



Singaporean-German Chamber  
of Industry and Commerce  
Deutsch-Singapurische  
Industrie- und Handelskammer

# Future of Manufacturing

To the Committee on the Future Economy

Crafted by the Singaporean-German Chamber of Industry and Commerce  
(SGC)

Contribution to the CFE's Goal to Position Singapore for the Future

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## **I. Executive Summary**

The worldwide economy is likely to see major changes in the coming decades. One aspect is the use of new technologies, advancement in automation and the intensely discussed topic of 'Industrie 4.0' and related issues, such as 'Internet of Things (IoT)', 'Internet of Services (IoS)' and others.

Singapore currently discusses how to gear up for the coming changes and the Singaporean-German Chamber of Industry and Commerce (SGC) is grateful to provide insights in the way Germany and the German economy deals with these topics. The SGC is part of the official foreign trade promotion of the Federal Republic of Germany, together with the German Embassies and Germany Trade and Invest (GTAI). The SGC, a not for profit organization, has been tasked to promote bilateral Germany-Singapore trade, advise German and Singaporean companies on investment and market opportunities in Singapore and Germany, respectively, and to assist these companies in developing international business contacts. More than 1,500 German companies are currently located in Singapore and most sectors and industries are represented.

The Committee on the Future Economy is developing economic strategies to position Singapore well for the future by consulting amongst others chambers. As part of this process, the SGC is grateful to be able to contribute to this goal by expressing and sharing its members' view on the Future of Manufacturing.

SGC has started to establish some thought leadership through collaboration with the relevant corporate representatives and industry associations, and can rely on an established network of partners in Germany. The SGC lately organized two successful events on Smart City and 'Industrie 4.0', both drawing up the attention of over 100 participants from the corporate and government world to receive information first hand from industry experts and government agencies alike. The Chamber continues with a series of events organised through the SGC committees on various aspects of Industrie 4.0, IoT, Big Data and so on.

The following paper is a result of research and feedback by selected SGC members (19/08/2016) and will give useful information on developments in Germany and observations in Singapore with some concluding thoughts on how the German industry and R&D could support the future growth of Singapore's manufacturing sector. The necessity to change HR development and management style is also covered, as well as the new skills needed for Industry 4.0. The paper also aims to establish ideas on how Singaporean companies could benefit from the presence of German businesses and institutions.

## **II. Background**

### **A. Manufacturing in Germany**

The German manufacturing industry is based on the one hand on big players such as the leading car manufactures and their suppliers, chemical MNC or precision engineering specialist. On the other hand, the backbone of the German economy is the German Mittelstand. Overall the manufacturing industry without construction is contributing 25.8% to the German Gross Domestic Product (GDP). The share of

the contribution decreased from 30.9% in 1991.<sup>1</sup> Still, the current share is comparably high. The Mittelstand companies are often “hidden champions” within their niche fields.<sup>2</sup> Meaning, they are market leaders in that respective field or hold major share in the global competition in those areas. The competitive advantages of the German manufacturing sector lie in the regional cluster structure, the capable enterprises of every size, research institutes which often co-operate closely with industry and the availability of highly qualified skilled labour and engineers.<sup>3</sup>

The most important industry sectors in terms of turnover and employees are the automotive industry, machine engineering, metal industry, chemical/ pharmaceutical industry, food and beverage and the electronic industry. Innovations within the respective fields are a key driver of the continuous advancement of the German economy and in staying relevant in the global market.<sup>4</sup>

Innovations are mainly driven by investments of the private sector.<sup>5</sup> For a split of R&D expenditures across private and public sector, please refer to the annex.

In 2014, 2.84% of the GDP (EUR 83.7 Billions) of Germany was invested into research and development. Thereof, the private sector contributed with EUR 56.996 Billion to research and development. This equals to around 68% of the overall spending of close to EUR 83.7 Billions.<sup>6</sup> German multinational corporations in e.g. the automotive sector (Robert Bosch GmbH, 10.3%) or the pharmaceutical industry (Boehringer Ingelheim, 19.9%) invest a considerable amount of their annual turnover into R&D.<sup>7</sup> These investments lead to either product-based innovation which increases turnover, or to process-based innovation, which allows cost savings. Germany also benefits from European projects which are partially funded by the European Commission.

## B. Manufacturing in Singapore

The Singaporean economy is globally connected, export-driven and trade-dependent. The external trade is more than three times Singapore’s GDP. Hence, global growth and global demand have a disproportionately large effect on the economy. Facing uncertainty in the world-markets, the export oriented sectors came under pressure lately and forecasts of GDP growth needed to be revised. The Singaporean manufacturing industry traditionally relies on multinational corporations and government-linked companies.<sup>8</sup> Those companies have benefitted from the Singaporean business-friendly policies, local Small and Medium-sized Enterprises (SME)<sup>9</sup> and investments into infrastructure and in return have highly contributed to the outstanding growth the Singaporean economy experienced previously. The

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<sup>1</sup> Cf. Statistisches Bundesamt. (2016). Anteil der Wirtschaftszweige an der Bruttowertschöpfung in Deutschland im Jahresvergleich 1991 und 2015.

<sup>2</sup> Cf. Simon, Hermann. (2007). Hidden Champions des 21. Jahrhunderts.

<sup>3</sup> Cf. Federal Ministry for Economic Affairs and Energy. Strukturelle Entwicklungen.

<sup>4</sup> Cf. Federal Ministry for Economic Affairs and Energy. Industrielle Schlüsseltechnologien und Leitmärkte mit Zukunftspotential.

<sup>5</sup> Cf. Statistisches Bundesamt. (2016). Ausgaben für Forschung und Entwicklung in Deutschland nach Sektoren von 1998 bis 2014 (in Millionen Euro).

<sup>6</sup> Cf. Statistisches Bundesamt. (2016). Ausgaben für Forschung und Entwicklung in Deutschland nach Sektoren von 1998 bis 2014 (in Millionen Euro).

<sup>7</sup> Cf. European Commission. (2014). Umsatzanteil der Forschungsausgaben der 50 weltweit führenden Unternehmen nach Ausgaben für Forschung und Entwicklung im Jahr 2014.

<sup>8</sup> Cf. OECD. (2013). Southeast Asian Economic Outlook 2013.

<sup>9</sup> Definition of SMEs according to SPRING (2011): Annual Sales turnover of not more than S\$100 million or Employment size of not more than 200 workers

aim is to keep manufacturing at around 20-% of Singapore's GDP (manufacturing contributed 19.8% to Singaporean GDP in 2015). Hence, a natural focus has been given to manufacturing industries.<sup>10</sup>

Lately, more attention was put on locally-established SME. Overall, 99% of all enterprises in Singapore are SMEs and 82% of all enterprises are mainly locally-owned. But, the value added (Gross Value Added) is to 55% attributable to foreign owned enterprises.<sup>11</sup> Investment commitments (fixed assets) in 2015 into manufacturing were roughly SGD 11,500 Million. Thereof, SGD 10,500 Million came from abroad.<sup>12</sup> Please refer to the annex for a detailed overview of the Singaporean manufacturing industry.

For many years, the economy could master the demands of growth by bringing in more labour from overseas. However, the situation has changed in many areas and since 6 years, the Singapore government has started to tighten the influx of foreign labour and at the same time has started numerous programmes and initiatives to upgrade Singapore workers, to support technological advancement and to subsidise effort to higher automation in companies.

The next step will be to prepare companies and the work force alike for the future demands. Singapore and Germany alike most industrialised countries with a significant share of manufacturing are working on measures and programmes to prepare for the future needs.

### III. Assessment of Current Situation

#### A. Singapore's Manufacturing Sector from a German perspective

##### Small and Medium-sized Enterprises face challenges

Singaporean SMEs struggle at the moment with uncertain global economy outlook. Furthermore, manufacturing in workforce-intensive sectors faces high competition from surrounding countries where labour costs are below those of Singapore. Finally, the workforce in Singapore is aging.<sup>13</sup>

The increase in cost and shortage of labour can currently not be set off by gains in productivity.<sup>14</sup> But Singapore being the clear quality leader in the region, benefits greatly in sectors such as biomedical, semiconductor or chemical.<sup>15</sup> The general picture regarding productivity is certainly not rosy, but Precision Engineering is an exception: In this industry, the Output/worker grew in the period from 2008-2015 by a CAGR of 6.5% - bucking the general trend. German multinationals and "Mittelstand" companies alike value the highly skilled workforce in these areas greatly.

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<sup>10</sup> Cf. MTI. (2016). Economic Survey of Singapore 2015.

<sup>11</sup> Cf. Economic Development Board. (2014). Report on the Census of Manufacturing Activities 2013.

<sup>12</sup> Cf. Department of Statistics Singapore. (2016). Singapore in Figures 2016.

<sup>13</sup> Cf. McKinsey. (2014). Understanding ASEAN: The Manufacturing Opportunity.; Singapore Business Federation. (2015). Business outlook of SMEs in Singapore falls to a 3-year low.; Department of Statistics. (2015). Population Trends.

<sup>14</sup> Cf. MTI. (2015). Minister Lim Hng Kiang's Written Reply to Parliament Question on GDP Per Dollar of Business Cost in Singapore

<sup>15</sup> Cf. McKinsey. (2014). Understanding ASEAN: The Manufacturing Opportunity.; Singapore Business Federation. (2015). Business outlook of SMEs in Singapore falls to a 3-year low.; Department of Statistics. (2015). Population Trends.

In terms of internationalisation, Singaporean SMEs are increasing their engagement abroad but are not ready in several areas yet. The government is actively working on easing the internationalisation of SME by setting up different programs that supports their efforts to go abroad financially and with expertise. Since all the necessary knowledge is available on both issues, best practise examples and workshops in the companies can deliver solutions on how to increase productivity and how to prepare Singapore SMEs for their next step in an international surrounding.

### **Innovative ecosystem to be enhanced**

So far, Singapore's inflow of knowledge and technology, hence innovation, came mainly through MNCs.<sup>16</sup> Singaporean SMEs have been classified as "defenders" in the past, meaning their strategy was to locate and maintain a secure niche in a relatively stable product area.<sup>17</sup> Currently, however, new and innovative start-up companies come to Singapore with government support. The Singaporean Government has invested already a considerable amount into fostering the innovation capabilities of enterprises. It is aimed to create an R&D ecosystem that integrates public sector research bodies, academic research institutes and corporate R&D laboratories.<sup>18</sup>

As the Global Innovation Index suggests, the output of Singapore's innovation efforts is comparably low.<sup>19</sup> As the Economic Strategies Committee in 2010 proposed, the R&D efforts hence are not well commercialized yet. Feedback from SGC members also support this argument. Factory automation, investment in modern equipment and a shift in focus on short-term profitability towards mid-term planning are urgently needed to prepare Singaporean SMEs for the industrial changes ahead. Co-operations with universities and Polytechnics can support SMEs in these topics. German Mittelstand companies faced similar challenges in the past and also today, some smaller companies do not have the capacity to envisage product innovation or co-operation with research institutes. However, all innovative companies co-operate with external parties at some point.

Moreover, SMEs also need to internationalise because the home market is too small. This was also the case in Germany some decades ago. Today, even small companies use the opportunities of expanding their sales in other markets. Their experiences could be shared with the Singaporean industry. Dr Michael Teng, CEO of Singapore Innovation and Productivity Institute (SiPi) of the Singapore Manufacturing Federation recently explained during a panel discussion that many Singapore SMEs are still very operational and focussed entirely on the day-to-day running of their business. Upgrading technology or implementing new processes would mostly be assessed under the investment perspective instead of the return-of-investment strategy. However, with a thriving start-up scene in Singapore, availability of financial support has also changed in the last years which might be a new perspective for established SMEs.

Analysis shows that an innovative ecosystem benefits also established companies. Either through competition or collaboration, established companies can push their innovation focus forward. Previously, it was reported that innovative entrepreneurs had difficulties to get financing due to the increased risk by conservative financing institutions.<sup>20</sup> With the increase of a lively start-up community

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<sup>16</sup> Cf. Worldbank. Increasing value-added: Singapore

<sup>17</sup> Cf. Ghosh, Liang, Meng, Chan. (2001). The key success factor, distinctive capabilities, and strategic thrusts of top SMEs in Singapore.

<sup>18</sup> Cf. OECD. (2013). Southeast Asian Economic Outlook 2013.

<sup>19</sup> Cf. Global Innovation Index. (2016). Analysis.

<sup>20</sup> Cf. PwC. (2015). Singapore's tech-enabled start-up ecosystem.; Compass. (2015). The Global Startup Ecosystem Ranking 2015.

in Singapore, funding has been addressed at different ends and more financial institutes should look into the opportunities as well.

### **Higher productivity necessary**

The productivity in Singapore increased from 2009 to 2014 within the targeted 2-3 % per years, but, excluding the 2010 rebound from the economic crisis, the productivity gain (CAGR 0,3%) falls short behind the expectations.<sup>21</sup> The reasons are manifold but one crucial element is the adequate training of professionals which is only provided inadequately in many industries. According to newspaper articles and HR analysis, some of the factors are the lack of perspective for employees in SMEs, insufficient training funds, no development paths and little flexibility on the employers' side. The prevalent top-down approach also hinders employees to take ownership of their tasks and propose new ideas to the management. If management puts productivity on the top of the agenda, it might mean a major overhaul of processes and current practices, but it also is the only chance to stay relevant in the next decade. Several SGC members also observed a high level of risk aversion of companies. Taking calculated risks however, will be needed as the new developments in industrial manufacturing will not support the status quo.

## **Human Capital**

### **Qualifications to meet future demand**

The challenge of qualification for the future of manufacturing in Singapore is two folded. Singaporean citizens are highly educated and surveys show that blue collar work is not highly appreciated. The reasons are ranging from over-qualification to the tendency to avoid low paid jobs and the unwillingness to work in a factory due to status reasons. The rapid development of Industry 4.0 will also need new skills by low-end workers. Many of the simple jobs of operators might not exist anymore and Singaporean workforce also needs to be prepared to those changes. By tightening the job market, the inflow of foreign manpower is limited. However, the local job market does not offer sufficient suitable talent for the needs of Industry 4.0<sup>22</sup>. Skills and qualifications that were mentioned by companies for Industrie 4.0 are cross-competence skills, big data specialists, data integration experts, cloud capacity managers and similar. If Singapore is unable to provide suitably qualified graduates and staff, companies will have to look for other locations that offer the talent or open policies to bring foreign talent in the country.

According to the Singapore Business Federation, the regulation of the labour market is cutting the inflow of workforce that Singaporeans are not able to provide at the moment.<sup>23</sup> This is a severe threat to the manufacturing sector in the future as Singapore might lack behind in crucial developments. Reportedly, local establishments as well as MNC suffer from this policy. The competition for new talents is intense, led by large corporations, and government institutions, by SMEs (including existing start-ups), and others.<sup>24</sup> With a shrinking Singaporean population these trends will become even more intense. First steps are implemented by introducing applied research and development in universities and other education providers. However, product development and innovation will need engaged engineers within the companies and they also need to have HR development opportunities. Experience from German

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<sup>21</sup> Cf. MTI. (2015). Driver of Labour Productivity Growth Trends in Singapore.

<sup>22</sup> Cf. SBF. (2016). Position Paper for a Vibrant Singapore.

<sup>23</sup> Cf. SBF. (2016). Position Paper for a Vibrant Singapore.

<sup>24</sup> Cf. Compass. (2015). The Global Startup Ecosystem Ranking 2015.

Mittelstand shows that introducing career prospects to professionals working on the development of new products or innovative solutions supports the competitiveness of companies. Singaporean SMEs can consider these aspects to get future ready.<sup>25</sup>

### **Identification with employer important**

Identification of the employees with the company is essential in order to avoid high fluctuation and increase motivation among employees. Fluctuation goes along with loss of knowledge and will cost any company time and money as new employees have to be trained. With an average monthly resignations rate in the manufacturing sector of 1.9%, employers are currently afraid that investment into training might not pay back. However, opening development path, branding of the companies, team building efforts and HR development avenues all can contribute to build up a workforce that identifies with the employer. Since SMEs also need to internationalise, staff can take over mid-management roles if the company increases its presence in neighbouring markets and abroad. Moreover, offering live-long learning possibilities keeps interested employees and is essential as new technology challenge mankind.<sup>26</sup> Since work-life balance is also increasingly important to the Singaporean workforce, experiences from German Mittelstand can support local companies in offering attractive opportunities to their staff.

## **B. Smart Manufacturing**

### **a. Technological Advancements and its influence on the Economy**

#### **In Germany – new technologies will lead to different skill set needs and more employment**

With the technological advancements made worldwide, the manufacturing sector will experience a dramatic change. Different technologies such as autonomous robots, additive manufacturing or cloud-based manufacturing will work together and transform the relation of suppliers, manufacturers and customers as we know it today. It is expected to have efficiency and productivity gains.

The Boston Consulting Group (BCG) expects Germany to benefit with productivity gains of 5% to 8% (EUR 90 to 150 Billion). The impact of the new technologies will differ between the industries with the highest changes being expected for the mechanical engineering – machinery sector. According to feedback from company representatives, some German Mittelstand companies expect concrete productivity gains of 30% in five years. While some might argue that due to automation, employment will decrease, the initiated growth will, according to the BCG report, lead to a 6 percent increase in employment. However, the skill set that employees are required to have will change. Competencies in software development and IT technologies will be core essentials, as well as cross-competencies from specialists that also have a good grasp of the whole Industrie 4.0 concept.<sup>27</sup>

The German government launched the Industrie 4.0 initiative in 2013. Thereby, granting up to EUR 200 Million aimed at research especially towards SME manufacturers. Furthermore, competence centres are established, where partnerships between industry associations, leading research institutes, universities and companies are planned. Thereby, consulting SME for the change and educating employees to make

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<sup>25</sup> Cf. Menkoff.(2015). Lessons from Germany's 'Hidden Champions'; The Business Times.(2015). S'pore Can Learn From Germany In Skills Training, Says PM Lee.

<sup>26</sup> Cf. MoM. (2016). Labour Turnover.

<sup>27</sup> BCG. (2015). Industry 4.0 The Future of Productivity and Growth in Manufacturing Industries.

them future-ready. Additional key challenges for the German government are standards and IT architecture as well as IT security and changed requirements for employees.<sup>28</sup>

#### **In Singapore – strategic roadmap for Industrie 4.0 necessary**

Singapore is a trusted business location for globally leading manufacturing companies. Both, enablers and adopters of advanced technologies are present in Singapore. This allows for an integrated and coordinated strategy to adapt to the future. Even though the Singaporean government is investing into smart manufacturing, many small manufacturing companies are not ready to participate in it in a meaningful way to expand their business. The Singapore budget 2016 included SGD 4.5 Billion under the Industry Transformation Programme. The Singapore budget 2016 included up to SGD 450 Million to develop a National Robotics Programme Office (NRPO) for the next three years. It is aimed to develop robotics and automation technology that can be applied within SME's at reasonable cost across different industries. Engaging with SMEs and reminding them of their own responsibility to develop further is crucial for preparing them for the future. A higher level of factory automation, change in funding structures and investment in talent development will be main factors for local SMEs to stay relevant in the environment of Industry 4.0. Skills Future and the drive to provide more practical oriented engineers from Polytechnics, SIT and universities will hopefully provide the right employees to companies in Singapore to play a role in the future manufacturing environment. Since Germany is currently the leader in Industry 4.0 and smart manufacturing processes, there should be meaningful opportunities for co-operation between the two countries. Since the smart factory of the future might not need operators and other staff in a certain location, it is important for Singapore's economy to provide enough incentives for companies to stay in the city state.

For industries already present, a strategic roadmap will most useful. This roadmap should outline the main focus industries and developments in conjunction with Industry 4.0.

## **IV. Recommendations**

1. Strengthen SME's by fostering cooperation with big industry players to leverage developed technologies and gain knowledge through cooperation. Make use of provided platforms and agencies. Get government bodies to work closely with gate-openers to new technologies that are established, such as the unions, chambers, industry associations and research institutes. Foster close co-operation with Germany for implementing industrial change through Industrie 4.0 developments.
2. Internationalise local SMEs and scale up start-ups to extend their reach and therefore increase incentives to invent and increase productivity. Still, Singapore should continue to put effort into restructuring the economy and allow to phase-out inefficient businesses. Employees of phased-out companies can be re-trained and integrated into the labour market.
3. Private investments into R&D need to grow. Incentivize investment further and continue to provide excellent conditions such as test beds for companies. Support innovation not with

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<sup>28</sup> Federal Ministry of Education and Research. Zukunftsprojekt Industrie 4.0

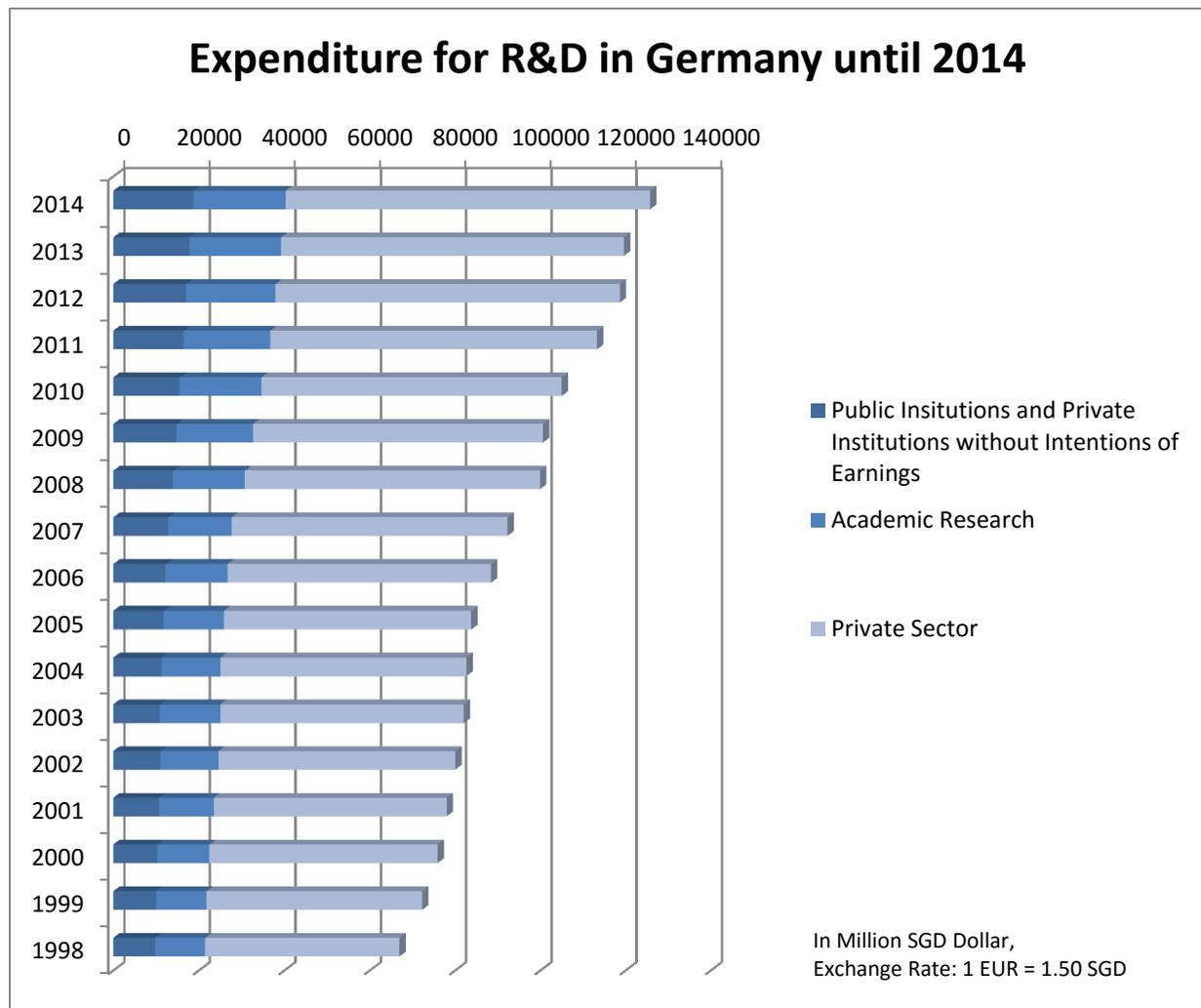
funding but with competition. Global branding should not be 'Made in Singapore' but 'Innovated in Singapore'.

4. Innovative solutions funded by the government must be better applied and commercialized. Technological developments should translate into industry application. Engage and offer platforms for cooperation between research and industry.
5. Gain in productivity is highly necessary to stay competitive. Labour productivity increase will need to arise from increased output, not additional manpower. Investment into machinery, automation and technology is necessary as well as continuous qualification and training on-site of employees especially in an aging society. This will allow creating high-value jobs for Singaporeans. At the same time, low-skilled jobs can be executed by machines, which will further decrease dependency on foreign workers.
6. In order to provide experienced and educated employees, practical training should further be introduced for Polytech students and students from other educational institutions. This will connect education (university, polytechnics and college) and hands-on experience from the beginning.
7. Employers will only invest into training and qualification, if employees are willing to stay and employer will benefit from higher productivity. Therefore, employees' identification with employer should be strengthened by change in management style, better branding, HR development and team building. Increase opportunities in mid-management area for staff to grow and take over responsibility. Allow to make mistakes and foster work-life balance with more flexible work arrangements. Experience of German Mittelstand can be very useful.
8. Workforce must be specifically trained for the future challenges. Hence, tertiary education should focus on future manufacturing industries and attract more Singaporeans. Career opportunities as an engineer should be presented during the studies and explained to pupils during their secondary school time. Collaboration with German educational institutions and Chambers of Commerce could be useful and serve as benchmark.
9. Until Singapore can supply her own experts in the technological field, highly-qualified foreign manpower is still necessary. Immigration laws should take into account the needs of the industry. Singaporean workforce also has to be trained to become more international and be willing to work and live in other ASEAN or Asian countries for a while. Companies need to understand surrounding markets with an insider's view.

## Annex

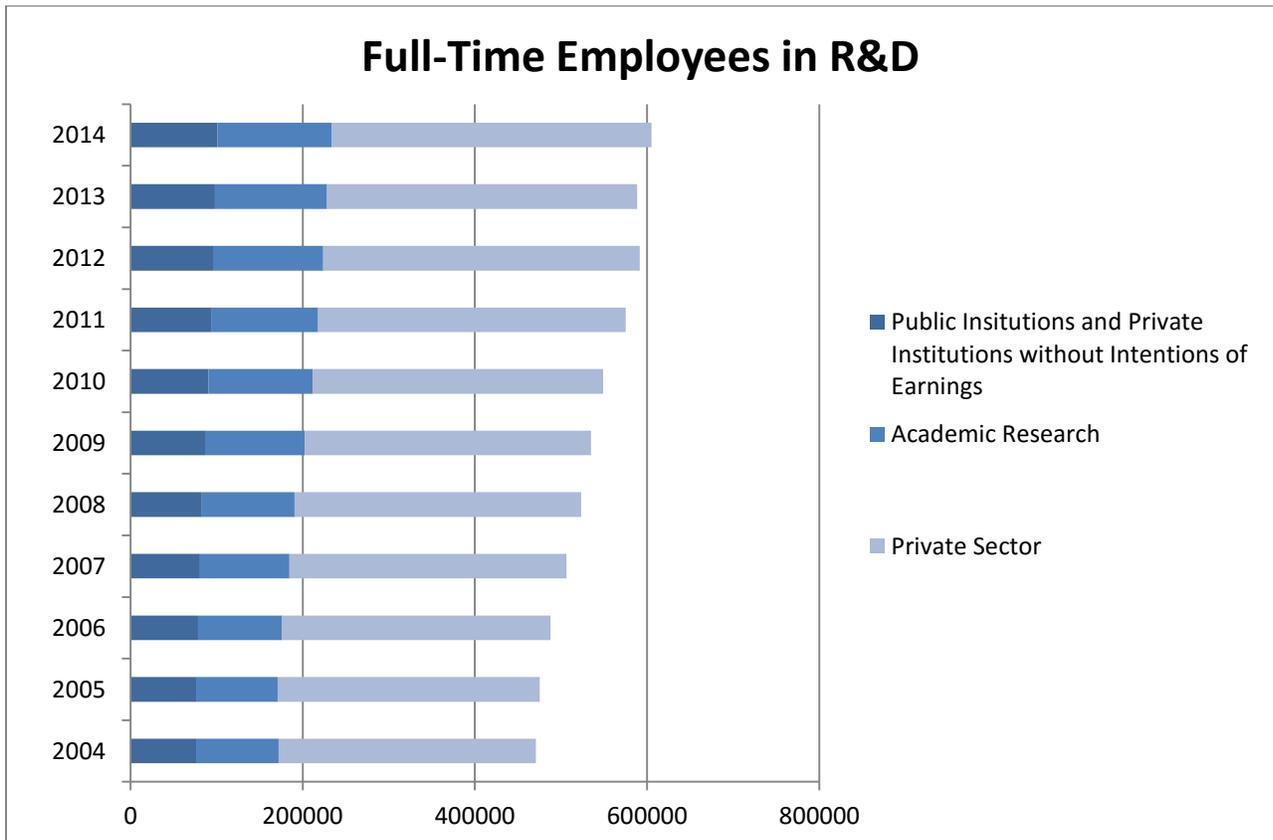
### Expenditure for R&D in Germany until 2014 – Split between Public and Private Funding

Own depiction based on source: Statistisches Bundesamt. (2016). Ausgaben für Forschung und Entwicklung in Deutschland nach Sektoren von 1998 bis 2014 (in Millionen Euro). Accessible under: <http://de.statista.com/statistik/daten/studie/154927/umfrage/ausgaben-fuer-forschung-und-entwicklung-seit-1998/>



**Full-time Employees in R&D until 2014 – Split between Public and Private Funding**

Own depiction based on source: Statistisches Bundesamt. (2016). Personal für Forschung und Entwicklung - Vollzeitäquivalent. Accessible under: <https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/BildungForschungKultur/ForschungEntwicklung/Tabellen/PersonalForschungEntwicklung.html>



## Singapore Manufacturing Structure

Source: EDB. Report on The Census of Manufacturing Activities 2013.

[https://www.edb.gov.sg/content/dam/edb/en/resources/pdfs/others/Report\\_on\\_the\\_Census\\_of\\_Manufacturing\\_Activities\\_2013.pdf](https://www.edb.gov.sg/content/dam/edb/en/resources/pdfs/others/Report_on_the_Census_of_Manufacturing_Activities_2013.pdf)

**TABLE 7 PRINCIPAL STATISTICS OF MANUFACTURING BY CAPITAL STRUCTURE, 2013**

CAPITAL STRUCTURE	ESTABLISHMENTS	WORKERS	MANUFACTURING OUTPUT	TOTAL OUTPUT	MATERIALS	REMUNERATION	OPERATING COST	VALUE ADDED	NET OPERATING SURPLUS	SALES	DIRECT EXPORTS	NET FIXED ASSETS
	NUMBER		THOUSAND DOLLARS									
Wholly Local	8,380	238,716	44,814,570	47,403,827	21,282,745	8,637,598	11,469,897	14,651,185	4,395,077	44,815,245	20,567,231	10,257,926
More Than Half Local	151	18,809	6,155,066	6,346,640	3,121,386	1,080,740	1,045,792	2,179,463	771,070	6,152,512	2,724,416	1,789,061
Less Than Half Local	111	9,005	5,327,552	5,403,694	3,199,048	515,433	1,211,964	992,682	519,626	5,302,234	4,309,866	708,709
Wholly Foreign	661	157,975	229,134,085	240,469,590	135,957,797	10,487,964	62,293,299	42,218,494	25,799,845	229,778,578	162,333,153	51,351,062
Total	9,303	424,505	285,431,273	299,623,751	163,560,976	20,721,735	76,020,952	60,041,824	31,485,619	286,048,569	189,934,667	64,106,757

Note : The values of fixed assets are at end of year.

**TABLE 4 PRINCIPAL STATISTICS OF MANUFACTURING BY VALUE OF OUTPUT, 2013**

VALUE OF OUTPUT THOUSAND DOLLARS	ESTABLISHMENTS	WORKERS	MANUFACTURING OUTPUT	TOTAL OUTPUT	MATERIALS	REMUNERATION	OPERATING COST	VALUE ADDED	NET OPERATING SURPLUS	SALES	DIRECT EXPORTS	NET FIXED ASSETS
	NUMBER		THOUSAND DOLLARS									
Less Than 1,000	5,575	36,190	2,276,084	2,416,387	690,304	853,752	684,150	1,041,933	47,324	2,281,601	54,436	379,599
1,000 - 1,999	1,107	18,870	1,572,762	1,758,804	601,042	573,643	390,261	767,501	60,554	1,575,213	204,790	430,908
2,000 - 2,999	457	15,144	1,112,393	1,238,208	383,747	433,424	271,970	582,491	37,065	1,113,286	170,238	436,501
3,000 - 4,999	530	22,173	2,032,270	2,198,728	802,543	664,065	478,151	918,034	86,790	2,030,911	361,472	765,187
5,000 - 9,999	525	37,218	3,845,887	4,457,196	1,524,175	1,210,483	1,131,137	1,801,883	276,295	3,833,799	937,011	1,318,409
10,000 - 19,999	359	33,822	5,064,546	5,447,494	2,176,040	1,304,659	1,167,376	2,104,078	501,162	5,073,557	1,751,425	1,474,720
20,000 - 29,999	182	21,209	4,527,809	4,840,560	2,346,532	928,918	984,863	1,509,165	355,306	4,538,302	1,922,012	1,289,727
30,000 - 49,999	156	25,244	6,075,112	6,635,052	2,983,567	1,217,261	1,482,460	2,169,025	730,891	6,078,688	3,322,315	1,337,534
50,000 - 99,999	144	33,471	10,399,582	11,241,269	5,396,685	1,695,995	2,416,759	3,427,825	1,351,532	10,381,703	6,206,485	2,843,062
100,000 And Over	268	181,164	248,524,828	259,390,053	146,656,340	11,839,535	67,013,825	45,719,889	28,038,700	249,141,508	175,004,481	53,831,111
Total	9,303	424,505	285,431,273	299,623,751	163,560,976	20,721,735	76,020,952	60,041,824	31,485,619	286,048,569	189,934,667	64,106,757

Note : The values of fixed assets are at end of year.

TABLE 3 PRINCIPAL STATISTICS OF MANUFACTURING BY NUMBER OF WORKERS, 2013

NUMBER OF WORKERS	ESTABLISHMENTS	WORKERS	MANUFACTURING OUTPUT	TOTAL OUTPUT	MATERIALS	REMUNERATION	OPERATING COST	VALUE ADDED	NET OPERATING SURPLUS	SALES	DIRECT EXPORTS	NET FIXED ASSETS
	NUMBER		THOUSAND DOLLARS									
0 - 9	4,860	21,873	4,603,230	4,717,151	2,811,764	601,966	934,241	971,145	275,005	4,626,841	406,062	670,742
10 - 19	1,843	24,584	3,067,682	3,179,308	1,454,128	774,752	671,783	1,053,396	122,151	3,071,466	505,710	664,343
20 - 29	516	12,404	2,761,852	2,910,721	1,492,280	480,259	615,888	802,553	211,648	2,760,408	1,136,955	806,007
30 - 39	353	11,992	2,899,419	3,034,982	1,396,972	468,517	783,693	854,317	272,301	2,905,258	1,446,657	578,234
40 - 49	254	11,276	3,314,699	3,506,003	2,075,149	442,958	524,621	906,233	368,465	3,275,442	1,846,344	743,086
50 - 69	347	20,346	5,941,365	6,364,690	3,411,988	852,009	1,488,704	1,463,997	419,039	5,966,743	3,410,914	1,127,969
70 - 99	321	26,756	8,929,492	9,777,451	5,336,196	1,139,854	1,809,563	2,631,692	1,226,324	8,863,226	5,315,402	2,541,897
100 - 149	298	35,665	23,330,029	24,072,928	12,195,839	1,578,668	7,376,052	4,501,037	2,599,194	23,415,247	16,698,391	3,713,003
150 - 199	154	26,430	10,884,096	11,340,092	6,175,552	1,135,276	2,537,379	2,627,161	1,238,234	10,911,586	7,544,845	1,890,807
200 - 299	129	31,466	24,150,863	25,419,004	8,383,766	1,496,115	7,823,708	9,211,529	7,387,866	23,136,927	19,098,098	3,389,454
300 - 499	100	37,905	42,429,482	44,664,500	18,639,763	2,215,406	17,184,918	8,839,818	6,038,944	42,010,419	26,443,066	9,986,604
500 - 999	83	58,046	86,572,101	89,396,476	61,278,418	3,472,583	16,774,912	11,343,146	6,067,075	88,367,301	59,770,071	19,493,494
1,000 And Over	45	105,762	66,546,963	71,240,445	38,909,158	6,063,371	17,495,489	14,835,799	5,259,373	66,737,705	46,312,152	18,501,117
TOTAL	9,303	424,505	285,431,273	299,623,751	163,560,976	20,721,735	76,020,952	60,041,824	31,485,619	286,048,569	189,934,667	64,106,757

Note : The values of fixed assets are at end of year.