Automatic Tool Changer Enabling In Automation Press Line

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Abstract- *In manufacturing environments, efficient tool change and setup processes are critical for maintaining productivity and meeting production targets. such as the malfunctioning of the Automatic Tool Change (ATC) system can significantly impact operational efficiency. This case study examines the repercussions of an ATC system failure on the shop floor of a manufacturing facility. Due to the non-functionality of the ATC system, the die change time has experienced an increase, leading to delays in production schedules. Additionally, the setup time for the press line has extended beyond the studied setup time by 10 minutes, from 30 minutes to 40 minutes. The importance of diagnosing and addressing equipment failures promptly to minimize downtime and optimize manufacturing processes. It underscores the need for proactive maintenance strategies and continuous improvement initiatives to enhance shop floor efficiency and mitigate the impact of unforeseen disruptions on production activities.*

Keywords- ATC, Robot gripper, Automation, Press Machine, Vacuum cup, Sensor,HMI

I. INTRODUCTION

In the realm of industrial automation, efficiency and precision are paramount, especially in processes such as metal forming and stamping. One key element that significantly enhances the productivity of press lines is the integration of an Automatic Tool Changer (ATC). The primary objective of an ATC in an automation press line is to automate the switching of tools used in the press, eliminating the need for manual intervention. This automation not only accelerates production cycles but also contributes to higher accuracy and repeatability in the manufacturing process. Traditionally, tool changes in press lines involved halting the production process, manually replacing tools, and restarting operations. An ATC system typically consists of a tool magazine, a tool changer mechanism, and a control system. The tool magazine stores a variety of tools, each suited for specific tasks, and the tool changer facilitates the quick and precise swapping of tools as needed. Key benefits of integrating an ATC in an automation press line include increased productivity, improved flexibility in handling diverse production tasks, minimized human intervention, and enhanced safety by eliminating the need for operators to manually change tools in potentially hazardous environments. As industries continue to evolve towards smart manufacturing and Industry 4.0 standards, the adoption of Automatic Tool Changers becomes a strategic move for companies seeking to optimize their production processes, reduce costs, and stay competitive in a dynamic marketplace. This introduction sets the stage for exploring the intricacies and advantages of ATC technology in the context of automation press line.

Die change times have increased significantly as a result of our shop floor's ATC automatic tool change system's inefficiency. The setup time in our press line has taken 40 minutes instead of the anticipated 30 minutes, an increase of 10 minutes. These difficulties emphasize how urgent it is to fix equipment issues and streamline setup processes in order to increase output and decrease downtime.

Fig:1 Manual gripper change process at die change time.

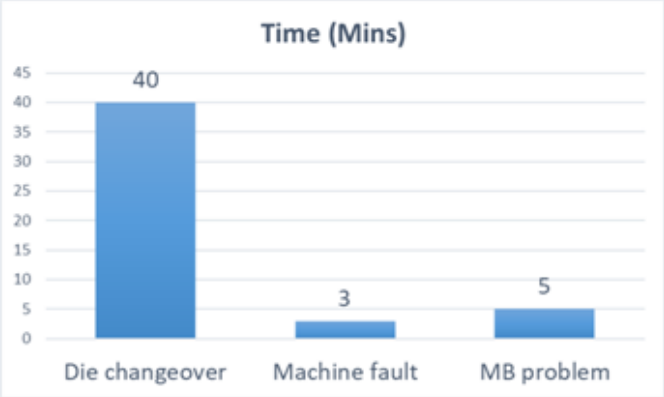

Fig:2 Time consuming activityin die change process.

1.1 Literature review:

Using the suction cup fitting in the gripper to pick up the work item in an automated fashion with varying profile sh apes was observed [1].

Observing how to improve the robot programme by minimising the amount of work that requires human interventi on and how to use the robot programme offline.And it's mostl y for everyone's safety[5].

Robot gripper fingers are validated in observation, de monstrating how to simulate the process and variation of the g ripper finger change in the necessaryshape[3].

II. METHODOLOGY

2.1 ATC not working:

ATC automatic tool changer not enabling dueto various parameter.

2.2 Problem statement:

In observation, while die change cycle time has been increased due to ATC not enabling, has studied setup time is 30 mins, but now it has happening 40mins.

2.3 Process for solution methodology:

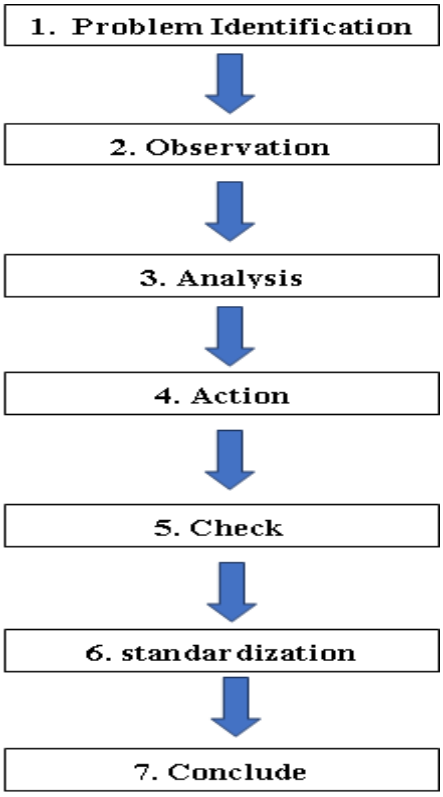

Fig:3 Project flow methodology.

2.4ATC system repair or replacement:

- If the automatic tool change (ATC) system is not functioning properly, prioritize repairing or replacing it.
- Engage maintenance personnel or external experts if necessary to troubleshoot and fix the issues with the ATC system promptly.

2.5 Process optimization:

- Review the existing die change and press line setup procedures to identify areas for improvement.
- Look for opportunities to streamline the processes, eliminate unnecessary steps, and reduce non-value-added activities.
- Involve operators and other relevant stakeholders in brainstorming sessions to gather ideas for optimization.

2.6Analysis process:

Problem which occurs in ATC process:
HMI – Human machine interface
TPS – Tool presences sensor

S.No	Description	Status
1	Check robot pravega sensor in HMI panel	Monitored
2	Check Tool present sensor in stand	Monitored
3	Check stand offset	Monitored
4	Check masters in robot pravega	Touch-up need to be done

Table:1 Problem occurs in ATC process.

Valid point: Check masters in robot Pravega

- In observation there is a mastering problem occurs in robot Pravega, where there are twoprocesses happening while tool change time one is hand-over and another is take-over process.
- Hand-over process happening smoothly, but while checking the ATC tool change process manually, take-over process having some offset issue has been observed.

Centre point measurement:

Line 2				
S.No	Centre point measurment			Devation
	R3	R4	R5	
1	-0.23	-0.14	-0.02	No error found
2	-0.48	-0.13	0.47	No error found
3	-0.49	-0.15	0.51	No error found

Table:2 Centre point reading in Pravega

- Centre point measurement accept range value <1mm.
- In observation there is no abnormality find in centre point measurement of Pravega.

Fig:4 Observation of centre point measurement.

2.7Action:

Robot Pravega mastering has been modified and touch-up also done parallelly.

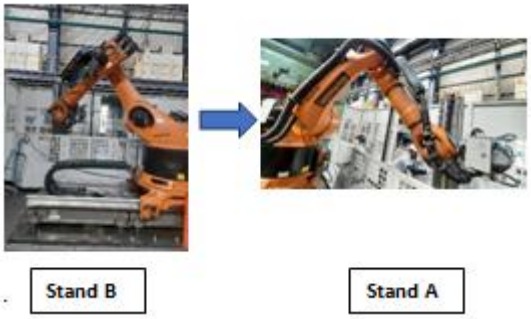

Fig:5ATC tool changeover.

Safety problem and Gripper vacuum cup damage:

- There are two processes going on in this procedure, the batch gripper that is currently in use and the batch gripper that will be available when the die changes. The gripper change process is done manually.
- The robot is equipped with a batch gripper now in use, and the next batch gripper is stored on the MB (**Moving bolster)**.
- The location of the next batch gripper on the MB could result in vacuum cup damage, vacuum fault and productivity loss from an automated production line.

2.8Continuous improvement:

- Establish performance metrics to monitor the effectivenessof the improvements implemented.
- Regularly review performance data and feedback from operators to identify further opportunities for optimization.
- continuous improvement where employees are encouraged to suggest and implement ideas for enhancing productivity and reducing downtime.

2.6 Training and standardization:

- Provide training to operators and maintenance personnel on the proper operation and maintenance of equipment, including the ATC system.
- Develop standardized procedures and checklists for die change is press line setup to ensure consistency and efficiency.
- Emphasize the importance of adhering to established procedures and safety protocols.

III. RESULT AND DISCUSSION

The EEI (**Effects and Ergonomics Index**) of the operator has decreased as productivity and safety have increased. All operators and executives received training and safety awareness. The stroke and output on a daily, monthly, and annual basis have now increased. And finally, seven minutes saved for ATC change process in automation press line.

Outcome of the project:

Seven minutes saved during the process, with our press line's average SPM (**Strokes per minute**) of 5.5 panels produced each minute. And average two die changes will happen per shift. Our company has run three shifts.

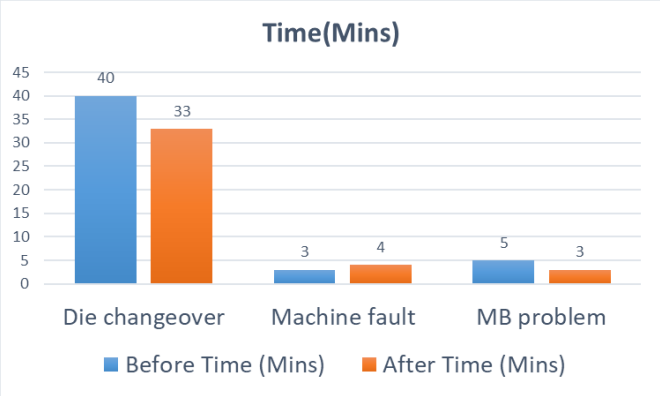

Fig:6 Before and after improvement in project.

Time savings and panels output:

S.No	Details	Time saving (mins)	Panels output
1	Per shift	14	77
2	Per day	42	231
3	Per month	1050	5544
4	Per year	12600	66528

Table:3 Output of the project.

IV. CONCLUSION

Die change times have increased as a result of the shop floor's faulty ATC automatic tool change system. Furthermore, the press line setup now takes 40 minutes instead of the 30 minutes that was investigated. In order to reduce downtime and increase production, this points to operational inefficiencies and emphasizes the pressing necessity for fixing the ATC system problem and streamlining the setup procedure. Productivity has improved due to enabling of ATC in automation press line and parallelly enhancing safety to the operator. Avoid loss in press line due to vacuum cup damage and vacuum fault problem while line running. And it creates more use full to the stakeholder and organisation. And our downtime has been reduced from 10 mins to 7 mins. It helps to increasing the productivity to both line 1 & 2.

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