During the interaction with our esteemed members it was really nice that I had spoken to all of them offline but there I got an opportunity to meet them personally and introduce myself. It was really a pleasure meeting them. All the members were really nice and I didn't feel that I am a fresher amongst them. They were so kind which made me extremely comfortable to speak to them.

The summit is really a great platform to interact and meet new members from different industries. It really helped to build my confidence. It gave me good insights through speakers discussions, presentations, panel discussions and was the best platform to meet varied industries with an excellent networking opportunity.

What role do you see VDMA India playing in the future?

We all know, VDMA India which acts as a bridge-head between the German and Indian Industry and shares expertise and experience with its member companies from different industrial sectors. VDMA India promoting technical collaboration and expert technology transfer between the German and Indian Industry for mutual benefit and serves the Indo-German economic relations in various engineering sectors. To support all the esteemed member companies, the VDMA India office offers comprehensive assistance for both newcomers in the orientation phase as well as for established members in further development.

VDMA also help Indian companies looking for German tie-up and collaboration. More than 600 VDMA member companies are engaged with their own business in the Indian market. VDMA India is the only association of its kind focusing on the Mechanical Engineering Industry and is active in various specialized sectors. Over the years, VDMA India has developed a good network with the Indian industry and government bodies.

Over all, with the strong business relationship with Indian Industry, German Industry, Government bodies and Chamber of Commerce, with all these positive points and with good teamwork, VDMA India would surely act as the main contact for the engineering industry in the future.

Indo-German collaboration in mechanical engineering requires more frugal solutions

India and Germany have emerged as partners with potential in the mechanical engineering sector. However, there is an enormous, untapped potential with ramifications for German, Indian and global markets. The key to unlocking that potential lies in the creation of innovative solutions that enable "affordable green excellence", also defined as frugal innovations.

India has emerged as the seventh largest foreign direct investment (FDI) destination for German firms from mechanical engineering sector. At the end of 2017, German firms had invested 1.3 billion euros in India that amounted to 3.3% of their global FDI stock. The largest chunk (almost 50%) was concentrated in three countries, i.e. the USA, China and Switzerland.

In Asia too, three countries dominate as FDI destinations for German mechanical engineering firms with a share of 90% in the total FDI stock of 9.1 billion euros. While China clearly leads the pack with a share of 65.8%, India comes second with 14.5%, followed by South Korea (10%), see Figure 1.

Indo-German trade in machinery has registered considerable growth between 2016 and 2018. As per data released by Germany's Federal Statistical Office, Germany's machinery export to

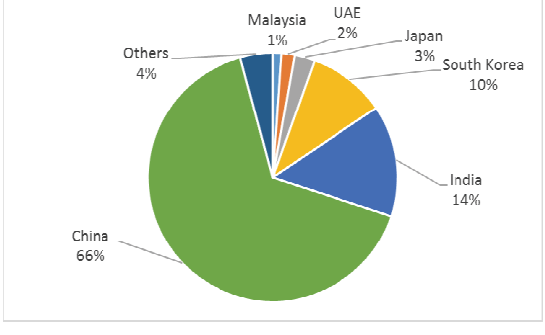

Figure 1: Top FDI destinations in Asia for German mechanical engineering firms as of 2017

India grew by almost 500 million euros in 2018 from the base of three billion euros in 2016. The cumulated growth of around 16% was, however, clearly outperformed by the growth in Germany's overall exports to India, which increased by about 28% (see Table 1).

	2016	2018	Growth
Machinery export to India	3,001.2	3473.5	15.7%
Machinery import from India	626.6	850.4	35.7%
Total exports to India	9,783.7	12499.1	27.8%
Total imports from India	7,652.9	8926.3	16.6%

Table 1: Growth of Indo-German trade between 2016 and 2018 (monetary values in million euros)

On the other hand, India's machinery exports to Germany registered a cumulated growth of nearly 36% in this period, even if on a lower absolute level, reaching 850 million euros (see Table 1). The growth in machinery export from India to Germany (almost 36%) also outperformed the growth in overall Indian exports to Germany by more than double (nearly 17%).

We can interpret this lop-sided growth pattern to deduce two key inferences, as discussed in the following:

First, the domestic market in Germany seems to be opening up for cost-effective and good quality equipment produced in India. While the mechanical engineering sector ("Maschinenbau") in Germany has continued to grow in the recent past – in terms of both production and revenues, the growth has been relatively subdued. Taking 2015 as base year, the cumulated growth in the three years period till 2018 stood at around 6%. In a globalized world that is faced with increasing and disruptive competition from domestic and overseas players, companies need to offer competitive solutions that can enable "affordable excellence".

Furthermore, customers are getting cost-conscious and increasingly unwilling to pay for over-engineered products. Features that are merely "nice to have" but not necessarily required by the customer, face the threat of rejection by cost-conscious customers.

There is also a growing concern for environment and many customers are opting for products and processes that fulfil their requirements without excessive harms for the environment. These trends have been confirmed by different studies undertaken by us in Germany and Austria. Second, the Indian market continues to grow. Despite occasional short-term slowdowns, it is clear that India with its large and young population and its unsaturated and aspiring market will be one of the core drivers of global growth in the years to come. India is undertaking a massive exercise to create/improve its basic infrastructure and meet new environmental standards.

This exercise is creating new opportunities for products that match aspirations with affordability in the Indian market for mechanical engineering goods can be assessed by the fact that the quantum of imported general industrial machinery, equipment & machine parts has increased almost eight-folds in the 18 years since the turn of the millennium, but the unit value in monetary terms has only increased by less than double. This suggests that Indian importers have been able to source their products from foreign-based suppliers in an affordable manner.

The discussion above demonstrates the need for solutions that are affordable and possess high/requisite quality. The term frugal innovation has established itself by now in the management literature. Frugal products (also processes, technologies and business models) can be characterized as enablers of "affordable excellence".

Frugal solutions meet the specific needs of the targeted customers in a resource efficient manner while ensuring compliance with all relevant quality and safety norms. They can open up new business segments by meeting the unmet needs of a customer group. A good example of a frugal solution from industrialized nations is the Hydro Mini-Grid created by Austrian firm Andritz. This mini grid was conceptualized for the African market and is

capable of decentral electricity generation in a simple, robust and reliable manner. It is a plug-and-play solution that is easy to operate and maintain. There are numerous such instances of frugal solutions, many of them in the components side so that they are not directly visible to the public eye.

Frugal solutions have been undergoing a transition from “affordable excellence” to “affordable green excellence”, and are not to be confused with “Jugaad”. The latter refers to improvisation and does not necessarily mean an outcome fulfilling all regulatory standards. Frugal innovations, on the other hand, can even create radical solutions by disrupting existing product architecture. In two large industry collaboration projects of our institute, we have successfully implemented frugal product development processes with western firms targeting both, markets in developed as well as developing countries.

Indo-German collaboration in this sphere seems to be very promising as it connects the engineering capabilities and the lead market potential of the two nations. The affordable and environment-friendly technological excellence can contribute to achieving sustainable development goals (SDGs) and open new business opportunities, where India can provide access to first-hand tacit knowledge of the unmet needs and German companies bring-in their expertise of the technological domain. A one-sided focus on technological performance can be market threatening unless coupled with strong orientation for emerging market needs in unsaturated markets. Not surprisingly, Reinhold Festge, then president of VDMA had commented in 2014: “German companies must not allow themselves to be pushed into the top of the technology pyramid. The market there is too small.”

About the authors

Prof. Dr. Cornelius Herstatt, Dr. Stephan Buse and Dr. Rajnish Tiwari have founded the Center for Frugal Innovation at Hamburg University of Technology. They have an extensive experience with India and Indo-German economic collaboration. For all queries related to their research or taking up contact, please see: www.frugal-innovation.net

India, HR and Industry 4.0

Behind the scenes of the world’s leading industrial and manufacturing companies, a profound digital transformation is now underway. At the end of this transformation process, successful industrial companies will become true digital enterprises, with physical products at the core, augmented by digital interfaces and data-based, innovative services, working together with customers and suppliers in the industrial digital ecosystem.

These developments will fundamentally change companies and transform market dynamics across industries worldwide. Industry 4.0 focuses on the complete digitization of all physical assets and integration into digital ecosystems with value chain partners. Generating, analyzing and communicating data seamlessly underline the gains promised by Industry 4.0, networking a wide range of new technologies to create value.

VDMA & M+V have teamed up to ask German companies in India how they are preparing for this change in their Indian operations. In this context, we conducted in-depth discussions with 12 companies (with representation from component manufacturers, automotive, solution integrators and robotics, categorized as mid-to-large setups in India).

The Key Aspects That Were Revealed

The Indian industry landscape is still operating within industry 3.0 and is still perfecting its technologies. Every participating industry does acknowledge that the global counterparts are in advance stages of adoption and are making changes to operate as industry 4.0 and subsequently is inevitable in India.

Presently, the German HQ sets the roadmap for India on data analytics and innovations. There are very few R&D centers/investments directed towards building products for India, aside from the large automotive R&D centers, others are directed as back-office for HQ.

The need for adopting industry 4.0 for some companies did not justify the investment due to many reasons - from the clear cost advantage, an appetite for a long gestation