The Industrial Internet of Things: A boon for small and medium-sized manufacturers

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Nothing new, but certainly still worthy of emphasis: smaller manufacturers represent an essential and dynamic component of the U.S. manufacturing industry. In 2015, according to the U.S. Census Bureau, about 98.5% (247,961) of the U.S. manufacturing firms had fewer than 500 employees (187,862 of those, or over 75% of the total, had fewer than 20!), and represented over 44% of the total manufacturing employment. In the same year, 96.4% of manufacturing exporters were small – and medium-sized companies that contributed 20.3% of the sector’s $798 billion (€675.33 billion) in exports.

Smaller manufacturers matter a great deal for the industrial sector

While, in general, small and medium-sized enterprises (SMEs) constitute a vital force in the economy in terms of job creation, innovation and role in exporting, smaller manufacturers in particular also are an indispensable link in the supply chain of larger manufacturing companies, says Mary Bunzel and Alain Louchez.

A 2015 eye opening report from the executive office of the president and the U.S. Department of Commerce on Supply Chain Innovation: Strengthening America’s small manufacturers is quite explicit in this regard (pp. 3-4): “dense networks of small- and medium-sized manufacturers increasingly power the engine of America’s supply chains.

For much of the 20th century, firms were likely to design and build their own products using internally produced parts and proprietary technologies developed by their own employees. In recent decades, such vertical integration has become less common, with many firms focusing instead on a few core competencies and outsourcing other stages of production to suppliers, sometimes thousands of suppliers.”
As a result, whatever happens regarding small- and medium-sized manufacturers (SMMs) matters a great deal for the health of the manufacturing sector, especially when it comes to the adoption of advanced technologies such as “Industrial Internet of Things” (IIoT) technologies.

The U.S. Smart Manufacturing Leadership Act

Many terms like “Industry 4.0” “digital manufacturing” and “digital transformation” are used around the world along with IIoT to refer to the insertion of automation and interconnection technologies in manufacturing. The related Bills introduced in March and July 2017 in the U.S. Congress (S.768 and H.R.3240: Smart Manufacturing Leadership Act) propose a useful definition for the purpose of this article:

“The term “smart manufacturing” means advanced technologies in information, automation, monitoring, computation, sensing, modeling, and networking that— A) digitally— (i) simulate manufacturing production lines; (ii) operate computer-controlled manufacturing equipment; (iii) monitor and communicate production line status; and(iv) manage and optimise energy productivity and cost throughout production; (B) model, simulate, and optimise the energy efficiency of a factory building; (C) monitor and optimise building energy performance; (D) model, simulate, and optimise the design of energy efficient and sustainable products, including the use of digital prototyping and additive manufacturing to enhance product design; (E) connect manufactured products in networks to monitor and optimise the performance of the networks, including automated network operations; and (F) digitally connect the supply chain network.”

Recent reports such as MPI’s 2017 Internet of Things study on the production of smart devices and the implementation of embedded intelligence within plants, processes, and products of manufacturers around the world, and the PwC/Manufacturers Alliance for Productivity and Innovation (MAPI) survey on monetizing the Industrial Internet of Things note the acceleration of adoption of IoT technologies among manufacturers.

However, it is also fair to acknowledge that IIoT adoption is uneven among enterprises and the concern exists of a growing divide between the large “haves” and the not-so-large “have-nots”. Echoing this concern, one of the goals of the “Smart Manufacturing Leadership Act” is to provide SMMs with the same opportunity as their larger competitors in the adoption of smart manufacturing technologies and practices.
Digital transformation still in early stages among SMMs

Very tellingly, a March 2017 White Paper from the World Economic Forum on Technology and Innovation for the Future of Production: Accelerating Value Creation quotes a recent study of 4,500 German SMEs, which “found that fewer than 20% had heard of Industry 4.0, much less taken steps to implement it.”, say Mary Bunzel and Alain Louchez.

It is quite a finding when we recall that the very concept of Industry 4.0 was born in Germany! The World Economic Forum White Paper ominously adds “this highlights the challenge many countries will face in assisting their small and medium-sized producers to reap the value of technologies.”

A 2015 White House press release relays the same kind of observation: “because of the unique barriers they face, small manufacturers often lag their larger peers in adopting critical new technologies. For example, a recent survey found that fewer than 60% of small manufacturers were experimenting in any way with 3-D printing, a potentially transformative technology that is especially beneficial for small companies due to its flexibility. In contrast, over 75% of large firms were using the technology.”

Yet, SMEs have a lot to gain from exploiting IIoT technologies to generate cost-cutting efficiencies and new revenue streams.

SMMs tend to be highly specialised, offering skills larger manufacturers can’t afford to maintain. Deep domain expertise is key to the development of analytic algorithms necessary for compute at the edge, digital twin specifications and artificial intelligence – just a few elements of Industrial Internet of Things technologies.

This domain expertise in combination with natural agility that comes from more nimble corporate structures creates fertile incubation for truly disruptive market opportunities through leverage of IoT-based tools.

For instance, a journeyman boilermaker, having spent 30 years maintaining the steam supply to production facilities at a food processing plant made the decision to retire. But like so many deeply experienced professionals, he sought to share his extensive knowledge on the science of hydraulics and to stay involved in industry best practices. Teaming with a supply partner he had worked with in the past, he worked with data scientists at the partner firm to incorporate operational models for steam feeds, hydraulics and boiler conditions into mathematical algorithms the firm was building into their IoT Platform for Industry.

Using the knowledge of variable conditions affecting steam performance gained over 30 years, he was able to help the partner develop condition models of performance that became part of an analytic platform available through subscription to any company needing the expertise.

In June 2017, MForesight: The Alliance for Manufacturing Foresight (a national consortium established in 2015 to provide coordinated private-sector input on national advanced manufacturing technology research and development priorities) published a report on Ensuring
American Manufacturing Leadership Through Next-Generation Supply Chains. They argue that for US manufacturers “regaining a competitive edge requires a different approach to managing suppliers, one in which the total supply chain is managed to maximise value.”

As a result, “private companies, large and small, will need to reassess their approaches to supply chain management using the tools and best practices that have proven to be successful and that lay the groundwork for full implementation of next generation supply chains.”

The MForesight report stresses that not only U.S. suppliers are especially important to the overall health of domestic production since 80% of gross output is domestic content, but also that the role of small and medium-sized enterprises (SMEs) in supply chains is “critical to manufacturing success”.

What path forward for the SMMs?

As far as the SMMs that have not yet triggered the digital switch, it is paramount that they understand that they can benefit on two levels from IIoT:

1. Directly: advanced manufacturing technologies should facilitate the development of efficient and nimble operations that bring about substantial productivity gains.
2. Indirectly, as part of a broad supply chain: “after a small supplier lands a big purchase order or a contract from a bigger company, the small company’s revenues go up 250% and they create about 150% more jobs in just two or three years,” (SBA website).
   In this case, the SMMs’ systems have to mesh seamlessly with those of the large firm. In all likelihood, they will have to demonstrate the same (presumably high) level of automation and integration to ease their insertion within a bigger whole.

In the latter case, they will have to show, before anything else, than they can be “trusted”, i.e., they exhibit tight trustworthiness management capabilities. Such capabilities suggested by the National Institute of Standards and Technology (NIST) in its Framework for Cyber-Physical Systems (Release 1.0, issued in May 2016 and updated in June 2017), are cybersecurity, privacy, safety, reliability, and resilience.

Undoubtedly, many challenges lie along the way regarding the utilisation of IIoT technologies by SMMs, but they can be overcome. Recommendations on implementing capability upgrades are at the core of the recently introduced Smart Manufacturing Leadership Act and included in the above-mentioned Supply Chain Innovation and MForesight reports; some of them centered on established programs the likes of the Manufacturing Extension Partnership (MEP) and Manufacturing USA.

In addition, the use of cost-effective tools such as modeling, emulation, simulation or novel approaches such as gamification can assist in smoothing out the transition to an IIoT-framed production environment.

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