1. Introduction

Electric Train or also known as Commuter Line is one of the most important public transportation in Jakarta and its surrounding area. According to [1], until August 2017 the daily average Commuter Line passengers reached 993,804 people. The highest number of Commuter Line daily passengers is 1,066,522. One of the prominent reasons why people prefer to use Commuter Line rather than other public transportation is its relatively economical ticket price. In addition, the passengers can also reach to destination place on-time without worrying about traffic congestion. Nevertheless, it still has many drawbacks, such as the frequent disruptions that happened almost every day. PT. Kereta Commuter Indonesia recorded 422 disruptions which was occurred in 2015 [2]. The disruptions can come from inside or outside Commuter Line system. When a disruption happened, the Commuter Line's officer need to trace the causes of the disruption and check whether it may lead to other disruptions. So, it is necessary to build a model that capable in representing the causative relationship among disruptions in train system.

In this research we construct a Prolog-based expert system to reason about disruption patterns for train system using Bayesian network and Prolog. We also add part-whole relation facts regarding the train system to reason about the influence of a disruption to entire train system. Bayesian networks are one of the most efficient and elegant frameworks for representing and reasoning with probabilistic models [3]. They have been applied to many real-world problems in diagnosis and forecasting [4]. We can see cause and effect relationship clearly through Directed Acyclic Graph (DAG) in Bayesian network. Moreover, they can handle uncertainty through probability theory. However, Bayesian networks have limitation regarding the inference implementation. The complexity of the inference in Bayesian networks limit the size of models that can be effectively reasoned over [5]. Several research [6, 7, 8, 9, 10] address this problem by integrating Bayesian networks and logic programming by including probabilistic information into a knowledge-base.

One of the most powerful and flexible logic programming frameworks is Prolog [11, 12, 13]. In Prolog, one can easily express the relationship among objects as well as develop rules to reason this relationship. This feature makes Prolog become a powerful language for Artificial Intelligent and non-numerical programming in general. There are well-known examples of symbolic computation whose implementation in other standard imperative languages took a lengthly incomprehensible code. However, when this algorithm is implemented in Prolog, the algorithm becomes more compact and easily understood [11].

The rest of this paper is organized as follows. In Section 2 we briefly review the related works about the disruption patterns in train system and how to represent Bayesian network in Prolog. In Section 3 we present the technique and process to construct Bayesian network of disruption patterns in train system. We provide Prolog codes for previously constructed Bayesian networks as well as other rules pertinent to their reasoning in Section 4. In Section 5, we describe some queries implementation of Prolog rules in a Prolog-based expert system. Finally, the conclusion and future works are discussed in Section 6.