Chapter – 3
Methodology

3.1 Introduction

This chapter presents the methodology of reliability analysis of dragline system. The complete methodology of reliability analysis of dragline is divided into four parts. The first part of the methodology has been explained the data collection, pre-processing of data , goodness of the best fit and identified the best theoretical distribution for the failure data of the components and estimated the corresponding parameters. The second part of the proposed methodology explains the reliability study of dragline using traditional and Bayesian Network models and also identify the critical subsystem of the dragline. The third part of the methodology describes the reliability analysis of the critical subsystem (dragging subsystem) of the dragline using DBN model. Finally the methodology for devising the maintenance policy for the critical components has been described., The chapter concludes by highlighting salient points of the proposed methodology.

3.2 Development of Methodology

The methodology consists of four major components and presented in Figure 3.1. Proposed methodology has been explained with reference to a case study dragline working in the opencast coal mines in Northern India. It starts with the collection of operational data from the field. The reliability of the dragline is studied based on the collected data and the critical subsystem of dragline is identified. The Bayesian network methodology as described in the sub-section 3.2.1, helped to estimate the reliability of the dragline and also in identifying the most critical subsystems of dragline. The reliability of the dragging subsystem (most critical) is studied using the DBN as described in sub-section 3.2.2. The methodology for developing apt maintenance policy for the components of the dragging system is detailed in the sub-section 3.2.3.

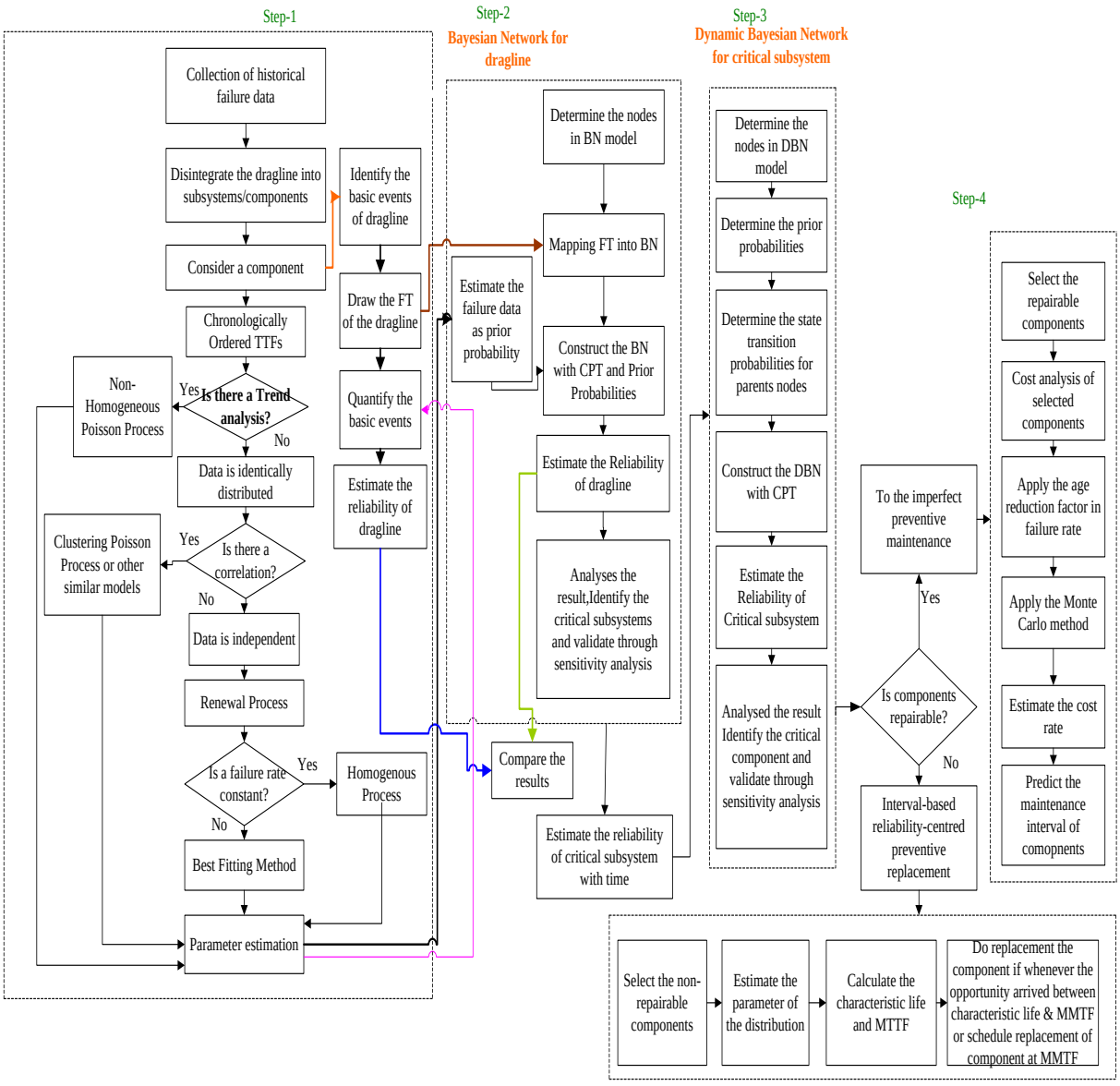

Figure 3. 1 Flowchart of the research methodology

3.2.1 Reliability analysis of dragline

Reliability of the dragline has been evaluated by traditional nonparametric method and FTA as well as using BN method. Collected failure data have been used to study the reliability of the dragline right from the component level and to fully understand the causal relationship between the components, subsystems and the dragline [141], [142], [143]. The flow chart of the reliability analysis of the dragline using BN is shown in Figure 3.1.

The developed BN model estimates the reliability of the dragline from the prior probability of parents' nodes (failure probability of the components). The first step in reliability study of the dragline and its subsystems using BN model is the construction of BN structure for the dragline system and its subsystems. To construct the BN structure, many software like Hugin, Netica, BayeFusion and BayesiaLab are available. In this research, BayesiaLab software was used to develop the BN structure. The casual relationship between the components of the dragline was developed through the FT to BN mapping algorithm. The CPT of the BN model is updated as and when new evidence is observed.

3.2.2 DBN based reliability study of the critical subsystem of the dragline

For dynamic behavior of the dragline system, a DBN model was constructed. The causal relationship between all the components of the dragging subsystem is established using *GENIE software* [144] . The three-axiom-based sensitivity analysis approach proposed by Jones et al. [145] was used to validate the DBN model. The details of data collection and classification for DBN model are presented in Chapter 4. The reliability analysis of dragging subsystem using DBN model and its validation is presented in Chapter 5.

3.2.3 Maintenance scheduling of the components of dragline

A methodology for framing and effective maintenance Policy was proposed based on the criticality of the components.

3.3 Summary

The method of proposed research work has been described, consisting of four sections. The first section of proposed methodology has been explained the data collection, pre-processing the data and parameter estimation through the statistical modelling. Second section has been explained the

estimation of the dragline's reliability along with subsystem's reliability. Also, identification of critical subsystem of dragline. The third section presented the reliability study of the dragging subsystem using Dynamic Bayesian Network model and also identify the most critical component. The fourth section has been presented the maintenance policy of critical components of the dragging subsystem.