ISSN: 0974-5823 Vol. 7 No. 2 February, 2022

International Journal of Mechanical Engineering

An analysis of the parameters for production effectiveness and maintenance Policy with multiple assignable causes

[a]* Ajay Kumar Pagare, [b]Neeraj Kumar

[a]Research Scholar, Department of Mechanical Engineering, Suresh Gyan Vihar University, Jaipur Rajasthan, India

[b]Professor and Head Department of Mechanical Engineering, Suresh Gyan Vihar University, Jaipur Rajasthan, India

Abstract

The research is based on maintenance engineering. A detailed study of maintenance policy with assessment for the attainment of target in an automobile manufacturing Industry is carried out. The study uses Predictive maintenance, Supply Chain Management and Inventory Management. The data was collected in an automotive manufacturing company (SMEs) and through analysis of data was carries out to identify the parameter and suggests measures for effective production. The study found a lack of policies and strategies and uses unconventional machining. The results of the study were plotted as response graph which showed as improvement in the production. The results are beneficial to the company and researchers for establishing the maintenance policy and improving the effeteness of a product.

Keywords: Maintenance (PM), Supply chain management, Inventory, Management, Reliability and safety

1. Introduction

Maintenance engineering is a very important part of any industry. The industries uses different type of maintenance policies includes predictive maintenance, preventive maintenance, schedule maintenance and routine based maintenance [1-2]. There are many other ways of maintenance in a company which depends on the strategy of the company [3]. Because maintenance has a proven effect on the production department or production target, if the machine breaks down while working in the company then the production will stop and the time taken to repair will increase the maintenance time which ultimately increases the cost of the product which is not fit for end user and of customer relationship point of view [4-6]. The maintenance engineering policies used preventive maintenance which is the regular and routine maintenance of equipment and assets in order to keep them running and prevent any costly unplanned downtime from unexpected equipment failure [7-10]. A successful maintenance strategy requires planning and scheduling maintenance of equipment before a problem occurs [11-12]. The present work focused on supply chain management therefore it considered both the outside and the inside material supply of the industry. The outside material supply focuses on every point related to the raw material like raw material from the vendor and raceway of a particular material [13-14]. In inside material supply the material is brought to the machine in the production house and is completed in raw form to finished good and finally sent to the inventory [15-17]. To overcome shortfall in the production target the movement of the materials should be performed in a planned way. In the present research the automobiles parts manufactures company is taken for study. A critical analysis of the parts was carried out as shown in Fig1 (a-d). Moreover, the report is prepared for the manufactured parts in two months duration giving a total of 1000 parts. The research uses both preventive and predictive maintenance policies for maintenance

2. Types of Preventive Maintenance

Time-based maintenance

Time-based maintenance (TBM) is maintenance performed on equipment based on a calendar schedule. It means that time is the maintenance trigger for this type of maintenance. TBM maintenance is planned maintenance, as it must be scheduled in advance [16].

Usage-based maintenance

Usage-based maintenance (UBM) is a form of predictive maintenance. This type of maintenance takes the average daily usage of an asset into account and uses it to forecast a due date. Predictive maintenance techniques are designed to help determine the condition of in-service equipment in order to estimate when maintenance should be performed. This approach promises cost savings over routine or time-based preventive maintenance because tasks are performed only when warranted [17-19].

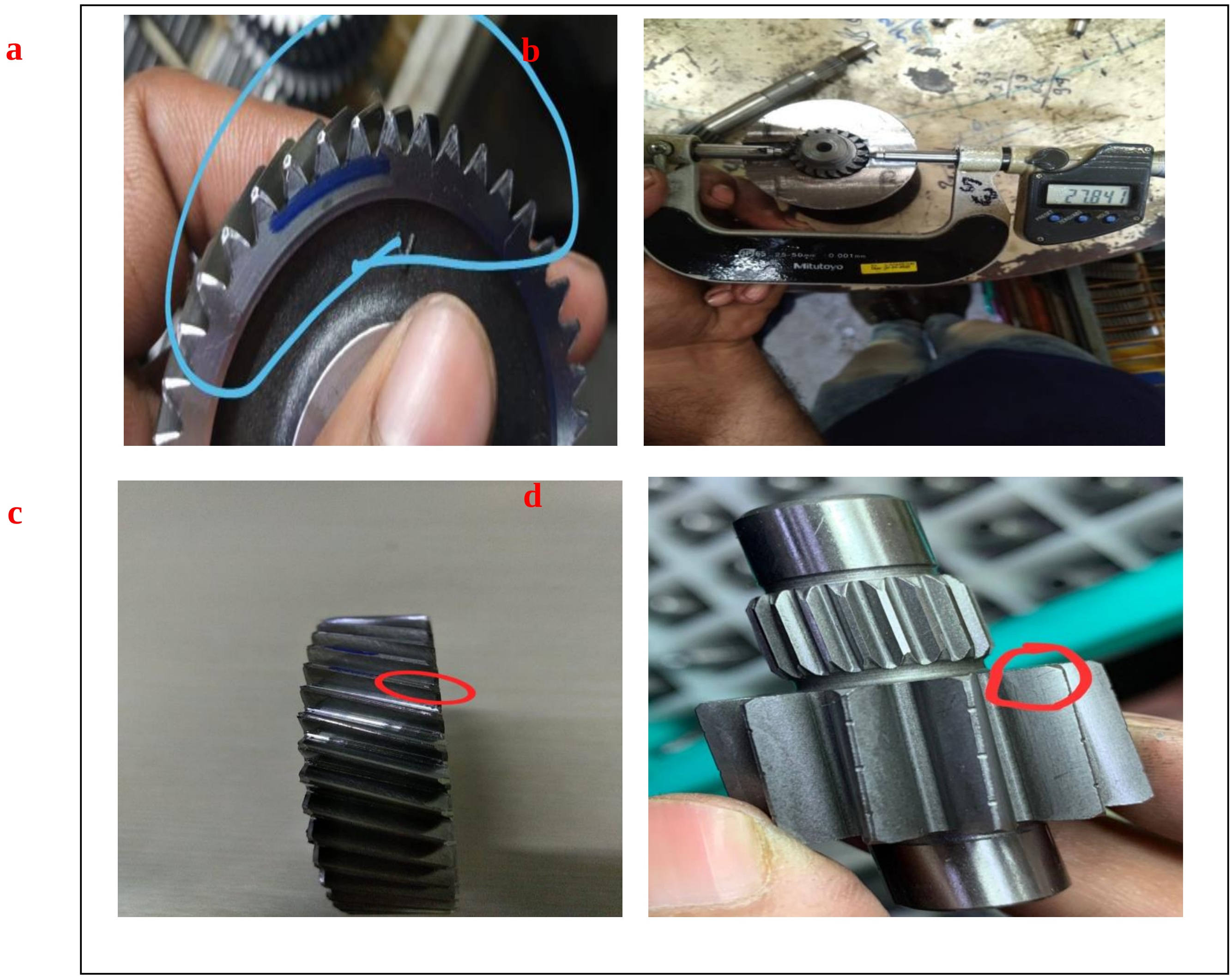

Fig.1 (a) Chamfer dent (b) Over sized ball dia. (c) Teeth dent (d) Cutter mark

3. Research gap

It is observed that many companies still follow the old strategies maintenance. Moreover it is found that in the industries are focused only on production, but there was no special policy for maintenance. Due to which the production target of the company is unfulfilled and there was always a lot of waste.

4. Research methodology

In the present research the data is collected from a manufacturing industry with the prior permission of the company. After that the collected data is analyzed for all the policies of the company like Maintenance, Inventory, Production scheduling, layouts of the company. A strategy is formed in relevant to the maintenance department of the company. The analysis id made for machine working time and break down maintenance. A list of failure is prepared then new strategies of production in the development section is proposed. Table 1 given below listed parts manufactured by the company.

The consideration for the development of strategy were:

1. Training of human beings of new technologies.
2. Settled new maintenance department to start timely inspection of machines and get ready to meet production target.
3. Some general uses, but very important according research point of view discuss in quality defects.

Table: 1 List of parts list manufactured by the company

S. No	Parts Category	Parts Name
1	Gear	Gear Counter KOPA-1624
2	Shaft	Input shaft (1475) - DU101400
3	Gear	Gear Ist driven (1220) - DU101080
4	Crank pin	Crank pin DK (558) - DK101453
5	Crank pin	Crank pin DK (558) - DK101453
6	Shaft	Output shaft (1546) - DU101406
7	Flange	Air shift cylinder (1103) - 3261N1106
8	Shaft	Output Shaft - Ducati (1216)
9	Gear	Gear 2nd drive (1476) - DU101401
10	Gear	Gear 4th drive (1082) - DX101049
11	Gear	Gear 4th drive (1082) - DX101049
12	Crank pin	Crank pin (761) - 570186/E
13	Shaft	Weight 1 (1050)
14	Shaft	Input shaft (1475) - DU101400
15	Crank pin	Crank pin C101 (1303) - JH531003
16	Gear	Multiple gear (1681)-AF101442
17	Shaft	Shaft counter-KOPA-1623
18	Gear	Gear final KOPA-1626
19	Gear	Gear Counter KOPA-1624
20	Shaft	Shaft drive-KOPA-1625

5. Results and discussions

Table 2 and Table 3 shows the details of shaft counter and gear counte and data are plotted as Fig.1 and Fig. 2 respectively

The data is collected for 10 days duration giving the details as:

(i) Daily Target Dispatch

(ii) Offer Quantity, Checked Quantity, FTR Quantity & FID Quantity

(iii) W/H OK & W/H Rejection Quantity

Table 2: Daily Inspection Report for 10 days of Shaft counter

Day Wise		1	2	3	4	5	6	7	8	9	10
Shaft Counter	Target Dispatch Qty (146nos/hr)	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
	Offer Qty	2535	3831	0	3256	1751	2535	2432	2535	2356	0
	Checked Qty	2621	3149	0	2845	2146	1336	2592	2116	2408	0
	FTR Qty	2545	3045	0	2408	1826	1229	2464	2012	2274	0
	FID Reject Qty	31	31	0	226	200	64	79	19	65	0
	W/H checked qty	2585	0	0	1363	2610	1065	2574	2669	2668	1269
	W/H OK Qty	2580	0	0	1360	2600	1060	2565	2660	2660	1260
	W/H Rej Qty	5	0	0	3	10	5	9	9	8	9

Table 3: Daily Inspection Report for 10 days of Gear counter

Day Wise		1	2	3	4	5	6	7	8	9	10
Gear Counter	Target Dispatch Qty (146nos/hr)	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
	Offer Qty	2977	3917	0	3250	3464	2977	2670	2977	2180	0
	Checked Qty	2791	3643	0	3138	3754	1028	1888	2325	2052	0
	FTR Qty	2666	3171	0	2505	3221	706	1649	1932	1815	0
	FID Reject Qty	77	207	0	224	106	46	160	86	116	0
	W/H checked qty	2530	1269	0	2512	1862	1861	1831	2531	2213	1011
	W/H OK Qty	2520	1260	0	2500	1850	1850	1818	2520	2200	1000
	W/H Rej Qty	10	9	0	12	12	11	13	11	13	11

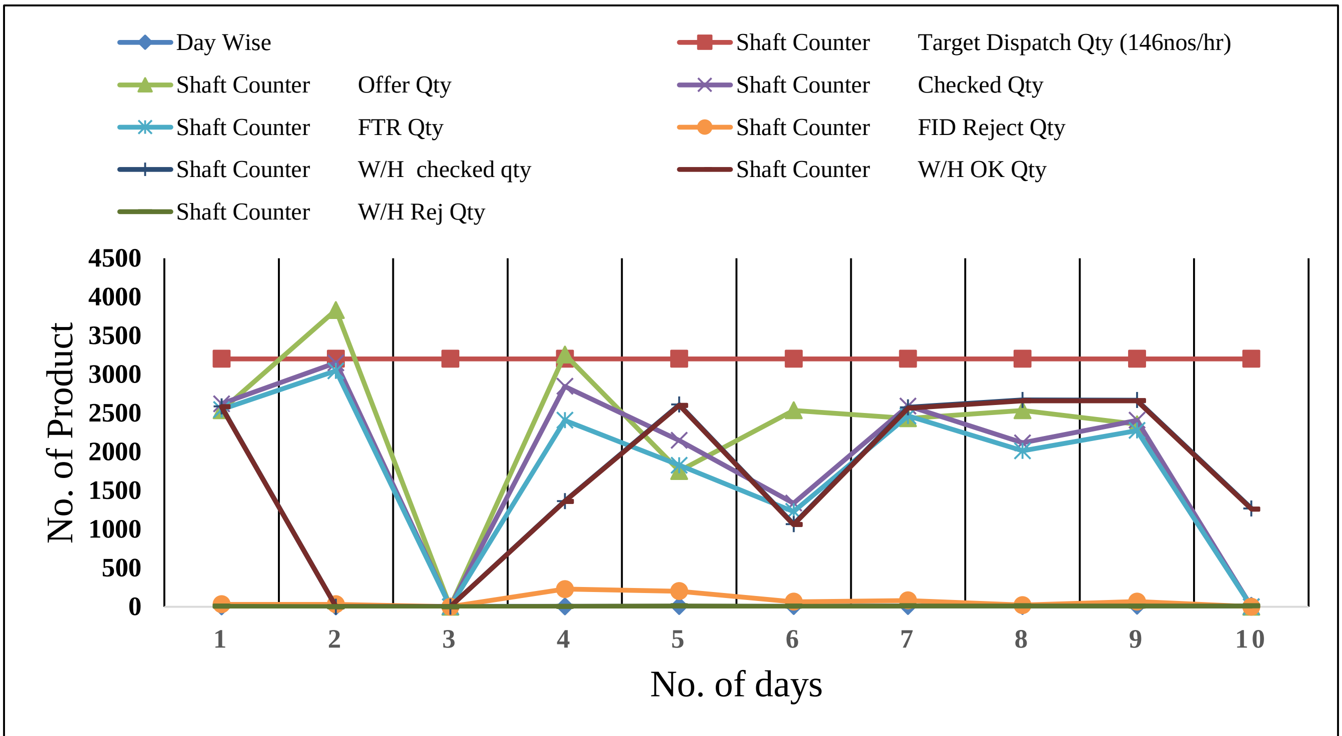

Fig. 1 Graph of parts produce in Shaft counter by KOPA process

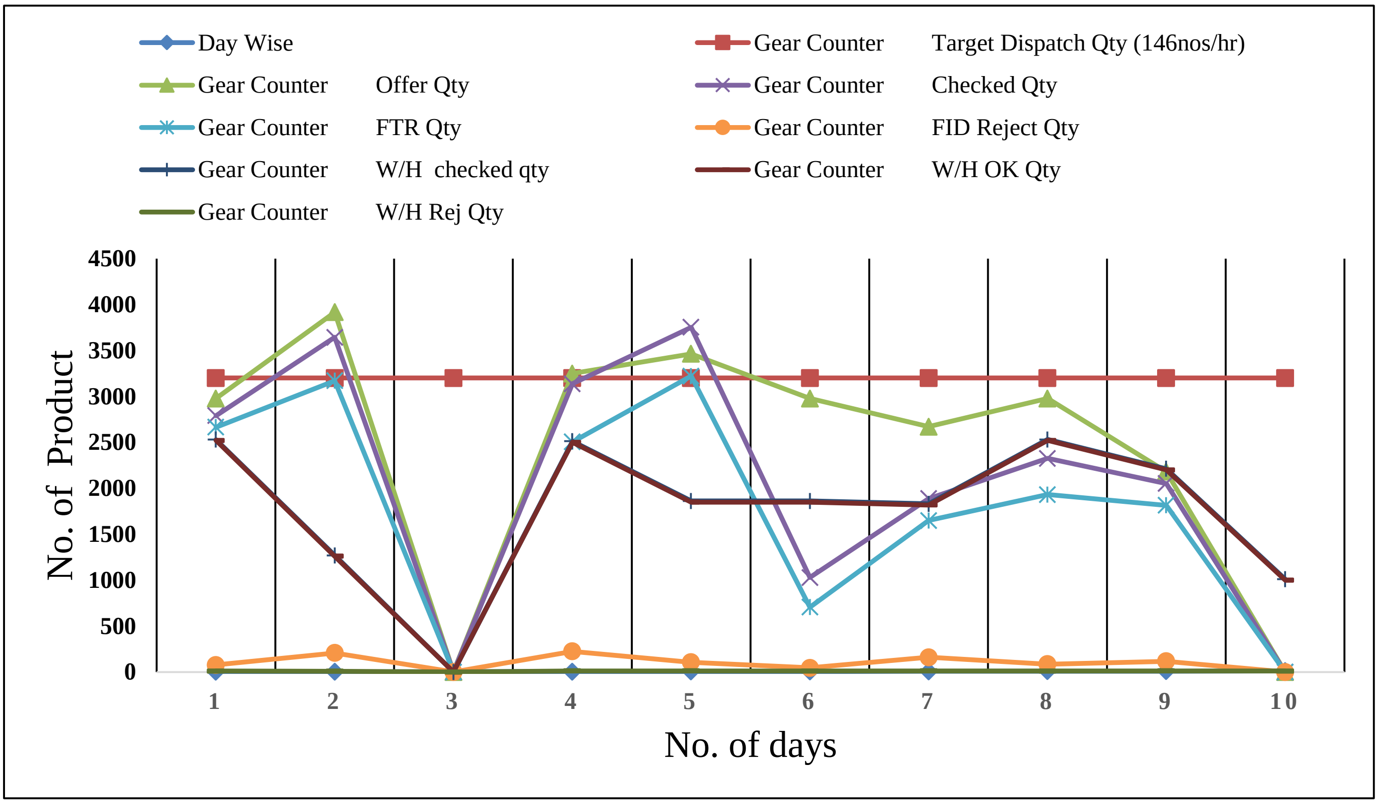

Fig. 2 Graph of parts produce in gear counter by KOPA process

In this, each department has set a target according to its capacity, which will continue to follow the same throughout the day which the company has to produce the production department with a daily target of 3200 parts. In this study, some key points were used as strategies to help achieve the final production goal, as shown below:

1. **Maintenance defects**
   First take maintenance engineering, collect the details of the whole machine, go through daily maintenance, and then prepare a list. After understanding the upcoming failures, solve them in time to make the goal easy. Here we have been using preventive maintenance tools.

2. **Tooth defect**
   When the product is ready near the machine after it is made, the work to get it to the correct position is the material handling process, but there will be many problems during this process, such as tooth damage, and then we performed his winning tooth A plastic cap is placed inside so that now if it comes in contact with other materials, its damage can be neglected.

3. **Over Ball Diameter (OBD)**
   This is called the industry root cause defect tool is like a product, if it is used for a long time, so its life span ends, so its lethal ability ends, because its lethal ability ends and The tool is not aware of proper finishing, so the life of each tool is set in the study, for example tool will be replaced after it will produce 20,000 parts.

4. **Human**
   The most important factor is the employees/operators in each industry, if you have a hybrid machine, then you have to run it. For this, a skilled operator will be required, and he must also provide you with training on its new functions in time, so that he also understands the machine. I will update it in time and allow the machine to perform minimal maintenance. This is a very time-saving process. And production helps achieve the goal.

5. **Quality defect**
   We have seen this problem many times in the research process, in the I.D. (inner diameter) size or part-time job. The main reason for this situation is that the fixtures used on the machine are often worn and the tools are blocked and cause

problems with the fixtures. Fixtures and fixtures repair life days to solve this problem just as it is done for tools. Now every time the life cycle ends, the fixtures will be replaced immediately, so that the wear and tear of the tools is minimized, and the accuracy begins to produce the product.

By formulating these five-point strategies, we started production again. The results are given as Table 4 and Table 5 for shaft counter and gear counter and plotted as Fig.3 and Fig. 4 respectively.

In this research article, the production target has been achieved, which we have fully analyzed in our further research. The company's productivity has also increased, and the entire industry is fully committed according to machine operators, design engineers, and quality engineers [20].

Table 4: Daily Inspection Report of 10 days for Shaft counter with new strategy

Day Wise		1	2	3	4	5	6	7	8	9	10
Shaft Counter	Target Dispatch Qty (146nos/hr)	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
	Offer Qty	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
	Checked Qty	2785	3197	00	3174	2900	2669	2952	2714	2900	00
	FTR Qty	2609	3067	00	2933	2736	2600	2867	2507	2865	00
	FID Reject Qty	57	29	00	74	47	13	19	23	08	00
	W/H checked qty	2755	3168	00	3170	2879	2656	2944	2691	2892	00
	W/H OK Qty	2749	3160	00	3166	2879	2656	2876	2685	2885	00
	W/H Rej Qty	06	08	00	04	00	00	68	06	07	00

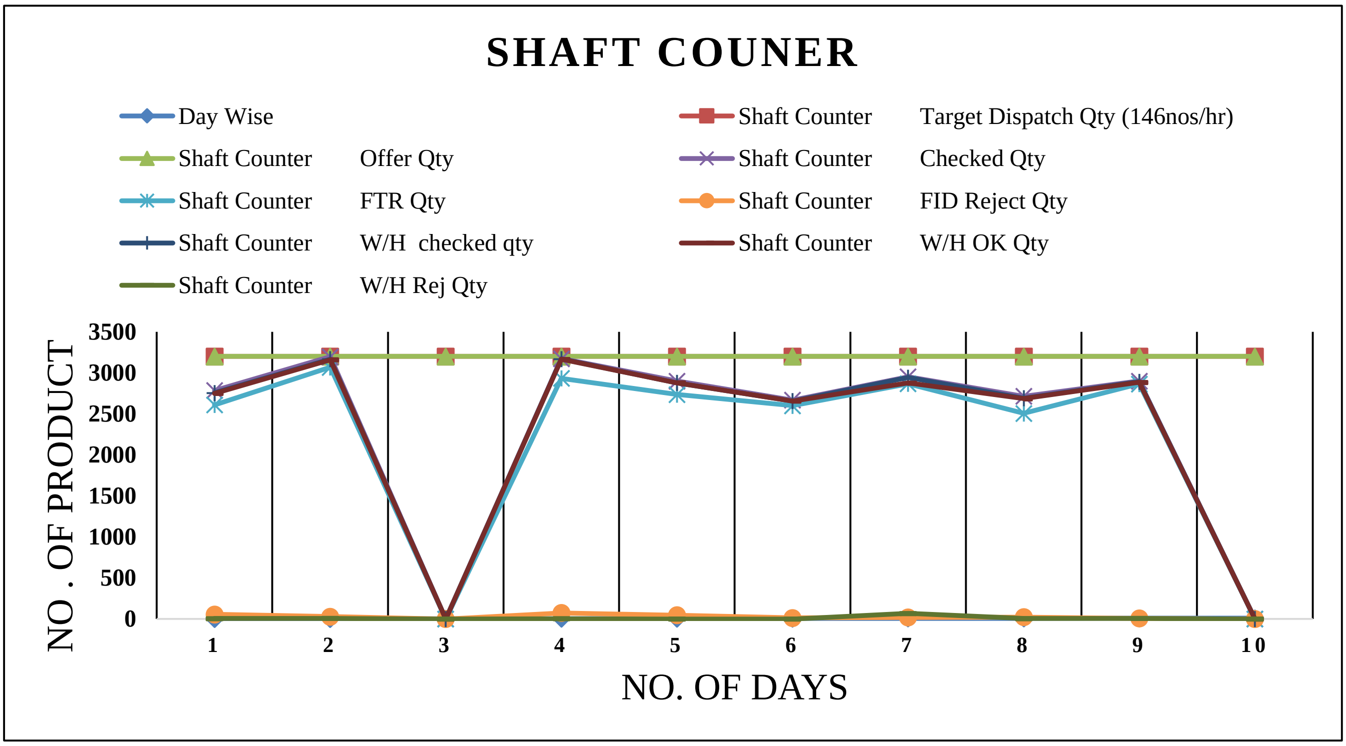

Fig. 3 Plot for Shaft counter with new strategy

Table 5: Daily Inspection Report of 10 days for Gear counter with new strategy

Day Wise		1	2	3	4	5	6	7	8	9	10
Gear Counter	Target Dispatch Qty (146nos/hr)	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
	Offer Qty	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
	Checked Qty	2850	3074	0	3150	3475	2500	2670	3078	2700	0
	FTR Qty	2800	2947	0	2900	3380	1500	2467	2656	2452	0
	FID Reject Qty	65	157	0	179	95	55	188	80	77	0
	W/H checked qty	3150	2380	0	2767	3175	2100	2650	2800	2670	0
	W/H OK Qty	3130	2365	0	2750	3157	2089	2647	2787	2656	0
	W/H Rej Qty	20	15	0	17	18	11	03	13	14	0

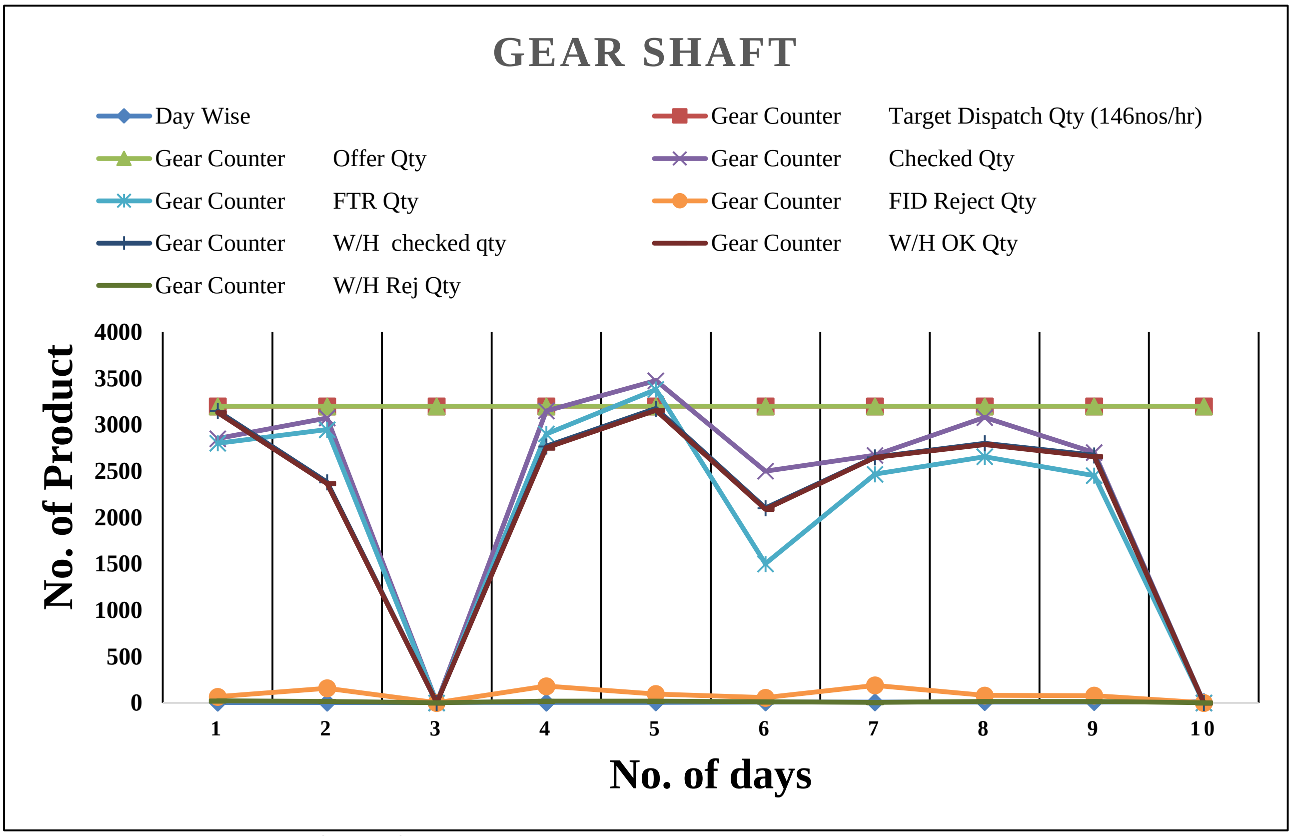

Fig. 4 Plot for Shaft counter with new strategy

Conclusions:

References:

1. Tangbin Xia, Bowen Sun, Zhen Chen et. al., 2021 Reliability Engineering and System Safety, Opportunistic maintenance policy integrating leasing profit and capacity balancing for serial-parallel leased systems, 0951-8320, Published by Elsevier Ltd. 205 (2021) 107233
2. K. Hamdan a, M. Tavangar a, M. Asadi, 2021, Reliability Engineering and System Safety, Optimal preventive maintenance for repairable weighted k-out-of-n systems, Published by Elsevier Ltd. 205 (2021), 107267
3. Gregory Levitin, Liudong Xing, Yanping Xiang, 2021, Reliability Engineering and System Safety, Optimizing preventive replacement schedule in standby systems with time consuming task transfers, Reliability Engineering and System Safety 205 (2021) 107227
4. Jon Bokrantz, et.al. 2020. International Journal of Production Economics, Smart Maintenance: a research agenda for industrial maintenance management, 224 (2020) 107547
5. Tavassoli et al. 2020, Engineering, Technology & Applied Science Research, Integrated Preventive Maintenance Scheduling Model with Redundancy for Cutting Tools on a Single Machine, Vol. 10, No. 6, 2020, 6542-6548
6. Mohamed Larbi Rebaiaia & Daoud Ait-kadi (2020), International Journal of Production Research, Maintenance policies with minimal repair and replacement on failures: analysis and comparison, DOI: 10.1080/00207543.2020.1832275
7. Wang Y, Liu Y, Chen J, Li X. Reliability and condition-based maintenance modeling for systems operating under performance-based contracting. Comput Ind Eng 2020; 142:106344.
8. Vu HC, Do F, Fouladirad M, Grall A. Dynamic opportunistic maintenance planning for multi-component redundant systems with various types of opportunities. Reliab Eng Syst Saf 2020; 198:106854.
9. Eryilmaz S. Age-based preventive maintenance for coherent systems with applications to consecutive-k-out-of-n and related systems. Reliab Eng Syst Saf 2020;204:107143.
10. Castro IT, Basten RJI, van Houtum G-J. Maintenance cost evaluation for heterogeneous complex systems under continuous monitoring. Reliab Eng Syst Saf 2020;200:106745.
11. Shi Y, Zhu W, Xiang Y, Feng Q. Condition-based maintenance optimization for multi- momponent systems subject to a system reliability requirement. Reliab Eng Syst Saf 2020; 202:107042.
12. Hashemi M, Asadi M, Zarezadeh S. Optimal maintenance policies for coherent systems with multi-type components. Reliab Eng Syst Saf 2020; 195. http://dx. oi.org/10.1016/j.ress.2019.106674.
13. Badíaa, F. G., M. D. Berradea, Cha Ji Hwan, and H. Lee. 2018. "Optimal Replacement Policy under a General Failure and Repair Model: Minimal Versus Worse Than old Repair." Reliability Engineering & System Safety 180: 362–372.
14. Ahmad W, Khan SA, Kim J-M. A hybrid prognostics technique for rolling element bearings using adaptive predictive models. IEEE Trans Indust Electron 2018; 65 (2):1577–84. https://doi.org/10.1109/TIE.2017.2733487.
15. Campbell, A. G. 2018. "Simple Approximations to the Renewal Function." Thesis/Capstones/Creative Projects 18.
16. Xia T, Dong Y, Xiao L, Du S, Pan E, Xi L. Recent advances in prognostics and health management for advanced manufacturing paradigms. Reliab Eng Syst Saf 2018;178:255–68. https://doi.org/10.1016/j.ress.2018.06.021.
17. Levitin G, Xing L, Dai Y. Optimizing computational mission operation by periodic backups and preventive replacements. IEEE Trans Syst Man Cybern 2018;48(9):1505–20
18. Alaswad, S., andY.Xiang. 2017. "AReviewonCondition-Based MaintenanceOptimizationModels for StochasticallyDeteriorating System." Reliability Engineering & System Safety 157:54–63.
19. Levitin G, Xing L, Dai Y. Preventive replacements in real-time standby systems with periodic backups. IEEE Trans Reliab 2017; 66(3):771–82.
20. Antonakis, J., 2017. On doing better science: from thrill of discovery to policy implications. Leadersh. Q. 28, 5–21.
21. Cha JH, Finkelstein M, Levitin G. On preventive maintenance of systems with lifetimes dependent on a random shock process. Reliab Eng Syst Saf 2017;168:90–7.
22. George-Williams H, Patelli E. Maintenance strategy optimization for complex power systems susceptible to maintenance delays and operational dynamics. IEEE Trans Reliab 2017; 66(4):1309–30.
23. Zhao L, Chen M, Zhou D. General $(N, T,\tau) $ opportunistic maintenance for multicomponent systems with evident and hidden failures. IEEE Trans Reliability 2016; 65(3):1298–313. https://doi.org/10.1109/TR.2016.2570547.
24. Shi H, Zeng J. Real-time prediction of remaining useful life and preventive opportunistic maintenance strategy for multi-component systems considering stochastic dependence. Comput Ind Eng 2016;93::192-204. https://doi.org/10.1016/j. cie.2015.12.016.
25. Xia T, Jin X, Xi L, Zhang Y, Ni J. Operating load based real-time rolling grey forecasting for machine health prognosis in dynamic maintenance schedule. J Intel Manuf 2015; 26 (2):269–80. https://doi.org/10.1007/s10845-013-0780-8.
26. Yang S, Bagheri B, Kao H-A, Lee J. A unified framework and platform for designing of cloud-based machine health monitoring and manufacturing systems. J Manuf Sci Eng 015; 137(4):040914https://doi.org/10.1115/1.4030669.

27. Lin J, Pulido J, Asplund M. Reliability analysis for preventive maintenance based on classical and Bayesian semi-parametric degradation approaches using locomotive wheel-sets as a case study. Reliab Eng Syst Saf 2015; 134:143–56.
28. Lin ZL, Huang YS, Fang CC. Non-periodic preventive maintenance with reliability thresholds for complex repairable systems. Reliab Eng Syst Saf 2015; 136:145–56.
29. Caballe NC, Castro IT, Perez CJ, Lanza-Gutierrez JM. A condition-based maintenance of a dependent degradation-threshold-shock model in a system with multiple degradation processes. Reliab Eng Syst Saf 2015; 134:98–109.
30. Aboelmaged, M.G., 2014. Predicting E-readiness at firm-level: an analysis of technological, organizational and environmental (toe) effects on E-maintenance readiness in manufacturing firms. Int. J. Inf. Manag. 34, 639–651.
31. Do Van, P., H. C. Vu, A. Barros, and C. Berenguer. 2012. "Grouping Maintenance Strategy with Availability Constraint under Limited Repairmen." In SAFEPROCESS 2012. IFAC Proceedings Volumes, Vol. 45, 486–491. Mexico: Elsevier.
32. S. P. Canto, "Application of Benders' decomposition to power plant preventive maintenance scheduling," European Journal of Operational Research, vol. 184, no. 2, pp. 759–777, Jan. 2008, https://doi.org/ 10.1016/j.ejor.2006.11.018.
33. J. A. C. Duarte, J. C. T. A. Craveiro, and T. P. Trigo, "Optimization of the preventive aintenance plan of a series components system," International Journal of Pressure Vessels and Piping, vol. 83, no. 4, pp. 244–248, Apr. 2006, https://doi.org/10.1016/j.ijpvp.2006.02.016.
34. C. R. Cassady and E. Kutanoglu, "Integrating preventive maintenance planning and production scheduling for a single machine," IEEE Transactions on Reliability, vol. 54, no. 2, pp. 304–309, Jun. 2005,https://doi.org/10.1109/TR.2005.845967.
35. Bouvard, K., S. Artus, C. Berenguer, and V. Cocquempot. 2011. "Condition-based Dynamic Maintenance perations Planning & Grouping: Application to Commercial Heavy Vehicles." Reliability Engineering&SystemSafety 96 (6): 601–610.