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INTELLIGENCE UNIT

How artificial intelligence and design thinking will transform technology production

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About the research

Prioritisation and precision: How artificial intelligence and design thinking will transform technology production is an Economist Intelligence Unit report, sponsored by HONOR.* It explores the impact of various innovations on product design and production operations in the technology industry. The analysis is based on a survey of 325 supply-chain and other executives conducted by The Economist Intelligence Unit in September and October 2018. The respondents hailed equally from five countries: China, Japan, South Korea, Germany and the US. All the respondents work in technology equipment companies, 34% of which earn annual revenue of US\$1bn or more. Supply-chain executives account for 39% of the sample and IT executives 33%. See paper appendix for full demographic data of survey respondents.

Additional insights were obtained from in-depth interviews with two experts on product design and production operations. We would like to thank the following individuals for their time and insights.

- Shantanu Bhattacharya, professor of operations management, Singapore Management University
- David Simchi-Levi, professor of engineering systems, Massachusetts Institute of Technology

The report was written by Denis McCauley and edited by Michael Gold.

*HONOR is a global smartphone e-brand under the Huawei Group

Executive summary

Two major developments in technology hardware production dynamics—adoption of advanced innovations such as artificial intelligence (AI) and growing adherence to design thinking—are giving executives in the technology industry opportunities to experiment, optimise and boost agility, particularly as product design grows in importance within the production process. This report finds that technology producers have a clear view of the opportunities these innovations afford, and some are pursuing them vigorously now.

The following are the key findings of the research:

- Al is a prime agent of change. More than other technologies, Al will bring change to production innovation, according to 58% of survey respondents. Executives expect the foremost benefit from Al will be better product design. Two-thirds believe (and out of this, a third strongly) that integrating Al into the supply chain will facilitate the development of products with new and innovative designs. Two major reasons for this are:
 - O Automated prioritisation and sophisticated segmentation. Al will give companies the tools to automate the prioritisation of customer design preferences, and with greater precision. It will also lead to greater supply-chain segmentation, helping to make production more efficient overall.
 - O Accelerated development of flexible materials. Al will also drive advances in materials science. It is helping scientists today to greatly accelerate the discovery of new compounds. In the survey, seven in ten respondents believe flexible smartphones may be ubiquitous by 2020 thanks to advances in material science.
- The logic for broader integration is becoming irresistible. In a more holistic sense, product design and supply-chain management are tightly interlinked today in the technology industry, and are likely to become more so. The spreading influence of design thinking—cited by 82% of executives in our survey—and adoption of advanced technologies are helping drive this trend.

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"No technology advances will be more influential for supply chains than those based on AI and machine learning."

- Shantanu Bhattacharya, Singapore Management University

Chapter 1. Intelligence in design, intelligence in production

The ability to analyse big data, in its burgeoning volumes and structured and unstructured forms, has enabled technology firms to design ever more user-friendly features into their mobile and other devices. Their production and supply teams have in turn been able to deliver components and final products faster, with greater adaptability, reliability and transparency. Data-driven analysis will remain the focal point of much technology innovation ahead.

Much of this will be due to the rise of AI. Asked to choose among several emergent technologies, more survey respondents point to AI over other trends as having a beneficial impact on supply-chain innovation in the next five years. This is no surprise to Shantanu Bhattacharya, professor of operations management at Singapore Management University. "No technology advances will be more influential for supply chains than those based on AI and machine learning," he says.¹ The power of AI rests on its ability to crunch enormous volumes of historical and current data, identify patterns from data analysis, prescribe actions based on this analysis, and in many cases to initiate the follow-up actions themselves.

Hardware production is already benefitting from AI today. Examples can be found in the use of computer vision, which allows software to inspect and evaluate images of static or moving

Figure I. All eyes on Al

Which technologies will be most important to supply-chain innovation in the next five years? (% of respondents)



¹ Machine learning is a branch of AI that enables software programmes to learn independently by analysing large sets of data physical objects, enabling automated inventory and shipment scanning; tools that predict when and where logistics bottlenecks will emerge, or anticipate potential equipment failures that could cause delays; and programmes that anticipate suppliers' quality-control issues.²

Asked to identify the chief benefits they expect AI to offer in this area of operations, executives cite product design innovation most frequently, ahead of quality, cost and speed. Two-thirds believe (and out of this, a third strongly) that integrating AI into the supply chain will facilitate the development of products with new and innovative designs.

Mr Bhattacharya explains how Al will manifest itself in design: "One of the essences of design thinking"—a highly iterative and user-centric approach to product design, explained further in chapter two—"is the prioritisation of customers' preferred product attributes and their pain points. Al will give companies the tools to automate this prioritisation, and with much greater precision." This, he says, will enable the design of more product iterations at a much lower cost, which ultimately leads to greater customisation and personalisation.

David Simchi-Levi, professor of engineering systems at MIT, believes AI will also help technology companies achieve greater levels of supply-chain segmentation, which will also ultimately benefit product design. If marketers and designers can use AI to develop a more detailed understanding of customers' behaviours and product preferences and segment them accordingly, supply-chain teams can do the same through an understanding of customers' fulfilment needs, he says.

Figure II. The intelligent edge



² For some examples of these uses, see Jon Walker, "Inventory Management with Machine Learning – 3 Use Cases in Industry", TechEmergence, February 20th 2018, and Maria Korolov, "Al in the supply chain: Logistics gets smart", CIO, May 2nd 2018 "Companies today often use one supply chain that tries to address all customer needs," says Mr Simchi-Levi. "But most technology companies have a portfolio of customers and channels, each having very different needs. For them, a single supply-chain strategy is not effective. AI can help them develop multiple supply chains, each tuned to the specific fulfilment needs of customers in that segment."

Material advantages

Al's influence will be felt in other areas of design. One is materials science, where Al promises to vastly accelerate the discovery of new material compounds. For example, using a machine-learning algorithm, a group of researchers in the US recently discovered a method to create metal-glass hybrids in a fraction of the time involved using traditional lab-based methods.³ The use of such techniques can allow researchers to test processes on thousands of materials simultaneously, with an algorithm predicting the combinations of materials most likely to fit the desired characteristics.

Such techniques are certain to find use in the technology sector, where competition to develop lighter, more flexible materials—for use in televisions and mobile devices, for example—is intense. Seven in ten survey respondents believe that new innovations in materials science can make flexible smartphones ubiquitous by 2020. Scientists also expect flexible screens and other new materials to be less costly to produce and the devices that incorporate them less energy-intensive to use.⁴

Al will become ever-present in smartphones in other ways. For example, in-built cameras are already benefitting from Al's data-crunching and decision-making power. Exposure, focus and other settings are adapted to the environment instantaneously as users get ready to snap a photo.⁵ Al-based smartphone cameras are also being used in the design of medical products, such as retinal-screening systems used to detect diabetic eye disease.⁶

Figure III. Doing the splits



New innovations in materials science can make flexible smartphones ubiquitous by 2020 (% agreeing)

³ For more on this and similar advances, see Angela Chen, "How AI is helping us discover materials faster than ever", The Verge, April 25th 2018

⁴ See, for example, "Route to flexible electronics made from exotic materials", ScienceDaily, October 8th 2018; and María Rodríguez Fernández, Eduardo Zalama Casanova and Ignacio González Alonso, "Review of Display Technologies Focusing on Power Consumption", *Sustainability*, 2015

⁵ JC Torres, "The future of smartphone cameras is AI", Slashgear, May 15th 2018

⁶ Ramachandran Rajalakshmi, Radhakrishnan Subashini, Ranjit Mohan Anjana and Viswanathan Mohan, "Automated diabetic retinopathy detection in smartphone-based fundus photography using artificial intelligence", Nature.com, March 9th 2018

Box. Manufacturing 2.0: Exploring an array of emergent technologies

The survey respondents may be eagerly anticipating the capabilities that AI will confer, but they have hopes for other technologies as well, some of which are making a difference to their operations today. Here is how respondents plan to put some of these technologies to work.

Internet of Things (IoT). Companies are actively deploying IoT sensors throughout their logistics fleets, in containers, lorries and pallets; in production equipment; and in products themselves. Greater visibility is the chief benefit surveyed executives hope to gain, to enable, for instance, better asset and inventory tracking and reduced downtime of assets.

Big data and analytics. Descriptive and prescriptive data analytics tools are becoming more intelligent and powerful even without the help of artificial intelligence (AI). Executives naturally value the benefits they bring to product design, but better visibility and reduced complexity are viewed as the most important gains analytics bring to the production process.

Figure IV. A barrage of benefits

Main positive impacts on supply chains from the following technologies (% of respondents)



Robotics. Robots have been moving about warehouses and factories for years, but intelligent, AI-driven machines represent a step-change in capabilities. Our survey respondents believe newer generations of robots will, more than anything else, enable greater speed and lower cost of operations. Robotic process automation (of back-office and support operations) can bring similar advantages.

Virtual and augmented reality (VR and

AR). Our surveyed executives expect the impact from VR and AR to be felt primarily in product design. Such technologies allow engineers to visualise new products under development in countless ways, at a much

lower cost and in much less time than traditional methods of product modelling.

3D printing. Shantanu Bhattacharya, professor of operations management at Singapore Management University, expects the growth of 3D printing to eventually lead to a shift from the distribution of finished goods to the distribution of raw materials, as individuals increasingly manufacture final products themselves. That, however, is in the distant future. In the meantime, executives see the technology being put to good effect in product design, where the simplified creation of prototypes brings greater efficiency, faster development and lower costs.

Chapter 2. A next-gen mentality: The role of design thinking in technology production

The technological leaps discussed previously require equally significant shifts in conceptualising and planning around the relationship between production, supply and product design. Design thinking is an approach to product innovation that has gained adherents in many industries in recent years. It puts a central focus on users' challenges and needs and has proven influential in well-known technology companies such as Apple.⁷ The concept's influence is likely to expand further: more than eight in ten executives surveyed for this study (82%) confirm that design thinking is growing in importance in the industry. Its impact is certain to be felt in technology production, as another feature of design thinking is its emphasis on involving teams from different parts of the enterprise-including supply and procurement-in the innovation process.

Figure V. An intimate relationship



How important is the development of new products in the marketplace to the way your

Source: The Economist Intelligence Unit

US

According to Mr Bhattacharya, the interlinkage of product design and supply-chain management in the technology industry is likely to grow as design cycles become more compressed and technology products increasingly customised. He explains: "Design thinking's laser focus on customer preferences leads to the development of enhanced customisation capabilities, which in turn ratchets up pressure on suppliers to operate with greater speed and flexibility."

26%

Flexibility means being able to adapt to changes in product design more frequently. For most (65%) of the companies in the survey, shifts in supply-chain operations that result from changes in ⁷ Rafiq Elmansy, "Design Thinking Case Study: Innovation at Apple", Designorate, April 7th 2016

product design occur every six months or less. Nearly a fifth (17%) of executives say such changes occur monthly on average. Mr Bhattacharya expects that many more technology companies will be dealing with that higher frequency of design-led change in the coming years.

Figure VI. Many flavours of innovation

Respondents agreeing with the following statements about design and supply-chain	
innovation	

(% of respondents)

 Design thinking is growing in importance in the technology hardware industry
 82%

 Our company is considering the impact of product design on technology supply chains
 81%

 Supply-chain innovation can lead to leaps in product design
 81%

 Source: The Economist Intelligence Unit
 81%

Getting to know you

Mr Simchi-Levi likens the technology industry's tightening integration of product design and supply-chain teams to their already-close integration in the fashion industry, in which products also have a fleeting lifecycle and operate at rapid clock speed. "In the fashion industry, supply chain, product design, sales and sometimes procurement people sit together to make sure new product designs consider supply and other challenges," he says. "It is increasingly the same in high tech, where such integration is now a requirement."

Short of full integration, the rise of design thinking will require the interaction between product design and supply-chain managers to increase in depth and frequency. They already meet regularly: at 73% of respondents' firms, such internal meetings occur at least every six months, and every month at 38% of them. Mr Bhattacharya believes they should be speaking with each other every two weeks.

Manufacturing innovators taking the lead

Innovation in supply-chain operations can bring about changes in product design, according to 81% of our surveyed executives. Mr Simchi-Levi cites as an example the ability of PC suppliers to manufacture and deliver components on demand, which has enabled final producers to modularise the devices and enhance their customisation capabilities. Two objectives of modularisation, according to Mr Simchi-Levi, have been to keep inventories of components to a minimum, and to more easily meet demand in different markets. The challenge was laid down by supply-chain managers but the modularisation was achieved by the designers.

This example makes it possible to see how problems in product design could hamstring innovation elsewhere. Over a fifth (21%) of the executives in our survey state that issues with new

product design have been a challenge to supply-chain innovation in their companies. Such issues could arise, for example, from product designers' failure to accurately assess user preferences for product characteristics, which in turn could affect the demand forecasting that is critical for all facets of operations.



Conclusion. Risks behind the rewards

For all their promise, none of the advances we have discussed in this paper will come about seamlessly. Expanded use of AI and IoT, for example, creates cyber-security vulnerabilities. Such concerns are top of mind among the survey respondents when asked about IoT challenges, and when it comes to challenges specific to AI, cyber-security ranks a close second behind cost. Cyber-security concerns are also the most oft-cited challenge to supply-chain innovation, ahead of such issues as cost and technology integration.

Figure VIII. Intelligent hazards



Greater segmentation and faster design cycle times exert strong pressure on technology producers to reduce time to market, but Mr Simchi-Levi says that most supply-chain managers are familiar with such pressures and know how to address them. "Cyber-security, however, is an entirely different type of challenge," he says. "In my experience, most companies are at a basic level in terms of their ability to manage cyber challenges."

Prominent as such concerns are, cyber-security fears are not likely to inhibit the use of AI, IoT, robotics or other emergent technologies in these operational areas. Rather, vulnerabilities will be monitored and defences updated. For example, security capabilities are now being built into most IoT sensors, something that was not the case with earlier generations of sensors. Confidence in their cyber defences will also improve if universal IoT security standards can be agreed.

The greater challenge to such technologies' beneficial use is bringing about the business process changes needed to capitalise on them. For AI, IoT and even data analytics to provide the biggest benefits, co-ordinated changes in processes must be made by multiple business functions. This by itself portends closer integration in the future between those responsible for product design and manufacturing. The walls separating the two functions are certain to erode further.

Appendix. Survey demographics*



D1. In which country are you personally located?





*Not all questions add up to 100 due to rounding



D3. Which of the following best describes your title?







D4a. Within the technology industry, what is your company's primary sub-sector?

D5. What is your company's annual global revenue?



D6. Do you consider your company primarily a supplier or purchaser of technology hardware in the supply chain?



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