



White Paper

The 4th Industrial Revolution: Opportunity and Imperative – Evolution for Some, Revolution for Others

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November 2015

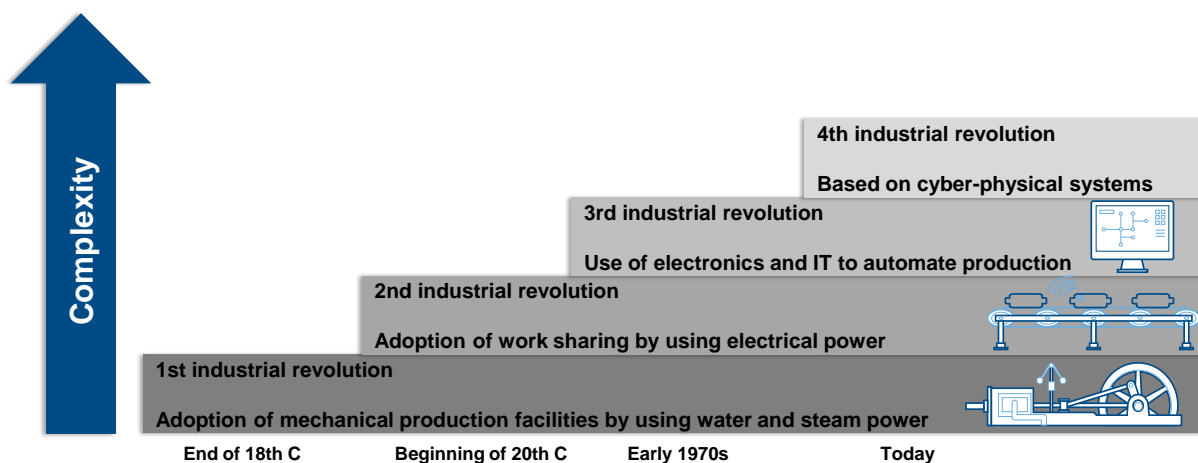
IN THIS WHITE PAPER

Business leaders today face the challenge of moving their enterprises to the next level, that of digital business transformation and revolution – coupling digital technologies with organizational, operational, and business model innovation to create new ways of operating and growing the business.

The "4th Industrial Revolution" enables enterprises to drive changes in their business models and ecosystems, leveraging digital competences and facilitating accelerated revenue and profit growth going forward.

FIGURE 1

The Industrial Revolution



Source: IDC Manufacturing Insights, 2015

What Drives Industrial Revolutions?

The Industrial Revolution was inspired by a transformation that occurred in the late 18th and early 19th centuries in the U.K., the U.S., and Western Europe, due in large measure to advances in technology.

Industrial revolutions have been inspired by human behavior and changes in institutions due to genetic change, changes in value, and changes in worldview.

At every stage productivity, innovation, and transfer of knowledge accelerated sharply beyond what came before. All previous revolutions were inspired by what people were able to achieve; the previous revolutions led to transformational change opportunities allowing enterprises to change what they do as well as how they do it. Industrial revolutions have been a stepping stone in the evolution of the world enabled by technology.

The Past

In the period since the world began to switch from rural and agrarian to urban and industrial societies, the Industrial Revolution has gone through three phases:

- **Mechanization:** the 1st Industrial Revolution was based on the introduction of mechanical production equipment driven by water and steam power.
- **Electrification:** the 2nd Industrial Revolution was based on mass production achieved by the division of labor concept and the use of electrical energy.
- **Digitalization:** the 3rd Industrial Revolution was based on the introduction of electronics and IT to further automate production.

The Future

A fourth industrial revolution is about to begin and is all about connectivity and digital transformation (DT). There are lots of terms for it – Industry 4.0, Factory of the Future, Digital Manufacturing, Smart Manufacturing, Advanced Manufacturing, Cyber Physical Manufacturing, the Internet of Things – but it's all the same.

Our vision of the 4th Industrial Revolution is as follows:

- The Internet of Things, Services, and People: cyber-physical systems (CPS) facilitate the vision, create a virtual view of the physical world, and let things, people, and service communicate in real time. It is time to make factories smarter and to unlock the full potential. It's time for a new supply chain organization and new management across the holistic product life cycle.
- The drivers and the industrial stage: extensive use of the Internet (the Internet of Things) is evolving from person-to-person to machine-to-machine to the ubiquitous connectivity of objects-to-objects. Smart products are uniquely identifiable at all times, and know the details of their own manufacturing process. Product information can be pooled to optimize the "smart factory" in terms of logistics, deployment, and maintenance.
- Individualized products: by implementing the technologies of the 4th Industrial Revolution, organizations will be in a position to incorporate individual customer-specific features into the design, ordering, planning, production, operation, and even recycling phases. Smart devices are turning into smart products turning into smart factories. Organizations need to get connected, get insights, and get optimized.

The Design Principles for the 4th Industrial Revolution

Interoperability

One of the key enablers and design principles of the 4th Industrial Revolution is about connecting and being connected, which will require a different level of standardization. Thanks to the new CPS open standards, people and smart factories will be able to connect and communicate to each other via the Internet of Things and the Internet of Service. This new and fast way of communication will be essential for successful and innovative manufacturing going forward.

Virtualization

The virtualization of processes and supply chains is providing real-time access to the required and relevant information about production, people, processes, and products within the entire organization. Embedded systems throughout the supply chain are enabling a virtual copy of a smart factory that is created by linking sensor data (from monitoring physical processes) with virtual plant models and simulation tools. In case of failure all those concerned are notified, with the embedded systems enabling employees to handle the complexity and optimize intercompany operations.

Decentralization

Rigid, centralized factory control systems are starting to give way to decentralized intelligence as machine-to-machine communications begin to hit the factory floor. The ability of CPS within the smart factory to make decisions on their own, like modular simulations and modular techniques, allows decentralized units to flexibly alter products and thereby facilitate rapid innovation. The rising demand for individual products makes it increasingly difficult to control everything centrally. Being able to make individual decisions is critical while maintaining holistic control and traceability, keeping track of the whole system anywhere anytime.

Real-Time Capability

Real-time context integration, rather than analyzing several months of data and performance rates (the ability to collect and analyze data, and provide insight immediately), will be a revolution in support of organizational tasks. The fact that data on machines and plant performance will be collected and analyzed in real time will allow organizations change automation processes and production systems. The factory will be able to react quickly in case of failure, continuous improvement becomes the standard, and key performance indicators will exceed previous records.

Service Orientation

Shorter product life cycles, shorter time to market, and quickly designed and deployed product line extensions and innovations all require a real-time service-oriented architecture. Next-generation manufacturing systems will be built with flexibility and reconfiguration concepts. The services (cyber-physical systems or smart factories via the Internet of Services) will allow organizations to set up product-specific processes to reflect specific customer required attributes. This will create an agile production approach that will be able to handle last-minute customization.

Modularity

Modularity is about being more flexible, being able to adapt to changing requirements, to build quickly and at the same time handle last-minute customization. Plug-and-play principles, based on standard units as well as new modules that are identified and integrated automatically, will be the backbone of smart factories. Modularity will allow rapid change-over times and speed up new product introduction as well as large-scale rollouts. Modularity will be enabled by network structured organizations, benefiting from the holistic integrated global supply chain network.

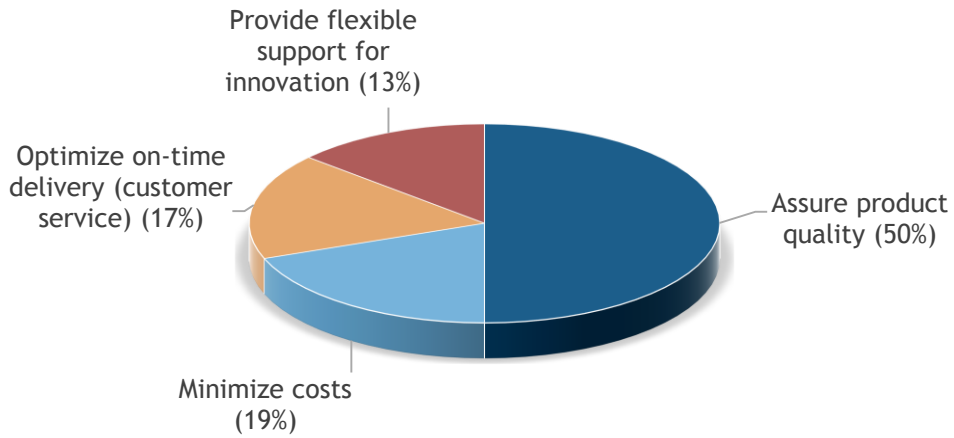
Where is Manufacturing Today?

IDC completed a number of surveys this year, asking a significant number of European companies about their manufacturing operations objectives, game-changing technologies, and benefits. The results are as follows:

FIGURE 2

Objective of Manufacturing Operations

Q. What statement describes the most important objective of your manufacturing operations?

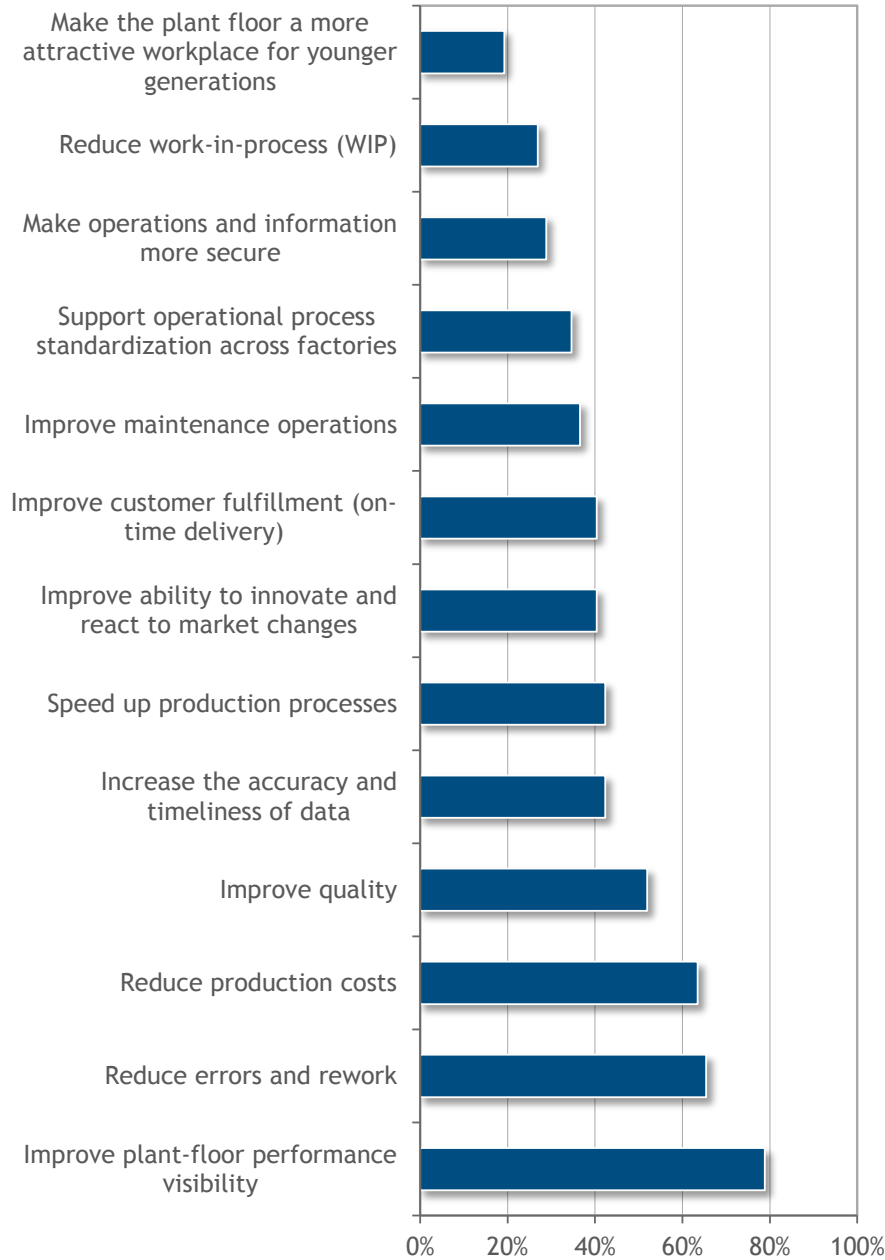


Source: IDC Manufacturing Insights 2015

FIGURE 3

Benefits on the Plant Floor

Q. For the game-changing technologies that are most relevant to your organization, what are the main benefits that are expected to be realized on the plant floor?



Source: IDC Manufacturing Insights 2015

What are the Game-Changing Technologies (Innovation Accelerators)?

There are a large number of game-changing technologies, including:

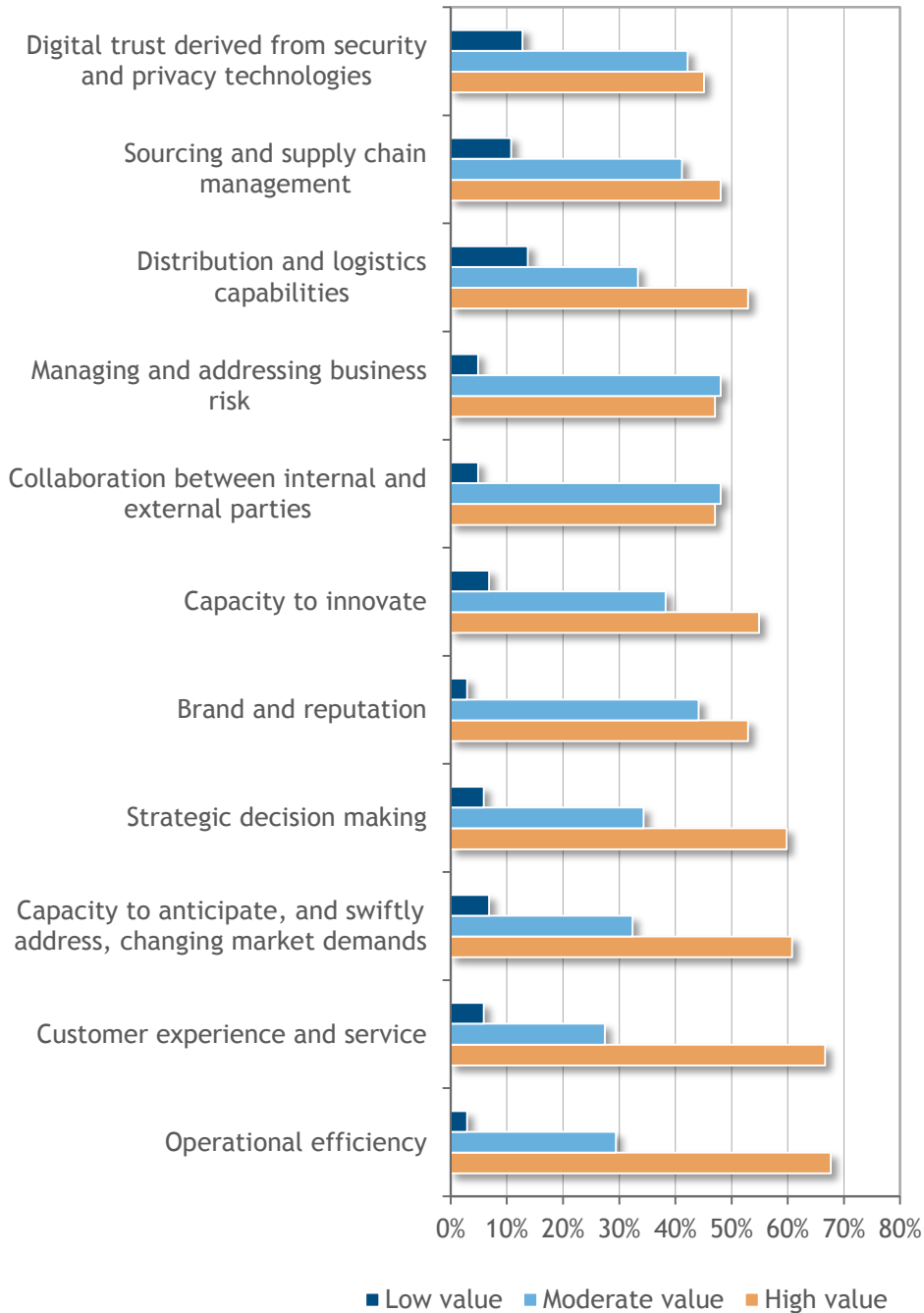
- Digitally-executed manufacturing – creating self-healing production processes
- Advanced automation/robotics – robots and humans interact in unprecedented ways

- Social business and collaboration – developing self-forming teams and addressing business issues from new perspectives
- Additive manufacturing – producing high-variability/low-volume products and components
- Big Data analytics – converting data into actionable information and enabling decision-based processes
- Cloud – simplifying and optimizing IT infrastructure and delivering cutting-edge applications
- Advanced data acquisition – capturing information at any point of activity along the process
- Security – ensuring that continuous interaction between people, IT, and operations happens in a safe and secure way
- Mobile devices – delivering data from/to a number of users

FIGURE 4

Digital Transformation Effort Areas

Q. How valuable will the outcomes of your digital transformation efforts for your organization be in the following areas?



Note: Number of valid respondents: 102

Source: IDC Pan-European Digital Transformation Summit Survey, 2015

It is good to see that manufacturing companies are starting their transformation journey. For those that haven't, we recommend that they partner up and start planning their journey for tomorrow's future.

The Key Role and Challenges for Industrial Engineering

Organizations should create new models built around go-to-market information.

From a Product Perspective

- **Integrated.** The need for a single product backup with up-to-date product data which is available across the entire organization, including all sites, business units, engineering, production, and service. The product should enable organizations to tackle business complexity and enable potential business acquisitions, and should be developed and produced faster at an increased quality level.
- **Fast.** A single solution to engineer and produce quickly, anywhere, on a single product backbone leading to a true business platform, with all engineering disciplines in a system view in one platform. Ease of use and seamless integration from any discipline (marketing, mechanical, tubing and piping, tooling and molding, simulation engineering, machining, and manufacturing up to the supply chain including the option of connecting suppliers). Product development goes from idea generation to service life governed by full program and change management, with improved flexibility and decision making at all times via business dashboarding that enables companies to combine multiple data sources.
- **Smart.** This is model-based system engineering in all design disciplines (electrical, fluidic, and mechanic) allowing synchronized multidiscipline and realistic behavior simulation to validate mechatronics systems prior to the physical build and synchronized control software to validate actual control on virtual equipment through a standard interface.
- **Seamless.** Here we can include robust product performance, quality, and reliability, and flexible testing processes across complex manufacturing networks. Advantages include minimizing validation costs and warranty issues and avoiding data redundancy and loss of information, as well as reducing tasks with no value-add by automating test report generation and retrieving existing information.

From a Business Perspective

- **Modular.** Make sure the next product generation is built on a modular architecture with great configuration capabilities to make them resonate with consumers. Offer more products while decreasing the number of parts, be first-to-market with new products (incremental innovations), and enable strategic supply chain creation and set up.
- **Anywhere.** Organizations should improve efficiency to simplify operations, enabling them to manufacture any product anywhere, leading to globally optimized local production.
- **Transformational.** Improve service operational efficiency, service definition and offerings, and service execution, all in one single environment. Provide a business dashboarding view, combining multiple data sources for improved decision making. Leverage product platforms to manage the product change impact on service offerings and installed base. Improve customer satisfaction, and leverage innovative and powerful web technologies to increase customer satisfaction during customer service interactions. Transform service from reactive to proactive by suggesting the right actions, meeting ecommerce standards for web service portal performance. Increase service sales, learn equipment "best practices" to increase OEE, predicting instead of curing, and increasing service sales.

Implementing the 4th Industrial Revolution in the Manufacturing Industry

One size does not fit all:

- **People-intensive factory of the future.** People will be at the center of the factory of the future as they provide the degree of flexibility and decision-making capabilities that are required to deal with increasing complexity.
- **IT-intensive factory of the future.** Information technology will be essential to create real-time decision-making environments to support the factory of the future.
- **Automation-intensive factory of the future.** The factory of the future will be automation intensive: all production processes will be highly or completely automated with few or no people involved in production operations.

FIGURE 5

The Factory of the Future



Source: IDC Manufacturing Insights, 2015

Ind. 4.0 – DT: Manufacturing Benefits and Considerations

Benefits

The exponential use of technology will have a huge impact on what and how we do things going forward. For those embracing this new journey, the benefits will boost the overall company in four key areas:

- **Excellence.** Concepts and principles enabling operational excellence: the best practices and standards of today will only be the norm for tomorrow. Connected and integrated ways of working will enable you to take your business to a different level.
- **Reinvention.** Business reinvention: the ability to reinvent yourself and your suppliers and customers in a holistic and integrated way.
- **Trust and compliance.** Trust and compliance, dynamic production network, including suppliers and customers across your end-to-end global supply chain network.

- **Service and experience.** Customer relationship management and connected and integrated tools and technology will enable you to increase customer experience through products and services.

Considerations

Most organizations will find themselves wanting when it comes to managing and leveraging the disciplines required to optimize returns from the 4th Industrial Revolution.

Many will attempt to transform through a series of initiatives targeting specific digital competencies while losing sight of the interplay and synergies that are needed for true digital transformation. Organizations that can digitally transform their operations, or partner with suppliers that can help them to do this, will thrive; those that don't may struggle to survive.

CONCLUSIONS

The pace of digital transformation will accelerate, particularly as IoM becomes more entrenched on the shop floor and in daily business and society. The proliferation of devices and the information that flows between them will require business leaders to increase their awareness of how their ecosystem is evolving on a continuous basis. As a result, strategic planning cycles will continue to shorten. Dashboards and other metric-oriented analytical tools will become the default feedback system in the production environment.

This leads to a new battlefield, requiring a different level of expertise, different processes and systems, and a new operating model, creating the need for outstanding front-end strategy supported by an outstanding back office. A successful digital transformation will lead to an end-to-end solution that facilitates accelerated revenue and profit growth going forward.

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