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Balancing of Maintenance Task during Preventive Maintenance of Four Wheeler

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Abstract:-
In the present scenario of autom obile sector, the number of vehicles is increasing day by day and the availability of the time with the users is less. Therefore it is important to schedule the maintenance activities within calculated optimum time of the maintenance generally there are different types of maintenance strategies especially Break down, Preventive and Predictive involves in automobile but for this purpose only restricted to preventive maintenance of the automobile The work has been conducted at authorized Marti service station, In this service station, the maintenance activities involved in automobile are not assigned properly to the workers due to which the maintenance personnel's idle time is more and the maintenance job cannot be completed within optimum time and as a result the delivery of vehicle is delayed to the customers.
The objective of the work is to reduce the maintenance time and enhance the productivity. By properly allocate the maintenance activities. So as to achieve this target, critical path method (CPM) is applied for the calculation of Optimum maintenance time& The new technique line balancing which is used in manufacturing for allocation of task is applied here for allocation of activities in that optimum maintenance time.

Keyword: - Critical path method, Line Balancing.

Introduction : The Success of a venture depends on its ability to provide services to Customers/user and remain financially viable. Service station is a workshop where some or every type of motor vehicle are fully inspected to trace out faults and repair it. The maintenance and servicing of the motor vehicles is essential after a certain period of time and so ensure that the vehicles are kept in running condition Safely and economically The maintenance activities in the automobile service center have restricted to checking adjusting, replacements, lubrication and refilling. It is only the major repairs that may involve minor machine Shop repairs in addition to the above mentioned activities. Under The circumstances different parameters like maintenance manpower, tools/spares and diagnostic equipment should be available at right time, gaining a lot of importance while implementation maintenance functions In almost all the cities of our country the number of authorized workshop are less as compared to the number of vehicles in use and to maintain the increasing number of vehicles. It is important to reduce the maintenance time and properly allocate the maintenance activities.

Problem Formulation:

We have studies the maintenance activities involved in automobile workshop and find that they are not assigned properly to the workers due to which the maintenance personnel's idle time is more and the maintenance job cannot be completed within optimum time and as a result the delivery of vehicle is delayed to the customers.

Research Approach:

The objectives of this work are:-

1. To reduce the maintenance time of the vehicle under servicing by using network analysis (critical path method).
2. To allocate the maintenance works or tasks properly and equally to the workers by line balancing technique so that task can be completed within optimum maintenance time. The sequence of the operations or the activities will be same during allocation of tasks.
3. To balance the maintenance tasks between workers during optimum maintenance time.

Data collection and Data analysis:

(1) Data collection: The data related to the maintenance time of the activities is collected from the Jeewan motors, Bhopal for this purpose. A Jeewan motor is an authorized service station for Maruit Udyog Ltd. and undertakes the service, maintenance and repairs of passenger vehicles manufactured by Maruti Udyog. The present

workshops have about 950 vehicle/month and about 10% to 20% vehicles are increasing per year. the numerous number of maintenance activities perform in the organization, data was collected for the important activities of systems.

S.no	Transmission system maintenance activities	Time
1	Inspection of clutch slippage/ gear shift [a]	10 min
2	Change of clutch plate [b]	120 min
3	Clutch pedal adjust [c]	10 min
4	Gear oil change [d]	15 min
5	Replace clutch cable [e]	30 min
6	Drive shaft boot change [f]	40 min
7	Inspection of mounting bolts [g]	07 min

4 Engine maintenance activities time:

S.no.	Engine maintenance activities	Time
1	Engine oil and oil filter change [a]	15 min
2	Valve clearance adjust [b]	15 min
3	Camshaft timing belt change [c]	20 min
4	Tappit setting [d]	30 min
5	fuel filter change [e]	25 min
6	Spark plug change [f]	20 min
7	Cleaning air element [g]	08 min
8	Engine stop solenoid fuse change [h]	05 min

Transmission system maintenance activities:

Steering system maintenance activities time

S.no	Steering system maintenance activities	Time
1	Steering wheel play adjust [a]	10 min
2	Rack and pinion change [b]	60 min
3	Power steering fluid top up [c]	05 min
4	Air removing by bleeding the system [d]	10 min
5	Tightening of power steering pump belt [e]	05 min
6	Tie rod change [f]	10 min
7	Wheel alignment [g]	20 min

Brake system maintenance activities time:

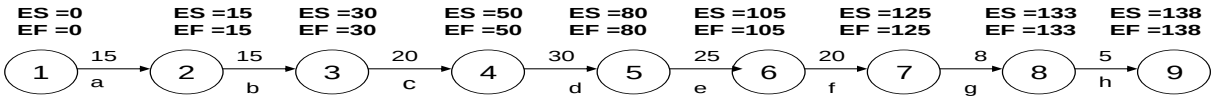
S.no.	Brake system maintenance activities	Time
1	Brake disc or brake pad change [a]	20 min
2	Brake master cylinder, wheel cylinder change [b]	90 min
3	Brake fluid change [c]	15 min
4	Air removal from brake system [d]	10 min
5	Replacing shoe return spring [e]	20 min
6	Replacing worn brake linings [f]	40 min
7	Tightening of bolts of brake anchor plate [g]	05 min

Suspension system maintenance activities time :

S.no	Suspension system maintenance activities	Time
1	Rear suspension spring replace [a]	30 min
2	Shock absorber oil replace [b]	60 min
3	Adjusting disturbed hub play [c]	20 min
4	Replacing tie rod [d]	10 min
5	Replacing lower ball joints [e]	15 min
6	Tightening of suspension bolts [f]	10 min
7	Replacing damaged wheel bearing [g]	30 min
8	Adjusting tyre pressure [h]	03 min

All the above data collected was further processed to calculate the optimum maintenance time of the systems by network analysis and to balance the tasks amongst the workers using line balancing technique.

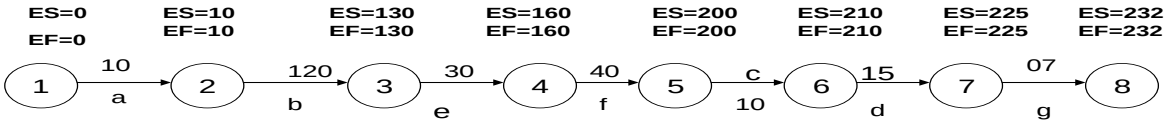
Existing network for engine system



ES= earlier start time
EF= earlier finish time

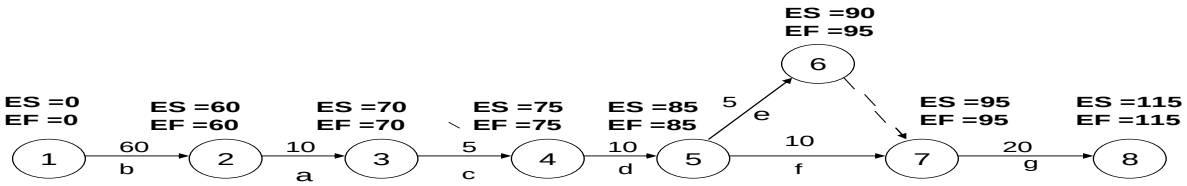
Project duration: 138 min

Existing network for transmission system



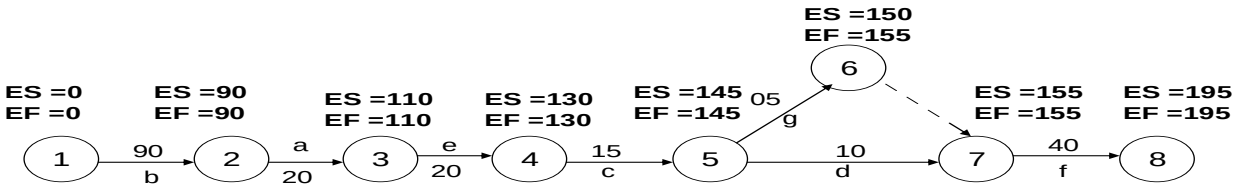
Project duration: 232 min

Existing network for steering system



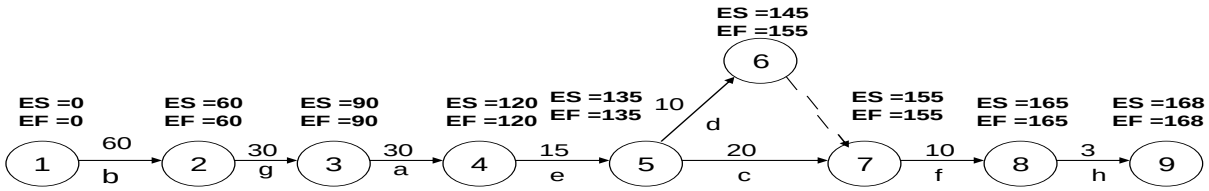
Project duration: 115 min

Existing network for brake system



Critical path:1- 2-3- 4- 5- 7- 8 Project duration: 195 min

Existing network for suspension system



Critical path: 1-2-4-5-7-8-9 Project duration : 168 min

Data analysis

For calculating the optimum maintenance time of automobile activities and to allocate the activities equally during the optimum maintenance time data analysis is necessary and for that following steps are required:-

(1) Preparation of master network of the major maintenance activities.

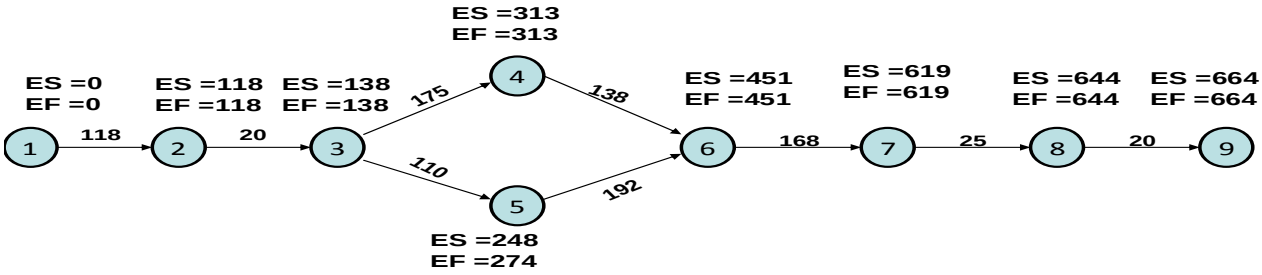
(2) Preparation of network of the sub activities.

(3) Allocation of the maintenance tasks of sub activities.

(1) **Preparation of master network of the major maintenance activities of vehicle.**

S.no	ACTIVITY	SYSTEM
1	1- 2	Engine system
2	2- 3	Cooling system
3	3- 4	Brake system
4	4 - 6	Suspension system
5	3 - 5	Steering system
6	5 - 6	Transmission system
7	6 - 7	Wheel and tyres
8	7 - 8	Lighting system
	8 - 9	Washing

MASTER NETWORK



Critical path: 1- 2 - 3 - 4- 6- 7- 8- 9

Project duration: 664 mins

3 Allocation of the maintenance tasks to both the maintenance personnel in the optimum maintenance time by line balancing method so that the assigned work is completed within optimum time without any delay. Also the maintenance work is equally distributed to the workers. The assumption during the allocation is that both workers are equally efficient, equally skilled and both can do any maintenance task of vehicle.

Steps for allocation of tasks are:-

i) Calculating weight age of each activity.

ii) Arranging the activities in the table according to the decreasing order of their weight age.

iii) Calculate the cycle time of each worker by dividing the total task time by number of workers.

iv) Allocation of tasks to the workers starting with the activity with highest RPW and proceed other activity.

Weightage of the maintenance activities of engine system are calculated by rank positioning method of line balancing.

Rank position weightage (RPW) = weight of the activity + weightage of all activities following the same.

Activities	**Elements**	**weightage**
a	15+15+30+20+25+20+08+05	138
b	15+30+20+25+20+08+05	123
c	20	20
d	30+25+20+08+05	88
e	25+20+08+05	58
f	20+08+05	33
g	08+05	**13**
h	**05**	**05**

Allocation of engine maintenance activities to the workers.

Optimum maintenance time for the engine system is118 min and the cycle time for each worker is 69 min.

Work elements	a	b	d	e	f	c	g	h
Worker 1	15	15	30				08	
Worker 2				25	20	20		05

Allocation of transmission system maintenance activities to the workers

Optimum maintenance time for the transmission system is192 min and the cycle time for each worker is 116 min.

Work element	a	b	f	e	d	c	g
Worker 1	10		40	30	15	10	07
Worker 2		120					

Allocation of steering system maintenance activities to the workers.

Optimum maintenance time for the steering system is 110 min and the cycle time for each worker is 60 min.

Work element	b	c	d	f	g	a	e
Worker 1	60						
Worker 2		10	05	10	05	10	20

Assignment of brake system maintenance activities to the workers.

Optimum maintenance time for the transmission system is175 min as and the cycle time for each worker is 100 min.

Work element	b	e	c	d	f	a	g
Worker 1	90			10			
Worker 2		20	15		40	20	05

Optimum maintenance time for the suspension system is138 min and the cycle time for each worker is 89 min.

Work element	b	a	e	c	g	f	d	h
Worker 1	60	30						
Worker 2			15	20	30	10	10	03

In this work the job has been allocated between the two workers but this can also balanced using three or more workers. The balancing of the same task during the optimum maintenance to the team of three workers for different systems

Result and Discussion:

In this work the results obtained by the proposed method have been compared with the results obtained by the existing method.

1. The total maintenance time of vehicle is reduced after applying CPM Network to the systems.

s.no		Time before	Time after
1	Engine system	138 min	118 min
2	Transmission system	232 min	192 min
3	Brakes system	195 min	175 min
4	Suspension system	168 min	138 min
5	Steering system	115 min	110 min

2. The maintenance task is equally distributed to both the workers by line

Balancing technique without disturbing the sequence of the activities.

s.no	System	Worker 1	Worker 2
1	Engine system	68 min	70 min
2	Transmission system	112 min	120 min
3	Brakes system	100 min	100 min
4	Suspension system	90 min	88 min
5	Steering system	60 min	60 min

Discussions

The time of the maintenance activities affected by the layout of the workshop of vehicle. So the optimum maintenance time of any system can varies marginally from workshop to workshop. For this thesis work, all the workers to who tasks are allotted are assumed that having equal efficiency. It is also assumed that all workers can do every type of maintenance task. The data collected does not include the maintenance delay time which may be due to unavailability of spares. Maintenance delay time can be reduced by proper spare part management Modern tools

and equipments are to be provided for further reduction of maintenance time. So we see that the completion of project in optimum time can benefit in so many ways like

i) Reduction of losses which cause due to delay.
ii) Reduction in maintenance cost.
iii) Employee satisfactions as the task are equally assigned amongst the workers.

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