The Radical Technology of Industrie 4.0 ▶

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Industrie 4.0 illustrates the interconnected nature of standards and software technology.

When traveling, you quickly learn that the software industry has imposed a great uniformity upon the world. Around the globe, programmers tend to work in the same kind of offices, follow the same kind of schedules, and submit to the same kind of discipline. As we turn to the fields that are currently being influenced or reshaped by software, we find that standards play a role that's equal to or perhaps even greater than that of the software itself.

The German manufacturing movement, often called Industrie 4.0, illustrates the interconnected nature of standards and software technology. Industrie 4.0 is part of an industrial plan called *The New High-Tech Strategy: Innovations for Germany*, which was originally drafted in 2006 (www.bmbf.de/pub/HTS_Broschuere_eng.pdf). This report claims that we're in the midst of a fourth industrial revolution: "the Internet of Services."

This claim is questionable. The report asserts that the first revolution occurred in the 18th century and was driven by new textile technology, that the second occurred in the 19th century and was driven by the assembly line, and that the third occurred in the 20th century and was driven by computer-controlled machine tools. Few scholars doubt the importance of these technologies, but most would argue that technology was the effect, rather than the cause, of industrial change.

In the 18th century, high labor costs encouraged manufacturers to build factories and invent the tools of mass production. A century later, large cities encouraged industrialists to develop assembly lines and build large-scale supply chains. Over the past 50 years, global competition has spurred the rise of systems that allow managers to reconfigure factories quickly and cheaply to produce different items.

The expansion of trade agreements over the past two decades has made it easier to move manufacturing across national boundaries. The Industrie 4.0 plan responds to this global competition by reconceiving manufacturing as a service that operates in much the same way as cloud computing. According to an early report, "Industrie 4.0 will involve networking and integration of several different companies through value networks." These networks would allow factories to share assets as well as specifications, plans, and even control. Companies would be able to contract with factories for only the amount of manufacturing they need. The factories would then distribute the work in a way that produces the highest-quality goods in the shortest amount of time for the least cost.

Industrie 4.0 requires a substantial investment in new technology. According to German policymakers, it will rely on the expansion of flexible manufacturing systems, new support for the Internet of Things, faster broadband networks, more powerful data analytics, and more machine intelligence for factory control systems. Above all, to be successful, this endeavor will demand new standards that enable factories to share work.

It might seem contradictory that an industrial revolution would center on standards rather than novel technologies, yet standards have been foundational for all major changes in manufacturing technology. In the 18th century, English textile manufacturers would copy Arkwright factories whereas their American counterparts would adopt the Lowell system. In the early 20th century, factory engineers would go to Dearborn, Michigan, to study the Ford system. In the past 30 years, we have seen a rapid standardization of computing technology, from standard machine instruction sets, databases, and languages to standard communications protocols and procedures for developing software. Industrie 4.0 will require all of these standards and more.

We're likely in the middle of a two- or three-decade transformation of manufacturing (the one first articulated by German policymakers in 2006). This might indeed create manufacturing technologies that will be unrecognizable to today's factory engineers. If Industrie 4.0 is successful, it'll be because a global economy demands it and because we'll have been able to create the global software standards that made it possible. ◼

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