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A New Strategy to Reduce Wasted Time during Production Processes Using Process-Oriented Layout Approach

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Abstract.

The process of arranging and organizing the physical space of a factory to optimize workflow, maximize efficiency, and create a safe and productive working environment is known as factory layout design. The placement of equipment, machines, storage areas, workstations, and other elements within the factory is planned during this process. An efficient production process that minimizes wasted time and resources is the goal. The approaches of layout design require the use of trial and error methods, which can be time-consuming but effective when other methods fail. In this study, a new approach will be provided without using a trial and error method to find the optimum result for low-cost of layout organization. The importance of considering the flow of materials and information when designing production layouts is highlighted in this paper and a practical solution for reducing the wasted time during these processes is provided.

Keywords: Trial and error method, Minimizes wasted time, Layout design, and workflow

الملخص:

تُعرف عملية ترتيب وتنظيم المساحة المادية للمصنع لتحسين سير العمل وزيادة الكفاءة إلى أقصى حد وإنشاء بيئة عمل آمنة ومنتجة باسم تصميم تخطيط المصنع. يتم التخطيط لوضع المعدات والآلات ومناطق التخزين ومحطات العمل والعناصر الأخرى داخل المصنع خلال هذه العملية. الهدف هو عملية إنتاج فعالة تقلل من الوقت الضائع والموارد. تتطلب مناهج تصميم التخطيط استخدام طريقة التجربة والخطأ التي يمكن أن تستغرق وقتًا طويلاً ولكنها فعالة عندما تفشل الطرق الأخرى. في هذه الدراسة، سيتم تقديم نهج جديد دون استخدام طريقة التجربة والخطأ للعثور على النتيجة المثلى لتكلفة منخفضة لتنظيم التخطيط. تم تسليط الضوء على أهمية النظر في تدفق المواد والمعلومات عند تصميم تخطيطات الإنتاج في هذه الورقة، ويتم توفير حل عملي لتقليل الوقت الضائع أثناء هذه العمليات.

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Introduction

There are a lot of methods and approaches to decreasing wasted time and cost during production processes such as: first is automate processes: Automating production processes can help reduce time and cost of production by eliminating manual labor, reducing errors, and increasing efficiency. The second is streamline supply chain: Streamlining the supply chain can help reduce costs by eliminating unnecessary steps and improving communication between suppliers and manufacturers. Third is implement lean manufacturing: Lean manufacturing is a process that focuses on eliminating waste and improving efficiency in the production process. This can help reduce time and cost of production by reducing the amount of resources used in the process. Fourth is utilize technology: Technology can be used to automate processes, streamline communication, and improve accuracy in the production process. This can help reduce time and cost of production by reducing errors and increasing efficiency. Fifth is outsource tasks: Outsourcing certain tasks to third-party vendors can help reduce costs by taking advantage of lower labor costs in other countries or regions. Sixth is designing a process layout base on minimizing time of handling, and so on.

Process layout is a type of layout that groups similar processes together. It is used to increase efficiency and reduce costs by reducing the amount of time and resources needed to move materials between processes.

First, identify the processes: The first step in designing a process layout is to identify the processes that need to be grouped together. This includes identifying what tasks are required for each process, as well as any equipment or materials needed. Second, analyze the flow of materials: Once the processes have been identified, it is important to analyze how materials will flow between them. This includes considering how long it takes for materials to move from one process to another, as well as any potential bottlenecks or delays that could occur. Third, design the layout: Once the flow of materials has been analyzed, it is time to design the actual layout of the process. This includes determining where each process should be located in relation to one another, as well as any additional equipment or storage areas that may be needed. Fourth Test and adjust: After designing the layout, it is important to test it out and make any necessary adjustments before implementing it on a larger scale. This can help ensure that all processes are running smoothly and efficiently before going live with the new system.

The big challenge that we have to use trial and error method to find the optimum arrangement or layout, as we know the trial and error method is a problem-solving technique in which a person attempts different solutions until they find one that works. This method involves making guesses, testing them out, and learning from the results. It is often used when an exact solution is not known or when a problem has multiple solutions. This approach can be time-consuming but can be effective when other methods fail.

Literature Review

Several studies have examined the effectiveness of process-oriented layouts in reducing wasted time during production processes. For example, a study by Kusiak et al. (2006)[1] found that implementing a process-oriented layout in a manufacturing facility led to significant reductions in cycle times and increased productivity.

Another study by Zhang et al. (2017)[2] examined the impact of process-oriented layouts on worker performance in an assembly line environment. The researchers found that workers in the process-oriented layout group had higher levels of job satisfaction and were more productive than those in the traditional layout group.

In addition to improving worker performance, process-oriented layouts can also help companies reduce costs associated with wasted time during production processes. A study by Wang et al. (2018)[3] found that implementing a process-oriented layout led to significant reductions in material handling costs and inventory levels.

Several case studies have been conducted to evaluate the effectiveness of process-oriented layout approach in reducing wasted time during production processes. One such study was conducted by Kuo et al. (2012)[4] in a semiconductor manufacturing company in Taiwan. The study found that implementing a process-oriented layout approach resulted in a 15% reduction in cycle time and a 20% increase in throughput.

Another case study was conducted by Lee et al. (2014)[5] in an automotive parts manufacturing company in Korea. The study found that implementing a process-oriented layout approach resulted in a 25% reduction in cycle time and a 30% increase in productivity.

However, implementing a process-oriented layout approach is not without its challenges. For example, companies may need to invest in new equipment or retrain workers to adapt to the new layout. Additionally, the process of redesigning the production process can be time-consuming and costly.

Methodology

In general there are some process should be followed for designing a layout process:

1. Identify the product or service to be produced: The first step in designing a production process layout is to identify the product or service that will be produced. This includes understanding the customer requirements and specifications for the product or service.

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2. Analyze the production process: The next step is to analyze the production process and identify all of the activities that are necessary to produce the product or service. This includes identifying any special equipment, materials, and labor that may be required.

3. Determine space requirements: Once all of the activities have been identified, it is important to determine how much space will be needed for each activity. This includes considering factors such as safety, ergonomics, and efficiency.

4. Design a layout: Once all of the space requirements have been determined, it is time to design a layout for the production process. This includes deciding where each activity will take place and how they will be connected with one another in order to create an efficient flow of work.

5. Test and refine after a layout has been designed, it is important to test it out and make any necessary changes in order to ensure that it is efficient and effective for producing the desired product or service.

In this study we will follow a strategy of reducing the time of process in a factory that has nine tasks, during monitoring this factory for one month we find the mean of motion of workers between and among the eight tasks as shown in table1.

Table 1. Number of workers motion (*from-to-from* matrix).

	A	B	C	D	E	F	G	H	I
A		30	15	10	8	60	7	8	20
B	20		7	20	30	60	7	18	15
C	18	17		30	20	20	16	15	30
D	30	13	13		20	8	29	15	60
E	24	12	15	22		17	18	13	14
F	16	9	8	23	9		22	22	85
G	8	7	9	14	6	8		23	76
H	21	6	6	12	15	2	22		20
I	19	11	0	8	0	7	3	4	

Table 2. Number of workers motion (*from-to-from collection* matrix).

	A	B	C	D	E	F	G	H	I
A		50	33	40	32	**76**	15	29	39
B			24	33	30	**69**	14	24	26
C				43	35	28	25	21	30
D					42	31	43	27	**68**
E						26	24	28	14
F							30	24	**92**
G								45	**79**
H									24
I									

Results

We assume that each adjacent tasks or offices have not time cost, the time consumed comes from the motion between not adjacent tasks, therefore we need to reducing wasted time among the factory's offices by reorienting places of tasks. **By trial and error** [1], we try to improve the layout pictured in **Fig 1** to establish a better arrangement of departments. The total motion based in **Fig 1** can be calculated as below.

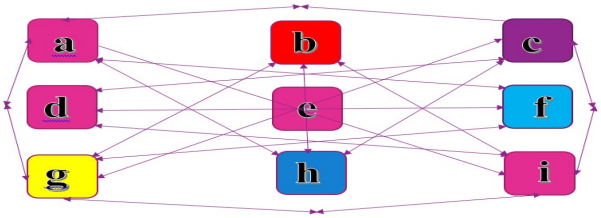

Fig 1. Departments before reorientation

Total motion = AC+GI+AG+CI+BH+DF+AI+GC+BG+AH+CH+BI+AF+CD+FG+DI

=33+79+15+30+24+31+39+25+14+29+21+26+76+43+30+68+35+33

= 583 motion

Old Strategy of reorientation (trial and error)

From **Table 2**. We can see clearly the biggest motion between AF and BF also there are another big motion between ID, IF and IG. In this case, departments A and B must be close to the department F, at the same time departments D, F and G must be close to department I.

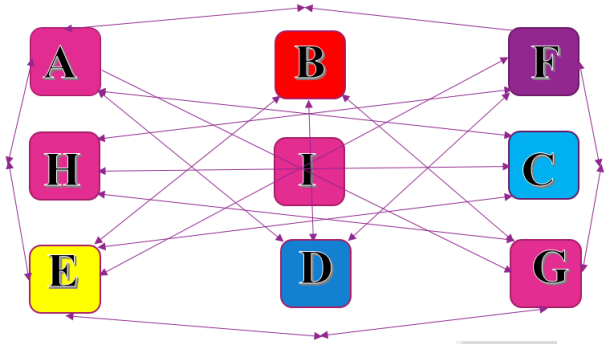

Fig 2. Departments' reorientation number 1

Total motion =AF+AE+AG+AD+AC+FE+FH+FG+FD+GE+GB+GH+ EB+EC+DB+CH

=76+32+15+40+33+26+24+30+31+24+14+45+30+35+68

= 523 Motion

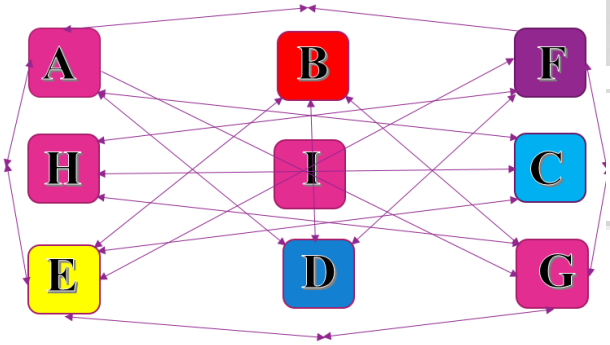

Fig 3. Departments' reorientation number 2

Total motion =AF+AE+AI+AC+AD+EG+EB+EF+HC+HG+HF+GF+GB+FD +BD+CE

=76+32+39+33+40+24+30+26+21+45+24+30+14+31+33+35

= 533 Motion

A new strategy for reorientations and designing layout at low cost or low time.

Table 3. Number of workers motion (from-to-from collection matrix).

	A	B	C	D	E	F	G	H	I	Total i
A		50	33	40	32	**76**	15	29	39	**314**
B			24	33	30	**69**	14	24	26	220
C				43	35	28	25	21	30	182
D					42	31	43	27	**68**	211
E						26	24	28	14	92
F							30	24	**92**	146
G								45	**79**	124
H									24	24
I										0
Total j	0	50	57	116	139	230	151	198	372	**1313**
Total i+j	314	270	239	327	231	**376**	275	222	372	**2626**

From Table 3 department F has the highest motion, with departments I, D and A, that lead us to but department F in the middle of factory close to departments I, D and A

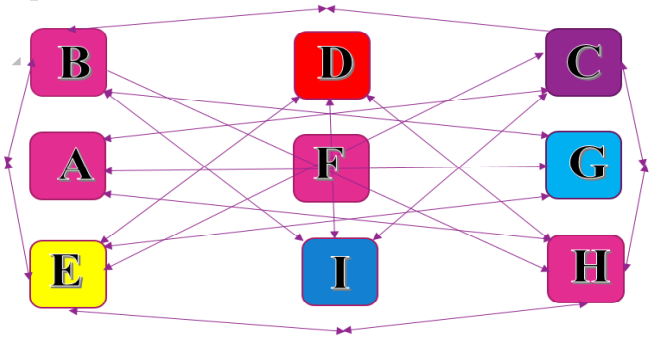

Fig 4. Departments reorientation number 4

Total motion = BC+EH+BE+CH+**DI**+AG+CE+BH+DH+CI+DE+BI+GE+GB+AC+AH

= 24+28+30+21+**68**+15+35+24+27+30+42+26+24+14+33+29

= 470 Motion

We can see all "not adjacent" departments have low number of motion except department D and I, they have about 68 motions, but we have only one high number. Therefore, we can assuming this is optimum result.

Conclusion

In conclusion, wasted time during production processes is a significant challenge faced by manufacturers. However, adopting a process-oriented layout approach can help companies reduce travel times between workstations and minimize delays caused by waiting for materials or tools. Several studies have shown that implementing a process-oriented layout can lead to significant improvements in productivity and worker performance while also reducing costs associated with wasted time. While there are challenges associated with implementing this approach, the benefits are clear and make it worth considering for any manufacturer looking to improve their production processes.

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