ANALYSIS AND SIMULATION OF THE PUNCHING SYSTEM AT FACTORY NO. 1, THANGLONG METAL COMPANY

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ABSTRACT

The research team collected and analyzed data related to punching process, working stations, moving flow, required number of workers and actual operating time at Factory No. 1 of Thang Long Metal Company. On that basis, design and simulate the system with Tecnomatix Plant Simulation software to see the productivity and output of the machines in the system.

Keywords: *Bottlenecks; Lean; Output; Productivity; Simulate the system.*

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NOMENCLATURE/SYMBOLISM

G	: Working time in 1 day
GV_{bq}	: Average number of hours a worker has time off in a working day
N	: Number of working days of a worker in a year
T_{bq}	: Actual working time of a worker in a month
CN	: Number of workers needed
DMsi	: Output norm (number of products/1 work hour)
a_i, b_i	: is the location coordinates of related parts
w_i:	: is the weight related to the movement of materials between departments

1. INTRODUCTION

Punching is a method used to create shapes on flat surfaces. The machine will include a punching part and a stamping part. When working, it can accurately punch holes quickly and continuously. This method can be used on many different types of soft and hard materials. Punching technology has been around for a long time, starting in 1863. In 1863 - 1946: MFO URNEAUX invented the world famous "Automatic Piano" called PIANNOLA. Perforated paper tape as a carrier was invented. Dr. Johnw Mauchly and Dr. Jspresper Eckert invented the first electronic computer called "ENIAC" for use by the US military.[5]. In 1948 - 1952: T. Parson and MIT Institute of Technology. (Masachusetts Institute of Technology) has researched and designed under a contract from the US Air Force (US AF) a control system for machine tools[5]. In 1958 - 1970: Kerny and Trecker jointly introduced the ATC (Automatic Tool Changer) automatic tool changer system also known as "Milwaukee Matic" introducing the first symbolic programming language APT associated with the IBM704 computer. The NC control system using semiconductor lamps has replaced the old control systems using electronic lamps (using electronic lamps). German machine builders displayed the first NC control machine at the Hanover fair [5].

At Thang Long Metal Company, currently the Punching line is not fully utilized at all steps of the job, directly affecting product quality as well as the productivity of the line. Therefore, analyzing and designing the Punching system in Factory No. 1 of Thang Long Metal Company uses software to provide data so that businesses can improve the system, streamline the production process, and maximize the production process profit [1].

2. RESEARCH METHODS

According to [3], Working time of workers in a day:

$$G = 8h - GV_{bq} \text{ (minutes)} \quad (1)$$

where GV_{bq} - the average number of hours a worker has time off in a working day..

GV_{bq} - takes the expected working timetable, usually from (0.5 - 1)h.

- The number of working days in a month of a worker:

$$N = k - NV \text{ (minutes)} \quad (2)$$

Where, N: The average number of working days per worker in a year

- The actual working time of a worker in a month:

$$T_{bq} = N \times G \text{ (minutes)} \quad (3)$$

Where, G: Average number of working hours per worker per day.

- Number of workers required:

$$CN = \sum_{i=1}^{m} Q_i \,.\, DM_{ti} \cdot \frac{1}{T_{bq}} \text{ (workers)} \quad (4)$$

In which: DM_{ti} - Quantity of output products (number of products/1 working hour)

Simulate the system using Tecnomaxtic Plan Simulation software, set cycle time, failure rate of machines in the system. Conduct a test run of the model to see the performance of the machines and the output of each line [5].

3. DISCUSSION RESULTS

3.1. Collect and analyze data

3.1.1. Types of products in the Punching Line

The Punching line produces 4 types of products including: 25mm dowel pieces, 10mm dowel pieces, trapezoidal pieces and triangular pieces. 25mm bolt catch, 10mm bolt catch: bolt used in manufacturing details of motorbike fork products, induction cookers, other mechanical components, etc. exported to foreign countries [1]. Trapezoidal pieces, triangular pieces: often widely used in many fork products, automatic bar feeders, etc.[1]. The following is information about the types of punching products produced at Factory No. 1 of Thang Long Metal Company.

Fig. 1. Punching products

3.1.2. Punching Process

The operating process of the punching system at Thang Long Metal Company includes 5 steps as shown Fig. 2.

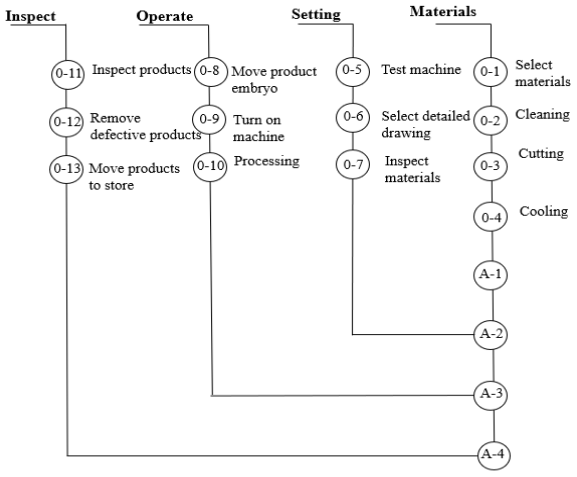


Fig. 2. Punching process at Factory No. 1 of Thang Long Metal Company

3.1.3. Types of moving lines

The overall design of the premises is in an I-shape with a straight flow from receiving goods to shipping and vice versa. This setup is said to provide the most optimization because it utilizes the entire length of the shop floor, keeps similar products separated according to the assembly line format, and minimizes bottlenecks by Avoid moving back and forth.

Table 1. Flow moves between parts

Part	Area	Flow moves between parts			
		Production workshop	Inspection area	Living area	Product shevles
Production workshop	60	-	50	30	45
Inspection area	40	60	-	10	45
Living area	30	40	30	-	10
Product shevles	18	30	40	5	-

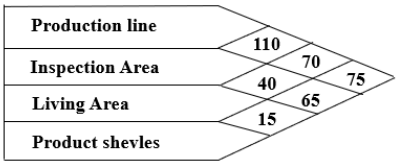
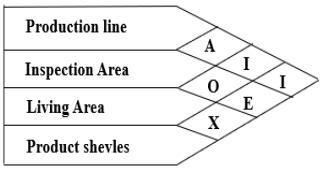


Fig. 3. From - To maxtric

From there we can establish the FROM – TO matrix



LADDER CONVERT	
A	101 - 120
E	81 - 100
I	61 - 80
O	41 - 60
U	21 - 40
X	0 - 20

Fig. 4. Realationship between parts matrix

From there we build a relationship diagram between the parts

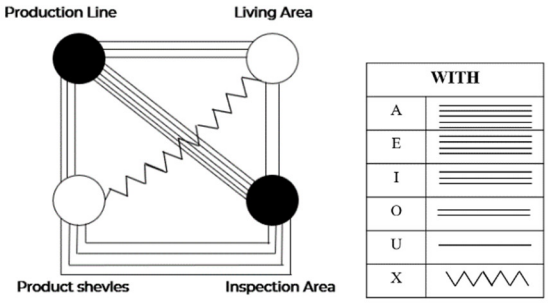


Fig. 5. Relationship diagram between the parts

3.1.4. Number of the workers

In Factory No. 1 of Thang Long Metal Company, there are 126,744 products [1] of finished goods to be exported/month. The rated time for this product is 0.33

minutes. Every day workers work 2 shifts of 8 hours. The enterprise operates 26 days/month, the average number of days absent for workers in a month is 1 day, and rest time is 120 minutes..

Working time of workers in a day:1800(minutes)

Number of working days in a month for workers:25 (days)

Actual working time of a worker in a month:750(hours)

Number of the workers 20 (workers)

→ Therefor in one working month, 20 workers are needed to ensure the proposed work plan.

3.2. Simulate

The research team used Tecnomatix Plant Simulation software to simulate the system.

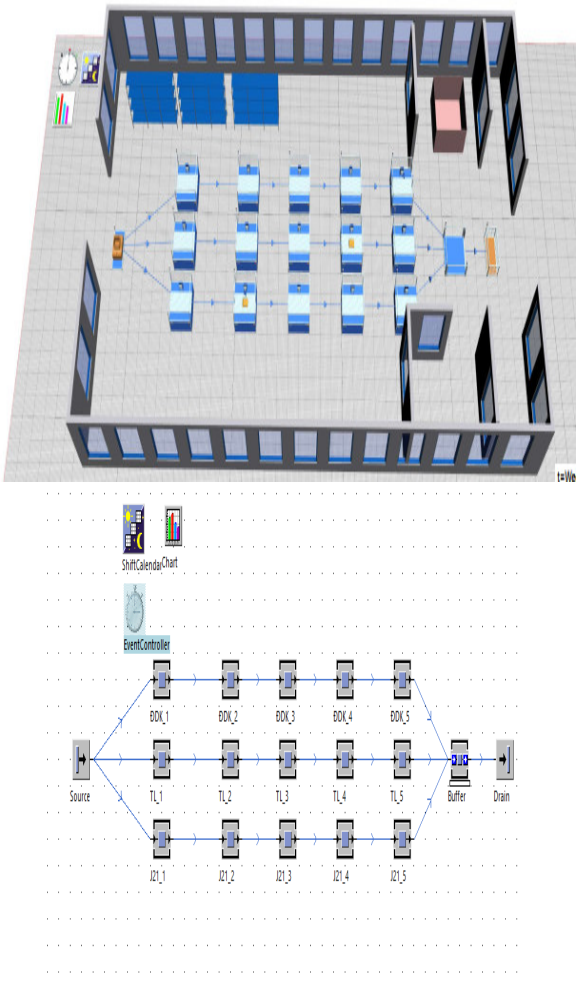


Fig. 6. Overall 2D and 3D plan of the system

Based on simulation software, we get the working rate of the equipment in the system in 1 Working days (actual working time 8 hours) are as follows.

Table 2. System output results

Simulation time:8:00:00.0000

Object	Name	Mean Life Time	Throughput	TPH	Production	Transport	Storage	Value added	Portion
Drain	Part	3:21.8334	1909	239	100.00%	0.00%	0.00%	70.91%	

Cumulated Statistics of the Parts which the Drain Deleted

From Table 2 we get the simulation results:

- Total output (Throughput): 1909
- Output per hour (TPH): 293
- Value added: 70.91%

Looking at the above results, we see that the added value of the system is quite high, reaching 70.91%, proportional to the company's profit source. The higher the added value, the greater the profit of the business. Besides, the total output has not met the plan.

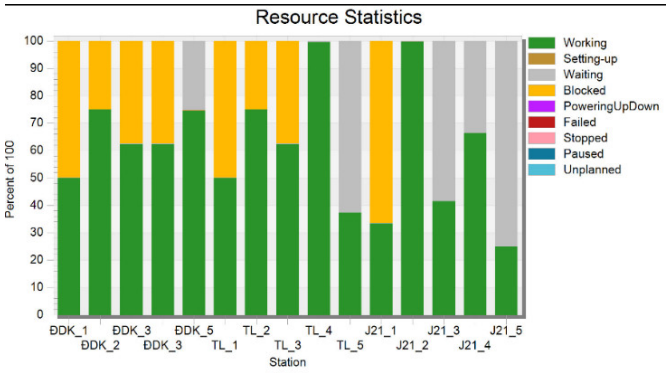


Fig. 7. Statistical chart of work performance of stations

Table 3. Average operating parameters of each part

Production line	Working rate	Blocking Rate	Waiting Rate	Failed Rate	Quantity in a hour (detail)	Total production per shift
ĐDK	64.2%	30.6%	5.2%	0%	101	810
TL	64.05%	22.45%	13.5%	0%	81	645
J21	33%	6.45%	60.55%	0%	57	454

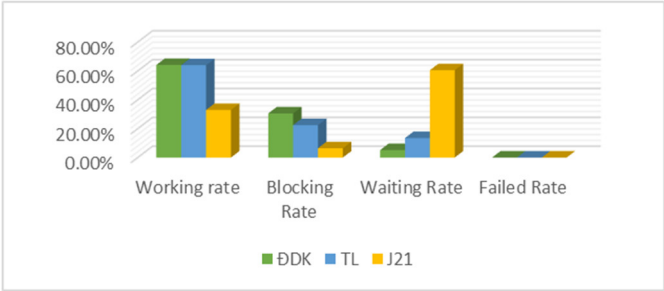


Fig. 8. System working rate diagram

The average working rate for machines in the DK area is 64.2%, accounting for the highest average rate of active machines in the areas, the average Block rate is 30.6%, the average waiting rate is 5.2% and the average failure rate is 0%. The working rate of the TL area is quite high, reaching 64.05%, not significantly different from the area with the highest operating rate. Block rate is up to 22.45% and has an average waiting rate of 13.25%. The waiting rate of area J21 is very high, accounting for 60.55%, while the working rate of the machines is only 33%. In particular, the congestion rate of machines in area J21 is the lowest, accounting for just over 6%. Thus, the parameters clearly show the working rate of each area in the punching system. The number of active machines in the system is still quite low but the congestion

rate is still very high. Especially the J21 machine has an average waiting rate among machines of more than 60%.

4. CONCLUSION

The research team has collected necessary data of the punching system such as movement flows, number of machines, work stations, number of workers needed, and product processing time. From there, simulate the system using Tecnomatix Plant Simulation software to see the productivity and output of the machines in the system. After simulation, the system results are as follows: Total output: 1909 products, Output per hour (TPH): 293 products, Value added: 70.91%.

1. Through simulation, analyze the system through the data shown in the tables. From there, it was realized that the working productivity between machines such as the highest performing die punching machine and the J21 punching machine needed to be rearranged so as not to affect the productivity of the whole system.

2. Application of Tecnomatix Plant Simulation software to simulate the system layout. Specifically, the software displays data and performance of each workstation. Through simulation, we found that the added value of the system is very high, accounting for 70.91%. That shows that the profit of the system is quite high. Besides, some working machines have not achieved high productivity like the work station of machine J21 and the output parameters have not met the set requirements.

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