Industry 4.0 Technologies

Industry 4.0 Market Research

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1 Industry 4.0 Technologies Background

The range of technologies that could significantly affect production and distribution is great. Technologies can complement each other in many ways. Today for instance, new software and advances in data science help to develop new materials. And new materials might soon replace silicon semiconductors with better-performing substrates, allowing more powerful software applications in turn. This combinatorial nature of technology implies that foresight is always tenuous. Indeed, retrospective analysis shows that predictions about technological timelines tend to be particularly inaccurate (Armstrong et al 2014). Nevertheless, many potentially disruptive production technologies are on the horizon. Underpinned by advances in various dimensions of digital technology, new production technologies will often be smaller, faster, more accurate, less expensive, more ubiquitous and more reliable than the technologies they supersede. A small sampling examined in this project includes:

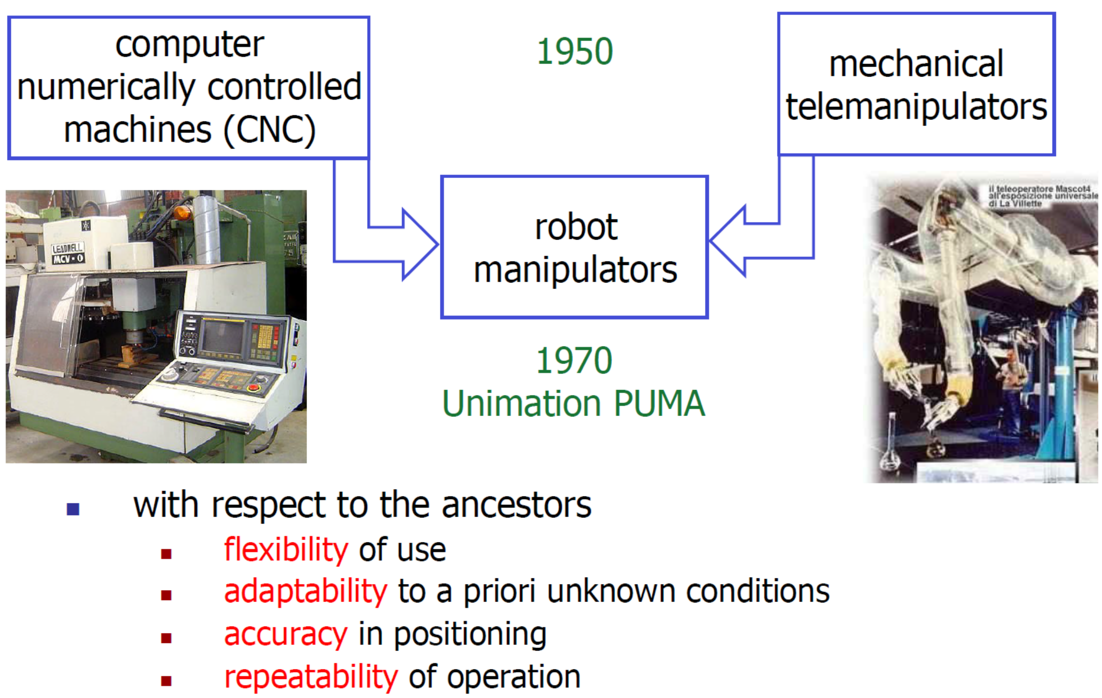
1. Powerful data analytics and large data sets which increasingly permit machine functionalities that rival human performance in tasks such as pattern recognition, where humans were long thought to possess a permanent advantage over machines.
2. Robots, which are set to become more intelligent, autonomous and agile.
3. An increased connectivity of parts, components and machines to the Internet.
4. Synthetic biology, which among other applications could allow petroleum-based products to be manufactured from sugar-based microbes, and which could bring the life sciences closer to engineering.
5. 3D printing, which already permits printing of complex objects (such as an electric battery) that embody multiple structures made from different materials.
6. Nanotechnology, through which new properties are being imparted to materials, making them stronger, lighter, more electrically conductive and more sieve-like.

2 The Forth Industrial Revolution Technologies

Industry and industrial processes are continuously evolving. The needs for competitive advantages in manufacturing have been historically the engine for the development of advanced and cost effective new mechanisms to manufacture. In this effort, and since the beginning of industrialization, from time to time, a technological leap takes place that revolutionizes the concept of industrial production, being referred to as industrial revolutions: First industrial revolution took place in the field of mechanization and steam engines; second industrial revolution was based in the intensive use of electrical energy and mass production; and third industrial revolution was founded in the IT environment and widespread digitalization.

We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society.

Figure 1 - Industrial Robots Evolution



The First Industrial Revolution used water and steam power to mechanize production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Now a Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres.

There are three reasons why today's transformations represent not merely a prolongation of the Third Industrial Revolution but rather the arrival of a Fourth and distinct one: velocity, scope, and systems impact.

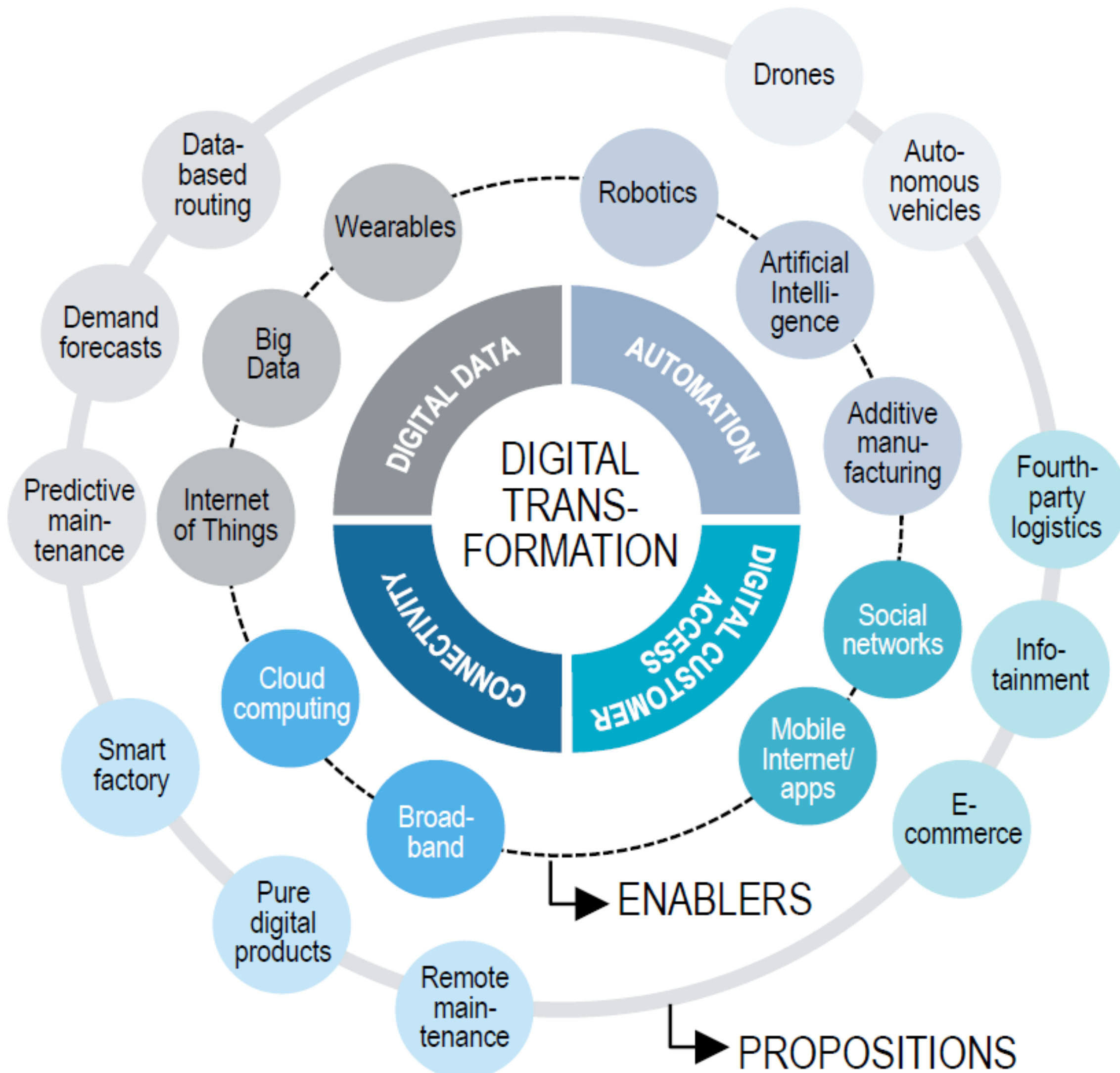
The speed of current breakthroughs has no historical precedent. When compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. Moreover, it is disrupting almost every industry in every country. And, the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance.

Table 1 - Next Generation Industrial Robots: Trends, Challenges & Technology Enablers

The Trends	The Challenges	The Enablers
Low volume high mix	Automation complexity and unpredictability	Collaborative automation for greater flexibility
Shorter cycles, faster launches	Shop floor disruptions and high engineering costs	Better software for engineering efficiency
Increased need for automation and scalability in SMEs	Lack of robot integration and programming expertise	Easier to use robots with more intuitive programming
Rising cost of downtime	Higher lifetime TCO due to increase in planned downtime	Advanced analytics and services for greater reliability
Increased and sporadic human intervention	Lost productivity to maintain safety	Collaborative automation to maintain safety and productivity

The possibilities of billions of people connected by mobile devices with unprecedented processing power, storage capacity, and access to knowledge, are unlimited. And these possibilities will be multiplied by emerging technology breakthroughs in fields such as artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing.

Figure 2 - Digital Transformation: Propositions & Enablers



Source: Roland Berger

The actual scenario of industrial production is stigmatic with a low predisposition for changes and unexpected situations. Production chains are characterized by static lines (with predefined sequences), which are hard to reconfigure to make new product variants. Today, regular situations of troubleshooting decrease or even stop production and lead to demotivation of employees. In conclusion, current industrial activity is rigid and difficult to change; innovations can hardly be afforded, reduction of raw material prices generally lowers quality and can increase process costs and in consequence, profit margins decline constantly.

There is also a great dependence on the in-house knowledge base, so when it drops, improvisation increases and development times get longer. Production systems although strongly automated, do not possess a self-conscious core to learn and act without constant human monitoring. All these inconveniences arise from the need for the next great revolution in industrial manufacturing which will lead to several enhanced attributes in comparison with actual production activities.

For this new revolutionary industrial age, there is a concept that keeps being repeated which can be narrowed into the self-consciousness of technology. An attribute that is directly linked with what artificial intelligence (AI) aims to achieve: The creation of systems that can perceive their environment and consequently can take action towards increasing the chances of success.

But the trigger for the new industrial revolution is based in two great pillars; the already described fixed industrial scenario that is not ready for unexpected changes in production, which adds up with another reality, which is that the forms of consumption are changing. Nowadays, producers want to focus into almost individualized demands in their efforts to reach every potential client, hence tomorrow's industry will need to provide a dynamic production line, where not only products are made, but a combination of product + service is offered to gain advantage against their competitors and driving production to constantly changing environments. To achieve this, the degree of automation should move to the next level, where sensitive computing and taking information from the environment should be able to predict next steps in production with barely any interaction with the user in the same way that artificial intelligence can work.

For this reason, under the intention to adjust to more flexible production schemes and increase the ability to compete, it can be said that we are in the prelude of a new paradigm shift in industrial production: Every step in the industrial process generates data (energy consumption, speed, power, weight etc.). Hence, once an advanced digitalized network in factories that monitors this information is established, the next logical step leads to the combination of internet technologies and "smart" objects to interpret this huge flow of information towards an advanced form of manufacturing, where, for example, it would be possible to foresee the need for preventive actions and adapt production before it happens.

Advanced manufacturing technology is then a term that refers to a set of highly flexible, data-enabled, cost-efficient processes. In other words, the implementation of modular and efficient manufacturing systems in scenarios where products control their own manufacturing process, embedded in a futuristic environment where machines, products, humans and systems are able to communicate with each other and make decisions related with the process itself, adapting to new situations, being able to automatically detect anomalies or requirements, and acting in consequence.

An example of what this fourth industrial revolution is planning to achieve in manufacturing environments, can be seen in a common object like the "airbag" from vehicles, which is one of the first developed systems that behaves as a self-conscious entity; that in front of a sudden and new problem (a crash) is able to detect by themselves, the need for actuation. And precisely the advance in fields like artificial intelligence, nanotechnology, robotics or additive manufacturing is the starting point for the development of more examples of flexible and adjustable operation of machines.

Under this hypothesis, the term industry 4.0 (or fourth industrial revolution) would not only imply a technological change, but versatile organizational implications as well. As a result, a change from product to service orientation is sought and expected: manufacturing and service industry will become complementary, encouraging a new form of production that some have labeled as servitization: “Servitization is the strategic innovation of an organization´s capabilities and processes to shift from selling products, to selling an integrated product and service offering that delivers value in use. Here the market goal of manufacturers is not one-time product selling, but continuous profit from customers by total service solution, which can satisfy unmet customers´ needs”.

Although complete development and employment of these technologies are still years ahead of us, first steps have already been taken towards the implementation of some of these measures, in order to achieve a more intelligent and efficient way of developing different industrial objectives. The journey towards a flexible, heterogeneous, decentralized, standardized, and self-aware production system has started, and as a consequence have all the revolutionary aspects associated with industry 4.0.

3 Industry 4.0 Manufacturing Technologies

Industry 4.0 is a new area where the Internet of things alongside cyber-physical systems interconnect in a way where the combination of software, sensor, processor and communication technology plays a huge role for making "things" to have the potential to feed information into it and eventually adds value to manufacturing processes. Industry 4.0 ultimately aims to construct an open, smart manufacturing platform for industrial-networked information applications. The hope is that it will eventually enable manufacturing firms of all sizes to gain easy and affordable access to modelling and analytical technologies that can be customized to meet their needs.

The concept Industry 4.0 is best defined by the project’s “smart factory” through the merging of the virtual and physical worlds through cyber-physical systems and the resulting fusion of technical and business processes. The industrial manufacturing life cycle becomes orientated towards the increasing individualism of customer requirements and encompasses: the idea and the order for development and production, the distribution of products plus recycling, and furthermore including all related Services. The interconnection of humans, objects and systems leads to dynamic, real time optimized and self-organized inter-company value creation systems which are evaluated and optimized using criteria such as costs, availability and resource efficiency. Industry 4.0 emphasizes the idea of consistent digitization and linking of all productive units in an economy. There are several technological areas that underpin Industry 4.0, which are horizontal and vertical system integration, the internet of things, Cybersecurity, the cloud, big data analytics, simulation, additive manufacturing (3D printing), augmented reality, and robot.

In Industry 4.0, the horizontal and vertical system integration among companies, departments, functions, and capabilities will become much more cohesive, as cross-company, universal data-integration networks evolve and enable truly automated value chains. The Industrial Internet of Things will also enrich more devices with embedded computing and will be interconnected using standard technologies. This allows field devices to communicate and interact both with one another and with a more centralized controller, as necessary. It also decentralizes analytics and decision-making, enabling real-time responses.

Reliable communications as well as sophisticated identity and access management of machines and users is important for industry 4.0 to address the issue of Cybersecurity threats which increases dramatically with the increased connectivity and use of standard communication protocols.

As the performance of technologies improves, machine data and functionality will increasingly be deployed to the cloud, enabling more data-driven services for production system. More production related undertakings in Industry 4.0 will require increased data sharing across sites and company boundaries.

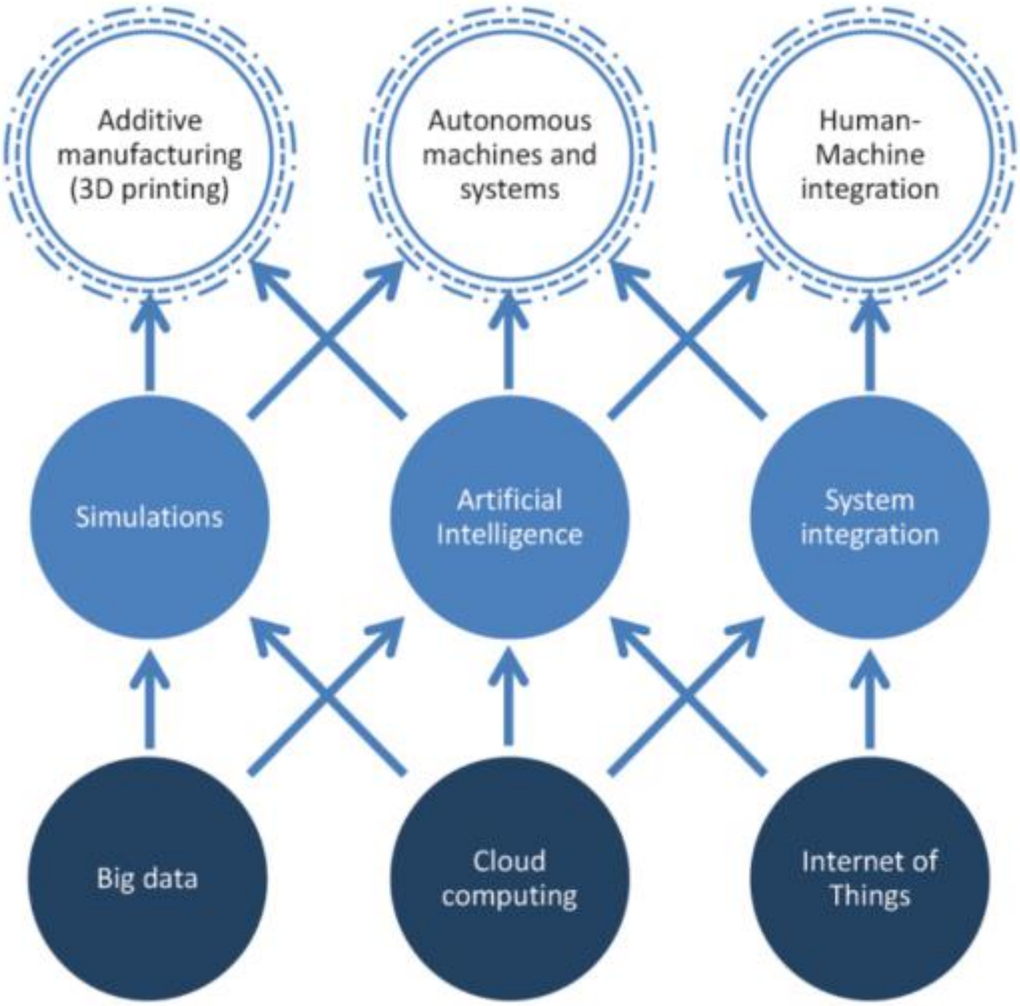
Big data and analytics enables the collection and comprehensive evaluation of data from various sources and customers to support real-time decision making, optimizes production quality, saves energy, and improves equipment service.

Simulations will leverage real-time data to mirror the physical world in a virtual model, which can include machines, products, and humans. This allows operators to test and optimize the machine settings for the next product in line in the virtual world before the physical changeover, thereby driving down machine setup times and increasing quality.

Additive manufacturing methods will also be widely used in Industry 4.0 to produce small batches of customized products that offer construction advantages, such as complex, lightweight designs. High-performance, decentralized additive manufacturing systems will reduce transport distances and stock on hand. Though the systems are still in infancy, companies will make much broader use of it towards industry 4.0.

Augmented-reality-based systems can support a variety of services, such as selecting parts in a warehouse and sending repair instructions over mobile devices.

Figure 3 - The Confluence of Key Technologies Enabling the Industrial 4.0 Digital Transformation



Robots are becoming more autonomous, flexible, and cooperative. Eventually, they will interact with one another, work safely side by side with humans, and learn from them. These robots will cost less and have a greater range of capabilities than those used in manufacturing today.

4 Cyber Physical Infrastructure (CPS)

The Cyber Physical Infrastructure (CPS) is the final responsible for the management and analysis of the information sent by these interconnected systems between its physical assets and computational capabilities; while the advanced connectivity network integrated in the IoT must ensure real time data acquisition from the physical world, as well as posterior information feedback from the cyber space. These capacities allow self-comparison between present and past states, and assist in the decentralized decisions of recommended course of action, making machines self-configure and self-maintainable. The structure of a CPS can be divided in different levels to make machines self-aware and self-adaptive: Smart connection level (gathering of all information); data-to-information conversion level (extract the relevant information); cyber level (includes the virtualization hub to exchange information through other cyber interfaces); cognition level (where optimization decisions take place); and configuration level (for feedback deployment).

5 Industry 4.0 Big Data and Cloud Computing

Fundamental concepts for industry 4.0 are Big Data and cloud computing, which creates a medium that can handle all the managed information by CPS and IoT. Huge amounts of information are expected to be stored and processed, so later on can be accessible from anywhere at any time. Thus cloud computing constitutes an optimum solution for storage performance, as well as Big Data analysis aids in the management of the information. The capacity to support and control big flows of information is one of the most important applications of industry 4.0, which relies on the maintenance of artificial intelligence networks supported by digital product memories, translated into the collection of all data records for all data stages during the product life cycle, and for posterior analysis that could lead to newer and innovative methodical approaches for planning and development of products.

6 Augmented Reality, Simulation & Visualization

Every decision, whereas it is related with logistics, manufacturing or future changes must be sustained in well-founded arguments. Industry 4.0 technologies will ease the deployment of simulation scenarios where different configurations can be tried and tested before their actual implementation, thus allowing the implantation of more complex systems. Simulation of how changes can affect process behavior is a huge benefit towards the prediction of how these resources or services will impact final value added for end users. Again, artificial intelligence can provide the means for simulation in every stage of the life cycle of a product (from model and design, to functionality prediction).

One example of this application may consist in the development of newer methods of modeling and reference models, like integrated computational materials engineering (ICME), where the performance of design materials and dimensions can be tested before construction of the element. However, this pillar of industry 4.0 does not only refer to product properties, being possible as well the implementation of virtualization technology that creates complete digital factories which can simulate the entire production process, in order to optimize layout disposition. This is especially useful for launching new products in already existing plants; by first simulating and verifying virtually the consequent impact in production and human-machine interactions; and only when the final solution is ready, the physical map is done, meaning that all software, parameters, and numerical matrixes are uploaded into the physical machines controlling the production.

7 Industry 4.0 ICT

7.1 Industry 4.0 Enterprise Resource Planning (ERP)

The common impression is that enterprise resource planning (ERP) is based on the early functions of the systems. For example, an early function included manufacturing resource planning which was designed to tackle a specific business process such as managing the mass production of standardized goods on assembly lines.

ERP was initially based on industry and manufacturing and geared predominantly to mass production, an inflexible process that limits the variety of products available to consumers. In mass production, the products produced in one production line are identical, thus making it very difficult to introduce variety and range to satisfy diverse needs. This type of manufacturing was in direct opposition to customization, a more expensive proposition. Mass production lends itself to only a limited amount of customization, and only when the customer is willing to make it worthwhile for the manufacturer/producer. A minimum order threshold needs to be reached for a new line in order to cover starting costs.

7.2 ERP 4.0

ERP in today's competitive and global marketplace must adapt to the demand for a leaner manufacturing process, as well as more sharing of information between the manufacturing floor and business systems, in order to achieve new levels of efficiency. ERP providers are obliged to take into account innovations such as the Industrial Internet of Things (IIot), which is revolutionizing manufacturing by leveraging intelligent, connected devices in factories. Better data and process integration are providing even more opportunities to fine-tune their operations.

ERP systems are known for their ability to manage large amounts of transactional and operational information. This data is typically used to forecast short- and long-term production needs. Today's on-demand consumption models paired with customers' desire for highly customized products require real-time or live data. There is enormous potential for real-time information exchange between the business layer and the production layer that could increase operational efficiency and enable organizations to become more flexible and responsive to customized and changing demands.

Major technological advancements such as cloud computing, the Internet of Things (IoT), cognitive computing and robotics – to name a few – enable ERP to assist manufacturers with just-in-time data. Live data insights can be applied to production strategies that cater to an on-demand consumption model.

Customer behavior data constitute the new fuel that drives the manufacturing production line and shop floor management capabilities of an ERP. However, analyzing customer behavior data and translating it into machine configurations requires powerful and precise data collection as well as powerful analysis technology. On one hand, ERP must analyze Omnichannel customer data — this includes physical and virtual customer touch points monitored with online and in-person data collection tools such as social media listening, website analytics, transaction history and sensors. On the other hand, ERPs must keep track of and analyze data from industrial machines empowered with sensors, software and internet connectivity.

The goal is for ERP to play a principal role in sustaining flexible production processes that can transform actionable customer insights into tangible personalized products. For instance, instead of bringing components and parts to the assembly line in a standardized manner that produce hundreds or thousands of identical goods, ERPs can indicate certain sequencing of parts that results in customized configurations of products for individual customer needs.

One of the principal benefits of ERP is that it helps companies track the profitability of their business model. In a nutshell, ERP manages all the costs and revenues of a company. It includes capabilities that capture sales, purchasing, or warehouse management information. ERP 4.0 has the ability to document operations and transactions more accurately, thus providing companies with an even clearer picture, with less cost and revenue errors.

For example, ERP 4.0 helps manufacturers to better track utility costs such as electricity and water consumption by breaking it down to how much each piece of equipment consumes at every location. In addition, ERP tracks the effectiveness and productivity of each piece of equipment. In other words, it tracks how much each piece of equipment contributes to the creation of revenue. Cost and revenue data collected at this very granular level are converted into accounting logic which in turn, calculates the profitability.

7.3 Quality Management ERP 4.0

Quality management is essential for companies because it allows them to respond to issues of recall proactively. This limits the negative impact that recalls can have on both customer satisfaction and the bottom line. But in order to pursue this strategy effectively, management requires a substantial amount of data. ERP 4.0 helps companies identify manufacturing issues across the entire supply chain because it gives companies total visibility into the manufacturing facilities involved in their supply chain. Consequently, when production or delivery needs to be stopped, ERP 4.0 makes it easier to set things back on track by cutting setup times for machines, thereby quickly adjusting schedules and shop floor operations. For highly sensitive products like food and chemicals, production can be stopped or adjusted as soon as a problem occurs. Since stopping a production line is very disruptive and costly, adjusting batches by changing the mix of ingredients is the preferred option.

Additionally, all the data collected on product quality can be used to create forecasts and simulations of possible future challenges. Simulating recall events can lead to improved corrective actions and lower costs.

7.4 Supervisory Control and Data Acquisition (SCADA)

SCADA stands for Supervisory Control and Data Acquisition and describes a computer system with which technical processes can be monitored and controlled in automated production. SCADA is located in the process control level of the automation pyramid or the OSI layer model. SCADA collects and processes measured data from the lower levels of automation pyramids (usually sensors, switch positions, etc.) and thus allows manual or automated control and optimization of the production processes according to the target parameters.

Communication takes place via point-to-point connections and field bus systems as well as - in the course of industry 4.0 - on the basis of TCP-based Internet technologies. Generally, proprietary protocols are prevailing, which are dependent on the manufacturers. However, the Modbus protocol also attempts to establish an open and universal form of communication that facilitates the further exchange of data with other systems. The trend towards data transmission using TCP-based techniques has also opened up automated production and made it vulnerable to cyber threats.

8 On-Demand Industry 4.0

Industry 4.0, more so than its predecessors, is poised to address the emergence of an on-demand economy. So, can Industry 4.0 be interpreted as a tool for manufacturers to respond to a consumer base that has rapidly changing demands and expectations? It is no longer just about the production of goods at the lowest cost, but also about producing those goods with speed and flexibility in order to meet the consumer's continually short-lived expectations and desires.

Currently, we are witnessing a strong shift in customer behavior and expectations, which in turn, is creating a radical long-term change in the relationship between customers and companies. Central to this customer revolution is the rise in power of the "social customer." The web as well as social technologies has facilitated obtaining more information with greater ease. Because of this, customers have a much greater say over the flow and control of this information, their products and their services. Social customers are no longer satisfied with the corporate response to their issues; they want and expect genuine engagement with the company. This significant change is contributing to the transformation in manufacturing from a mass production model to an on-demand production model.

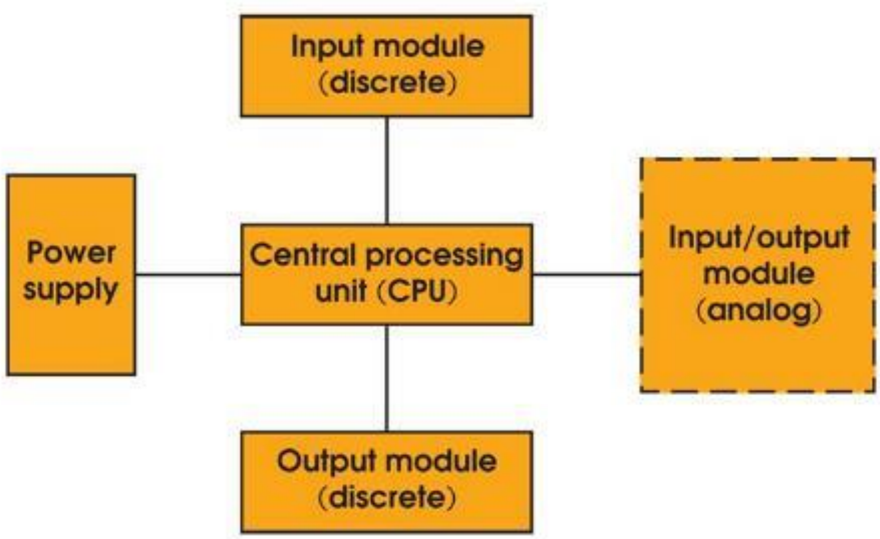
More so than in the past, customers have a greater impact on how companies plan production, as their demands can be heard loud and clear — a result of cloud, mobile and social technologies. Clients are no longer in a position where they have no choice; rather, they're in a position to inform themselves about the various options available and can exercise choice and discretion before making a purchasing decision. This is the overarching environment that has produced the on-demand economy.

9 Programmable Logic Controller (PLC)

A programmable logic controller (PLC), or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines or robotic devices or any activity that requires high reliability control and ease of programming and process fault diagnosis.

They were first developed in the automobile industry to provide flexible, ruggedized and easily programmable controllers to replace hard-wired relays and timers. Since then, they have been widely adopted as high-reliability automation controllers suitable for harsh environments. A PLC is an example of a "hard" real time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

Figure 4 - Programmable Logic Controller Block Diagram



9.1 Distributed Control System (DCS)

As it was said before, the combination of hardware and software into smart embedded systems will be greatly resting in AI applications. However, sometimes those smart devices are generally referred to as a whole scale with blurred barriers, where it is difficult to establish when one element ends and the other starts.

For example, during the first years of development of this concept, IoT was proposed to refer to just uniquely identifiable interoperable connected objects with radio-frequency identification (RFID) technology. Later however, as the connectivity of these networks were getting bigger by including modern technologies and concepts, the term grew with it to include all the innovations, applied to measure, identify, position, track and monitor objects, referring now to IoT more as a dynamic global network where self-conscious objects connect with each other. In this new context where CPS can be considered the proper “brains” inside industry 4.0, one way to establish some frontiers can be to consider IoT as the global framework where identification and sensor technologies become integrated with interpretation technologies like CPS. In other words, CPS forms part of IoT´s new step towards its development, with the help of ICT elements to guide the autonomous communication between all of them. Next paragraphs will depict the most relevant parameters in this established network by IoT and CPS that constitute the embedded system; including sensory equipment, their communication protocols through software architecture, standardization languages for the gathered information, big data management, cloud computing and middleware connectivity, or architecture guidelines for construction of CPS.

10 Industry 4.0 Standardization Languages

Information can be provided from different sources in the network, whether it is measured by sensors, controllers or manufacturing systems such as ERP. One of the first steps in the development of the network is to acquire this data in a reliable way and interpret it. However, considering that the different sources may give different types of data, there is a need for a seamless method that can manage the acquisition of information, the connection between various types of networks through various communication technologies, and the transformation into a final uniform type of data to be sent to the central server. For these matters, specific protocols such as MTConnect, OPC or ROS are effectively useful.

In the same way, machines and robots in industry 4.0 must ensure as well certain level of standardization and trustworthiness in the management of information, so it can be integrated with other branches within the same industry and with other industries and industry types; in order to extract conclusions from hypothesis of how is the best way to support different types of plant with information technology. In conclusion, standardization methods must be sought and implemented to support heterogeneity at architectural and protocol levels, where artificial intelligence is necessary not only for the interpretation of different languages, but for the transmission of the main conclusions to users in an accessible way.

This idea is linked with innovative concepts for manufacturing execution systems (MES) or enterprise resource planning systems (ERP) that can complement the shift towards new business models, where products become modular and configurable in order to be able to adapt to specific requirements. Nevertheless, this task would include a very complicated heterogeneous network, and that is why there is still lack of a widely accepted common platform that can embrace the large heterogeneity of communication technologies. In addition, the large traffic of data at the same time would also cause delay and communication issues.

11 Visual Intelligence

In order for industrial automation systems to meaningfully interact with the objects they're identifying, inspecting and assembling, they must be able to see and understand their surroundings. Cost-effective and capable vision processors, fed by depth-discerning image sensors and running robust software algorithms, continue to transform longstanding industrial automation aspirations into reality. And with the emergence of the Industry 4.0 "smart factory," this visual intelligence will further evolve and mature, as well as expand into new applications, as a result becoming an increasingly critical aspect of various manufacturing processes.

Computer vision-based products have already established themselves in a number of industrial applications, with the most prominent one being factory automation, where the application is also commonly referred to as machine vision. Machine vision was one of the first, and today is one of the most mature, high volume computer vision opportunities.

12 Industry 4.0 Technologies: Conclusions

Industrial environments are currently setting the foundations for a new shift in the production and manufacturing processes, drawing away from static production chains, to a more flexible, individualized and efficient idea of production. The base of this revolution is settled in the combination of hardware and software components towards a more intelligent, self-conscious, self- configurative and self-optimized structure that can foresee problems and launch preventive actions to minimize stopping times during production; and to understand the whole lifecycle of the production process in order to be ready to respond to new and continuously changing environments. Four main challenges rise in this revolution:

- Energy and resource efficiency
- Reduce time-to-market
- Increase flexibility towards an almost individualized mass production
- Upgrade Existing Infrastructure

There are different variables that configure the embedded systems that influence the new, flexible, standardized, decentralized, heterogeneous, innovative form of production, where processes are more client-focused and more resource efficient The main tools are cyber physical systems, the internet of things, big data and cloud computing (with the entire required infrastructure to support them); and other complementary elements like autonomous robots, simulation and virtualization models and additive manufacturing. In these embedded systems, information gathered by different sensors and devices is interconnected and communicate with each other based on the compilation, process, and analysis of this great amount of data by smart objects, to take decentralized decisions towards optimization of the production. Although this idea as a whole is still in its first steps of development, some possible applications are already being identified and tested in domains such as transportation, food supply chain, logistics, environmental monitoring, prototypes domain or industrial activities.

This situation gives form to a broth of several ideas and technologies where artificial intelligence may have a perfect niche for its thriving and implementation in the industrial environment, since its applications can give answers to different questions and possibilities within each one of the main pillars in which industry 4.0 will be structured.

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