Layout planning and evaluation of X Company manufacturing workshop based on linear system theory (MSLP)

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Abstract:

To China's accession to WTO, the process of reform and opening up has made an unprecedented breakthrough in the context of economic globalization. To meet the challenges, China's manufacturing enterprises to start first from the enterprise itself. This one crucial point is the production plant layout problem, the problem relates to the production capacity, efficiency, cost, safety and market competitiveness, advanced workshop layout to optimize the production process and significantly reduce overall logistics costs. Therefore, the layout setting is an important factor determining productivity of low.

In this paper, the use of dynamic linear system layout planning approach (MSLP) for the multi-product manufacturing plant layout planning. Compared to traditional methods, SLP, MSLP can perform logistics strategic planning, so that the whole system has the characteristics of dynamic flexibility, and thus action line analysis. By determining the type of facility layout, multi-product PQ analysis, integrated logistics and non-logistics from the point of view of the degree of association sector approach to the existing layout of the more in-depth and detailed analysis, to draw a more perfect layout scheme. Then using AHP and AHP-Fuzzy comprehensive evaluation method to improve program evaluation, selection of the optimal solution as the optimal manufacturing plant of Company X.

1. Preface

Currently logistics has gradually become enterprise's third "profit source" companies, it depends greatly on the rationality of the layout, therefore, the research on the workshop layout design is highlighted.

2. Research and diagnosis of X company

The practice facility is the Faw Baoyou Steel processing and distribution company, after a lot of research and data collection, and owing to understand relevant staff, we have a full understanding about the existing layout of the plant, to diagnose some aspects can be improved.

There exists the following three points can be improved through analysing layout：

(1)the inventory management of the whole plant is not accurate enough, and finished and semi-finished products storage area set up near the line, and it may against a unified inventory management, and could easily lead to unnecessary waste.

(2) there is a large amount of logistics between department 1 and department 5, but the distance is far away, and the intensity of logistics is greater, so produced higher logistics costs.

(3) The raw materials of the department 4 directly from the entrance, and the entrance is the starting point of logistics, because of the low sector productivity of department 4, the current layout arrangement may cause unnecessary waste.

Next, under the premise of not changing the existing process, and using SLP and MSLP

method to improve the layout of the workshop.

3. On the basis of the theory of the system layout theory (SLP) to improve the existing layout

Improvements to the existing layout according to the first steps of the traditional SLP method, after calculation and analysis can be obtained as shown in table 3-1 operations units integrated relationship calculation table:

Table 3-1 operations units integrated relationship calculation table

Serial number	Operating Unit pair	Close degree					
		Logistics relationship (weighted value:3)		Relationship between non-logistics(weighted value:1)		Comprehensive relationship	
		Grade	Score	Grade	Score	Score	Grade
1	(1—2)	A	4	A	4	16	A
2	(1—3)	I	2	U	0	6	I
3	(1—4)	U	0	U	0	0	U
4	(1—5)	U	0	O	1	1	O
5	(1—6)	U	0	U	0	0	U
6	(1—7)	U	0	O	1	1	O
7	(2—3)	I	2	E	3	9	E
8	(2—4)	E	3	I	2	11	E
9	(2—5)	U	0	I	2	2	O
10	(2—6)	U	0	X	-1	-1	X
11	(2—7)	U	0	O	1	1	O
12	(3—4)	O	1	E	3	6	I
13	(3—5)	U	0	U	0	0	U
14	(3—6)	U	0	U	0	0	U
15	(3—7)	U	0	U	0	0	U
16	(4—5)	U	0	U	0	0	U
17	(4—6)	U	0	O	1	1	O
18	(4—7)	U	0	U	0	0	U
19	(5—6)	U	0	U	0	0	U
20	(5—7)	U	0	U	0	0	U
21	(6—7)	U	0	U	0	0	U

Then draw the job location line chart, and as shown in figure 3-1:

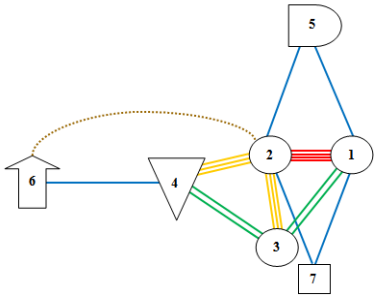


Figure 3-1 The job location line chart

Getting the job location line chart, according to this and combined with working units of the actual area occupied, we can get two layout improvement project, as shown in figure 3-2 and figure 3-3:

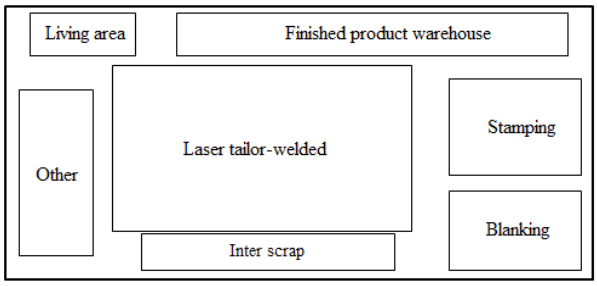


Figure 3-2 Improved Programme 1

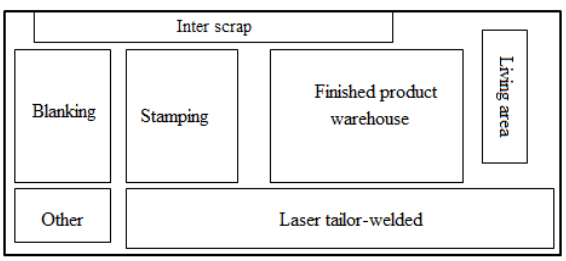


Figure 3-3 Improved Programme 2

4. Using MSLP method to improve the existing layout

4.1 MSLP method step process

The method processes of dynamic linear system arrangement theory as shown in figure 4-1, where the blue part is different from the traditional SLP method.

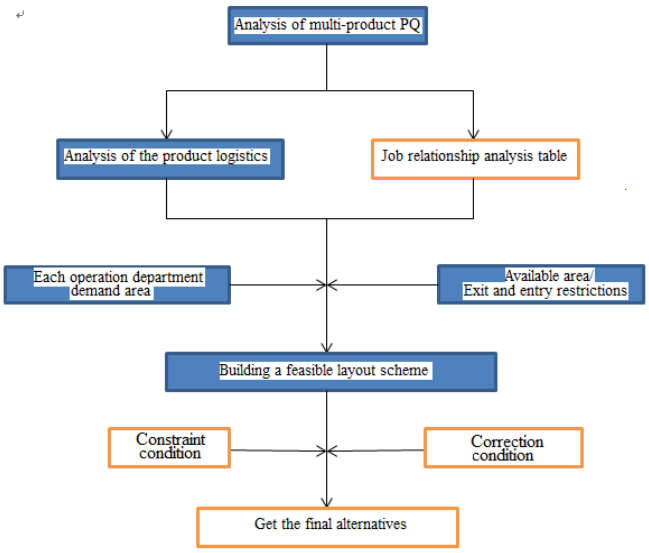


Figure 4-1 Improved SLP method process

1) The new calculation method is adopted for the analysis of multi-product PQ, not only take into account the demand of product output, more consideration is different products on profit contribution as well as the difficulty of material transport.

2) The product stream analysis is used the method of drawing flow chart, and calculation of each department on comprehensive and monthly weighted volume, finally, you can get the from-to chart of the amount of logistics between the various departments.

3) Demand area statistics of the department, the available area and exit and entry restriction is to be processed on the grid area chart, and it is prepared for the layout of the next.

4) Construction feasible layout scheme is based on the design of new heuristic rules, specific rules are as follows：

（a）：Analysis of all the jobs sector, to identify all valid paired relationship.

（b）：For manufacturing plant layout, the entrance is the starting point for all the logistics of R, the inlet box with a virtual representation and as stream starting point.

（c）：Comparison of the remaining pairs of relations, to find out which one party has arranged a good pair of relationships (when the relationship between the two parties have a good layout, it is no longer considered), and the highest degree of comprehensive close associate relationship.

（d）：The third step is repeated until all sectors are arranged end. In this process, the outlet (end C) should be done with the inlet arrangement the same adjustment.

（e）：When all sectors are arranged well after the end of the stage.

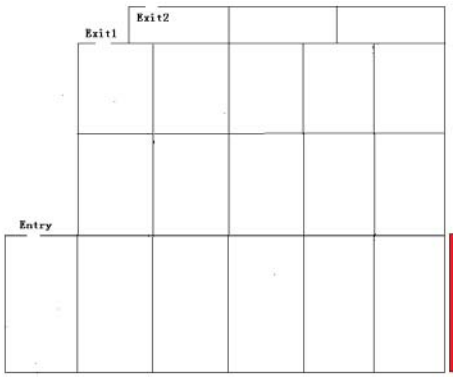
4.2 Specific program design

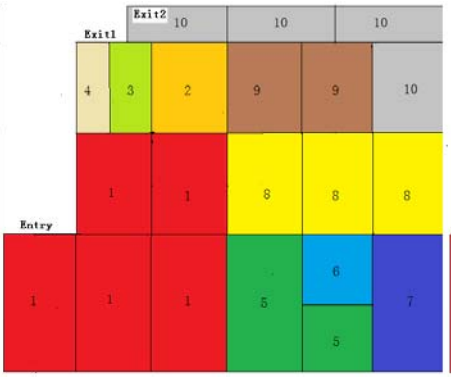
On the basis of data collected and the research methods employed, to improve the existing layout design, to give a comprehensive relational tables as shown in table 4-1:

Table 4-1 Job Logistics - operating units relationship table

Department Numbering	R	1	2	3	4	5	6	7	8	9	10	C1	C2	
R	0	16			6									
1		0	14			14								
2			0	7				2	1	1		1		
3				0							7	1		
4					0			6	1			1		
5						0	14	2	1	1		1		
6							0		14	5		1		
7								0	6			1		
8									0			16		
9										0		5		
10											0		7	
C1												0		
C2													0	

Then perform raster producing area, to give the area shown in figure 4-2:





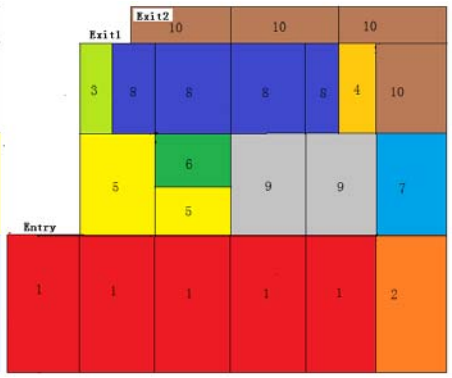


Figure 4-2 Factory area expressed view grid number Figure 4-3 The first alternative Figure 4-4 The second alternative

Finally, according to heuristic rules laid out in the area of the map, to get the two to improve the scheme shown in figure 4-3 and figure 4-4:

4.3 Comprehensive comparison of the two systems arrangement method

Two arrangements methods in the practical application in the process of comparison can be drawn:

1) Traditional SLP method to determine the operating units first relationship, then build a layout based on association graph, and using an iterative (mostly to swap adjacent unit) to calculate the satisfaction layout scheme, the entire comparison and calculation process will be time-consuming, and involve more departments and much more frequent adjustment, and longer time-consuming.

2) When the layout constructed, SLP law does not shape the plant and entrances into account only if the decision-making phase of the program need to consider amending the conditions and practical constraints may be adjusted, so that will undoubtedly complicate the practical problems and take longer.

3) In the analysis of the relevant departments to do when you close relationship, SLP rely on subjective experience of the staff, and then the relationship between the use of work tables and

diagrams job qualitative judgments.

After these comparisons, we can see that compared to the traditional method SLP the MSLP method is more scientific, more in line with objective reality, can better solve practical problems. This selection system is arranged so modified theory (MSLP) were designed as an improvement.

5. Using two evaluation methods to evaluate and select options

For the design of two improvement plan, this paper selects the analytic hierarchy process (AHP) and AHP-fuzzy comprehensive evaluation method to evaluate alternatives and choices.

Then to get the index weights from the expert questionnaires, expressed in matrix form, and then use matlab software programming calculated to obtain the final total of consistency ratio 0.0285 <0.1, meet consistency. And plan 3 identified as the best option.

Similarly, in the use of AHP- fuzzy comprehensive evaluation method is also concluded that plan 3 is the optimal solution. Therefore, plan 3 could eventually determine the best improvement plan.

6. Conclusion

In this paper, X company manufacturing plant for the study, with X company manufacturing plant layout planning and evaluation of research. For manufacturing enterprises, its plant layout is good, rational use of space could directly affect their economic and social competitiveness. Therefore the factory should carry on the reasonable planning of production facilities and production workshop design, so as to exert the maximum production capacity of its production systems to enable enterprises to meet customer requirements, but also greatly enhance its overall competitiveness.

In this paper, the significance of the X company manufacturing plant is also here. So the topic of great theoretical and practical value.

The main research work are as follows:

1) Description about the present situation of X company and its manufacturing plant, manufacturing workshop analyze the situation, diagnose the problems.

2) Using System Layout Design (SLP) method to improve plant layout.

3) Using the modified system layout design method (MSLP) to design improvement of workshop again, by using two different methods to improve the layout,and comparing the two is reasonable, the final choice of method is to get MSLP program as an alternative.

4) Were used AHP and AHP- fuzzy comprehensive evaluation methods of the three programs contain the initial layout and improving program evaluation, including merit, a comparative analysis of the two methods, both come to the same conclusion, more proof of conclusion correctness. Finally, select the best solution.

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