Application of Virtual Manufacturing Technology Based on Computer in Automotive Stamping Production Line

Li Xu*
Jilin Jiaotong vocational and technical college, automobile engineering college, Changchun City, Jilin Province, China

*Corresponding author e-mail: 1653182879@qq.com

Abstract. With the rapid progress of information technology, it has been widely used in various fields and made a lot of achievements. The application of virtual manufacturing technology can analyze and manage the process of automotive stamping production. It can improve the usage of various resources and the decision-making ability in the process of automotive stamping. It can also analyze the automotive manufacturing process from many angles in order to ensure the efficiency of stamping technology. In this paper, through the generalization of virtual manufacturing technology and automotive stamping production line, it analyses and summarizes the application process of virtual manufacturing technology in automotive stamping line.

Keywords: Computer, Virtual manufacturing, Stamping production

1. Introduction
In order to improve the effect of automotive stamping manufacture, people are constantly researching various types of applied technology[1]. The application of virtual manufacturing technology can simulate and analyze the stamping process of automobile, so that it can make the controllable effect of automotive manufacturing process better[2]. Many researches show that the combination of virtual manufacturing technology and automotive stamping production can effectively avoid various technical problems in the process of automotive production and manufacture[3]. It can fundamentally improve the productivity of automobile, and lay a solid foundation for the future development of automotive industry.

2. Overview of virtual manufacturing technology

2.1. Virtual manufacturing technology
Virtual manufacturing technology of computer is a popular software technology, which aims to realize the model of the design, manufacture and inspection by computers[4]. It can reduce the problems of product quality caused by the unsuitable mold. Virtual manufacturing technology is divided into the simulation of product model, product virtual design and virtual manufacturing system. According to the principle and structure of digital product model, virtual design can obtain many manufacturing schemes by computer. In general, virtual manufacturing uses computer simulation technology to analyze the feasibility of resources, environment, production capacity and other factors[5]. It can establish a virtual model and optimize the manufacturing process of products.

2.2. Applied advantages of virtual manufacturing technology
In recent years, China's automotive industry has made rapid progress. How to improve the efficiency of automotive manufacturing has become an important issue. The application of virtual manufacturing technology can realize the high concentration of all kinds of information and provide much space for the development of automotive stamping manufacturing technology[6]. Computers can contribute to the whole automotive production process in practice. This way can improve the technical personnel's cognition of automotive stamping technology and combine their theory with practice. It allows technicians to learn much knowledge about computers and cars. Virtual manufacturing technology can help enterprises to train production personnel. The establishment of informational system platform is shown in Fig 1.

![Figure 1. The establishment of information system platform](image)

3. An overview of the technology of automotive stamping production line

3.1 Development of stamping production line
Looking at the developmental history of automatic production line, people found that the earliest
stamping production line was operated manually due to the limitation of capital and technology. After that, people invented a simple manipulator to replace part of the labor to improve labor productivity. However, the development of stamping production line is inseparable from robots. Therefore, researchers began to explore the field of robotics. In 1980, robotic technology gradually matured. In the automotive stamping production line, robots gradually completely replace the manual operation.

3.2. The realization of stamping automation technology
The automation of stamping production line is based on communication control. The automatic system combines the action signal of robots with that of power press or other equipment to realize the sequential action of various actuators. The production line will stop automatically when a process breaks down or waste products are produced. This way can avoid a lot of waste products and ensure the quality of automotive products.

3.3. Rhythm of stamping automation production line
The beat time of automatic stamping production line directly affects the production efficiency of automotive products. Workers must set proper cycle time and waiting time of equipment to ensure production efficiency. In addition, the material of automotive parts is also one of many elements that affect the rhythm of production line. Therefore, the choice of materials is also very important in the process of automotive manufacturing. The steps of model establishment are shown in table 1.

| Steps | The mission                      | Operation |
|-------|----------------------------------|-----------|
| 1     | Material selection               | User      |
| 2     | Rough dimensions of parts        | Computer  |
| 3     | Size of power press              | Computer  |
| 4     | Check of punching pressure       | Computer  |
| 5     | Input Part Model                 | User      |
| 6     | Determine chamfer and fillet     | Computer  |
| 7     | Determine the limiting ratio     | Computer  |
| 8     | Thickness distribution of parts   | Computer  |
| 9     | Calculate initial shape and size | Computer  |
| 10    | Establishment of solid model     | Computer  |

4. The applied steps of virtual manufacturing system in automotive stamping production line

4.1. Establishment of solid model
①Layout and 3D model
Unit is the basis of production system. Workers need to lay out the components of the automobile, which the simulation model of the unit can be built to infer the 3D model of the automotive products. However, the parameters of the 3D model are not accurate. If you want to build a solid model, you need to get the specific parameters of the product.
2. Setting of basic operation parameters

The main sources of the original parameters are the reports of the production system, the operation records of the equipment and the production time of the products. The original parameters enter the database through the data transfer interface, so it can become the basic parameters of the solid model after being screened and analyzed by the computer. The stamping parameters of auto parts are shown in Table 2 and Table 3.

| Punch parameter       | A | B | C | D | E |
|-----------------------|---|---|---|---|---|
| Stroke times          | 6 | 5 | 3 | 4 | 6 |
| Number of mode changes| 3 | 2 | 4 | 2 | 2.4 |
| Time of mode changes  | 60| 41| 20| 60| 40|
| Movable rate          | 70%| 79%| 76%| 91%| 86%|
| Number of effective strokes | 2.5 | 3.1 | 2.1 | 2.9 | 4.1 |

Table 2. Stamping parameters of auto-parts

| Production model     | A  | B  | C  | D  | E  |
|----------------------|----|----|----|----|----|
| Compact car          | 75 | 78 | 28 | 39 | 94 |
| Midsize car          | 20 | 17 | 37 | 42 | 49 |
| Big Car              | 20 | 10 | 38 | 35 | 57 |
| Minicars             | 20 | 10 | 23 | 39 | 55 |
| Premium car          | 41 | 28 | 23 | 14 | 33 |

Table 3. Stamping parameters of automotive model

4.2. Establishment of logical model

The universality and flexibility of virtual manufacturing system ensure the establishment of logical model. The computer can establish accurate logical model only by flexibly using the parameters of production scheduling and process time of different products. However, sometimes the structure of production data and production process data will also affect the setting of model parameters. This situation will lead to errors in the setting of logical model, which will affect the simulation and analysis of computer.

4.3. Simulation and analysis of the computers

The computer can build the model of automotive stamping production line through entity model and logic model. We can predict various problems in the automotive manufacturing process through this model. After solving these problems, enterprises can improve the productivity of automotive products and reduce the emergence of waste products.

5. Development strategy of virtual manufacturing technology

The emergence of virtual manufacturing technology brings about the reform of enterprises’ organization and management. However, at present the virtual manufacturing technology in China is not mature. It needs further development and improvement.

5.1. The influence of government

The government should work out the development plan of virtual manufacturing technology with
China's national conditions. It should strengthen the guidance and research of virtual manufacturing technology from the macro level.

5.2. The influence of enterprises
Enterprises should vigorously introduce virtual manufacturing technology to solve the problems faced by the automotive industry according to the actual needs. This way can promote the positive circle and further development of virtual manufacturing technology.

5.3. Impact of industry technology
Researchers in the automotive industry can collect research information of foreign virtual manufacturing technology. This way can make an important contribution to the development of feature modeling technology in China.

6. Conclusion
Virtual manufacturing technology provides a visual and interactive simulation environment. It can help enterprises predict various problems in the production process of automotive products. Despite the rapid development of China's automotive industry, its technology still lags behind other countries. The application of virtual manufacturing technology in automotive stamping technology is obviously very effective. We should closely follow the development trend of virtual manufacturing technology in the world and actively establish our virtual manufacturing system. In addition, we should also constantly study new technologies in various automotive fields to help promote the future development of China's automotive industry.

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