References

[1] M. Goel, “Implementing clean coal technology in India: Barriers and prospects,” *India Infrastruct. Report, Infrastruct. Dev. low carbon Econ. 3iNetwork, Oxford Univ.*, pp. 208–221, 2010.

[2] S. Mukherjee and D. P. Pahari, “Underground and opencast coal mining methods in India: A comparative assessment,” *Sp. Cult. India*, vol. 7, no. 1, pp. 39–55, 2019, doi: 10.20896/saci.v7i1.395.

[3] B. Scott, P. G. Ranjith, S. K. Choi, and M. Khandelwal, “A review on existing opencast coal mining methods within Australia,” *J. Min. Sci.*, vol. 46, no. 3, pp. 280–297, 2010, doi: 10.1007/s10913-010-0036-3.

[4] P. Dayawansa, G. Chitty, B. Kerezsi, H. Bartosiewicz, and J. W. H. Price, “Fracture Mechanics Of Mining Dragline Booms”.

[5] A. Mishra, S. K. Palei, and S. Gupta, “Reliability Analysis of Dragline Using Equivalent Aging Model,” *Arab. J. Sci. Eng.*, vol. 45, no. 8, pp. 6975–6984, 2020, doi: 10.1007/s13369-020-04622-3.

[6] O. Golbasi and N. Demirel, “A cost-effective simulation algorithm for inspection interval optimization: An application to mining equipment,” *Comput. Ind. Eng.*, vol. 113, pp. 525–540, 2017, doi: 10.1016/j.cie.2017.09.002.

[7] M. Mohammadi, P. Rai, and S. Gupta, “Improving productivity of dragline through enhancement of reliability, inherent availability and maintainability,” *Acta Montan. Slovaca*, vol. 21, no. 1, pp. 1–8, 2016.

[8] D. Kumar, S. Gupta, and P. K. Yadav, “Reliability, availability and maintainability (RAM) analysis of a dragline,” *J. Mines, Met. Fuels*, vol. 68, no. 2, pp. 68–77, 2020.

[9] S. K. Palei, S. Das, and S. Chatterjee, “Reliability-Centered Maintenance of Rapier Dragline for Optimizing Replacement Interval of Dragline Components,” *Mining, Metall. Explor.*, vol. 37, no. 4, pp. 1121–1136, 2020, doi: 10.1007/s42461-020-00226-5.

[10] O. Golbasi and N. Demirel, “Optimisation of dragline inspection intervals with time-counter algorithm,” *Int. J. Mining, Reclam. Environ.*, vol. 31, no. 6, pp. 412–425, 2017, doi: 10.1080/17480930.2017.1339168.

[11] N. Demirel and O. Gölbası, “Preventive replacement decisions for dragline components using reliability analysis,” *Minerals*, vol. 6, no. 2, 2016, doi: 10.3390/min6020051.

[12] J. Barabady and U. Kumar, “Reliability analysis of mining equipment: A case study of a crushing plant at Jajarm Bauxite Mine in Iran,” *Reliab. Eng. Syst. Saf.*, vol. 93, no. 4, pp. 647–653, 2008, doi: 10.1016/j.ress.2007.10.006.

[13] J. Barabady, “Reliability and maintainability analysis of crushing plants in Jajarm bauxite mine of Iran,” *Proc. - Annu. Reliab. Maintainab. Symp.*, pp. 109–115, 2005, doi: 10.1109/rams.2005.1408347.

[14] A. Taghizadeh and N. Demirel, “Application of Machine Learning for Dragline Failure Prediction,” vol. 3002, pp. 1–6, 2017.

[15] Y. Zhao, S. Dong, and F. Jiang, “Reliability analysis of mooring lines for floating structures using ANN-BN inference,” *Proc. Inst. Mech. Eng. Part M J. Eng. Marit. Environ.*, vol. 235, no. 1, pp. 236–254, 2021, doi: 10.1177/1475090220925200.

[16] E. F. Alsina, M. Chica, K. Trawiński, and A. Regattieri, “On the use of machine learning methods to predict component reliability from data-driven industrial case

studies," *Int. J. Adv. Manuf. Technol.*, vol. 94, no. 5–8, pp. 2419–2433, 2018, doi: 10.1007/s00170-017-1039-x.

[17] F. Zhao, J. Wu, Y. Zhao, X. Ji, L. Zhou, and Z. Sun, "A machine learning methodology for reliability evaluation of complex chemical production systems," *RSC Adv.*, vol. 10, no. 34, pp. 20374–20384, 2020, doi: 10.1039/c9ra09654j.

[18] H. Li, Z. M. Deng, N. A. Golilarz, and C. Guedes Soares, "Reliability analysis of the main drive system of a CNC machine tool including early failures," *Reliab. Eng. Syst. Saf.*, vol. 215, no. June, 2021, doi: 10.1016/j.ress.2021.107846.

[19] J. Park, C. Park, and S. Ahn, "Assessment of structural risks using the fuzzy weighted Euclidean FMEA and block diagram analysis," *Int. J. Adv. Manuf. Technol.*, vol. 99, no. 9–12, pp. 2071–2080, 2018, doi: 10.1007/s00170-018-1844-x.

[20] A. Peinado Gonzalo *et al.*, "RAM analysis and availability optimization of thermal power plant water circulation system using PSO," *Reliab. Eng. Syst. Saf.*, vol. 7, no. 1, pp. 1133–1153, 2021, doi: 10.1016/j.egyr.2020.12.025.

[21] S. Gupta and J. Bhattacharya, "Reliability analysis of a conveyor system using hybrid data," *Qual. Reliab. Eng. Int.*, vol. 23, no. 7, pp. 867–882, 2007, doi: 10.1002/qre.843.

[22] B. Queensland, "Catastrophic failure of a dragline boom," no. 13, 1999.

[23] S. F. Azam and P. Rai, "Finite element-based simulation and analysis of dragline bucket in static and dynamic loading condition," *Curr. Sci.*, vol. 40, no. 4, pp. 810–818, 2019, doi: 10.1007/s40430-018-1016-9.

[24] A. Gustafson, H. Schunnesson, and U. Kumar, "Reliability analysis and comparison between automatic and manual load haul dump machines," *Qual. Reliab. Eng. Int.*, vol. 31, no. 3, pp. 523–531, 2015, doi: 10.1002/qre.1610.

[25] S. Gupta, N. Ramkrishna, and J. Bhattacharya, "Replacement and maintenance analysis of longwall shearer using fault tree technique," vol. 115, no. 2, pp. 49–59, 2006, doi: 10.1179/174328606X111433.

[26] L. Liu, J. Liu, and Q. Zhou, "Mine ventilation system reliability evaluation based on a Markov chain," *Sci. Rep.*, vol. 12, no. 1, pp. 1–12, 2022, doi: 10.1038/s41598-022-22098-z.

[27] P. Pandey, A. K. Mukhopadhyay, and S. Chattopadhyaya, "Reliability analysis and failure rate evaluation for critical subsystems of the dragline," *J. Brazilian Soc. Mech. Sci. Eng.*, vol. 40, no. 2, pp. 1–11, 2018, doi: 10.1007/s40430-018-1016-9.

[28] N. L. Pang, X. L. Zhao, F. R. Mashiri, and P. Dayawansa, "Full-size testing to determine stress concentration factors of dragline tubular joints," *Eng. Struct.*, vol. 31, no. 1, pp. 43–56, 2009, doi: 10.1016/j.engstruct.2008.07.014.

[29] P. Ridley and R. Algra, "Dragline bucket and rigging dynamics," *Mech. Mach. Theory*, vol. 39, no. 9, pp. 999–1016, 2004, doi: 10.1016/j.mechmachtheory.2004.04.007.

[30] R. G. Metcalfe and R. Costanzi, "Fatigue cracking of dragline boom support strands," *Eng. Fail. Anal.*, vol. 99, no. January, pp. 46–68, 2019, doi: 10.1016/j.engfailanal.2019.01.084.

[31] Y. Li and W. Liu, "Dynamic dragline modeling for operation performance simulation and fatigue life prediction," *Eng. Fail. Anal.*, vol. 34, pp. 93–101, 2013, doi: 10.1016/j.engfailanal.2013.07.020.

[32] P. Dayawansa, G. Chitty, B. Kerezsi, H. Bartosiewicz, and J. W. H. Price, "Fracture mechanics of mining dragline booms," *Eng. Fail. Anal.*, vol. 13, no. 4,

pp. 716–725, 2006, doi: 10.1016/j.engfailanal.2005.04.013.

[33] A. R. Sahu and S. K. Palei, "Real-time fault diagnosis of HEMM using Bayesian Network: A case study on drag system of dragline," *Eng. Fail. Anal.*, vol. 118, no. April, p. 104917, 2020, doi: 10.1016/j.engfailanal.2020.104917.

[34] A. R. Sahu and S. K. Palei, "Fault prediction of drag system using artificial neural network for prevention of dragline failure," *Eng. Fail. Anal.*, vol. 113, no. 104542, pp. 1–12, 2020, doi: 10.1016/j.engfailanal.2020.104542.

[35] V. R. Ranganath, G. Das, S. Tarafder, and S. K. Das, "Failure of a swing pinion shaft of a dragline," *Eng. Fail. Anal.*, vol. 11, no. 4, pp. 599–604, 2004, doi: 10.1016/j.engfailanal.2003.08.004.

[36] S. Conrady and L. Jouffe, "Introduction to Bayesian Networks & BayesiaLab Arti fi cial Intelligence for Research and Analytics Table of Contents," 2014, pp. 1–30. doi: 10.13140/2.1.4737.6965.

[37] J. H. Saleh and K. Marais, "Highlights from the early (and pre-) history of reliability engineering," *Reliab. Eng. Syst. Saf.*, vol. 91, no. 2, pp. 249–256, 2006, doi: 10.1016/j.ress.2005.01.003.

[38] C. E. Ebeling, "Intro to Reliability & Maintainability Engineering.pdf." p. 486, 1997.

[39] A. Coppola, "Reliability Engineering of Electronic Equipment: a Historical Perspective.," *IEEE Trans. Reliab.*, vol. R-33, no. 1, pp. 29–35, 1984, doi: 10.1109/TR.1984.6448271.

[40] M. Mohammadi, P. Rai, and S. Gupta, "Improving productivity of dragline through enhancement of reliability, inherent availability and maintainability," *Acta Montan. Slovaca*, vol. 21, no. 1, pp. 1–8, 2016, doi: 10.3390/ams21010001.

[41] M. Javad Rahimdel, M. Ataei, R. Khalokakaei, and S. Hadi, "International Journal of Mining Science and Technology Reliability-based maintenance scheduling of hydraulic system of rotary drilling machines," *Int. J. Min. Sci. Technol.*, vol. 23, no. 5, pp. 771–775, 2013, doi: 10.1016/j.ijmst.2013.08.023.

[42] U. Kumar, "Reliability analysis of Load-Haul-Dump machines," p. 63, 1990.

[43] K. B. Misra, "Performability Engineering: An Essential Concept in the 21st Century," in *Handbook of Performability Engineering*, 2008, pp. 1–12. doi: 10.1007/978-1-84800-131-2_1.

[44] W. R. Wessels, *PRACTICAL RELIABILITY and ANALYSIS for PRACTICAL RELIABILITY and ANALYSIS for*. 2010.

[45] E. Ã. Zio, "Reliability engineering : Old problems and new challenges," vol. 94, pp. 125–141, 2009, doi: 10.1016/j.ress.2008.06.002.

[46] B. K. Low and H. H. Einstein, "Reliability analysis of roof wedges and rockbolt forces in tunnels," *Tunn. Undergr. Sp. Technol.*, vol. 38, pp. 1–10, 2013, doi: 10.1016/j.tust.2013.04.006.

[47] U. D. Kumar, J. Crocker, T. Chitra, and H. Saranga, *Reliability and six sigma*. 2006. doi: 10.1007/0-387-30256-5.

[48] S. H. Kumar U Dinesh, Crocker John, Chitra T., *Reliability and Six Sigma*, 1st editio. New York: Springer, 2006.

[49] B. S. Dhillon, *Mining Equipment Reliability,Maitainability and Safety*, vol. 53, no. 9. 2013. doi: 10.1017/CBO9781107415324.004.

[50] A. Singh, P. Rai, N. Sharma, and J. Pandey, "Failure Analysis and Performance Improvement Using Surface Miner on Field Breakdown Data: A case study," *Ind.*

Eng. J., vol. 12, no. 9, pp. 1–31, 2019, doi: 10.26488/iej.12.9.1198.

[51] Y. Du, L. Liao, and L. Wang, "Failure Mode , Effects and Criticality Analysis of Remanufactured Machine Tools in Service," vol. 18, no. 3, pp. 425–434, 2017, doi: 10.1007/s12541-017-0051-2.

[52] G. V. R. Goodman, "An assessment of coal mine escapeway reliability using fault tree analysis," *Min. Sci. Technol.*, vol. 7, no. 2, pp. 205–215, 1988, doi: 10.1016/S0167-9031(88)90610-X.

[53] B. Ünver, S. Gürgen, B. Sahin, and İ. Alt, "Crankcase explosion for two-stroke marine diesel engine by using fault tree analysis method in fuzzy environment," vol. 97, no. January, pp. 288–299, 2019, doi: 10.1016/j.engfailanal.2019.01.007.

[54] F. Sihombing and M. Torbol, "Parallel fault tree analysis for accurate reliability of complex systems," *Struct. Saf.*, vol. 72, pp. 41–53, 2018, doi: 10.1016/j.strusafe.2017.12.003.

[55] R. Yan, Z. Ma, Y. Zhao, and G. Kokogiannakis, "A decision tree based data-driven diagnostic strategy for air handling units," *Energy Build.*, vol. 133, pp. 37–45, 2016, doi: 10.1016/j.enbuild.2016.09.039.

[56] A. Nouri.Gharahasanlou, A. Mokhtarei, A. Khodayarei, and M. Ataei, "Fault tree analysis of failure cause of crushing plant and mixing bed hall at Khoy cement factory in Iran," *Case Stud. Eng. Fail. Anal.*, vol. 2, no. 1, pp. 33–38, 2014, doi: 10.1016/j.csefa.2013.12.006.

[57] Y. Mahmood, A. Ahmadi, A. Verma, and U. Kumar, "Fuzzy fault tree analysis : A review of concept and application Fuzzy fault tree analysis : a review of concept and application," no. April 2014, 2013, doi: 10.1007/s13198-013-0145-x.

[58] A. C. Marquez, *The maintenance management framework, Models and Methods for Complex Systems Maintenance*, 3rd editio., vol. 49. London: Springer International Publishing, 2012. doi: 10.1007/978-1-4471-2757-4_5.

[59] D. J. . Smith, *Reliability, Maintainability and Risk, Practical methods for engineers*, vol. 4, no. 1. 2001.

[60] B. Samanta, B. Sarkar, and S. K. Mukherjee, "Reliability modelling and performance analyses of an LHD system in mining," *J. South African Inst. Min. Metall.*, vol. 104, no. 1, pp. 1–8, 2004.

[61] A. K. Agrawal, V. M. S. R. Murthy, and S. Chattopadhyaya, "Investigations into reliability, maintainability and availability of tunnel boring machine operating in mixed ground condition using Markov chains," *Eng. Fail. Anal.*, vol. 105, no. October 2018, pp. 477–489, 2019, doi: 10.1016/j.engfailanal.2019.07.013.

[62] M. J. Rahimdel, S. H. Hoseinie, and B. Ghodrati, "Ram analysis of rotary drilling machines," *Min. Sci.*, vol. 23, pp. 77–89, 2016, doi: 10.5277/msc162307.

[63] R. B. Patil and B. S. Kothavale, "Reliability analysis of CNC turning center based on the assessment of trends in maintenance data A case study," vol. 34, no. 9, pp. 1616–1638, 2017, doi: 10.1108/IJQRM-08-2016-0126.

[64] N. F. Pan and H. Wang, "Assessing failure of bridge construction using fuzzy fault tree analysis," *Proc. - Fourth Int. Conf. Fuzzy Syst. Knowl. Discov. FSKD 2007*, vol. 1, pp. 96–100, 2007, doi: 10.1109/FSKD.2007.193.

[65] G. Merle, J. M. Roussel, J. J. Lesage, V. Perchet, and N. Vayatis, "Quantitative Analysis of Dynamic Fault Trees Based on the Coupling of Structure Functions and Monte Carlo Simulation," *Qual. Reliab. Eng. Int.*, vol. 32, no. 1, pp. 7–18, 2016, doi: 10.1002/qre.1728.

[66] C. M. Lin, H. K. Teng, C. C. Yang, H. L. Weng, M. C. Chung, and C. C. Chung,

"A mesh network reliability analysis using reliability block diagram," *IEEE Int. Conf. Ind. Informatics*, pp. 975–979, 2010, doi: 10.1109/INDIN.2010.5549610.

[67] J. Soszynska, "Reliability and risk evaluation of a port oil pipeline transportation system in variable operation conditions," *Int. J. Press. Vessel. Pip.*, vol. 87, no. 2–3, pp. 81–87, 2010, doi: 10.1016/j.ijpvp.2010.01.002.

[68] W. Zhao, T. Tao, and E. Zio, "Parameters tuning in support vector regression for reliability forecasting," *Chem. Eng. Trans.*, vol. 33, no. January, pp. 523–528, 2013, doi: 10.3303/CET1333088.

[69] P. F. Pai, "System reliability forecasting by support vector machines with genetic algorithms," *Math. Comput. Model.*, vol. 43, no. 3–4, pp. 262–274, 2006, doi: 10.1016/j.mcm.2005.02.008.

[70] L. Bing, Z. Meilin, and X. Kai, "Practical engineering method for fuzzy reliability analysis of mechanical structures," *Reliab. Eng. Syst. Saf.*, vol. 67, no. 3, pp. 311–315, 2000, doi: 10.1016/S0951-8320(99)00073-3.

[71] Q. Wang and G. E. Dinse, "Linear regression analysis of survival data with missing censoring indicators," *Lifetime Data Anal.*, vol. 17, no. 2, pp. 256–279, 2011, doi: 10.1007/s10985-010-9175-8.

[72] P. Weber, G. Medina-Oliva, C. Simon, and B. Iung, "Overview on Bayesian networks applications for dependability, risk analysis and maintenance areas," *Eng. Appl. Artif. Intell.*, vol. 25, no. 4, pp. 671–682, 2012, doi: 10.1016/j.engappai.2010.06.002.

[73] Z. Cai, W. Si, S. Si, and S. Sun, "Modeling of failure prediction Bayesian network with divide-and-conquer principle," *Math. Probl. Eng.*, vol. 2014, 2014, doi: 10.1155/2014/210714.

[74] H. Langseth and L. Portinale, "Bayesian networks in reliability," *Reliab. Eng. Syst. Saf.*, vol. 92, no. 1, pp. 92–108, 2007, doi: 10.1016/j.ress.2005.11.037.

[75] C. Li, H., Guedes Soares, "Reliability analysis of floating offshore wind turbines support structure using hierarchical Bayesian network.," *Proc. 30th Eur. Saf. Reliab. Conf. 15th Probabilistic Saf. Assess. Manag. Conf.*, no. January, 2020, doi: 10.3850/978-981-11-2724-3.

[76] Y. Zhao, F. Xiao, and S. Wang, "An intelligent chiller fault detection and diagnosis methodology using Bayesian belief network," *Energy Build.*, vol. 57, pp. 278–288, 2013, doi: 10.1016/j.enbuild.2012.11.007.

[77] Y. Chetouani, "Model selection and fault detection approach based on Bayes decision theory : Application to changes detection problem in a distillation column," *Process Saf. Environ. Prot.*, vol. 92, no. 3, pp. 215–223, 2013, doi: 10.1016/j.psep.2013.02.004.

[78] Y. He, R. Wang, S. Kwong, and X. Wang, "Bayesian classifiers based on probability density estimation and their applications to simultaneous fault diagnosis," *Inf. Sci. (Ny).*, vol. 259, pp. 252–268, 2014, doi: 10.1016/j.ins.2013.09.003.

[79] B. Cai, X. Shao, Y. Liu, X. Kong, and H. Wang, "Remaining Useful Life Estimation of Structure Systems Under the Influence of Multiple Causes : Subsea Pipelines as a Case Study," vol. 67, no. 7, pp. 5737–5747, 2020.

[80] T. Amin, F. Khan, and S. Imtiaz, "Dynamic availability assessment of safety critical systems using a dynamic Bayesian network," *Reliab. Eng. Syst. Saf.*, vol. 178, no. June, pp. 108–117, 2018, doi: 10.1016/j.ress.2018.05.017.

[81] P. Weber and L. Jouffe, "Complex system reliability modelling with Dynamic

Object Oriented Bayesian Networks (DOOBN)," *Reliab. Eng. Syst. Saf.*, vol. 91, no. 2, pp. 149–162, 2006, doi: 10.1016/j.ress.2005.03.006.

[82] Y. Wang and S. Lin, "Shujun Wang The application of dynamic bayesian network to reliability assessment of emu traction system Zastosowanie dynamicznych sieci bayesowskich do oceny niezawodności elektrycznego systemu trakcyjnego," vol. 19, no. 3, pp. 349–357, 2017.

[83] M. Ramos and M. C. Maturana, "Application of Bayesian Belief networks to the human reliability analysis of an oil tanker operation focusing on collision accidents," *Reliab. Eng. Syst. Saf.*, vol. 110, pp. 89–109, 2013, doi: 10.1016/j.ress.2012.09.008.

[84] P. cheng Li, G. hua Chen, L. cao Dai, and L. Zhang, "A fuzzy Bayesian network approach to improve the quantification of organizational influences in HRA frameworks," *Saf. Sci.*, vol. 50, no. 7, pp. 1569–1583, 2012, doi: 10.1016/j.ssci.2012.03.017.

[85] O. Morales-Nápoles and R. D. J. M. Steenbergen, "Large-Scale Hybrid Bayesian Network for Traffic Load Modeling from Weigh-in-Motion System Data," *J. Bridg. Eng.*, vol. 20, no. 1, pp. 1–10, 2015, doi: 10.1061/(asce)be.1943-5592.0000636.

[86] O. Doguc and J. E. Ramirez-Marquez, "A generic method for estimating system reliability using Bayesian networks," *Reliab. Eng. Syst. Saf.*, vol. 94, no. 2, pp. 542–550, 2009, doi: 10.1016/j.ress.2008.06.009.

[87] Z. Hamza and S. Hacene, "Reliability and safety analysis using fault tree and Bayesian networks," *Int. J. Comput. Aided Eng. Technol.*, vol. 11, no. 1, pp. 73–86, 2019, doi: 10.1504/IJCAET.2019.096720.

[88] M. C. Kim, "Reliability block diagram with general gates and its application to system reliability analysis," *Ann. Nucl. Energy*, vol. 38, no. 11, pp. 2456–2461, 2011, doi: 10.1016/j.anucene.2011.07.013.

[89] H. Li and C. Guedes Soares, "Assessment of failure rates and reliability of floating offshore wind turbines," *Reliab. Eng. Syst. Saf.*, vol. 228, no. August, p. 108777, 2022, doi: 10.1016/j.ress.2022.108777.

[90] D. Marquez, M. Neil, and N. Fenton, "Improved reliability modeling using Bayesian networks and dynamic discretization," *Reliab. Eng. Syst. Saf.*, vol. 95, no. 4, pp. 412–425, 2010, doi: 10.1016/j.ress.2009.11.012.

[91] M. Bensi, A. Der Kiureghian, and D. Straub, "Efficient Bayesian network modeling of systems," *Reliab. Eng. Syst. Saf.*, vol. 112, pp. 200–213, 2013, doi: 10.1016/j.ress.2012.11.017.

[92] J. Mi, Y. F. Li, W. Peng, and H. Z. Huang, "Reliability analysis of complex multi-state system with common cause failure based on evidential networks," *Reliab. Eng. Syst. Saf.*, vol. 174, no. December 2016, pp. 71–81, 2018, doi: 10.1016/j.ress.2018.02.021.

[93] X. Li, Y. F. Li, H. Li, and H. Z. Huang, "An algorithm of discrete-time Bayesian network for reliability analysis of multilevel system with warm spare gate," *Qual. Reliab. Eng. Int.*, vol. 37, no. 3, pp. 1116–1134, 2021, doi: 10.1002/qre.2784.

[94] W. Huang *et al.*, "Operational failure analysis of high-speed electric multiple units: A Bayesian network-K2 algorithm-expectation maximization approach," *Reliab. Eng. Syst. Saf.*, vol. 205, no. August 2020, p. 107250, 2021, doi: 10.1016/j.ress.2020.107250.

[95] Z. Liu, Y. Liu, B. Cai, D. Zhang, and C. Zheng, "Dynamic Bayesian network

modeling of reliability of subsea blowout preventer stack in presence of common cause failures," *J. Loss Prev. Process Ind.*, vol. 38, pp. 58–66, 2015, doi: 10.1016/j.jlp.2015.09.001.

[96] S. Rebello, H. Yu, and L. Ma, "An integrated approach for system functional reliability assessment using Dynamic Bayesian Network and Hidden Markov Model," *Reliab. Eng. Syst. Saf.*, vol. 180, no. June, pp. 124–135, 2018, doi: 10.1016/j.ress.2018.07.002.

[97] P. A. P. Ramírez and I. B. Utne, "Use of dynamic Bayesian networks for life extension assessment of ageing systems," *Reliab. Eng. Syst. Saf.*, vol. 133, pp. 119–136, 2015, doi: 10.1016/j.ress.2014.09.002.

[98] D. Codetta-Raiteri, A. Bobbio, S. Montani, and L. Portinale, "A dynamic Bayesian network based framework to evaluate cascading effects in a power grid," *Eng. Appl. Artif. Intell.*, vol. 25, no. 4, pp. 683–697, 2012, doi: 10.1016/j.engappai.2010.06.005.

[99] B. Cai *et al.*, "Performance evaluation of subsea BOP control systems using dynamic Bayesian networks with imperfect repair and preventive maintenance," *Eng. Appl. Artif. Intell.*, vol. 26, no. 10, pp. 2661–2672, 2013, doi: 10.1016/j.engappai.2013.08.011.

[100] R. K. Mobley, *8 - Rotor Balancing, in Maintenance Fundamentals (Second Edition)*. 2004.

[101] B. Danielson, "A Study of Maintenance Problems in Swedish Mines, Study Report," 1987.

[102] M. Ben-Daya, U. Kumar, and D. N. P. Murthy, *Introduction to Maintenance Engineering Modeling, Optimization, and Management*, 1st editio. Pondicherry, India: Wiley, 2016.

[103] H. Maros and S. Juniar, *The USA Departement of Energy, 2010*. 2010, pp. 1–23.

[104] A. Al-Meshari, E. Al-Zahrani, and M. Diab, "Failure analysis of cooling fan gearbox," *Eng. Fail. Anal.*, vol. 20, pp. 166–172, 2012, doi: 10.1016/j.engfailanal.2011.11.009.

[105] O. Pourhosseini and F. Nasiri, "Availability-Based Reliability-Centered Maintenance Scheduling: Case Study of Domestic (Building-Integrated) Hot Water Systems," *ASCE-ASME J. Risk Uncertain. Eng. Syst. Part A Civ. Eng.*, vol. 4, no. 1, pp. 1–13, 2018, doi: 10.1061/ajrua6.0000935.

[106] T. Zhang, M. Nakamura, and H. Hatazaki, "Optimizing maintenance scheduling of equipment by element maintenance interval adjustment considering system availability," *Proc. IEEE Power Eng. Soc. Transm. Distrib. Conf.*, vol. 1, pp. 205–210, 2002, doi: 10.1109/PESW.2002.984986.

[107] Z. Li, J. Guo, and R. Zhou, "Maintenance scheduling optimization based on reliability and prognostics information," *Proc. - Annu. Reliab. Maintainab. Symp.*, vol. 2016-April, no. January, 2016, doi: 10.1109/RAMS.2016.7448069.

[108] T. O. Alamri and J. P. T. Mo, "Optimisation of Preventive Maintenance Regime Based on Failure Mode System Modelling Considering Reliability," *Arab. J. Sci. Eng.*, 2022, doi: 10.1007/s13369-022-07174-w.

[109] M. Shafiee and J. D. Sørensen, "Maintenance optimization and inspection planning of wind energy assets: Models, methods and strategies," *Reliab. Eng. Syst. Saf.*, vol. 192, 2019, doi: 10.1016/j.ress.2017.10.025.

[110] E. Sitompul and A. Rohmat, "IoT-based Running Time Monitoring System (E.Sitompul, et al.)," vol. 13, no. 1, pp. 33–40, 2021.

[111] I. A. Okaro and L. Tao, "Reliability analysis and optimisation of subsea compression system facing operational covariate stresses," *Reliab. Eng. Syst. Saf.*, vol. 156, pp. 159–174, 2016, doi: 10.1016/j.ress.2016.07.018.

[112] S. S. Islam, T. Lestari, A. Fitriani, and D. A. Wardani, "The implementation of preventive maintenance using machine damage analysis: A case study of power plant machine," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 885, no. 1, pp. 6–11, 2020, doi: 10.1088/1757-899X/885/1/012030.

[113] R. Li and X. Zhang, "Preventive Maintenance Interval Optimization for Continuous Multistate Systems," *Math. Probl. Eng.*, vol. 2020, 2020, doi: 10.1155/2020/2942940.

[114] Y. R. Melo, C. A. V. Cavalcante, P. Scarf, and R. S. Lopes, "A hybrid maintenance policy with fixed periodic structure and opportunistic replacement," *Proc. Inst. Mech. Eng. Part O J. Risk Reliab.*, 2022, doi: 10.1177/1748006X221100365.

[115] Z. Liang and A. K. Parlikad, "Predictive group maintenance for multi-system multi-component networks," *Reliab. Eng. Syst. Saf.*, vol. 195, no. September 2018, p. 106704, 2020, doi: 10.1016/j.ress.2019.106704.

[116] L. Qiu, "Preventive Maintenance Schedule of CNC Machine Tool Based on Monte Carlo Simulation," *2014 17th Int. Conf. Electr. Mach. Syst. ICEMS 2014*, pp. 993–996, 2014, doi: 10.1109/ICEMS.2014.7013630.

[117] K. Das, R. S. Lashkari, and S. Sengupta, "Machine reliability and preventive maintenance planning for cellular manufacturing systems," *Eur. J. Oper. Res.*, vol. 183, no. 1, pp. 162–180, 2007, doi: 10.1016/j.ejor.2006.09.079.

[118] H. Korving, F. H. L. R. Clemens, and J. M. Van Noortwijk, "Failure of sewage pumps : Statistical modelling and impact assessment Statistical Modeling of the Serviceability of Sewage Pumps," no. October 2017, 2006, doi: 10.2166/wst.2006.577.

[119] H. Al-chalabi *et al.*, "Case Study : Model for Economic Lifetime of Drilling Machines in the Swedish Mining Industry Case Study : Model for Economic Lifetime of Drilling," vol. 2701, 2015, doi: 10.1080/0013791X.2014.952466.

[120] S. Alaswad, "On The Maintenance Modeling and Optimization of Repairable Systems : Two Different Scenarios," 2012.

[121] M. Li, X. Jiang, J. Carroll, and R. R. Negenborn, "A multi-objective maintenance strategy optimization framework for offshore wind farms considering uncertainty," *Appl. Energy*, vol. 321, no. June, p. 119284, 2022, doi: 10.1016/j.apenergy.2022.119284.

[122] J. P. T. Mo and D. Chan, "Reliability based maintenance planning of wind turbine using bond graph," *Univers. J. Mech. Eng.*, vol. 5, no. 4, pp. 103–112, 2017, doi: 10.13189/ujme.2017.050401.

[123] M. D. Ramere and O. T. Laseinde, "Optimization of condition-based maintenance strategy prediction for aging automotive industrial equipment using FMEA," *Procedia Comput. Sci.*, vol. 180, pp. 229–238, 2021, doi: 10.1016/j.procs.2021.01.160.

[124] W. Safira Rahmania, H. Elvian Gayuh Prasetya, and F. Hesty Sholihah, "Maintenance analysis of boiler feed pump turbine using failure mode effect analysis (fmea) methods," *IES 2020 - Int. Electron. Symp. Role Auton. Intell. Syst. Hum. Life Comf.*, pp. 54–59, 2020, doi: 10.1109/IES50839.2020.9231886.

[125] S. Nag, "EVALUATION OF DRAGLINE MINING IN INDIAN EVALUATION OF DRAGLINE MINING IN INDIAN," 2013.

[126] "'Draglines and front shovel excavator: Tractor & construction.' [Online]. Available: https://tractors.fandom.com/wiki/Draglines_and_Front_Shovel_Excavator."

[127] A. R. Sahu and S. K. Palei, "Reliability analysis of a dragline for productivity improvement : A case study," *J. Mater. Metall. Eng.*, vol. 8, no. 1, pp. 62–69, 2018.

[128] S. Bandopadhyay and P. Venkatasubramanian, "A fault-diagnostic expert system for walking draglines," *Min. Sci. Technol.*, vol. 11, no. 1, pp. 71–83, 1990, doi: 10.1016/0167-9031(90)80007-4.

[129] Z. Allahkarami, A. R. Sayadi, and A. Lanke, "Reliability Analysis of Motor System of Dump Truck for Maintenance Management," *Lect. Notes Mech. Eng.*, pp. 681–688, 2016, doi: 10.1007/978-3-319-23597-4_50.

[130] C. Mouli, "Reliability Modeling and Performance Analysis of Dumper Systems in Mining by KME Method," *Int. J. Curr. Eng. Technol.*, vol. 2, no. 2, pp. 255–258, 2013, doi: 10.14741/ijcet/spl.2.2014.46.

[131] M. Soleimani and M. Pourgol-Mohammad, "Design for Reliability of complex system with limited failure data; case study of a Horizontal Drilling Equipment," *PSAM 2014 - Probabilistic Saf. Assess. Manag.*, vol. 2014, 2014.

[132] N. Vagenas and T. Nuziale, "Genetic algorithms for reliability assessment of mining equipment," *J. Qual. Maint. Eng.*, vol. 7, no. 4, pp. 302–311, 2001, doi: 10.1108/13552510110407087.

[133] S. R. Dindarloo, "Support vector machine regression analysis of LHD failures," *Int. J. Mining, Reclam. Environ.*, vol. 30, no. 1, pp. 64–69, 2016, doi: 10.1080/17480930.2014.973637.

[134] B. Samanta, B. Sarkar, and S. K. Mukherjee, "Performance evaluation of a dragline machine in a surface mine," *Saf. Reliab.*, vol. 22, no. 3, pp. 57–72, 2002, doi: 10.1080/09617353.2002.11690745.

[135] S. K. Roy, M. M. Bhattacharyya, and V. N. A. Naikan, "Maintainability and reliability analysis of a fleet of shovels," *Inst. Min. Metall. Trans. Sect. A Min. Technol.*, vol. 110, no. SEPT/DEC, pp. 163–171, 2001, doi: 10.1179/mnt.2001.110.3.163.

[136] N. Uzgören and S . Elevli, "Homojen olmayan poisson süreci : Bir maden makinesinin güvenilirlik analizi ," *J. Fac. Eng. Archit. Gazi Univ.*, vol. 25, no. 4, pp. 827–837, 2010.

[137] O. Gölbaşı and N. Demirel, "Failure Types of Draglines and Their Classification," in *Proceedings of Mining Machinery Symposium and Exhibition of Turkey*, 2013, pp. 47–55.

[138] O. Gölba and N. Demirel, "Investigation of stress in an earthmover bucket using finite element analysis : a generic model for draglines," vol. 115, no. JULY, pp. 623–628, 2015.

[139] L. Uusitalo, "Advantages and challenges of Bayesian networks in environmental modelling," *Ecol. Modell.*, vol. 203, no. 3–4, pp. 312–318, 2007, doi: 10.1016/j.ecolmodel.2006.11.033.

[140] H. B. Jun and D. Kim, "A Bayesian network-based approach for fault analysis," *Expert Syst. Appl.*, vol. 81, pp. 332–348, 2017, doi: 10.1016/j.eswa.2017.03.056.

[141] N. S. Arunraj and J. Maiti, "Risk-based maintenance - Techniques and applications," *J. Hazard. Mater.*, vol. 142, no. 3, pp. 653–661, 2007, doi: 10.1016/j.jhazmat.2006.06.069.

[142] H. W. Lo, J. J. H. Liou, C. N. Huang, and Y. C. Chuang, "A novel failure mode and effect analysis model for machine tool risk analysis," *Reliab. Eng. Syst. Saf.*, vol. 183, pp. 173–183, 2019, doi: 10.1016/j.ress.2018.11.018.

[143] Z. Wang, Y. Ran, Y. Chen, H. Yu, and G. Zhang, "Failure mode and effects analysis using extended matter-element model and AHP," *Comput. Ind. Eng.*, vol. 140, p. 106233, 2020, doi: 10.1016/j.cie.2019.106233.

[144] B. F. LLC, "BAYES FUSION GENIE," *https://www.bayesfusion.com/genie/*.

[145] B. Jones, I. Jenkinson, Z. Yang, and J. Wang, "The use of Bayesian network modelling for maintenance planning in a manufacturing industry," *Reliab. Eng. Syst. Saf.*, vol. 95, no. 3, pp. 267–277, 2010, doi: 10.1016/j.ress.2009.10.007.

[146] N. Blaikie, *Analyzing Quantitative Data, From Despriction to Explanation*, 2003rd ed. London: Sage Publications Ltd, 2003. doi: 10.4324/9781003080688-4.

[147] W. W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences.*, vol. 44, no. 1. 1988. doi: 10.2307/2531929.

[148] P. Wang, D. Ph, and U. Technologies, "Repairable Systems Reliability Trend Tests and Evaluation," *Annu. Reliab. Maintainab. Symp. 2005. Proceedings.*, pp. 416–421, 2005, doi: 10.1109/RAMS.2005.1408398.

[149] J. K. Vaurio, "Treatment of general dependencies in system fault-tree and risk analysis," *IEEE Trans. Reliab.*, vol. 51, no. 3, pp. 278–287, 2002, doi: 10.1109/TR.2002.801848.

[150] F. I. Khan and S. A. Abbasi, "Techniques and methodologies for risk analysis in chemical process industries," *J. Loss Prev. Process Ind.*, vol. 11, no. 4, pp. 261–277, 1998, doi: 10.1016/S0950-4230(97)00051-X.

[151] L. Stoffel, *Risk assessment*, vol. 2002, no. 8. 2002. doi: 10.1016/S1361-3723(02)00812-6.

[152] V. Ramesh and R. Saravannan, "Reliability assessment of a co-generation power plant in a sugar mill using fault tree analysis," *Energy Sources, Part A Recover. Util. Environ. Eff.*, vol. 33, no. 12, pp. 1168–1183, 2011, doi: 10.1080/15567031003681978.

[153] C. A. Ericson, *Hazard Analysis Techniques For System Safety*, vol. 1, no. 1. 1999.

[154] E. Bobbio, A.; Portinale, L.; Minichino, M.; Ciancamerla, "Improving the Analysis of Dependable Systems by Mapping Fault Trees into Bayesian Networks. Realiability Engineering & System Safety," *Reliab. Eng. Syst. Saf. 71*, vol. 71, pp. 249–260, 2001.

[155] Z. Wang, Z. Wang, S. He, X. Gu, and Z. F. Yan, "Fault detection and diagnosis of chillers using Bayesian network merged distance rejection and multi-source non-sensor information," *Appl. Energy*, vol. 188, pp. 200–214, 2017, doi: 10.1016/j.apenergy.2016.11.130.

[156] F. Taroni, A. Biedermann, P. Garbolino, and C. G. G. Aitken, "A general approach to Bayesian networks for the interpretation of evidence," *Forensic Sci. Int.*, vol. 139, no. 1, pp. 5–16, 2004, doi: 10.1016/j.forsciint.2003.08.004.

[157] J. Shang, M. Chen, H. Ji, D. Zhou, H. Zhang, and M. Li, "Dominant trend based logistic regression for fault diagnosis in nonstationary processes," *Control Eng. Pract.*, vol. 66, pp. 156–168, 2017, doi: 10.1016/j.conengprac.2017.06.011.

[158] Y. L. He, R. Wang, S. Kwong, and X. Z. Wang, "Bayesian classifiers based on probability density estimation and their applications to simultaneous fault diagnosis," *Inf. Sci. (Ny).*, vol. 259, pp. 252–268, 2014, doi: 10.1016/j.ins.2013.09.003.

[159] B. G. Xu, “Intelligent fault inference for rotating flexible rotors using Bayesian belief network,” *Expert Syst. Appl.*, vol. 39, no. 1, pp. 816–822, 2012, doi: 10.1016/j.eswa.2011.07.079.

[160] N. T. Jensen FV, *Bayesian networks and decision graphs*. New York: Springer Berlin Heidelberg, 2007.

[161] A. E. Bialocerkowski and P. Bragge, “Measurement error and reliability testing: Application to rehabilitation,” *Int. J. Ther. Rehabil.*, vol. 15, no. 10, pp. 422–427, 2008, doi: 10.12968/ijtr.2008.15.10.31210.

[162] E. Castillo, J. M. Gutierrez, and A. S. Hadi, “Sensitivity analysis in discrete Bayesian networks,” *IEEE Trans. Syst. Man Cybern. Part A-Systems Humans*, vol. 27, no. 4, pp. 412–423, 1997, doi: 10.1109/3468.594909.

[163] H. Wang, “Using Sensitivity Analysis to Validate Bayesian Networks for Airplane Subsystem Diagnosis,” in *IEEE Airospce conference*, 2006, pp. 1–10. doi: 10.1109/AERO.2006.1656104.

[164] X. Chen, S. Member, G. Anantha, and X. Lin, “with Mutual Information-Based Node Ordering in the K2 Algorithm,” *Knowl. Creat. Diffus. Util.*, vol. 20, no. 5, pp. 1–13, 2008.

[165] G. M. Naidoo and M. K. Naidoo, *Digital Communication*. 2021. doi: 10.4018/978-1-7998-6745-6.ch010.

[166] E. Dagum, Paul ; Galper, Adam ; Horvitz, “DBN.pdf,” in *Proceedings of the Eighth Conference on Uncertainty in Artificial Intelligence*, 1992, pp. 41–48.

[167] K. P. Murphy, “Dynamic Bayesian Networks: Representation, Inference and Learning.pdf,” *Ann. Phys. (N. Y).*, vol. Ph. D., p. 225, 2002, [Online]. Available: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.93.778&rep=rep1&type=pdf%5Cnhttps://www.cs.ubc.ca/~murphyk/Thesis/thesis.html

[168] J. Lamour and V. C. France, *DYNAMIC BAYESIAN NETWORKS IN SYSTEM RELIABILITY ANALYSIS*, vol. 39, no. 13. IFAC, 2004. doi: 10.3182/20060829-4-CN-2909.00073.

[169] P. Ladyzynski, M. Molik, and P. Foltynski, “Dynamic Bayesian networks for prediction of health status and treatment effect in patients with chronic lymphocytic leukemia,” *Sci. Rep.*, vol. 12, no. 1, pp. 1–14, 2022, doi: 10.1038/s41598-022-05813-8.

[170] N. Khakzad, “Application of dynamic Bayesian network to risk analysis of domino effects in chemical infrastructures,” *Reliab. Eng. Syst. Saf.*, vol. 138, pp. 263–272, 2015, doi: 10.1016/j.ress.2015.02.007.

[171] B. Cai, Y. Liu, and M. Xie, “A dynamic-bayesian-network-based fault diagnosis methodology considering transient and intermittent faults,” *IEEE Trans. Autom. Sci. Eng.*, vol. 14, no. 1, pp. 276–285, 2017, doi: 10.1109/TASE.2016.2574875.

[172] Pearl Judea, *PROBABILISTIC REASONING IN INTELLIGENT SYSTEMS: Networks of Plausible Inference*, Second Edi. San Francisco, California: MORGAN KAUFMANN PUBLISHERS, INC. San Francisco, California, 1988.

[173] M. J. Rahimdel, “Residual lifetime estimation for the mining truck tires,” *Proc. Inst. Mech. Eng. Part D J. Automob. Eng.*, 2022, doi: 10.1177/09544070221121855.

[174] Y. Wang, C. Deng, J. Wu, Y. Wang, and Y. Xiong, “A corrective maintenance scheme for engineering equipment,” *Eng. Fail. Anal.*, vol. 36, pp. 269–283, 2014, doi: 10.1016/j.engfailanal.2013.10.006.

[175] H. ;Artiba. A. Allaoui, “Integrating simulation and optimization to schedule a

hybrid flowship with maintenance intervals," *Comput. Ind. Eng.*, no. 47, pp. 431–450, 2004.

[176] S. Wu and M. J. Zuo, "Linear and nonlinear preventive maintenance models," *IEEE Trans. Reliab.*, vol. 59, no. 1, pp. 242–249, 2010, doi: 10.1109/TR.2010.2041972.

[177] Y. H. Chien, Z. G. Zhang, and X. Yin, "On optimal preventive-maintenance policy for generalized Polya process repairable products under free-repair warranty," *Eur. J. Oper. Res.*, vol. 279, no. 1, pp. 68–78, 2019, doi: 10.1016/j.ejor.2019.03.042.

[178] T. Nakagawa, "Sequential Imperfect Preventive Maintenance Policies," *IEEE Trans. Reliab.*, vol. 37, no. 3, pp. 295–298, 1988, doi: 10.1109/24.3758.

[179] E. Aghezzaf, A. Khatab, and P. Le, "Optimizing production and imperfect preventive maintenance planning ' s integration in failure-prone manufacturing systems," *Reliab. Eng. Syst. Saf.*, vol. 145, pp. 190–198, 2016, doi: 10.1016/j.ress.2015.09.017.

[180] Y. Zhou, G. Kou, H. Xiao, Y. Peng, and F. E. Alsaadi, "Sequential imperfect preventive maintenance model with failure intensity reduction with an application to urban buses," *Reliab. Eng. Syst. Saf.*, vol. 198, no. February, p. 106871, 2020, doi: 10.1016/j.ress.2020.106871.

[181] M. Malik, "Reliable preventive maitenance policy," *AIIE Trans.*, vol. 11, no. 3, pp. 221–228, 1979.

[182] T. Bin Liu, J. S. Kang, Y. Y. Li, and G. K. Luo, "Imperfect preventive maintenance model with two modes of failure," *Proceeding 2012 Int. Conf. Inf. Manag. Innov. Manag. Ind. Eng. ICIII 2012*, vol. 3, pp. 492–495, 2012, doi: 10.1109/iciii.2012.6340025.

[183] A. Khatab, "Maintenance optimization in failure-prone systems under imperfect preventive maintenance," *J. Intell. Manuf.*, vol. 29, no. 3, pp. 707–717, 2018, doi: 10.1007/s10845-018-1390-2.

[184] Y. Liu, H. Z. Huang, and X. Zhang, "A data-driven approach to selecting imperfect maintenance models," *IEEE Trans. Reliab.*, vol. 61, no. 1, pp. 101–112, 2012, doi: 10.1109/TR.2011.2170252.

[185] L. Yang, Z. sheng Ye, C. G. Lee, S. fen Yang, and R. Peng, "A two-phase preventive maintenance policy considering imperfect repair and postponed replacement," *Eur. J. Oper. Res.*, vol. 274, no. 3, pp. 966–977, 2019, doi: 10.1016/j.ejor.2018.10.049.

[186] C. Chareonsuk, N. Nagarur, and M. T. Tabucanon, "A multicriteria approach to the selection of preventive maintenance intervals," *Int. J. Prod. Econ.*, vol. 49, no. 1, pp. 55–64, 1997, doi: 10.1016/S0925-5273(96)00113-2.

[187] C. Duan, C. Deng, Q. Gong, and Y. Wang, "Optimal failure mode-based preventive maintenance scheduling for a complex mechanical device," *Int. J. Adv. Manuf. Technol.*, vol. 95, no. 5–8, pp. 2717–2728, 2018, doi: 10.1007/s00170-017-1419-2.

[188] H. Yi, Z. Ruixin, F. Juntao, and Y. Xin, "Research on the Optimal Preventive Maintenance Cost of Electronic Equipments," *2013 Fifth Int. Conf. Meas. Technol. Mechatronics Autom.*, pp. 950–952, 2013, doi: 10.1109/ICMTMA.2013.236.

Publications

A. From this research work

1. Deepak Kumar, Debasis Jana, Pawan Kumar Yadav, & Suprakash Gupta. (2022)"Reliability Assessment of Dragline's subsystem using Dynamic Bayesian Network". Int. J. of Industrial and Systems Engineering. https://doi.org/10.1504/IJISE.2023.10054814 (Accepted)
2. Kumar, D., Jana, D., Gupta, S. et al. Bayesian Network Approach for Dragline Reliability Analysis: a Case Study. Mining, Metallurgy & Exploration (2023). https://doi.org/10.1007/s42461-023-00729-x
3. Deepak Kumar, Debasis Jana, Pawan Kumar Yadav, & Suprakash Gupta. (2022). Reliability Analysis of Dragline Subsystem using Bayesian Network Approach. Journal of Mines, Metals and Fuels, 70(7), 341–353. https://doi.org/10.18311/jmmf/2022/31958
4. Deepak Kumar, Suprakash Gupta and Pawan Kumar Yadav, Reliability, availability and maintainability (RAM) analysis of a dragline, Journal of Mines, Metals & Fuels, Vol. 68, No. 2, February 2020, pp 68-77
5. Deepak Kumar, Pawan Kumar Yadav, Suprakash Gupta, "FMECA Model for Dragline System Using Grey TOPSIS Method", Conference: International Conference on Technological Innovations in Mechanical Engineering (TIME - 2021), April 2021, Sharda University, Noida
6. D. Kumar, S. Gupta and P. K. Yadav, Replacement model for the dragline system, in the proceeding of National Conference on Advances in Mining, February 14-15, 2020, CSIR-Central Institute of Mining and Fuel Research, Dhanbad, Jharkhand, India.

7. K. Mohan, D. Kumar, S. Gupta and P. K. Yadav, "Prediction of dragline failures using gradient Boosting algorithm", in the proceeding of National Conference on Advances in Mining, February 14-15, 2020, CSIR-Central Institute of Mining and Fuel Research, Dhanbad, Jharkhand, India.

B. Other related publication

1. Jana, D., Kumar, D., Gupta, S. et al. Availability Optimization of a Dragline Subsystem using Bayesian Network. J. Inst. Eng. India Ser. D (2023). https://doi.org/10.1007/s40033-023-00457-y
2. Pawan Kumar Yadav, Suprakash Gupta and Deepak Kumar, Benchmarking the performance of heavy earthmoving machines – a review, Journal of Mines, Metals & Fuels, Vol. 69, No. 7, July 2021, pp 225-232, doi.org/10.18311/jmmf/2021/28540
3. Pawan Kumar Yadav, Suprakash Gupta and Deepak Kumar, Search for a comprehensive performance measurement for mining equipment – a review, Journal of Mines, Metals & Fuels, Vol. 68, No. 8, August 2020, pp 264-269.
4. Pawan Kumar Yadav, Suprakash Gupta and Deepak Kumar, Measurement and analysis of performance of mining dump trucks, Int. J. Vehicle Performance, Vol. 6, No. 2, 2020, pp 129-150, DOI: 10.1504/IJVP.2020.106984.
5. Pawan Kumar Yadav, Deepak Kumar, Suprakash Gupta, "Performance Analysis of Mining Shovels - A Case Study", Conference: International Conference on Technological Innovations in Mechanical Engineering (TIME - 2021), April 2021, Sharda University, Noida

6. Pawan Kumar Yadav, Deepak Kumar, Suprakash Gupta, “Benchmarking the Performance of Heavy Earth Moving Machineries”, Conference: International Conference on Technological Innovations in Mechanical Engineering (TIME - 2021), April 2021, Sharda University, Noida
7. Pawan Kumar Yadav, Deepak Kumar, Suprakash Gupta, “Effect of Working Hours on the Dump Truck Performance”, Conference: International Conference on Technological Innovations in Mechanical Engineering (TIME - 2021), April 2021, Sharda University, Noida

Appendix- 1

Raw failure data of the case study dragline

Sr. No	Electrical	Mechanical	HMR	TTF	Remarks
1		0.5	134331.5	40	T.P.
2		0.5	134371.5	20.5	T.P.
3		1.5	134392	17.5	Hitch shackle pin-0.5, Dump rope-1
4		1	134409.5	63	Dump rope broken
5		1	134472.5	21.5	Dump pulley pin out
6		0.5	134494	82.5	Pin out
7		2.5	134576.5	18.5	Drag rope broken-2, T.P.-0.5
8		0.5	134595	17	T.P.
9		3.5	134612	20	Drag rope broken
10		0.5	134632	18.5	T.P.
11		3	134650.5	41.5	Drag rope broken
12		0.5	134692	63	T.P.
13		0.5	134755	39.5	T.P.
14		4.5	134794.5	37.5	Hitch shackle pin out
15	1.5		134832	24.5	Hoist shackle pin out
16		5	134856.5	19	Drag rope out from drum
17		1.5	134875.5	14.5	Dump pulley pin out
18		4.5	134890	59	Dump pulley pin out
19		2	134949	18.5	Down hoist chain pin out-1, T.P.-1
20		1	134967.5	20.5	T.P.
21		2	134988	80	Hoist shackle pin out
22		1.5	135068	39	Adapter
23		1	135107	20.5	T.P.
24		1.5	135127.5	21.5	Adapter
25		0.5	135149	20	Adapter
26		2	135169	56.5	Adapter
27		1	135225.5	29	Adapter
28	54.5		135254.5	26.5	DM-2 failed
29	1	1	135281	17.5	Both dump rope broken
30	1	2	135298.5	42	DM-2 blower motor not working-1, Adapter-2
31		0.5	135340.5	146	T.P.
32	40		135486.5	15	DM-2 problem
33	8		135501.5	41	DM-2 problem
34		2	135542.5	62	Adapter
35		0.5	135604.5	18.5	Hitch shackle pin out

36		3.5	135623	32	Adapter
37		5.5	135655	0	DM-2 failed-1, Drag socket-4.5
38	1		135655	18	Drag power problem
39	2	2	135673	40.5	Drag motor failed-2, Drag rope broken-2
40		1.5	135713.5	38	T.P.-0.5,Adapter-1
41		0.5	135751.5	18.5	T.P.
42		3	135770	16	T.P.-1, Adapter-2
43		150	135786	39	Boom bucket broken
44		121.5	135825	7	Drag pinion gear wheel broken
45		1	135832	61.5	Dump rope broken
46	1.5		135893.5	13.5	Main DT tripping
47	6	4	135907	42.5	Swing oil pump motor burnt-6, dump rope broke-4
48		1	135949.5	341	Compressor on leakage
49		1	136290.5	4	Hitch shackle pin out
50		44	136294.5	11	DM-2 motor pinion shaft broken
51		52.5	136305.5	82.5	DM-2 motor pinion shaft broken
52		0.5	136388	38.5	T.P.
53		0.5	136426.5	20.5	T.P.
54		0.5	136447	20.5	T.P.
55		0.5	136467.5	62.5	T.P.
56		1	136530	19.5	Adapter
57		2.5	136549.5	98.5	Dump socket pin out
58		5	136648	19.5	Drag rope out from guide pulley-3.5,dump socket pin out-1.5
59	0.5		136667.5	98.5	Drag brake problem
60		2.5	136766	54	Both dump rope broken
61	3		136820	20.5	Swing oil pump motor burnt
62	1.5		136840.5	39	swing oil pump motor pinion shaft broken
63		0.5	136879.5	65	T.P.
64		0.5	136944.5	28.5	hitch shackle pin out
65		100	136973	25	Drag rope out from guide pulley DM-1 motor pinion shaft broken
66		1	136998	19	Equiliser pin broken
67	1.5		137017	36	Swing system not working
68		0.5	137053	39.5	T.P.
69	0.5		137092.5	39	DC tripping
70		0.5	137131.5	17	lower rail path broken
71		3	137148.5	31	Drag chain link broken
72		6.5	137179.5	58	Lower rail path broken-4.5, trunion pin broken
73		1	137237.5	46.5	Dump rope broken
74		2.5	137284	20	Hitch shackle pin out
75		0.5	137304	42	T.P.
76		0.5	137346	18.5	T.P.

77		0.5	137364.5	61.5	Drag socket broken
78		2	137426	18	Dump link pin out-1, Drag chain link broken-1
79		3	137444	558	Drag chain pinion
80	32.5		138002	49	H.M. Failed
81	2.5		138051	37.5	Hoist problem
82		4.5	138088.5	148.5	Dump rope broken-2,Drag chain link-2.5
83		1.5	138237	13	Drag rope rope out from drum
84		2	138250	15.5	T.P-0.5, Dump rope-1,T.P.-0.5
85		4.5	138265.5	83.5	Adapter
86	1		138349	18	Tripping
87		1	138367	52	Anchor pin out
88	3		138419	34	Swing brake not working
89	3	1	138453	18	Hoist out from drum-3,Anchor pin out-1
90		0.5	138471	32	Hoist not prper working
91	5		138503	18.5	Switching problem
92		1.5	138521.5	19	Adapter
93	3.5		138540.5	17.5	Hoist not working
94		2	138558	227.5	Dump socket pin out-0.5,Hitch shackle pin out-1.5
95		2.5	138785.5	14	drag rope out from drum
96		7	138799.5	58.5	Drag rope broken-5,drag rioe out from drum-2
97		1	138858	18.5	Hitch shackle pin out
98	3		138876.5	19.5	Starting problem
99		0.5	138896	60	Pulley pin out
100		0.5	138956	16.5	T.P.
101		3	138972.5	29.5	Eccentric z broken
102		0.5	139002	18.5	T.P.
103		0.5	139020.5	40	T.P.
104		1.5	139060.5	20	T.P.
105		1.5	139080.5	21.5	T.P-0.5,Adapter-1
106		0.5	139102	18.5	Dump rope broken
107		1.5	139120.5	28	Adapter
108		1	139148.5	63.5	Equiliser chain broken
109		0.5	139212	38.5	T.P.
110		0.5	139250.5	61	T.P.
111		1	139311.5	34	Adapter
112	3	1	139345.5	76	Hoist not working-1,Dump rope-1
113	4		139421.5	13.5	walking problem
114		4	139435	40.5	Swing roller cable broken
115		0.5	139475.5	18	T.P.
116	2		139493.5	16.5	Hoist not working
117		2	139510	17	adapter

118		5	139527	37	Drag chain link broken
119	5.5		139564	42	Hoist not working
120		1	139606	37	Drag rope out from drum
121		0.5	139643	27	Hoist bake jam
122		2	139670	59	Dump rope broken
123	1		139729	18	Hoist tripping
124	0.5		139747	5.5	Hoist tripping
125	2		139752.5	33	Hoist tripping
126		1.5	139785.5	60	Hitch shackle pin lock broken
127		1.5	139845.5	18	Dump pulley pin out
128		1	139863.5	19.5	T.P.
129		2	139883	41.5	Equilizer chain broken
130		0.5	139924.5	34.5	T.P.
131		6	139959	68.5	Drag rope broken
132		1	140027.5	134	Adapter
133		0.5	140161.5	99	T.P.
134		0.5	140260.5	39	Equilizer chain broken
135		1	140299.5	18.5	Equilizer chain broken
136		0.5	140318	17	T.P.
137		1	140335	38	T.P.
138		2	140373	31.5	Anchor pin out-1, T.P.-1
139	0.5	2.5	140404.5	2.5	Hoist not working-0.5, dump pulley-2.5
140		2.5	140407	10.5	Hoist not working
141		3.5	140417.5	58	dump p
142		0.5	140475.5	37	Dump pulley cable bolt broken
143		1.5	140512.5	30.5	Adapter
144		4	140543	14	Drag chain broken
145		4	140557	20	Swing roller out
146		0.5	140577	136	T.P.
147		2	140713	59	Equiliser chain-1,T.P.-1
148		2	140772	18	Drag chain link broken
149		2.5	140790	21	Drag chain link broken
150		1.5	140811	41	Dump rope-1,T.P.-0.5
151	2		140852	55	Hoist not working
152		122.5	140907	11.5	Abnormal sound in drag
153	1	7.5	140918.5	20	Hoist jam-1,Abnormal sound in drag
154		0.5	140938.5	52	Draf pinion bolt loose
155		2	140990.5	4.5	Dump rope broken
156		19.5	140995	20	Swing roller segment out
157		2	141015	40	Swing motor brake jam
158		1	141055	6.5	Drag rope broken

159		17.5	141061.5	58.5	Drag rope broken-8,Swing roller segment out-9.5
160		1	141120	114.5	Spreader Bar pin out
161		1.5	141234.5	17.5	Hoist chain pin out
162		65	141252	30	suspension rope broken
163	0.5		141282	56.5	walking problem
164		0.5	141338.5	2.5	T.P.
165		55.5	141341	26	DM-1 motor pinion shaft bearing broken
166		4.5	141367	50	Hitch chain shackle broken
167		3	141417	33	Anchor link out
168	5.5	2	141450	14	HM-1 connecting rod out-5.5, Swing oil pump motor coupling problem-2
169		19.5	141464	55.5	Swing roller cage broken
170		0.5	141519.5	15.5	Hitch shackle pin broken
171		4	141535	17	Hitch shackle pin broken
172		5	141552	54	Dump rope broken-4, Swing roller out-1
173		1.5	141606	12	Adapter
174	4	3	141618	15	Hoist brake -4, dump rope broken-3
175		620.5	141633	29	Swing roller cage broken
176		1	141662	20	T.P.
177		0.5	141682	35	T.P.
178	4.5	2	141717	5	Swing oil pump motor burnt-4.5,Adapter fallen-2
179	18		141722	5	Swing oil pinion motor no-3 problem
180	19		141727	20	Swing oil pinion motor no-3 problem
181	2		141747	20	Hoist not working
182	2		141767	16	Hoist not working
183		2	141783	56	Dump pulley connecting link broken
184		0.5	141839	34.5	T.P.
185	2		141873.5	77.5	Hoist not working
186		4.5	141951	50.5	Equiliser pin broken
187	9.5		142001.5	6.5	DM-2 blower motor broken
188	15.5	1.5	142008	66	DM-2 blower motor broken-15.5, Dump rope-1.5
189		2.5	142074	36	Upper hoist chain pin out
190		1.5	142110	94	T.P.
191		4	142204	190	Swing oil pump no-3 coupling problem
192		1	142394	37.5	T.P.
193	1.5		142431.5	20.5	Hoist not working
194	0.5		142452	61	Electric problem
195		1	142513	20.5	T.P.
196		0.5	142533.5	18.5	T.P.
197		0.5	142552	17	T.P.
198		5	142569	18	Drag rope broken
199		0.5	142587	38.5	Drag rope broken

200	1		142625.5	47	Hoist problem
201		5	142672.5	100.5	Lower hoist chain pin out
202		0.5	142773	17.5	T.P.
203		0.5	142790.5	79.5	Sartage
204		0.5	142870	60.5	T.P.
205		0.5	142930.5	40	T.P.
206		1.5	142970.5	34	T.P.-0.5, Dump rope-1
207		7	143004.5	18.5	Turnion pin broke-3,Swing link broken-4
208		5	143023	143.5	Pinion problem in swing link
209		2.5	143166.5	17	T.P.
210		1.5	143183.5	17.5	Dump rope broken
211		0.5	143201	36.5	T.P.
212		1	143237.5	192.5	T.P.
213		6.5	143430	17	Hitch shackle broken
214		1	143447	113.5	Dump equiliser pin fallen
215		1	143560.5	52	Balance pin out
216		0.5	143612.5	131.5	Equiliser pin broken
217		2	143744	79	Dump rope broken
218		0.5	143823	6	Dump rope broken
219	11		143829	27	Trailing cable punch
220		2.5	143856	71	Swing joint bolt broken
221		2.5	143927	165	Dump rope broken
222		1	144092	17	T.P.
223		1	144109	35	T.P.
224		1.5	144144	13.5	Adapter fallen
225		5	144157.5	11	Drag rope Broke-4.5,T.P.-0.5
226		6.5	144168.5	20.5	Drag rope out
227		2.5	144189	19	T.P.-0.5,Drag rope-2
228		0.5	144208	142	Adapter broken
229		2	144350	0	Equiliser chain broken
230		1	144350	76.5	Hitch shackle pin out
231		0.5	144426.5	76	T.P.
232		1.5	144502.5	80	Adapter
233		1	144582.5	75.5	Dump rope broken
234		7	144658	18	Spreader Bar end cracked-5,Dump rope broken-2
235		4	144676	10	Hitch shackle pin-3,T.P.-1
236		8	144686	13	Dump rope-1,Hitch shackle-7
237		6.5	144699	55	Drag socket broken-1.5, coupling bolt-5
238		2	144754	16.5	Equiliser chain broken
239		5	144770.5	54.5	Drag rope broken
240		3	144825	19.5	Adapter-1,Anchor pin-2.0

241		0.5	144844.5	17	T.P.
242		1	144861.5	19.5	Hitch shackle broken
243		1	144881	21	T.P.
244		1	144902	19.5	T.P.
245		0.5	144921.5	17	T.P.
246	2		144938.5	20	Hoist problem
247		1.5	144958.5	70.5	Dump rope-0.5, adapter-1
248	3		145029	52	DM-1 blower motor problem
249		0.5	145081	17	Hoist chain problem
250		2	145098	8	Dump rope broken
251	12.5		145106	14.5	DM-2 blower motor burnt
252	3.5		145120.5	19	DM-2 blower motor burnt
253	0.5	1.5	145139.5	75	Hoist not working-0.5,Adapter-1.5
254		5	145214.5	19.5	Lower hoist chain pin out
255		1	145234	19.5	Adapter
256	0.5		145253.5	13	M.G. set problem
257	3.5	2.5	145266.5	4.5	Starting problem-3.5,Drag socket-2.5
258	1		145271	48	MG-2 starting problem
259	10	1.5	145319	71.5	Starting problem-10,Adapter-1.5
260		2	145390.5	38	Hitch pin fallen
261		2.5	145428.5	21	Drag rope out from pulley
262		1	145449.5	12.5	Equiliser chain line broken
263		8	145462	16.5	Drag rope broken
264	5	1	145478.5	92	Swing system not working-5,Hoist air booster leakage-1
265		1.5	145570.5	18.5	Adapter fallen
266		0.5	145589	75.5	T.P.
267		2	145664.5	19	Adapter
268		0.5	145683.5	39	Drag rope loose from drum
269		1.5	145722.5	19.5	Dump rope broken
270		0.5	145742	18	T.P.
271		3.5	145760	19	Equiliser pin broken-1,Hitch pin-0.5,Bucket cracked-2
272		1.5	145779	20.5	Adapter
273		0.5	145799.5	80.5	Equiliser chain broken
274	1.5		145880	58	DG-1 sparking
275		1.5	145938	62	Dump rope slip from socket-1, T.P-0.5
276		1.5	146000	58	T.P.-0.5,Adapter-1
277	2		146058	97	Blower motor-1,Drag brake-1
278	2		146155	62.5	Starting problem
279		2	146217.5	20.5	Equilizer chain broken
280		0.5	146238	39.5	Drag socket pin loose
281		0.5	146277.5	60	T.P.

282	5		146337.5	14.5	Swing oil pump motor no-3 burnt
283	9		146352	17	Swing oil pump motor no-3 burnt
284	2	4	146369	60	T.P-0.5,Starting prb-2, Drag rope-3.5
285		1.5	146429	18.5	HM-2 brake cylinder broken
286	0.5	0.5	146447.5	18.5	T.P-0.5,Extension light D.T. problem
287		3.5	146466	30	Both dump rope broken
288	4.5		146496	39.5	Swing oil pump motor no-2 problem
289		1.5	146535.5	19	Adapter
290		2	146554.5	38	Hoist chain pinion-1,T.P-1
291		0.5	146592.5	34.5	T.P.
292		1	146627	18.5	Equiliser pin fallen
293		3.5	146645.5	19	Drag chain-1,Hitch pin-1, Adapter-1.5
294		1.5	146664.5	16.5	Equiliser chain link broken
295		3.5	146681	78	Swing oil pump motor coupling
296		2	146759	12	Drag chain pin-1,T.P.-1
297		10	146771	16.5	compressor not working
298		5	146787.5	51.5	drag rope broken
299		4.5	146839	14	Drag chain shackle broken
300		2	146853	12	Drag chain shackle broken
301		1	146865	40	drag rope out from pulley
302		1	146905	20	drag rope-0.5,T.P-0.5
303		1	146925	60	drump rope broken
304		3	146985	78.5	trunion barpin broken
305		3.5	147063.5	41.5	adapter-2,dump rope-1.5
306		0.5	147105	67	T.P
307		1.5	147172	13	hitch shackle broken
308		8.5	147185	59	Hitch shackle broken-1, Drag rope-7.5
309		0.5	147244	40	T.P.
310		0.5	147284	36	T.P.
311		1.5	147320	18	Adapter
312		1	147338	19.5	Dump rope fallen
313		1	147357.5	19.5	Dump rope pinion failed
314		1	147377	13.5	Hitch pin fallen
315		6.5	147390.5	41	Hitch shackle pin-25,Dump rope-4
316		1	147431.5	20	T.P.
317		0.5	147451.5	15.5	Hitch chain shackle broken
318		4	147467	38	Hitch pinion broken
319		2.5	147505	37.5	Hitch shackle broken-2,T.P.-0.5
320		2.5	147542.5	40.5	Adapter-2,Drag rope out from pulley-0.5
321		0.5	147583	138	T.P.
322		3.5	147721	12.5	Drag chain link broken

323		6.5	147733.5	21	Rail broken
324	1	1	147754.5	20.5	Swing problem-1,Rail broken-1
325		0.5	147775	41.5	T.P.
326		2.5	147816.5	60.5	T.P.-0.5,Adapter-2
327		0.5	147877	39	Spreader Bar pin out
328		1	147916	18	Dump socket pin
329		1	147934	57.5	RHS dump socket pin
330		4.5	147991.5	20	Drag chain link broken
331		0.5	148011.5	18.5	T.P.
332		3	148030	32	Hitch shackle broken
333		3	148062	19	Hitch shackle broken
334		0.5	148081	13.5	T.P.
335		8.5	148094.5	21.5	Dump rope-3,Hitch shackle-5.5
336		0.5	148116	38	T.P.
337		0.5	148154	60.5	T.P.
338	0.5		148214.5	11.5	DM1 abnormal
339	66.5		148226	60.5	DM1 abnormal
340		3.5	148286.5	41	Dump rope
341		0.5	148327.5	55.5	Equilizer chain broken
342		1	148383	17	Adapter
343		3.5	148400	21	Drag chain shackle broken
344		3	148421	17	Drag chain shackle broken
345		5.5	148438	38.5	Drag socket
346		2	148476.5	20	Drag chain
347		1.5	148496.5	35	Drag chain-0.5,T.P.-1
348	4	0.5	148531.5	48	Not available
349	0.5		148579.5	20	Swing system not working
350		1	148599.5	20.5	T.P.
351	1		148620	19.5	Hoist not working
352		0.5	148639.5	48	T.P.
353		0.5	148687.5	19.5	T.P.
354		1.5	148707	120	T.P.
355		3	148827	17	Dump rope
356		3.5	148844	43.5	Dump rope
357	2		148887.5	54.5	Starting Problem
358	1	1	148942	41	DM-1,T.P.-1
359		1	148983	17	drag rope out from pulley
360		4	149000	19	drag rope out from pulley
361		0.5	149019	20.5	T.P.
362		0.5	149039.5	18	T.P
363		4	149057.5	20.5	T.P-0.5,Trunion link pin-3.5

364		1	149078	16	T.P.
365		3.5	149094	120.5	T.P. -1 , Drag chain broken 2.5
366		2	149214.5	37	Spreader Bar pin out
367		2	149251.5	57	dump rope broken
368		0.5	149308.5	17.5	swing roller broken
369		3	149326	21	drag chain broken
370		0.5	149347	19	drag chain broken
371		1.5	149366	58	drag chain broken-1, adaptor
372	3.5		149424	19.5	swing motor problem
373		1	149443.5	97.5	dump rope broken
374	0.5		149541	108.5	D.G failed
375		4.5	149649.5	20	Hitch shackle pin out
376		0.5	149669.5	23.5	Drag rope out from drum
377	9.5		149693	41.5	Transformer D.T> burnt
378		2	149734.5	13.5	Dump rope broken
379		1	149748	59	Dump rope broken
380		1.5	149807	54.5	Adapter
381		2	149861.5	57.5	Adapter
382		1.5	149919	18	Adapter
383		3.5	149937	19.5	Adapter -3,T.P.-0.5
384		2.5	149956.5	28	Adapter-1.5,Hitch shackle pin-0.5,others-0.5
385		1.5	149984.5	40.5	Adapter
386		1	150025	21.5	Adapter
387		0.5	150046.5	17.5	Adapter
388		0.5	150064	30.5	Adapter
389		6	150094.5	18	Drag chain and link broken
390		5.5	150112.5	36.5	Drag chain-3.5,Adapter fallen-2
391	2.5		150149	14	Swing problem
392	0.5	4	150163	88	T.P.-1,Adapter-3
393		3.5	150251	38	Adapter
394		1	150289	101	Drag rope broken
395		0.5	150390	17	Adapter
396		1	150407	16.5	swing roller broken
397		4	150423.5	15	Adapter
398		3	150438.5	18	Swing roller broken
399		1.5	150456.5	17	Adapter
400		2.5	150473.5	16	T.P. & Adapter
401	2	2.5	150489.5	11	Drag brake-2,Adapter-2.5
402		6.5	150500.5	17	Adapter-0.5,Drag chain-6
403	1	3	150517.5	18.5	Swing problem,Adapter
404		3.5	150536	19.5	Adapter

405		2	150555.5	18.5	T.P.
406		1.5	150574	17	Hitch shackle pin
407		1.5	150591	17.5	Adapter
408		2	150608.5	9.5	Adapter
409	51		150618	25	HM-1 starting problem
410		1.5	150643	19	Adapter , T.P.
411		1	150662	19	Dump rope broken
412		1	150681	2	Adapter
413	22		150683	24.5	DM-1 blower motor problem
414	2.5		150707.5	19	Drag brake
415	1.5		150726.5	15	DM-1 motor blower
416	5	2	150741.5	34.5	DM-1 blower motor problem-5, Adapter-2
417		3	150776	16	Adapter
418		5	150792	16	Drag chain
419		4	150808	11	Adapter-1,Drag rope-3
420		11	150819	17	Drag rope-5,Drag rope out from pulley-6
421		4.5	150836	16.5	Adapter,T.P.
422		3.5	150852.5	18.5	Adapter
423		3	150871	16	Adapter
424		3	150887	59	Hitch shackle pin broken-2,Adapter-1
425		3	150946	13	Adapter
426		8.5	150959	32.5	Adapter-2.5,Dump rope-6
427		0.5	150991.5	26	Spreader Bar pin out
428		2.5	151017.5	16.5	Adapter
429		0.5	151034	37	Adapter
430		1	151071	19.5	Adapter
431		0.5	151090.5	18	Adapter
432		2.5	151108.5	19.5	Hitch shackle-1.5,Adapter-1
433		2	151128	37.5	Adapter
434		3	151165.5	54.5	Adapter
435		1	151220	18.5	T.P.
436		1	151238.5	12.5	Drag rope broken
437		7.5	151251	151	Drag rope-6.5,T.P.-1
438		3.5	151402	20	T.P.
439		0.5	151422	18	T.P.
440		1.5	151440	31	hitch shackle pin out
441		6.5	151471	20	Drag rope out from pulley-4.5,Adapter-2
442	0.5		151491	60.5	Drag limit switch not working
443		1	151551.5	17.5	Equiliser pin broken
444		2.5	151569	18	Adapter-0.5,T.P.-2
445		2	151587	80	T.P.

446		2.5	151667	17.5	Adapter
447	1		151684.5	10	Swing oil pump motor burnt
448	14		151694.5	14	Swing oil pump motor burnt
449		6.5	151708.5	18	Swing oil pump motor coupling
450	0.5	1.5	151726.5	96.5	Anchor pin out-1.5,Hoist broken-0.5
451		1	151823	59.5	
452		0.5	151882.5	15	T.P.
453	2	2.5	151897.5	17.5	Swing oil pump motor-2, Adapter-2.5
454		3.5	151915	12.5	Drag socket pin-2.5,Adapter-1
455		3	151927.5	3.5	Oil pump motor coupling rubber broken
456	19.5		151931	36	Swing oil pump motor burnt
457		4.5	151967	19	T.P.-0.5,Hitch shackle-1.5,Adapter-2.5
458		2	151986	19	Adapter
459		1	152005	14.5	Ram lead pulley giude roller fallen
460		3.5	152019.5	13	T.P.-1,Drag rope-1,Adapter-1.5
461	4.5	4	152032.5	14.5	Adapter-4,Swing oil pump motor-4.5
462		2	152047	18.5	Fan lead pulley pin out
463		0.5	152065.5	34.5	Adapter
464		6.5	152100	30	Drag rope out from pulley
465	2	1	152130	20	Drag system not working-2,Adapter-1
466		0.5	152150	58	Adapter lock broken
467		2.5	152208	20	Adapter
468		0.5	152228	17	Adapter
469		5.5	152245	16	Dump rope broken-2,Drag chain link-3.5
470		1.5	152261	38.5	hitch shackle pin out
471		1.5	152299.5	59	Dump socket pin
472		1	152358.5	38	Dump socket pin
473		2.5	152396.5	17.5	Adapter
474		3	152414	59.5	Adapter
475		0.5	152473.5	35.5	Hitch shackle pin lock broken
476		6	152509	35.5	Boom pipe crack
477		9	152544.5	5	Boom crack welding
478		16	152549.5	8.5	Boom crack welding
479		15	152558	17.5	Boom crack welding
480		6	152575.5	17.5	Boom crack welding
481	1	3.5	152593	17.5	Swing nit working-1,T.P.-1,Hitch shackle-2.5
482		3	152610.5	17.5	Adapter
483		2.5	152628	19.5	Adapter-0.5,Dump rope-2
484		1	152647.5	40.5	Adapter
485		0.5	152688	41	Adapter
486		2	152729	19	Dump socket pin-1,Adapter-1

487		1	152748	42	Adapter-0.5,T.P-0.5
488		0.5	152790	59	Adapter
489		1	152849	17	Adapter
490		4	152866	15.5	Adapter-1.5,Dump rope broken-2.5
491		5	152881.5	16.5	Dump rope-0.5,adapter-0.5,Guide-4
492		2	152898	39	Dump rope broken
493	4.5		152937	70	Swing oil pump motor burnt
494		1	153007	76.5	Adapter
495		2	153083.5	38	Adapter
496		3	153121.5	36	Adapter
497		2	153157.5	20	Walking brake jam
498		4	153177.5	16	Drag rope out from socket
499		3.5	153193.5	18	Adapter-1,Hitch shackle-2.5
500		1.5	153211.5	15.5	Hitch shackle pin out
501		2	153227	26	Adapter-0.5,Spreader bar pin out-1.5
502		1	153253	31.5	T.P.
503		1	153284.5	79	Hitch shackle broken-0.5,T.P.-0.5
504		1	153363.5	35.5	Hitch pin lock
505	0.5		153399	33	Drag broke not work
506		0.5	153432	58.5	Swing oil pump
507		0.5	153490.5	56.5	Blower hoist chain pin
508		0.5	153547	41	Dump socket lock
509	1	0.5	153588	56	Others
510	2.5		153644	89.5	Drag rope out
511		5.5	153733.5	18.5	Hitch shackle pin out-1,Drag chain-4.5
512		1	153752	35.5	Equiliser pin broken
513		1.5	153787.5	17.5	Adapter
514	2.5		153805	17.5	Hoist brake not working
515		1.5	153822.5	16.5	Dump rope broken
516		1.5	153839	54	Drag rope-0.5,Drag-1
517		4.5	153893	37.5	Drag rope out from drum
518		1.5	153930.5	15.5	Dump socket pin out
519		4.5	153946	16.5	Drag rope ut from pulley-1,Drag chain-3.5
520		1.5	153962.5	13	Hitch shackle pin out
521		3	153975.5	35	T.P.-0.5,Dump socket-2.5
522		3	154010.5	19.5	Dump rope broken & Hitch shackle pin out
523		1.5	154030	17	Drag rope out from pulley
524		0.5	154047	92.5	Hitch shackle pin broken
525		2	154139.5	33	Dump rope broken
526		4	154172.5	14.5	Hitch chain shackle broken
527		1	154187	13	Hoist lower chain pin out

528		0.5	154200	68	Dump rope broken
529		81.5	154268	9.5	Eccentric arm out
530		14	154277.5	25	Eccentric arm out
531		4.5	154302.5	52	Drag line shackle broken
532		4	154354.5	13.5	Hitch chain shackle broken
533		3.5	154368	117	Upper hoist chain pin out
534	2		154485	14	Blower not working
535		1.5	154499	31.5	Balance bar pin out
536		4.5	154530.5	13	Drag rope broken
537		7	154543.5	117.5	Drag rope-4, Balance pin out-3
538		3	154661	49	Hitch shackle-1.5,T.P.-1.5
539		2.5	154710	44	Hitch shackle pin out
540		11	154754	33	Hitch shackle pin out
541		6	154787	36	Hitch shackle pin out
542		0.5	154823	33	T.P.
543		6.5	154856	16	Hitch shackle pin broken
544		1	154872	32	Hitch shackle pin broken
545		3.5	154904	18	Hitch shackle pin broken
546		0.5	154922	24	Spreader Bar pin out
547		2	154946	18.5	Adapter
548		2	154964.5	55.5	Hitch shackle pin out
549		1	155020	87	Dump rope broken
550		1	155107	69	Balance bar pin out
551		2	155176	38	Balance bar pin out
552		1	155214	54	Hoist chain pin out
553		4	155268	119	Hoist chain end link broken
554		3.5	155387	109	T.P.-1.5,Dump rope-2
555		2.5	155496	17.5	Dragrope out from pulley
556		2.5	155513.5	16	Drag chain link broken
557		3.5	155529.5	16.5	Drag chain-3,T.P.-0.5
558		2	155546	35	T.P.-1,Drag rope-1
559		1	155581	0	Drag rope
560		2.5	155581	33	Dump rope-0.5,T.P.-2
561		5.5	155614	22	Drag chain broken
562	1.5		155636	44	Hoist not working
563		0.5	155680	12	Drag chain
564	2	0.5	155692	32	Dump rope-0.5,Swing brake-2
565		4.5	155724	56	Drag chain
566		0.5	155780	8	T.P.
567		0.5	155788	26	T.P.
568		3.5	155814	15	Drag chain link broken

569		0.5	155829	17	T.P.
570		0.5	155846	18	T.P.
571		2.5	155864	13	T.P.-1,Adapter-1.5
572		103.5	155877	12	T.P.-0.5,Drag chain pinion brakes
573		10.5	155889	35.5	Pinion motor burnt
574		1	155924.5	17.5	Drag rope
575		3	155942	19	Dump socket pin out
576		1	155961	14	T.P.-0.5,Hoist chain link broken-0.5
577		2	155975	18.5	Hoist chain pin out
578		2	155993.5	73.5	Both dump rope broken
579	1.5		156067	89	Hoist switch not working
580	5		156156	56	Oil pump motor burnt
581		2	156212	13	Adapter
582		2.5	156225	24	Drag socket pin out-1,Drag rope-1.5
583		116	156249	10	DM motor inion shaft broken
584		9	156259	31.5	DM motor inion shaft broken
585		5	156290.5	55	Drag rope out from drag socket
586		8	156345.5	35.5	Drag rope broken
587	0.5	4.5	156381	20.5	Trunion barpin broken-4.5,Starting problem-0.5
588		0.5	156401.5	15	T.P.
589		2.5	156416.5	14	Dump socket pin out
590		2.5	156430.5	17.5	Dump rope broken
591		2	156448	37.5	Dump socket pin out
592	0.5	2	156485.5	58	Starting problem-0.5,Adapter-2
593	3		156543.5	56	Drag walking problem
594		0.5	156599.5	71	T.P.
595		2	156670.5	48.5	Swing pin broken
596		5.5	156719	55.5	Lower chain pin out-5, Dump socket-0.5
597		1	156774.5	55.5	T.P.
598		1	156830	25	T.P.
599		59.5	156855	12	DM motor inion shaft broken
600	2	8.5	156867	63.5	DM motor pinion shaft broken-8.5,swing broke-2
601		6	156930.5	57.5	Drag link broken
602	1		156988	16.5	swing motor problem
603		3.5	157004.5	20	Drag chain shackle broken
604		1	157024.5	104.5	T.P.
605		1.5	157129	13.5	Dump socket pin out-1,Lower hoist chain-0.5
606		3	157142.5	36.5	Lower hoist chain pin out
607		1	157179	15	Dump rope broken
608		4.5	157194	38	Drag chain link broken
609		1.5	157232	35	Dump socket pin-1,T.P.-0.5

610		1	157267	36	T.P.
611		1	157303	15	Hitch shackle broken
612		3.5	157318	16.5	Hitch shackle broken
613		2.5	157334.5	16	Hitch shackle pin out-2,T.P.-0.5
614		4.5	157350.5	56	Dump socket broken-3.5, T.P.-1
615		2.5	157406.5	65.5	Drag rope out from pulley
616		1	157472	18	T.P.
617		1.5	157490	52	Dump rope broken-1, T.P.-0.5
618		3.5	157542	21	Drag chain shackle broken
619		1.5	157563	91	Drag chain shackle broken
620		0.5	157654	38	Hitch shackle broken
621		2	157692	38.5	Dump socket pin broken
622		1	157730.5	18	T.P.-0.5,Rope-0.5
623	1		157748.5	56.5	Starting problem
624	1		157805	14.5	Walking problem
625	4.5		157819.5	38.5	Swing problem-1.5, Walking-3
626		1.5	157858	12.5	Spreader Bar pin out
627		1.5	157870.5	16	Lower hoist chain pin out
628		2.5	157886.5	27.5	T.P.-1,Lower hoist chain-1.5
629		7	157914	48.5	
630		3.5	157962.5	15.5	Drag rope out from drum
631		0.5	157978	36	T.P.
632		2	158014	32	Dump rope broken
633		1.5	158046	138	Dump socket pin out
634		3.5	158184	17.5	Hitch shackle pin out
635		1.5	158201.5	18.5	Dump rope broken
636		0.5	158220	19	Drag socket pin broken
637		0.5	158239	112.5	Adapter
638		0.5	158351.5	16.5	T.P.
639	2.5		158368	73.5	Hoist brake not working
640		1	158441.5	17	T.P.
641		2	158458.5	16	Drag rope broken
642		5	158474.5	17.5	T.P-1,Dump rope-4
643		1	158492	9	Drag rope out from drum
644		13.5	158501	49	Drag rope broken
645	4		158550	35	Starting problem
646		1.5	158585	16.5	Drag chain broken
647	1		158601.5	60.5	Hoist limit switch not working
648	3		158662	14	H.M motor not working
649	1		158676	29	LHS wing not working
650		1	158705	54	Adapter

651		1	158759	1	Guide pulley pin lock
652		106.5	158760	25	DM motor pinion shaft broken
653	4		158785	61	Swing oil pump motor burnt
654	3		158846	56	Hoist system not working
655		1	158902	13.5	
656		1.5	158915.5	12	Spreader Bar pin out
657	3.5	1	158927.5	15	Starting problem-3.5,Spreader pin out-1
658		1.5	158942.5	11	Spreader Bar pin out-0.5,Pin out-1
659		1	158953.5	53	Drag rope out pulley
660		3	159006.5	15	Guide roller fallen
661		3.5	159021.5	37.5	Hitch shackle pin-2.5,T.P-1
662		1	159059	37	Swing problem-0.5,Equlisier pin out-0.5
663		0.5	159096	33	Drag rope out from pulley
664		1	159129	16	Dump socket pin out
665		1	159145	36.5	Equiliser pin broken
666		1.5	159181.5	17.5	Adapter
667		1	159199	18.5	T.P.
668		1	159217.5	16.5	T.P.
669		1	159234	12	Adapter
670		5	159246	15	Balance bar pin out-1,Drag chain link broken-4
671	4.5	0.5	159261	32.5	Adapter-0.5,Swing oil pump motor burnt-4
672	3		159293.5	16.5	Swing blower motor connector coil burnt
673		4	159310	8	Dump socket-0.5,Hitch shackle-2,T.P-1.5
674	35		159318	19	H.P problem
675	3.5		159337	34	H.P. rope motor problem
676		6.5	159371	16.1	T.P-0.5,Drag chain-6
677		3.5	159387.1	16.4	Dump socket pin out
678	0.5	0.5	159403.5	52.5	Hitch pin out-0.5,Blower motor-0.5
679		1.5	159456	14	Dump rope broken
680	1		159470	16.5	Walking problem
681		1	159486.5	9.5	T.P.
682	6	3.5	159496	19	Swing oil pump motor burnt-6,Hitch shackle pin out-3.5
683		0.5	159515	17	T.P.
684		0.5	159532	36	Lower chain pin out
685		3	159568	15.5	Hitch chain shackle broken
686		0.5	159583.5	20	T.P.
687		3	159603.5	14	Dump rope broken
688		0.5	159617.5	70.5	Equiliser pin broken
689		1.5	159688	56	Spreader bar pin out
690	25.5		159744	16	Srarting problem
691	3	0.5	159760	16.5	HM on problem-3,Adapter-0.5

692		3.5	159776.5	19	Hitch shackle pin broken- 2.5, T.P.-1
693		1.5	159795.5	19	Trunion link pin broken
694		1.5	159814.5	17	Drag rope out from pulley
695	0.5		159831.5	74.5	Electric problem
696	1	1	159906	6.5	Hoist brake not worked-1,T.P-1
697	7		159912.5	33.5	Lighting problem
698		2	159946	36	Drag rope broken-1,T.P.-1
699		2	159982	76	Lower dump socket pin out
700		1	160058	57	T.P.
701		1	160115	17	Drag rope out from dump-0.5,Pin out-0.5
702		1.5	160132	12.5	Rail path crack
703	5		160144.5	13.5	T.P.-0.5, Rear gear bolt loose
704	1		160158	19	Starting problem
705		1	160177	10	T.P.
706		5.5	160187	21	Both dump rope broken
707		3	160208	44.5	Drag chain shackle broken
708	3		160252.5	34	Swing not working
709	2		160286.5	14	HM on problem
710		0.5	160300.5	28	Drag rope lock broken
711		1.5	160328.5	48.5	Adapter lock broken
712	3		160377	4	Swing oil pump motor burnt
713	38.5		160381	24	Swing oil pump motor burnt
714	36.5		160405	55	HG problem
715		2	160460	10	Low oil level in swing motor pump
716		6.5	160470	8.5	Both drag rope broken
717		9	160478.5	29.5	Both drag rope broken-8.5, T.P.-0.5
718		6	160508	11.5	T.P.-1,Drag chain-5
719		6	160519.5	112	Drag chain shackle broken-1, Hoist rope broken-5
720		2	160631.5	33.5	Drag rope broken
721		4.5	160665	8.5	walking shoe fallen
722		1	160673.5	11.5	Dump rope broken
723	4.5		160685	278	Starting problem
724		0.5	160963	74.5	Dump socket problem
725		1	161037.5	40	Adapter
726		1	161077.5	21.5	T.P.
727		7	161099	8	Eccentric z broken-3,Drag socket broken-4
728	1.5	7	161107	7	Blower not working-1.5,Drag socket-5,Adapter-2
729		8.5	161114	65.5	Drag rope broken
730		40	161179.5	225.5	DM-2 pinion shaft teeth broken
731		1.5	161405	14	T.P.
732		5.5	161419	16	T.P.-0.5, Drag socket pinion-5

733	1		161435	18	Starting problem
734		0.5	161453	67	Adapter
735	2.5		161520	16	Starting problem
736		1	161536	140.5	T.P.
737		4.5	161676.5	53.5	Dump rope broken
738		2.5	161730	34.5	Hitch chain shackle broken
739		1	161764.5	10	T.P.
740	6		161774.5	66	Starting problem
741	2.5		161840.5	14.5	Starting problem
742		0.5	161855	17	Rope out from drum
743		1	161872	33.5	Equiliser pin broken
744		1.5	161905.5	17.5	T.P.
745		0.5	161923	94.5	Drag rope out from pulley
746		7	162017.5	11.5	T.P.-1.5,Dump rope-5.5
747		7.5	162029	9	Dump blocked-3, Hitch chain-4.5
748		1	162038	18	T.P.
749		1.5	162056	48.5	Hoist chain lock broken
750		2	162104.5	80.5	Drag gear bolt loss
751		4	162185	90	Drag chain broken
752		0.5	162275	28	T.P.
753	5.5		162303	14.5	Excitation problem
754	0.5		162317.5	48.5	Swing not working
755	3.5		162366	18	Swing not working
756		0.5	162384	64.5	Air leakage
757	0.5		162448.5	9	Swing hoist brake not working
758		9	162457.5	9.5	Dump rope-0.5,Drag socket-8.5
759		14	162467	16.5	Dump rope pinion failed
760	0.5	1	162483.5	55.5	Swing brake-0.5, T.P.-1
761		2	162539	77.5	Adapter
762		1	162616.5	31.5	T.P.
763		0.5	162648	19	T.P.
764		6.5	162667	34	T.P.
765		4.5	162701	31	T.P.-2.5, Dump rope-2
766		2	162732	128	Dump socket pin out
767		43	162860	22	DM-2 motor pinion shaft broken
768		2	162882	18	Adapter
769		1.5	162900	39	T.P.-0.5,Hitch shackle-1
770		1	162939	18	Dump rope broken
771		0.5	162957	55	T.P.
772		2.5	163012	74	Adapter
773		0.5	163086	18	T.P.

774		1.5	163104	71.5	T.P.
775		1.5	163175.5	106	Drag rope out from drum
776		1	163281.5	68.5	Dump rope broken
777		2	163350	12	T.P.
778		3.5	163362	10	Adapter
779		4	163372	16.5	T.P.-1.5, Anchor pin out-2.5
780		2	163388.5	32	Lower dump socket pin out
781		1.5	163420.5	2.5	Adapter
782	21		163423	11.5	HM armature fallen
783	10.5		163434.5	45.5	HM armature pinion broken
784		2.5	163480	8.5	Trunion link pin broken
785	35		163488.5	14.5	HM problem
786	8.5		163503	68	Rear arm motion fitted
787		2.5	163571	36	Pin leakage fro compass regulator
788		0.5	163607	52.5	T.P.
789		0.5	163659.5	23	Hitch shackle pin lock broken
790		6	163682.5	7	Drag rope out from drum
791		7	163689.5	135.5	Drag rope out from drum
792		0.5	163825	35.5	T.P.
793		0.5	163860.5	60	T.P.
794		1.5	163920.5	34	Dump rope broken
795	1.5		163954.5	35	Starting problem
796		1	163989.5	33.5	Dump socket pin out
797		1	164023	32.5	T.P.
798		1	164055.5	13	T.P.
799		1.5	164068.5	28	Hoist chain pin out
800	4.5		164096.5	13.5	Trailing cable punch
801	4		164110	16.5	Swing oil pump-1,Power trailing-3
802		0.5	164126.5	15.5	T.P.
803		3	164142	13	Hitch shackle pin out
804		2.5	164155	13.5	Hitch shackle pin out
805		5.5	164168.5	90	T.P.-0.5,Hoist chain-5
806		1	164258.5	16.5	Drag lock
807		2	164275	37	Dump rope broken
808		0.5	164312	16	T.P.
809		2	164328	16	Hitch shackle broken
810		3.5	164344	17.5	Hitch shackle broken
811		2	164361.5	12.5	Drag rope out from pulley
812		1.5	164374	66.5	Equiliser pin broken
813		4	164440.5	72	T.P.-0.5,Adapter-3.5
814		2	164512.5	19	Hoist chain link broken

815		1	164531.5	17.5	T.P.
816	144		164549	8.5	Hoist problem
817	11	4	164557.5	18	Adapter-4, DM2 problem-11
818	2		164575.5	28.5	Drag not working
819	4		164604	8.5	DM compensating winding joint problem
820	7.5		164612.5	12.5	DM compensating winding joint problem
821	4		164625	14	Trailing cable punch
822	9		164639	13	Trailing cable punch
823		2	164652	32.5	T.P.
824		1.5	164684.5	40	Hitch chain shackle broken
825	11	1.5	164724.5	26	T.P.-1.5,DM-1 problem
826		2	164750.5	82	Dump rope broken
827	64		164832.5	7.5	DM-1 starting problem
828	15.5		164840	29	Steam side plate loose-5.5, in driver-10
829	5		164869	15	Starting problem
830	0.5		164884	2	Light problem
831		1	164886	157.5	Dump rope broken
832		1.5	165043.5	17	Dump rope broken
833	1		165060.5	15	Drag problem
834		2	165075.5	9.5	Drag rope problem
835		7.5	165085	104.5	Drag rope problem
836	6.5		165189.5	15.5	Trailing cable punch
837	6		165205	136.5	Trailing cable punch
838		3.5	165341.5	70.5	T.P.-2, Dump rope-1.5
839		2.5	165412	34.5	Hitch shackle-0.5, Dump socket-2
840		0.5	165446.5	14.5	Hitch shackle socket pin out
841		0.5	165461	35.5	Drag chain broken
842		0.5	165496.5	17.5	Drag chain broken
843		2.5	165514	35.5	Dump rope broken
844		1.5	165549.5	74	T.P.
845		0.5	165623.5	76	T.P.
846		8	165699.5	79.5	Upper hoist chain pin out
847		1	165779	31.5	Hoist chain broken
848		7	165810.5	17	Balance bar pin out-1,Adapter-1.5,Drag chain link broken-4.5
849		1	165827.5	44	T.P.
850		4	165871.5	17.5	Hitch shackle pin out-2.5, Dump rope broken-1.5
851		2.5	165889	116	Drag chain link broken
852		4	166005	71	Hitch shackle pin out-2.5, Dump rope broken-1.5
853	5.5		166076	102	Oil pump not working
854	6		166178	7.5	Trailing cable punch
855	14.5		166185.5	28.5	Excitation problem-6.5, Trailing cable-8

856		2	166214	14.5	Dump rope broken-1.5, T.P.-0.5
857		0.5	166228.5	18.5	T.P.
858	0.5	0.5	166247	49.5	Lower hoist chain pin out-0.5,Aux M.G. set starting problem-0.5
859		3.5	166296.5	17	Drag chain link broken
860		3	166313.5	36	Adapter
861		1.5	166349.5	13	Lower dump socket pin out
862		6	166362.5	11.5	T.P.-1.5,Lower dump socket pin out-4.5
863	5	2.5	166374	17.5	Hoist brake-5, T.P.-2.5
864		1	166391.5	13	T.P.
865		7	166404.5	15.5	Hitch shackle pin out
866		3.5	166420	18	Drag rope broken
867		106	166438	60	Line rail assembly
868		2	166498	68.5	Hoist brake problem
869	1		166566.5	13	Swing system not working
870		2	166579.5	37.5	Both dump rope broken
871		56.5	166617	32	Abnormal sound come from drag
872		6	166649	18.5	LHS trunion bar pin broken
873		0.5	166667.5	17	LHS trunion bar pin broken
874		2	166684.5	126	Adapter
875		3	166810.5	15	Adapter-2.5,T.P.-0.5
876		2.5	166825.5	16.5	Anchor pin fallen
877		4	166842	74.5	Anchor pin fallen
878		1	166916.5	30.5	Dump socket pin out
879		7	166947	18	Hitch pin out-2.5,Hitch shackle broken-4.5
880		1	166965	37.5	Dump socket pin out
881		1	167002.5	30.5	Adapter
882		0.5	167033	52.5	Rope out from drum
883		3.5	167085.5	133.5	Trunion link pin broken
884	1.5	1	167219	37	Balance bar pin out-1,Walk shoulder-1.5
885		1.5	167256	32.5	Hitch shackle pin out
886		8	167288.5	20	Both dump rope broken-2, Spreader bar pin out-3,Hitch shackle-3
887		2	167308.5	82	Htich chain shackle pin out
888		5	167390.5	8	Heavy sound in drag gear
889		5	167398.5	3	Machine problem
890		124.5	167401.5	191	DM-2 motor pinion shaft broken
891		5.5	167592.5	15	Drag rope broken
892		0.5	167607.5	114	T.P.
893		0.5	167721.5	73.5	T.P.
894		1	167795	21	Hitch shackle pin out
895		322.5	167816	116.5	DM1 bearing problem
896		1.5	167932.5	15	Dump rope

897		1.5	167947.5	16	Dump rope-0.5,Hitch shackle-1
898		3.5	167963.5	44	Hitch shackle pin out
899	88		168007.5	12.5	Heavy sparking in synchronous motor
900	10.5		168020	35	Synch. Motor problem
901		2.5	168055	16	Hitch shackle pin out
902		3.5	168071	14	Lower hoist chain link
903		2	168085	114	Trailing cable punch
904		2	168199	152.5	Drag chain pin out
905		2	168351.5	24.5	LHS rope out from Guide pulley
906	53		168376	100	HM-2 motor problem
907	1		168476	58.5	Drag brake problem
908		1.5	168534.5	14	Balance bar pin lock broken
909	5.5		168548.5	14.5	HG-2 over heat-0.5, D.C. tripping-5
910	6		168563	50.5	T.C. tuning
911	1		168613.5	43	Starting problem
912		1.5	168656.5	69.5	Dump rope broken
913		1.5	168726	53.5	Spreader bar pin broken
914		2	168779.5	47	Drag rope out from drum
915	3	1.5	168826.5	17	Dump rope-1.5, Starting problem-3
916		1	168843.5	17	Drag chain broken
917		1	168860.5	18	T.P.
918		0.5	168878.5	70	T.P.
919	1.5		168948.5	20.5	Swing system not working
920		1	168969	64.5	Equiliser pin out
921	2		169033.5	44	Starting problem
922		2	169077.5	37	Adapter
923		1.5	169114.5	15.5	Hitch shackle pin out
924	2	1.5	169130	11	Starting problem-2, Adapter-1.5
925	3		169141	29	Starting problem
926		4	169170	9.5	Dump pulley broken
927		11	169179.5	18	Drag rope broken
928		1.5	169197.5	18.5	Hitch shackle pin out
929	0.5		169216	16	Drag/walk problem
930	3		169232	42.5	Starting problem
931		0.5	169274.5	20	Adapter
932		0.5	169294.5	17	Drag chain pin out
933	0.5		169311.5	17.5	Boom light problem
934		1	169329	16.5	Spreader bar pin broken
935		4	169345.5	18.5	Adapter-2.5,Balance bar pin out-1.5
936	1		169364	18.5	Starting problem
937		1.5	169382.5	16	Hitch shackle pin out

938	0.5		169398.5	79.5	Starting problem
939		3.5	169478	18	Adapter
940		1	169496	18	Adapter
941		2	169514	17.5	Both dump rope broken
942		1	169531.5	33.5	Drag chain link broken
943		2	169565	49.5	Hitch shackle pin out
944		2	169614.5	56.5	Adapter
945		1.5	169671	36	Anchor pin fallen
946		1.5	169707	13	Adapter
947		2	169720	18	Dump pulley broken
948		2.5	169738	18	Hitch shackle pin out
949	1.5		169756	17.5	Starting problem
950	1.5		169773.5	12.5	Starting problem
951		4.5	169786	15	Adapter-2, Trunion pin out-2.5
952		2	169801	34.5	Anchor link out-1.5, Trunion pin out-0.5
953	2		169835.5	17.5	Starting problem
954		1	169853	92.5	T.P.
955	2		169945.5	36.5	Starting problem
956		1	169982	37.5	T.P.
957		2	170019.5	11.5	Adapter
958		4.5	170031	13.5	Dump rope-3,T.P.-1.5
959		6.5	170044.5	33	T.P.-1, Drag chain-5.5
960		2	170077.5	17.5	T.P.
961		2.5	170095	18	Adapter
962		2	170113	18.5	Hitch shackle pin out
963		1.5	170131.5	48.5	Adapter
964		3	170180	52.5	Drag rope out from pulley
965		1	170232.5	16	Dump rope broken
966		0.5	170248.5	15	Hitch shackle pin out
967		77	170263.5	60.5	Drag drum pedestrol drive break
968		1	170324	53	Hitch shackle pin out
969		1	170377	4	Hitch shackle pin out
970		43.5	170381	6.5	Swing gear pinion problem
971	2	15	170387.5	11.5	Trailing cable punch-2, Swing gear pinion problem-15
972	11.5		170399	14.5	Trailing cable punch
973		2.5	170413.5	14	Adapter fallen
974		1.5	170427.5	74	Adapter fallen
975		1.5	170501.5	19.5	T.P.
976		0.5	170521	16	Adapter
977		2	170537	71.5	Hitch shackle pin out
978		2	170608.5	17.5	Adapter

979		4	170626	17	Adapter
980		4	170643	51	Drag chain fallen
981		3	170694	53	T.P.
982		0.5	170747	132	Hitch shackle pin out
983	0.5		170879	35.5	Starting problem
984		1	170914.5	6.5	Hitch shackle pin out
985	47.5	2	170921	76	DM-2 ammeter problem,Dump rope broken-2
986		1	170997	12.5	Adapter
987		2	171009.5	19	DM-2 brake jam
988	1.5		171028.5	16	Down rotor not working
989		1.5	171044.5	14	Lower hoist chain pin out
990		5	171058.5	51.5	chain shackle broken
991		0.5	171110	53.5	Drag socket pin lock broken
992	1.5		171163.5	10	Starting problem
993		1	171173.5	43.5	Drag rope broken
994		5.5	171217	38	Hitch shackle pin out
995		30	171255	19	Intermediate pinion bearing broken
996		7	171274	71.5	Hitch shackle pin out
997	1		171345.5	113	DC not working
998		1	171458.5	38	Dump rope broken
999		1.5	171496.5	55	Equiliser pin out
1000		1	171551.5	26.5	T.P.
1001		3.5	171578	36	Hitch shackle pin out
1002	2		171614	14.5	Power problem
1003	1	2	171628.5	36.5	Power problem-1,Dump rope-2
1004		1	171665	42.5	DM brake over
1005		3.5	171707.5	90.5	Fan lead pulley struck-1.5,Drag rope out from drum-2
1006		0.5	171798	32.5	Brake problem
1007		1	171830.5	125.5	DM brake over
1008		1	171956	72	T.P.
1009		3	172028	158	Dump pulley broken
1010		1.5	172186	12	Hoist rope broken
1011		10	172198	73.5	Hoist rope broken
1012	1		172271.5	19	Power problem
1013	1		172290.5	16.5	DC not working
1014		3	172307	110.5	Equiliser pin out
1015		0.5	172417.5	18	DM brake over
1016	1	1	172435.5	111	DM brake over-1,T.P.-1
1017		1	172546.5	14	T.P.-0.5, lower hoist chain pin-0.5
1018	5		172560.5	138	HG-2 smoking problem-3,Hoist not working-1,Power rotor not working-1
1019	1		172698.5	64	Power problem

1020	1		172762.5	84.5	Power problem
1021	0.5		172847	10	Walking problem
1022		0.5	172857	45.5	Drag chain
1023		3.5	172902.5	52	Drag rope out from pulley
1024		2.5	172954.5	16.5	Drag rope out from pulley
1025		3	172971	102.5	Drag rope pinion problem
1026		6.5	173073.5	148	Dump pulley broken
1027		8	173221.5	94	Trunion link pin broken-0.5, Drag chain-7.5
1028		1	173315.5	166.5	Hitch shackle pin out
1029		1.5	173482	150.5	Dump rope broken
1030		4.5	173632.5	38	Hitch chain shackle broken
1031		0.5	173670.5	15	T.P.
1032	5	2.5	173685.5	17	Hoist system not working-5, T.P.-2.5
1033	2.5	1.5	173702.5	18	Hitch shackle pin out-1.5, Hoist system not working-2.5
1034	1.5		173720.5	17.5	Drag system not working
1035		2.5	173738	62.5	T.P.-0.5, Hitch shackle pin out-2
1036		31	173800.5	80	Eccentric out from shaft
1037		6.5	173880.5	16	Drag rope-4.5, Dump rope-2
1038		6.5	173896.5	18	Hitch chain shackle broken
1039	1	3	173914.5	75.5	Hitch shackle-3, Power problem-1
1040	1.5	5.5	173990	33.5	Drag chain-5.5, Swing system not working-1.5
1041		1	174023.5	18	Hitch shackle pin out
1042		0.5	174041.5	15.5	others
1043		5.5	174057	16.5	Rotor crack
1044	1.5		174073.5	13.5	Drag walking problem
1045	4	2	174087	19	T.P.-2, Swing system motor not working-4
1046	2		174106	88	DM-2 blower motor burnt
1047		2	174194	56	Dump rope broken
1048		0.5	174250	18.5	Hoist chain pin out
1049		0.5	174268.5	51.5	Hitch shackle pin out
1050		1	174320	19	Hitch shackle pin out
1051		0.5	174339	36.5	T.P.
1052		1	174375.5	16.5	Hitch shackle pin out
1053		6	174392	15	Swing pin broken
1054		6.5	174407	16	Drag chain link broken
1055	3.5		174423	122.5	Starting problem
1056		8.5	174545.5		Hoist proper not working