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Manufacturing Enhancement in Car Body Shop Line

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Abstract

This paper deals with the increase in productivity of a car manufacturing industry. This can be achieved by eliminating the idle time of the robots and also by eliminating the unnecessary interlock mechanism between the robots. It is also done by reducing the number of welding points. In this paper Hyundai robots with Hi -5 controllers are used. In the welding robots the pneumatic gun is replaced by servo gun and automatic tool dresser is used to clean the welding tip periodically. It is observed that the hanger holding position of the robot disturbs the work of the other robots in the same station.so the position of the hanger holding is be modified to allow the others to work simultaneously. Some stations take too much of time because of the large number of welding points it can be reduced by shifting the welding points from one station to another. Robot speed is modified to increase the speed of operation of the robot which thereby reduces the cycle time. The main objective of the project is to reduce the cycle time from 72 seconds to 68 seconds per car body. This will increase the production by 4 units per hour. Thus by overcoming all the above mention problems the increase productivity can be achieved.

Keywords: component; Wireless communication; GSM network; Embedded System; Automation

1. INTRODUCTION

Productivity is the average measure of the efficiency of the production. It can be expressed as the ratio of outputs to inputs used in the production process, i.e. output per unit of input. It is the major criteria in any manufacturing industry, hence every manufacturing industry wants to increase their productivity by all means. The main aim of the project is to increase the productivity at Hyundai Motors India Ltd by eliminating the idle time of the robots. "Time saved is unit produced" this is the policy of Hyundai Motors India ltd, so we have to eliminate the downtime and idle time and have to use the robots efficiently

In this project we have proposed to enhance the productivity at side line by elimination of the ideal time of the robots used in the Body shop. And by eliminating the unnecessary interlock mechanism between the robots by modifying their path of work. And also by shifting the welding points from one robot to another. Hyundai Motor India indulges the world class technology as the input for their processes and thus contributes in the making of India's top quality cars, which are carried out in various shopsThe production management processes at Hyundai Motor India are overlaid with an organization-wide implementation of manufacturing best practices like Just-in-time inventory management, Kaizen, TPM and TQM, that help us in making the world's best cars, right here in India. To manufacture car right from the raw material, it has to pass the following shops.

A. Press Shop

A computer controlled line that converts sheet metal to body panels of high dimensional accuracy and consistency.

B. Body Shop

A hi-tech line that builds full body shells from panels. Automated robotic arms are used for intricate welding operations that ensure superior and consistent build quality.

C. Paint Shop

This is one of the most modern paint shops in the country and uses the environment friendly water based process for superior and lasting exterior. A unique process management system followed here helps us deliver the most extensive color range, independent of minimum batch requirements, helping customers get their preferred color anytime.

D. Engine and Transmission Shop

One of the biggest engine shops in the country, this unit is equipped with the most modern tooling and testing facilities to make a wide range of engines in-house.

E.Test Track

With comprehensive performance testing facilities like rattle testing and ABS brake testing; this track is designed to meet pre-delivery (PDI) certification standards to exacting Euro specifications.

2. RELATED WORK

Mushtaq Patel, Praveen Singh Sisodiya, Sajid Qureshi, Dr. Vivek Bansod in their paper "Reduction in Process Cycle Time In Mechanical Production Industries By Using Eight Core Approaches"[1] that this work presents a new approach for the reduction of process cycle time and its impact on a company's competitive edge. Reduction in cycle time has been gaining significant attention in recent times. The shorter cycle times effect in higher consumer satisfaction, lower manufacturing rate, higher yield, and better potential given tool inventory and facility constraints. This research paper provides a brief review of core approaches related to cycle time and also describes a methodology for cycle time reduction in any manufacturing and automobile production industry. It includes the assessment and potential gains of the projected cycle time reduction methodology.

Joerg Domaschke, steven Brown, Franz Leibl, in their paper "Effective Implementation of Cycle Time Reduction Strategies For Semiconductor Back-End Manufacturing"[4] said that Using discrete-event simulation models, a study was conducted to evaluate the current production practices of a high-volume semiconductor back-end operation. The overall goal was to find potential areas for productivity improvement that would collectively yield a 60% reduction in manufacturing cycle time. This paper presents the simulation methodology and findings pertaining to analysis of the Assembly, Burn-In, and Test operations. Many of the recommendations identified can be implemented at no additional cost to the factory. The most significant opportunities for improvement are in the Test area, the system constraint. Additionally, the model is extremely sensitive to changes in operator staffing levels, an accurate reflection of many back-end operations. The model shows that the cumulative impact of these recommendations is a 41% reduction in average cycle time, a significant contribution to the overall goal.

Sanjay Sharma in his paper "Cycle time reduction in context to the make to order (MTO) environment" [5] A flexible production rate has been discussed and analyzed

in the literature for different business situations. This paper aims to consider this for a make_to_order (MTO) environment. Generally the production rate and cycle time are significant parameters among others, where other parameters might include demand, and production time cost. An improvement in the cycle time or the cycle time reduction is a prime objective in the context of an overall productivity improvement particularly in the MTO environment. In order to gain some insights, an interaction of the production rate and cycle time is described. The focus of the present paper is on the supply chain cost using these parameters among others. A framework for the conceptual understanding and analysis is provided along with the practical implementation issue. A relevant measure for the degree of flexibility (DOF) in the context of supply chain is also discussed in this paper.

Cycle Time Improvement by a Six Sigma Project for the Increase of New Business Accounts **[6]** in this paper reports the application of a 6σ project about the reduction of the cycle time for acquiring a new credit account in a finance group. The methodology used in this project was the DMAI technique of 6σ. The paper documents the analysis and tasks performed by the management team that reduced cycle time from 49 days to 30 days which resulted in an expected annual savings of $300,000.00. Also an increased customer satisfaction and an increase of sales is expected.

A Systematic Cycle Time Reduction Procedure for Enhancing the Competitiveness and Sustainability of a Semiconductor Manufacturer**[7]** in this paper cycle time reduction plays an important role in improving the competitiveness and sustainability of a semiconductor manufacturer. However, in the past, cycle time reduction was usually unplanned owing to the lack of a systematic and quantitative procedure. To tackle this problem, a systematic procedure was established in this study for planning cycle time reduction actions to enhance the competitiveness and sustainability of a semiconductor manufacturer. First, some controllable factors that are influential to the job cycle time are identified. Subsequently, the relationship between the controllable factors and the job cycle time is fitted with a back propagation network. Based on this relationship, actions to shorten the job cycle time can be planned. The feasibility and effectiveness of an action have to be assessed before it can be taken in practice. An example containing the real data of hundreds of jobs has been used to illustrate the applicability of the proposed methodology. In addition, the financial benefits of the cycle time reduction action were analyzed, which provided the evidence that the proposed methodology enabled the sustainable development of the semiconductor manufacturer, since capital adequacy is very important in the semiconductor manufacturing industry.

In order to increase the productivity we must know the process involved in the production of the car. Since we are going to work in the body shop we must know the

organization of the body shop. In order to minimize the existing cycle time we must analyze the bottle neck in the production flow.

3. BODY SHOP

In Body Shop, all the sheet metal panels and parts, which are supplied by press shop, MIP (Made in Plant), imported, KD (Knock Down) and vendors, LP (Local Parts) are converted into final shape of car body. The major process being used is electric resistance welding. Body manufacturing is divided into Floor, Side, Build, Moving and Complete. After welding the complete body (Body in White) is sent to paint shop through conveyor skid for painting.

There are about 134 robots for performing various operations and nearly 285 auto guns for doing spot welding. The weld automation in body shop is about 99.6%.

A. DIVISIONS OF BODY SHOP

There are seven divisions of body shop as follows.

Floor Line (Front/Center/Rear floor)- In this line the floor sections of the car like the front rear and center are produced by the robots in these work station. Side line (LH/RH)-In these line the side portions of the car like the side doors and rear doors are produced. The right side and left side doors are produced on the separate lines. The LH (Left Hand Side) line is the mirror image of RH (Right Hand Side) line. CRP (Cowl /Roof/ Panel)-In these lines the cowl, roof and panel are produced by the robots in the work station. The panel for each car changes and it is produced accordingly.BB (Body Build)-In these line the doors and the roof are attached to the floor in Hyundai Motor India has a universal production which is common for the production of all model cars in all single line. If the floor for a particular model comes to this line then the respective models doors and roof are automatically fed in Hyundai this is handled by TVS Logistics.BR (Body Respot)- In this line the remaining welding in the built body and all welding are checked here.

4. INTERLOCK PROBLEM

When two robots are working in a same work station and sharing a same work space means a clash will occur between the robots if they are operating at same time. In order to avoid the clash an interlock [2] between the robots will be implemented which is nothing but the hand shake between the robots acknowledging their work. When there is an interlock between the robots one robot have to wait till the other robot

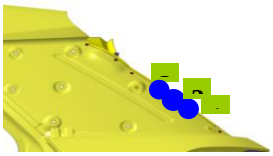
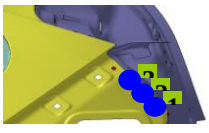
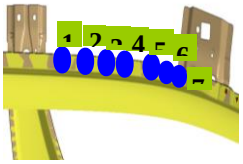
finishes its work, hence one robot idle waiting for the other. The interlock is in much need between the turn table which is present in between the work stations #703 and # 705. Due to the idle time of the robots in that work stations the cycle time of those work stations are high as 85 sec in LH side and 75 sec in RH side.

A. Proposed Plan

The main of any manufacturing industry is to use the machines to their fullest extent i.e. their idle time should be avoided between the outer shuttle station 705 R1 and turn table station 703 R1, interlock position is modified. It is also modified by changing the hanger holding position since the R1 robot interferes the work volume of R2 when its hanger is fully extended so the hanger position is modified.

In Station #703 to #705 Interlock waiting position is modified. At station #703 Side assembly hanger holding position is changed. At station #705 Interlock Position Modified. The total improvement is the reduction of 15 to 18 sec in the cycle time.

Table 1. SPOT SHIFTING PROCESS

S NO	LINE	MDL	BEFORE	AFTER	ACTIVITY	PHOTO
1	SD LH	IB	704 R4	707 R1	3 SPOT SHIFTED	
2		IB	705 R1	707 R1	3 SPOT SHIFTED	
3		IB	707 R1	704 R2	4 SPOT SHIFTED (1-4)	

5. RESULTS:

The time taken for the production of one unit car is called cycle time.to increase the productivity we must be aware of the time taken to produce those. Hyundai currently produces three model cars such as i10, i 20, EON they are called as IB, PB, HA respectively inside the plant. All the three cars are produced in a single production line rather than having a separate line for each model[2]. In the body building line all body parts such as roof door etc. are assembled, all the parts are done automatically example if the floor of IB comes to the work station mean all the other parts are automatically fed. The cycle time for both the LH and RH side is studied for all there models at each and every station for each and every robot.

TABLE 2 Cycle Time Check List LH Side (IB)

LINE	STN NO.	ROBOT NO.	WELD POINT	CYCLE TIME(IB)	ROBOT SPEED
SIDE (LH)	703	R1	●		90%
	704	R1	10	**75**	100%
		R2	9		100%
		R3	9		100%
		R4	10		100%
	705	R1	10	**73**	90%
	706	R1	12	**67**	100%
	707	R1	12	**77**	90%
		R1-1	●		75
	709	R1	11	**77**	100%
		R2	11		100%
		R3	14		100%
		R4	5		100%
		R5	10		100%
	711	R1	14	**73.6**	100%
		R2	17		100%

		R3	12		100%
	712	R1	19	**76.3**	100%
	713	R1	●		80%
	715	R1	●	**72.6**	100%

Table3.Cycle Time Check List RH Side (HA)

LINE	STN NO.	ROBOT NO.	WELD POINT	CYCLE TIME(HA)		ROBOT SPEED
				ROBOT	STATION	
SIDE (RH)	703	R1	●	**82**		80%
	704	R1	11	**60**	**71**	100%
		R2	11	**55**		80%
		R3	15	**56**		100%
		R4	5	**38.6**		100%
	705	R1	11	**44.1**	**78**	100%
	706	R1	10	**42.1**	**51**	100%
	707	R1	7	**31.2**	**70**	95%
		R1-1	●	**65**		85
	709	R1	9	**30.8**	**72**	95%
		R2	12	**53**		80%
		R3	11	**57.9**		100%
		R4	5	**34.3**		70%
		R5	12	**47.9**		95%
	711	R1	10	**46.5**	**65.1**	100%
		R2	12	**48.7**		60%
		R3	12	**60**		100%

	712	R1	11	**44**	**59.2**	100%
	713	R1	●	**36.1**		80
	715	R1	●		**74**	70%

CONCLUSION

Productivity is the main objective in any manufacturing industry, so every company is trying to concentrate on the increase in production. The other main criteria is the efficient use of machines and the available man power. Time saved is unit produced, so we had reduced the idle time of the robots by assigning alternative work to that robots. The cost of this project is actually very minimum because we are altering the system rather than making new manufacturing setup. Spot shifting from side LH is shifted to the new robot in body building line which is brought for the new model and it is currently idle, so that robot is engaged with the new welding task .Interlock position is modified to avoid clash between the robots. The position of the hanger is changed. In spot welding pneumatic gun is replaced with servo gun. Automatic tool dresser is used. Clamp unit & jig unit airline modification and valve adjustment is made. Thus the cycle time is reduced from 72 seconds to 68 seconds.

REFERENCES

[1] Mushtaq Patel, Praveen Singh Sisodiya, Sajid Qureshi, Dr. VivekBansod. "Reduction in Process Cycle Time in Mechanical Production Industries by Using Eight Core Approaches", International Journal of Engineering Development and Research (IJEDR), ISSN:2321-9939, Vol.2, Issue 1, pp.772-778, 2014.

[2] Mikell P Groover, “Automation Production Systems and Computer- Integrated Manufacturing” Pearson Education, New Delhi, 2001.

[3] Mikell P Groover, "Industrial Robots – Technology Programmes and Applications” , McGraw Hill , New York, USA. 2000.

[4] http://www.fabtime.com/abs_Siem98.shtml

[5] Sanjay Sharma "Cycle time reduction in context to the make to order (MTO) environment” Journal of Manufacturing Technology Management, Vol. 24 Iss: 3, pp.448 -464

[6] M.White “Cycle Time Improvement by a Six Sigma Project for the Increase of New Business Accounts” International Journal of Industrial Engineering, 16(3), 191-205, 2009.

[7]. www.mdpi.com/journal/sustainability, 2013, 5, 4637-4652; doi:10.3390/ su5114637.