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Manufacturing Plant LayoutOptimization Using Simulation

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Abstract:- Today most of industries manufacturing layout can be develop and design using either traditionally or new engineering techniques. Most of small and medium scale industries facing the real time problem due to the layout designed in Traditionalway which are time consuming and not much easier. Traditional designed layout facing the number of problems like delay in handling of material,product back tracking and bottleneck, machine ideal condition etc. FlexSimsoftware is used to develop layout model, simulateandanalyses the machine locations and plant activities.FlexSimsimulation software is used to analyze the performance of layout byapplying different conditions. Result of each condition shows that productivity is continuous improved.In this study paper investigates the effect discrete plant layout on production capacity and throughput time inmanufacturing process.

Main function is focuses on a critical plant layout and machine bottleneck. Simulation offers economical alternative to increasing the productivity of all machines in such plant.Finally this paper makes better layout to get a result which based on modeling and simulation for the manufacturing plant layout.

Keywords:-*Simulation, Layout, FlexSim, Analysis, Model, Optimization.*

I. INTRODUCTION

At present days, most of the small and medium scale manufacturing industries is highly technically developed and more complicated. Therefore, such industries system is not properlydeveloped or design with scientific solution.[2]. So they are requiredscientific and proper stable technique to reducecostly mistakes or errors. Simulation is one of the technique used for such conditions. Simulationis a virtual technique for analyzing a production system without having actualexperiment onthe system [1,4]. The simulation model guidedfor improvementon machine performance, material movement and process sequence. Hence, it provides clear picture to the management for taking decision whether the investment is useful for it or not. [6,7]. This paper case study reviews that, the model ofcurrent production system are simulate through simulation software Flexsim andanalyses the production system to define a Productivity improvement optimization.

The case study performed at a manufacturing industry located in MIDC area of Taswade-(Karad), Satara. Theproduction system for simulation using the software, FLEXSIM. The performance of the selected process system developed through compare the output results of the simulation system andactual system. Flexsim software designed for industrial solution which is developed by Flexsim simulation Software Production Company (US).Flexsim is technologically combination of simulation, computer processing 3D image and datainterpretation [1,3]. The Flexsim software is easy to use and compatible with other software. The basic steps involved inthis software are like creating the model layout, define the layout process, setting parameter, compilationand running the model, analyzing results and theirperformance [8,9].

II. FLEXSIM SOFTWARE

1. Steps of Modeling and simulation:

Flexsim simulation software mostly useful in manufacturing industries, storage plants and material transport system. Flexsim provides processing data, modeling and optimization the total system.

Modeling and simulation are based on following steps:

a) Plant or System Survey:

Analyze or survey the existing system and then determine the different ways of simulation.

b) Collection of basic data:

The collection of simulation data involved that, data is collected as per the simulation targetand data regarding initial condition of system.

c) Create the Model of system:

Define the model of simulation by usingflow diagram. Flow diagram includes: 1. Model of temporary entities, 2. Queuing discipline, 3. Model of service.

d) Create the simulation model:

Such process includes choosing a software development and language program design according to mathematical model.

e) Validate system Model:

Validate whether simulation model and Physical system are same. The output results are comparing and which are similar to each other.

f) Simulate and running model:

Simulation the model and running the system is important tounderstand the output response with different inputs and different simulation parameter or conditions.

g) Outputs and analysis result:

Finally after software simulation of system, analysis their output data & adopted best optimize results.

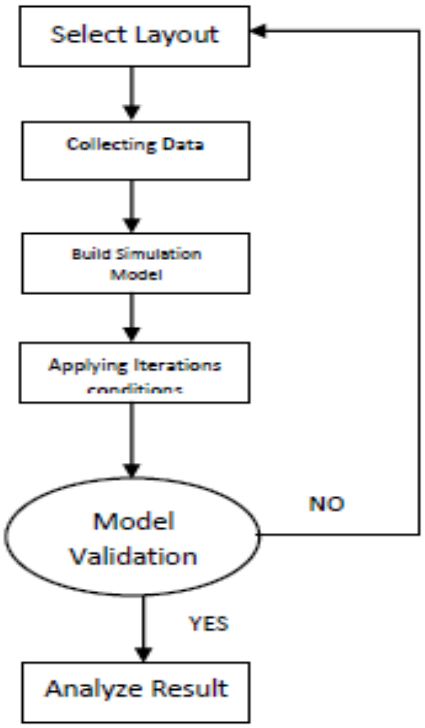

Fig- 1: Steps of Modeling and Simulation

2. Areas of Application:

1. Applicable in Manufacturing system:

- Dynamic modeling of layout in continuous manufacturing systems.
- Simulation analysis in automobile assembly line.
- Simulation for quality and productivity improvement in manufacturing unit.

2. Applicable in Construction and Project Management:

- Simulation for drainage operations maintenance system.
- Develop a virtual steel construction model for analysis of layout.
- Simulation of the residential material supply chain.

3. Applicable in Defense Applications:

- Analysis of technology effects on human performance through trade-space development and evaluation of technology.
- Analyses the Impact of an automatic logistics system.
- Modeling and simulation of Research plan for military operations in urban areas.

4. Applicable in Logistics & material Supply Chain system:

- Simulation of inventory system computer manufacturing environment.
- Analysis of bottleneck detection in material supply system.
- Analysis of passenger flows in an airport.

III. PROBLEM DEFINATION

After conducting survey it is found that in actual industrial scenario, shop floor problems are tackled with less scientific approach. Perfect Components is an industry involved in manufacturing of various components located at Karad MIDC. The company is facing with various problems like complicated plant layout, less space for material handling, repetitive material backtracking, more component cycle time/ Considering these difficulties, present project work aims at tackling above problems in more scientific manner by taking help of tools like simulation software. Considering above factors purpose of this paper is performance improvement through modeling and simulation.

IV. SCOPE

As per information received from company following products have more demand per month whose process time is more. Therefore as per company's direction we focus the work with Performance improvement of following products –

1. Y-Bracket PUNCH and DIE Plate.
2. M-Bracket PUNCH and DIE Plate
3. Frame Die Plate
4. Bush Sleeve

V. EXPERIMENTAL FRAMEWORK

Here we perform the experimental work by using Flexsim simulation software. First of all select the 01 component for experimentation and develop existing layout model in software. Afterward give input data of that component and apply different conditions or iterations on that layout. Finally analyses their results.

Component select for Experimental work: M-Bracket Die Plates.

Steps of Experimentation:

A) Survey and Data Collection:

Initially study the existing plant layout of manufacturing unit shown in figure 2. Afterward collect the machining data by adopting Time study technique.Data collection include Machining time, Setup time and Machine to machine distance etc shown in Table 1. In manufacturing process every operation processing time is the important effectivefactor.Accuratelycalculating time required for each

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operation is allows manufacturer to reduce cost, increase profit and customers satisfaction.

For this experimentation work we choose 02 components from the manufacturing unit on the basis of process time is more which is discussed earlier.

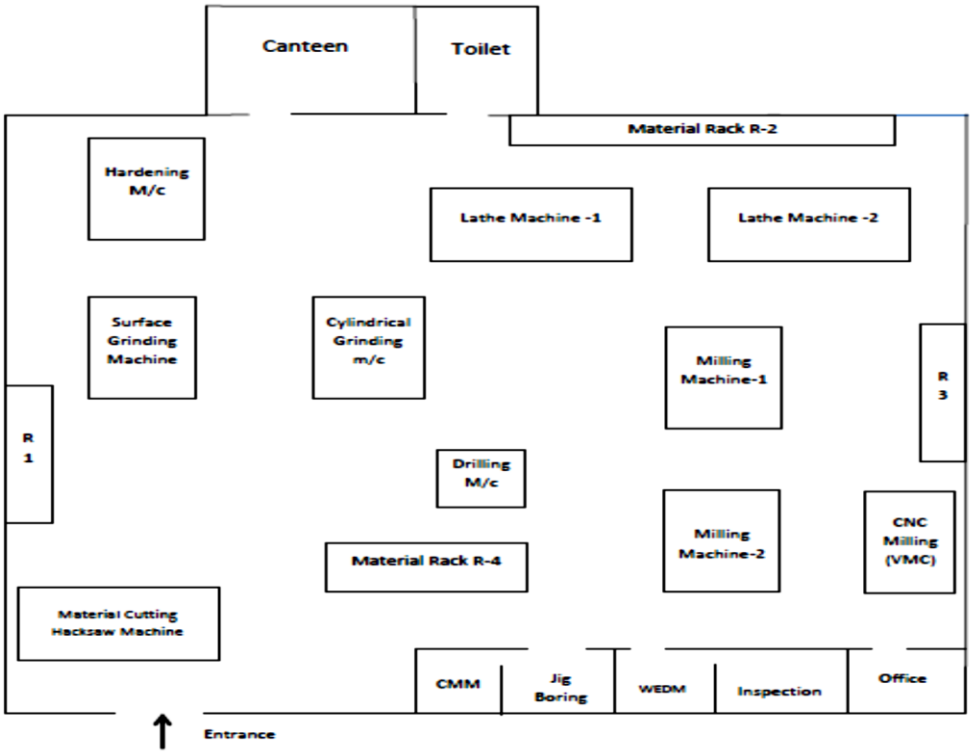

Fig- 2: Existing plant Layout

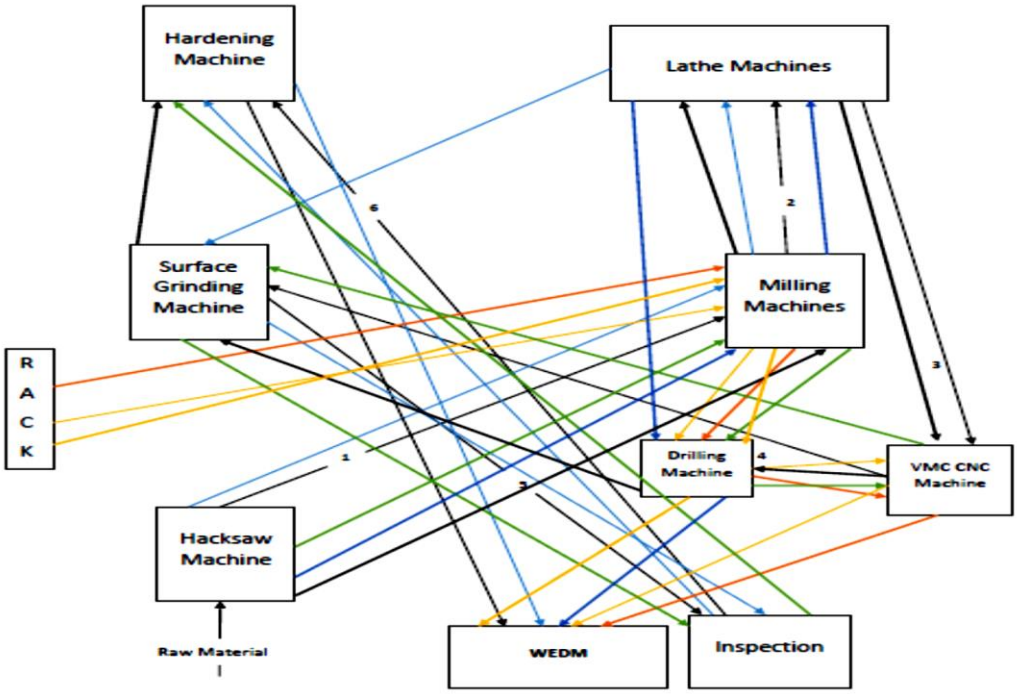

Fig- 3: Process Layout

Sr No	Machine 1	Machine 2	Distance between two Machines (Meter)	Material Travel Time in Sec
1	Hack Saw Machine	Milling 2	10	80
2	Milling	Lathe	3	32
3	Lathe	VMC	4	42
4	VMC	Grinding	11	95
5	Grinding	WEDM	9	60
6	WEDM	Hardening	12	120

Table-1: Machine-Machine distance data

Operation No	Machine Name	Processing Time (Min)	Setup Time (Min)	Operation Type
01	Hacksaw Cutting Machine	60.14	4.99	Setup Manual, Processing Automatic
02	Vertical Milling Machine	180	15	Manual
03	Lathe Machine	86.70	17.8	Manual
04	CNC Machine	29.72	2.95	Setup Manual, Processing Automatic
05	Surface Grinding Machine	183.5	10.25	Setup Manual, Processing Automatic
06	WEDM Machine	260.68	31.3	Setup Manual, Processing Automatic
07	Hardening Machine	120	20	Setup Manual, Processing Automatic
08	Inspection	15	20	Setup Manual

Table-2: Machining data

B) Simulate Existing layout usingsimulation software:

The existing plant layout is designed by using Flexsim simulation software. It clearly indicates that number of machines, operators etc.

Give input data like Processing and Setup time, machine distance for each machine which is shown in Table No 1 & 2.

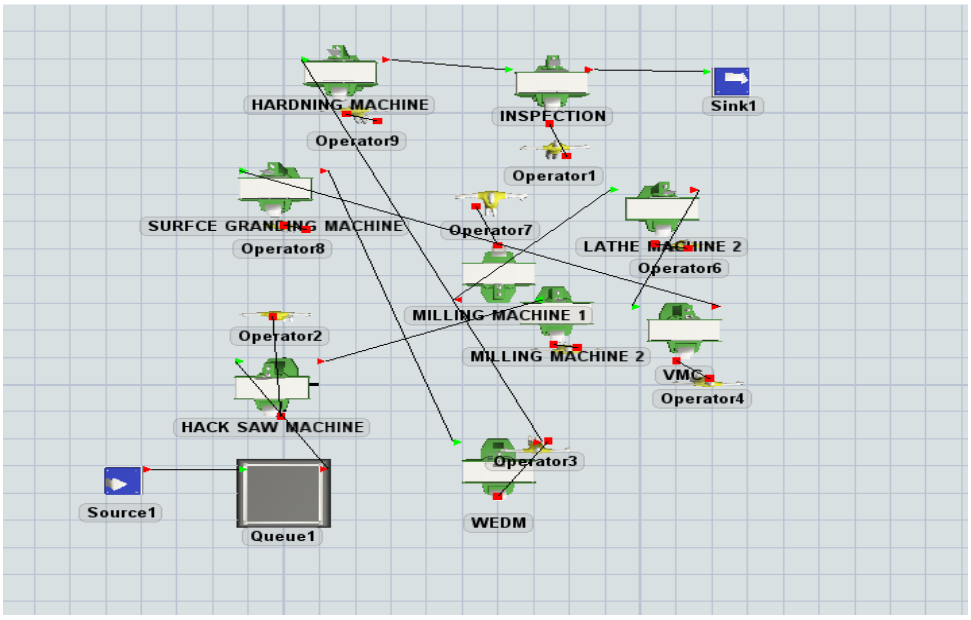

Fig- 4: Existing plant layout

Flexsim Results:

After simulating current layout using Flexsim software and applying input parameters,the existing layouts output production componentsis **17 quantity**in week.

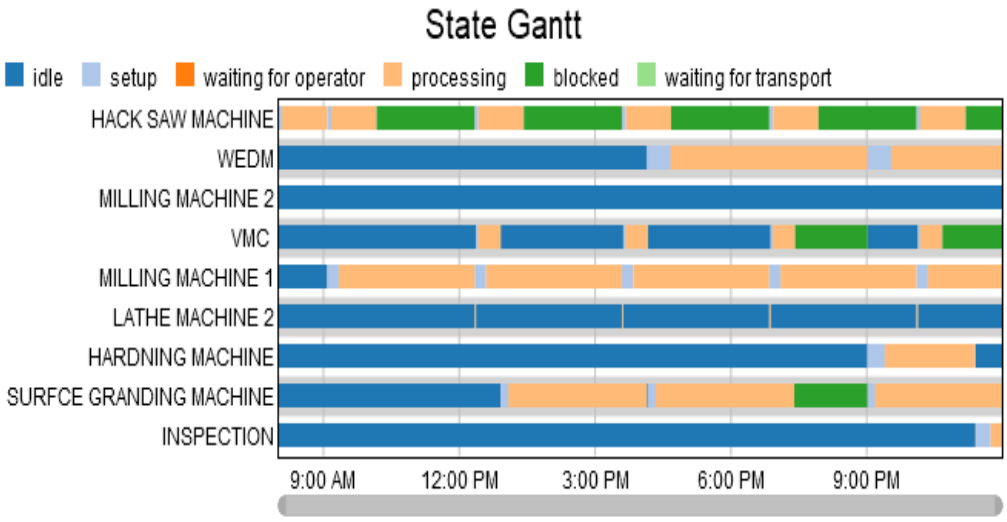

Fig- 5: Gantt Chart

Gantt chart shows the different machines conditions for ideal, setup, operator, processing, transport etc.

Object	Class	Stat Input	Stat Output
Source 1	Source	0	124
Hack saw machine	Processor	124	23
Milling machine 1	Processor	23	22
Lathe	Processor	22	21
VMC	Processor	21	20
Grinding	Processor	20	19
WEDM	Processor	19	18
Hardening	Processor	18	17
Inspection	Processor	17	17
Sink	Source	17	**17**

Table-3: Result for Week (6days) & considering 2 shift (8Hr/shift)

C) SimulatingLayout for betterproductivity:

The simulated model gives answer of the question i.e. how many Machines are really required in the process to keep production process working properly. The simulation model should use in the system for analyses influence parameters in whole process.

Flexsim Simulation Software is used to solve the process problem. Flexsim is new generation simulation software where models are built directly in 3D.

1] Iteration 1: Arrangement of Machines as per process or Workstation-

We know that extra addition of machine or workstation which automaticallyreflected as a result to improve productionquantity. Such condition happens when the operators remain idle frequently. So these operators efficiencymay be used in production so as to improve the productivity of the system.

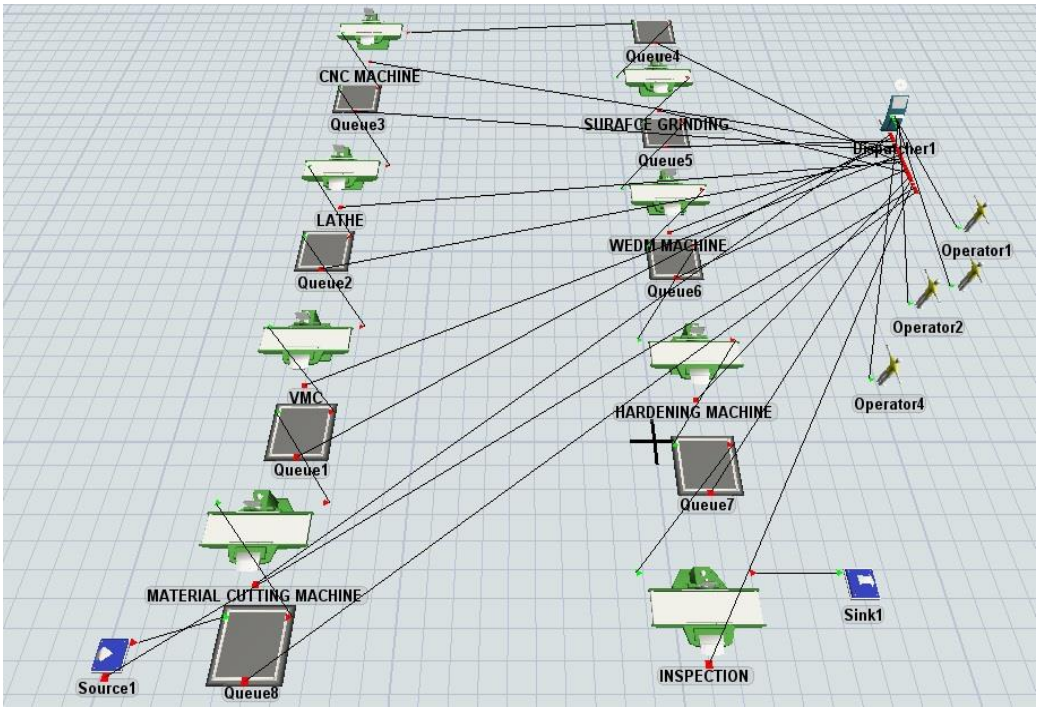

Fig- 6: Iteration-1

Flexsim Results :

Object	Class	Stat Input	Stat output	Idle	Processing
Source2	Source	0	1352	0	0
MCM	Processor	1352	356	57338.71	1898160
MILLING MCH	Processor	356	122	55550.39	1896840
LATHE	Processor	122	122	58722.57	1895520
CNC MCH	Processor	122	123		
GRINDING	Processor	123	65	62725.14	1892880
WEDM	Processor	65	35	61731.37	1891560
Hardening MCH	Processor	35	38	63732.91	1891240
INSPECTION	Processor	38	46	63074.97	1894200
Sink16		46	**46**		
Operator1	Sink	0	0	0	0
Operator2	Operator	0	0	2057951	0
Operator3	Operator	0	0	2056992	0
Operator4	Operator	0	0	1945626	0
	Operator	0	0	2058557	0

Table-4: Result for Week (6days) & considering 2 shift (8Hr/shift)

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After simulating modified layout- Iteration-I using Flexsim software and applying all input parameters, the modified layouts output production components is **46 quantity** in week.

2] Iteration-2:

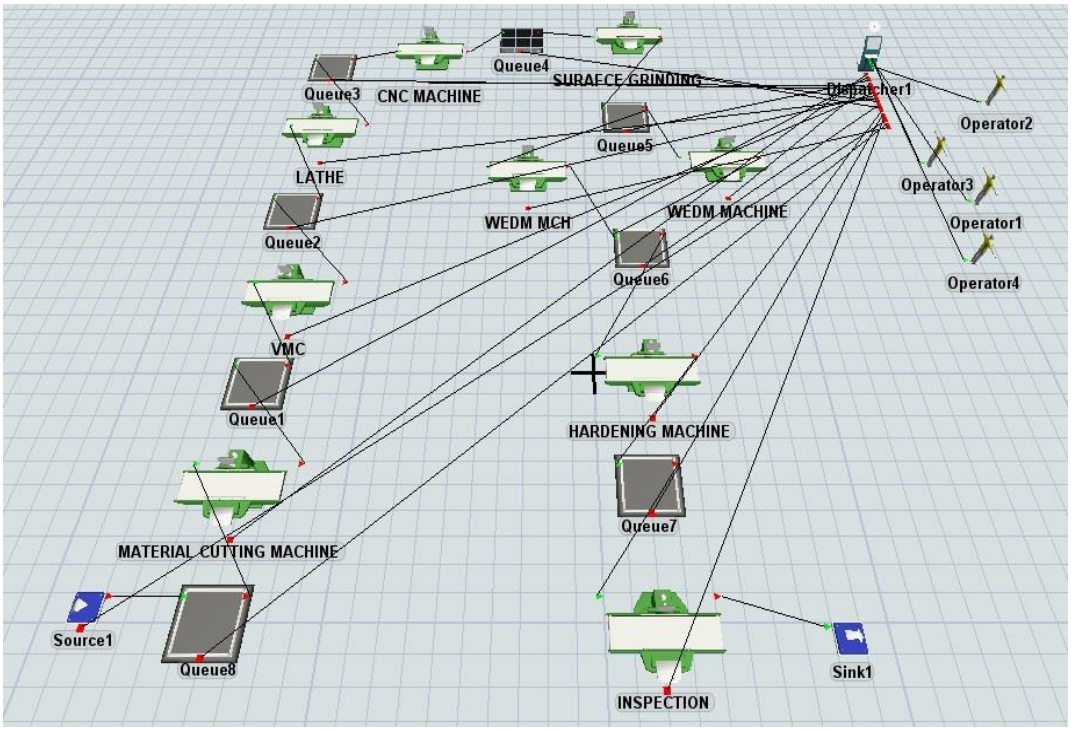

Fig- 7: Iteration-2

Flexsim Results :

Object	Class	Stat Input	Stat output	Idle	Processing
Source2	Source	0	1352	0	0
MCM	Processor	1352	356	57338.71	1898160
MILLING MCH	Processor	356	122	55550.39	1896840
LATHE	Processor	122	122	58722.57	1895520
CNC MCH	Processor	122	123		
GRINDING	Processor	123	65	62725.14	1892880
WEDM	Processor	65	35	61721.37	1891560
Hardening MCH	Processor	35	42	63732.91	1890240
INSPECTION	Processor	42	54	63104.97	1895200
Sink16		54	**56**		
Operator1	Sink	0	0	0	0
Operator2	Operator	0	0	2057951	0
Operator3	Operator	0	0	2056992	0
Operator4	Operator	0	0	1945626	0
	Operator	0	0	2058557	0

Table-5: Result for Week (6days) & considering 2 shift (8Hr/shift)

After simulating modified layout- Iteration-II using Flexsim software and applying all input parameters, the modified layouts output production components is **56 quantity** in week.

Resultstable:

Layout	Remarks	Production quantity
Existing	Simulation is done as per current layout.	**37**
1st Iteration	Instead of adding any new processor, we just rearrange machine arrange.	**46**
2nd Iteration	Extra WEDM machine is added	**56**

Table-6: M-Bracket Die plate

Similarly, simulation done on remaining three components as usual applying iterations like rearrangement of machines, adding extra machines etc. We get the following results-

2. Y-Bracket Die Plate:

Layout	Remarks	Production quantity
Existing	Simulation is done as per current layout.	**32**
1st Iteration	Instead of adding any new processor, we just rearrange machine arrange.	**37**
2nd Iteration	Extra WEDM machine is added	**43**

Table-7: Y-Bracket Die plate

3.Frame Die Plate:

Layout	Remarks	Production quantity
Existing	Simulation is done as per current layout.	**35**
1st Iteration	Instead of adding any new processor, we just rearrange machine arrange.	**39**
2nd Iteration	Extra WEDM machine is added	**46**

Table-8: Frame Die plate

4. Bush Sleeve:

Layout	Remarks	Production quantity
Existing	Simulation is done as per current layout.	**124**
1st Iteration	Instead of adding any new processor, we just rearrange machine arrange.	**156**
2nd Iteration	Extra Turning machine is added	**194**

Table-9: Bush Sleeve

Final Result:

From above results of Four components comparing with existing layout, it is found that by arrangements of machines in workstation and extra adding the machine (where mostly bottleneck problem are identify) the production quantity per month is increases means process time decreases and productivity is increased.

VI. CONCLUSION

As per the results of 4-componats output we concluded that by analyzing the parameters like manpower, Machine process time, Machine setup time, layout, production rate etc. Simulation software gives the information about effect of modification of system layout. However it reduce processing time, increase space, reduce material movement, a back tracking issue etc. optimizing Flexsim software the Performance of two iteration is calculated. Every iteration shows different results.

It is noticed that 2nd iteration given better productivity and improve the performance than others. Finally the paper shows the improved and optimized better machine system layout with the help of Flexsim software.

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