

# Automobile Engine Block Machining Line Simulation

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**Abstract.** In this paper, using the production system simulation software Plant Simulation to model and simulate an automobile engine block machining line, and then analysis the simulation data. Experimental data shows that the production line program has a strong production capacity and good economic, which can be implemented.

## 1. The basic steps of Simulation and Modeling

General computer simulation activities include three stages, which are preparation, implementation and evaluation. The main aspects of the various stages included in the figure below.

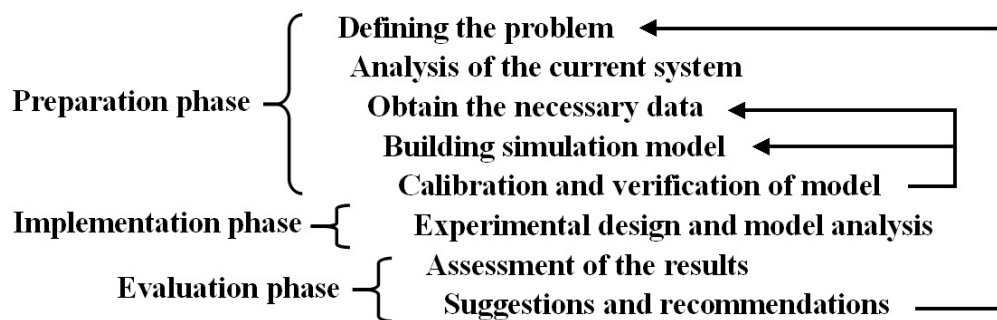


Fig. 1 Computer simulation steps to solve the problem

In the preparation stage is mainly on the issue of quantitative or qualitative description and Clear purpose and mission of the simulation. Get Comprehensive and in-depth understanding of the system through investigation and analysis and then abstract and separate the problem. Isolating study object from the complex problems, which can be reflected the characteristics by, to describe the system in detail as possible.

According to the set simulation target, completing selection, organization, abstraction and simplification of the system, then build the simulation model. The main contents that needed to be consider of when modeling are: System processes, operating procedures and logical relationships. Start by establishing a relatively simple model, which reflect the principal contradiction of the system, And then gradually to supplement and improve it. The complexity of the model should adapt the research objectives you want to achieve.

The implementation phase of work includes experimental design, experimental run and model validation. The assessment phase of the work is to read and interpret the results of the simulation, for Illustrating the effect of the decision variables to the system.

## 2. Automobile engine block machining line systems analysis

Automobile engine block machining line design. The program reference certain engine block production line, Production line consists of five sets of CNC, 3 sets of plane, 2 sets of online gages, 2 washing machine, one honing machine and two auxiliary. in addition to offline gages, the outside

equipment include one CMM and one coordinate washing machine.

The process production line use U-shaped and annular layout, and the entire cylinder line use parallel, serial hybrid arrangement. Since most CNC have longer beats, they are divided into A/B two parallel modules. Auxiliary equipment, washing machine and honing machine have shorter beats, so they use the serial arrangement. Since the box parts are similar in processing complexity and processing time, when shunting parts, use the control strategy of percentage. The two machining centers are average used averagely, and each fraction was 50%, making maximum utilization of the machining center. Layout diagram is shown below.

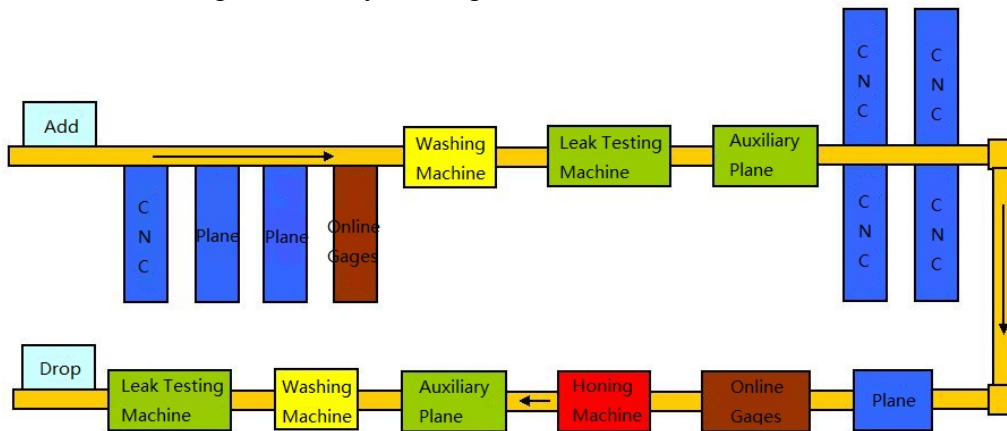


Fig. 2 Production line layout1

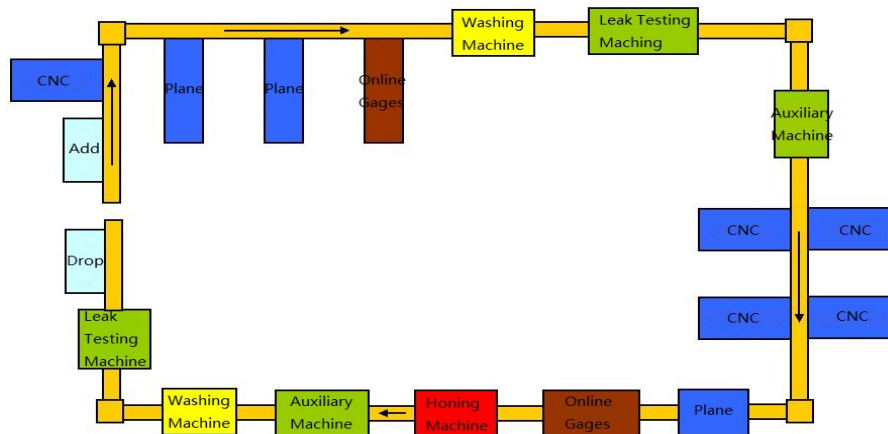


Fig. 3 Production line layout2

### 3. Creation of the simulation model

#### 3.1 The basic modeling steps of Plant Simulation.

1. Selection of the object entity: Select the appropriate object according to the function that the system of simulation modeling need to achieve, corresponding software Plant Simulation function in the object. Mapping relationships between entities and software objects are shown in Table 1, For an object not in the software, you can create your own, Plant Simulation provides a good secondary development environment.

2. Construction of the system layout: According to the actual assembly line layout, drop the required libraries from the toolbox or drag to the appropriate hierarchy.

3. Determination of the object flow: According to the actual production process systems, link model objects and build the basic flow simulation system.

4. Determination of the parameters and rules: In order to realize the function of the actual system, the model object must be set and the corresponding rules are written in the software, which can be completed by using method in the software.

5. Model Debugging: First, the model initialization, and then run the debugger. If inconsistent with the actual, return to step 3 or 4, keep the constant debugging until a practical function is completed.

The basic idea of this model are:

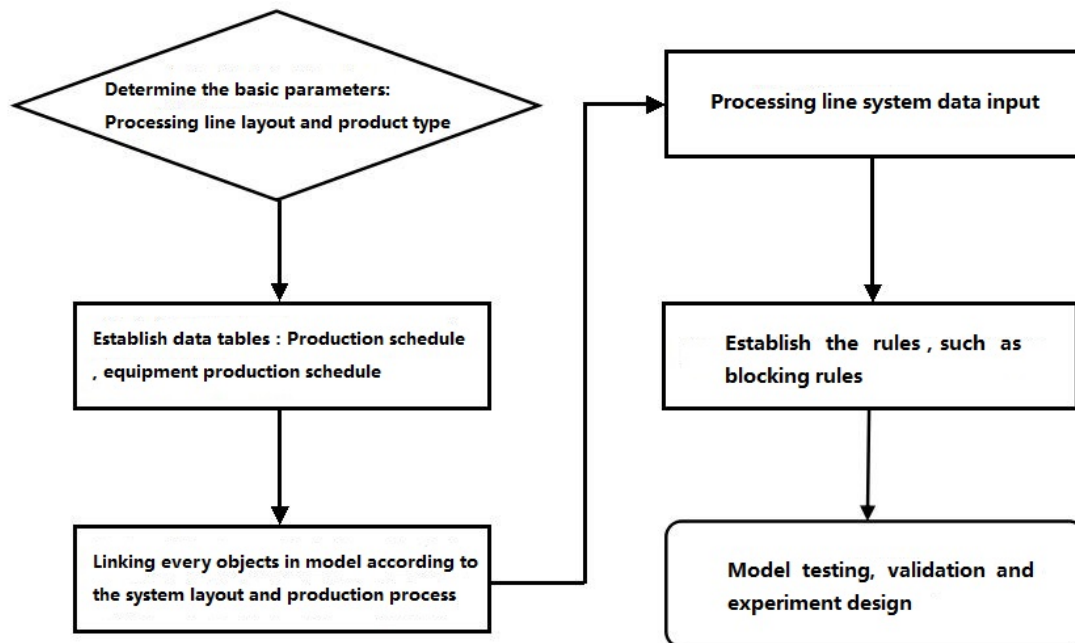


Fig.4 The basic idea of modeling

### 3.2 Creation of the basic model layout.

According to the system layout and production processes as well as the analysis of mixed assembly line, select the appropriate object library into the model layer and then establish the basic Plant Simulation simulation models based on the production model of the actual adjustment position, size and length.

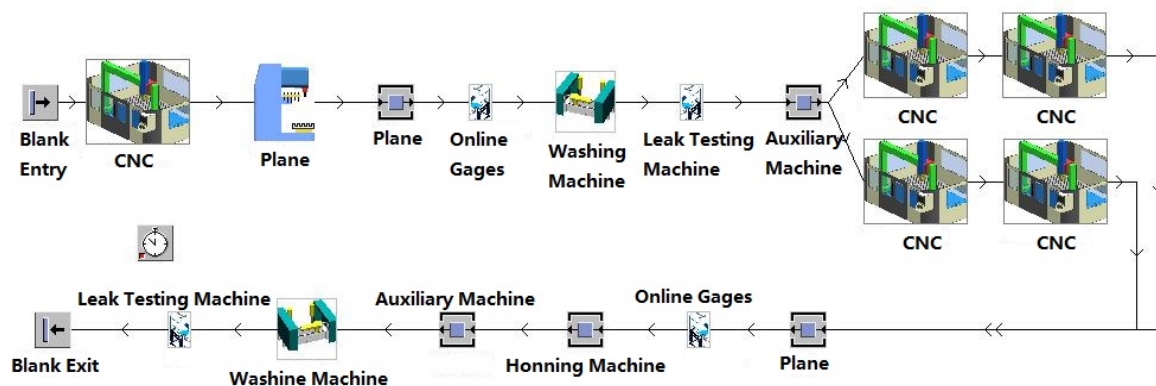


Fig.5 Cylinder production line simulation model program1

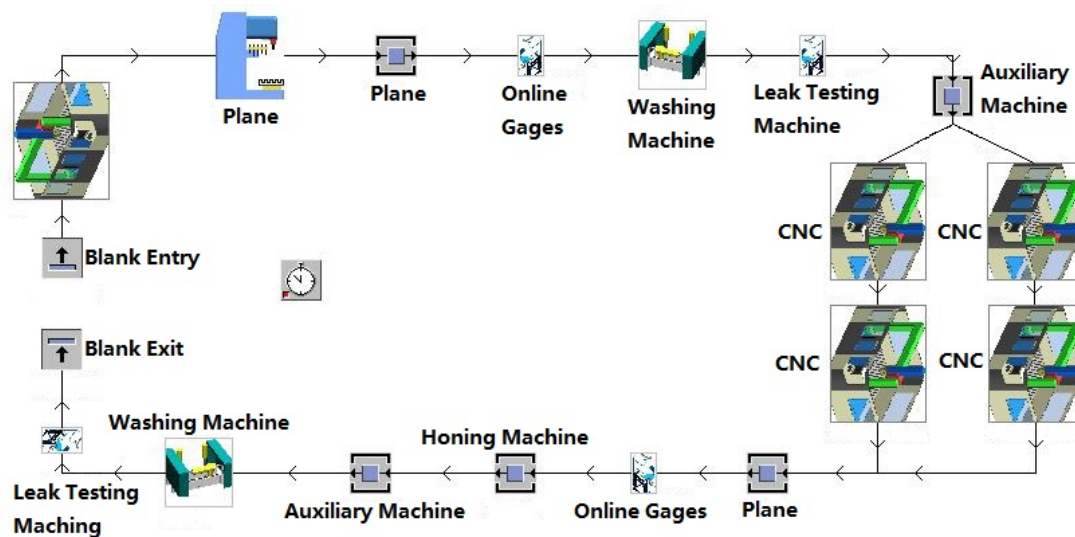


Fig.6 Cylinder production line simulation model program2

#### 4. The execution of Processing line simulation

##### 4.1The execution of Cylinder block machining line simulation.

The running processes of automobile engine block machining line are as follows: After into the automatic raceway, the blank successively transported by the rail to each station, then transported by rail to idle CNC Machining Center (CNC). After the processing is completed, Track will move the blank out of machining center. The inspected blank will exit the system when it completed all the steps.

Table 1 Production line simulation program tact

Station	Equipment Category	Beat	Station	Equipment Category	Beat
OP10	CNC Machine	74.9	OP110A	CNC Machine	76.5
OP20	Plane	73.3	OP110B	CNC Machine	76.7
OP30	Plane	79.8	OP160-1	Plane	76.2
OP35	Online Gages	79.1	OP160-2	Online Gages	72.1
OP40	Washing Machine	50	OP210	Honing Machine	73.5
OP50	Leak Testing Machine	74.1	OP220	Auxiliary Machine	80.5
OP60	Auxiliary Machine	75.8	OP230	Washing Machine	33.8
OP70A	CNC Machine		OP250-2	Leak Testing Machine	
OP70B	CNC Machine				

When The system running, Simulation entity triggered by the simulation clock according to different control strategies, forming a event simulation of the discrete system, and change the operating state of the entity. Manufacturing resource of the system interaction, forming a specific process. If the parts and trays go into the production line as 1min intervals, using the above table tact, simulating 8 hours on the production line, its utilization is shown in the following table:

Table 2 Production line simulation utilization

Station	Equipment Category	Equipment utilization	Station	Equipment Category	Equipment utilization
OP10	CNC Machine	93.87	OP110A	CNC Machine	46.75
OP20	Plane	91.62	OP110B	CNC Machine	46.73
OP30	Plane	99.49	OP160-1	Plane	93.19
OP35	Online Gages	98.30	OP160-2	Online Gages	92.32
OP40	Washing Machine	92.71	OP210	Honing Machine	87.12
OP50	Leak Testing Machine	61.81	OP220	Auxiliary Machine	88.55
OP60	Auxiliary Machine	91.33	OP230	Washing Machine	96.68
OP70A	CNC Machine	46.59	OP250-2	Leak Testing Machine	40.49
OP70B	CNC Machine	46.57			

Simulation results show that eight hours of production parts 345, in article number 16.

## 5. Conclusion

This section use a car engine cylinder block production line for example. Using simulation technology to simulation and analysis automobile engine cylinder block production line design. Experimental data shows that the production line program has a strong production capacity and good economic, which can be implemented.

## Acknowledgments

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