INDUSTRY 4.0: THE FUTURE CONCEPTS

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Abstract: The world around us has been changing on a daily basis along with development of human civilization. Therefore, technical and technological developments of production are changing as well. Industry 4.0 is a model that shows how industrial production follows the latest developments and changes over time. Thereby, the man, machine and the production itself constitute the force in one intelligent and independent network. The term "Industry 4.0" means the smart factory in which smart digital devices are networked and they communicate with raw materials, semi-finished product, products, machines, tools, robots and men. This industry is characterized by flexibility, efficient use of resources and integration of customers and business partners in the business process.

IndexTerms **- Industry 4.0, Cyber security, Standardization, digitalization and Integration.**

I. INTRODUCTION

When computers were introduced in Industry 3.0, it was disruptive thanks to the addition of an entirely new technology. Now, and into the future as Industry 4.0 unfolds, computers are connected and communicate with one another to ultimately make decisions without human involvement. A combination of cyber-physical systems, the Internet of Things and the Internet of Systems make Industry 4.0 possible and the smart factory a reality. As a result of the support of smart machines that keep getting smarter as they get access to more data, our factories will become more efficient and productive and less wasteful. Ultimately, it's the network of these machines that are digitally connected with one another and create and share information that results in the true power of Industry 4.0.

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II. THERE ARE A FEW KEY REASONS COMPANIES ARE ADOPTING INDUSTRY 4.0:

- To keep up with demands of globalization—the globalization of industry demands the need for speed to gain access to new customers.
- To achieve optimal operational efficiency—the digital integration of organizations increases organizational operating efficiencies.
- To see a quick return on digital investments—the payback on digital investments for Industry 4.0 is less than two years with a high level of operational cost improvement, which equals higher customer retention rates as well as new customer acquisition.

1. Integration: Industry 4.0 requires interoperability between machines, devices and people. In order for interoperability to be achieved, there must be vertical data integration between all aspects of the business—manufacturing, procurement, supply chain, design, product life cycle management, logistics, operations and quality—as well as horizontal integration with suppliers, customers and key partners.
Horizontal and vertical integration often requires updating and upgrading existing legacy equipment, networks and processes, while also being able to incorporate new equipment, networks and processes into one seamless integrated digital ecosystem.

2. Analytics: Data integration, integrity and analytics are the driving force behind Industry 4.0. Having solid data services with powerful analytic capabilities is at the core of successful adaptation to Industry 4.0. Improvements in communication technologies, processing power and the field of data science will allow industries to reach unprecedented levels of efficiency, uptime, productivity and safety.

3. Cyber security: Factory-wide connectivity is also leading to increased cyber security risks from internal and external actors. This can jeopardize intellectual property, proprietary manufacturing techniques, and plant uptime and worker safety. Continuous cyber security improvement is a cycle that leaders of strong organizations are embracing.

III. PRINCIPLES OF INDUSTRY 4.0

The design principles allow manufacturers to investigate a potential transformation to Industry 4.0 technologies. Based on the components above, the following are the design principles:

1. Interoperability: Objects, machines and people need to be able to communicate through the Internet of Things and the Internet of People. This is the most essential principle that truly makes a factory a smart one.

2. Virtualization: CPSs must be able to simulate and create a virtual copy of the real world. CPSs must also be able to monitor objects existing in the surrounding environment. Simply put, there must be a virtual copy of everything.

3. Decentralization: The ability of CPSs to work independently. This gives room for customized products and problem solving. This also creates a more flexible environment for production. In cases of failure or having conflicting goals, the issue is delegated to a higher level. However, even with such technologies implemented, the need for quality assurance remains a necessity on the entire process.

4. Real-Time Capability: A smart factory needs to be able to collect real time data, store or analyze it, and make decisions according to new findings. This is not only limited to market research but also to internal processes such as the failure of a machine in production line. Smart objects must be able to identify the defect and re-delegate tasks to other operating machines. This also contributes greatly to the flexibility and the optimization of production.

5. Service-Orientation: Production must be customer-oriented. People and smart objects/devices must be able to connect efficiently through the Internet of Services to create products based on the customer's specifications. This is where the Internet of Services becomes essential.

6. Modularity: In a dynamic market, a Smart Factory's ability to adapt to a new market is essential. In a typical case, it would probably take a week for an average company to study the market and change its production accordingly. On the other hand, smart factories must be able to adapt fast and smoothly to seasonal changes and market trends.

IV. INDUSTRY 4.0: ADVANTAGES

1. Efficiency: With fewer people and more automation, companies can make decisions more rapidly and keep efficiency high. Automation also tends to keep quality high, and that's an area that further boosts efficiency.

2. Agility: With a focus on high mix, small lots, and even one-off manufacturing, Industrie 4.0 brings agility to the next level. When products know their own specifications, it accelerates processes throughout production processes.

3. Innovation: Since Industries 4.0 production lines are made to accommodate high mix and low volumes, they are ideally suited to new product introduction and experimentation in design. The extreme visibility from IIoT feeds at intelligent products and equipment enables deeper understanding of what works in both product and process design.

4. Customer experience: The responsiveness and deep information availability available with Industry 4.0 mean manufacturers can give customers better service. In some cases, self-service views into the operation may be possible. Detailed, yet in-context, data from MES can be a foundation for quickly resolving issues between customers and manufacturer.

5. Costs: While Industries 4.0 will require initial investments, once the intelligence is built into products and processes, the costs will plummet. Fewer quality problems lead to less material waste, lower personnel and operating costs. The speed and ability to handle such a high mix seamlessly will also lower costs.

6. Revenues: With better quality, lower costs, higher mix, and the ability to serve customers well, Industries 4.0 puts manufacturers on a path to be a preferred supplier to current customers. It also opens up ways to serve larger markets, offer customized and thus higher-margin products, and with intelligent products and operations to offer services to accompany the products..

V. INDUSTRY 4.0: THE CHALLENGES

1. Investment: A huge issue for many enterprises who wish to implement Industry 4.0 is a buying strategy that is less than clear for a lot of them. As a result, there are often unclear economic incentives for implementation, and organizations find themselves having to spend over the odds to implement these new initiatives.

2. .Work force: Bringing together manufacturing automation and Smart Factories will bring unprecedented levels of efficiency and speed to a business, but the downside of this is that many companies will see a workforce that will be unused to the new developments taking place, and ill-equipped to adapt to them.

3. Standardization: There is some confusion with companies trying to innovate as to which standards will be adopted in the next five years. A huge challenge to overcome will be to derive a standardized system that works for all parties and allows for both horizontal and vertical integration, and results in maximum value for both present and future investments.

4. Data security: Small and medium-sized enterprises are primed to benefit the most from Industry 4.0, but this represents a problem. It requires them to publicize their data, whereas before they could use their own in-house data. This puts them at risk of having their intellectual property stolen by larger organizations, and causes small organizations to hesitate.

VI .THE FUTURE WORKFORCE

Industry 4.0 might be the peak of technological advancement in manufacturing, but it still sounds as if machines are taking over the industry. Consequently, it is important to further analyze this approach in order to be able to draw conclusions on the demographics of labor in the future. This will help workers of today prepare for a not so far future.

Given the nature of the industry, it will introduce new jobs in big data analysis, robot experts, and a huge portion of mechanical engineers. In an attempt to determine the type of jobs that Industry 4.0 will introduce or need more labor in, BCG has published a report based on interviews with 20 of the industry's experts to showcase how 10 of the most essential use cases for the foundation of the industry will be affected.

The following are some of the important changes that will affect the demographics of employment:

1. Big-Data-Driven Quality Control: In engineering terms, quality control aims at reducing the inevitable variation between products. Quality Control depends to a large extent on statistical methods to show whether a specific feature of a product (such as size or weight) is changing in a way that can be considered a pattern. Of course such a process depends largely on collecting real-time or historical data regarding the product. However, since Industry 4.0 will rely on big data for that, the need for quality control workers will decrease. On the other side, the demand for big data scientists will increase.

2. Robot-Assisted Production: The entire basis of the new industry relies of the smart devices being able to interact with the surrounding environment. This means that workers who assist in production (such as packaging) will be laid off and be replaced with smart devices equipped with cameras, sensors, and actuators that are able to identify the product and then deliver the necessary changes for it. Consequently, the demand for such workers will drop and will be replaced with "robot coordinators".

3. Self-Driving Logistics Vehicles: One of the most important focuses of optimization is transportation. Engineers use linear programming methods (such as the Transportation Model) to utilize the use of transportation. However, with self-driven vehicles, and with the assistance of big data, so many drivers will be laid off. In addition, having self-driven vehicles allows for restriction-free working hours and higher utility.

4. Production Line Simulation: While the need for optimization for transportation declines, the need for industrial engineers (who typically work on optimization and simulation) to simulate productions lines will increase. Having the technology to simulate production lines before establishment will open up jobs for mechanical engineers specializing in the industrial field.

5. Predictive Maintenance: Having smart devices will allow manufacturers to predict failures. Smart machines will be able to also independently maintain themselves. Consequently, the number of traditional maintenance technicians will drop, and they'll be replaced with more technically informed ones.

6. Machines as a Service: The new industry will also allow manufactures to sell a machine as a service. This means that instead of selling the entire machine to the client, the machine will be set-up and maintained by the manufacturer while the client takes advantage of the services it provides. This will open up jobs in maintenance and will require an expansion in sales.

VII CONCLUSION

Industry 4.0 is definitely a revolutionary approach to manufacturing techniques. The concept will push global manufacturers to a new level of optimization and productivity. Not only that, but customers will also enjoy a new level of personally customized products that may have never been available before. As mentioned above, the economic rewards are immense. However, there are still many challenges that need to be tackled systematically to ensure a smooth transition. This needs to be the focus of large corporations and governments alike. Pushing research and experimentation in such fields are essential. While speculations regarding privacy, security, and employment need more study, the overall picture is promising. Such approach to manufacturing industries is truly revolutionary.

Industry 4.0 is new industrial revolution of the 21st century, which enables companies to create "smarter" products and services by reducing costs and increasing efficiency, where the human factor is crucial for the application and the work is based on the existing literature in the area. Smart Factory makes a solution which, due to the system's automated procedures, uncomplicated setup including simple, need-based installation, and, ultimately, high degree of scalability can help companies in the

manufacturing sector further optimize their processes and significantly boost their internal efficiency. Five million workplaces could be lost due to digitalization in major industrialized nations by 2020. Also, it will quickly stop the market demand for the products made with outdated technologies due to lack of quality and such production would have to be shut down due to high costs and inefficiency

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