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Optimization Design of Workshop Facility Layout for Company A

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ABSTRACT

With the continuous growth of China's economy and the improvement of living standards, consumers have increasingly higher expectations for product quality. To meet market demand and promote industrial upgrading, enterprises are accelerating product renewal and placing greater emphasis on product design and quality assurance. However, this has also led to rising operating costs and declining profit margins. Therefore, reducing unnecessary daily expenses has become an important issue for enterprises, and workshop layout optimization is one effective way to improve operational efficiency and reduce costs. FlexSim is a computer-based simulation software used to model discrete-event processes, and it is widely applied in manufacturing, material handling, and office workflow analysis. In this study, POSCO-OSTEM (Suzhou) Automotive Parts Co., Ltd. in Kunshan is selected as the research object. Based on its workshop layout and production process, a production flow simulation model is established. Following the Systematic Layout Planning method, the production process and workshop layout are analyzed and improved, with the aim of developing a practical layout optimization scheme to reduce on-site management costs.

KEYWORDS

Facility Layout Optimization; Systematic Layout Planning; Flexsim Simulation; Workshop Layout; Automotive Parts Manufacturing.

1. INTRODUCTION

With the continuous development of the manufacturing industry, enterprises are facing increasing pressure from rising operating costs, intensified market competition, and higher requirements for production efficiency. For automotive parts manufacturers, the rationality of workshop facility layout directly affects material handling distance, production continuity, space utilization, and overall operating cost. An unreasonable layout may lead to problems such as long transportation routes, congestion in loading and unloading areas, scattered storage areas, and inefficient coordination between production processes. Therefore, optimizing workshop facility layout has become an important approach for manufacturing enterprises to improve operational efficiency and reduce unnecessary costs [1].

This study takes Company A, an automotive parts manufacturing enterprise in Kunshan, as the research object. Based on its existing workshop layout, production process, material flow, storage areas, and loading routes, the main problems in the current layout are identified and analyzed. The Systematic Layout Planning method is applied to evaluate the logistics and non-logistics relationships among different functional areas [2], and an improved facility layout scheme is proposed accordingly. Furthermore, FlexSim simulation software is used to model and compare the original and optimized layouts[3], so as to verify the feasibility and effectiveness of the proposed scheme. The results are

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expected to provide practical reference for improving workshop layout, reducing material handling waste, and enhancing production management efficiency in automotive parts manufacturing enterprises [4].

2. CURRENT LAYOUT AND EXISTING PROBLEMS OF COMPANY A

(1) production areas are not well coordinated

Production areas are not well coordinated. In the existing workshop layout, the production functions are distributed among three workshops, but the connection between different processes is not smooth. Workshop 1 is mainly responsible for raw material storage, stamping and welding, Workshop 2 is used for painting and quality inspection, while Workshop 3 is mainly used for press-fitting, finished product storage and outbound delivery. However, some semi-finished products need to be transferred repeatedly between different areas, and finished goods are stored in several scattered locations. This leads to unnecessary material handling, longer transportation routes, and lower coordination efficiency among production, storage and delivery activities. Therefore, the current arrangement fails to support a continuous and efficient production flow

(2) storage areas are scattered

In the current layout, finished products and semi-finished products are stored in several separate areas, including the storage area between Workshop 1 and Workshop 2, the passage between Workshop 2 and Workshop 3, and the finished goods area inside Workshop 3. Some products are even placed in outdoor or temporary storage areas before delivery. This scattered storage arrangement makes it difficult for warehouse staff to quickly locate goods, increases the workload of material handling, and extends the loading and delivery time. In addition, the lack of centralized storage management may also lead to congestion, space waste, and potential quality risks when products are exposed to rain or poor storage conditions.

(3) loading and transportation routes are unreasonable.

In the existing layout, inbound and outbound vehicles mainly enter and leave the plant through the same gate, while different loading points are distributed in separate areas of the factory. Some vehicles have to detour around workshops to reach the loading areas, and several routes overlap with each other. As a result, trucks often queue near the entrance and loading zones, causing congestion and delaying both material receiving and product delivery. In addition, the low utilization of alternative gates further increases transportation distance and reduces the efficiency of logistics operations. Therefore, the current route planning fails to support smooth and efficient inbound and outbound transportation.

3. LAYOUT OPTIMIZATION BASED ON SLP METHOD

(1) Determination of Functional Units

In order to optimize the workshop layout of Company A, the main functional units in the production and logistics process were first identified. According to the actual production process of automotive parts, the main production units include raw material storage, stamping, welding, painting, press-fitting, quality inspection, finished goods storage, waste recycling, office areas and loading areas. These units are closely related to material flow, production continuity and outbound delivery efficiency.

In the original layout, different functional areas were distributed in several workshops, which caused repeated material handling and poor coordination between production, storage and delivery activities. Therefore, the SLP method was adopted to analyze the relationship among different functional units and to provide a basis for layout improvement. The details are shown in Figure 1.

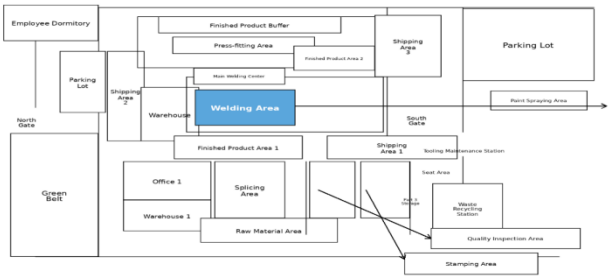


Figure 1. Schematic Diagram of the Plant Area

(2) Logistics Relationship Analysis

The logistics relationship mainly reflects the material flow intensity between different functional units. In this study, the production process of automotive subframes was selected as the main analysis object. The basic process includes raw material input, stamping, welding, painting, press-fitting, storage and delivery. During this process, materials and semi-finished products need to be transferred between different workshops, and waste materials are also generated in some production stages.The details are shown in Figure 3.

According to the direction and quantity of material movement, the logistics intensity between each pair of functional units was evaluated. The relationship levels were classified into five grades: A, E, I, O and U, representing different degrees of closeness. A higher relationship level means that two units should be arranged closer to each other in the layout. For example, raw material storage and stamping have a strong logistics relationship, because raw materials need to be supplied to the stamping area continuously. Similarly, stamping, welding, painting and press-fitting should also maintain a close spatial relationship to ensure the continuity of production flow.

Through the logistics relationship analysis, the key production units with high material flow intensity were identified. These units should be given priority in layout adjustment so as to reduce unnecessary transportation distance and improve material handling efficiency.The details are shown in Figure 2.

F1	Raw Material Area
F2	Stamping Area
F3	Welding Area
F4	Spray Painting Area
F5	Press-fitting Area
F6	Waste Recycling Area
F7	Final Inspection Area
F8	Finished Product Area 1
F9	Finished Product Area 2
F10	Finished Product Area 3
F11	Shipping Area 1
F12	Shipping Area 2
F13	Shipping Area 3
F14	Office 1
F15	Office 2

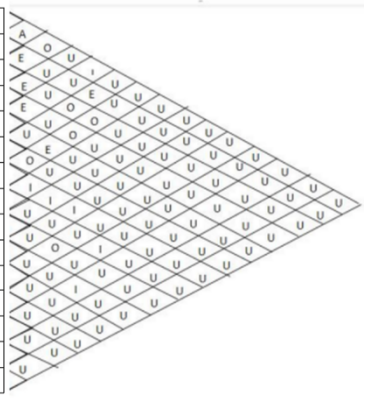
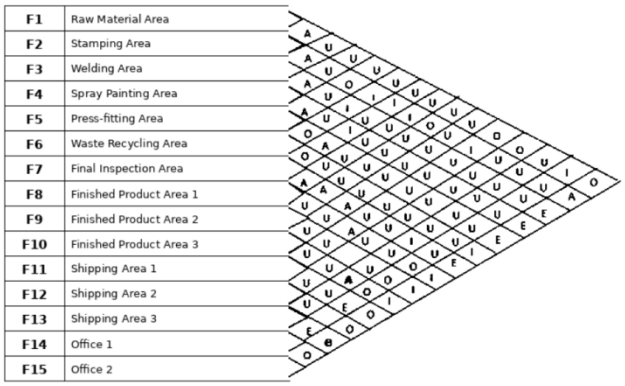


Figure 2. Logistics Operation Relationship Table

(3) Non-logistics Relationship Analysis

In addition to material flow, non-logistics factors were also considered in the layout optimization. Non-logistics relationships refer to the closeness between functional units caused by management, communication, safety, environmental protection, quality control and operational convenience. For example, the production management office should maintain a certain degree of closeness with the main production areas, because daily production coordination and on-site management require frequent communication. The quality inspection area should also be reasonably connected with production and storage areas to improve inspection efficiency.

Based on the actual operation of Company A, the non-logistics relationship among different functional units was evaluated and graded. The same A, E, I, O and U grading method was used to express the closeness of non-logistics relationships. This analysis helped avoid a layout scheme that only focuses on material flow but ignores management convenience, quality control and environmental requirements. The details are shown in Figure 3.3.



F1	Raw Material Area
F2	Stamping Area
F3	Welding Area
F4	Spray Painting Area
F5	Press-fitting Area
F6	Waste Recycling Area
F7	Final Inspection Area
F8	Finished Product Area 1
F9	Finished Product Area 2
F10	Finished Product Area 3
F11	Shipping Area 1
F12	Shipping Area 2
F13	Shipping Area 3
F14	Office 1
F15	Office 2

Figure 3. Non-Logistics Operation Relationship Table

(4) Comprehensive Layout Optimization Scheme

After completing the logistics and non-logistics relationship analysis, the two types of relationships were combined to obtain the comprehensive closeness degree among functional units. In this process, both material flow efficiency and management convenience were considered. Functional units with stronger comprehensive relationships should be arranged closer to each other, while units with weaker relationships can be placed relatively farther away.

Based on the comprehensive relationship analysis, the layout optimization scheme was proposed from the following aspects. First, production units with strong process continuity, such as stamping, welding, painting and press-fitting, should be arranged more closely to reduce repeated handling of semi-finished products. Second, scattered finished goods storage areas should be integrated as much as possible to improve warehouse management efficiency and reduce the time required for product searching and loading. Third, loading and transportation routes should be reorganized to reduce route overlap, avoid vehicle congestion and improve the efficiency of inbound and outbound logistics. Finally, auxiliary areas such as office areas, waste recycling areas and quality inspection areas should be adjusted according to their relationship with production activities.

Through the SLP-based optimization, the new layout is expected to form a smoother production flow, shorten material handling distance, reduce unnecessary logistics activities and improve the overall coordination of workshop operations. This provides the basis for the subsequent FlexSim simulation and comparative analysis between the original layout and the optimized layout.

4. FLEXSIM SIMULATION AND COMPARATIVE ANALYSIS

(1) Establishment of the FlexSim Simulation Model

In order to verify the effectiveness of the proposed layout optimization scheme, a discrete-event simulation model was established by using FlexSim [5]. The model was developed according to the actual workshop layout, production process and logistics flow of Company A. The main production process includes raw material input, stamping, welding, painting, press-fitting, quality inspection, finished goods storage and outbound delivery. In the simulation model, different functional areas were represented by corresponding FlexSim objects, such as sources, processors, conveyors, storage areas, transporters and sinks.

The original layout model was first constructed based on the existing arrangement of the three workshops. Workshop 1 mainly includes raw material storage, stamping and welding areas; Workshop 2 mainly includes painting and quality inspection areas; and Workshop 3 mainly includes press-fitting, finished goods storage and outbound delivery areas. Different product flows were distinguished in the model to represent different storage and delivery routes. This made it possible to observe the movement of materials, semi-finished products and finished goods among different functional areas more clearly.

To ensure the comparability of simulation results, the same basic parameters were used for both the original layout and the optimized layout. According to the collected production data, the processing time of the stamping machine was set to 124.6 s, the welding time was set to 133.6 s, the painting time was set to 64.3 s, the press-fitting time was set to 106.5 s, and the quality inspection time was set to 204.3 s. In addition, the maximum walking speed of workers was set to 2 m/s, and the maximum speed of forklifts was set to 4 m/s. The simulation time was set to 86,400 s, representing one working day.

Based on these settings, the FlexSim model was used to simulate the operation of the workshop under different layout schemes. The output indicators mainly included equipment utilization, material output, finished goods delivery volume and the smoothness of logistics flow. Through the comparison between the original and optimized models, the influence of layout adjustment on production efficiency and logistics performance could be evaluated more intuitively.

(2) Simulation Analysis of the Original Workshop Layout

Based on the established FlexSim model, the original workshop layout of Company A was simulated for one working day. The simulation model reflected the existing arrangement of the three workshops, three loading areas, raw material storage area, production equipment, finished goods storage areas and transportation routes. In the original layout, trucks mainly entered the plant through the north gate, while different categories of products were stored in different areas before delivery. The simulation process showed that the existing layout could complete the basic production and delivery tasks, but the overall logistics flow was not smooth.

According to the simulation results, the total output of the raw material source was 3,943 units within one working day, while the total receiving quantity of the three delivery areas was about 1,246 units. This indicates that although the material input was sufficient, the actual outbound delivery efficiency was relatively limited. The main reason is that semi-finished products and finished goods needed to be transferred among several workshops and storage areas, resulting in repeated handling and longer transportation routes.

The equipment utilization results also reflected the inefficiency of the original layout. The utilization rates of the three stamping machines were 37.51%, 35.46% and 34.37%, respectively. The utilization rates of the four welding machines were 44.57%, 42.17%, 41.61% and 16.49%, respectively. The utilization rates of the painting equipment were around 31%, while the utilization rates of the two press-fitting machines were only 16.39% and 16.37%. These results show that several key production processes were not fully utilized under the original layout.

In addition, the simulation revealed that the scattered storage areas and overlapping transportation routes increased the workload of material handling. Finished products had to be moved to different storage and loading areas according to product type and delivery demand. As a result, trucks and forklifts were likely to experience waiting, detouring and route conflicts during inbound and outbound operations. Therefore, the original layout had obvious limitations in terms of logistics continuity, equipment utilization and delivery efficiency.

Overall, the FlexSim simulation of the original layout provides a quantitative basis for layout optimization. The low utilization of key equipment and the relatively low outbound delivery volume indicate that the existing workshop layout needs to be improved through a more reasonable

arrangement of production areas, storage areas and transportation routes. The details are shown in Figure 4.

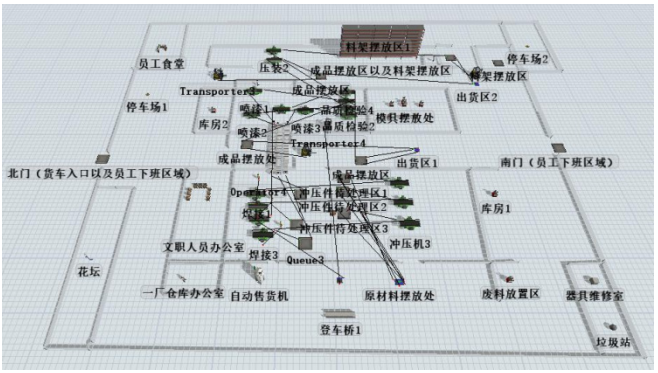


Figure 4. FlexSim Operation Diagram

(3) Simulation Analysis of the Optimized Workshop Layout

After the optimization scheme was proposed based on the SLP method, the optimized workshop layout was further simulated in FlexSim. The simulation parameters, including processing time, worker speed, forklift speed and simulation duration, were kept the same as those of the original layout to ensure the comparability of the results. The optimized model mainly adjusted the spatial relationship among production areas, storage areas and loading areas, so as to reduce unnecessary material handling and improve the continuity of the production process.

The simulation results show that the optimized layout achieved better production and delivery performance. Within one working day, the output of the raw material source reached 3,946 units, which was close to that of the original layout. However, the total receiving quantity of the three delivery areas increased to 1,640 units. This indicates that under almost the same material input condition, the optimized layout was able to support a higher outbound delivery volume and a smoother logistics flow.

The utilization rates of key equipment were also significantly improved in the optimized layout. The utilization rates of the three stamping machines increased to 91.38%, 89.21% and 89.20%, respectively. The utilization rates of the four welding machines reached 87.10%, 85.46%, 85.79% and 65.56%, respectively. In addition, the utilization rates of the two press-fitting machines increased to 51.77% and 51.77%. These results show that the optimized layout improved the connection between different production processes and reduced the idle time caused by unreasonable material transfer.

In the optimized layout, the arrangement of storage and loading areas became more reasonable. Finished goods could be transferred to the corresponding delivery areas more efficiently, and the transportation routes between workshops were shortened and clarified. As a result, the waiting time of materials and vehicles was reduced, and the coordination among production, storage and outbound delivery was improved.

Overall, the FlexSim simulation of the optimized layout demonstrates that the SLP-based adjustment can improve equipment utilization, increase delivery capacity and enhance the smoothness of logistics operations. The optimized layout therefore provides a more efficient workshop operation scheme for Company A.

5. COMPARATIVE EVALUATION OF SIMULATION RESULTS

Based on the simulation results of the original and optimized layouts, the performance of the two schemes was compared from the aspects of material output, delivery capacity and equipment

utilization. The comparison shows that the optimized layout achieved better operational performance under almost the same material input condition.

Within one working day, the output of the raw material source in the original layout was 3,943 units, while that of the optimized layout was 3,946 units. The difference between the two layouts was very small, indicating that the material input level remained basically unchanged. However, the total receiving quantity of the three delivery areas increased from 1,246 units in the original layout to 1,640 units in the optimized layout, with an increase of about 31.62%. This result shows that the optimized layout can improve outbound delivery efficiency without increasing material input.

The comparison of equipment utilization also demonstrates the effectiveness of the optimized layout. In the original layout, the utilization rates of the three stamping machines were 37.51%, 35.46% and 34.37%, respectively, while those in the optimized layout increased to 91.38%, 89.21% and 89.20%. The utilization rates of the welding machines also increased significantly. In the original layout, the four welding machines had utilization rates of 44.57%, 42.17%, 41.61% and 16.49%, while in the optimized layout they increased to 87.10%, 85.46%, 85.79% and 65.56%. In addition, the utilization rates of the two press-fitting machines increased from about 16.38% to 51.77%. These results indicate that the optimized layout reduced idle time and improved the continuity between different production processes.

Compared with the original layout, the optimized layout has three main advantages. First, the production flow becomes smoother, and the connection among stamping, welding, painting, press-fitting and storage is improved. Second, the storage and delivery areas are arranged more reasonably, which reduces repeated handling and shortens the movement distance of semi-finished and finished products. Third, the transportation routes become clearer, which helps reduce congestion and improve the efficiency of loading operations.

Overall, the FlexSim simulation results verify the feasibility of the SLP-based optimization scheme. Under similar input conditions, the optimized layout improves delivery capacity, increases the utilization rate of key equipment, and enhances the overall coordination of workshop operations. Therefore, the proposed layout scheme can provide practical support for improving production efficiency and reducing unnecessary logistics waste in Company A.The details are shown in Figure 5.

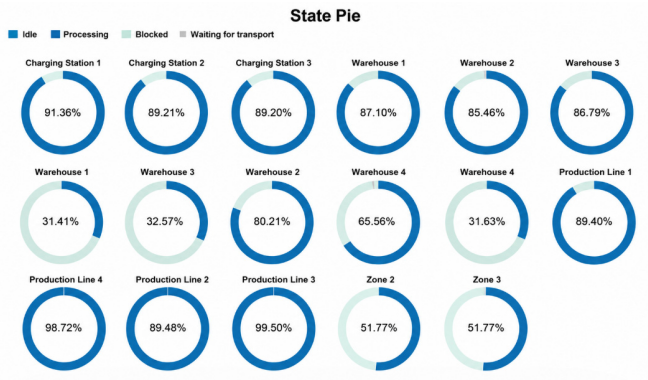


Figure 5. Improvement in Equipment Utilization

6. CONCLUSION

This paper studied the workshop facility layout optimization problem of Company A, an automotive parts manufacturing enterprise. Based on the analysis of the existing workshop layout, the main problems were identified, including poor coordination among production areas, scattered storage areas, and unreasonable loading and transportation routes. These problems increased material

handling distance, caused congestion during logistics operations, and reduced the overall efficiency of workshop management.

To solve these problems, the Systematic Layout Planning method was applied to analyze the logistics and non-logistics relationships among different functional areas. On this basis, an optimized layout scheme was proposed by adjusting the arrangement of production units, storage areas and loading routes. FlexSim simulation was then used to compare the original layout and the optimized layout. The simulation results show that, under almost the same material input condition, the optimized layout improved outbound delivery capacity and increased the utilization rate of key equipment. The receiving quantity of delivery areas increased from 1,246 units to 1,640 units, indicating that the optimized layout can improve logistics efficiency and production continuity.

Overall, the results verify the feasibility and effectiveness of combining the SLP method with FlexSim simulation for workshop layout optimization. The proposed scheme can reduce unnecessary material handling, improve the coordination between production and logistics activities, and provide practical support for improving workshop operation efficiency. However, this study still has some limitations. Future research can further introduce quantitative cost analysis, more detailed production data, and intelligent optimization algorithms to improve the accuracy and applicability of the layout optimization scheme.

The simulation results show that the receiving quantity of delivery areas increased from 1,246 units to 1,640 units, indicating an improvement of about 31.62% in outbound delivery capacity.

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REFERENCES

[1] Te King Chien. An empirical study offacility layout using amodified SLP procedure[J].Journal of Manufacturing Technology Management, 2004, (15):455-465.

[2] Liu H J. Problems and Countermeasures in Allocating Supply Chain Cooperative Benefits Using the Shapley Value Method [J]. Industrial Engineering, 2010, (6): 33-36.

[3] Zhang H, Gao Z L. Research on Benefit Allocation of Coal Supply Chain Based on the Improved Shapley Value Method [J]. Modern Electronics Technique, 2014, (11): 148-150.

[4] Wang Y R. Research on Production Workshop Layout Optimization of a Steel Structure Company Based on SLP [J]. Modern Manufacturing Engineering, 2019, (3): 31-37.

[5] Zhang Z Y, Zheng C H, Song X F. Analysis of Benefit Allocation in Port Logistics Service Supply Chain Based on the Improved Value Method [J]. Industrial Technology & Economy, 2009, (6): 113-115.