Analysis and Simulation of Crankshaft Manufacturing Unit Using Arena

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Abstract- Discrete event simulation is the process of designing a model of a real system and conducting experiments with that model, for purpose of either understanding the behavior of the system or evaluating strategies for the operation of a system, discrete event simulation is a tool suitable for the study of manufacturing systems and improves the overall efficiency. Arena is a discrete event simulation and automation software developed by Systems Modeling and acquired by Rockwell Automation in 2000.It uses the SIMAN processor and simulation language. In this work, the existing layouts were studied and utilization of each station is analyzed, the efficiency of production depends on how well the various machines, production facilities and employee's amenities are located in a plant.

Index Terms- ARENA, Simulation, Utilization

I. INTRODUCTION

DES (Discrete-Event Simulation) is a tool suitable for the study of manufacturing systems and improves overall efficiency. The manufacturing system can be modeled in a simulation environment to study the different options for improving the system both to predict the effect of changes to an existing system as well as a tool to predict performance of new systems. The work involves analyzing utilization of each work station in the factory lay out. Attempt is made to simulate the factory layout using the software ARENA (student's version). Utilization of each machine is calculated. Bottle neck station in the present manufacturing line, and queues in each work station is identified.

II. LAYOUT OF INDUSTRY AND DATA COLLECTION

In this work discrete event simulation of a crank shaft manufacturing unit is done by using ARENA software.
For stimulating the current manufacturing system using ARENA, the work flow in each station is identified figure 1 shows the work low o crank shaft in the current lay out. Processing time and inter arrival time in each station is determined.Table 1 shows the processing time and interarrival time in each work station.

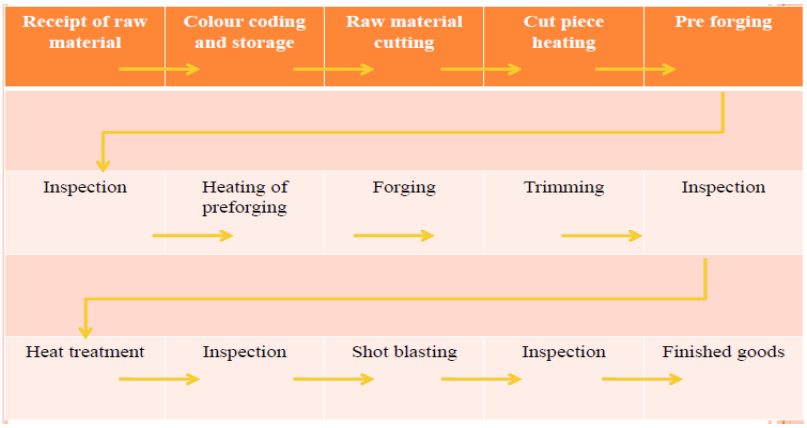


Figure 1: Work f low of crank shaft

WORK STATION	PROCESS TIME (min)	INTER ARIVAL TIME (min)	TOTAL TIME (min)
Receipt of raw material	30		30
Colour coding and storage	25	15	40
Raw material cutting	5.5	5.5	11
Cut piece heating	90	20	110
Pre forging	10	3.5	13.5
Heating of preforging	42.5	15	57.5
Forging	4	5	9
Trimming	.75	3	3.75
Heat treatment	1800	15	1815
Shot blasting	45	2.5	47.5
Grinding	15	5	20

Table 1: Process time and inter arrival time in each work station

III. RESULTS AND DISCUSSION

The figure below shows the layout created by ARENA .9 students' version software. The figure: 2 show the layout that created using the arena software and its simulation. From the software itself we can found the utilization of the machines in the existing layout. The figure: 3 show the utilization of the stations in the existing layout. The figure: 4 shows the total number of parts seized in each work station. During simulation replication length is 50 hours.

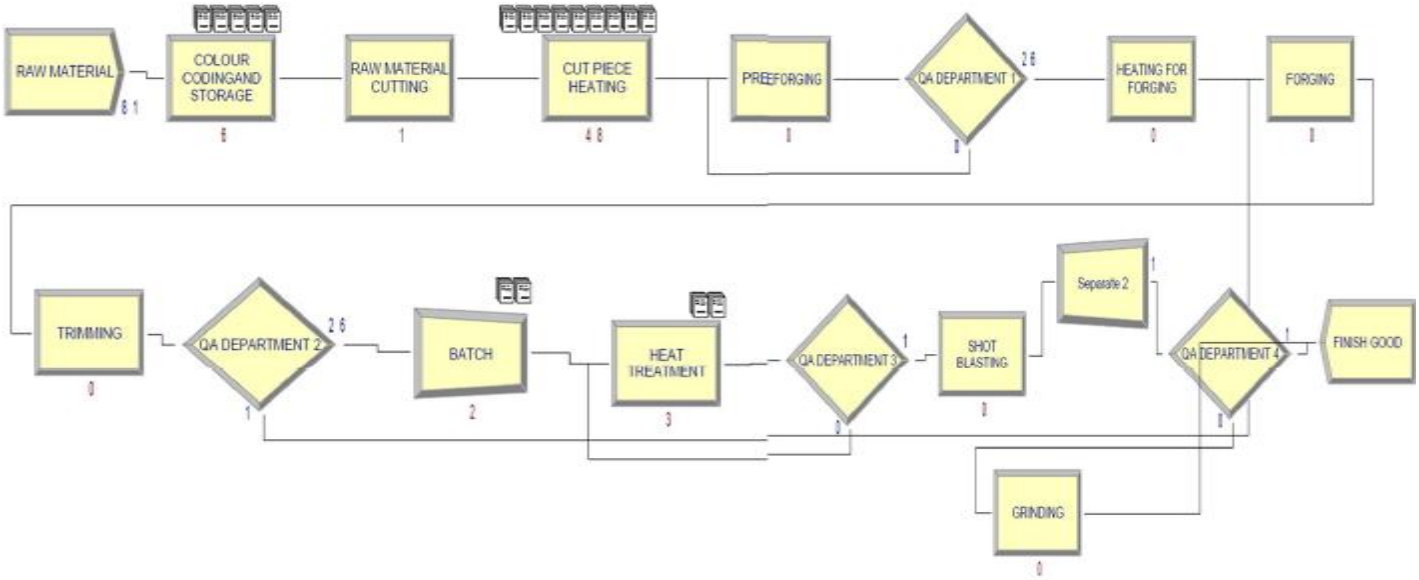
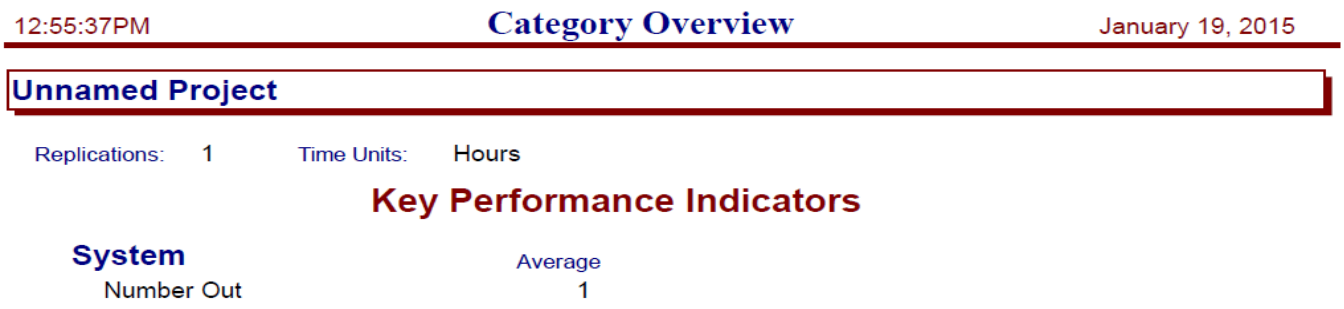


Figure 2: Simulation using ARENA

Number of simulation replication = 50 hours

Number of output = 1

Total time for one unit production = 42 hours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Unnamed Project

Replications: 1 Time Units: Hours

Key Performance Indicators

System

	Average
Number Out	1

Figure 3: Simulation using result

Analyzing the current work station utilization

Usage

Scheduled Utilization	Value
10 TON HAMMER	0.1213
16 TON HAMMER 2	0.08100000
COLOUR CODING AND STORAGE MACHINE	1.0000
FURNANCE 1	0.9830
FURNANCE 2	0.5027
FURNANCE 3	0.7347
GRINDING MACHINE	0.00
POWER HACK SAW	0.2713
SHOT BLASTING MACHINE	0.01492308
TRIMMING MACHINE	0.03600000

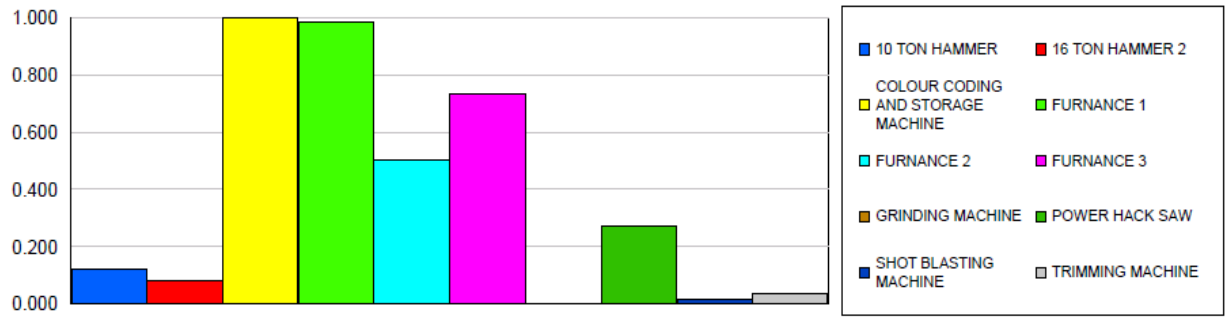

Figure 4: Simulation using result graphical

Total number of seized

Total Number Seized	Value
10 TON HAMMER	26.0000
16 TON HAMMER 2	27.0000
COLOUR CODING AND STORAGE MACHINE	76.0000
FURNANCE 1	27.0000
FURNANCE 2	26.0000
FURNANCE 3	2.0000
GRINDING MACHINE	0.00
POWER HACK SAW	75.0000
SHOT BLASTING MACHINE	1.0000
TRIMMING MACHINE	27.0000

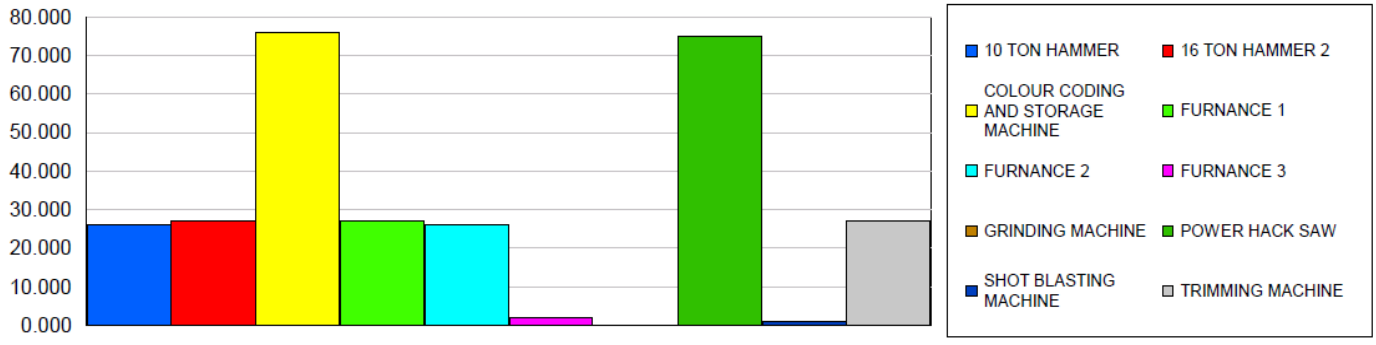

Figure 5: Total number seized

Queue

Queue Detail Summary

Time

	Waiting Time
BATCH.Queue	4.57
COLOUR CODINGAND STORAGE.Queue	4.57
CUT PIECE HEATING.Queue	15.17
FORGING.Queue	0.00
HEAT TREATMENT.Queue	9.50
HEATING FOR FORGING.Queue	0.00
PREFORGING.Queue	0.00
RAW MATERIAL CUTTING.Queue	0.00
SHOT BLASTING.Queue	0.00
TRIMMING.Queue	0.00

Other

	Number Waiting
BATCH.Queue	2.24
COLOUR CODINGAND STORAGE.Queue	7.11
CUT PIECE HEATING.Queue	23.06
FORGING.Queue	0.00
GRINDING.Queue	0.00
HEAT TREATMENT.Queue	0.75
HEATING FOR FORGING.Queue	0.00
PREFORGING.Queue	0.00
RAW MATERIAL CUTTING.Queue	0.00
SHOT BLASTING.Queue	0.00
TRIMMING.Queue	0.00

Resource Detail Summary

Usage

	Inst Util	Num Busy	Num Sched	Num Seized	Sched Util
10 TON	0.12	0.12	1.00	26.00	0.12
16 TON	0.08	0.08	1.00	27.00	0.08
COLOUR	1.00	1.00	1.00	76.00	1.00
FURNANCE 1	0.98	0.98	1.00	27.00	0.98
FURNANCE 2	0.50	0.50	1.00	26.00	0.50
FURNANCE 3	0.73	0.73	1.00	2.00	0.73
GRINDING	0.00	0.00	1.00	0.00	0.00
POWER	0.27	0.27	1.00	75.00	0.27
SHOT	0.01	0.01	1.00	1.00	0.01
TRIMMING	0.04	0.04	1.00	27.00	0.04

Queues are found at colour coding and storage station and cut piece heating furnaces. Bottle neck station in the current lay out is colour coding and storage work station.100 % utilization for colour coding and storage station.98% utilization for furnace 1.

IV.SUGGESTIONS

The following suggestions have been made to improve the utilization of the machines

Queues are found at colour coding and storage section and cut piece heating. Furnaces Bottle neck station in the current lay out is colour coding and storage station. Implementation of one more colour coding and storage facility will reduce the queue in that section. Installation of an extra furnace can solve the queue in cut piece heating.

V.FUTURE WORKS

Install one more arrangement for colour coding and storage and a cut piece heating furnace and conduct new simulation to avoid bottle neck in production.

VI. REFERENCE

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