

THE EVOLUTION OF FACTORIES OF THE FUTURE

WHAT YOU NEED TO KNOW

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IPC recently convened a roundtable of electronics industry executives to discuss the current evolution of the industry's factories of the future. These executives, representing a cross section of the electronics manufacturing industry, discussed the factory of the future adoption process; the challenges surrounding the implementation of advanced manufacturing solutions; and factors that could contribute to a smoother transition moving forward.

In particular, the executives discussed how the current economic climate is influencing companies' decisions to adopt new technologies, as well as the importance of company culture and how it impacts the transition towards smart manufacturing solutions. Participants in the roundtable discussion also identified emerging workforce challenges, in particular the skills that are needed among employees as virtualization becomes more integrated on the factory floor. Executives agree that despite the challenges in transitioning to the factory of the future, they have recognized the value in doing so and are now looking to integrate solutions that will deliver measurable benefits to their company.

WHAT IS THE “FACTORY OF THE FUTURE”?

The “factory of the future,” also referred to as smart manufacturing, advanced manufacturing, or Industry 4.0, is a vision and set of supporting initiatives that would enable manufacturers to digitize and enhance their manufacturing operations and modernize plant communication. As [envisioned by IPC](#) for the electronics industry, the move to factories of the future is intended to technologize manufacturing processes in order to boost operational efficiency, improve product quality and reliability, increase competitiveness, minimize supply chain disruptions, and increase sustainability efforts. Some of the technologies associated with the factory of the future include AI-machine learning, real-time data analytics, and 3D design/simulation. Other technological trends, such as automation, the Internet of Things (IoT), digital twins, and big data, also play a large role in factory of the future initiatives.

Internet of Things

The Internet of Things, sometimes referred to as the Industrial Internet of Things (IIoT) in the context of manufacturing, represents the interconnection of machines and devices so that they may exchange information and data with each other. In other words, equipment connected to IoT platforms on the factory floor are able to communicate with each other and with the people who run them. This is accomplished through the use of sensors, software, and other supporting technologies. In an electronics manufacturing setting, IoT integration is extremely beneficial as it provides instantaneous information about various metrics within the manufacturing process such as production and quality metrics, energy consumption, and maintenance needs. Another application for using this information is to improve sustainability efforts. As regulations surrounding energy consumption and sustainability increase, IoT allows companies to easily collect and provide data to show they are in compliance or to identify processes that need to be improved. Alternatively, some IoT solutions, such as [IPC-CFX](#) (Connected Factory Exchange) can be used to predict equipment malfunctions, which can significantly reduce downtime.

Digital Twins

Another technology that allows for greater connectivity and virtualization throughout the manufacturing process is the digital twin. A digital twin is a virtual representation of a physical system, allowing for system simulation, testing, monitoring, and maintenance. Some benefits to utilizing digital twins are enhancing R&D efforts and predicting the lifetimes of components in critical systems. In particular, digital twins allow for perfect virtual replicas of physical systems, it is possible to develop new technologies without having to create physical prototypes.

The Data Imperative

The importance of collecting and analyzing data has become a focal point for businesses in all industry sectors. Companies are continually looking into ways they can leverage the data they generate to make better informed business decisions. The ability to collect data through technologies such as IoT and digital twins allows for in-depth analysis of manufacturing processes, which may lead to valuable insights including productivity and utilization levels, quality and reliability levels, and volume production delivery progress metrics.

Collecting, utilizing, and analyzing data is one way that the electronics manufacturing industry can capitalize on factory of the future solutions. As smart manufacturing solutions are increasingly being implemented on the factory floor, the amount of data being produced will also increase significantly. Being able to analyze and interpret large amounts of data effectively can dramatically improve productivity and efficiency. Companies can use data for predictive maintenance, for instance, in order to minimize equipment downtime. Moreover, analyzing data produced throughout the manufacturing process can also improve production yield.

With the emergence of new technologies and business procedures, manufacturing processes must not only be faster, but also more adaptive. Many of the technologies under the factory of the future umbrella allow for more timely alterations of manufacturing processes and business operations. In order to compete, companies must be able to predict and adapt to changes in near real-time. Adopting smart manufacturing solutions is a necessary step for every company that wishes to compete in the fourth industrial revolution.

CURRENT STATE OF THE FACTORY OF THE FUTURE

The executives who participated in IPC's roundtable discussed where they think the industry is today in terms of transitioning to the factory of the future. Participants largely agreed that executives and management teams have recognized the need to increase digitization but are often unsure how to proceed. Those who have made investments in advanced manufacturing solutions are now trying to leverage those solutions to the fullest extent.

For others, making any investment toward the factory of the future is a high hurdle, most likely due to not having the bandwidth to incorporate new systems and processes. One executive said it feels like "fighting a fire on both sides" as companies confront both supply chain disruptions as well as high attrition rates. Executives agreed that these circumstances induce general risk aversion, which in turn results in a reluctance to make significant modifications to their current processes. Consequently, investments in smart manufacturing solutions often sit on the back burner while executives instead try to find ways to do more with what they already have.

Roundtable participants also noted that there is a population of companies ready to take the next step towards automation and digitization but are unsure of what the end state looks like. Since there are a broad array of technologies and solutions available, it can be difficult to know which ones will be the most beneficial. One participant observed that when it comes to implementing new solutions, there is not a "one size fits all" approach. Rather, companies generally have specific areas they would like to improve and are therefore looking for a technology solution that will help them in that particular domain. Companies looking to adopt factory of the future technologies should first identify the key pain points that are unique to their operations and focus on solutions in those areas.



AN INNOVATIVE CULTURE FROM THE TOP DOWN

Executives agreed that company culture and openness to change is a significant factor affecting advanced manufacturing implementation. This sentiment is not unique to electronics manufacturing; it is echoed across many industries in which automation, digitization, and data analytics are being evaluated and implemented. Participants further agreed that the top executives within a company have the most influential role in establishing that culture of openness and adopting factory of the future initiatives. If the leaders of a company are not firmly committed to adopting innovative technologies, then it is unlikely to happen. As stated by one executive, “There must be individuals at the top of the company who are able to make decisions and advocate for the transition.”

The reality is, making the transition towards the factory of the future and implementing new solutions is time-consuming and costly. Having an empowered executive team that firmly believes in digitization and is willing to invest in technical solutions in order to gain the benefits will make the transition towards advanced manufacturing much smoother. This is especially true when the implementation of a certain technology or system requires workers to learn new skills or become familiar with new processes. Employees may not recognize the value-add to the company and may be reluctant to utilize new tools. In these scenarios, it is important that the company has an individual who is able to motivate employees throughout the adoption process.

Participants in the forum also observed the importance of trust between the lower and higher levels of the company. One executive observed that some employees may be wary of incorporating systems that provide more information to executives because it might not be completely representative of the work involved. Managers may look at the data and attempt to improve a process without fully understanding all of the relevant pieces. Thus, it is important for managers and executives to have confidence in their employees and the work that they do. Likewise, it is also important for employees to trust their managers to understand the data they see may not be fully representative of the process and work involved.



ADDRESSING THE SKILL DISPARITY

Current workforce trends also present challenges in transitioning to factories of the future. One of the most prominent pain points in the electronics manufacturing industry is a chronic shortage of skilled workers. Previous IPC surveys have shown that professionals in the industry attribute this shortage to competition with other industries as well as a general lack of awareness of the job opportunities that exist within the electronics industry. Executives participating in the roundtable discussion mentioned the importance of having competent workers who are able to acquire new skills. With the implementation of new technologies, workers must be able to adapt to a changing environment quickly.

Even among the skilled workers who are hired, a lack of digital skills can be an obstacle to smart manufacturing solutions. Most individuals entering the manufacturing workforce have little knowledge of data analytics. Thus, there is a skills gap among workers in the industry resulting in a missed opportunity to fully leverage the technologies in the factory of the future. Those who are able to collect, clean, and analyze the data often don't have the subject expertise to accurately interpret the results and apply them to the business at hand. Alternatively, those who possess subject matter expertise may not have good data sense. One executive remarked that these skills gaps may impede the implementation of data solutions. One step that companies can take to address this issue is to provide statistics and data analytics training and invest in the professional development of their existing workforce.

Although there is a shortage of skilled workers in the electronics manufacturing industry, adopting smart manufacturing technologies could attract interest among younger individuals entering the workforce. Some of the jobs [most sought after](#) by those entering the workforce, such as software engineers, mechanical engineers, and data analysts, are ones in which newer technologies are heavily integrated. By publicizing the ways they are implementing smart technologies, manufacturing companies may be better able to market themselves to potential applicants.

Workers are also increasingly looking for more flexibility in their jobs. Having the ability to work remotely or on a flexible schedule are features that more and more jobseekers are prioritizing in their search for work. Many companies have already noticed this shift and have responded to accommodate these trends. A recent IPC study showed that 53% of electronics manufacturing companies offer some type of flexible hours program, up from 47% in 2019. Additionally, 79% of companies allow telecommuting for employees whose jobs can be done remotely. Integrating smart technologies could further allow for remote work, making positions in electronics manufacturing more desirable to jobseekers.

LOOKING FORWARD

There are many challenges associated with the transition towards the factory of the future. However, there are some measures that company leaders can take to simplify the process.

- Industry executives agree that identifying critical pain points within their manufacturing operations is an important step to inform which solutions to implement first. By having a clear idea of how and why a technology or data solution is being integrated, companies can better prepare for the requirements that need to be met beforehand.
- Executives also agree that establishing a company culture rooted in adaptability and innovation is essential to be successful in the next industrial revolution. It is becoming progressively more important for executives to make constant changes to capture opportunities in production and workforce efficiencies.
- Leaders should also invest in the professional growth of their employees to ensure they are able to adapt to new technologies successfully.

Executives ultimately agree that although there are difficulties in transitioning to the factory of the future, it is necessary in order to compete in the industry.

For more information:

IPC offers many resources to assist and guide the electronics manufacturing industry through the next industrial revolution. For more information, visit: www.ipc.org/solutions/ipc-factory-future.

For information on IPC industry intelligence programs, visit: www.ipc.org/advocacy/industry-intelligence.

