PREDICTING OCCUPATIONAL ACCIDENT AT AUTOMOTIVE MANUFACTURING INDUSTRY IN MALAYSIA USING DECISION TREE TECHNIQUE

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Abstrak

Menurut Jabatan Statistik Malaysia (DOSM) pada tahun 2018, industri pembuatan menyumbang 91.2% kes hilang upaya sementara dan 6.9% kes hilang upaya kekal. Walaupun terdapat peningkatan jumlah penyelidikan berkenaan kemalangan tempat kerja dalam industri pembuatan automotif di Malaysia, setiap kajian mempunyai objektif dan kaedah kajian yang berbeza. Kajian ini meramalkan kecenderungan hilang upaya sementara dan hilang upaya kekal dengan mengenal pasti secara tepat ciri-ciri kemalangan di tempat kerja yang berlaku dalam industri pembuatan automotif di Malaysia. Teknik pepohon keputusan telah digunakan untuk membina pemodelan ramalan kemalangan pekerjaan di industri pembuatan automotif. Model pepohon keputusan dibina dengan pelbagai algoritma (Khi-kuasa dua, Indeks Gini dan Entropi), bilangan cabang (dua dan tiga) dan pembahagian data (80/20, 70/30 dan 60/40). Model yang berbeza dibandingkan untuk menentukan model terbaik bagi meramal dan mengenal pasti kesan daripada kemalangan pekerjaan. Model terbaik tersebut ialah model pepohon keputusan dengan tiga cabang menggunakan Khi-kuasa dua sebagai kriteria sasaran nominal dan pembahagian data 60/40. Nilai ketepatan bagi data ujian ialah 75.52%. Pembolehubah terpenting dalam model ini ialah *jenis kemalangan*, *punca kemalangan* dan *jenis pekerjaan*. Kajian ini menghasilkan satu set faktor yang signifikan dalam menerangkan sistem keselamatan tempat kerja dan membina model ramalan untuk meramal kesan kemalangan pekerjaan. Kajian ini boleh dijadikan garis panduan untuk pengurusan keselamatan dalam industri pembuatan automotif di Malaysia.

Kata kunci: Kemalangan di tempat kerja, Hilang upaya sementara, Hilang upaya kekal, Teknik perlombongan data dan Pepohon keputusan.

Abstract

According to the Department of Statistics Malaysia (DOSM) in 2018, manufacturing industry accounted for 91.2% of temporary disability cases and 6.9% of permanent disability cases. Even though there is an increasing number of research on analyzing occupational accidents at automotive manufacturing industry in Malaysia, each research aimed for different purposes and methods. This study predicts the tendency of temporary and permanent disability by accurately identifying the characteristics of workplace accidents that occurred within automotive manufacturing in Malaysia. Decision Tree was used to build the predictive modelling of occupational accidents at automotive manufacturing industry. Decision Tree models were constructed with various algorithms (Chi-square, Gini Index and Entropy), numbers of tree branches (two and three) and data partitions (80/20, 70/30 and 60/40). The different models were compared to determine the best model for predicting and identifying the effects of occupational accidents. The best model was a three-branch decision tree model using Chi-Square as the nominal target criterion and 60/40 data partition. The testing accuracy value is 75.52%. The most important variables in the model were *types of accident*, *cause of accidents* and *job types*. This study produced a set of significant factors in explaining safety workplace system and built a predictive model for predicting effect of occupational accidents. It can be served as a guideline to safety management in automotive manufacturing industry in Malaysia.

Keywords: Workplace accident, Temporary disability, Permanent disability, Data mining technique and Decision tree.

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CHAPTER ONE

INTRODUCTION

1.1 Background

With the aim of becoming an industrialized country, industrialization has become an important part in the Malaysian development strategies. Manufacturing industry has shown to be one of the significant supports and a major contributor to Malaysian economy (Said et al., 2012). Apparently, this industry has offered a vast amount of job opportunities in the recent years. According to Department of Statistic Malaysia (DOSM), total employees engaged in the manufacturing sector in December 2018 was 1,075,635 persons, an increase of 1.7 per cent or 18,044 persons as compared to 1,057,591 persons in December 2017 (Department of Occupational Safety and Health, 2018). Instead of improving income distribution and improving quality of life, economic growth through industrialization unfortunately also resulted in growing in number of occupational accidents. In accordance with estimation made by International Labor Organization (ILO), every year about 270 million occupational accidents occur (Amirah et al., 2013).

Normally, factors such as large employment of new workers, machinery and equipment are associated with rapid expansion of manufacturing industries. Regrettably, the application of new technologies would expose new hazards to the unskillfulness workers (Said et al., 2012). Moreover, hiring new worker might as well expose higher risk of accident as they are not familiar to the hazard of workplace environment.

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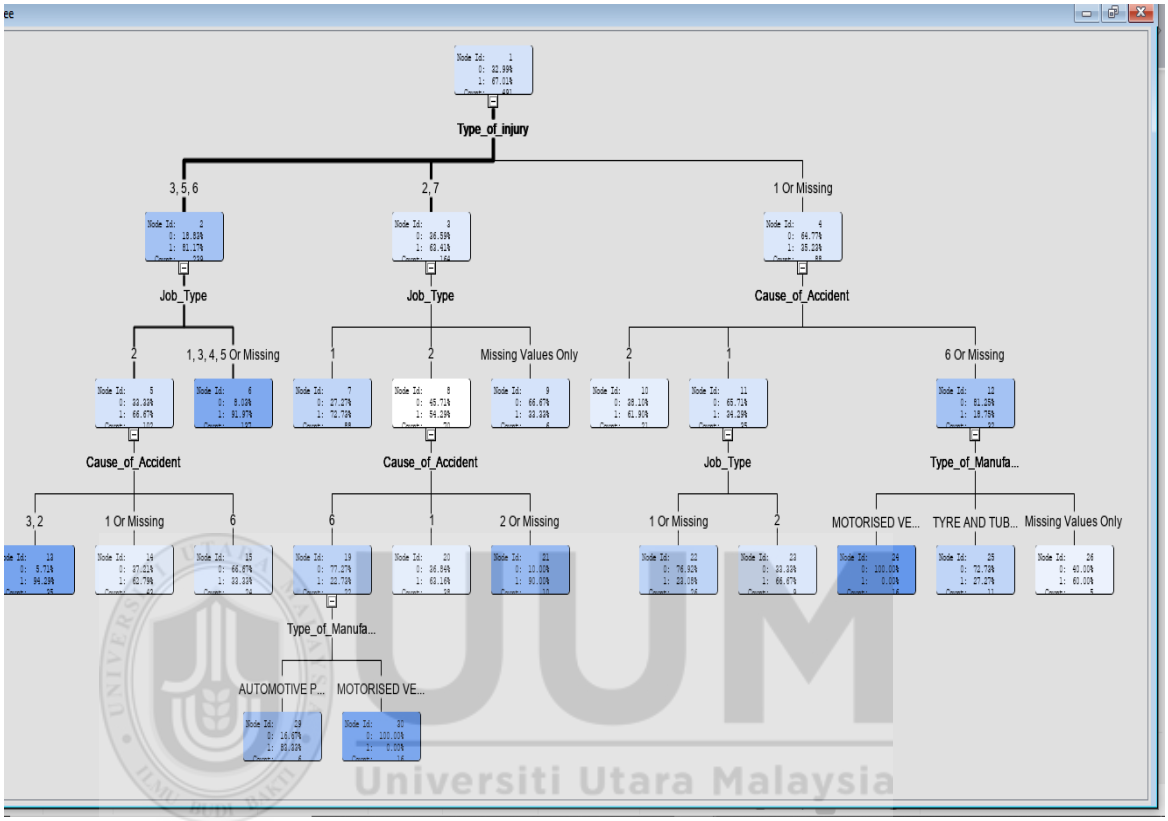
Appendices

Appendix 1. Tree Diagram of Decision Tree Best Model; Chi-Square splitting rule with 60 % train data 40% test data



Appendix 2. Node rules of Decision Tree Best Model

Node = 6

---

if Type of injury IS ONE OF: 3, 5, 6

AND Job Type IS ONE OF: 1, 3, 4, 5 or MISSING

then

Tree Node Identifier = 6

Number of Observations = 137

Predicted: Effect of accident=1 = 0.92

Predicted: Effect of accident=0 = 0.08

Node = 7

---

if Type of injury IS ONE OF: 2, 7

AND Job Type IS ONE OF: 1

then

Tree Node Identifier = 7

Number of Observations = 88

Predicted: Effect of accident=1 = 0.73

Predicted: Effect of accident=0 = 0.27

Node = 9

----

if Type of injury IS ONE OF: 2, 7

AND Job Type equals Missing

then

Tree Node Identifier = 9

Number of Observations = 6

Predicted: Effect of accident=1 = 0.33

Predicted: Effect of accident=0 = 0.67

Node = 10

----

if Type of injury IS ONE OF: 1 or MISSING

AND Cause of Accident IS ONE OF: 2

then

Tree Node Identifier = 10

Number of Observations = 21

Predicted: Effect of accident=1 = 0.62

Predicted: Effect of accident=0 = 0.38

Node = 13

----

if Type of injury IS ONE OF: 3, 5, 6

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 3, 2

then

Tree Node Identifier = 13

Number of Observations = 35

Predicted: Effect of accident=1 = 0.94

Predicted: Effect of accident=0 = 0.06

Node = 14

----

if Type of injury IS ONE OF: 3, 5, 6

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 1 or MISSING

then

Tree Node Identifier = 14

Number of Observations = 43

Predicted: Effect of accident=1 = 0.63

Predicted: Effect of accident=0 = 0.37

Node = 15

----

if Type of injury IS ONE OF: 3, 5, 6

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 6

then

Tree Node Identifier = 15

Number of Observations = 24

Predicted: Effect of accident=1 = 0.33

Predicted: Effect of accident=0 = 0.67

Node = 20

----

if Type of injury IS ONE OF: 2, 7

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 1

then

Tree Node Identifier = 20

Number of Observations = 38

Predicted: Effect of accident=1 = 0.63

Predicted: Effect of accident=0 = 0.37

Node = 21

----

if Type of injury IS ONE OF: 2, 7

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 2 or MISSING

then

Tree Node Identifier = 21

Number of Observations = 10

Predicted: Effect of accident=1 = 0.90

Predicted: Effect of accident=0 = 0.10

Node = 22

----

if Type of injury IS ONE OF: 1 or MISSING

AND Job Type IS ONE OF: 1 or MISSING

AND Cause of Accident IS ONE OF: 1

then

Tree Node Identifier = 22

Number of Observations = 26

Predicted: Effect of accident=1 = 0.23

Predicted: Effect of accident=0 = 0.77

Node = 23

----

if Type of injury IS ONE OF: 1 or MISSING

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 1

then

Tree Node Identifier = 23

Number of Observations = 9

Predicted: Effect of accident=1 = 0.67

Predicted: Effect of accident=0 = 0.33

Node = 24

----

if Type of injury IS ONE OF: 1 or MISSING

AND Type of Manufacturing IS ONE OF: MOTORISED VEHICLES

AND Cause of Accident IS ONE OF: 6 or MISSING

then

Tree Node Identifier = 24

Number of Observations = 16

Predicted: Effect of accident=1 = 0.00

Predicted: Effect of accident=0 = 1.00

Node = 25

----

if Type of injury IS ONE OF: 1 or MISSING

AND Type of Manufacturing IS ONE OF: TYRE AND TUBE INDUSTRIES

AND Cause of Accident IS ONE OF: 6 or MISSING

then

Tree Node Identifier = 25

Number of Observations = 11

Predicted: Effect of accident=1 = 0.27

Predicted: Effect of accident=0 = 0.73

Node = 26

----

if Type of injury IS ONE OF: 1 or MISSING

AND Type of Manufacturing equals Missing

AND Cause of Accident IS ONE OF: 6 or MISSING

then

Tree Node Identifier = 26

Number of Observations = 5

Predicted: Effect of accident=1 = 0.60

Predicted: Effect of accident=0 = 0.40

Node = 29

----

if Type of injury IS ONE OF: 2, 7

AND Type of Manufacturing IS ONE OF: AUTOMOTIVE PART

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 6

then

Tree Node Identifier = 29

Number of Observations = 6

Predicted: Effect of accident=1 = 0.83

Predicted: Effect of accident=0 = 0.17

Node = 30

----

if Type of injury IS ONE OF: 2, 7

AND Type of Manufacturing IS ONE OF: MOTORISED VEHICLES or MISSING

AND Job Type IS ONE OF: 2

AND Cause of Accident IS ONE OF: 6

then

Tree Node Identifier = 30

Number of Observations = 16

Predicted: Effect of accident=1 = 0.00

Predicted: Effect of accident=0 = 1.00