

The Cooperation between Germany and China for Industry 4.0

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Abstract—Industry 4.0, which we are currently in, is creating a new type of business environment. Europe is actively changing, which gives rise to the necessity for strong international partners; and it is precisely China that represents the major investor with an active interest in Industry 4.0. Industry 4.0 was created by the Federal German government to preserve the competitiveness of German industry in the long run. It is for precisely this reason that Germany becomes a dream partner for China. The necessity for studying the problems of the emerging close cooperation between Germany and China based on Industry 4.0 is vital not just for the European market but for global business as well because it will have a major influence on future economic and technological changes on a European level and a global level. China and Germany are among the largest economies in the world, but whereas Chinese industry is largely based on significantly low labor costs, German industry is based on continuous technical progress. In recent years Chinese industry has had an urgent need for the development of new and less labor-consuming manufacturing practices, which requires more automated machines and robots to be integrated in autonomous manufacturing structures. "A journey of a thousand miles begins with a single step." (Chinese proverb)

Index Terms—Industry 4.0, Germany trade, China trade, digitalization, industrial software, internet of things, international standards, digital technology

I. INTRODUCTION

Industry 4.0 is the most discussed and immediate topic both in Germany (the heart of Europe) and worldwide. The term Industry 4.0 refers to new technology and fundamental changes in the development, use and maintenance of products and production capacity in a globalized world. The implementation of technical requirements in standardization systems is vital for the German industry which is extremely dynamic and export-oriented, with the primary goal being single technical functioning and applicability in international standards. Industry 4.0 attracts the interest of powerful players on the international scene – countries like China, the USA, Korea or Japan. A country like China plays a dominating role in Industry 4.0 – a role which is manifested in China's partnership with Germany. The mutual cooperation and strengthening of bilateral relations with China are done through multiple workshops, conferences

and development of joint projects. Generally speaking, Industry 4.0 is an intelligent connection between people, machines and industrial processes. After the steam engine, the production line and the computer, intelligent factories are on the agenda now. Industry 4.0 shows manufacture which combines state-of-the-art information and communication technology. Economic and social development focuses on the digitalization of society and economy not just in Germany, but in all industrial countries.

II. MARKET ANALYSIS OF CHINA AND GERMANY

In order to study the cooperation process between Germany and China, we need to get an overview of the economies of both countries. Information about economic data for Germany are visible in Table I, same data for China are visible in Table II. Additional the trade share for both countries in Table III (Germany) and Table IV (China).

TABLE I. ECONOMIC DATA FOR GERMANY [1].

Area	357.022
Population (millions)	2017: 82,7
Business language(s)	German, English
Economic growth by sectors (%)	2017: Manufacturing industry +2,5; Commerce, hospitality u. Traffic +2,9; Suppliers of business services +2,5; Property u. Residence +1,4; Information u. Message +3,9; Construction +2,2; Funding u. Insurance 0,0; Agriculture, forestry and fishing industries -0,7
Industrial production growth by sectors (%)	2017: Car parts 2,0; Mechanical engineering 0,3; Foods 1,5; Chemical products 0,0; Hardware 2,4; Electric equipment 1,3; Rubber and plastic products 2,2; Electronics 3,0
Highway network (km, fixed)	2016: 645.000
Railway network	2014: 43.468,3
Container ports	2018: 21

Of course, in order to do market analyses for each country, it is vital to know which countries the biggest traders are, which countries are the main suppliers and which countries are the main buyers [1], [2].

TABLE II. ECONOMIC DATA FOR CHINA [2]

Area	9.596.960
Population (millions)	2017: 1.390,1
Business language(s)	Chinese, English
Economic growth by sectors (%)	2017: Real estate 5.6; Restaurants / Hotels 7.1; Wholesale / Retail 7.1; Construction 4.3; Transport / Logistics / Communication 9.0; Industry / Mining 6.4; Financial sector 4.5; Agriculture / Forestry / Fishing industries 4.1
Industrial production growth by sectors (%)	2017: Integrated circuits 18.7; Vehicle 3.2 (including 1.6 cars); Mobile phones 2.2; Chemical fibers 0.7; Cement - 3.2; Steelwork 0.1; Steel 3.0; Manure -6.7; PC equipment 5.8
Highway network (km, fixed)	2015: 4.046.300
Railway network	2017: 124.000
Container ports	2018: 43

TABLE III. TRADE SHARE FOR GERMANY WITH OTHER COUNTRIES

Main supplier countries for Germany 2017; Share in %	Main buyer countries from Germany 2017; Share in %
The Netherlands 13,8%	US 8,8 %
China 7,0%	France 8,2 %
France 6,6 %	China 6,8 %
Belgium 5,9 %	The Netherlands 6,7 %
Italy 5,4 %	Italy 5,1 %
Poland 5,4 %	Austria 4,9 %
The Czech Republic 4,8 %	
Other 51,1%	Other 52,9 %

TABLE IV. TRADE SHARE FOR CHINA WITH OTHER COUNTRIES

Main supplier countries for China 2017; Share in %	Main buyer countries from China 2017; Share in %
South Korea 9,6%	USA 19,0 %
Taiwan 8,4 %	Hong Kong 12,3 %
USA 8,4 %	Japan 6,1 %
Germany 5,3 %	Germany 3,1 %
Austria 5,2 %	South Korea 4,5%
Malaysia 2,9%	Vietnam 3,1 %
Brazil 3,2%	India 3,0 %
Other 57,0 %	The Netherlands 3,0 %
	Other 45,9 %

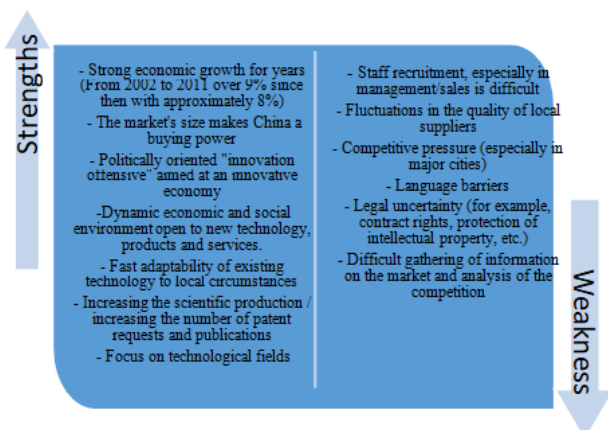


Figure 1. SWOT analysis of China

Another part of studying and analyzing China and Germany's business relations in the field of Industry 4.0 is the necessity to present the SWOT Analysis of China (Fig. 1) and the SWOT Analysis of the Cooperation between Germany and China (Fig. 2) graphically [3].

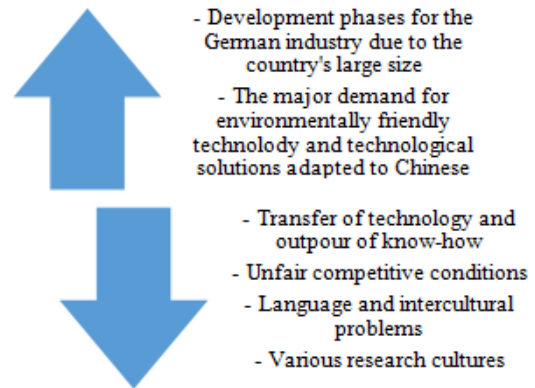


Figure 2. SWOT analysis of the cooperation between Germany and China

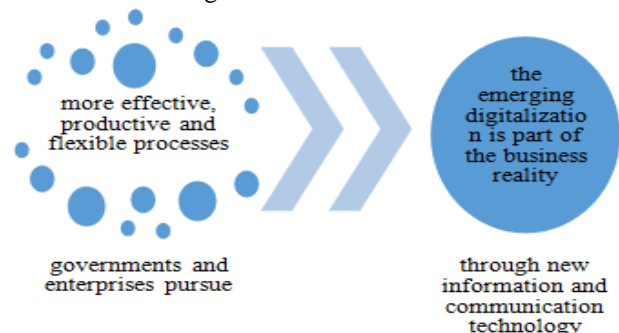
III. A VISION FOR THE FUTURE: INDUSTRY 4.0

China strives to improve its technological level, and industrial digitalization provides this opportunity. The best partner for Industry 4.0 is Germany. It is important to mention that the German-Chinese partnership in the field of Industry 4.0 began in 2014.

This partnership is so intense and successful that it has attracted the attention of many analysts and experts in the digital field. Germany and China are becoming key players of global magnitude in the business of the future.

A typical characteristic of Industry 4.0 is that machines will work, solve and optimize largely autonomously in cooperation with people [4].

Production processes will be more flexible, transparent and effective. Customers are at the center of the business process. I see digitalization like a goal and a process and visualize this in Fig. 3.



Source: The Author

Figure 3. Presenting digitalization as a goal and a process.

China's policy is efficiency and quality improvement through long-term technological progress and industrial development. Industry 4.0 will make this possible. According to the latest analyses, through Industry 4.0 China will increase its productivity by 25-30% and reduce unforeseen production losses by 60% [5].

The Chinese government encourages the digitalization of the industry through extensive promotional programs,

which include Internet of Things, robotics, intelligent conditioning systems, computing clouds and the transformation and modernization of the industry. Investments in future technology have led to the development of the “Made in China 2025” industrial strategy for the next ten years [6].

It is important to define that “Industry 4.0” is much more than a concept for China – it is a high-level business partnership with Germany. This partnership is mutually beneficial for both parties – on one hand, China wishes to purchase from German companies the technology which is necessary for Industry 4.0 and which makes Germany a leader: industrial software, production technology and system integration; on the other hand, if German companies hesitate for too long, they will miss major Industry 4.0 market opportunities in China. In any case, however, the Chinese industry will be quickly digitalized – if not with Germany’s help, then with the products of international competitors afterwards. Firms like ABB, Cisco, IBM and General Electric are willing to provide China with the necessary technology [7].

Therefore, German market leaders like Siemens and SAP should pursue a quick commitment in China [8].

Markets for sale of German industrial software, calculating clouds, sensors, robots and radio chips are still quite large. If China does manage to significantly improve the digitalization of its industry, it will become a serious competitor for Germany in the field of high-quality industrial products.

“Made in China 2025” – China’s roadmap for restoring the industry. MPT began developing the “Made in China 2025” strategy in early 2014. The goal is to establish China as an “industrial power”. According to the project, China wishes to transition to an industry aimed at innovations, effectiveness, quality, green productions and service-oriented industries. At the heart of this fourfold transfer is the transition to intelligent network economy (Industry 4.0). In the early stages of the planning process, the government wanted to formulate a strategy up to 2020. Inspired by Germany’s high-tech strategy, however, it decided to examine the strategy in a more long-term way up to 2025 [9].

Leading German industries such as mechanical engineering, electrical engineering and, ultimately, even the automobile sector will be under pressure. Small and medium Chinese enterprises are far from modern production capabilities. About half of these companies still have not made investments in automated and digital technology like robots. The digitalization of the industry holds economic, technological and social significance. Industry 4.0 offers a lot of possibilities, but also risks, for companies and governments [10].

Cooperation should be a dynamic process of adapting to the changing circumstances [11].

Permanent working groups, conferences, good business dialogue, close cooperation with representatives of the German industry and Chinese working groups.

Both parties want to accelerate the automation and digitalization of manufacture and take up leading positions on an international level.

IV. STRATEGIC THOUGHTS

Chinese culture is vastly different from European culture – the Chinese way of thinking is based on strategy and analysis of partners and competitors. The Chinese business model has a specific approach of established strategy and thought. Chinese companies make bold moves on the European market, acquiring market shares, even seeking to build offices for their firms in Europe.

Chinese companies attack wherever they detect flaws in their Western competitors, be they in design, innovations or service. The business strategy of Chinese companies is seen in their patents. By registering as many patents as possible, they strategically secure their offers in competitions.

China is one of the largest investors and users of digital technology in the world. The future belongs to digital business models, which is possible only through significant investments which China has and actively makes. Chinese Internet giants Alibaba, Baidu, Tencent and BAT are in the process of creating a multifunctional and multi-industrial digital ecosystem which will also have a huge and lasting impact on Western companies [12].

Technological progress and business development cannot be stopped. We can adjust to everything new that emerges in the business environment in the face of digitalization, artificial intelligence and Internet of Things in Industry 4.0 and extract the best, facilitating and optimizing working business processes, or lose by being passive observers to the emerging changes and continuing to work with the old methods because technological development and the revolution in the business environment cannot be stopped; they are part of the future we are creating here and now. It is precisely the firms that realize and perceive the wind of change faster and more actively that will be the firms of tomorrow, the successful ones.

This is where the successful business partnership between Germany and China comes in – it is a huge challenge and a big chance. The secret to successful business no longer involves offering a product on the market to fill the niche market and gathering information for customers and potential competitors – it is necessary to analyze the information and make the working process effective and satisfy customers through the incorporation of digital business models. Digital technology creates a new business approach and a new type of strategies thanks to research and development activities.

China focuses on network technology, energy efficient wireless communications and RFID equipment. China’s patents in sector 4.0 are experiencing a strong growth. The technological development of candidates for Chinese patents – from central control to intelligent, decentralized and self-adaptive control

Period: 2005-2013, 513 issued patents.

Period: 2013-2015, 2541 new priority applications [13].

Leading Chinese companies in the field of digitalization:



Chinese companies happily take part in European exhibitions and present their firms and the technology and innovations they offer. In 2015 about 600 Chinese companies attended CeBIT 2015 where they presented: “data and analyses, cloud applications, mobile devices, business decisions, IT security and Internet of Things” [13].

Research institutions also announce patents in the field of “Industry 4.0”. In 2014 Huawei invests \$64 million in the automation of production lines and \$80 million in 2015.

China is a market that attracts suppliers of technology from Industry 4.0. Unlike in the past, Chinese industry and science patent their own ideas from the very beginning, before working together with foreign know-how firms [14].

In the field of Industry 4.0 China strives to determine national and international standards based on rights of property which should be aimed at foreign suppliers of technology.

The future of business is currently being created through “smart economy” which is manifested in the development, manufacture and industrial application of cyber-physical systems and “Internet of Things”. The innovations and business potential for “Industry 4.0” in China and Germany have limitless scales of development. German-Chinese projects for cooperation and implementing “Industry 4.0” technology will result in the creation of new growth potential for both economies.

Perspective can be viewed through innovations, which are the future of business [15].

The future begins now, with research and development activities taking their key place worldwide. A trend of intense international cooperation is observed [16].

V. CONCLUSION

The Federal German Republic’s “Industry 4.0” project fits in really well with China’s future business strategy because Germany offers leading technology in this field. China seeks to modernize, automate and digitalize its industry by learning from Germany. Germany provides China with a plan and a specific development concept. Therefore, it comes as no surprise that the two countries have signed a cooperation agreement for digital industrial technology. Both countries take up leading positions on an international level. The German-Chinese cooperation in Industry 4.0 is a unique opportunity, but some analysts define it as a major risk. China will be the strong competitor of tomorrow. The changes in Chinese industry will provide opportunities for multiple German companies, especially in terms of joint projects for research and development activities. Chinese investments

for close cooperation with German partners grow as a result of the Chinese government’s policy. Industry 4.0 creates investment flows in both directions, from investments to joint enterprises. The exclusive cooperation between both countries will lead to stable economic development for both of them and for the world. Germany has a positive influence on European and Chinese economic relations. The European market remains one of the most important investment markets for China, with Germany welcoming Chinese investments. The cooperation between Chinese and German companies is undergoing a new stage and new opportunities are being offered. Through the multitude of forums, conferences and working groups, both parties seek dialogue in terms of modern industrial technology, infrastructure and energy efficiency of industrial production. The future belongs to globalized markets, which requires digitalization and intelligent network connection. While financial crises and political changes on an international level will not stop business changes in global economic growth, it is necessary to create new strategies and reconsider priorities. Every crisis carries lessons and leads to development because it results in the creation of a new type of business approach, emergence of new ideas and supplying the market with new products. Global economy is undergoing a process of revival and is giving strong indications of stabilization and growth.

CONFLICT OF INTEREST

The author declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors had approved the final version.

REFERENCES

- [1] Germany Trade & Invest 2018“ - Gefördert vom Bundesministerium für Wirtschaft und Energie aufgrund eines Beschlusses des Deutschen Bundestages
- [2] China-Strategie des BMBF 2015 -2020, Strategischer Rahmen für die Zusammenarbeit mit China in Forschung, Wissenschaft und Bildung; Bundesministerium für Bildung und Forschung, Deutsch -Chinesische Zusammenarbeit in Wissenschaft und Forschung, 2015.
- [3] Merics, Mercator Institute for China Studies, China Monitor, Nummer 23, 11 März, 2015.
- [4] Industrie 4.0, Chancen und Herausforderungen der vierten industriellen Revolution, 2014.
- [5] Made in China 2025 - U.S. Chamber of Commerce, 2017.
- [6] The Internet of Things - Oliver Wyman, 2015.
- [7] Siemens in China, 2017.
- [8] Made in China 2025 – China's Hightech Strategie – WKO, 3 Mai 2018.
- [9] Industrie 4.0 im internationalen Vergleich, Vergleich der Industrie 4.0 – Wettbewerbsfähigkeit Chinas, Deutschlands, Japans und der USA. 2016 Handelsblatt Research Institute.
- [10] Industrie 4.0 und digitale Wirtschaft. Impulse für Wachstum, Beschäftigung und Innovation, 2015.
- [11] S. Tzvetkova, *The Effective Management of Innovation Activities in Transport*, UNWE’s Publishing Complex, Sofia, 2014.
- [12] Aktivitäten Chinesischer Investoren in Deutschland, Institut der Deutschen Wirtschaft Köln, IW 2017.
- [13] China-Perspektiven und Herausforderungen, “Bericht zur 3. Sitzung des Netzwerks Strategie und Vorausschau,” Bundesministerium der Verteidigung, Januar 2018.

- [14] Chinese Companies enter Germany, 2011.
- [15] S. Tzvetkova, "The role of innovations and entrepreneurship in the modern development of transport enterprises," Scientific-practical Conference 'Mobility for a Connected World', Sofia, UNWE's Publishing Complex, pp. 151-158, 2017.
- [16] S. Tzvetkova, "Globalization as a Factor for Increasing the Transportation of Energy Resources" (Jubilee Scientific Conference, 60 years of the "Transport" Department – "Transport in Global Economy", Sofia – UNWE, 2011), pp. 37-43;

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