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ANALYSIS OF APPLICATION OF MATERIALREQUIREMENT PLANNING (MRP) IN HELMET PRODUCTION USING BILL OF MATERIAL (BOM) TO HELMET AND BILL OF MATERIAL (BOM) VERSUS PRE ORDER APPROACH AT PT.POLIPRIMA CIPTA UNGGUL

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Abstract.
PT. Poliprima Cipta Unggul is a company in manufacturing which is a plastic injection molding company with one of its superior products is G2. The purpose of this research is to optimize the production process and ordering raw materials. Minimizing excess stock of materials and protecting out-of-stock safety. The first thing to do this research is the stocktaking of all materials starting from post 1 to post 4. List all existing POs, Next is the formation of future state mapping in identifying the type of waste that occurs in the company, the main typeof waste is the type of waste of overproduction, waste of inventory and waste of overprocessing

Keywords: *MRP (Material Requirement Planning), current state mapping, future state mapping, kaizen, BOM to Helmet, BOM vs PO, FIFO (First in First Out) process cycleefficiency, pull system, Stockopname*

Introduction

The manufacturing industry is a group of companies whose main activity is to produce and process raw or semi-finished materials into ready-to-use or finished goods. The goods are purchased by the company from other companies or providers. The purposeof the manufacturing industry is to produce goods economically so that they can make a profit and can deliver the product on time. In addition, the manufacturing industry also ensures that the production process can be continuous and develop so that the survival of the company is guaranteed. Currently, companies are also required to be more competitiveso that they can compete to seize the existing market.

PT. Poliprima Cipta Unggul is a manufacturing company which is a plastic injection molding company with one of its superior products being Helmet G2. PT. Poliprima Cipta excels which directly produces the helmet production process starting fromthe manufacture of helmet shells and visors, the buffing process, the painting process, the decall or sticker installation process, the varnish process and finally the assembly or assembly process. One of the efforts in increasing productivity and Optimizing Material Requirement Planning. In the production process there is some waste

Waiting, which does not require material items, or materials that are lacking. provide added value among others in every production process so that it is not effective and efficient. The waiting time or waste waiting does not add value to the helmet production process. So there is a long lead time in each process which causes a lot of waste. Waste isan indication of resource utilization that is not optimal. Waste minimization efforts can produce efficiency and reduce product lead time so as to increase output.

Library Review

- Material Requirements Planning

  Material Requirement Planning (MRP) Is a technique or logical procedure for translatingthe induction production schedule (JPI) from finished goods or end items into netrequirements for several components needed to implement JPI. This MRP is used to determine the amount of material requirements to support the master production schedule and determine when the material requirements are scheduled.
- BOM To Helm

  The Bomb to Helm method is a stock monitoring method and the overall amount of material, to be able to conclude how many helmets will be ready to be made or ready tobe assembled, from here we can see the overall available helmet models.

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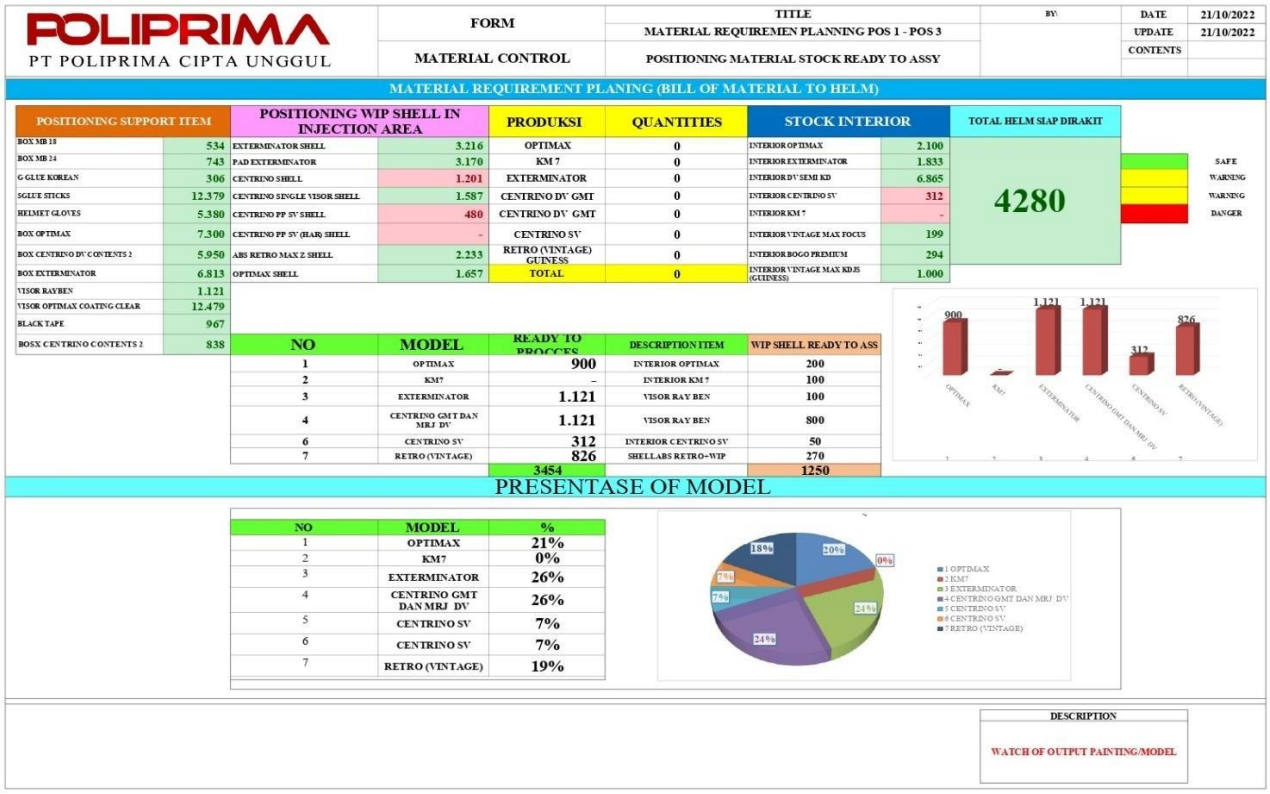

POLIPRIMA
PT POLIPRIMA CIPTA UNGGUL

FORM	TITLE	BY	DATE	21/10/2022
	MATERIAL REQUIREMEN PLANNING POS 1 - POS 3		UPDATE	21/10/2022
MATERIAL CONTROL	POSITIONING MATERIAL STOCK READY TO ASSY		CONTENTS	

MATERIAL REQUIREMENT PLANING (BILL OF MATERIAL TO HELM)

POSITIONING SUPPORT ITEM		POSITIONING WIP SHELL IN INJECTION AREA		PRODUKSI	QUANTITIES	STOCK INTERIOR		TOTAL HELM SIAP DIRAKIT
BOX MB 18	534	EXTERMINATOR SHELL	3.216	OPTIMAX	0	INTERIOR OPTIMAX	2.100	4280
BOX MB 24	743	PAD EXTERMINATOR	3.170	KM 7	0	INTERIOR EXTERMINATOR	1.833	
G GLUE KOREAN	306	CENTRINO SHELL	1.201	EXTERMINATOR	0	INTERIOR DV SEMI KD	6.865	
SGLUE STICKS	12.379	CENTRINO SINGLE VISOR SHELL	1.587	CENTRINO DV GMT	0	INTERIOR CENTRINO SV	312	
HELMET GLOVES	5.380	CENTRINO PP SV SHELL	480	CENTRINO DV GMT	0	INTERIOR KM 7	-	
BOX OPTIMAX	7.300	CENTRINO PP SV (HAR) SHELL	-	CENTRINO SV	0	INTERIOR VINTAGE MAX FOCUS	199	
BOX CENTRINO DV CONTENTS 2	5.950	ABS RETRO MAX Z SHELL	2.233	RETRO (VINTAGE) GUINESS	0	INTERIOR BOGO PREMIUM	294	
BOX EXTERMINATOR	6.813	OPTIMAX SHELL	1.657	TOTAL	0	INTERIOR VINTAGE MAX KDJS (GUINESS)	1.000	
VISOR RAYBEN	1.121							
VISOR OPTIMAX COATING CLEAR	12.479							
BLACK TAPE	967							
BOSX CENTRINO CONTENTS 2	838							

SAFE
WARNING
WARNING
DANGER

NO	MODEL	READY TO PROCCES	DESCRIPTION ITEM	WIP SHELL READY TO ASS
1	OPTIMAX	900	INTERIOR OPTIMAX	200
2	KM7	-	INTERIOR KM 7	100
3	EXTERMINATOR	1.121	VISOR RAY BEN	100
4	CENTRINO GMT DAN MRJ DV	1.121	VISOR RAY BEN	800
6	CENTRINO SV	312	INTERIOR CENTRINO SV	50
7	RETRO (VINTAGE)	826	SHELLABS RETRO-WIP	270
		3454		1250

PRESENTASE OF MODEL

NO	MODEL	%
1	OPTIMAX	21%
2	KM7	0%
3	EXTERMINATOR	26%
4	CENTRINO GMT DAN MRJ DV	26%
5	CENTRINO SV	7%
6	CENTRINO SV	7%
7	RETRO (VINTAGE)	19%

DESCRIPTION
WATCH OF OUTPUT PAINTING/MODEL

Figure 1. BOM to helm

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Research Methods

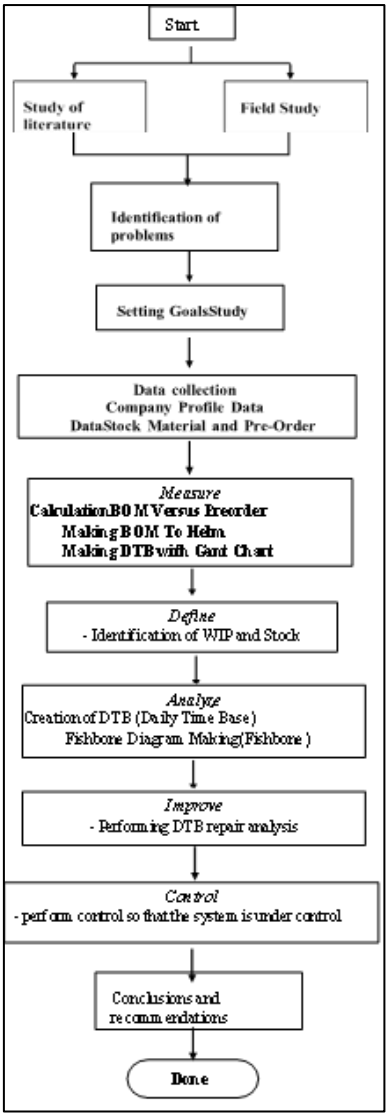

Figure 2*. Research flow chart*

Result and Discussion

A. Define

One of the efforts in increasing productivity and Optimizing Material Requirement Planning. In the production process there is some waste waiting, which does not requirematerial items, or materials are lacking. provide added value) among others in every production process so that it is not effective and efficient. The waiting time or waste waiting does not add value to the helmet production process. So there is a long lead timein each process which causes a lot of waste.

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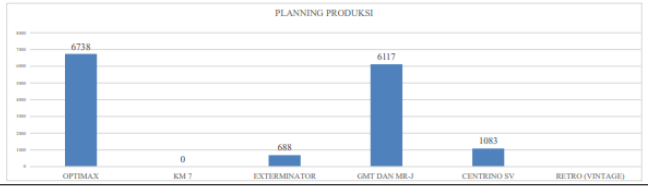
B. Measure

POLIPRIMA PT POLIPRIMA CIPTA UNGGUL	FORM	BY	DATE	27/10/2022
	MATERIAL REQUIREMENT, CONTROLLING STOCK HAND		UPDATE	22/07/2022

MODEL	PLANNING PRODUKSI
OPTIMAX	6738
KM 7	0
EXTERMINATOR	688
GMT DAN MR-J	6117
CENTRINO SV	1083
RETRO (VINTAGE)	
TOTAL	14626



OPTIMAX			
PART NAME	WARAHOUSE DATA	MATERIAL NEEDS	MATERIAL NEED 30%
[2.01.0053] VISOR OPTIMAX CLEAR (COATING)	0	(6738)	(8759)
[3.01.0066] VISOR RAY-BAN EXTERMINATOR	4421	(2317)	(3012)
[3.01.0080] INNER VISOR KEY SYSTEM OPTIMAX	2496	(10980)	(14274)
[2.01.0109B] STYROFOAM OPTIMAX D.30	3501	(3237)	(4208)
[2.01.0090] INTERIOR OPTIMAX	2213	(4525)	(5883)
[3.01.0025L] HORNS LIST OPTIMAX	1496	(5242)	(6815)
[2.02.0087] LIST HELM OPTIMAX	5096	(1642)	(2135)
[2.01.1553] HELMET GLOVES G2	1630	(5108)	(6640)
[2.01.1560] BOX G2 OPTIMAX	313	(6425)	(8353)
[2.01.1505C] BOX MB EXTERMINATOR 18 1030X540X846	8	(366)	(476)
[2.02.1060B] STIKER STATIK G2 CENTRINO SV	3946	(2792)	(3630)
[2.02.1059] STIKER PRODUKSI DATE/QC	834	(5904)	(7675)
[3.01.0025] OPTIMAX SHELL	758	(5980)	(7774)
[3.01.0025S] SPOILER OPTIMAX	6155	(583)	(758)

EXTERMINATOR			
PART NAME	DATA WAREHOUSE	MATERIAL NEEDS	MATERIAL NEEDS 30%
[3.01.0066] VISOR RAY-BAN EXTERMINATOR	-2317	(3005)	(3907)
[3.01.0080] INNER VISOR KEY SYSTEM EXTERMINATOR	(10980)	(12356)	(16063)
[2.01.1505C] BOX MB EXTERMINATOR 18 1030X540X846	(366)	(405)	(526)
[2.01.1553] HELMET GLOVES G2	-5108	(5796)	(7535)
GMT DAN MR-J			
PART NAME	DATA WAREHOUSE	MATERIAL NEEDS	MATERIALNEEDS 30%
[3.01.0066] VISOR RAY-BAN	-3005	(9122)	(11859)
[3.01.0091] INNER KEY SYSTEM CENTRINO	1330	(10904)	(14175)
[2.01.0120B] EPS FOAM GT-2 ASTRO DV DENSITY 18	3288	(2829)	(3678)
[2.01.0083B] INTERIOR CENTRINO DV SEMI KD	1985	(4132)	(5372)
[2.01.1553] HELMET GLOVES G2	-5796	(11913)	(15487)
[3.01.0018] CENTRINO DOUBLE VISOR SHELL	1288	(4829)	(6278)
[3.01.0071] TOP VENT CENTRINO ATAS BELAKANG R/L	3590	(2527)	(3285)
[3.01.0074] TOP VENT CENTRINO ATAS [DEPAN]	2690	(9544)	(12407)
[2.02.1509A] BLACK VISATERRY 2 MM	333	(53)	(69)
CENTRINO SV			
PART NAME	DATA WAREHOUSE	MATERIAL NEEDS	MATERIALNEEDS 30%
[2.01.0121] EPS FOAM ASTRO ONE DENSITY 22	153	(930)	(1209)
[2.01.1553] HELMET GLOVES G2	(11913)	(12996)	(16895)
[2.02.1053] STIKER SIZE S.L.M	1000	(83)	(108)
[2.02.1059] STIKER PRODUKSI DATE/QC	(12709)	(13792)	(17930)
[3.01.0022] BATOK CENTRINO SINGLE VISOR	239	(844)	(1097)
[2.01.0010B] SPOILER CENTRINO [SSI]	(3617)	(4700)	(6110)
[3.01.0071] TOP VENT CENTRINO ATAS BELAKANG R/L	(2477)	(3560)	(4628)
[3.01.0074] TOP VENT CENTRINO ATAS [DEPAN]	(9494)	(11660)	(15158)

Figure 3. *Material requirement*

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Table 1. *Supporting material*

Supporting Material		
[2.01.1553] SARUNG HELMET G2	1630	(12996)
[2.02.2001] LEM BATANG (SATUAN PCS)	2304	(1353)
[2.02.2002] LEM TETES	310	(275)
-	1000	0

Material Requirement Planning is a method which has a function to meet the materialneeded in a product, the method is very useful for increasing the quantity and tax time of the production pattern, not only that, this method also functions to reduce inventory waste, increase WIP behind. Material Requirement Planning can be seen from the total material needed. In Optimaxthe material that must be met is Visor OPtimax clear (coating) 8759, Visor Ray-Ban Exterminator 3012, Inner Visor key System Optimax 14274, Styrofoam Optimax D.304208, Interior Optimax 5883, List of Horns Optimax 6815, List of Helmets Optimax 2135, Holster Helmet G2 6640, Box G2 Optimax 8353, Box MB Exterminator 18 489,Static Sticker G2 Centrino SV 3630, Shell Optimax 7774, Spoiler Optimax 758,Exterminator Model Materials that must be fulfilled are Visor Ray Ban, Inner Visor KeySystem Exterminator, Glove G2 Helmet, For GMT and MRJ Models, Visor Ray Ban, Inner System Centrino 14175, Eps Foam GT-2 Astro DV Density 18 3678. Interior Centrino DV Semi KD 5372, Batok Centrino Double Visor 6278, Topvent Centrino TopRear 328 and Topvent Centrino Top (front) 12407. For Centrino Single Visor Eps FoamAstro Density 22 1209, Shell Centrino Single Visor 1097, Top Vent Top Rear and TopVent bag. For Supporting Materials, Helmet Holster 12996, Stem Glue (PCS Unit) 1353and Drip glue 275 are needed.

C. Analyze

Require Planning Analysis Using Daily Time Base is an overview of the overall material that comes, there is a visualization of when the material will come based on the existing DTB. In fulfilling or meeting the existing material needs, the pattern comes in rhythm with the existing production pattern, from Styrofoam, Interior, Shell and others as follows:

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Table 2. *Display*

Display Week: 1

TASK	ASSIGNED TO	CAPACITY REQUIRED	SHIPPING POWER	STORAGE	LEADTIME	START	END
KEDATANGAN MATERIAL							
Task 1 INTERIOR OPTIMAX		5.883	400	2.600	2	7/28/22	8/26/22
OUTPUT DAILY		300					
BALANCE							
Task 2 INTERIOR CENTRINO DV		5.372	3000	900	2	7/28/22	7/31/22
OUTPUT DAILY		500					
BALANCE							
Task 3 INTERIOR CENTRINO SV		2.205	1750	1300	1	7/28/22	7/29/22
OUTPUT DAILY		1.000					
BALANCE							
Task 4 INTERIOR EXTERMINATOR		8.759	1000	1900	4	7/28/22	9/1/22
OUTPUT DAILY		300					
BALANCE							
Phase 2 title							
Task 1 BOX G2 OPTIMAX		8.353	800	4200	4	7/28/22	9/7/22
OUTPUT DAILY		300					
Task 2 BOX G2 EXTERMINATOR		16.895	2800	1630	3	7/28/22	8/15/22
OUTPUT DAILY		1.000					
BALANCE							
Task 4 BOX MB EXTERMINATOR 18		526	210	8	5	7/28/22	8/9/22
OUTPUT DAILY		28					
BALANCE							
Task 5 BOX MB EXTERMINATOR 24		7.774	1008	758	1	7/28/22	8/4/22
OUTPUT DAILY		300					
BALANCE							
Phase 3 Title							
Task 1 SPOILER OPTIMAX		758	1550		1	7/28/22	7/28/22
OUTPUT DAILY		300					
BALANCE							
Task 2 EPS FOAM GT-2 ASTRO DV DENSITY 18		3.678	1500	3288	2	7/28/22	8/1/22
OUTPUT DAILY		500					
BALANCE							
Task 3 EPS FOAM GT-2 ASTRO DV DENSITY 22		1.209	1000	153	2	7/28/22	7/30/22
OUTPUT DAILY		100					
BALANCE							
TASK 4 CENTRINO DV SHELL		5.372	1008	1288	1	7/28/22	8/2/22
OUTPUT DAILY		500					
BALANCE							
TASK 5 CENTRINO SV SHELL		1.209	1008	239	1	7/28/22	7/29/22
OUTPUT DAILY		100					
BALANCE							
BAHAN PENDUKUNG							
Task 1 GLUE STICK		1.630	2000	2304	3	7/28/22	7/30/22
OUTPUT DAILY		250					
BALANCE							
Task 2 DRIP GLUE		275	310	310	3	7/28/22	7/30/22
OUTPUT DAILY		40					
BALANCE							

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D. Analysis on Optimax Material Arrival Pattern

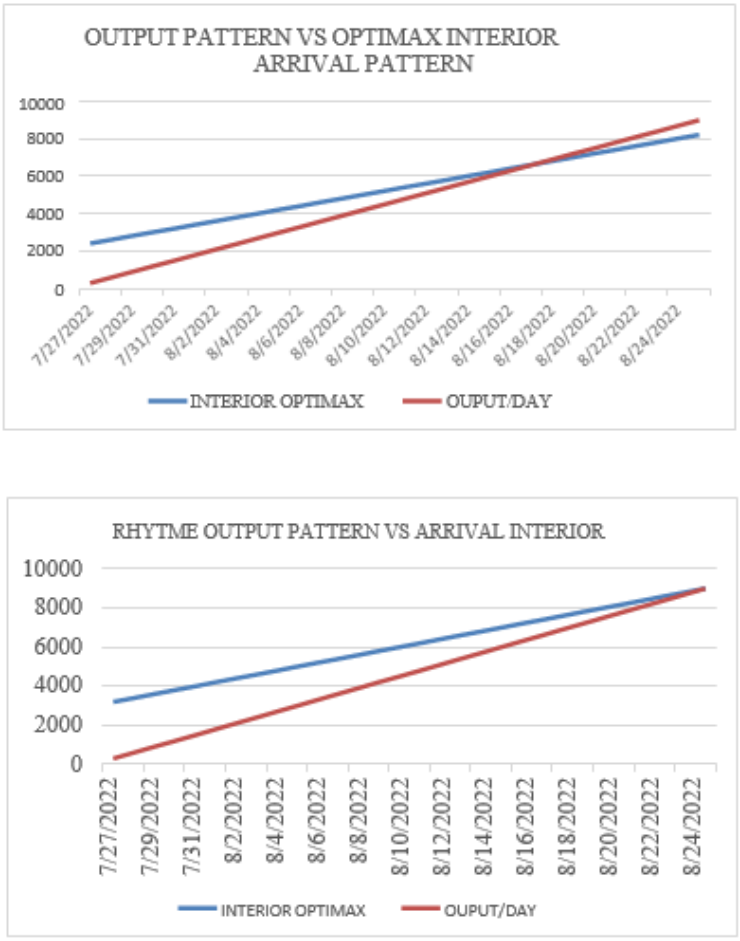

Figure 4. *Analysis on Optimax Material Arrival Pattern*

In the Optimax interior material arrival pattern to achieve material needs and rhythmicallyto the Optimax output pattern per day, on the graphic line it is shown that on 20/08/2022did not find the same rhythm pattern, then the daily output is reduced or hampered, because the material output pattern is not rhythmic. The solution to solve this rhythm problem, must have a buffer behind 3000 of the interior set and the resulting rhythm witha buffer of 3000.

E. Graphical Analysis of the Visot Optimax Pattern

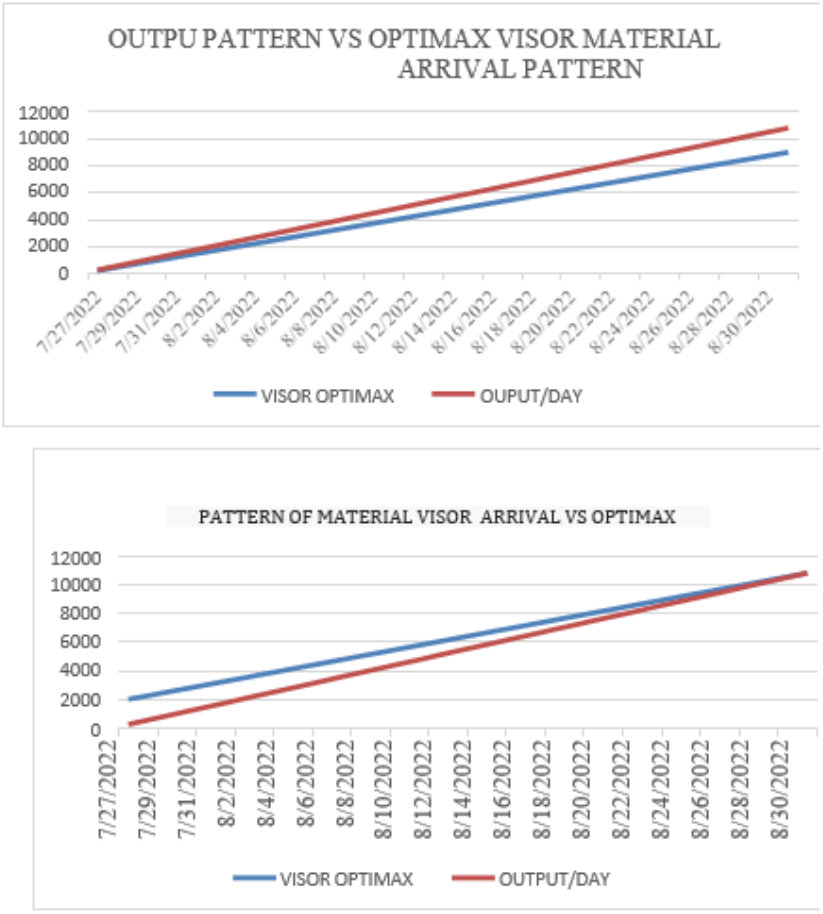

Figure 5. *Graphical Analysis of the Visor Optimax Pattern*

In the pattern of arrival of the Optimax Visor material to achieve material needs andrhythmically on the daily Optimax output pattern, the graphic line shows that on 02/08/2022did not find the same rhythmic pattern, then the daily output is reduced or hampered, becausethe material output pattern is not rhythmic. The solution to solve this rhythm problem, must have additional Vendors for buffers behind 1800 pcs of optimax visors following rhythm results with buffers.

F. BOX G2 Optimax Pattern Graphic Analysis

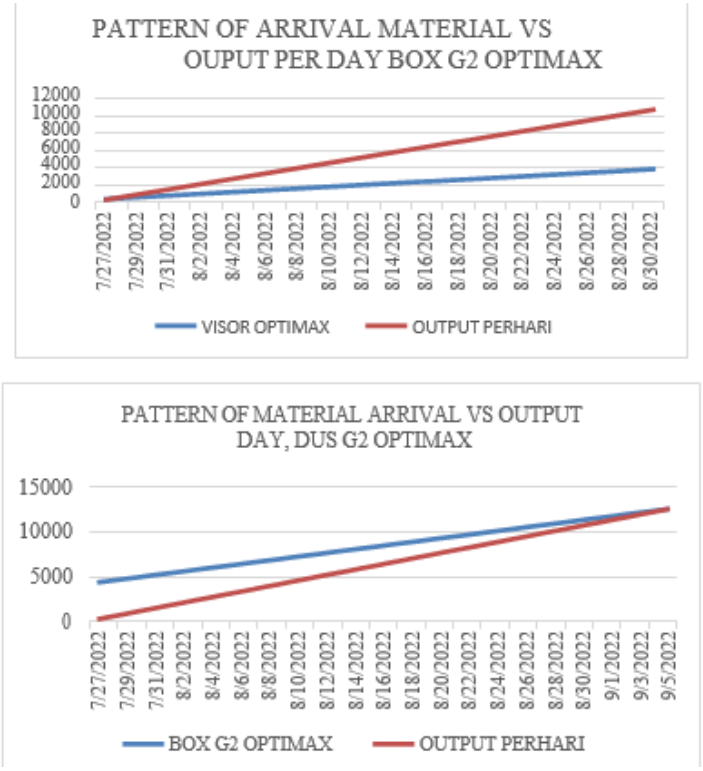

Figure 6. *BOX G2 Optimax Pattern Graphic Analysis*

In the pattern of arrival of the Optimax Visor material to achieve material needs andrhythmically on the daily Optimax output pattern, the graphic line shows that on 02/08/2022did not find the same rhythmic pattern, then the daily output is reduced or hampered, becausethe material output pattern is not rhythmic. The solution to solve this rhythm problem, must have additional Vendors for buffers behind 1800 pcs of optimax visors following rhythm results with buffers.

G. Improve

After the BOM (Bill Of Material) analysis was carried out, improvements were made to theBOM vs PO and BOM To Helm research, the following are the recommended steps towards increasing Production and improving Material Requirement Planning as follows:

1. Make a visualization of the pattern of material arrivals vs. output per day
2. Make material stock in order to know the age of the material.
3. Add or find new vendors so that daily time accumulates well
4. Reducing demand for materials that are in excess of what is needed
5. Implementing 3 M (Muda Mura Muri)

Conclusion

1. Based on the Visualized Bomb to Helmet from all available materials from Heading 1 and Heading 3 we can make Optimax 0, KM 7 200, Exterminator 1248, Centrino DV 665, and Centrino SV 153 from the total existing material accumulated we can produce 2,266 Helmets on 25/07/2022.
2. Based on the results of BOM Vs PO, the entire model has a Material RequirementPlanning Material Requirement that can be seen from the total required material. In Optimax the material that must be met is Visor OPtimax clear (coating) 8759, Visor Ray-Ban Exterminator 3012, Inner Visor key System Optimax 14274, Styrofoam Optimax D.30 4208, Interior Optimax 5883, List of Horns Optimax 6815, List of Helmets Optimax 2135, Holster Helmet G2

6640, Box G2 Optimax 8353, Box MB Exterminator 18 489, Static Sticker G2 Centrino SV 3630, Shell Optimax 7774, Spoiler Optimax 758, Exterminator Model Materials that must be fulfilled are Visor Ray Ban, Inner Visor Key System Exterminator, Glove G2 Helmet, For GMT and MRJ Models, Visor Ray Ban, Inner System Centrino 14175, Eps Foam GT-2 Astro DV Density 18 3678. Interior Centrino DV Semi KD 5372, Centrino Shell Double Visor 6278, Topvent Centrino Top Rear 328 andTopvent Centrino Top (front) 12407. For Centrino Single Visor Eps Foam Astro Density 22 1209, Shell Centrino Single Visor 1097, Top Vent Top Rear and Top Vent bag. For Supporting Materials, Helmet Holster 12996, Stem Glue (Unit PCS) 1353 and Drip Glue 275 are needed..

3. In the Optimax interior material arrival pattern to achieve material needs and rhythmically to the Optimax output pattern per day, on the graphic line it is shownthat on 20/08/2022 did not find the same rhythm pattern, then the daily output is reduced or hampered, because the material output pattern is not rhythmic. The solution to solve this rhythm problem, must have a buffer behind 3000 of the interior set and the resulting rhythm with a buffer of 3000
4. In the pattern of arrival of the Optimax Visor material to achieve material needs and rhythmically on the daily Optimax output pattern, the graphic line shows thaton 02/08/2022 did not find the same rhythmic pattern, then the daily output is reduced or hampered, because the material output pattern is not rhythmic. The solution to solve this rhythm problem, must have a buffer behind 1800 pcs of optimax visors along with rhythm results with buffers.
5. In the pattern of arrival of the Visor BOX G2 Optimax material to achieve material needs and rhythm it to the Optimax output pattern per day, the graphic line shows that on 31/07/2022 did not find the same rhythm pattern, then the dailyoutput is reduced or hampered, because the material output pattern is not rhythm. The solution to solve this rhythm problem, must have a buffer behind 4200 pcs Box G2 Optimax and have 2 different vendors along with rhythm results with buffers
6. BOM vs PO Is a Visual Description of all Material Requirements Needed plus 30% safety on the required materials, Bomb Vs Po is useful for reducing WasteInventory and reducing material Arrival Pattern errors, Material Arrival Patternerrors can cause production delays Due to materials running out at the time Production.

Table 3. *Material*

Material name	Causes of Unrhythm	Solution
Optimax interior	Too Little Warehouse Buffer, and Vendor strength does not meet the Daily Time Base Output Daily productionstandard	Adding a Warehouse Bufferat the back of at least 3000 or adding an Interior Vendor to be in tune withthe Production Pattern
Optimax Visor	No Warehouse Buffer or 0, due to Vendor not Sending or Late Request Process	Adding a Warehouse Bufferin the back (safety Stock) ofat least 1800, and using Stock Limit material so that requests are not late
Box G2 Optimax	Too Little Warehouse Buffer Due to Late Processing Requestsor Unmonitored Cartons, and Lack of Vendors	Adding a warehouse bufferbehind (safety stock) of at least 4200, funds using Stock Limit so that it is monitored and can be processed on box requests

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