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Determining the Optimum Number of Locomotives in the Steel Industry Using Motion and Time Study Techniques

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ABSTRACT

Due to the rising prices of energy products, shipping by truck will cost less. The use of rail transport costs will be significantly reduced. Currently, Mobarakeh Steel about 500,000 tons of steel coils, hot and cold Board, tin-plated, color via rail to bring customers, the company's goal is that this will amount to 1.5 million tons to 12 million tons of goods and materials for transport to rail. Study is essentially descriptive - analytical and applied research is the goal of trying to work through the ergometer and timing optimization of railway locomotives needed to determine the organization's future goals. Results indicate that organizations achieve their future goals in the rail transportation of materials and products are needed to fifteen locomotives device. This could be used in line with the results of its work to provide useful information in assessing and predicting the future goals of the organization as a model.
KEYWORDS: motion and time study, optimum number of locomotives.

INTRODUCTION

A glimpse into the development of applications in industrial countries and developing countries, who eagerly desire to understand product development and to increase the share of national industrial production and industrialization we need, is the right choice for industrial design. The right choice, the only way ergometer and the technical and economic feasibility of the application of technical and economic and technical results used in system design, project economics, and vice versa is possible. Purpose must be estimating technical and economic assessment of a dynamic system is connected together. This seems to prevent the waste of resources, the optimal choice is very important. Expected to increase in developing countries to the industrial production during the next decade and reach a large amount of new industrial investments. The number and size of pre-investment studies increases. More advanced industries, not only because of the final products, but due to technological alternatives will produce more complex. In our country because of cheap energy for transportation is not optimal. But little by little, by reducing energy subsidies, the fundamental question, choose the method of transportation to reduce both the cost and reduce the loss of life and property and the railway line, as the complex is considered to be cheap and reliable. Due to the portability of steel products and materials on elevated rail freight tonnage will have a significant role in the steel industry [17]. Taken very broad range of applications and other complex mental processes also involve other human activities. Industrial engineers deal efficiently with all the activities that they are involved with, have a different system clock to create a range of different applications [15].

For determine the optimal number of locomotives for freight purposes of future, the present paper initially describes motion and time study according to the theoretical backgrounds. This is followed by the ergometer techniques for determining the optimum number of locomotives in the Mobarakeh steel industry. The findings of the study are provided in the last section. The model presented in this paper is new and has not been seen in previous studies.

Motion and Time Study

Search to find an appropriate method of operation is not new and the History of the Human Community was formed. Always finding ways to improve the operations of their attention and most talented people to hire are also methods [18]. It is well known that the timing of the workshop of Steel Company in 1881 AD by Taylor has begun. Evaluate the work and time and timing is one of the most trusted ways through which one can promote the many benefits of human performance, increasing production value, better service and lower costs achieved. Although Taylor is known as the father of the clock, but the clock before he was in Europe, and in 1760 a Frenchman, when an extensive study conducted for the pin and an economist for 60 years English as an archivist continued to do so [3]. Following Taylor's theories, based on Frank Gilbreth and his wife Lillian Gilbreth motion analysis necessary, spend a lot of effort established by scientific methods of motion analysis and have achieved great success in this field. Efforts of Taylor, Frank and Lillian Gilbreth, analysis activities as one of simple techniques work and it was one of the requirements for the measurement. In the mid-twentieth century, in the context of bilateral simultaneous motion was carried, and the combination of the two, emerged called a "time and motion study". Due to the rapid changes that have recently emerged in this field, today the term (motion and time study) the broad sense, changes in the field of basic science have found this method [11]. A time and motion study (or time-motion study) is a

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business efficiency technique combining the Time Study work of Frederick Winslow Taylor with the Motion Study work of Frank and Lillian Gilbreth (the same couple as is best known through the biographical 1950 film and book Cheaper by the Dozen). It is a major part of scientific management (Taylorism). After its first introduction, time study developed in the direction of establishing standard times, while motion study evolved into a technique for improving work methods. The two techniques became integrated and refined into a widely accepted method applicable to the improvement and upgrading of work systems. This integrated approach to work system improvement is known as methods engineering [7,16]. and it is applied today to industrial as well as service organizations, including banks, schools and hospitals[1].

The design of the method of performing an operation when a new product is being put into production, or the improvement of a method already in effect, is a very important part of motion and time study. The logical and systematic approach to solve almost any problem (Barnes, 1980) includes (1) problem definition and analysis; (2) search for possible solutions; (3) evaluation and discussion the alternatives and (4) recommendation for action. Improving worker satisfaction and productivity especially in repetitive production tasks are major concerns for management as these tasks are monotonous, boring, fatiguing, and demotivating and consequently affect satisfaction and productivity (Shikdar and Das, 2003).There is a body of knowledge which has evolved over the years that is designed to increase the productivity of an organization and of the individuals who make up the organization. The elimination of unnecessary work and the design of methods and procedures (which are most effective, and require the least effort, and are suited to the person who uses them) are the most important objectives of motion and time study [8].

Ergometer is a term for motion and study techniques that that will be effective in providing manpower, equipment and materials. Systematic recording methods, performance techniques and critical evaluation of current and proposed methods are more efficient and easier to use And the measurement time work and working time is characterized [3,5]. The main objective of the motion study to reduce the extra work is the main measure used to assess the time ineffectual is the combination of the two methods lead to a standard time for the operation improved the work is [4, 10]. Ergometer and the standard time for work performed, there are several techniques. Depending on the condition and use of the standards, the appropriate techniques are used [6]. The ergometer should be reviewed and evaluated the method, not the individual worker. A method for the ergometer is chosen, it should be understood to apply and what standards should be set. Not too high and not too low-level hard to be real and simple [2].

In this study, we have tried to determine the necessary cycle for rail transportation of materials and products, using a stopwatch to determine the time of each cycle, and the results determine the optimum number of locomotives for future goals.

Research Design

In this section, we first determination cycles Rail transportation of materials and products by motion study of rail activity then uses the timing of activities during each cycle is determined by the stopwatch. In Continue number of cycles needed to transport materials and products are calculated according to the company's future goals. And the operating time per locomotive time working directly determine the optimal number of locomotives needed to reach future goals specified.

1- Material Station

Rail transport in the material, the Hassan Abad station to station wagons of the raw material is transferred in this cycle, 12 station wagon by two locomotive shipped in raw materials is parked. Ingredients station has a capacity of 8 lines, which are lines (line 42:1 wagon, the wagon 43:2, 44:3 trolley line, trolley line, 45:4, 50:5 line of carriages, wagons 50:6 line, line 46 : 7 wagon, the wagon 43:8). Then a locomotive wagon, hooked them up to 12 Kardampr discharge unit carries. If you do not hook the winch hook type Karayndksr in Kardampr evacuated. Is the total number of 1,450 wagons and 300 wagons are circling the hook and locomotive exhaust are Kardampr after an empty wagon locomotive 50 pass from behind Kardampr station materials. Finally carrying 50 empty wagons of food station to station, Hassan Abad, which is done by the Locomotive 12? After the cycles, the rail transportation of materials during normal activity after 15 times per clock cycle, and the average and considering the performance factor of 100% was obtained in Table (1).

Table (1): cycles taken for carrying railway materials

The number of locomotives used	Cycle time (min)	Description	Number cycle
2	102	moving single locomotive to Hassan Abad station, preparation and transportation full vagons to materials station	**1**
1	57	Preparing and moving vagons to Kardampr	**2**
1	24	Unloading vagons in Kardampr	**3**
1	39	Preparing and transfer empty vagons from kardamper to materials station	**4**
2	55	Transfer empty vagons from materials station to Hassan abbad station	**5**

2- Product station

Empty vagons carrying products in the locomotive required to transport goods from station to station, Hassan Abad brings products. Where wagons are weighed and inspected the arrangements made to have vagons parts requests are sent weekly. Each point has a specific loading capacity of wagons. After loading wagon, locomotive rail vagons filled to the

blocking buffer is known to take place there. After loading all the coaches and their accumulation in the buffer, the locomotive station wagon full range of products.

A weigh wagon to be printed bill of lading, the freight bill of lading and inspection by law enforcement officials are adapted, the wagon train officer will check the brakes and bleed, and Hassan Abad issued a permit to move Station and the line from the station to the Hassan Abad Hassan Abad locomotive moves. Station wagon in its separator and locomotive either individually or with the empty wagon is a station on the products. Done at the shipped product cycle time and cycle numbers in Table 2 are shown.

Table (2): cycles taken for Rail Products

The number of locomotives used	Cycle time (min)	Description	Number cycle
1	111	Moving locomotive with empty vagons from Hassan abbad station to productions station	1
1	26	Reporting loading plan and moving locomotive to loading points	2
1	95	loading wagon	3
1	91	Transfer full vagons from loading points to buffer	4
1	23	Transfer full vagons from buffer to productions station	5
1	20	Weighing full vagons	6
1	66	Moving locomotive with 10 full vagon to Hassan abbad station	7

3- Calculate the direct labor time per locomotive

To calculate the time each locomotive working directly with the table number (3) the need for operational and non-operational time is calculated. In the first profile when locomotives a year, according to data available at the railway organization in accordance with Table (4) was calculated. The standard working time for each locomotive the percentages obtained directly before and at the scheduled times were calculated in Table 5 are shown.

Table (3): The overall structure of the time

(TC) Calendar Time			
Operation Time (To)			Not Operation Time (Tno)
Working Time (Tw)		Not Working Time (Tnw)	Schedule maintenance .1
Direct Working Time .6 (Tdw)	Indirect Working .5 Time (Tiw)	Delays .3 Emergency .4	Schedule inactivity. 2

Table (4): Profile of the locomotive when the conditions for a year

Percent	In a year (Hours)	Part time
6.34	556	schedule maintenance
58.97	5166	Schedule inactivity
65.31	5721	Not Operation Time
6.46	566	Emergency
8.82	77	Delays
15.82	643	Not Working Time
7.55	62	Refueling and Inspection and Adjustment
7.55	62	Indirect Working Time
26.64	2334	Direct Working Time
34.19	2396	Working Time
34.69	3038	Operation Time
100	8760	Calendar Time
34.69		Operation Index (Io)
76.79		Utilization Index (Iu)

Table (5): specifications of each locomotive when planning for a year

A time machine for a year (hours)	Percent	Time
8760	100	Calendar Time
1610	18.37	Schedule maintenance
263	3	Preparation time
350	4	Idle time
263	3	Delays Time in repairs
876	10	emergency repairs Time
5398	61.63	Direct Working Time

4- Determine the optimal number of locomotives

This section doors, working directly with the amount of tonnage a locomotive at standard conditions and forecast for future delivery were determined optimum number of locomotives in the coming years. Thus, the formula number (1) is used.

$$\text{number of required locomotives} = \frac{\text{Total duration of activities to achieve the aims}}{\text{Total cycle time}} \quad (1)$$

In order to determine the time required to carry out activities aimed at increasing the product shipped from 500,000 tons to 1,500,000 tons shipped increased 7.5 million tons to 12 million tons of material, First is the number of cycles of the targets, we determined. Therefore, the predicted amount of material transported per cycle, where the cycle of tonnage shipped, we divided each cycle and frequency can be calculated as follows.

$$\text{number of cycles} = \frac{\text{Total Weight}}{\text{weight of per cycle}} \quad (2)$$

The number of repetitions of cycles per year (1.2.3.4) =12000000/ 1260 = 9523 (3)
The number of repetitions of cycles per year(5) =12000000/ 5250 = 9523 (4)
The number of repetitions of cycles per year (6,7,8,9,10,11,12) =1500000/ 500 = 9523 (5)

Table (6): The time required for the attainment of future goals

The number of locomotives used	Time required (min)	The number of repetitions of cycles per year	Cycle time (min)	Description	Number cycle
2	1942692	9523	102	moving single locomotive to Hassan Abbad station, preparation and transportation full vagons to materials station	1
1	542811	9523	57	Preparing and moving vagons to Kardampr	2
1	228552	9523	24	Unloading vagons in Kardampr	3
1	371397	9523	39	Preparing and transfer empty vagons from kardamper to materials station	4
2	251460	2286	55	Transfer empty vagons from materials station to Hassan abbad station	5
1	333000	3000	111	Moving locomotive with empty vagons from Hassan abbad station to productions station	6
1	78000	3000	26	Reporting loading plan and moving locomotive to loading points	7
1	285000	3000	95	loading wagon	8
1	270000	3000	91	Transfer full vagons from loading points to buffer	9
1	69000	3000	23	Transfer full vagons from buffer to productions station	10
1	60000	2000	20	Weighing full vagons	11
1	198000	3000	66	Moving locomotive with 10 full vagon to Hassan abbad station	12
	4629912(min) 77165(h)			Total cycle time	

In order to calculate the required number of locomotives, rail transportation of materials and products for the future, beginning standard when considering the 5% allowable latency, and calculated according to the time required to calculate directly the work of any loco locomotive number said.

standard time = 77165 ×(1 + 0.05) = 81023.25 (6)

According to the standard working directly in the pre-calculated and is equal to 5,398 hours for each locomotive, the locomotive number is equal to 15 locomotives.

number of required locomotive = 81023.25 / 5398≈ 15 (7)

RESULTS

A study to determine the optimum number of locomotives using the ergometer and timing of activities Mobarakeh Steel is made. In the case of two job evaluation and determining the optimal number of locomotives is important. First, reduce costs, and secondly to provide timely delivery of orders to customers and raw material production line.This study determines

the cycles and standard time of work required for each cycle, the total time required to achieve your future goals rail transport 77,165 hours to get. Then, according to standard straight time was 5398 hours per locomotive, We were able to obtain the optimum number of 15 locomotives. The results of the study can be expressed as follows:

A) Capital costs Sleep is today one of the major issues that have occupied the minds of many industries. The study found that the goals need to Mobarakeh Steel has a number of locomotives in this way will avoid wasting capital. Also, when polls showed that a significant proportion of time spent locomotives in products that will be created due to limited lines.

B) observations show that the locomotives are not ready to make optimum use of the available capacity is, Because sometimes a shortage of skilled labor, lack of motivation or lack of adequate and careful planning, direct labor time is reduced.

C) rail transport have a significant impact on the delivery of goods to customers and also materials to supply product lines that unfortunately there is sometimes preferred to be shipped by truck.

D) Locomotive stoppages in the months before the survey was to spend much of the time repairing locomotives can - be. Largely because they can be worn out the lack of maintenance and lack of spare parts expert said that sanctions have had a significant impact on this issue.

E) Observations showed that the domestic and global steel Board will have a greater impact on the need for a stronger rail fleet that is capable of carrying various products in less time.

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