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Diagnosis of Construction Risks in Railway Tunnel Engineering Based on Knowledge Ontology Basis

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Abstract

China is the most populous and the most complex country of the tunnel and underground engineering, so in tunnel construction there are often the occurrence of water inrush, large deformation, landslides, landslides and other risk accident, in order to be more effective for diagnosis of risk, the in construction based on the risk management of ontology library, using the Bayesian network this probabilistic image model, to the construction of the railway tunnel construction risk factors of occurrence probability for diagnostic reasoning so that we can better for the possible risk events measures formulation and prevention.

Key words: RAILWAY ENGINEERING, ONTOLOGY LIBRARY, RISK, DIAGNOSIS.

1. Introduction

China is the most populous which has the most complex country of the tunnel and underground projects in the world, due to different reasons may occur in different geological risks tunnel construction[1].

At present, tunnel construction risk management in China is mainly through risk identification, risk analysis, risk planning, risk tracking, risk control and risk communication to manage. A complete set of scientific risk diagnosis theory did not form, while many mature foreign construction theories are not suitable for China's specific geological structure [2].

In order to be more effective in diagnosing risk in construction based on the risk management of ontology library[3,4], using the Bayesian network probabilistic image model to establish the railway tunnel construction risk factors of occurrence probability for diagnostic reasoning so that we can better the possible risk events measures formulation and prevention[5,6,7,8].

2. Creating an ontology library

The important concepts in Tunnel Engineering Construction Risk includes: Risk environment, Risk factors, Risk event, Risk body, Risk symptom, Water and mud bursting, Large deformation, Landslide, Tunnel face Landslide, Tunnel, Crack, Pressure, Make-up water, Construction disturbance, Geological, Sand gushing[9].

In ontology development tool protégé 4.3, the important concepts related to tunnel construction risk, the relationship between the properties and concepts are defined. Figure 1 (a) is a risk of the tunnel body diagram (part); the figure represents the connection of different colors attribute relationship diagram 1 (b) defined. In order to facilitate risk body transformation to Bayesian networks, we have nothing to hide and reasoning pregnant risk environment, which causes risk factors class, as shown in 1 (c), the From this figure we can clearly see that each concept the causal relationship between.

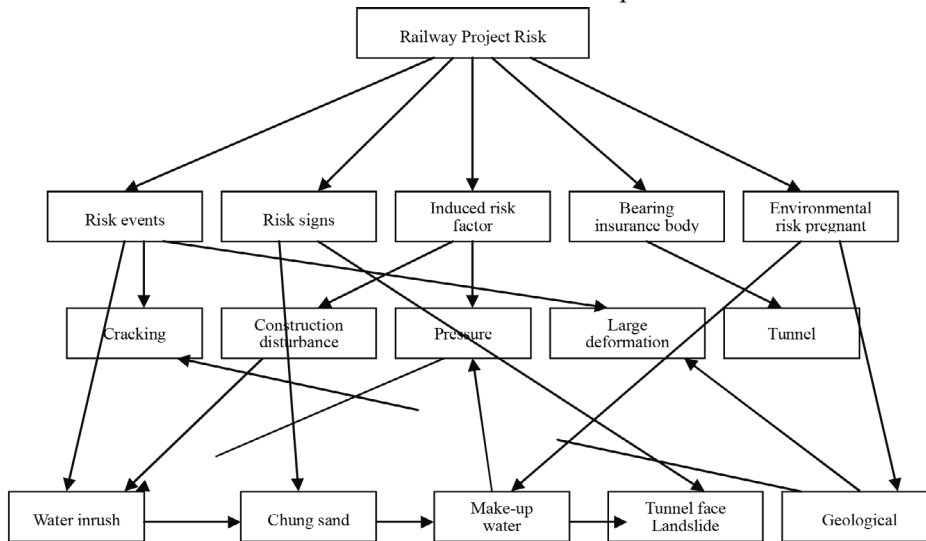


Figure 1 (a)

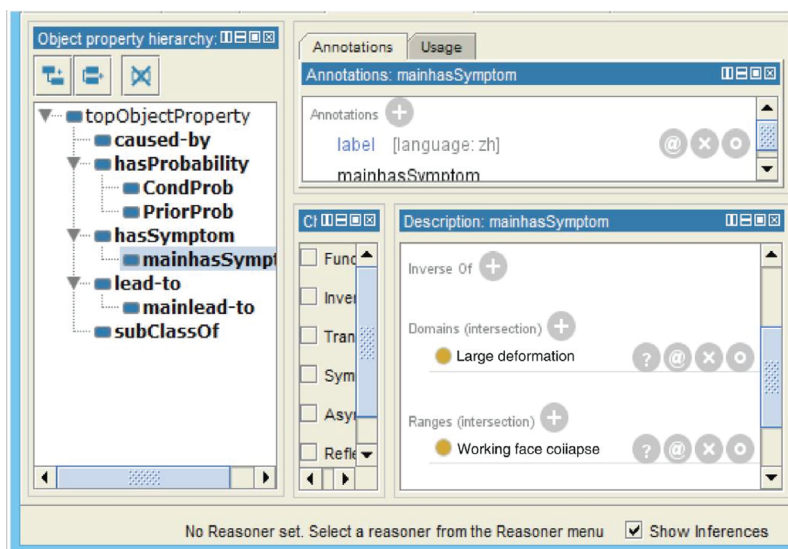


Figure 1 (b)

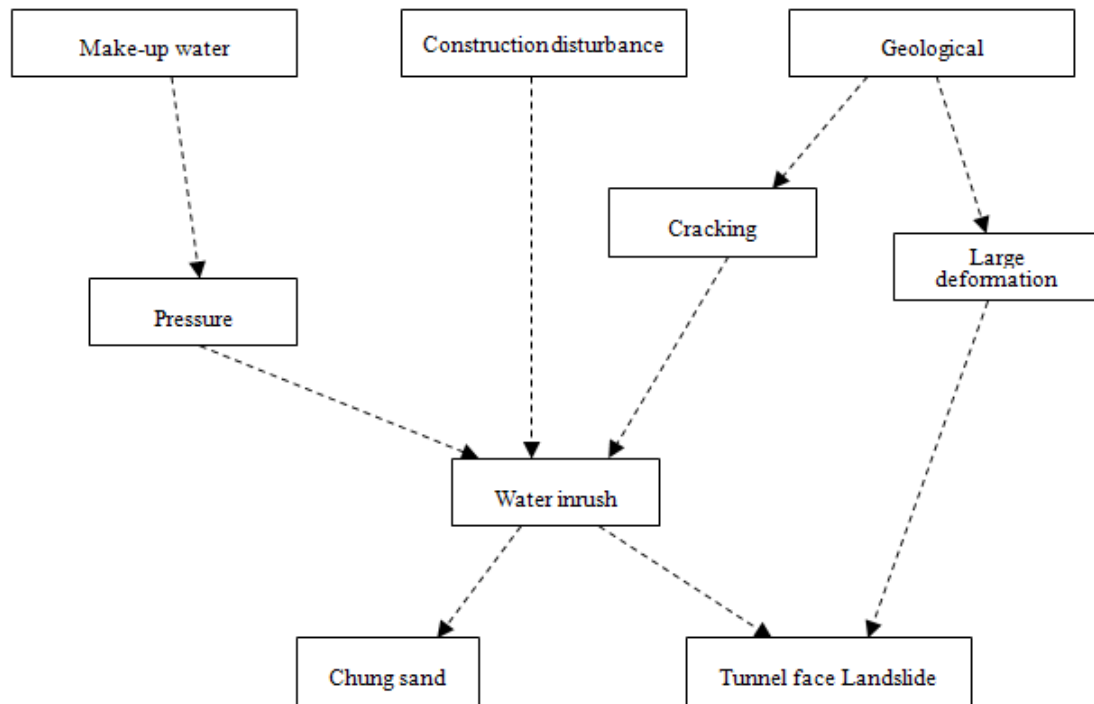


Figure 1 (c)

Figure 1. Tunnel risk body diagram

3. Body Bayesian network transformation

Before the body Bayesian network transforming, we need to firstly define the concept of property values of each node. Property values include: node

name, node status, and the status values. A simple calculation we have taken the two states each node, as shown in Table 1.

Table 1. Bayesian Network node property value

The concept name	Node Name	Node Status	Status values	Status Explanation
Water inrush	W	occur	1	Water and mud outburst event
		Unoccur	0	Water and mud outburst event does not occur
Large Deformation	L	present	1	Tunnel excavation face large deformation
		absent	0	No tunnel excavation face large deformation
Cracking	Cr	present	1	Rock cracking
		absent	0	Rock uncracked
Pressure	P	high	1	Formation pressure is higher than or equal to 1Mpa
		low	0	Formation pressure lower than 1Mpa
Water supply	M	adequate	1	Rainfall greater than or equal 50mm/d or surface water development
		inadequate	0	Rainfall is less than 50mm/d, less surface water
Working face collapse	T	present	1	Working face landslides
		absent	0	Working face collapse does not appear

Bay Sand	S	present	1	There Chung Nai Chung sand phenomenon
		absent	0	No Chung Nai Chung sand phenomenon
Geological conditions	G	good	1	No adverse geological conditions
		bad	0	Caves, fault fracture zone, swelling rock area, chipping and loose structure, and other joints fractured
Construction interference	Co	present	1	Increasing pressure on surrounding rock loose
		absent	0	Did not affect the surrounding rock

Figure 1 (c) into the tunnel construction risk Bayesian network shown in Figure 2. Then Bayesian network diagram cannot be used for reasoned, be-

cause there is no definition of conditional probability tables for each node.

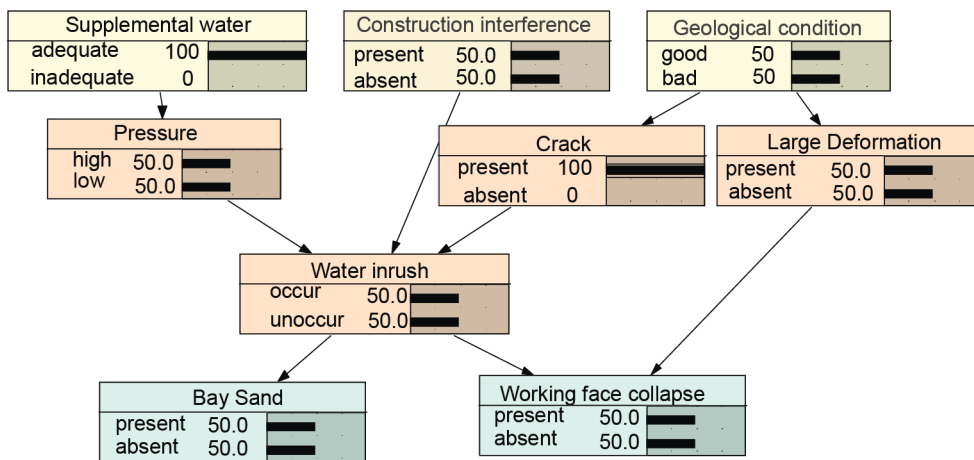


Figure 2. Bayesian network Tunnel Engineering Construction Risk

4. Construction of conditional probability tables Model

We use Bayesian Network Toolbox[10] (BNT), which is under the conditions of a given network parameter simulation training simulation data generated

in different periods, to give the conditional probability of each node as shown in Table 2. Known M, Cd, prior probability of G [2] is: P (M = adequate) = 0.4, P (Cd = present) = 0.9, P (M = good) = 0.2.

Table 2. Conditional probability tables

		(MP)	
		M	
		T	F
P	T	0.8	0.1
	F	0.3	0.9
		(GCr)	
		G	
		T	F
Cr	T	0.01	0.1
	F	0.99	0.9
		(GL)	
		G	
		T	F
L	T	0.05	0.3
	F	0.95	0.8
		(WS)	
		W	

		T	T
S	T	0.99	0.05
	F	0.02	0.95

(WL, T)

		WL			
		TT	TF	FT	FF
T	T	0.9	0.8	0.9	0.1
	F	0.1	0.3	0.2	0.9

(PCdG, W)

		PCdG							
		TTT	TTF	TFT	FTT	TFF	FTF	FFT	FFF
W	T	0.9	0.8	0.55	0.25	0.3	0.1	0.1	0.01
	F	0.2	0.3	0.45	0.85	0.8	0.9	0.9	0.99

According to tunnel risk probability distribution obtained from the tunnel has been brought to the probability of risk Bayesian network diagram shown in Figure 3.

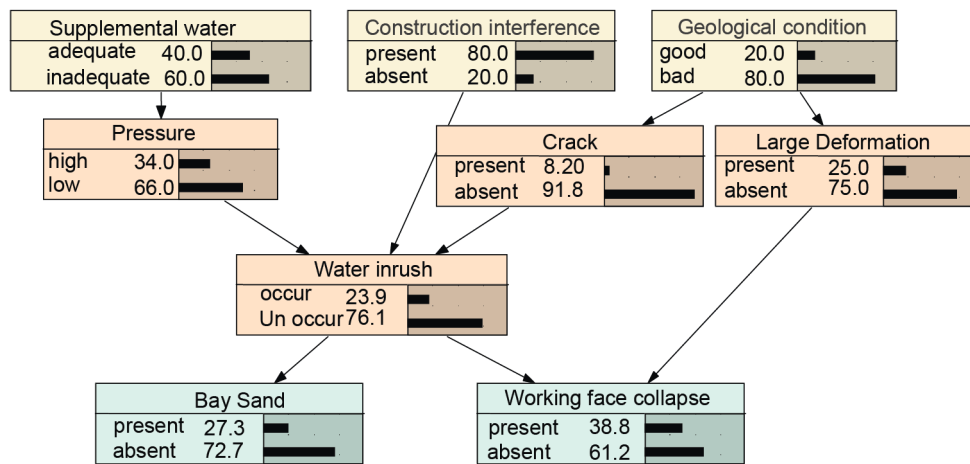


Figure 3. Tunnel Engineering Construction Risk Bayesian network

5. Case Applications

A railway tunnel is conducted under more karsts geological conditions and construction fault fracture zone, which produce a certain amount of disturbance surrounding rock, that poor geological conditions, and there has been construction disturbance, in this case, changing the probability change of occurrence of each risk is shown in Figure 4, we can see the risk of the occurrence of water and mud outburst by a 23.9% increase in the probability of 28.1%, while Chung sand, the probability of the tunnel face the risk of collapse signs appearing significantly increased.

If at this time it began to rain, rainfall is more than or equal 50mm/d, that is, under adequate water supply situation, the probability of occurrence of each risk that will be new changes, and is shown in Figure 5. The probability of inrush risk events reached to 43.8%, while Chung sand, the probability of the

risk of collapse of the working face signs have also increased, so at this time we have to take preventive measures to deal with the risk of water and mud outburst events.

If in the course of construction, the sudden emergence of the phenomenon of the working face collapse, so in this case, we can determine what risk is. As shown, the probability of collapse in case the working faces of each risk event. From Figure 6, we can clearly see the water and mud outburst, large deformation, the probability of increased pressure has changed a lot, from the original 23.9 percent, respectively, 25% and 34% increase of 46.3% 53.1% and 45.9%. So we have to be aware of and high-pressure water inrush hazards, large deformation and other risk events.

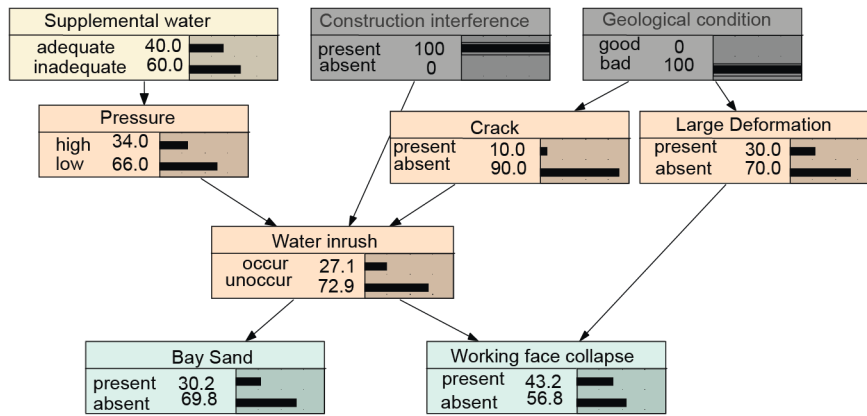


Figure 4. Under adverse geology and construction disturbance Bayesian Figure

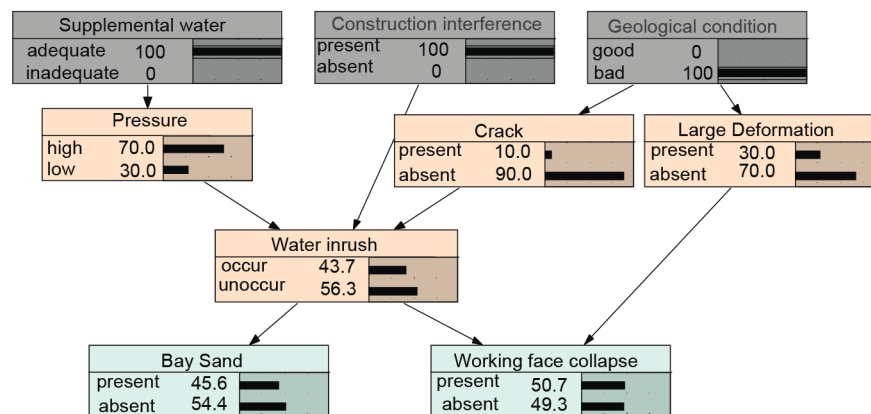


Figure 5. Below adequate water supply, construction interference, Poor geological conditions Bayesian Figure

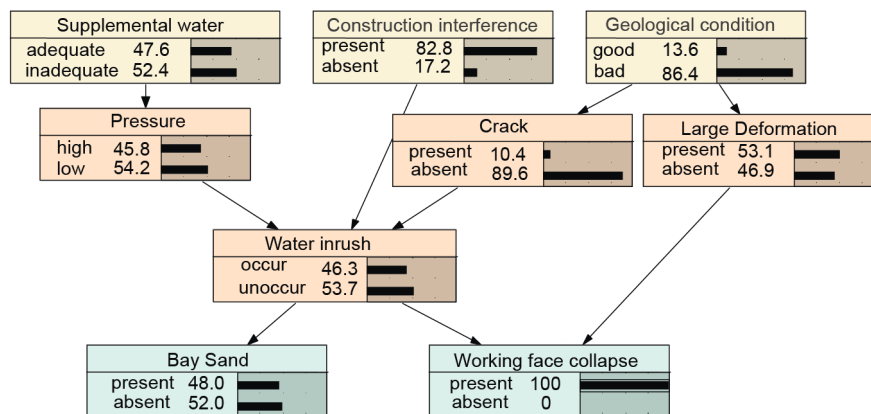


Figure 6. Heading face collapse under the circumstances Bayesian Figure

6. Conclusions

This paper describes the diagnostic railway tunnel construction risks in the construction of the library on the basis of ontology, firstly proposing building a railway tunnel construction risk ontology, followed by the body to convert Bayesian network constructed on Railway Tunnel Construction Risk of conditional probability table model, and finally by a further risk diagnostic reasoning, draw Probability railway tunnel construction risk point of change. It provides a practical reference for railway tunnel construction risk

management.

Acknowledgments

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Array LED Light Source Used with CCD Optical Target

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Abstract

There are currently no test systems which can work in indoor environment of large screen set target. According to CCD optical target applying outdoor, the constitute of the light is analyzed, the method that the light source is designed to provide background illumination for CCD optical target using specific wavelengths light emitting diode is proposed. According to the CCD responsivity, the light source of CCD optical target is designed with wavelength of 680nm LED. Through the simulation