Abstract  Advanced manufacturing consists of continuity of manufacturing, its broad sense, and the core of the manufacturing process. The technology of continuous manufacturing is discussed according to both historical and modern perspectives. The relationship between human development and manufacturing technology is also discussed. Manufacturing is a continuously evolving topic. It is not only the foundation and means of imagination, conception, the science, and the technology of material change, but also the expression of national economy, national defense, and the support industries. The broad sense of manufacturing theory, which extends the concept of manufacturing, is an important development in the 20th century. The sense is analyzed in connection with design, material forming theory, synthesis of manufacturing technology, manufacturing modes, life cycle of product, hardware and software, and support environment, etc. At the same time, the core action and the development of the theory and technology of process is also discussed. At the end of this paper, the development directions of mechanical manufacturing science and technology are mentioned.

Keywords  manufacturing technology, eternity of manufacturing, broad sense of manufacturing, core of manufacturing process.

1 Eternity of manufacturing

1.1 Formation of manufacturing technology

Modern or advanced manufacturing technology was brought forward only in the 1980s, despite it was founded on experience for more than half a century. Manufacturing was first performed manually, and then done by machines. By replacing manual labor, machines had improved the product’s quality, met the requirement of productivity, emancipated labor power, and reduced hard manual labor. Thus, mechanical manufacturing technology appeared. Since then, as the manufacturing methods developed rapidly, non-traditional manufacturing methods, such as electro machining, optical processing, and chemical machining appeared besides mechanical machining. Therefore, mechanical manufacturing technology expanded and was called manufacturing technology in general, in which mechanical manufacturing technology was still its main part and base component [1].

Modern manufacturing technology is considered an overall machining process that crosses, merges, and integrates various techniques including mechanics, electricity, information, material, energy, and management, etc., for the entire product life cycle.

Modern manufacturing technology is comprised of market need, product design, technological design, processing and assembling, testing, distributing, using, maintaining, and scrapping, etc., to realize high-quality, agility, high-efficiency, low consumption, clean production, and quick response to market needs.

The development of information technology and its application in manufacturing caused a revolution in manufacturing technology. Then, manufacturing system and manufacturing science appeared. The combination of manufacturing technology and system theory, methodology, information theory, control theory, synergetics, and symbiosis theory formed a new manufacturing science called manufacturing systems engineering, as shown in Fig. 1. The manufacturing system is a new milestone in the development process of manufacturing technology.

Synergetics, which means the science of co-action, can be traced to the ancient Greeks. The modern manufacturing system is complex. Extended enterprise formed in the network environment is a more complex one in production and management. Synergetics is needed to resolve the problems that arise in multi-disciplinary integration in the product development process. Therefore, synergetics theory is also another important theory foundation.

Symbiosis theory states that during production, some other materials will be produced. It has two meanings. First, some other useful materials are produced, such as some useful byproducts usually accompanying chemical products. Second,
waste or harmful materials will be produced and contaminate the environment, such as during the production of automobiles where various materials to be processed after automobile scraps are also produced.

1.2 Eternity of manufacturing technology

The development of mankind is inseparably related to manufacturing technology. As manufacturing technology develops, people's working and living standards are also being raised. As demand for better living standards increase, people also have more and more demand for manufacturing technology. Therefore, people have been more and more closely related with manufacturing technology.

Manufacturing technology, a continuously developing subject, is the basis and means for materializing concepts and science and technology. It is also the reflection of national economic and defense power, which is crucial to a country's industrialization. As the international and domestic situations change, the development of manufacturing also has both high and low periods, both high-speed and low-speed periods, and both international and ethnologic characteristics like other industries. Anyhow, it should be paid enough attention to and be developed continuously. For instance, in the case of vehicles, only hand trucks, ox-driven carts or carriages were used in ancient times; then the train, the automobile, and the steamboat were introduced. As manufacturing technology improved, aircraft and spacecraft were produced. Then, advanced means of transportation such as jet aircraft, hovercraft, and high-speed train appeared. Furthermore, people could not remain satisfied with the achievements on earth and thus the space station, satellites, and space shuttle were produced. There is no doubt that humans will make greater progress as manufacturing improves continuously.

The human evolution history is a continuous manufacturing progress. At the beginning, people produced stone implements to hunt and gather food. Then pottery, bronze ware, ironware, and some simple mechanical devices such as weapons, living vessels, and agricultural machines, etc., came forth. The manufacturing progresses were simple and focused on living needs and warfare. The machining sources, scale, and technology level were limited greatly. As society developed, the scope and scale of manufacturing technology extended and the level continuously improved, which was manifested in not only the upgraded living standards and warriors but also the development of culture, art, and industry. Under capitalist and socialist society, large-scale industrial production came into being, which greatly improved social material life and civilization and set higher standards for them. With the faster development of novel science and technology, the relationship between man and manufacturing became closer. The appearance of the steam engine manufacturing techniques led to the industrial revolution and large-scale industrial production. Later, internal combustion