:: IJEBD ::
(International Journal of Entrepreneurship and Business Development)
Volume 05 Number 01 January 2022

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Air Starting System Reliability Uses Reliability Requirement Setting (RRS) Model and Management Action Selection (MAS) Method

Tungga Bhimadi Karyasa
Faculty of Engineering and Informatics, Malang Gajayana University
tunggabhimadi@unigamalang.ac.id

ABSTRACT

Purpose: Interpretation of the reliability can be used as a quality measurement of operational system of safety. We propose maintenance methodology based on reliability as a solution for predicting reliability system. To make a convenience system appropriate with regulation, we begin to define the three reliability scopes, they are: interval reliability, component reliability, and system reliability. Proposal of Engineering Calculation is the RRS Model for predicting design of component reliability and MAS Method to correct reliability caused by real operation.

Design/methodology/approach: MAS method consists of harmonization of maintenance schedule, resetting or hazard or overhaul, revitalization (component reliability improvement), and innovation (component replacement with actual part).

Findings: Case study to implement these model and method based on Air Starting System of Tanker. Predict of system reliability design is 0.438044295. To obtain reliability based on regulation, it is necessary to do overhaul once in every five years. Innovation and revitalization for valve follow procedure of MAS method also done in every five years.

Originality/value: This paper is original

Paper type: Is categorized as a research paper.

Keywords: *Air Starting, Management Action, Three Reliability Scope.*

Received : December 28th

Revised : January 14th

Published : January 31th

I.INTRODUCTION

Changing in maintenance method started from an event before industrial revolution. Defect component was replaced directly. Sparepart procurement was very important issues. After industrial revolution happened, workshop worker tried to tinker with used component and initiate in component repaired reviewing as engineering aspect of replaced component. The component replacement was possible not always use new component. Thinker knowledge has been developing variously and it is be heritable to next generation. Influence of this knowledge has recorded organized maintenance to be a methodology which is to be referenced for composing maintenance schedule. Methodology description is completed with engineering explanation. For example, after year of 1930, maintenance engineering was enclosed in methodology of Reliability Centre Maintenance (RCM), (Moubray, 1992)

Make maintenance to be an engineering concept is interesting as a research topic. One aspect to review is safety aspect, it is system reliability. To reach a prediction value of certain system reliability, we proposed to start with making parallel of a set of interval reliability for each component. The set of interval reliability is converted to be a component reliability in a basic condition. By considering configuration and environment condition of component in the system, sum of components in a system with each basic Component Reliability will be developed to be a value of basic System Reliability. It is necessary to check the design of system reliability with a regulation. In general, it does not meet the regulation so that it is necessity to predict new system regulation of action to predict component reliability. Reliability resulted from simulation of action to predict component reliability.

To evaluate the prediction value of system component reliability was done by two approaches. They were failure type and failure rate curve. Both of them used a unique phase curve. The failure type approach consists of three choices follow component behaviour. They are A-type, Bc-type, and Bd-type. The failure prediction of failure type was begun as an engineering concept with empiric equation formula experimentation reliability by Knudson (1961). And then, used two constantas of Duane, but both constantas replaced with two constantas in the exponential equation known as weibull parameter. They were a scale parameter notation by 'λ', and a shape function parameter notation by 'β' (Crow, 2004). W (1982) had an experiment for component reliability with other treatment (Crow identified the other failure type as Bd-type). Crow popularized terminology of Reliability Growth Method in situs www.weibull.com. This situs prtesents for calculating design of component reliability, as Bc-type. In year 1989, Seber-Wild created a failure type, A type. This type stated that if failure happened onto equipment component, so that the component will be replaced with the reserved component or will be repaired which stop operation. The solution is based on and popularized by Alice, Crow & Lester D (1992) from selected Failure type, (Crow, 2008).

Reliability prediction approach with failure rate curve is a choice for this research. Application of this research was done to predict reliability of Air Starting Tanker System. This approach based on the result of survey on Failure Rate Function assumption of the aeroplanes in America and Europe component reliability, P. (2009). It has been being researched started at year 1976. The result showed that, 9 % fault operation of software, 22 % using component not meet the standard reliability, 15 % failure of manufacturer, 9 % error design, 4 % mismanagement system, 9 % wearout phase for example replace any components, 12 % set addition device, and 20 % initial defect of component. Wearout is the third phase of reliability curve assumptions for bathub model. 20% of Pertamina machinery ship system uses bathtub curve with Plan Maintenance System Program (PMS). PMS supports mechanics to determine component schedule and manual repairing procedure of reliability tanker ship design with assuming bathtub Failure Rate Function, (Pertamina, 2007). Design reliability research for this Air Starting System is based on the use of bathtub curve assumption.

II.METHODOLOGY

Phase of methodology is developed from Sujono (2014), started from choice of failure rate curve for bathub model with completing data for example : empiric equation description of each phase of failure rate curve, chart and picture system, data of failure rate for each component based on assumption from W. Denson, G. Chandler, W. Crowell (1991), data of intermitten time of components to the system, distribution choice for interval reliability assumption, ratio as consequence valve placement, log book data, and MAS choices. The unity of this data wil be used to determine for example: maintenance interval, harmonization of some intervals which have very nearly values, design of interval reliability curve in the beginning and the end of each phase, parameter of empiric equation of component reliability, and design of component reliability curve for each component (U, 1995)

Design of reliability system is obtained by consider these matters : configuration of system component, utility of each component, and a formula of empiric equation to determine system reliability. Design of system reliability from the end of life time system operation will be checked to the regulation. In general, predict to the design of reliability system did not meet the regulation, so that it is necessity to do simulation of management action to revise the design of system reliability with applying these choices : innovation, resetting, and revitalization. Evaluate the result of simulation in the beginning operational of reliability is still fulfill the regulation until certain operational. In condition when until the certain operational does not meet the regulation, operational simulation is made more than one to fulfill regulation requirement. Each simulation will be checked based on regulation, if the regulation has not been fulfilled yet, the simulation will be re-adjusted.

A. Model and Configuration

System model is chosen from one of system of the tanker *KM Samudera Baru*. Its Air Starting System with identifications, for example : total length 112.944 metres, width 16.34 metres, and height 9.71 metres. This system operational is supported by Regulation and recommendation from Marine Engineering SNAME 1992, Biro Klasifikasi Indonesia 1996 vol-III and section 1.1, and Project Guide MAN B&W S26MC. Design for Air Starting System ***KM Samudera Baru*** follows I. T. Daulay (2006). Picture explanation for the design as follows : A.Starting Air Compressor, B. Oil and

Water Separation, C. Valve, D. Starting Air Receiver, E. Reduction Valve, and F. Capasitor, is shown as figure-1.

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

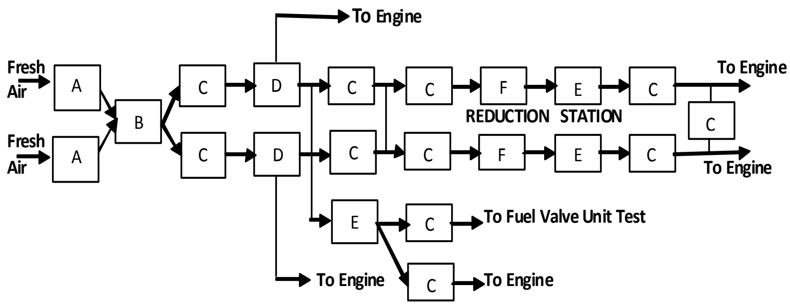

Figure 1. Air Starting System Design

Air Starting System produces 6(six) times of engine starting with initial air pressure about 30 bar. This pressure is produced from air compressor to tube or starting air receivers, and then it enters into main engine by reduction station with the pressure about 7 bar. Pressuring clean air enters into engine to be used for activities preparation : emergency ceasing, air control when it manuver with the outtake valve, and soft blast cleaning of turbochanger for testing fuel valve unit, based on (I. T. Daulay 2006).

B. Design of Component Reliability

Reliability is a value of quality of operating system. This research based on type of failure rate function. Prediction to calculate Design of component reliability were prepaired on Reliability Requirement Setting Model or RRS model application. This reliability prediction needs correction, and it uses Management Action Selection Method or MAS method. RRS model with MAS method are compounded to be a maintenance methodology based on the reliability.

We expect these method and model include as the alternative solution in methodology. We begin to define the scope, the reliability of components, they are: interval reliability, component reliability, and system reliability. RRS model is used to calculate ideal or design of component reliability, and MAS is used to make correction on these values follow the recommendation from operator system. RRS model used three phases of component reliability, they are : phase-1 or infant mortality phase with normal distribution or lognormal distribution, phase-2 or random failure phase with exponential distribution, and phase-3 or wareout phase with Weibull distribution.

Equation of each phase is modified to produce as sum (refers to component amount) of detail design of component reliability curve as equation for each component in this research. The three equations of phase are expressed at (Priyatna, 2008). The next step is making a design of system reliability curve which is influenced by configuration condition. Generally, a design of system reliability curve has not required one of safety regulation, so that it is necessary to modify the design curve.

C. Prediction of Component Reliability

Principle of modification into design of system reliability curve is a treatment to adjust value of component reliability for specific component. This done with MAS method application. Component reliability is always descending as long as operational system. The result of design of component reliability curve shows that operational phenomenon can reduce reliability. Effort to achieve ‘deducting’ of the reliability reduction is proposed with follow alternative management action from the MAS method.

MAS method gives 4(four) alternative choices of management actions, they are : innovation or reduce slowly of gradient reliability caused by replacement or component maintenance by actual technology, resetting (for example : overhaul and hazard) or reduce slowly of gradient reliability because of resetting or sudden stopping operational machine; revitalization or reduce slowly of gradient reliability caused by replacement of actual component with a steady maintenance interval; harmonization or reduce slowly of gradient reliability caused by some components replacement at the same compound maintenance schedule.

D. Reliability Evaluation for Regulation

Design and final result of system reliability needs corrective action because of occurence outer of prediction causes reliability is not valid. Validation result from Biro Klasifikasi Indonesia (BKI) is fail if minimum reliability equal to 0.55 for ship machinery system, and cooperation between Departemen Perhubungan with Japan Authority-IJCA for minimum average reliability system 0.8, (M. Suef 2008).

Scheme and 3-D figure complete with supporting data of the Air Starting System on a tanker will be selected to be made its system layout. Excel calculation is applied to get respective values of the following :

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

maintenace interval, interval reliability of each components by selecting certain distribution assumption, component reliability design with RRS model calculation, correction of component reliability with MAS method selection properly, and system reliability with configuration approach iteration until come into value of system reliability appropriate with the regulation.

III. RESULTS AND DISCUSSION

Data of component operasional characteristics, for example : failure rate assumption from W. Denson, G. Chandler, W. Crowell (1991) and assumption of value of intermitten ratio, gives value of Time To Failure or TTF. The TTF value is to determine maintenance interval for each component. To predict the value interval will be adjusted with applying MAS method from alternative interval reliability distribution for each component so that we can get the design of interval reliability for each the end of interval. Sum of interval reliability value in the end of phase for each component could be determined.

Table 1. Prepare Data From Denson

Main Component	*Reff.List Number*	*Fail/E6 Hours*	*Intermltten Time*	*Total Fail*
Starting A C	*2-107*	*68.16*	*0.2*	*0.059*
Oil &water sept	*2-123*	*296.59*	*0.85*	*0.04*
Valve	*2-150*	*107.48*	*0.5*	*0.03*
S A Receiver-1	*2-141*	*7.24*	*0.95*	*0.0002*
Reduc. Valve	*2-158*	*79.36*	*0.95*	*0.0129*
Capasitor	*0.001*	*2-55*	*28.81*	*0.98*

Table 2. Data For Determine Internal Reliability

Main Component	*TTF (year)*	*Valve effect*	*TTF(year) correction*	*Harmonisasi (year)*
Starting A C	*0.96*	*0*	*0.96*	*1*
Oil &water sept	*1.45*	*0*	*1.45*	*1*
Valve	*1.19*	*0*	*0.89*	*1*
S A Receiver-1	*6.35*	*2*	*3.01*	*3*
Reduc. Valve	*1.07*	*2*	*1.01*	*1*

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Capasitor	*2*	*4.90*	*2*	*2.40*

Six design of component reliability curves are determined from application of empiric mathematics equation refer to procedure of RRS model for each phase. Coefficient parameter for RRS model equation follows distribution regulation of the phase. The result of six design of component reliability curves are shown at the figure-2.

A design of component reliability curves is determined from configuration of entire system component.

The last reliability of design of component reliability curves produced from system operation in the year-36 is equal to 0.438, and this value < 0.55, or minimum average system reliability equal to 0.645, this value < 0.8. So that system reliability of 'full operating' system follows maintenance standard based on maintenance interval determination, but it has not fulfilled the regulation.

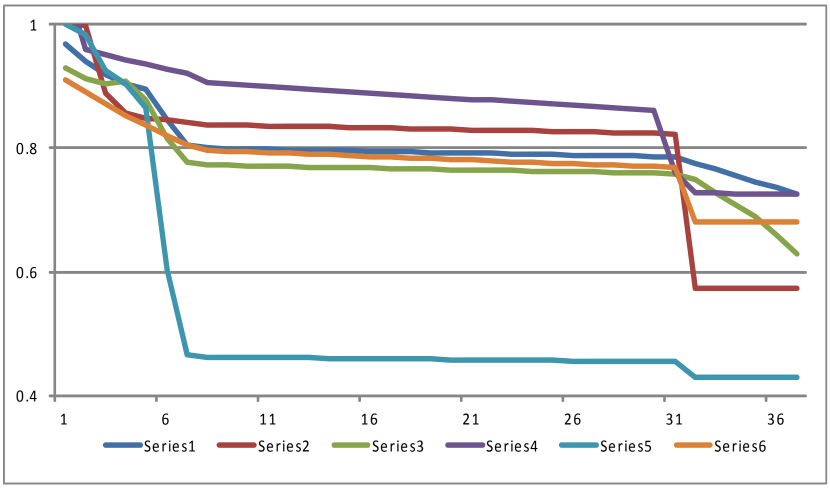

Figure-2 Design of component reliability curve for each component

Series1-Starting Air Compressor
Series2-Oil and Water Separation
Series3-Valve
Series4-Starting Air Receiver
Series5-Reduction Valve
Series6-Capacitor

Simulation to achieve system reliability refers to regulation are produced by MAS method, which each of basic condition with some alternatives as folows : overhaul onto entire components every five years with resetting ability from 20% to 50%, revitalization with maintenance improvement which is able to increase next reliability for the same maintenance interval from valve with ability every five years from 10% to 40%, and technology innovation, assume that also every five years for replacement component more sophisticated compare with valve before from 10% to be 40%.

The result is just to judge assumption of one MAS method alternative, for example : from 60% innovation for every five years, we can get average reliability in the end of system operational 0.808 and this value > 0.8, just from valve revitalization every five years with the average reliability of the end of system operational 0.825 for 20%, and just from resetting every five years with average reliability in the end of system operational 0,719 for 40%, and this value < 0.8. Real treatment valve resetting can not form system reliability fulfill the requirement. In fact, prediction of the improvement of system reliability to meet the requirement, does not come from just one aspect of MAS method. The event until this time follows the science and technology development, they are innovation for five years maximum 20% increase, and maximum 10% increase for revitalization, (T. Bhimadi, H. A. Sujono 2014) Combination of 20% innovation with 10% revitalization and 50% resetting of Air Starting still gave the average value in the end of operational system of reliability system equal to 0.676 and this value < 0.8.

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

IV.CONCLUSION

RRS model and MAS method can apply as alternatives to predict system reliability. From the four choices of MAS method, real treatment valve resetting can not form system reliability fulfill the requirement.

60% of innovation for every five years average reliability in the end of system operational was 0.808 and this value > 0.8. 20 % of valve revitalization every five years with the average reliability of the end of system operational was 0.825. Resetting every five years with average reliability in the end of system operational 0,719 for 40%, and this value < 0.8.

Percentage fact combination of three MAS method alternatives are used at system reliability prediction still produce average value below of requirement in the end of operational system. It is necessary to review in giving of feasible requirement of system safety. The purpose of average reliability choice to reach the suitable value.

ACKNOWLEDGMENT

This project were sponsored by Fundamental Research General Directorate of Higher Education (DP2M) 2014 by Grant: DIPA SP-DIPA-023.04.2.415015/2014. The authors would like to thank: Syamsuri, Suparjo, and Irmawati for their contribution to this research.

REFERENCES

Alice, Crow & Lester D, C. (1992). *Educational Psychology*. Litlefeld Adams and co.

Crow, L. H. (2004). *An Extended Reliability Growth Model for Managing and Assessing Corrective Actions Proceeding of Annual Reliability and Maintainability Symposium*.

Crow, L. H. (2008). Practical Methods for Analyzing the Reliability of Repairable Systems. *Reliability Edge Hc – Reliasoft Doc*, *5*.

I. T. Daulay. (2006). *Secondary Room of Machinery Tanker System Report Ship System Engineering Department,*. Ocean Engineering Faculty, Surabaya Sepuluh Nopember Institute of Technology.

Knudson, D. (1961). *Fundamental of Biomechanics. California State University at Chico*. Kluwer Academic / Plenum Publisher.

M. Suef, and E. W. (2008). Management System of Ship Maintenance Design" Post Graduate Faculty, Surabaya Sepuluh Nopember Institute of Technology. *Proceeding of 7th National Seminar at Management Role in Performance Improvement, Magister Management Technic*, 14–10.

Moubray, J. (1992). *Reliability Centered Maintenance*. Industrial Press Inc.

P., D. D. D. and M. G. (2009). A new Reliability Assessment Technique for Aging Electronic Systems. *Paper from Reliability Analysis Center-RAC, Illinois Institute of Technology*, 18. https://doi.org/http://rac.iitri.org

Pertamina. (2007). *Planned Maintenance System Manual Trade and Commercial Ship Directory*.

Priyatna, D. (2008). *Maintenance and Reliability", High Education Program of Engineering, Register Number NE 1602*. Ocean Engineering Faculty Surabaya Sepuluh Nopember Institute of Technology.

Sujono, T. B. and H. A. (2014). Maintenance Methodology Based on Reliability Using Reliability Requirement Setting Model and Management Action Selection Method for Tanker Oil System Proceeding the Third North Sumatra Islamic Univer. *International Conference on Multidisciplinary Research*.

T. Bhimadi, H. A. Sujono, and S. (2014). *, "Reliability Centered Maintenance System, Unipress,*. Surabaya State University.

U, B. V. G. and I. A. (1995). *Probabilistic Reliability Engineering*. A Wiley Interscience Publication.

W. Denson, G. Chandler, W. Crowell, and R. W. (1991). *Nonelectronic Parts Reliability Date, Ordering Number NPRD-81 Reliability Analysis Cente*. Rome Laboratory Griffiass.

W, N. (1982). *Applied Life Data Analysis*. John Wiley and Sons Inc.