International Research Journal of Mathematics, Engineering and IT
ISSN: (2349-0322)
Association of Academic Researchers and Faculties (AARF)
Impact Factor- 8.132 Volume 10, Issue 10 Oct 2023
Website- www.aarf.asia, **Email** : editoraarf@gmail.com

COMPARISON OF COST-BENEFIT ANALYSIS BETWEEN PVC AND STEEL MANUFACTURING PLANT

Rohit[1],Dr. Mahender Singh Poonia[2]
[1]Research Scholar, Department of Mathematics, OM Sterling Global University, Hisar, Haryana, India
[2]Professor, Department of Mathematics, OM Sterling Global University, Hisar, Haryana, India
Email: [1]rabhardwaj24@gmail.com, [2]drmahender@osgu.ac.in
DOI:aarf.irjmeit.78863.88908

Abstract: For the current investigation, one has selected the PVC and Steel plant. PVC plants are only regarded as commercially viable when all four units are in good operating condition. When all four of the system's parts are in good operating order, the system operates at its peak efficiency. In the current investigation one have picked the steel industry arranged. The industry comprises of consists of four subsystems such as descaling, grinding, hot steckel and cutter machine. The steel plant is made up of various subsystems that operate in parallel and sequence. The current study will assist the relevant administration in making practical decisions for the framework's efficient operation. A single repairman is available 24*7. Precise cases remain produced to consider the consequence of disappointment/RR on MTSF, accessibility, and server of busy period. Profit optimization is additionally talked about. Structure behaviour is argued through the assistance of graphs and tables. The mathematical formulation has been carried out by using RPGT technique.The RPGT technique was used to carry out the mathematical formulation. Different formulas for system parameters are produced by assuming that failure/RR are independent and constant. Tables and figures are used to discuss system profit analysis.

Keywords: PVC, Steel

1. Introduction

In the organizing, manufacturing, and planning processes of mechanical segments, reliability is a major concern. The ramifications of segment disappointment become constantly basic as the number of systems and size of the mining equipment continue to grow. When compared to planned maintenance or repairs, an unexpected failure can result in much greater repair expenses. Enhancing the segments' availability and dependability is one strategy for minimizing the effects of failures. The collection and examination of the appropriate information is a first step in improving reliability and availability.

This chapter presents a novel research study of the cost-benefit regarding failure/RR of subunits of a PVC and Steel plant system comprising of a various of subunits of varying manufacturing nature. In the present investigation we have picked the PVC industry arranged. This industry is a multicomponent framework. The framework stays usable for a short indicated timeframe even after the disappointment of portion of its subsystems. To keep away from the significant separate the subsystems are fixed prior to going to bombed state. PVC is a common commercial polymer that is widely utilized as a raw ingredient in a variety of chemical and petrochemical products. Unplasticized PVC, Chlorinated PVC, Molecular oriented PVC, and High Impact PVC are the four chief sub-units in the PVC industry. In other words, Unplasticized increases plasticity, decreases viscosity, or decreases friction. A PVC-U pipe is also commonly known as rigid PVC. Molecularly oriented PVC (PVC-O) is the result of a production process that turns the amorphous structure of unplasticised PVC (PVC-U) into a layered structure. C-PVC stands for chlorinated PVC. Pipes and fittings made of C-PVC share many of PVC-U's advantages. PVC-HI stands for High Impact PVC. The PVC-HI grade is obtained by adding an impact modifier to PVC-U that increases the resistance of the pipes to external blows.

In the current investigation one have picked the steel industry arranged. The industry comprises of consists of four subsystems such as descaling, grinding, hot steckel and cutter machine. The steel plant is made up of various subsystems that operate in parallel and sequence. The current study will assist the relevant administration in making practical decisions for the framework's efficient operation. Additionally, the study assumes a big role in finishing the repair analysis of specific subsystems. By adding a few subsystems that are now functioning at a reduced level, the framework's dependability and accessibility can be increased. For this inquiry, we have chosen to focus on the stainless steel manufacturing steel industry located. This industry has several different parts. Even when some of its subsystems fail, the framework continues to function for the little period of time suggested. Before entering the bombed condition, the subsystems are patched to prevent the considerable separation.These stand answerable for influencing the accessibility of the organization. These units arranged in arrangement. A single repairman is available 24*7. Precise cases remain produced to consider the consequence of disappointment/RR on MTSF, accessibility, and server of busy period. Profit optimization is additionally talked about. Structure behaviour is argued through the assistance of graphs and tables. The mathematical formulation has been carried out by using RPGT technique.The RPGT technique was used to carry out the mathematical formulation. Different formulas for system parameters are produced by assuming that failure/RR are independent and constant. Tables and figures are used to discuss system profit analysis.The dependability, availability, and maintainability study gives several techniques to conduct out structure alteration, according to Komal et al. In 2021, Kumari et al. discussed benefit analysis of the stable agricultural harvester plants utilizing RPGT. Kumar, A., Garg, D., and Goel (2019) investigated mathematical modelling and behavioural analysis in a paper mill washing unit. A work by Kumar, A., et al. (2018) looked at the profitability analysis of a 3:4:: outstanding system plant. The system modelling and analysis of the EAEP manufacturing plant was the subject of research by Rajbala et al. in 2019. Behavioural analysis has been studied in the urea fertiliser industry by Kumar, A., Goel, P., Garg, and Sahu (2017). The RPGT technique was used to carry out the mathematical formulation. Different formulas for system parameters are produced by assuming that failure/repair rates are independent and constant. Tables and figures are used to discuss system sensitivity and behavior analysis. Bhunia et al. (2010) introduced GA in a series structure with a span portion to address issues with unshakable quality stochastic augmentation. Given the chance imperatives of the series framework, the review was able to find a solution to the issue of streamlining stochastic unshakeable quality. In 2017, Kumar, A., Garg, and Goel examined the mathematical modelling and profit analysis of an edible oil refinery facility. Researchers Kumar, A., Goel, and Garg (2018) looked into the behaviour of a system that makes bread in their discussion of the reliability technology theory and its applications. Using RPGT, Kumar, A., et al. (2019) looked at the profitability of a cold standby structure with priority for preventative maintenance that comprises of two identical units with server failure. The current paper consists of two units, one of which is accessible online and the other of which is kept in cold standby mode. The only two modes for both online and cold standby units are good and entirely failed.

2. Results and Discussions

2.1 Modeling system parameters of Steel Plant using RPGT

MTSF (T_0): The regenerative un-failed states to which the system can transit (initial state '2'), before entering any failed state are: 'i' = 2, 6, 10 taking 'ξ' = '2'.

$T_0 = (V_{2,2}\mu_2 + V_{2,6}\mu_6 + V_{2,10}\mu_{10})/\{1 - V(2, 6, 2)\}(1 - p_{2,6}p_{6,2})$

AOS (A_0): The RS at which the system is available are 'j' = 2, 6, 10 and the RS are 'i' = 2 to 14 taking 'ξ' = '10' the total fraction of time for which the system is available is given by

$A_0 = \left[\sum_j V_{\xi,j}\ , f_j\, , \mu_j\right] \div \left[\sum_i V_{\xi,i}\ , f_j\, , \mu_i^1\right]$

$A_0 = (V_{10,2}\mu_2 + V_{10,6}\mu_6 + V_{10,10}\mu_{10})/D$

Where $D = V_{10,2}\mu_2 + V_{10,3}\mu_3 + V_{10,4}\mu_4 + V_{10,5}\mu_5 + V_{10,6}\mu_6 + V_{10,7}\mu_7 + V_{10,8}\mu_8 + V_{10,9}\mu_9 + V_{10,10}\mu_{10} + V_{10,11}\mu_{11} + V_{10,12}\mu_{12} + V_{10,13}\mu_{13} + V_{10,14}\mu_{14}$

BPOS: The RS where server is busy are j = 3 to 14 and RS are 'i' = 2 to 14, taking ξ = '2', the total fraction of time for which the server remains busy is

$B_0 = \left[\sum_j V_{\xi,j}\ , n_j\right] \div \left[\sum_i V_{\xi,i}\ , \mu_i^1\right]$

$B_0 = (V_{10,3}\mu_3 + V_{10,4}\mu_4 + V_{10,5}\mu_5 + V_{10,6}\mu_6 + V_{10,7}\mu_7 + V_{10,8}\mu_8 + V_{10,9}\mu_9 + V_{10,10}\mu_{10} + V_{10,11}\mu_{11} + V_{10,12}\mu_{12} + V_{10,13}\mu_{13} + V_{10,14}\mu_{14})/D$

EFNIR: The RS where the repairman visit is j = 3, 4, 5, 6 the RS are i = 2 to 14, Taking 'ξ' = '2', the number of visit by the repair man is given by

$V_0 = \left[\sum_j V_{\xi,j}\right] \div \left[\sum_i V_{\xi,i}\ , \mu_i^1\right]$

$V_0 = (V_{10,3} + {}_{10,4} + V_{10,5} + V_{10,6})/ D$

2.2 Modeling system parameters of PVC Plant using RPGT

MTSF (T_0): Reformative un-fizzled states in which framework can transit from early state '2', Earlier any failed state are: 'i' = 2, 4, 3, 5, 12 taking 'ξ' = 2.

$$\text{MTSF } (T_0) = \left[\sum_{i,sr}\left\{\frac{\left\{pr\left(\xi \xrightarrow{sr\,(sff)} i\right)\right\}\mu i}{\prod_{m_1 \neq \xi}\{1 - V_{\overline{m_1 m_1}}\}}\right\}\right] \div \left[1 - \sum_{sr}\left\{\frac{\left\{pr\left(\xi \xrightarrow{sr\,(sff)} \xi\right)\right\}}{\prod_{m_2 \neq \xi}\{1 - V_{\overline{m_2 m_2}}\}}\right\}\right]$$

$T_0 = (V_{2,2}\,\mu_2 + V_{2,4}\,\mu_4 + V_{2,3}\,\mu_3 + V_{2,5}\,\mu_5 + V_{2,12}\,\mu_{12})/ [1- \{(2, 3, 2) - (2, 4, 2) -$

(2, 5, 2) - (2, 12, 2)}]

$= (V_{2,i}\,\mu_i)/ (1- p_{2,3}\,p_{3,2} - p_{2,4}\,p_{4,2} - p_{2,5}\,p_{5,2} - p_{2,12}\,p_{12,2})$

where i= 2, 4, 3, 5, 12

AOS (A_0): The reformative states in which outline is reachable are 'j' = 2, 5, 4, 3, 12 and states are 'i' = 2 ≤ i ≤ 12 attractive 'ξ' = '2' the all-out portion of time which outline is reachable is assumed by

$$A_0 = \left[\sum_{j,sr}\left\{\frac{\{pr(\xi^{sr}\rightarrow j)\}fj,\mu j}{\Pi_{m_1\neq\xi}\{1-V_{\overline{m_1 m_1}}\}}\right\}\right] \div \left[\sum_{i,s_r}\left\{\frac{\{pr(\xi^{sr}\rightarrow i)\}\mu_i^1}{\Pi_{m_2\neq\xi}\{1-V_{\overline{m_2 m_2}}\}}\right\}\right]$$

$$A_0 = \left[\sum_j V_{\xi,j}\,, f_j\,, \mu_j\right] \div \left[\sum_i V_{\xi,i}\,, f_j\,, \mu_i^1\right]$$

$= (V_{2,j}\,\mu_j)/ D$; (where j = 2, 5, 3, 4, 12)

Where $D = V_{2,i}\,\mu_i$; (2 ≤ i ≤ 12)

Server of the busy period (B_0): The states in which attendant is hectic are 'j' = 3 ≤ j ≤ 12 after base state ξ = '2'

$$B_0 = \left[\sum_{j,sr}\left\{\frac{\{pr(\xi^{sr}\rightarrow j)\},nj}{\Pi_{m_1\neq\xi}\{1-V_{\overline{m_1 m_1}}\}}\right\}\right] \div \left[\sum_{i,s_r}\left\{\frac{\{pr(\xi^{sr}\rightarrow i)\}\mu_i^1}{\Pi_{m_2\neq\xi}\{1-V_{\overline{m_2 m_2}}\}}\right\}\right]$$

$$B_0 = \left[\sum_j V_{\xi,j}\,, n_j\right] \div \left[\sum_i V_{\xi,i}\,, \mu_i^1\right]$$

$B_0 = (V_{2,j}\,\mu_j)/ D$; (3 ≤ j ≤ 12)

EFNIR (V_0): Reformative states everyplace repairmen do this job 'j' = 3, 4, 5, 12; reformative states are 'i' = 2 ≤ i ≤ 12, Attractive 'ξ' = '2',

$$V_0 = \left[\sum_{j,sr}\left\{\frac{\{pr(\xi^{sr}\rightarrow j)\}}{\Pi_{k_1\neq\xi}\{1-V_{\overline{k_1 k_1}}\}}\right\}\right] \div \left[\sum_{i,s_r}\left\{\frac{\{pr(\xi^{sr}\rightarrow i)\}\mu_i^1}{\Pi_{k_2\neq\xi}\{1-V_{\overline{k_2 k_2}}\}}\right\}\right]$$

$$V_0 = \left[\sum_j V_{\xi,j}\right] \div \left[\sum_i V_{\xi,i}\,, \mu_i^1\right]$$

$= (V_{2,j}\,\mu_j)/ D$; (Where; j = 3, 4, 5, 12)

3. Analytical Example with Particular Cases: RPGT andData Analysis Results

Profit Function of Steel Plant (P_0):

The system can be done by utilized PF

$P_0 = D_1A_0 - (D_2B_0 + D_3V_0)$

$= D_1A_0 - D_2B_0 - D_3V_0,$

Taking $D_1 = 1200$;

$D_2 = 100$;

$D_3 = 200$, we have

Table 1: Profit Function

e \ f	0.50	0.60	0.70
0.10	653.80	678.30	700.30
0.20	504.20	550.40	587.20
0.30	415.40	443.70	462.5

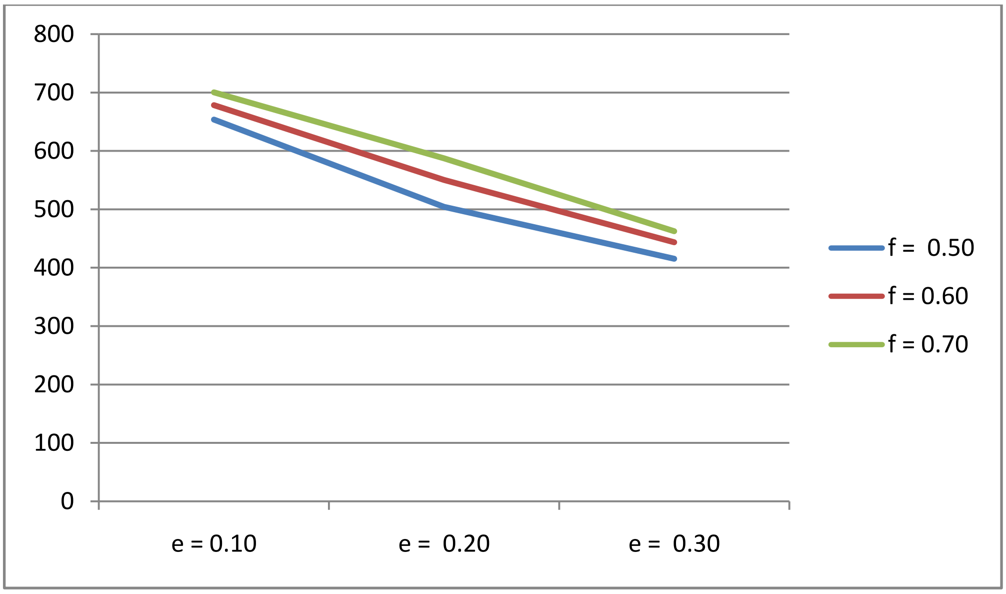

Figure 1: Profit Function

Figure 1 and Table 1 show that profit rises with an increase in RR, for instance, and declines with an increase in estimates of unit FR. As a result, the PF is inversely PP to disappointment/FR, so for the best PF estimates, repairmen should be as efficient as is reasonably possible with regard to repairs.

PF of PVC Plant:

The system can be done by utilizing PF

$P_0 = D_1A_0 – (D_2B_0 + D_3V_0) = D_1A_0 – D_2B_0 - D_3V_0$

Where: $D_1 = 1000$;

$D_2 = 500$;

$D_3 = 300$

Table 2: Profit Function (P_0)

e \ f	f= 0.55	f = 0.65	f = 0.75
e = 0.15	415.6	544.5	602.1
e = 0.25	180.8	312.5	483.3
e = 0.35	16.1	56.4	158.6

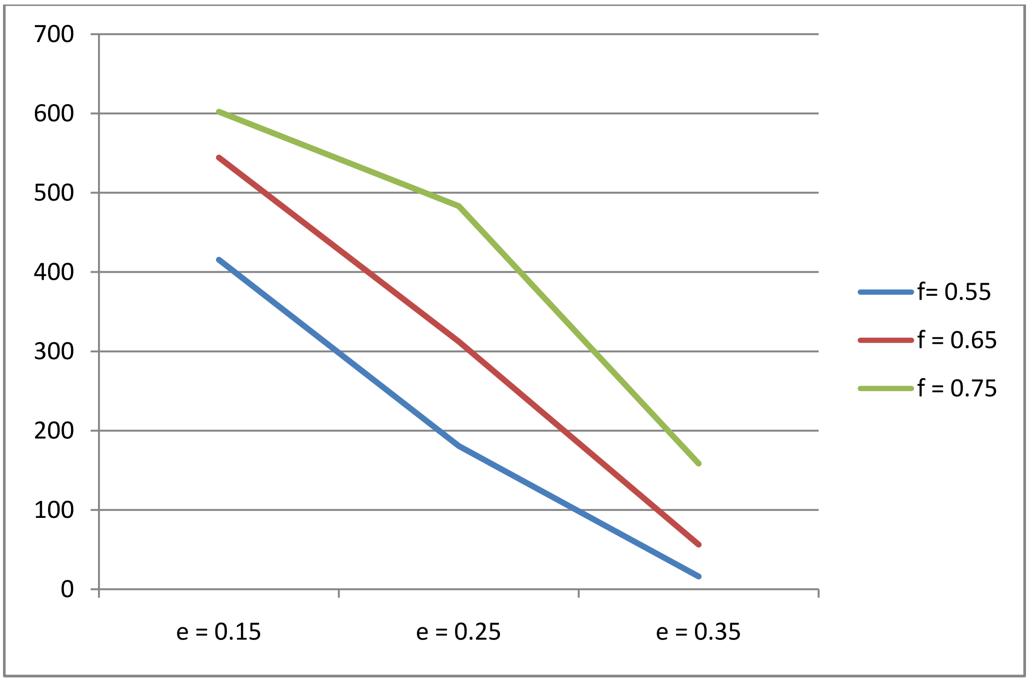

Fig. 2: Profit Function

From the analytical and graphical discussion, it is noted that the values for P_0, profit table above and graph above may besides be set and conclusion with respect to repair and disappointment rates of units. Maximum value of profit is **602.1,** when disappointment rates of units are minimum and RR maximum.

4. Conclusion:

The table 1and figure 1, it is shows that when FR increases the PF decrease and RR increases then the PFs increases. Figure 2 and Table 2 show that profit rises with an increase in RR, for instance, and declines with an increase in estimates of unit FR. As a result, the PF is inversely PP to disappointment/FR, so for the best PF estimates, repairmen should be as efficient as is reasonably possible with regard to repairs.Table 2 shows that when the FR is 0.15 and the RR is 0.75, the system's profit value is at its highest (602.1).The compression of the current study is due to the unavailability of any known publication which addresses the reliability and costoptimization of a Steel and PVC plant an emerging technology that had been situated. According to another claim, when a degraded unit is inspected before it completely fails, we can determine whether it can be repaired or whether it needs to be replaced with a new unit, which makes the system more functional and profitable.

References:

1) Kumari S, Khurana P, Singla S (2021) Behaviour and profit analysis of a thresher plant under steady state. *International Journal of System Assurance Engineering and Man*., 1-12.
2) Kumar, A., Goel, P., Garg, D., and Sahu A. (2017). System behaviour analysis in the urea fertilizer industry. *Book: Data and Analysis communications in computer and information Science*, 1, 3-12.
3) Rajbala, Kumar, A. and Garg, D. (2019), "Systems Modeling and Analysis: A Case Study of EAEP Manufacturing Plant", International Journal of Advanced Science and Technology, 28(14), 250-259.
4) Kumar, A., Goel, P., Garg, D., and Sahu, A. (2017)," System behavior analysis in the urea fertilizer industry", Book: Data and Analysis [978-981-10-8526-0], Communications in computer and information Science (CCIS), Springer, 3-12.
5) Bhunia, A. K., Sahoo, L., and Roy, D. (2010). Reliability stochastic optimization for a series system with interval component reliability via genetic algorithm. *Applied Mathematics and Computation*, 216(3), 929-939
6) Kumar, A. Garg, D. and Goel, P. (2019). Mathematical modelling and behavioural analysis of a washing unit in paper mill. *International Journal of System Assurance Engineering and Management*, 10, 1639-1645.
7) Jieong, S., Hasegawa, S., Shimoyama, and Obayashi, S. (2009). Development and investigation of efficient GA/PSO-hybrid algorithm applicable to real-world design optimization. *IEEE Computational Intelligence Magzine,* 4, 36-44.
8) Kumar, A., Goel, P. and Garg, D. (2018). Behaviour analysis of a bread making system. *International Journal of Statistics and Applied Mathematics*, 3(6), 56-61.
9) Kumar, A., Garg, D., and Goel, P. (2019), "Profit analysis of a cold standby system with priority for preventive maintenance", Journal of Advance and Scholarly Researches in Allied Education, 16(4), 253-258.

10) Komal, S., P. and Kumar, D. (2009). RAM analysis of the press unit in a paper plant using genetic algorithm and lambda-tau methodology. *In Proceeding of the 13th online International Conference (WSC '08), (Springer Book Series),* 127–137.
11) Kumar, A., Garg, D., and Goel, P. (2017), "Mathematical modeling and profit analysis of an edible oil refinery industry", Airo International Research journal, XIII, 1-14.
12) Kumar, A., and Garg, D. (2019), "Reliability technology theory and application", Lap Lambert Academic Publishing in Germany, ISBN 978-613-9-47665-7.
13) Anchal, Majumder A, Goel P (2021) Irregular Fluctuation of Successive SW Release Models. *Design Engineering,* 7, 8954-8962.
14) Kumar, A., Garg, D., Goel, P., Ozer, O. (2018), "Profit analysis of 3:4:: good system", International Journal of Advance Research in Science and Engineering, 7(2), 851-862.
15) Malik, S., Verma, S., Gupta, A., Sharma, G., and Singla, S. (2022). Performability evaluation, validation and optimization for the steam generation system of a coal-fired thermal power plant. *Methods,* 9, 1-14.