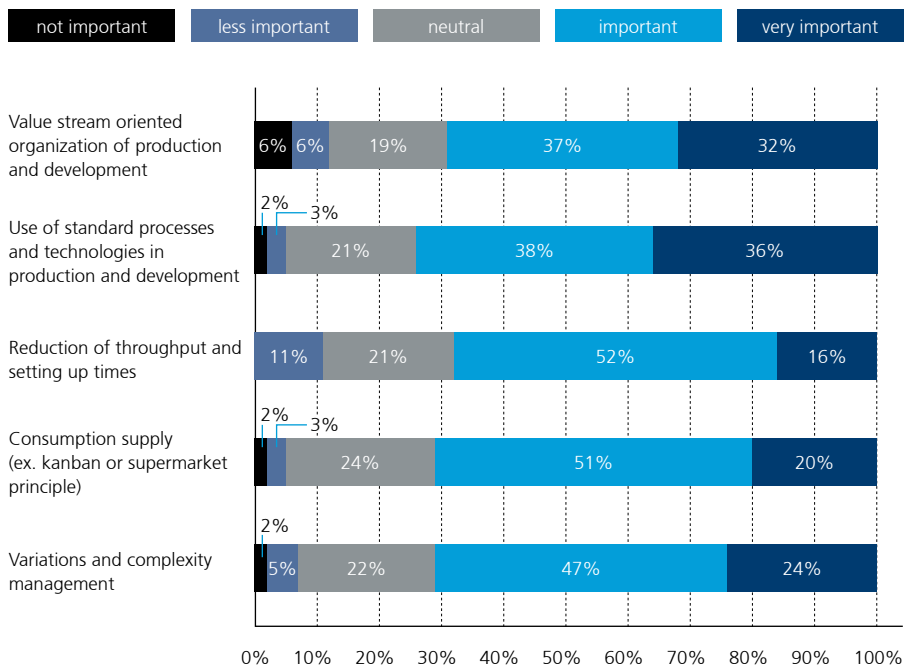


## Standard procedures and value stream orientation as an important foundation

The use of standard procedures and technologies and secondly the value stream-orientated organisation of production and development are the lean methods that Chinese companies consider most helpful in the implementation of Industry 4.0. They are deemed very important or important by at least seven in 10 companies. In addition, the majority of companies rate variations and complexity management, consumption supply and the reduction of lead and set-up times as important or very important.

Looking at Germany: Similarly to China, companies describe value stream orientation as the most effective Lean Management method with respect to the establishment and operation of a smart factory. Variations and complexity management are next in line. The details are revealing, as on this aspect the businesses set themselves different priorities. One in two German companies consider the aforementioned method very important, which can be said for just one in four Chinese. Almost half of the companies in Germany attach great important to reducing lead and set-up times, while the same applies only for around one in six Chinese.

**In your opinion, how important are the following lean management methods when implementing Industry 4.0?**

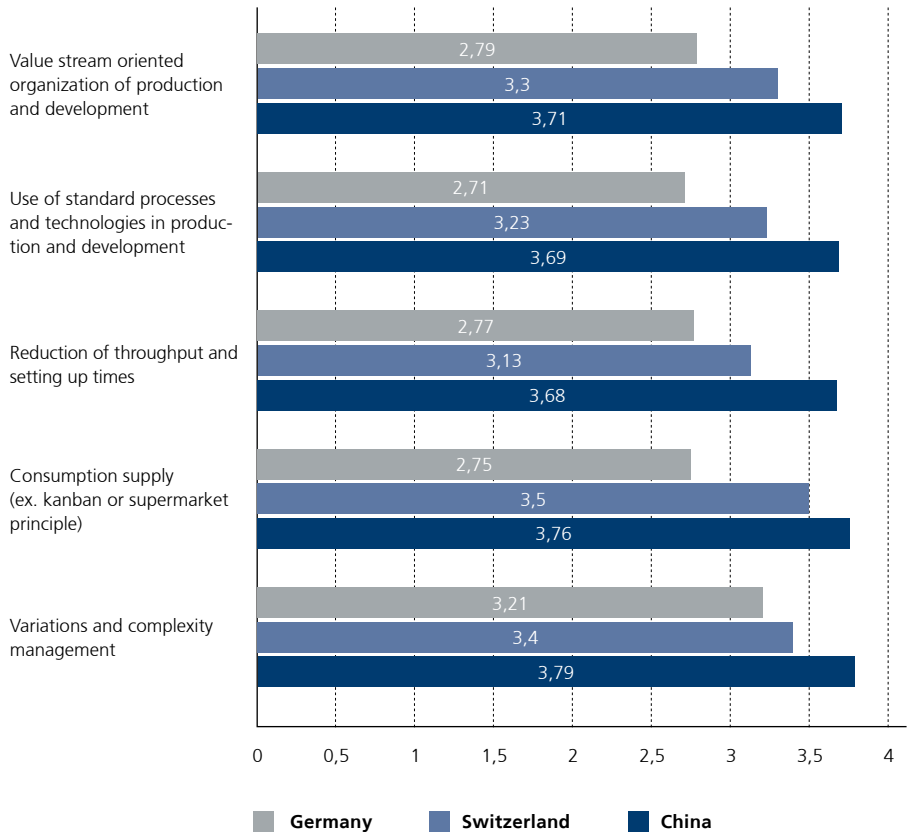


## Lean methods are not yet being implemented with sufficient rigour

The results show that, according to Chinese companies, Lean Management forms the foundation for the successful implementation of Industry 4.0. However, the firms have more to do in this respect than they recognise by themselves. On the implementation of the individual lean methods, those surveyed see plenty of additional scope. With regard to the use of standard procedures and value stream-orientated organisation, which are considered particularly important, only around one in five companies believe they are in a good or strong position. The businesses feel they have come farthest with respect to variations and complexity management – around one in four give themselves a clean or very clean bill of health. Yet it is precisely in this area that one in two companies also consider themselves poorly positioned.

Indeed, there is also a great deal of potential for German companies with respect to Lean Management, but in terms of the individual methods, German businesses consider themselves better positioned than the Chinese. German firms see the greatest need for action in variations and complexity management, with only one in four regarding themselves as good or very good in this area. This value comes closest to the Chinese study results.

### What is your company's current position regarding the following lean management methods?



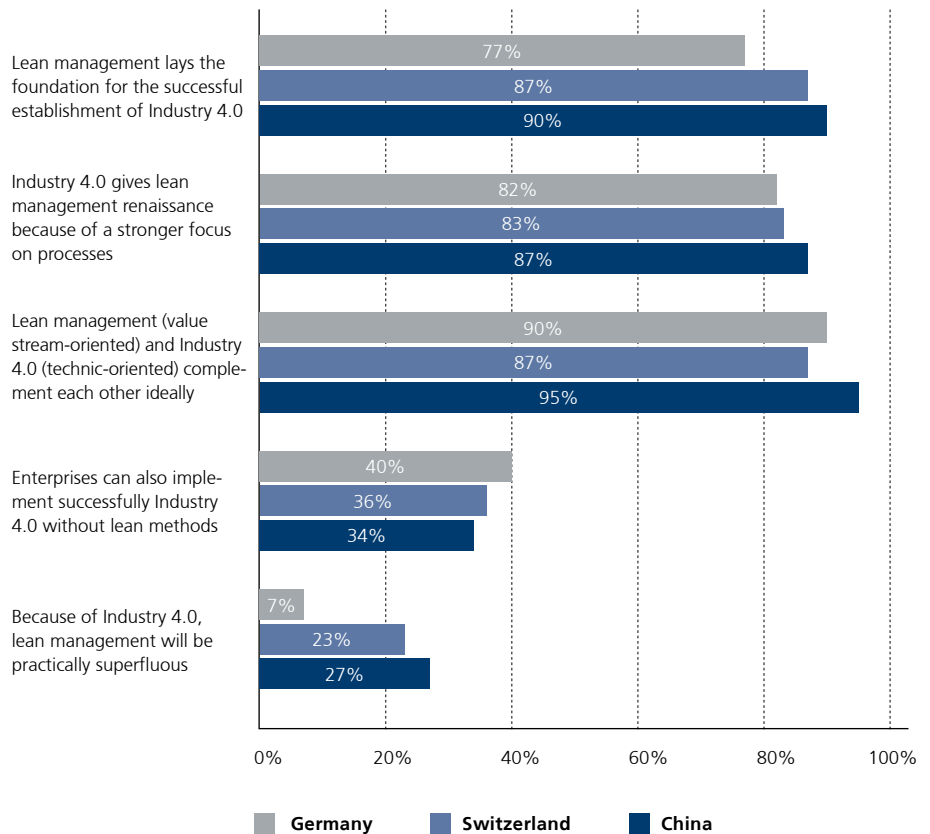
## Lean and Industry 4.0 complement one another

To date, the changes effected in China towards increasing efficiency have been more gradual in nature. However, it is expected that more and more companies will adopt the lean methods given that businesses have identified the link between the lean philosophy and a smart factory. Almost all companies believe Lean Management and Industry 4.0 complement each other extremely well. A further nine in 10 companies are convinced that Lean Management makes for a successful implementation of the digitalised and networked industry. And almost as many assume that Lean Management is experiencing a renaissance as a result of smart production, as greater emphasis is again being given to thinking in processes.

Among German businesses too, there is strong agreement with these three statements, albeit less than in China. Seventy-seven percent of German companies are confident that Lean Management makes for a successful implementation of Industry 4.0 – compared to 90 percent of Chinese companies. These results reflect the fact that Chinese companies are still very much at an early stage when it comes to Lean Management, while it has become somewhat more established within German companies.

### How will the use of lean management be affected by Industry 4.0?

answers: correct + rather correct



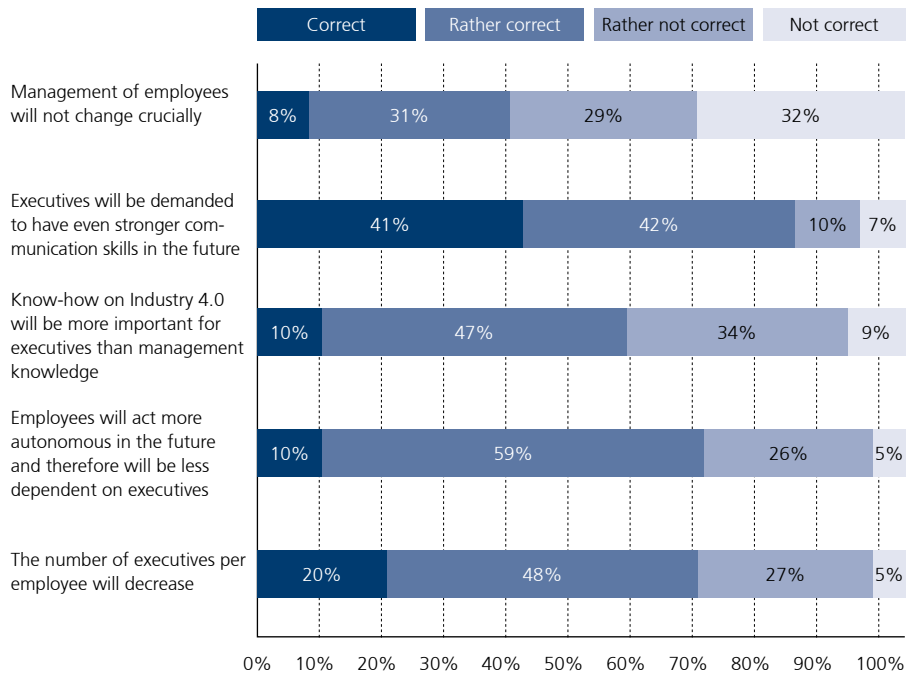
## Managers required to be communicators

Researchers believe the role of managers will change in a smart factory, a view increasingly shared by Chinese companies, too. More than eight in 10 companies expect that the managers of the future will need to be better communicators.

As ever, there are sceptics: Around four in 10 of those surveyed believe their conventional management behaviour is future-proof. Yet one in three businesses are convinced that the way in which employees are managed will soon fundamentally change. By way of comparison: In Germany, over half of companies believe their conventional management behaviour is future-proof and only one in ten businesses are anticipating extensive changes.

In addition, two in three Chinese companies expect to see a fall in the number of managers per employee, which can be said for just 42 percent of those surveyed in Germany. This implies that most of the Chinese businesses expect Industry 4.0 to have a significant impact on the composition of the workforce over the coming five years, a belief shared by only one in two German companies. This is hardly surprising, however: After all, Chinese companies have not yet come as far as German firms with respect to implementing smart production. They are facing steps that many German companies have long since taken. In this respect, there is still somewhat of a euphoric mood prevailing in China with regard to Industry 4.0.

Which impacts does Industry 4.0 have regarding the leadership?



<sup>7</sup> Cio.de, 23 June 2014: <http://www.cio.de/a/wie-industrie-4-0-den-fuehrungsstil-veraendert,2960778>



## Industry 4.0 is changing company and leadership models

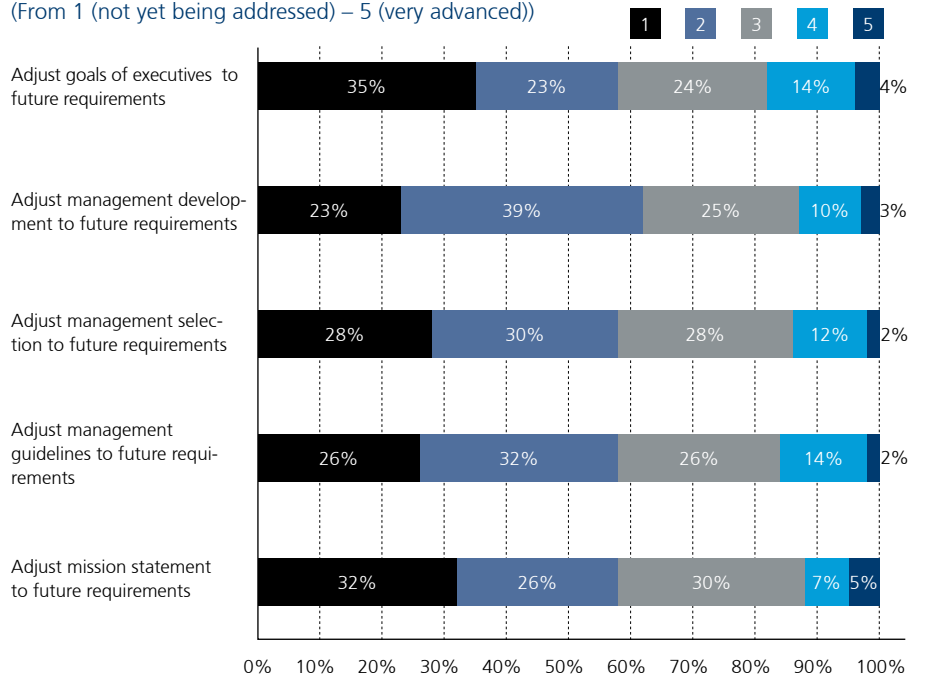
Transitioning to a smart factory goes hand in hand with a change in attitude within the company, and this requires management of the highest quality. However, almost six in ten Chinese companies are yet to begin adjusting their mission statement to future requirements, despite the fact that almost one in five firms describe themselves as being advanced or very advanced in this regard.

The survey results are equally disappointing with respect to the statements on adjusting the target agreements of executives and adjusting management development, their selection and management guidelines. In this respect too, almost six in ten companies are yet to take any serious steps.

The country comparison shows that top executives in German companies are also still facing significant challenges. Their change in attitude, however, is somewhat more advanced than that of Chinese businesses.

### Which methods has your company already established in terms of Industry 4.0 management / leadership?

(From 1 (not yet being addressed) – 5 (very advanced))

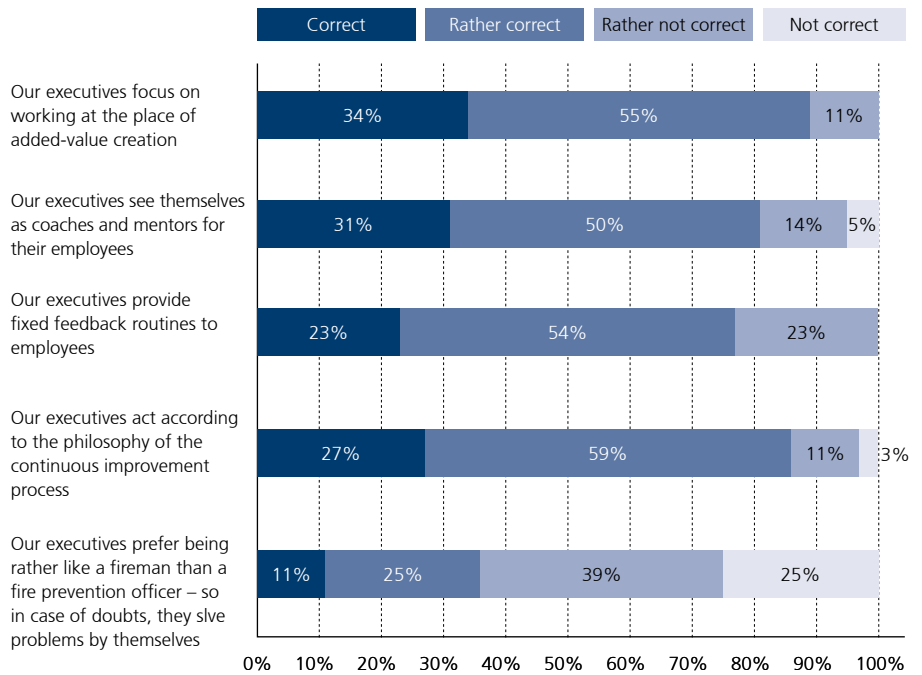


## Shop Floor Management is catching on

So-called “Shop Floor Management”, which is catching on in more and more Chinese companies, forms the foundation for the smart factory. For one in three companies, managers already operate at the site of added-value creation, i.e. in the factory itself rather than exclusively at a desk. If we include the number of businesses that are at least trying to some extent, nine in ten companies are already on the right track. Moreover, the top managers of eight in ten companies consider themselves coaches and mentors to their employees – with some already applying this rigorously in practice and others working towards achieving it. In addition, top executives in the majority of Chinese companies have set themselves continuous improvement as a mission statement and have established feedback routines in place with their team members. However: In one in three businesses, executives still compare their role to that of a firefighter, someone who prefers to solve all problems rapidly by themselves instead of equipping their employees with the skills to do so.

The country comparison with Germany is interesting, here. While German companies have come further than Chinese businesses in terms of the web-based, real-time networking of objects, machines and people, German executives evaluate their role in a more reserved way than the managers of China. Particularly striking is the distinction with respect to the coaching function. While two in three German companies more or less consider themselves mentors to their employees, such mentoring takes place consistently in just 15 percent of businesses – compared to 31 percent of Chinese businesses. Also with respect to Shop Floor Management, at 20 percent the proportion of German managers who consistently go into the factories is considerably lower than in China at 34 percent. And in one in two German companies, executives consider themselves more in a traditional sense as firefighters instead of fire prevention officers – the number is therefore significantly higher than in China.

### How do your executives evaluate their role?



## CONCLUSION

The results of this study show that while many Chinese companies have set their sights on the subject of Industry 4.0, only one in ten are on their way to becoming smart factories by way of concrete individual projects.

The comparison with the “German Industry 4.0 Index” conducted back in summer 2014 makes it clear: In summer 2015, businesses in the Middle Kingdom are roughly in the same position German firms were in one year ago with respect to smart production. In both countries, Lean Management is considered a prerequisite for a successful transition to the smart industrial world. Also with respect to lean philosophy, Chinese businesses are a step behind their German counterparts. Nevertheless: Many companies in China are already re-defining the role of their executives and in doing so creating a suitable environment for Industry 4.0.



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# STAUFEN.

## EDITOR

### STAUFEN.AG

Consulting.Academy.Investment

Blumenstraße 5  
D-73257 Köngen

☎ +49 7024 8056-0  
☎ +49 7024 8056-111

[www.staufen.ag](http://www.staufen.ag)  
[kontakt@staufen.ag](mailto:kontakt@staufen.ag)

### STAUFEN.SHANGHAI

Consulting.Academy.Investment

22H Cross Region Plaza  
899 Ling Ling Road  
CN 200030 Shanghai

☎ +86 21 64417112  
☎ +86 21 64417105

[www.staufen.cn](http://www.staufen.cn)  
[shanghai@staufen.cn](mailto:shanghai@staufen.cn)

## CONTACTS

Daniela Ingrosso  
Head of Sales, Marketing  
and Academy

[d.ingrosso@staufen.cn](mailto:d.ingrosso@staufen.cn)  
Tel: +86 21 6441 7112

## CONTACT FOR MEDIA REQUESTS

Kathrin Kurz  
Junior Marketing Manager

[k.kurz@staufen.ag](mailto:k.kurz@staufen.ag)  
Tel: +49 7024 8056 155