

Ubiquitous Manufacturing

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Abstract: Ubiquitous manufacturing is one of the emerging production paradigms towards which manufacturing companies are evolving. It refers a “design anywhere, make anywhere, sell anywhere, and at any time” paradigm. In recent years, ubiquitous manufacturing has attracted great attention in both academia and industry. This paper provides a brief introduction to ubiquitous manufacturing.

Keywords: *Ubiquitous Manufacturing, Ubiquitous Factory*

I. INTRODUCTION

Advances in computer science and engineering, such artificial intelligence, context-aware applications, ubiquitous computing, cyber-physical systems (CPS), Internet of things (IoT), Internet of services (IoS), big data, cloud computing, virtualization, and semantic networks are making their way into industry. Unfortunately, these applications are isolated and not working together [1]. Manufacturing companies are currently confronted with challenges created by rapid technological changes. Today’s manufacturing enterprises have to deal with: (1) coverage of the whole product life cycle, (2) environmentally conscious manufacturing, (3) simultaneous improvement of productivity and sustainability, and (4) enhancement of total performance of the product through the entire life cycle. Other challenges include time-to-market reduction, mass customization realization, reconfigurability enhancement, and speed/quality/cost improvements in product development and manufacturing [2].

Ubiquitous manufacturing (UM), also known as ubiquitous factory, is an application of ubiquitous computing in the manufacturing sector. It provides an environment in which manufacturing is done everywhere and anywhere. The concept of ubiquitous manufacturing (UM) is a nontraditional classification of industry and the inclusion of market-oriented manufacturing. The concept carries the idea that one can control a whole production and retailing chain from anywhere in the world and at any time. The emergence of some advanced manufacturing technologies, such as lean manufacturing, cloud manufacturing, manufacturing grid, global manufacturing, virtual manufacturing, agile manufacturing, Internet manufacturing, sustainability manufacturing, smart manufacturing, and additive manufacturing have contributed to ubiquitous manufacturing [3]. UM implies that products could be supplied ubiquitously, but manufacturing a product ubiquitously is impossible.

II. BACKGROUND ON UBIQUITOUS MANUFACTURING

Customers these days prefer highly customized products. This leads to a need of a major change in the traditional production paradigm. The major change in manufacturing is from mass-production/ consumption to a new model that enables sustainable development. This challenge has given birth to the concept of ubiquitous manufacturing [4].

The word “ubiquitous” means existing everywhere. Ubiquitous computing (or pervasive computing) refers to an environment that enables people to use a variety of information and communication services by networking anywhere, anytime without any interruption. It makes computing power available at all times and all places in a convenient way. This is the idea behind the concept of ubiquitous manufacturing.

Ubiquitous manufacturing (UM) is an application of ubiquitous computing and it features an environment in which manufacturing services are provided at any location. UM uses ubiquitous technologies such as GPS, RFID (Radio Frequency Identification), USN (Ubiquitous Sensor Network), and autonomous industrial mobile robots. It employs wireless devices integrated in the products, manufacturing machines, and the factories themselves. A factory can be small or complex. GPS has been used extensively in tracing the location of a delivered order. The RFID (radio frequency identification) is widely adopted wireless sensor technology in many industries [5]. Wi-Fi has been applied for ubiquitous positioning, diagnoses, and control inside a factory. Sensors, machines, equipment, computers, products, etc., are equipped with embedded intelligence which makes them smart.

Cloud manufacturing (CM) is similar to UM. CM enables ubiquitous, convenient, on-demand network accesses to a shared pool of manufacturing resources, while UM emphasizes the mobility and dispersion of manufacturing resources and users. Both

CM and UM grant factories unlimited production capacity and permanent manufacturing service availability [6].

III. BENEFITS AND CHALLENGES

Ubiquitous manufacturing provides new service models and business opportunities for manufacturing industry. It grants factories an unlimited production capacity and permanent manufacturing service availability. Using UM, products can be supplied ubiquitously. Product quality is one of the competitive advantages. Introducing a UM service in convenience stores would help the store achieve profitable business opportunities.

Although ubiquitous manufacturing is a reality today, we are still wrestling with the challenges. The manufacturing problems are often in large size with uncertainties. People are faced with the reality of users that are increasingly mobile and need access to multiple, heterogeneous devices at different times and locations. As more devices are being equipped with wireless communication interfaces, the frequency bands allocated for this purpose will soon be exhausted. Many UM applications will only be successful when they are based on vendor-independent open standards [7].

CONCLUSION

Manufacturing activities have evolved over the years. With the convergence of wireless technologies, advanced electronics, and computer networks such as the Internet, the scope of

manufacturing has expanded beyond geographical boundaries. Ubiquitous manufacturing implies product design, manufacturing, and recycling via ubiquitous computing technology. It introduces changes to the factors and elements of traditional manufacturing systems and incorporates the current requirements of smart systems. Recently, a cloud-based system is developed for ubiquitous manufacturing. The cloud technology offers on-demand service access and resource pooling on the computing market [8].

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