The identification and optimization of bottleneck of the production system based on TOC

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Abstract. According to TOC, there is at least one constraint on any system, or it may have unlimited output. Therefore, in order to improve the output of a system, the constraint of the system must be broken down. In this paper, the production process of M company is analyzed by means of Method and Time study. We find the problems in the production process of M company based on TOC , then proposed improvement and optimization scheme.

1. Introduction

The theory of constraints is first proposed by Israeli physicist Goldratt , after continuous development, it has achieved the achievement and attracted people's attention, a new way of organizing production after MRP and JIT.[1] TOC is about how to improve and best to implement a set of management ideas and management principles, can help enterprises to quickly identify the constraints in the process of achieving the objectives, and further pointed out how to implement the necessary improvements to eliminate these constraints, so as to achieve the goal of the enterprise.[2]

The implementation steps of TOC management can be summarized as follow: ①construction of the production flow chart; ②defining indexes and determine the constraint index; ③identification of the bottleneck; ④determining how to make full use of resource of bottleneck;⑤taking necessary measures to improve the bottleneck; ⑥after eliminating the bottleneck, if the system gets a balance, otherwise it returns step ③ to recognize system bottleneck.[3]

2. Capacity and Index

The first step is to construct the production flow chart of TOC management, this paper mainly studies the production process of a new product of M company（As shown in Figure 1 and Figure 2).

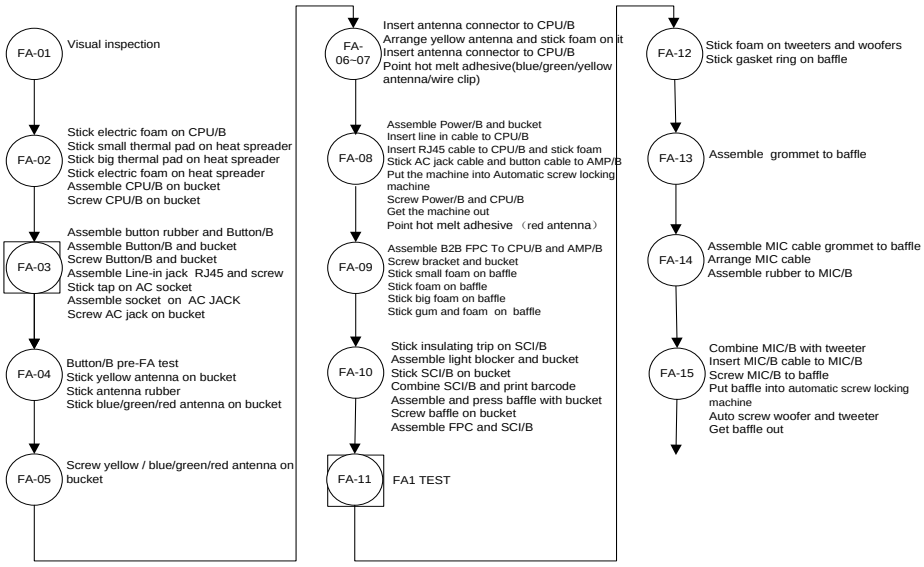

Figure1. Production flow chart

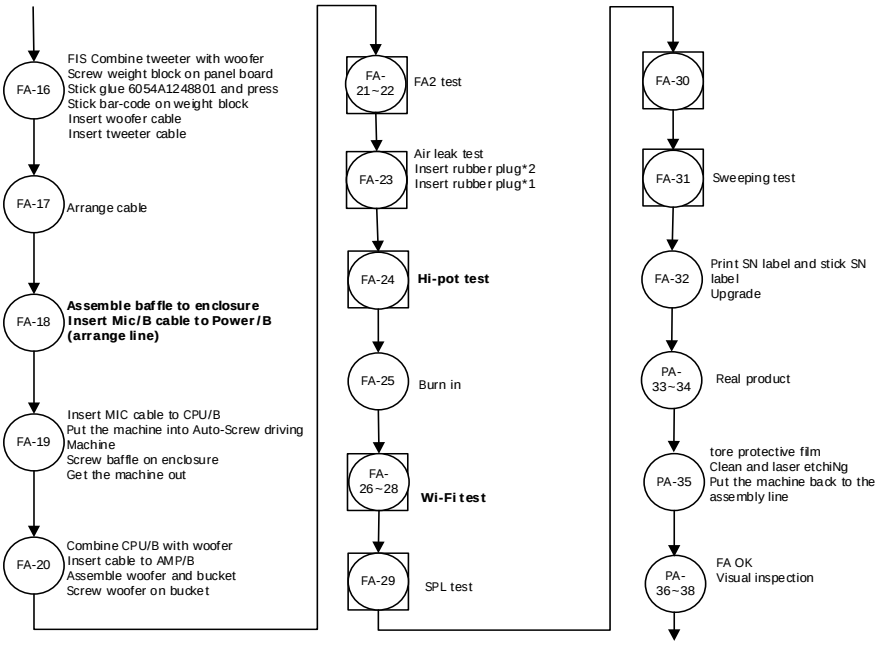

Figure2. Production flow chart

The second step is to define the index and determine the bottleneck station of the product process .This paper measures time of each station by stop watch, record the actual average operating time of each station(As shown in Table1 and Table2).

Table1. Standard time of each station

Workstation				Man-power	Motion Unit	Time(s)	Total(s)
FA	1	-	1	1	Visual inspection	140	140
FA	2	-	2	1	Stick electric foam on CPU/B	32	118
					Stick small thermal pad on heat spreader	18	
					Stick big thermal pad on heat spreader	18	
					Stick electric foam on heat spreader	16	
					Assemble CPU/B on bucket	8	
					Screw CPU/B on bucket	26	
FA	3	-	3	1	Assemble button rubber and Button/B	15	156
					Assemble Button/B and bucket	8	
					Screw Button/B and bucket	26	
					Assemble Line-in jack RJ45 and screw	6	
					Screw line in Jack	12	
					Assemble RJ45	6	
					Screw RJ45	12	
					Stick foam on AC Socket	16	
					Assemble foam on AC Socket	12	
					Assemble AC Jack on AC Socket	25	
					Assemble AC Jack and screw	18	
FA	4	-	4	1	Button/B pre-FA test	22	90
					Stick yellow antenna on bucket	12	
					Stick antenna rubber	20	
					Stick blue antenna on bucket	12	
					Stick green antenna on bucket	12	
					Stick red antenna on bucket	12	
FA	5	-	5	1	Screw yellow antenna on bucket	18	72
					Screw blue antenna on bucket	18	
					Screw green antenna on bucket	18	
					Screw red antenna on bucket	18	
FA	6	-	7	2	Insert antenna connector to CPU/B	34	184
					Arrange yellow antenna and stick foam on it	135	
					Point hot melt adhesive(antenna/wire clip)	15	
FA	8	-	8	1	FIS and print the barcode	12	178
					Arrange Power/B on the bucket	8	
					Insert Line in cable into CPU/B	14	
					Insert RJ45 cable into CPU/B and stick the foam	20	
					Insert AC jack cable and button cable into AMP/B	32	
					Put the machine into automatic screw locking	6	
					Screw Power/B and CPU/B	60	
					Get the machine out	6	
					Insert red antenna and connector into CPU/B	5	
					Point hot melt adhesive (red antenna)	15	
FA	9	-	9	1	Assemble B2B FPC to CPU/B and AMP/B	16	109
					Screw bracket and bucket	36	
					Stick small foam on baffle	12	
					Stick foam on baffle	10	
					Stick big foam on baffle	10	
					Stick gum and foam on baffle	25	
FA	10	-	10	1	Stick insulating trip on SCI/B	22	110
					Assemble light blocker and bucket	10	
					Stick SCI/B on bucket	15	
					Combine SCI/B and print	14	
					Assemble and press baffle with bucket	15	
					Screw baffle on bucket	14	
					Assemble FPC and SCI/B	20	
FA	11	-	11	1	FA1 test	112	112

Table2. Standard time of each station

Workstation				Man-powe	Motion Unit	Time(s)	Total(s)
FA	12	-	12	1	Stick foam on the pipe	20	60.00
					Stick seal ring on the baffle	40	
FA	13	-	13	1	Stick seal strip on the baffle	120	120.00
FA	14	-	14	1	Assemble MIC/B cable grommet on the baffle	40	104.00
					Arrange MIC cable	50	
					Arrange Rubber on MIC/B	14	
FA	15	-	15	1	Combine MIC/B with tweeter	8	124.00
					Insert MIC/B cable into MIC/B	20	
					Screw MIC/B to baffle	35	
					Put baffle into Automatic screw locking machine	6	
					Put woofer and tweeter into baffle	20	
					Auto screw woofer&tweeter	30	
					Get baffle out	5	
FA	16	-	16	1	FIS combine tweeter with woofer	12	135.00
					Screw weight block on panel board	22	
					Stick glue 6054A1248801 and press	18	
					Stick bar-code on weight block	4	
					Insert woofer cable	25	
					Insert tweeter cable	54	
FA	17	-	17	1	Arrange cable	103	103.00
FA	18	-	18	1	Assemble baffle to enclosure	20	113.00
					Insert MIC/B cable to Power/B	93	
FA	19	-	19	1	Insert MIC/B cable to CPU/B	24	68.00
					Put the machine into Auto-Screw driving machine	8	
					Screw baffle on enclosure	30	
					Get the machine out	6	
FA	20	-	20	1	Combine CPU/B with woofer	12	110.00
					Insert cable to AMP/B	40	
					Assemble woofer and bucket	18	
					Screw woofer on bucket	40	

FA	21	-	22	2	FA2 test	134	134.00
FA	23	-	23	1	Air leak test	33	67.00
					Insert rubber plug	16	
					Insert rubber plug	18	
FA	24	-	24	1	Hi-pot test	33	33.00
FA	25	-	25	1	Insert the line	300	16800.00
					Burn in	16200	
					Pull plugs	300	
FA	26	-	28	3	Put the machine into the tester	21	360.60
					Wi-Fi test	320	
					Put it back to assembly line	20	
FA	29	-	29	1	Put the machine into the tester	25	106.00
					SPL test	81	
					Put it back to assembly line	13	
FA	30	-	30	1	Grille inspection	30	140.00
					Tear off Mic/B barcode	3	
					Assemble the Grille with bucket	27	
					Press the Grille with the bucket	80	
FA	31	-	31	1	Put the machine into the tester	17	87.00
					Sweeping test	48	
					Put it back to assembly line	22	
FA	32	-	32	1	Print SN label and stick SN	22	145.00
					Upgrade	123	
FA	33	-	34	2	Real product	181	181.00
FA	35	-	35	1	Tear off protective film	35	74.00
					laser etching	23	
					Put the machine back to the assembly line	16	
FA	36	-	38	3	Visual ispection and FA OK	300	300.00

3. Standard Time of each station

The company's production line is straight line , the operator is located at both sides of the production line, each time the product flows through an operator , the operator takes the product off the assembly line, then puts it on the table and assembles it, then puts it back on the pipeline. After the completion of assembling, flowing to the next station. In order to ensure large-scale production and make sure the process of trial production capacity, requesting human constant production line to ensure the hourly capacity of not less than 25, so that the relevant technical personnel and engineers to verify that the product performance.

The third step is identification of the bottleneck. By analyzing the standard time of each station of the process of the product, it is found that the bottleneck station of the process is FA25. Considering there is sufficient Terminal Block for charging in products, so as to exclude this station as bottleneck station. By analyzing further, it is found that both station FA3 and FA8 are bottleneck stations.

The fourth and fifth step is determining how to make full use of resource of bottleneck and taking measures to improve the production process bottlenecks stations: (1) change the production of straight lines into U-shaped layout[4], arrange logistics counterclockwise direction; (2) change the way of offering material instead of placing mass material next to production line, using" water spider"; (3) combine 3rd and 12th station , combine 8th and 19th station.

According to the improvement program, carried out "5S" activities of the production line, and to develop the station standard documents and PFMEA, especially the bottleneck station.

4. Summary

Through constraint theory, there are often a few constraints having a significant impact on the system, maybe there are a number of factors, but at least one. Therefore, in the actual improvement, we should consider toward system problems overall, and consider and deal with the problem from the overall benefit , then take measures to relax the constraint and solve the constraints, so as to achieve the goal.

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