Hanns Peter Becker | October 2014

TIME FOR 70-YEAR-OLD TEST DRIVERS?

How engineering in the German car industry needs to react to demographic change.

Demographic change – in the form of the decline in rates of birth and increases in life expectancy – is one of the greatest challenges facing Germany now and in the near future. There is no area of society that will not experience its effects, and it goes without saying that the work of the nation's automotive development departments is no exception to this. Might there soon even be a shortage of qualified experts, meaning that today's development engineers will still have to speed round the test circuits at 70? We examine the effects of this development in conjunction with the birth of engineering goliaths in the emerging economy and offer recommendations on which measures the German automotive industry can take to respond to these challenges.

1| ENGINEERING – THE CURRENT SITUATION

The success of the German automotive industry is predicated on its power to innovate and its technological lead, and these advantages are upheld by experienced networks of engineers inside the country's OEMs (original equipment manufacturers), suppliers, and engineering service providers. Over the last 30 years, Germany has continually developed its philosophy around the car as a product further, garnering itself a reputation as the best carmaker in the world; this esteem manifests itself most clearly in the country's premium brands, which also happen to earn a proportionally higher profit margin per vehicle than the mass-market producers.

Developments going into the future, too, would seem to confirm the hypothesis that research and development (R&D) will be decisive in prospects of defending, perhaps even extending this position on the global marketplace. The last report of the German Parliamentary Office for the Consequences of Technological Developments (published in 2012) identifies seven central challenges to the automotive industry in the coming two decades. The first five of these, if not all, can only be mastered through intensive efforts in R&D[i]:

1. Developing efficient vehicles
2. Developing alternative powertrains
3. Maintaining the position of the German car industry as a technological leader and premium manufacturer on the world market
4. Completing product portfolios with new mini and micro vehicle concepts
5. Reducing the number of vehicle platforms while increasing variety within product portfolios
6. Tapping into BRIC growth markets and surmounting the crisis in Europe
7. Participating in the introduction of new mobility concepts

If the innovation around autonomous cars and C2C communication is added to these seven issues, then the continued importance of the development departments becomes even clearer: but how will they look in the future with regards to demographic change?

2| STATISTICS – PRESENT AND FUTURE

The automotive industry remains Germany's industrial sector with the highest turnover, and the importance of research and development (R&D) in this sector is correspondingly high: at around 40%, this sector contributes the highest proportion of overall spending on R&D in the German economy. In 2011, this sum was approx. 22.2 billion Euros[ii], and of the total of roughly 750,000 people working in Automotive nationwide, around 91,000 (i.e. 12%) were employed in R&D; this figure is added to by further experts employed by engineering services providers who do not appear in the statistics for Automotive, but often carry out a great deal of the development work in many projects. According to research carried out by IW Cologne in 2009, there were around 162,000 engineers in the sector[iii]. By the same token, these figures cannot be taken entirely at face value for two reasons.

1. Engineers are not just deployed in R&D departments, but in many other business divisions where they frequently do not actually work as engineers (the cross-sector average for this is 48%).
2. The number of atypical career paths into R&D is not recorded by statistics, and yet development departments in the sector are composed not only of engineers, but of a more than negligible number of scientists, mathematicians, economists, and qualified staff without academic degrees.

With this in mind, it can be assumed that there are more than 100,000 experts in vehicle construction R&D, which adds up to an impressive 28% of staff in development departments across all sectors.

The age distribution of these employees is strongly correlated to the type of company they are in. Smaller businesses often have a very low age average with only very few or no workers above 50; however, vehicle development in Germany is dominated by the larger OEMs, their suppliers, and larger engineering service suppliers – as are staff numbers in the area.

According to the age distribution of engineers in the engineering professions given in IW research cited above, 30% of the workforce was already older than 50 in 2009; this is roughly equivalent to the overall proportion of this age cohort in overall employment statistics for Germany.

The German R&D location of an international vehicle parts supplier is a case in point for this assumption[iv]:

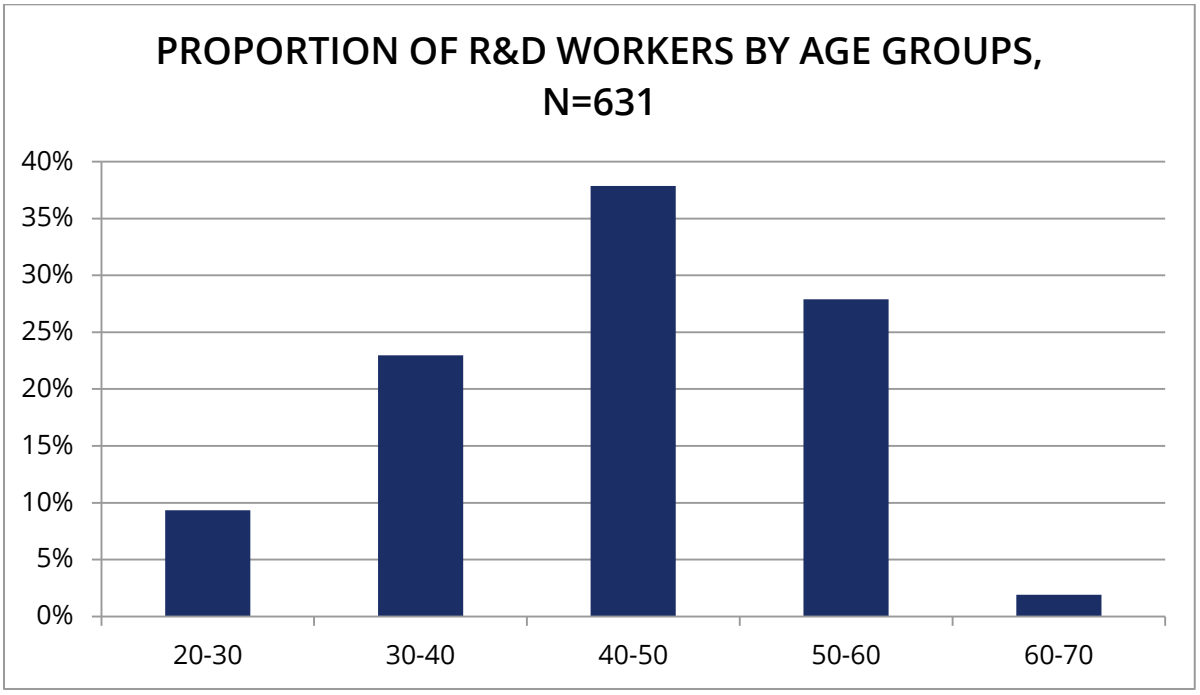


Figure 1: Example of an age distribution of development engineers at a supplier location in Germany

These figures mean that in the next 10-15 years, more than 30,000 highly-qualified employees (or between 2,000 and 4,000 annually) will leave the development departments of German vehicle-makers. In a cross-European comparison of engineers in all sectors, however, Germany's predicament looks even more alarming; none of the labour markets in the other countries examined are set lose so many experienced engineers within the next 10-15 years.

GERMANY'S MISSING GENERATION

Engineer demographics in Europe (figures in percent)

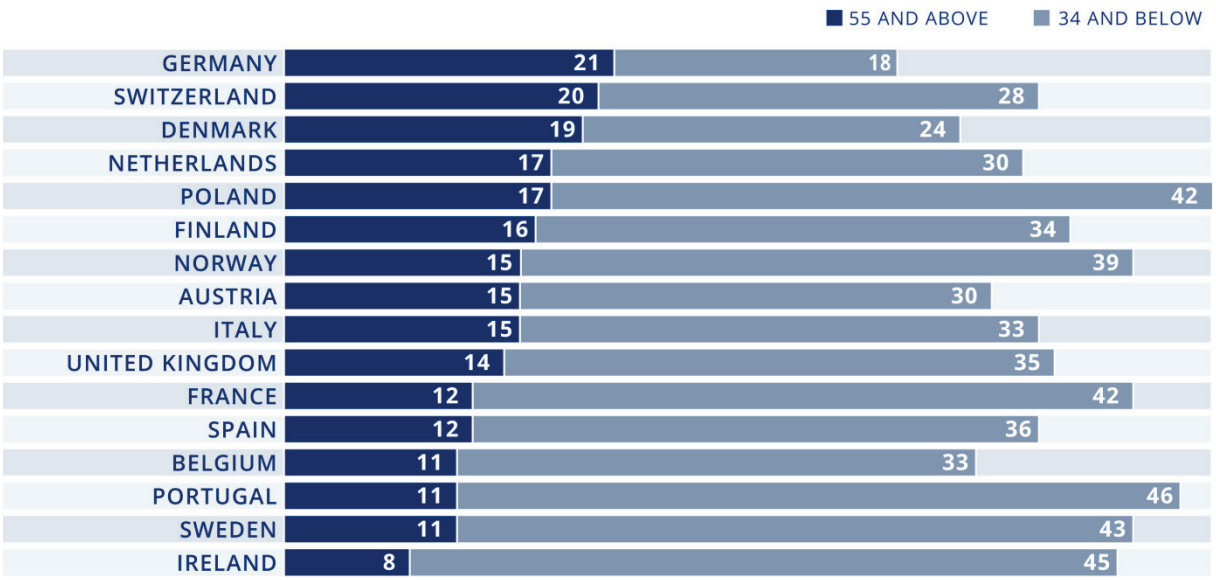


Figure 2: Engineer demographics in Europe[v]

In addition to this, overall population demographics mean that more employees are leaving the labour force than are joining it: the potential supply of workers is shrinking, and this trend is set to continue after 2015 as the baby-boomer generation reaches pensionable age[vi].

A combination of several indicators (levels of unemployment, the number of vacancies, and the relation of jobseekers to vacant posts) has been developed to identify professions in which a lack of qualified labour is approaching, and by this measure, engineers in mechanical and automotive engineering join doctors and pharmacists in the statistics of professions facing a shortage of qualified workers[vii].

Nevertheless, this view is not universally accepted. Depending on the interests at stake, an approaching shortage of qualified labour is often branded either as "a storm in a tea-cup" or as "a serious issue that is consistently ignored". In 2012, for example, the business-friendly Institut der Deutschen Wirtschaft sounded the alarm about "an accelerating decline in engineers in the workface due to a high average age", at the same time as the Deutsche Institut für Wirtschaftsforschung was warning of a "flood" of engineering graduates (see p. 15 of the Forschungsinstitut Betriebliche Bildung, or f-bb, report on life-long learning in a period of demographic change, or the documentary on "The Myth of the Shortage of Qualified Labour" broadcast by German public service broadcaster ARD on 21/07/2014 and available through until 21/07/2015 in the *ARD Mediathek* player).

Regardless of these discussions – rarely free from ideology of one political colour or another – those working in the world of automotive engineering will have to concede the following points.

1. In view of the continuing innovative power in the sector (see the challenge described in the introduction), the requirement for engineers looks more set to increase in the future than to decrease.

2. The overall feeling is that is becoming increasingly difficult to fill vacancies, especially at management level (project leaders, engineering managers).

3. The accumulated expertise of the 50+ cohort is immense, making the transfer of knowledge between the old and the young one of the greatest challenges for businesses (in a survey about the value of further education carried out by the f-bb, 95% of respondents mentioned this issue, with 70% of this number seeing the issue as of "high" or "very high" importance[viii]).

In order to understand these challenges, there are three perspectives from which the issue must be viewed.

- The **time perspective**, or: to what extent are new engineers needed in the coming years and to what extent is Germany producing engineers to keep up the present level of supply?
- The **global competition perspective**, or: how is the relevant workforce developing elsewhere, especially in the economies of the major competitors China and India?
- The **knowledge perspective**: how can loss be minimised in the knowledge transfer process?

| > GERMANY REMAINS A COUNTRY OF ENGINEERS

The trend towards university education in Germany has strengthened dramatically in recent years, with an increase in the number of young people with tertiary qualifications remaining a key goal of German education policy. This has led to a 37% increase in the number of students at German universities between 1997 and 2012; the number of students enrolling in university courses has actually gone up by 85% to roughly 500,000 annually (in 2012). The increase in engineering is in fact even larger, with 57% more students and 137% more young people starting an engineering course; the increase since 2008 has been particularly high[ix]. In 2012/2013, the suspension of military service in Germany led to a small dip in the figures, but this looks set to be smoothed out by the end of 2013/2014 (there are no nationwide figures available as yet).

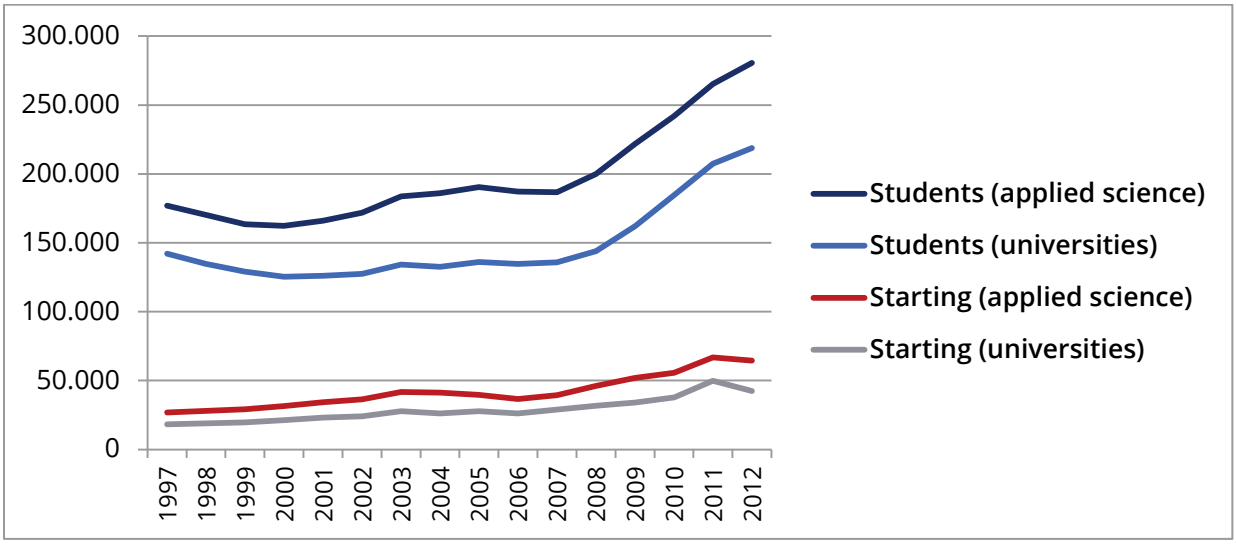


Fig. 3: Starters at all engineering university courses in Germany.

Of course, the numbers of students completing degrees is far more decisive with regards to competition for the brightest and best; yet these figures are very difficult to predict on the basis of students in each progressive semester of their courses due to the high and volatile numbers of drop-outs and subject switches (see mechanical engineering and process technology as an example[x]). Further to this, past drop-out rates can only be used to extrapolate up to a point as, especially in bachelors courses, there has been a noticeable increase in these figures.

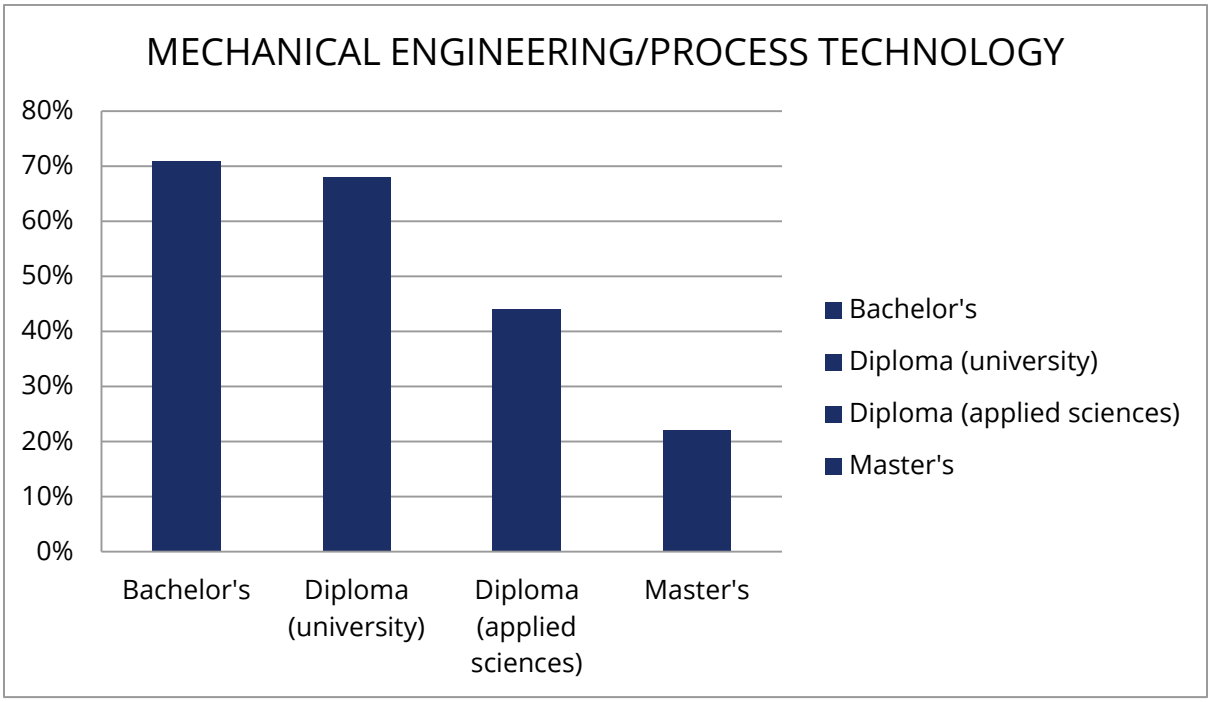


Fig. 4: Drop-out rates in mechanical engineering/process technology

This means that our 2014-2019 forecast for **mechanical engineering and process technology**, an area of particular importance for the German automotive industry, comes with no small degree of statistical uncertainty; but it nevertheless allows us to conclude that there is no reason to assume that there will be a lack of engineering graduates in the relevant topic areas in the coming years (see figure 5).

In fact, with several year groups of double school-leavers who entered higher education in 2011 to 2013 due to a reform shortening secondary education set to graduate, there will probably be a surplus of engineers to balance out staff retiring through until the end of the decade at least.

How the situation will develop from 2020 on remains uncertain, yet given both these statistics and the rise in international mobility for engineers from both Eastern Europe and the emerging economies, panic-inducing predictions of shortages of skilled labour would appear to be alarmist.

By the same token, statistics say nothing of the quality of graduates: from 2016 onwards, all of them will have gone through the newly standardised bachelor's and master's programmes which have replaced the previous German system of qualifications.

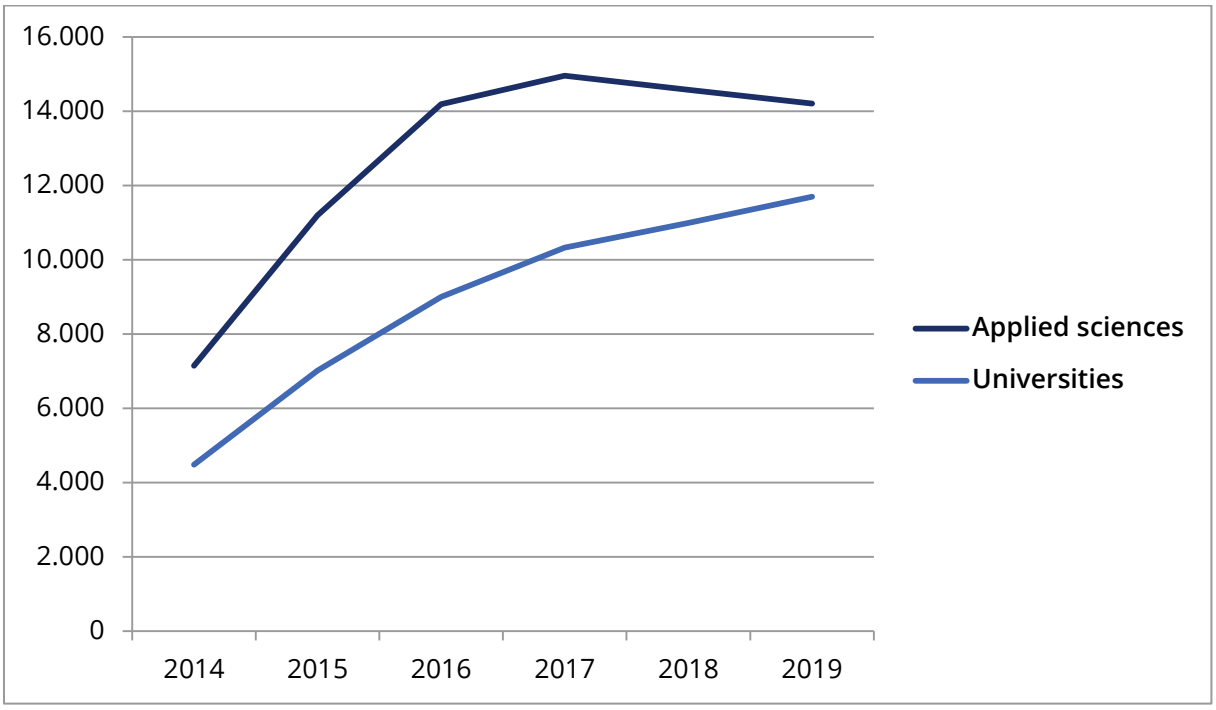


Fig. 5: Number of graduates in mechanical engineering and process technology, POLARIXPARTNER GmbH forecast.

As the first full tertiary education qualification, the bachelor's degree is now decisive: for one, master's programmes are only accessible to students with the highest marks, or access is limited in other ways; at the same time, would-be master's students are also competing for a lower number of available places. This will result in a lower number of master's graduates as compared to numbers of diploma engineers under the old system, in turn causing a multitude of problems for businesses.

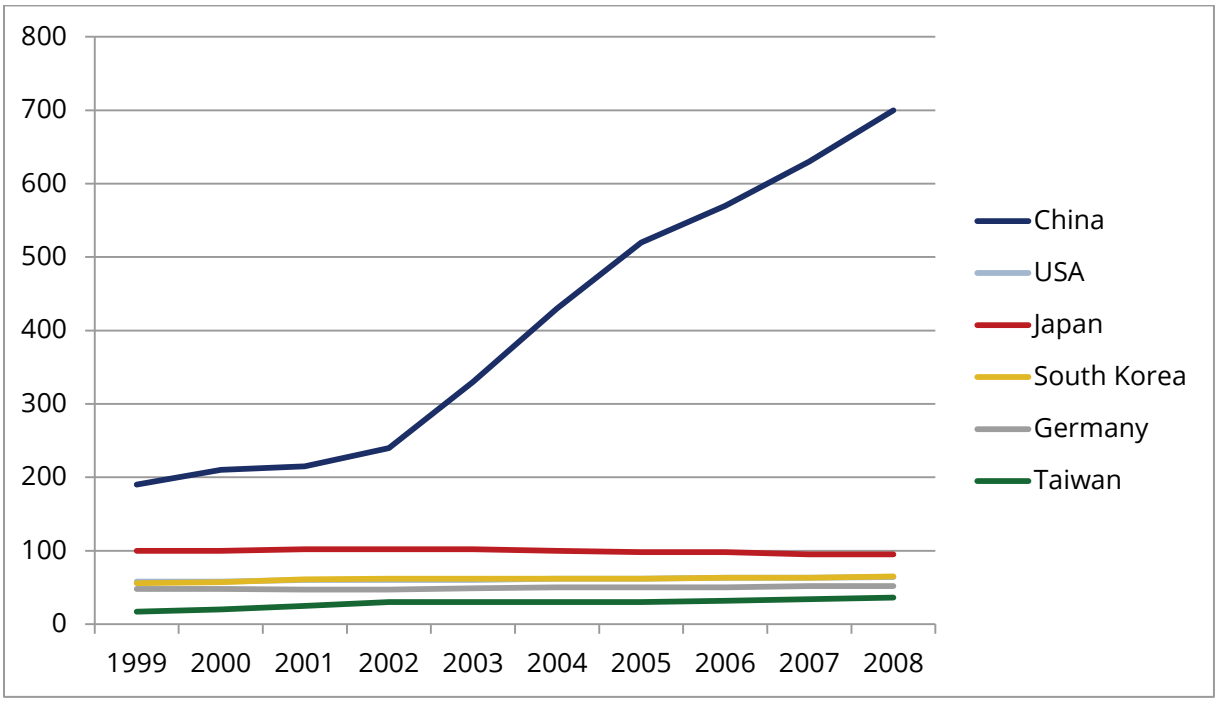
In-depth subject knowledge and relevant practical skills: Graduates from bachelor's degree courses tend not to have the same level of education as diploma or master's graduates. By and large, they lack the necessary degree of specialisation and in-depth knowledge, and also have less practical experience. While the old diploma degree programme generally contained an entire semester of work placements, this practical course element is, in subject areas like economic and mechanical engineering, now condensed into a ten-week internship.

This, in turn, has knock-on effects on the level of staff development required of companies (i.e. more specialist qualification programmes will be needed) and on how to fill vacancies in specific areas.

Personal development of new staff: Recent bachelor's graduates tend to be two-to-three years younger than comparable diploma degree holders; moreover, the shorter and denser course structure means that they generally have spent less time abroad. These factors, along with a far more rigid university system more focussed on guiding students, have long-term effects in reducing the graduates' capacity for independent thought and activity.

| > A DIVERSION VIA THE NEW HOT-SPOTS FOR ENGINEERING STUDIES

Every year, over two million graduates leave the universities of the world with a degree in engineering. Already, more than a third of this figure is taken up by China, which produces more than twice the number of engineers as the EU.



What is even more impressive is the period of time in which this development has taken place, as the curve of the graph above shows (all figures in thousands), The fact is that, in recent years, around ten times more engineers have graduated from Chinese universities than from German ones, despite China only recently having created the infrastructure to offer high-quality courses in this area.

Fig. 6: The library of the University of Shenzen (albeit designed by British architects). ©RMJM Architects

It will doubtless take longer for the cultural preconditions for education to the level enjoyed in Germany to come about: Chinese courses still have a lot of frontal lecturing and little – or at least less – practical relevance and application than those offered in Germany. Yet times are changing in this respect too, and Reinhart Poprawe, Professor in Laser Technology and China officer for the RWTH Aachen with regard to the differences between German and Chinese engineering studies, warns against catch-all statements regarding the low quality of Chinese graduates. Yet he points out that "Germany earns more than a quarter of national income by producing products. The culture of these companies is to demand university graduates with applicable knowledge, and this has a track record of success. […] Federal and state-level support for research based on project bids is a further catalyser for industry-defined research initiatives, closing the circle of implementation and innovation-orientated research complemented by of-the-moment educational courses. China (as yet) does not have this system"[xi]." In addition, the Confucian culture of knowledge tends to promote strict hierarchical structures, which will prove to be a detrimental factor in innovation alliances which are increasingly being organised as networks and blurring the lines between the inside and outside of organisations.

In Poland, for example, the situation is quite different. Engineering is traditionally a high-prestige profession there, with a broader course programme than in Germany often complemented by secondary degrees to reach deep specialisation. In terms of disciplined behaviour, responsible attitudes, and productivity, Polish engineers – especially the young generation – are entirely on a par with their German counterparts, despite a gap in salaries that still runs at 1:3. To put no too fine a point on it: a Polish development centre offers the same performance at one third of the costs.

Yet even in comparison with Poland, the exceptional performance of German engineering remains founded above all on the networks between academia and industry, especially in view of the continuing decline in the period in which knowledge retains its value. The diversity of research activities, not only in the Fraunhofer Institutes and a range of excellence clusters, but also at "standard" universities, is a source of continuing opportunities for innovation that must – and will – be made the most of by future generations of engineers.

| > TRIED AND TESTED REACTIONS

As we have shown thus far, the problem in the coming years will not so much be the number of engineers entering the workforce.

Rather, the focus looks set to be on the qualitative aspects of changes: the greatest challenge will, in our view, be to coordinate the measures necessary in human resources and R&D. At present, both of these business areas are often cut off from one another with a deficient understanding of how the other works. This leads to top-down restructuring measures initiated and implemented in the personnel department with the aim of offering older employees part-time solutions with no regard to whether the necessary knowledge transfer can be organised. Conversely, R&D people often view recruiting as their wish-list, which is to be ticked off by HR as it sends exactly the profiles needed at the click of their fingers: this approach results in unrealistic requirements that are either not available on the market, or in such high demand that they are as rare as they are dear.

Yet the issues goes deeper, resting more than anything on the way in which engineering teams – frequently subconsciously – view themselves. As Francis Bacon's old saying goes, "knowledge is power", and those who explain their knowledge – making it understandable and documenting their experience – are passing on power, perhaps making themselves expendable in the process. The transfer of accumulated knowledge often takes place only in training, demonstrating to, and supervising new employees – i.e. in much the same way as novices are initiated into monastic orders.

While this may well be an effective form of passing on knowledge, it is to a large extent reliant on the person giving and the person receiving knowledge being in the same place at the same time, and indeed often close to each other within the organisation; but precisely these three prerequisites are becoming ever rarer.

- **Not in the same place** because, as a consequence of globalisation, more and more engineering tasks are being carried out abroad, often in low-wage countries such as China and India.
- **Not at the same time** because (older) members of staff have to transfer their knowledge without there being a direct recipient for it.
- **Not in the organisation** either, because the share of work between companies in the triangle of OEM, supplier network, and engineering services supplier is currently changing a pace. The *Automobilindustrie* magazine has even produced a special issue on engineering service providers in 2014 in which it states that the industry is heading for a "time of turmoil" and a "sea-change".

3| WHAT EFFECT DOES ALL THIS HAVE ON THE ISSUE AT HAND?

1 | EXPLAINING EXPERT KNOWLEDGE REGARDLESS OF TIME, SPACE, AND ORGANISATIONAL STRUCTURES

Older engineers need the freedom to explain their know-how. This is typically achieved using knowledge databases (e.g. using IBM's Rational Doors); at the same time, strong motivational structures must be created to drive this process using agreed goals or other measures.

Prioritisation is a perquisite for success in this matter inasmuch as knowledge about more recent products is frequently well documented, while knowledge regarding older products is in some cases not considered important enough to be transferred due to the not inconsiderable effort of passing it on. Yet here is where careful prioritisation is of the essence, as "field" knowledge of older products (gleaned from complaints, returns, or other experiences) can be a crucial input of inestimable value for new developments, above all in terms of avoiding errors.

2 | STRATEGIC USE OF OFFSHORE AND NEARSHORE IN ENGINEERING

Lots of companies have been using development centres in emerging economies for years, decades even, mostly as a reaction to the explosion in development costs as a result of increasing complexity, but also to develop products or derive product versions for local markets. Especially in IT areas such as electronics, software development, and CAD, India and other Asian countries, and indeed – since the early 1990s – eastern European states (Poland, Rumania, Ukraine) have been used by the German car industry, above all suppliers, to create development centres.

In view of the upcoming transition scenarios with regard to experts leaving the workforce, the use these locations should be strategically re-orientated.

- The strategic strengths and weaknesses of the existing offshore and nearshore development centres should be analysed.
- There should be a new orientation focussing on project management, requirements management, product architecture and validation in Germany with implementation completely offshore.
- In this context, the explanation phase described above is an indispensable prerequisite.
- Top experts from the foreign development centres need to spend extended periods at central development facilities in order to move forward.

3 | ESTABLISHING SUCCESSION PLANNING AS CORE ELEMENT OF ENGINEERING HUMAN RESOURCES STRATEGY

Succession planning is a long-established instrument in the personnel repertoire in order to guarantee a clear hand-over path in the top levels of management. In view of the high value of knowledge holders with years of experience in engineering, this implement ought to be extended to the engineering staff set with the same degree of attention. This will mean:

- identifying key positions;
- evaluating risks, especially with regard to the know-how loss when the employee retires or leaves the company;
- talent scouting for the recipients of the know-how or portfolio;
- preparing the successor identified using appropriate knowledge transfer measures.

What is truly decisive is that this instrument is not only implemented on a one-off basis, but as a routine in the regular management structure that is practised by all management staff – just as budget and project planning are.

Using part-time arrangements towards the end of careers intelligently, or even reactivating retired employees to mentor and stabilise levels of know-how in the organisation, can also be a part of this initiative.

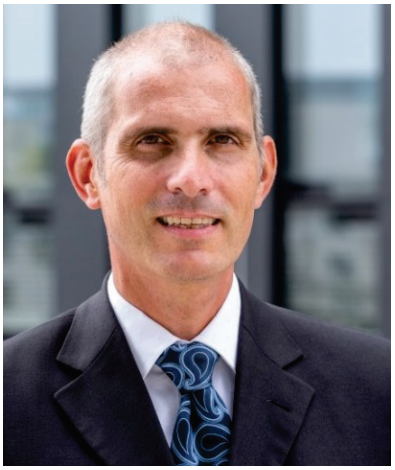
USE OUR EXPERTISE FOR YOUR BUSINESS

As we have seen, the challenges of demographic change are – when viewed in the cold light of day – definitely present, but by no means uncontrollable as long as R&D divisions are able to renounce out-of-date habits and deal with the approaching challenges.

We would be happy to accompany you on this journey as your experienced consulting partner by setting the points for the qualitative aspects of demographic change now. We will analyse your individual situation, and then define, supervise, and coordinate the implementation of the necessary measures in HR and R&D departments – either at 70kph or, if you prefer, at high speed.

THE GUIDING STAR FOR THE MANUFACTURING INDUSTRY

THE AUTHOR: YOUR EXPERIENCED POLARIXPARTNER CONTACT



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- More than 20 years' experience as a project manager for technical product development. More than 15 years' experience as a consultant in various industries – mainly automotive.
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