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Enhancing Assembly Line Efficiency Using RPW Method and Kw Method in Eicher Tractor Limited

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Abstract: ***assembly lines are special flow lines production systems which are of great importance in industrial production of high quality standardized commodities. Assembly line balancing is a classic problem in any business. The line balancing problem is to arrange the individual processing and assembly task at the workstations, so that the total time required at each station should approximately same for smooth production flow. Assembly line balancing problem have been conventionally classified into two types that is type-1 focuses on minimizing the number of workstations for a given cycle time and type -2 is minimizing the cycle time for a fixed number of workstations. The present work study is based on comparative analysis of two heuristic methods for assembly line balancing problem. In the current case type -1 problem has been taken into consideration .a simulation software tecnomatix plant simulation is also used for simulation purpose. This software shows satisfactory result when run on the given data. The results show that by using the rpw method, there is a reduction in the number of workstations thereby reducing the requirement of human resources and improvement in line efficiency by increase in the throughput.***
Keywords: assembly line problem, rpw method, kw method, plant simulation, line efficiency, cycle time

I. INTRODUCTION

A. Assembly Line & Efficiency

An assembly line is a sequence of workstations connected together by mechanical material handling equipment in which a dedicated group of tasks are performed in predetermined sequence The total work content to be performed by the production system is split–up into economical individual work elements which are called task and among the set of tasks there exist technological precedence relations The assignment of these tasks to workstation along an assembly line to achieve same or close to same working time at each workstation The goal of this assignment of task is to create a smooth and continuous flow of product through the assembly line for maximum productivity and minimum idle time at each workstation A well-balanced assembly line has the advantage of high personnel and facility utilization and equity among the employees work loads. Assembly lines are flow-oriented production systems which are typical in the industrial production of high quality standardized commodities and even gain importance in low volume production of customized products among the decision problems which arises in managing such systems, assembly line balancing problems are important tasks in medium–term production planning The measurement of the capacity utilization of the line. The idle capacity is reflected by the balance delay time. It is expressed as: Efficiency = Total task time / (no. of work station × Max. assignable cycle time)Delay = 100% - Efficiency The fundamental of line balancing problems is to assign the tasks to an ordered sequence of stations, such that the precedence relations are satisfied and some measurements of effectiveness are optimized. (e.g. minimize the balance delay or minimize the number of work stations; etc) The first published paper of the assembly line balancing problem (ALBP) was made by Salveson (1955) who suggested a linear programming solution. Since then, the topic of line balancing has been of great interest to researchers.

B. Objective of the Work

Assembly Line balancing (ALB) is a main part of a mass production the primary objective of the assembly line balancing problem is to balance workload across workstations so that no workstation has an excessively high or low workload. Therefore, the issue of idle time at workstations will be minimized The objective is to minimize the required labour input and facility investments for a given amount of output or productivity which can be achieved if number of workstations is reduced. So, the objectives of Assembly Line Balancing can be summarized as follows: To Minimize number of workstations in an assembly line for a given cycle time to enhance the efficiency of an assembly line.

II. METHODOLOGY USED

There are number of heuristic methods but two methods have been used-RPW & KW as follows

A. Ranked Positional Weights (RPW) method

The Ranked Positional Weights approach used to be introduced by Helgeson and Bernie. This approach assigns operations to the stations in an order that corresponds to the length of time every control by way of the rest of the network. All succeeding operations are considered in the ranking. The sum of the occasions of those operations controlled in this manner by means of a certain operation is defined as the positional weight. Ranking operation in decreasing sequence in step with their positional weights leads to the technical designation of ranked positional weight process. The venture of aspect to work stations is then carried out within the following manner.

1) The work with the easiest positional weight is selected and assigned it to the primary work-station.
2) The unassigned time is calculated for the work-station by means of calculating the cumulative time of all works items assigned to the station and this sum is subtracted from the cycle time.
3) The work unit is chosen with the next best positional weight and tried to assign it to the work-station after making the next investigate.
a) The list of already assigned work items. If the instantaneous precedent Work unit has been assigned, precedent will not be violated, we proceed to step 4(b). If the instant precedent has not been assigned proceed to step 4.
b) The work models time is when put next with unassigned time .If the work unit time is not up to the work-station unassigned time assigns the work unit and recalculates unassigned time. If the work unit time is bigger than the unassigned time, proceed to step 4.
4) Picking out, checking and assigning is continued to if feasible unless one of the vital two stipulations is met.
a) A combination is acquired where the remainder unassigned is less then, or equals the slack units on hand (5 is to proceeded).
b) No unassigned work unit stays that can satisfy each the 'precedence' and ' unassigned time' specifications.
5) Unassigned work unit is assigned with the very best positional weight to the 2D work-station, and preceded through the previous step in the identical method.

B. Kilbridge and Wester (KW) method

This method has acquired a great deal of attention on account that its introduction in 1961 by means of Kilbridge and Wester This technique has been applied to a few complicated line balancing issues with just right success Kilbridge and Wester proposed a heuristic process that assigns a number to each and every operation describing how many predecessors. This is complete via referring to precedence diagram. The operations are rank ordered in keeping with the quantity of predecessors each and every. The first operation assigned to station with the bottom predecessor quantity. The operations are assigned to stations so as of the least number of predecessors. The place ties exist a different rule applies first the longest operation time that can be used. When an operation with the next smallest number of predecessors has too tremendous an operation time to be incorporated in the station, we select the operation with the subsequent smallest quantity of predecessor that matches within the station time. On this heuristic method, work detail:-

1) Priority diagram is constructed Column- I is made where include all work detail and wouldn't have a precedence work element. Column II is made checklist all factors which follow factors in column I and are persisted till all work elements are exhausted.
2) To examine cycle time (Tc) by discovering all combinations of the primes of summation of all undertaking time, this is the total elemental time. A viable cycle time is chosen. Number of station would be: J = total task time / cycle time
3) To assign the work factors within the work-station in order that total station time is the same as or slightly not up to the cycle time.
4) Step 3 is repeated for unassigned work elements.

Here Simulation tool is also used for analysis the Line efficiency. Tecnomatix plant simulation software is a PC utility developed via Siemens PLM software for modelling, Plant simulation, inspecting, visualizing and optimizing creation systems and strategies, the flow of materials and logistic operations.

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III. OBSERVATIONS & SOLUTION

In this research work, the predominant object to scale back the quantity of stations or to discover premiere number of stations this is also known as Type-1 problem. Simulation software TECNOMATIX PLANT SIMULATION also used for visualize the whole method what alterations takes location when distinctive approaches observe on that data. The simulation software used for discover most suitable answer or checking purpose for the reason that all these methods offers the results in mathematical method and this software effect in useful method. This software indicates adequate effect when run on given data via given the most effective solution to the present meeting line work station for the product there via reducing the human resources, work place require for existing set up. Heuristic RPW and KW approaches are used by taking actual data from EICHER TRACTOR Ltd. and information is taking from the study paper.

IV. RESULTS ANALYSIS

Results have been taken by applying all methods, describe below:

A. Results from current method

S. No.	Description	Current method
1	Cycle time	155 Sec
2	Efficiency	48%
3	No. of work station	28
4	No. of operation	28
5	Delay	52%

Table 4.1: Result from current method

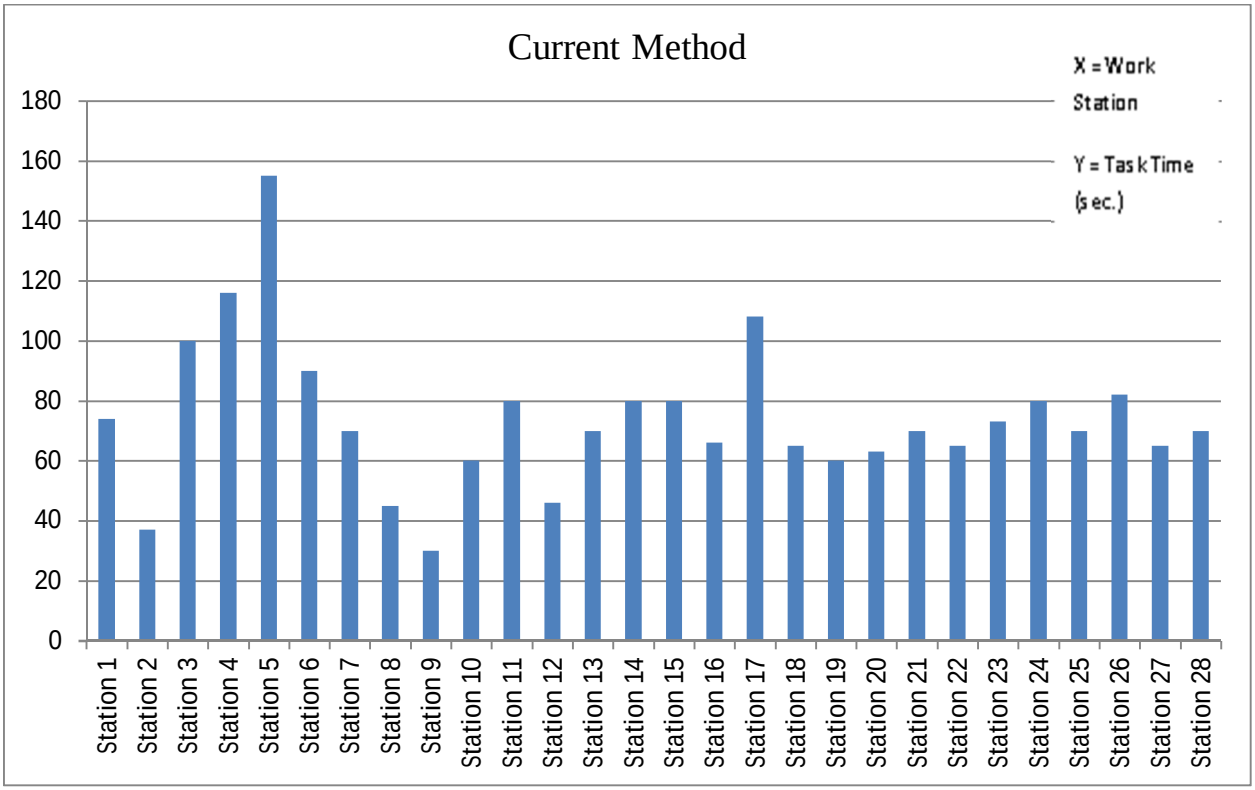

Fig. 4.1: Current Method

Volume 5 Issue VI, June 2017
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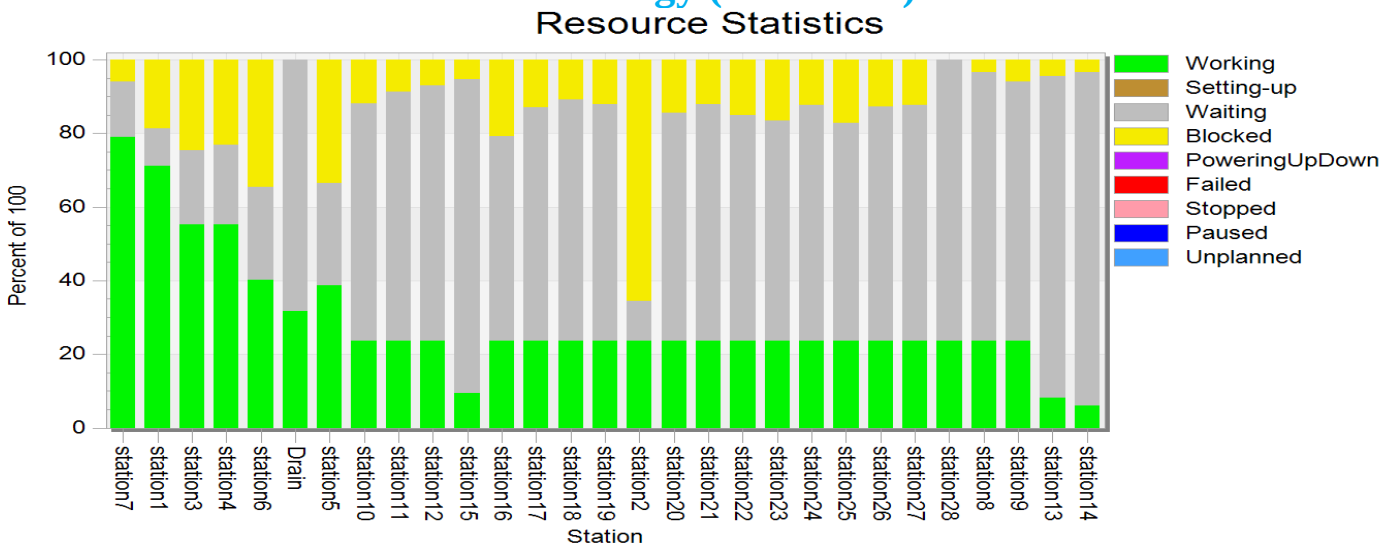

Mean Exit Time	Throughput per Hour	Throughput per Day
4:13.0463	14.190414	340.56995

Fig. 4.2: Simulation result from Current method

B. Result from RPW Method

S. No.	Description	RPW method
1	Cycle time	155 Sec
2	Efficiency	89%
3	No. of work station	15
4	No. of operation	28
5	Delay	11%

Table 4.2: Results from RPW Method

Volume 5 Issue VI, June 2017
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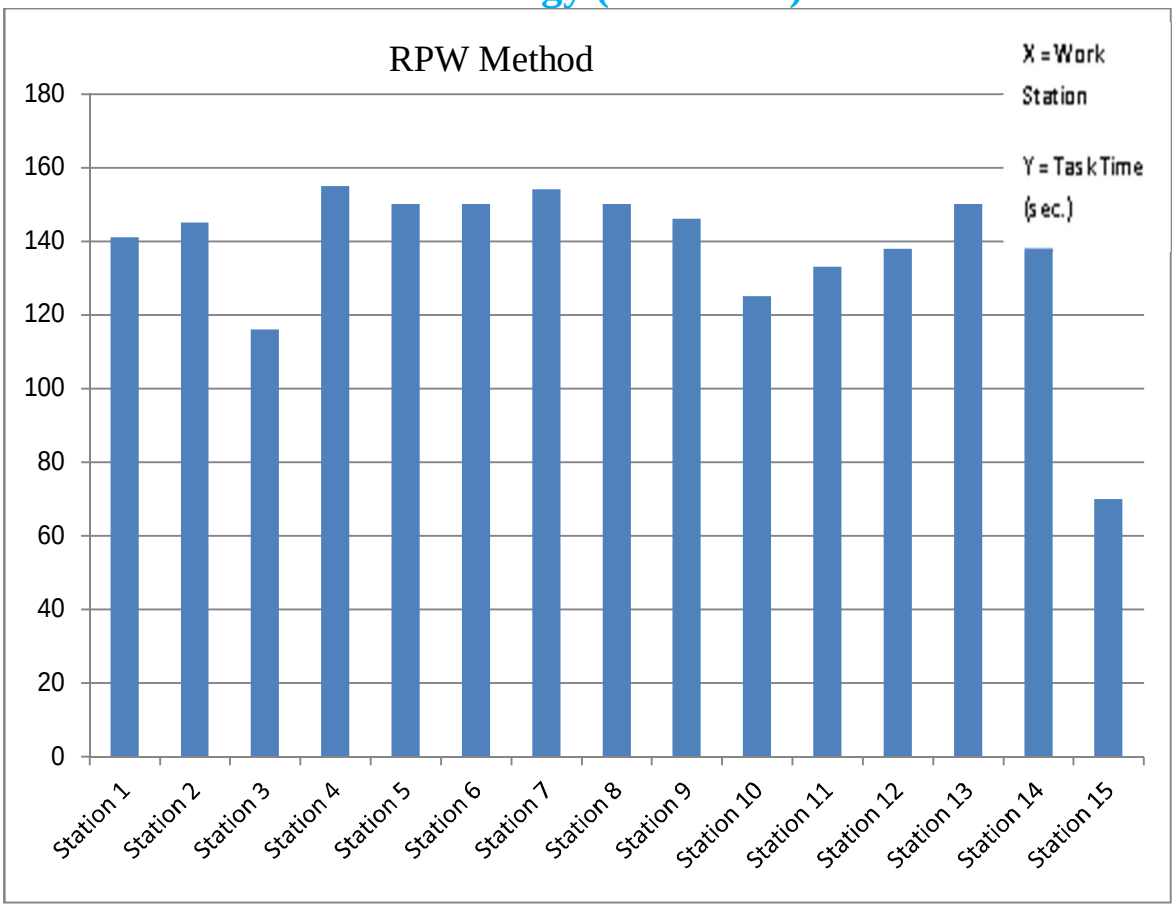
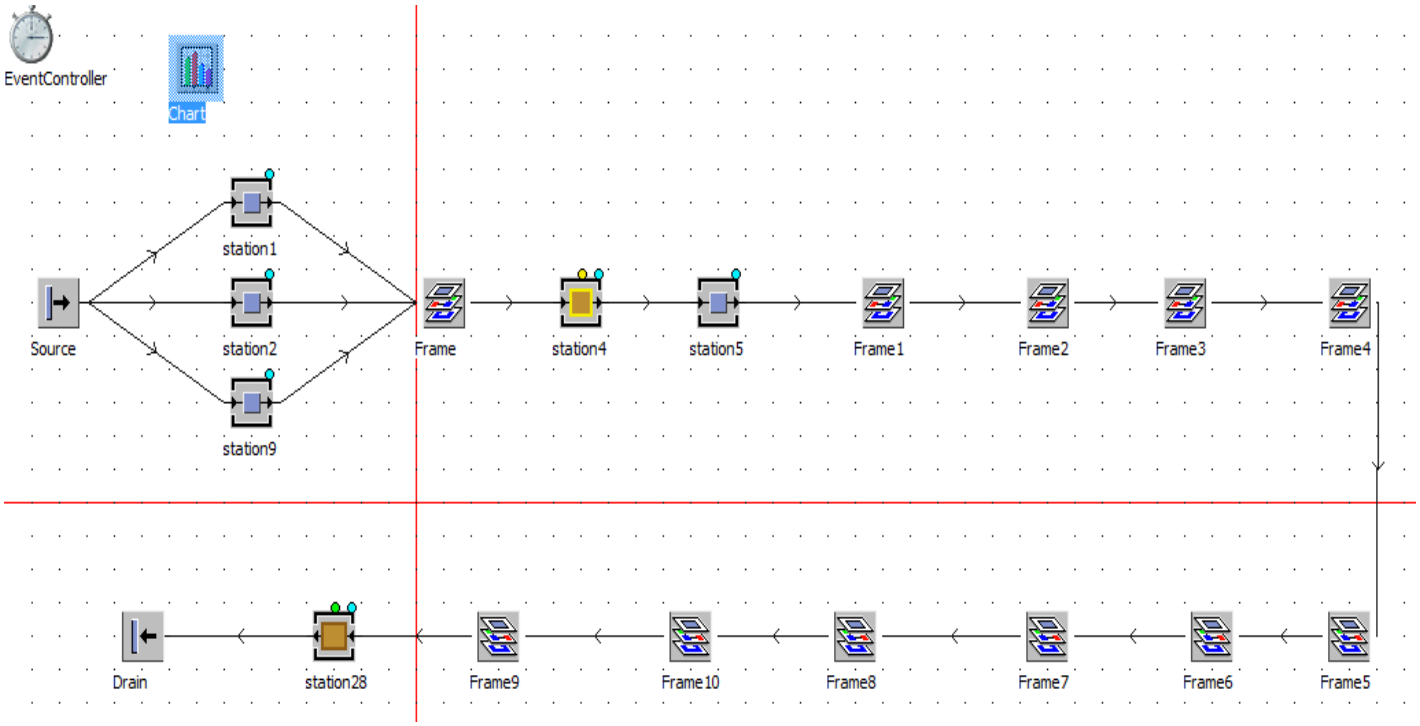


Fig. 4.3: RPW Method



Volume 5 Issue VI, June 2017
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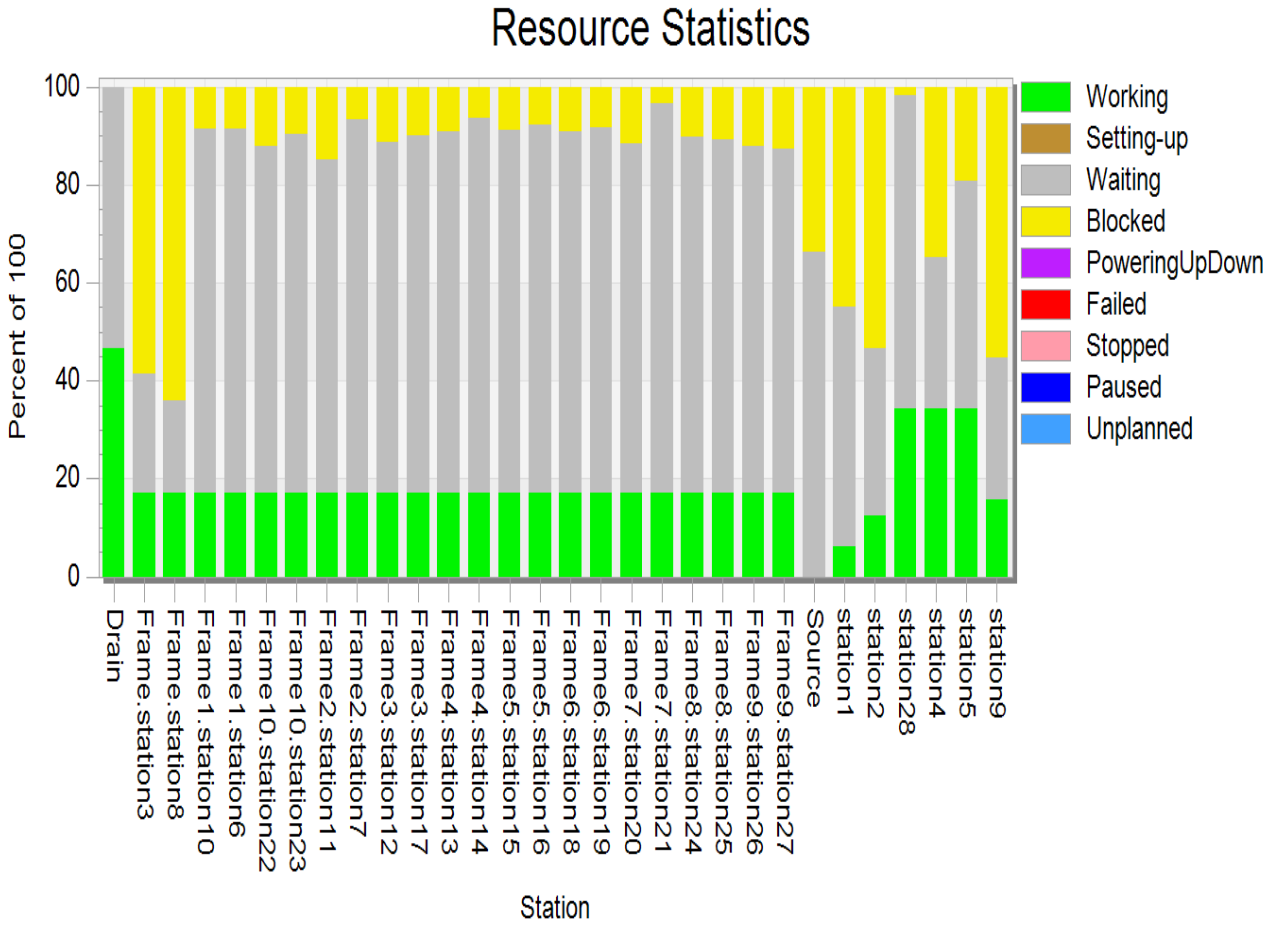

Mean Exit Time	Throughput per Hour	Throughput per Day
2:55.419	20.519394	492.46546

Fig. 4.4: Simulation result from RPW method

C. Results from KW Method

S. No.	Description	KW method
1	Cycle time	155 Sec
2	Efficiency	74.2%
3	No. of work station	18
4	No. of operation	28
5	Delay	25.8%

Table 4.3: Results from KW Method

Volume 5 Issue VI, June 2017
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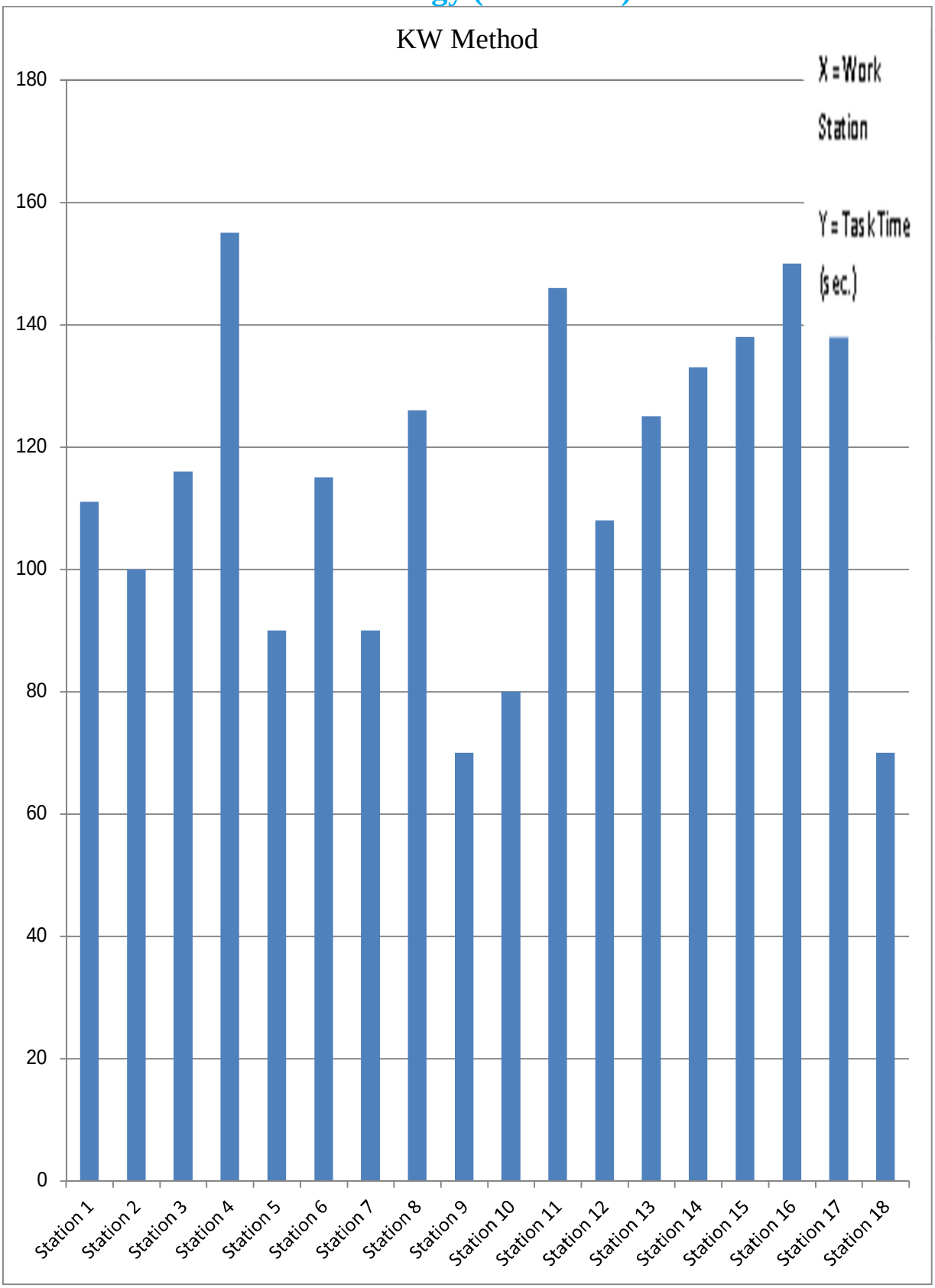

Fig. 4.5: KW Method

Volume 5 Issue VI, June 2017
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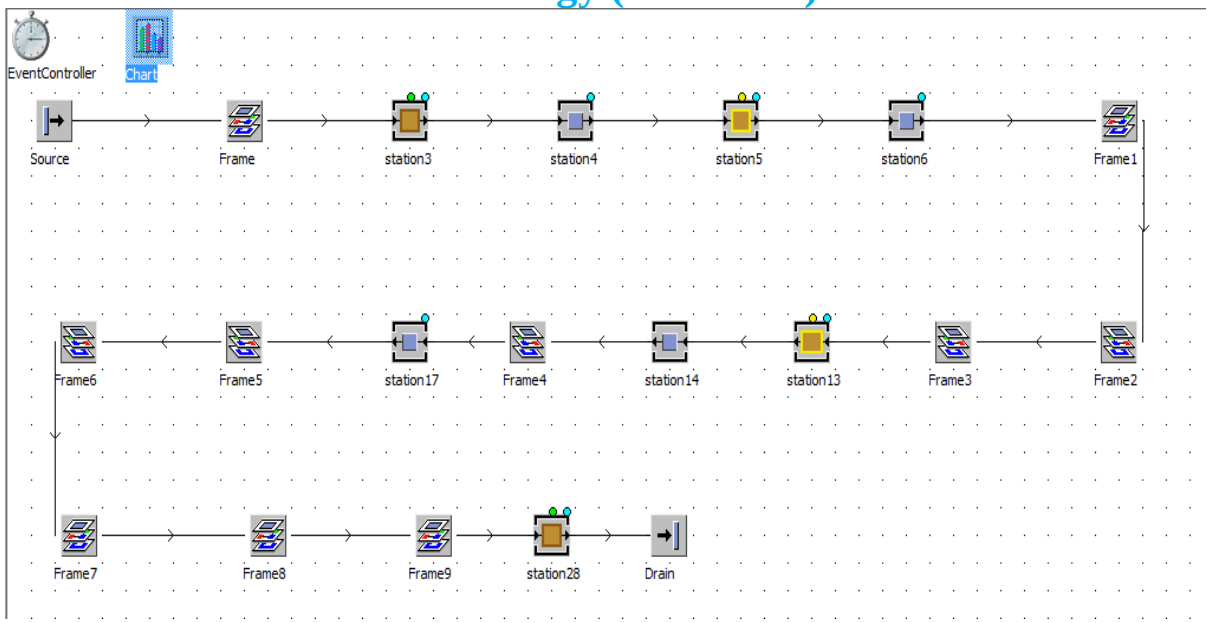

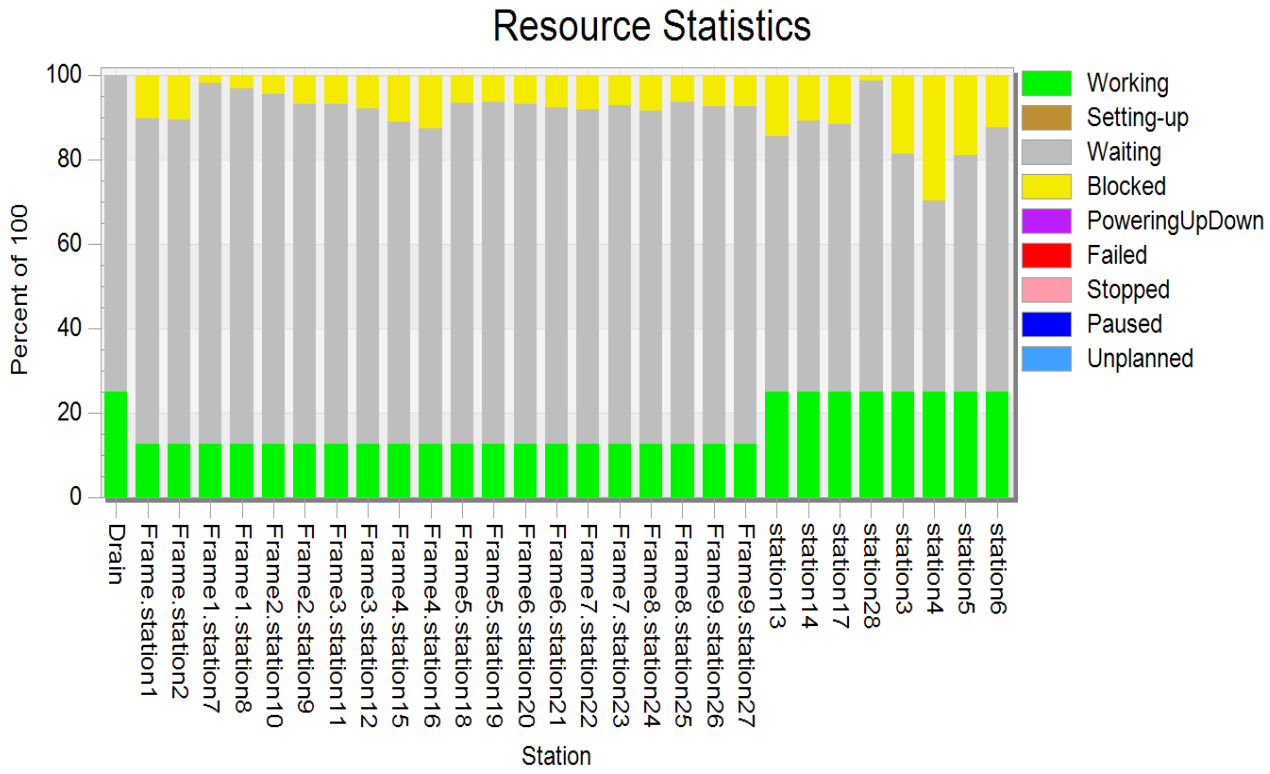

Mean Exit Time	Throughput per Hour	Throughput per Day
3:59.999	14.999681	359.99235

Fig. 4.6: Simulation result from KW Method

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

D. Comparison of results

S. No.	Description	Current Method	RPW Method	KW Method
1	Cycle time	155	155	155
2	Line efficiency	48%	89%	74.2%
3	No. of work station	28	15	18
4	No. of operation	28	28	28
5	Delay	52%	11%	25.8%
6	Throughput	340	492	359

Table 4.4: Comparison of results

Comparison Graph between above Methods

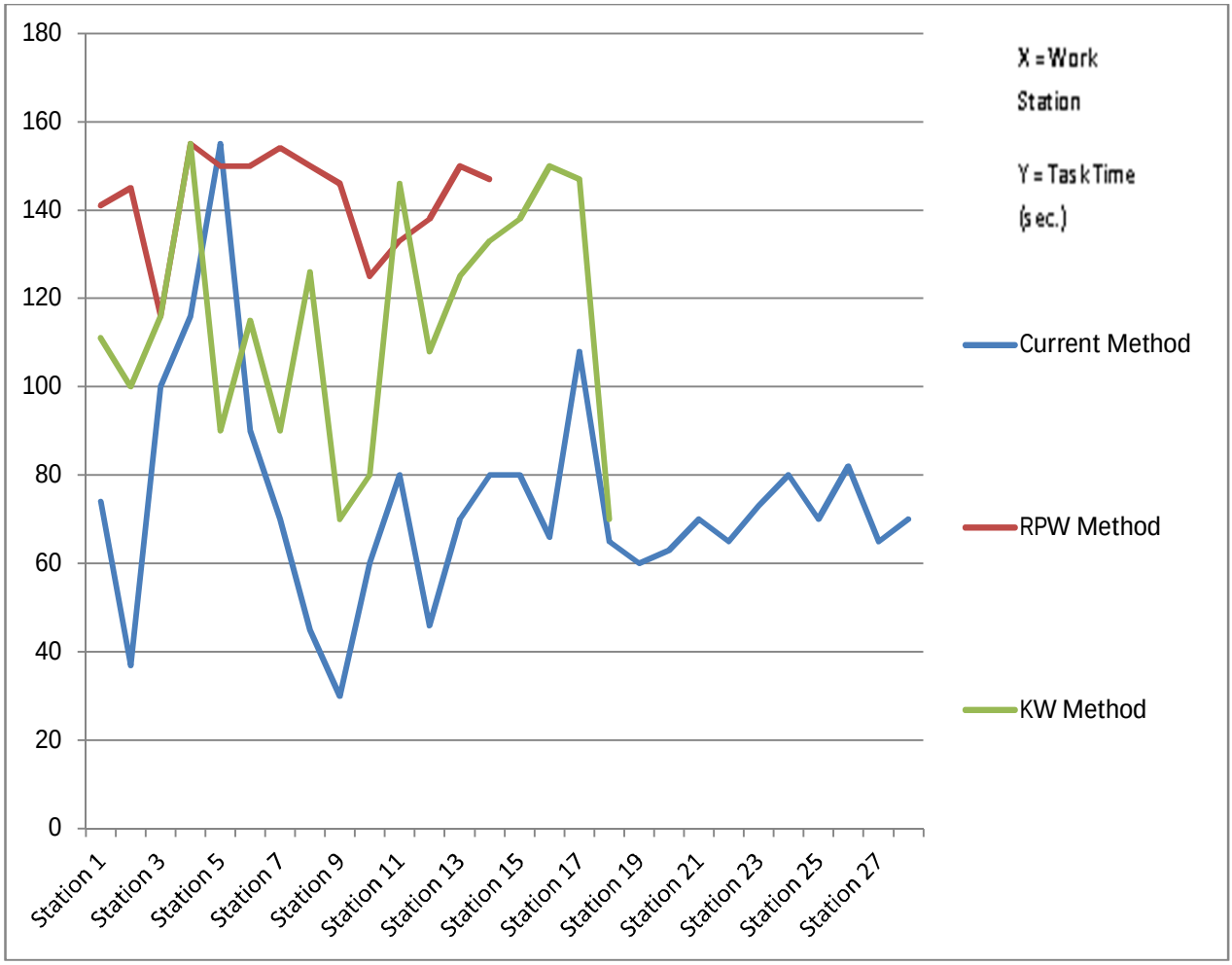

Fig. 4.7: Comparison Graph

Volume 5 Issue VI, June 2017
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E. Result Analysis

Keeping the same cycle time the objective here is to reduce the number of workstations by using the RPW method and KW method. It can be seen that the line efficiency enhances from 48% to 89% and also delay reduces from 52% to 11%. Simulation software named "Tecnomatix Plant Simulation" is also used to visualize whole process of assembly line which gives throughput from current method – 340, KW method – 359 and RPW method – 492 products per day. After analyzing the result that the RPW method is more efficient than all of the other methods

V. CONCLUSION

From the present analysis it is concluded that all two method gives better results than the present method which is using by the EICHER TRACTOR Ltd. But if we compare Ranked positional method and kilbridge & wester method so found that RPW gives the better result in present industry EICHER TRACTOR Ltd. RPW Heuristic approach shown better results as compared with present traditional method. In EICHER TRACTOR Ltd. whole process for assembly or subassembly is preset and all work take place according to that preset procedure. From beginning to till now procedure is going on without any change in assembly line. Any approach is not adopted by them for productivity improvement. But now the day's competition is increases each company wants to manufacture a product with good quality, minimum time and in minimum cost. This research work concentrate on maximize the production efficiency so the major role of this study is to look all these problems and introducing the heuristic approach to minimize delay. Whole research work summarized into some important points described below-

A. This research work totally based on TYPE-1 problem in which cycle time will constant and workstation may vary.
B. Data is taken from EICHER TRACTOR Ltd.
C. To solve the problem of line balancing two methods RPW and KW are used.
D. Results are represented in the form of EFFICIENCY, DELAY and THROUGHPUT.
E. Simulation software named "TECNOMATIX PLANT SIMULATION" is also used to visualize whole process of Assembly Line in practical manner which cross check mathematical calculation too.
F. Got throughput from RPW-492 product per day, KW-359 and current method-340 product per day.
G. It is concluded that RPW method is more efficient than all of other methods.

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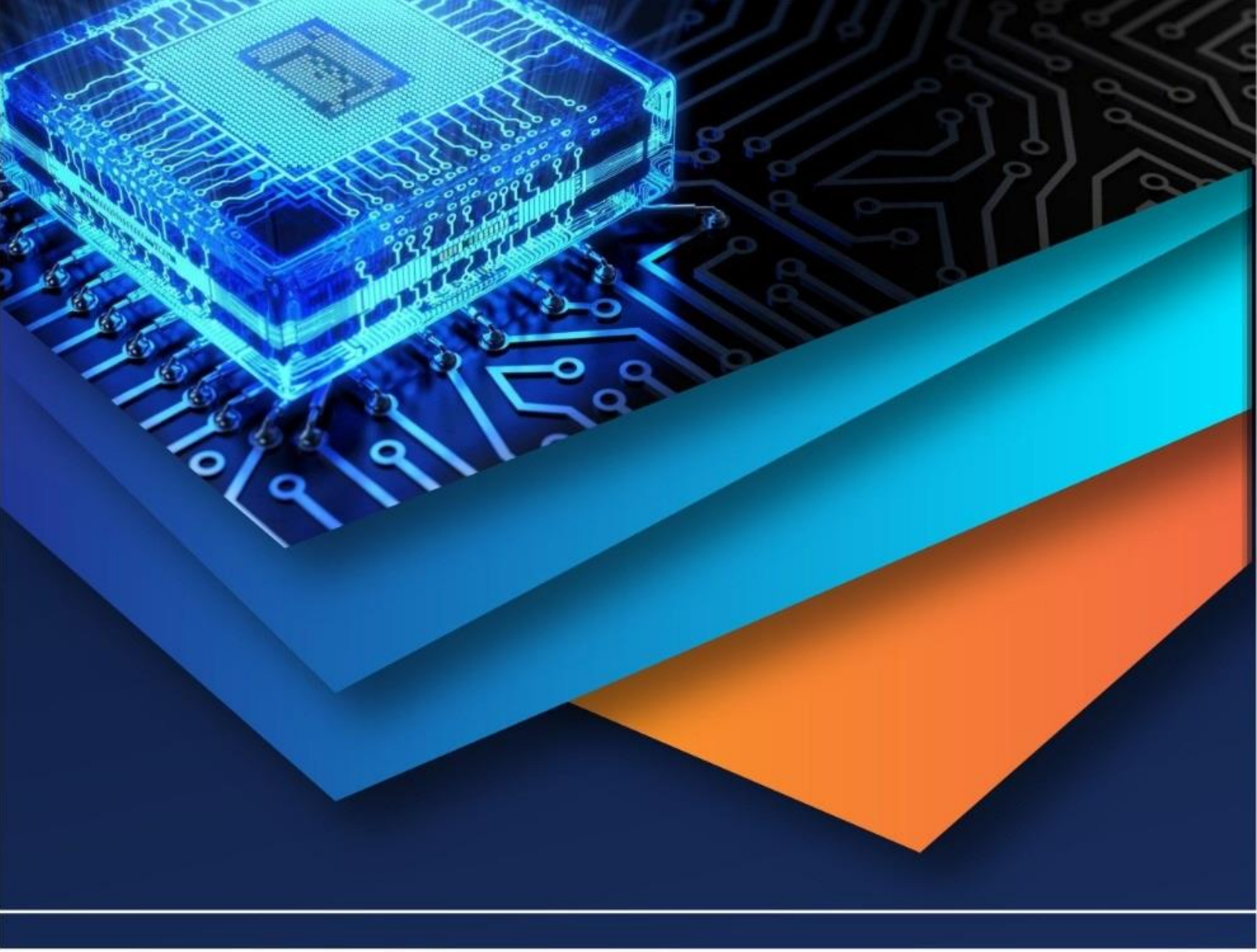

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