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Introduction/Credits

For the UK manufacturing industry, the internet economy and Industry 4.0 is seen more a chance than a threat. Facing a couple of challenges in the old industrial world, Industry 4.0 gives the UK in the new “game” the opportunity to establish an innovative manufacturing sector made up of smaller and new players. Whereas new digital services and new digital competition for the established industries come up, British industries could be among the new players: The changes in the existing business models and their extension towards “servitization”, where production and services will come together, is the chance for British manufacturing, which Government and industry is keen to take it.

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Summary for Online Edition

Although the UK manufacturing industry has to fight for international competitiveness and was facing challenges regarding reputation, quality, workforce or cost level in the past, the UK industry clearly fits the nature of industry 4.0 well. One reason is the strength of UK industry in deliver customer specific approaches and good customer service. This will be a key future success factor in the Internet economy, which brings the “buy-precisely-what-you-want market” and therefore the shift toward consumer markets, where consumers decide on production schemes. The changes in technology, consumer’s influence and therefore market implicates means a change for business models, especially the servitization, which is the enlargement of the business models with new (smart) services or the prolongation of the value chain, for example a printer-copier, a customer pays a usage related fee. Smaller innovators can suddenly become significant players, not through large initial investments, but through the utilization of a network of manufacturing services provided through

manufacturers that focus on niche specialities. The rise of new and smaller innovators in the digital economy is the chance for UK manufacturing industries.

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Highlight Quotes

A UK perspective at the future of manufacturing

Since its inception as the consequence of the enactment of the Merchandise Marks Act 1887, "Made in Germany" has become a symbol of quality products with a decent price. Indeed, the label has gained worldwide renown. The UK manufacturing sector is much less well known, and indeed is not even a third of the size of the German sector [1], and per capita less than half, both slightly below OECD and EU levels. But size is not the only difference, the reputation, deserved or undeserved, is also different.

Within the country, manufacturing suffers from an undeserved reputation of failing to be competitive, the recent closures of steel plants come to mind. Perhaps due to the love for self-deprecation that is a cornerstone of the British culture, the successes of manufacturing are not sufficiently celebrated. Fact is that the manufacturing sector has shifted from competing on price to competing on quality. There are two major players in jet engines, UK based Rolls-Royce being one of them. The British car manufacturing sector is strong, albeit in foreign (quite often German) hands. Perhaps stealthily, various British companies have actually reshored their production back to Britain [2].

How British manufacturing differs from German manufacturing

British brands are more known for their innovative nature or sometimes even their quirky nature than for the robustness of the quality. The quality is there though, made in Britain is not the seal of lack of quality that "made in China" was 25 years ago, something that China has long since recovered from. What remains true however is that manufacturing in the UK is in some ways different to manufacturing in Germany, despite the massive equalization brought on through globalization.

Without the ironclad brand of "made in Germany," nor a particularly cheap or highly skilled workforce, British manufacturing relies even more on innovation and smart approaches to deliver quality and good customer service with 93 percent of companies agreeing that flexibility and being responsive to customers is becoming more important [2]. Industry 4.0 brings combines a set of technologies that don't only allow for the further optimization of already highly optimized mass production lines, they can also allow the quality and costs structures of those mass production approaches to be used for smaller production runs.

How the Internet changes expectations of industry

A big influencing factor in all sectors of the economy is the Internet. In the British high street its influence can be felt through "to let" signs instead of welcoming store fronts. The Internet has exposed both retailers and manufacturers of goods to customer choice. Where previously you bought what was in stock in the shops in your area, these days even customers on the Outer Hebrides (Islands that are "part of" Scotland, but especially known from having little population and being very far away from anything significant) are able to buy the goods of their choice with the click of a mouse.

Independently of many other opportunities and threats that the Internet brings to manufacturing, this buy-precisely-what-you-want market, has a strong influence on production. Some products build up very large demands while other products establish themselves with small but solid niche positions.

While the effect of the Internet is most visible in the consumer market, this does not mean that it is just as important in the business to business market. Ultimately, the need for flexibility and customizability, this time for practical rather than fashionable reasons, is also present in the business market. It is clear that customers are increasingly expecting shorter order-book times.

Where manufacturing in China doesn't work

While there is of course always a market for traditional mass production, there are many reasons why there is a place for the other approaches that Industry 4.0 entails. Looking at innovation, a focus on fast turnaround cycles (shipping from China can take 4 or 5 weeks) as well as the locality of the manufacturer can help a new or adjusted product hit the market quickly without unneeded "birth defects". Fast reconfiguration of production lines

allows for rapid adjustments, and makes small batches much more cost effective. Additive and subtractive manufacturing (3d printing), while not quite at cost levels of even small batch mass production, make prototyping affordable, so much that some products never graduate other forms of production.

What actually makes industry 4.0

Perhaps like the hype of web 2.0 the concept of Industry 4.0 is a label for a set of poorly defined parallel developments. Perhaps it will gain more substance. Despite a lack of precise definition or being sold as a technology (which it is not) Web 2.0 is real. The technologies and approaches have let the Internet become what it is today, much richer, in many ways, than its more humble beginnings.

Industry 4.0 has been defined with 4 contributing technologies: big data and analytics, digital modelling, additive manufacturing, and computer integrated manufacturing. These technologies, and perhaps others less significant or well known, allow approaches such as servitization where the product becomes a service instead of a one-time purchase.

Changing manufacturing through servitization

Perhaps servitization is a very interesting example to explore how industry 4.0 can let an innovative manufacturing sector made up of smaller players thrive. Core to servitization is that through the change of business model, the manufacturer is directly responsible for the operating costs of machinery. Any malfunction or waste directly hits the profit margin of the producer.

In cases of servitization, for example a printer-copier, a customer pays a usage related fee. Integrated network functionality does not only allow for supplies to be ordered when they get low, it also provides large amount of usage data (big data) that, when the data of different customers is combined and analysed drives product innovation.

As the manufacturer has a direct interest in the usage cost of the device, there is little incentive to delay introduction of the innovations. Indeed, local manufacturing can significantly reduce the lead times. Digital modelling of production and the parts, in combination with additive and subtractive manufacturing allows for rapid prototyping of enhancements and innovations.

Where in traditional approaches, it is often not worthwhile to design for the retrofitting of improvements on existing devices, in servitization it may very well be. The cost of retrofitting is often dependent on the quantity of retrofitted devices. If left to customers themselves, many devices are never upgraded, but when the manufacturer itself is directly responsible, it can determine exact cost benefit analyses. Indeed, it is incentivised to design its products such that retrofitting, upgrading and maintenance are easy and cheap.

Computer integrated manufacturing

The fourth pillar of industry 4.0 is perhaps the most significant one, computer integrated manufacturing. Where traditional automation approaches such as CNC and CAM control individual tools in the manufacturing process, computer integrated manufacturing integrates manufacturing across tools and production steps. This not only from a resource planning perspective as provided by ERP systems, but from a much broader perspective. With CIM systems the production line, including design, planning and supplies can truly be managed from a single system.

Computer integrated manufacturing is successfully used in areas such as the automotive and aviation industries. Those industries are examples of manufacturing that involve expensive, largely static production line setups. While there is often place for variation in the form of mass customization this does not require the change of production line.

As computer integrated manufacturing adds a large amount of software complexity it is perhaps not surprising that it's initial use is in capital intensive, static, production environments. The concept however can be applied to other production processes. Standardization of product line components and increased design for flexibility and robustness should reduce the setup cost of computer integrated manufacturing.

Bringing service innovation to manufacturing

In parallel, however, with manufacturing innovation, innovation in service science and process management has not stood still. Concepts such as cloud computing, (semi-) automated service composition and virtual organizations can be translated to the manufacturing context. Fundamentally, a step in a production process is a transformation just as much as the execution of a function is in a computing context. The difference

between a physical or a logical transformation does not make a difference in the design of a composition, only in the cost of getting it wrong.

In an environment where low quantity manufacturing at quality has become possible again at low prices there are new market opportunities. Smaller innovators can suddenly become significant players, not through large initial investments, but through the utilization of a network of manufacturing services provided through manufacturers that focus on niche specialities. Large quantities of initial investment are not initially needed, and even small kickstarter campaigns can successfully fulfil niche market needs.

Industry 4.0 is clearly able to push existing trends even further towards local manufacturing that adapts to local demand. It is striking that the top two concerns cited to encourage UK manufacturing are energy cost and availability of suitably qualified employees, both cited in about 50 percent of the cases, more than tax burden which came in at 44 percent [2]. More recent data points out that 84 percent of respondents have multiple vacancies, often filled by recent graduates [3].

UK Government policy

The UK government has various initiatives to promote manufacturing, from research council funding into various aspects of innovation to a strong emphasis on changed educational pathways in the form of apprenticeships, now also being available at higher education level. Years of austerity have however taken their toll, both in closure of services such as the Manufacturing Advisory Service as well as the dire state of many further education colleges. A large problem in work preparedness exists, and while this year government has recognised the problem of low aspirations and has significantly increased expectations on primary school children, the effects of that will not be visible soon.

While currently still in the EU, the UK does directly benefit from the Industry 4.0 strands of the Horizon 2020 plans. The UK own focus within the EPSRC Manufacturing the future strategy [4] is on actual innovation of specific manufacturing processes with only 2 percent of the currently allocated budget allocated on IT related topics.

The UK industry clearly fits the nature of industry 4.0 well, but to capitalize on the trend, a stronger focus on the enablers is needed. Especially in light of the Brexit vote, the UK

government must invest in not only innovation of the production itself, but also in innovation of the process. High quality, high aspiration education as delivered at world class within the independent education sector needs to be brought to the public sector, perhaps the academisation programme will allow headmasters the independence to do so. One thing is clear, the idea that factories of the future have only two employees, a man and a dog, is not true: they will have armies of designers, process engineers and programmers. The UK has sufficient excellence to provide those, but to do so it must go back to being visionary and outward looking.

11.840 Zeichen inkl. Leerzeichen

References

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- [2] EEF: [Backing Britain - a manufacturing base for the future](#). 2014.
- [3] The manufacturer: <http://www.themanufacturer.com/reports-whitepapers/annual-manufacturing-report-2016/>. 2016
- [4] <https://www.epsrc.ac.uk/research/ourportfolio/themes/manufacturingthefuture/>

Bournemouth University

Bournemouth University is a modern and innovative institution with four distinctive faculties and over 17,300 students with a significant proportion of international students from 120 countries; 450 postgraduate researchers studied at Bournemouth in 2015/16. The main applicants are based in The Faculty of Science and Technology, a home to Archaeology, Anthropology, Biology, Geography, Design, Engineering, Computing and Forensic Sciences research, and therefore represent pan university expertise and discipline of design and innovation. The department of computing and informatics has well established undergraduate and postgraduate programmes. The department does research into various computing related areas, ranging from cyber security and human computer interaction to smart technology and information systems.

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