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Integration of Six Sigma and Anylogic Discrete Event Simulation Methodology in Surgical Toolbox Manufacturing: A Case Study

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Abstract: ***The purpose of this paper is to examine and identify the problem of small medium sized (SME) real case industry by integration of Anylogic Discrete Event (DE) simulation and six sigma method. The work starts with collection of data's of every processing time at their station with specific number of worker. The all the collected data of real case industry has simulated by anylogic software to get capacity utilization of every processing station, time distribution of every processing station, flow time analysis and defects analysis.***
After the successfully analysis of data in simulation paradigm, with the help of six sigma experimentally validated it by changes in process. In the validating phase of conventional and experimental data, the result have been progressive specially in total manufacturing time have been reduces which is good for company.
Keywords: Anylogic simulation, Discrete event simulation method, six sigma, capacity utilization, flow time.

I. INTRODUCTION

Manufacturing industries are facing dynamic competitive environment they have to need increase their customer's requirement and stand the position in competitive and also they have to do increase their productivity with optimal time and optimized product.(Ali Ahmed, J.F. Olsen, and Jhon Page,2017) Here on implementation of six sigma and anylogic simulation have become helps to meet the reduction process and increase the productivity by statistical data analysis. Simulation technology has progressed continuously in recent times and various new software packages are coming into the market while already existing software packages are being improved and update. Anylogic simulation widely uses in many business (eg. Manufacturing, Supply chain, Railway etc.) for effectively progress and the three most common part of anylogic simulation in discrete event (DE), agent based (AB), system dynamics (SD) simulation (Andrei Borshchev, 2014)

If the level of output is increased faster than that of input, productivity will increase. Conversely, productivity will be increased if the level of input is decreased faster than that of output. Also, an organization may realize a productivity increase from reducing more output with the same level of input. Finally, producing more output with a reduced level of input will result in increased productivity.(Suraj D. Patil[1], M. M. Ganganallimath[2] 2015) Productivity is the ratio between output and input. It is quantitative relationship between what i produced and what i have spent to produce. Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc.

The case study is performed in surgical tool box manufacturing industry situated in eastern state Gujrat, india. Study work experimentally focus on re-arrangement of worker at few processing station to maximize there working capability by skill enhancement and on the other hand improve the working method. The all experimentally method changes effectively control the manufacturing time and enhance productivity as well as capitalization of real case industry. In study i worked only with discrete event simulation method.

II. PROBLEM IDENTIFICATION OF REAL CASE INDUSTRY BY ANYLOGIC SIMULATION

I have seen in manufacturing industry if i do directly reduction in processing time and cost of product then there will be directly or indirectly quality, design of finished product to minimized or say compromised. So in these research work tried to overcome that compromised by implementing integration of six sigma and anylogic discrete event simulation in real case industry and tried to optimized production time and capacity utilization. Fig 1 illustrate the manufacturing process of the surgical toolbox, and all the collected process data is simulation illustrate in fig.2. and it's statistical graphs shown in fig. 3-6.

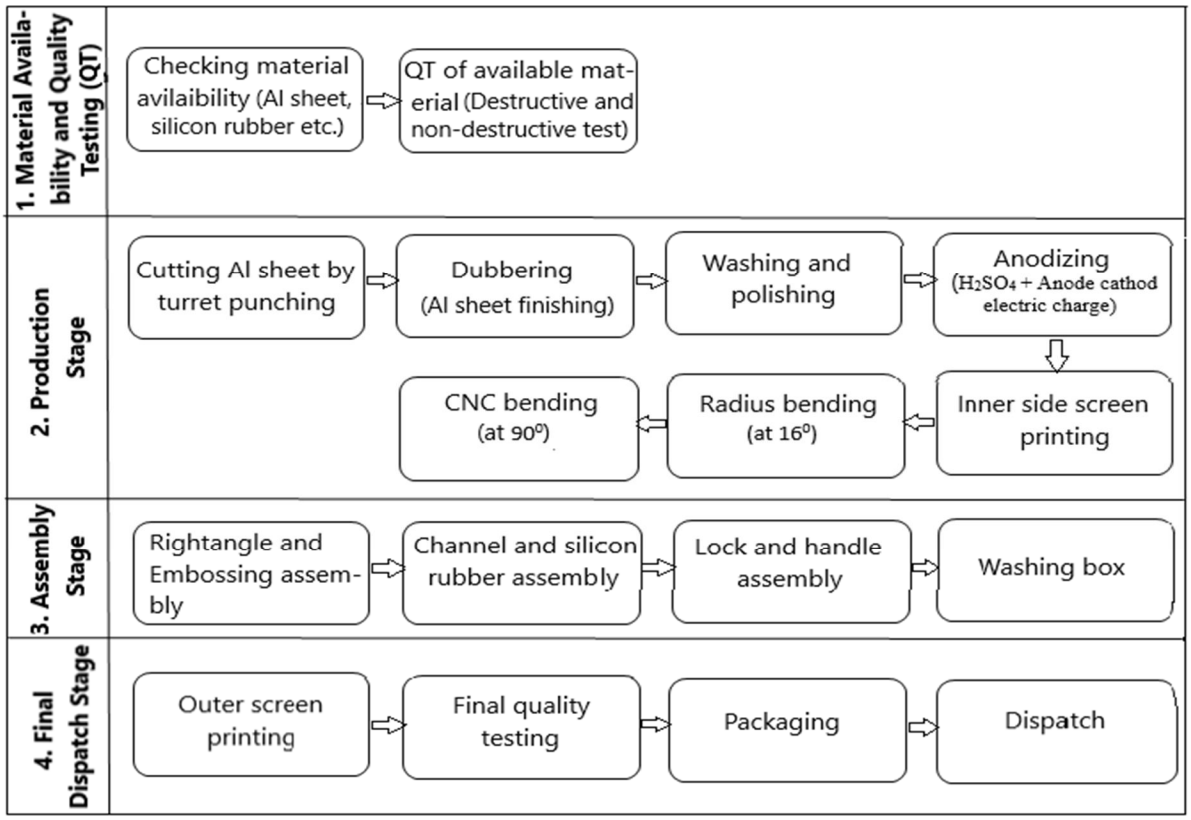

Fig.1 Flow Chart of Surgical Tool Box Manufacturing Process

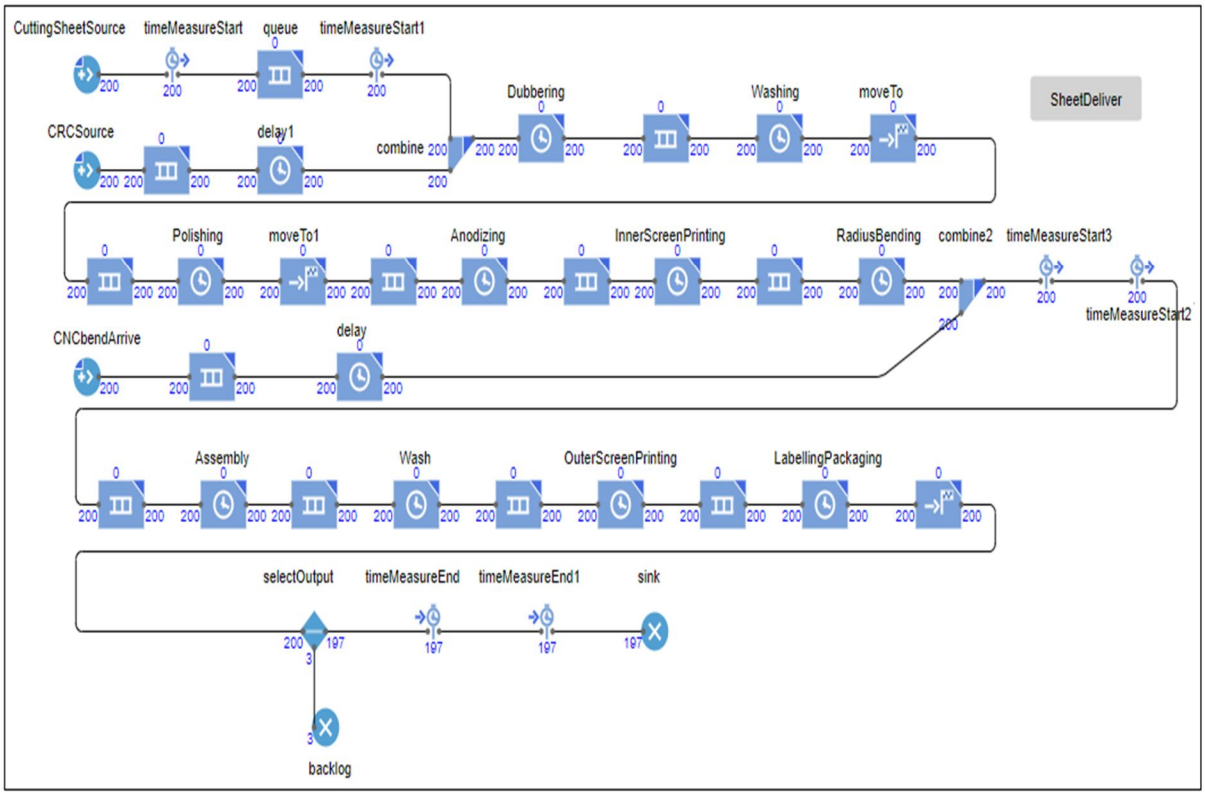

Fig.2 Anylogic DE Simulation of Theoretical Manufacturing Activity

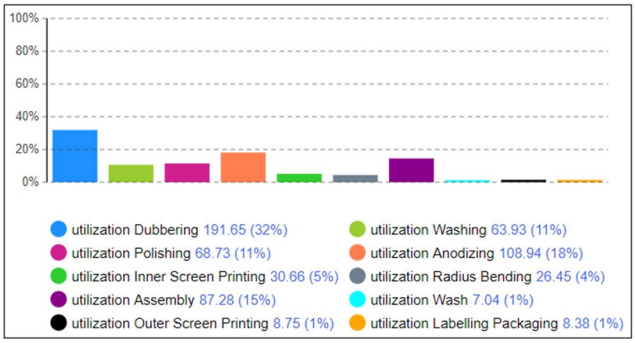

Fig.3 Theoretical Activity Capacity Utilization Utilization

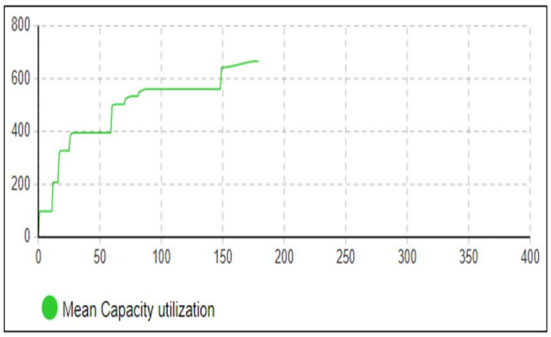

Fig.4 Theoretical Activity Mean Capacity

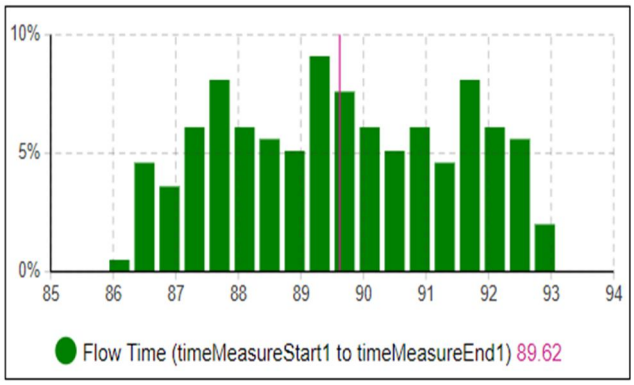

Fig.5 Theoretical Manufacturing Flow Time Time Distribution

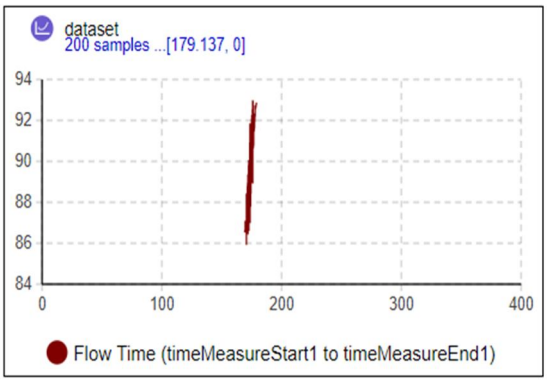

Fig.6 Theoretical Manufacturing Mean Flow

III. OBJECTIVE OF CASE STUDY

A. Analysis and optimization of processing flow time.
B. Analysis and optimization of capacity utilization.

IV. METHODOLOGY

A. Experimental Manufacturing Process Time And Capacity Optimization

After the getting conventional or theoretical data of manufacturing process flow time of real case industry, now i have some changes in number of worker from debburing, washing, polishing to inner screen print. There is an interval of ~3 days between every 2 batches (Al sheet it to be form toolbox) comes in process, mainly due to the sending of al sheets to other steel plant for cutting. It takes 3 days for the sheet to be cut and returned origin manufacturing industry, During this 3 workers of debburing and washing are sent to rubber cutting after working 18 hours and 2 workers of polishing working 10 hours, due to which the time of rubber cutting remains 4 days.

If the 2 workers of polishing are removed from polishing and sent to inner screen printing by skilled them and 2 out of 3 workers of debburing and washing go to polishing work after 18 hours, then the working time of rubber cutting will be 6 days, which will be good means rubber cutting time period will be of 6 days that won't effect any lead time of manufacturing process. It is notable that where the capacity utilization of inner screen print is 5% in theoretical method but its total processing time is 12 hours (max) if seen in experimental method then its capacity utilization is 3% at 6 hours (max) processing time. Basically the experimental capacity utilization seems to be less than the theoretical but on comparing its processing, the utilization is more than the theoretical method. Below fig.7-10 illustrate the experimental capacity utilization and flow time.

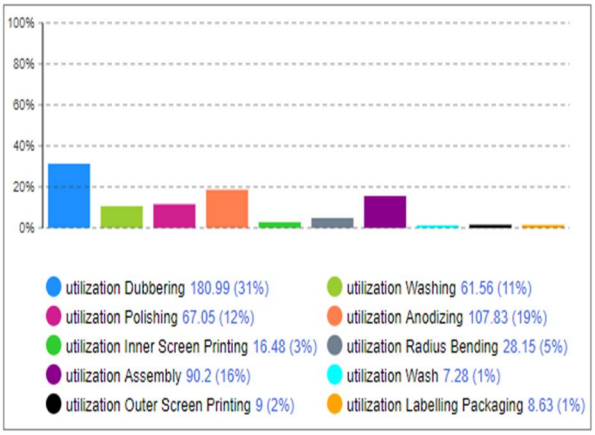

Fig.7 Experimental Activity Capacity Utilization Utilization

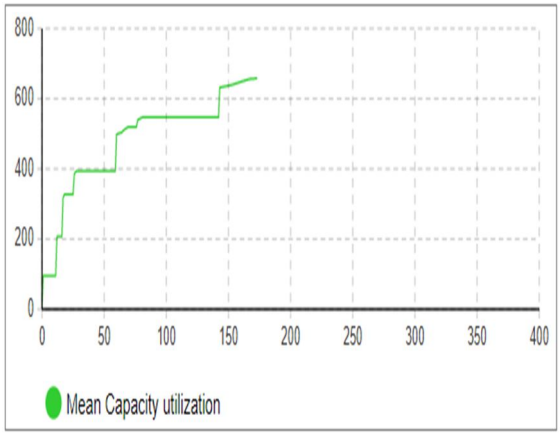

Fig.8 Experimental Activity Mean Capacity

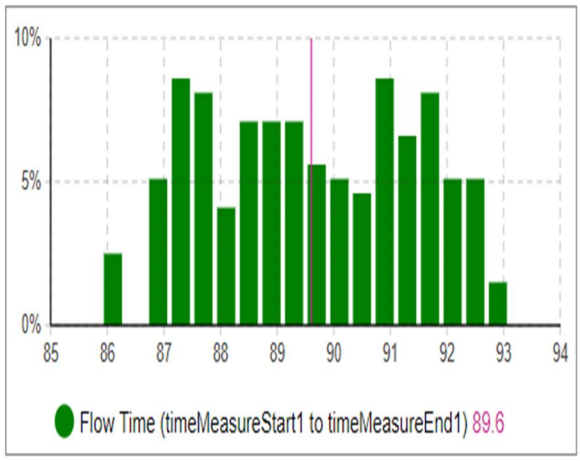

Fig.9 Experimental Manufacturing Flow Time Time Distribution

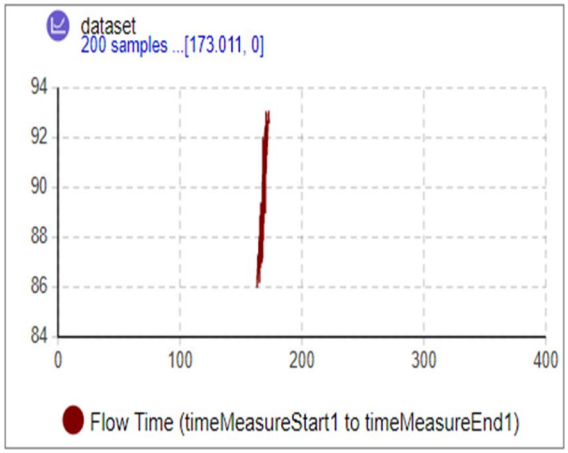

Fig.10 Experimental Manufacturing Mean Flow

V. RESULT

In the result the data of Theoretical method and experimental data which has been taken from different simulated chart and has compared to get changed data. The resultant of experimental data has been effectively and progressively.

Table.1 Manufacturing Optimized Performance Report Compare to Theoretical Method

KPI		Theoretical Method	Experimental Method	Change
Inner screen print capacity Utilization		5%	3%	-2%
Flow Time Distribution	Average	89.62	89.61	- 0.01 hour
	Min	86.38	86.02	
	Max	93.04	93.07	
	Deviation	1.83	1.84	
Total Processing flow Time		179.14 hour	173.01 hour	- 6.13 hour

VI. SCOPE AND LIMITATION

The using of anylogic simulation method is based in ideal condition in real case industry. In this research work capacity of producing product is in 200 per batch and number of worker is fixed. The simulation result will be change if the number of producing product change, number of worker change if any machinery breakdown.

VII. CONCLUSION

The aim of study is to find the progressively report for surgical tool box manufacturing industry. The integration of six sigma and anylogic discrete event simulation in based on critical success factor or can say to achieve goal at less time which has successively achieved in this study work.

According to the result the experimentally method it successively validates the conventional simulated data which will be profitably for the industry. Integrated six sigma and anylogic simulation experimentally report given the progressively result on which average flow distribution time reduces to 0.01 hour and the total manufacturing time reduced by 3.4% or 6.13 hour that data's less then to conventional working method data.

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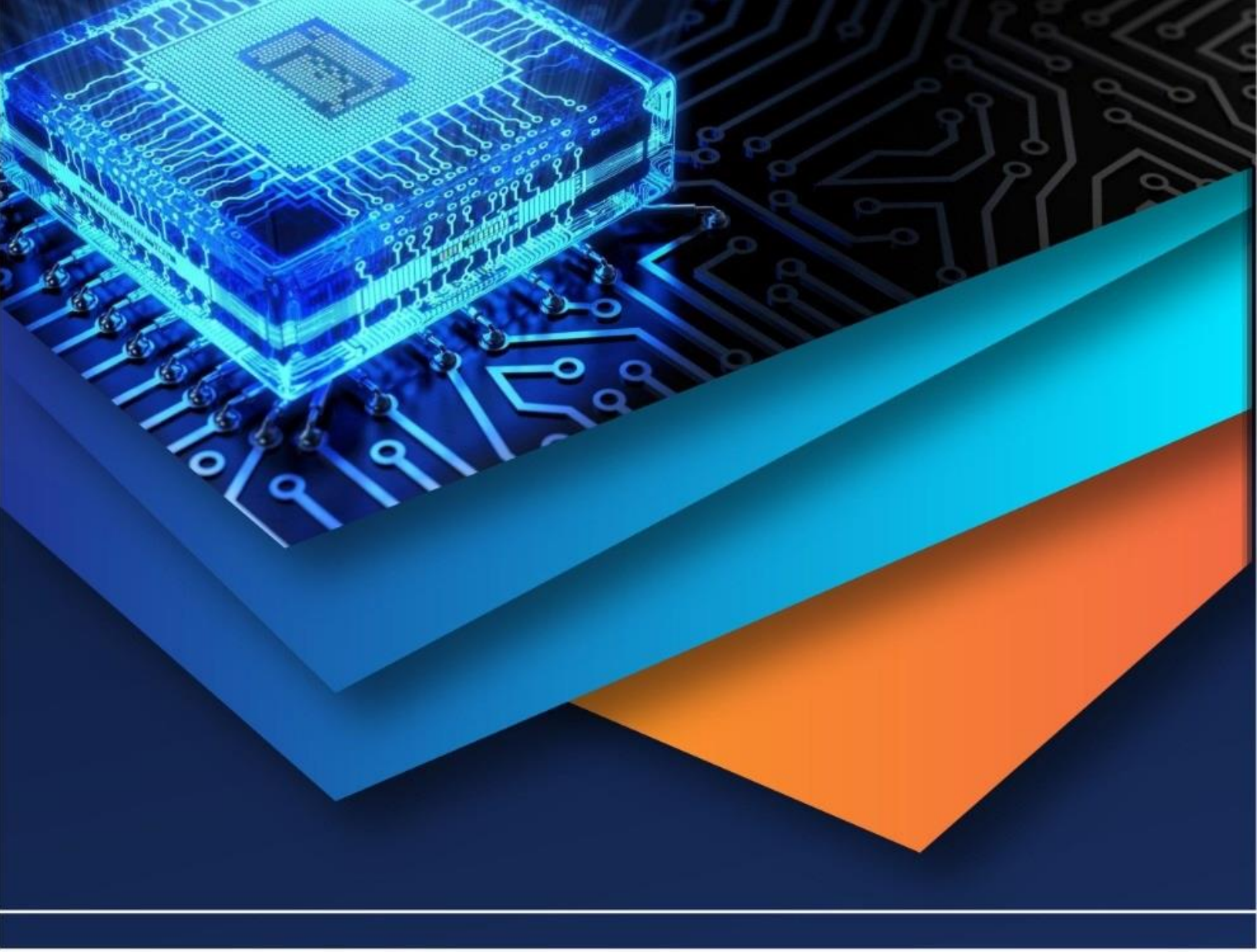

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