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White Paper

Innovation in Next-Generation Production Platforms

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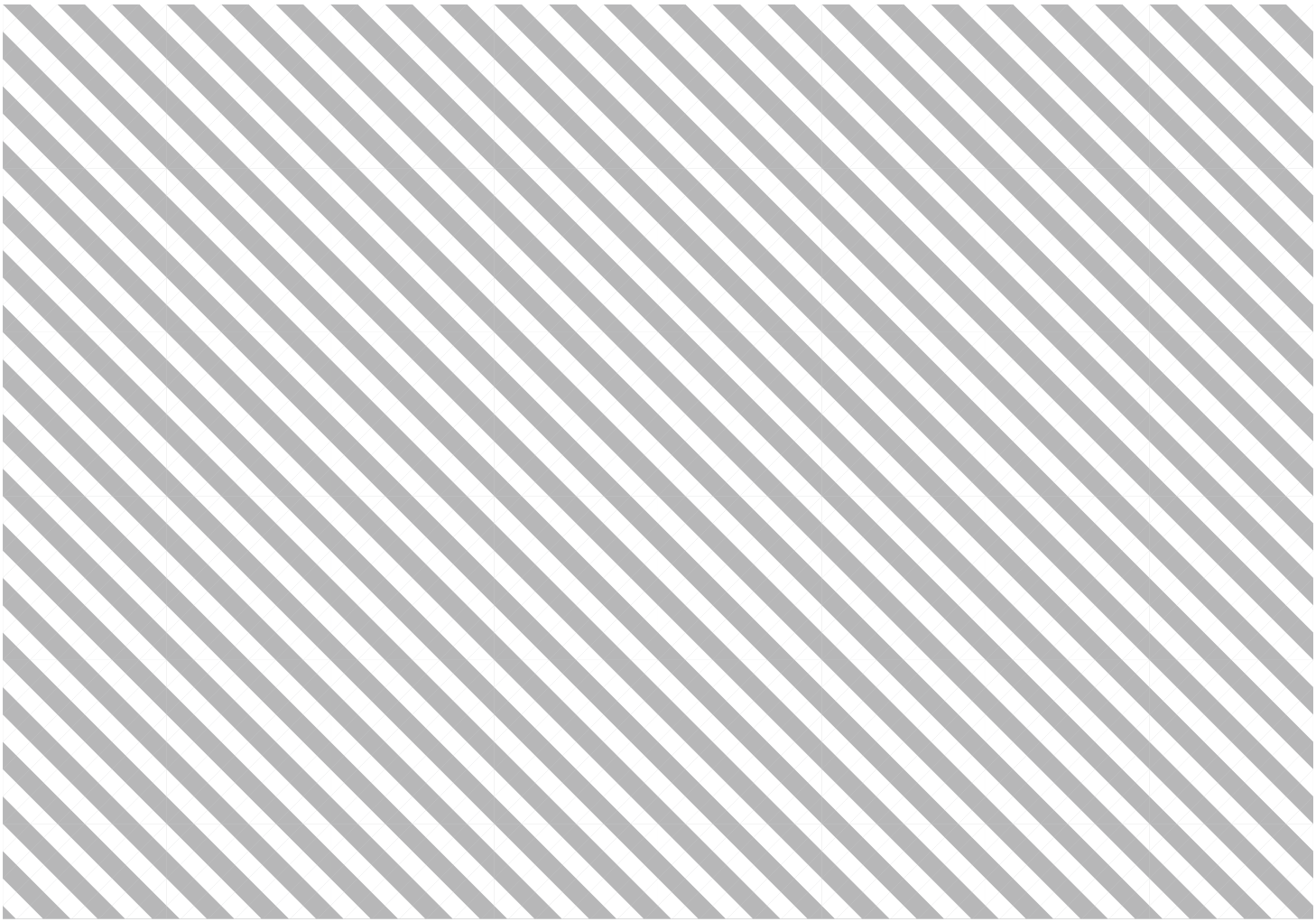

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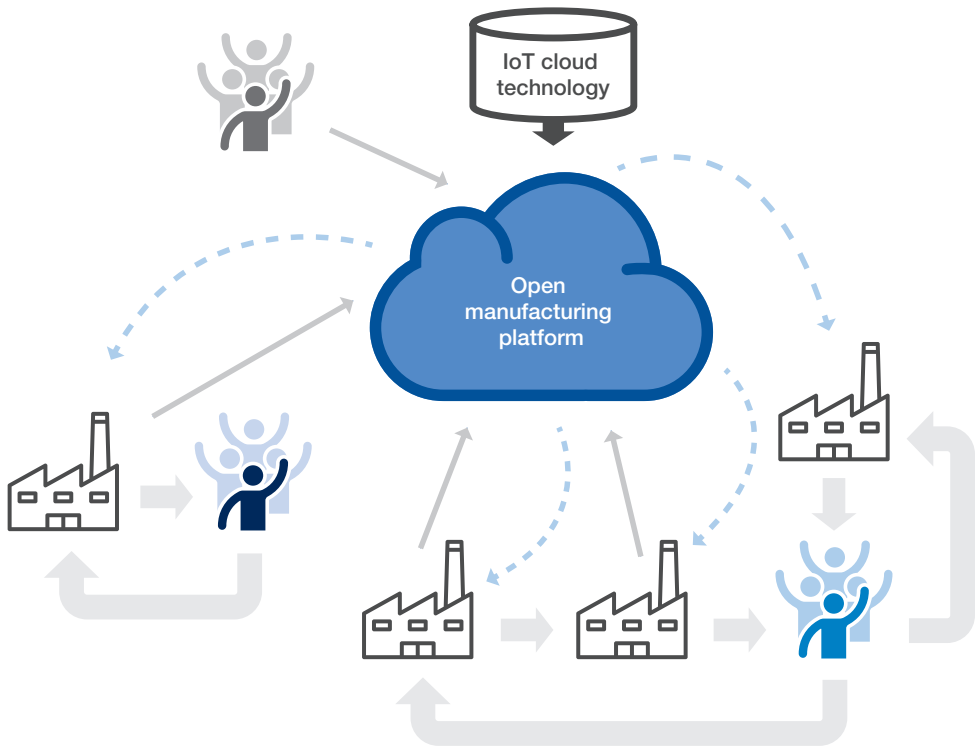
Manufacturing is entering the platform economy

The platform economy has disrupted many industries, but not manufacturing. However, next-generation production platforms are now emerging as the new delivery model for breakthrough innovations in manufacturing. A production platform is one in which multiple tiers of suppliers and many tiers of buyers, technology developers, value-chain providers and providers of complementary services are brought together using a common interface (e.g. digital web-based platforms, collaborative networks, co-located physical locations) to exchange ideas, knowledge, purchases, plans and expertise (see Figure 1).

For example, Hyperloop Transportation Technologies (HTT) is on a mission to change the world of public transport into one that is sustainable, seamless, inexpensive and fast. The firm is "crowd-powered", having over 800 professionals (including engineers, production planners, scientists, financial planners and artists) and 40 companies contributing on a part-time basis in exchange for stock, managed by a small staff of fewer than 40 people. This crowd platform has designed and deployed next-generation plans for a low-cost frictionless transportation system to construction firms, with R&D labs in Toulouse, France, production in-progress in the Middle East, and feasibility studies ongoing in more than 10 countries worldwide. It has a "fan club" of over 60,000 followers who provide HTT's management with the business opportunities to pursue. HTT provides the purpose, management structure, expertise and collaborative tools to encourage interactions among all of the relevant parties (from governments though to insurance companies) to discuss how to systemically improve public transport into the future. HTT is only one of many emerging examples of next-generation production platform models.

Another piece of evidence for the disruptive change taking place in manufacturing is the emergence of a number of semi-open internet of things (IoT) platforms. Many of these platforms are developed and offered by traditional manufacturers, including, for example, MindSphere by Siemens, ABB Ability by ABB, Predix by GE, Bosch IoT Suite by Robert Bosch, Foxconn4Tech open industrial IoT platform by Foxconn and ADAMOS (Adaptive Manufacturing Open Solution) by a joint venture of machine producers including among others ZEISS, Engel, Karl Mayer, DMG MORI and Dürr. Other platforms are offered by IT companies such as Watson IoT Platform by IBM, Oracle IoT Cloud Service, S/4HANA by SAP, Amazon Web Services by Amazon, ThingWorx by PTC and Google Cloud IoT. A case in point is BMW and Microsoft's joint Open Manufacturing Platform (OPM) that launched in 2019. OPM enables the creation of a cross-industry community that cooperates in an open technology framework. Powered by Microsoft's industrial IoT cloud platform Azure, the objective of OPM is to create an open cloud reference architecture based on open industrial standards and an open data model. While this initiative is still in its early phase, the move towards an open platform model can unlock great potential for innovation and drive productivity improvement for BMW and other companies that engage in this or other platforms.

Figure 1: Innovation in Next-Generation Manufacturing Platform



Characteristics of future production firms

Firms that take advantage of this emerging model have several characteristics. They are structured to be both lean and agile. They quickly integrate Fourth Industrial Revolution technologies to efficiently initiate and respond to shifts in the marketplace and displace existing product solutions. They follow a lean manufacturing model that allows just-in-time and quick delivery of customized products and services. When feasible, they use 3D printers to enable rapid tailoring to individual customer needs. They manage both design and production, since production increasingly requires tailoring to each customer's personalized context. Production and design tasks are undertaken cooperatively among partner companies depending on which is the "best of breed" at that point in time. They take advantage of data by converting data to information and gaining real-time transparency in their global operations. They increasingly rely on data-centric decision-making for new products, processes and managing workers. They use their platform partners to scout for new business, hedge against uncertain futures and source external innovations. They use the gig economy of external workers offering their unique talents for short periods to address specific production and design issues, such as software developers participating in hackathons. For example, HTT sourced contributors specialized in the biological effects of gravitational pull to offer suggestions for avoiding passenger discomfort when riding on high-speed tracks.

The platform business model allows these companies to serve as hubs of innovation. They provide artificial intelligence (AI), contractual frameworks, standards, collaborative tools and communities to aid combined efforts among partners. Instead of focusing on formal joint ventures, they concentrate on providing a common workplace and sandbox to innovate. They use open product innovation and open process innovation to stay at the cutting edge of performance. For example, Bosch hosted an analytics competition on Kaggle (a platform for data science competitions) and provided real data from a production line for 1,373 participating teams that helped to predict production failures.

Implications for future value chains and networks

Platform firms revolutionize how product and service delivery is undertaken through multi-layered supply chains. The conventional tier 1, tier 2, tier *x* supply networks observed in conventional ways during the innovation cycle are supplanted by direct engagement regardless of the tier. For example, tier 2 suppliers can step forward without their traditional tier 1 interlocutors, directly offering new structural components that may be either technically or commercially feasible. These disintermediation pathways are seen not just on the supplier side, but can also be observed at the customer end. For example, in the construction of high-specification maritime ships, vital functional equipment such as state-of-the-art thrusters are specified by the end client, who converses directly with the high-end equipment provider, to be incorporated by the shipyard during vessel assembly. This is not an altogether new phenomenon, as we are well aware of the "Intel" inside processors in PCs. However, what is new is that in, these new "multisided" production platforms, disintermediation is *promoted* by the prime manufacturer, whether in design, component equipment or subassembly. Therefore, next-generation production platform models are moving away from the largely closed and regimented tiered supply networks, where disintermediation is a rarity and generally discouraged, to open bidirectional networks.

Production platforms may also be structured as defined collaborative networks that bring together multiple production companies, technology providers and universities as part of a precompetitive collaboration model. These are often focused on more radical innovation outcomes not easily delivered by a single organization. While these networks exhibit similar patterns to the open innovation model, partners transact within a defined group activity, engaging with partner entities in a non-transactional manner. The collaboration consortium collectively draws in regulators and other external parties to drive transformational innovation. Notably, technology and business model innovations through the value chain are managed in parallel without the traditional stage-gate sequential process.

An example of this form of precompetitive collaboration model is the various GlaxoSmithKline-led pharmaceutical consortia, which include other primes (such as arch-rivals AstraZeneca, Novartis, Bayer), multiple technology providers offering competing technologies and strategic university partnerships, all focused on the move from batch to continuous production processing. Here, firms that would normally compete against each other and be fiercely protective of new intellectual property have come together to co-create future production models that offer radically new production scale flexibility and more responsive supply chains. The conversations with the UK health regulator, normally single-entity written submissions seeking formal go/no-go responses, are now undertaken collectively as an ongoing group dialogue redefining all aspects of quality assurance with the focus on outcomes rather than established procedure. Interestingly, the collaborating partners are able to develop further follow-on projects that progressively build the new platform capabilities, spanning the fundamental science research as well as the applied projects and demonstrators required to implement the transformation. It is common to have many partners in these projects as initial successes build momentum and trust, creating a powerful "flywheel effect". Here, the role of institutions such as innovation centres and universities is demonstrated by, for example: the universities of Strathclyde and Cambridge providing continuity, expertise and demonstration facilities on production technology and the future supply-chain platform; the UK medicine and health regulator proactively co-developing new regulatory frameworks; and the UK government providing co-funding and facilitating early adoption. The collaborating partners thus form part of the new environment required to drive commercialization of these new radical technologies.

Overcoming the hurdles

Despite the efficiencies and opportunities they provide, these platform models present many organizational hurdles. These include the management of intellectual property, building trust between partners, equitable value-share mechanisms, quality management and supply security. Within highly regulated environments, there are added complexities regarding product safety and liability. However, we can learn from emerging business models within the digital e-commerce sector where non-production companies have faced similar challenges: for example, in building trust between users, platform owners and product manufacturers. Exactly how production companies overcome these challenges, whether there is a next-generation maturity curve, the impact of these changes on the marketplace for workers, and the role, if any, of government policy deserves further attention. We suggest that in-depth case studies may help to address these issues.

A defining characteristic of next-generation business models in manufacturing is the merging of the physical supply network and the digital network. The companies that win are those that make strategic choices on what data to take advantage of, how, where and when this should take place, and how to effectively use their in-house and potential external workforces. Sharing data in the network enables profitable mining of data for some actors and feedback benefits for the companies that share. For example, machine users can share non-strategic data with the machine supplier, which can use AI algorithms to uncover hidden losses and new opportunities for product design and efficient machine operations. While these benefits can be small for each application, they quickly amount to a competitive advantage when adopted at scale in the firm.

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This white paper was prepared for the World Economic Forum Shaping the Future of Advanced Manufacturing and Production Initiative.

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