

**DEVELOPING A MODEL TO PREDICT  
UNSAFE BEHAVIOUR OF CONSTRUCTION WORKERS  
IN SRI LANKA**

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**July 2017**

## DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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## **ABSTRACT**

The construction industry is known to be one of the most accident-prone of work sectors around the globe. Although the construction output is less in Sri Lanka, compared to developed countries in general, the magnitude of the accident rate in the construction industry is significantly high. Most of the occupational accidents happen due to the unsafe behaviour of the workers. Along with this revelation, behaviour based safety has emerged as an effective approach to ensure occupational safety. The principal step of behaviour based safety approach involves the identification of the unsafe behaviour of the workers. The research, therefore, focused on investigating factors influencing construction workers' unsafe behaviour and developing a model to predict unsafe behaviour originated from those factors.

Quantitative research strategy was selected to carry out the study considering the nature of this investigation. The acts characterising the unsafe behaviour of construction workers, and the factors influencing those were identified through a literature survey. A pilot study was undertaken to validate and generalise the literature findings to the Sri Lankan construction industry. Fifteen unsafe acts those characterise the unsafe behaviour and fourteen factors those influence the unsafe behaviour were identified relevant to the local context. A survey approach was used to collect data. C1 grade building construction organisations were selected as the sampling framework. Twenty organisations were chosen within Colombo district to gather information from construction workers. The processed data were used to develop and train an Artificial Neural Network (ANN) predictive model that could predict unsafe behaviour of a construction worker with respect to a score.

Backpropagation architecture using Neuroph Studio software was employed to develop the predictive model. 277 data points taken from the survey were used to train the network. The architecture of the trained model was demonstrated by conducting a sensitivity analysis. Mean Absolute Error was the technique used in this process. Sensitivity analysis showed that the model is highly sensitive to the neuron corresponding to "education", while the lowest sensitivity was evident for the neuron corresponding to "employee involvement in safety". The results suggests that educational level of a worker has the highest influence on his unsafe behaviour at work. Similarly, the co-workers' involvement in safety on site has the lowest influence on unsafe behaviour of a worker. Furthermore, the predictive model was validated for generalisability using seven data points those were not used in training the network. The findings depict that the performance of the model is accurate due to high generalisation capabilities in the validation session. The model serve as a prototype tool to determine the unsafe behaviour level of construction workers and their safety training needs. This model can further be employed as a tool to proactively design interventions to avoid or minimise occupational accidents based on the unsafe behaviour levels of construction workers.

**Keywords: Construction Industry, Construction Safety, Construction Worker, Unsafe Behaviour, Artificial Neural Networks.**

*To my parents...*

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## TABLE OF CONTENTS

DECLARATION .....	i
ABSTRACT .....	ii
DEDICATION .....	iii
ACKNOWLEDGMENT .....	iv
LIST OF FIGURES .....	viii
LIST OF TABLES .....	ix
LIST OF ABBREVIATIONS .....	x
1. INTRODUCTION TO THE RESEARCH .....	1
1.1 Background .....	1
1.2 Research problem statement.....	4
1.3 Research aim and objectives .....	5
1.4 Research design .....	6
1.5 Scope and limitations .....	7
1.6 Chapter breakdown.....	8
1.7 Summary .....	9
2. LITERATURE REVIEW.....	10
2.1 Introduction .....	10
2.2 Occupational safety & accidents in construction industry .....	10
2.3 Causes of construction accidents.....	12
2.4 Behaviour based safety.....	16
2.5 Human behaviour .....	17
2.6 Unsafe behaviour of construction workers.....	19
2.7 Factors influencing unsafe behaviour of construction workers.....	21
2.7.1. Person (Individual dynamics) .....	22

2.7.2.	Process (Work environment).....	28
2.7.3.	Place (Organisational safety culture) .....	31
2.8	Predictive modelling.....	39
2.9	Model for predicting unsafe behaviour of construction workers .....	43
2.10	Overview of ANN .....	44
2.10.1	Architecture of ANN.....	44
2.10.2	Mathematical illustration of ANN .....	45
2.10.3	Training the ANN .....	46
2.11	Summary .....	47
3.	RESEARCH METHODOLOGY.....	48
3.1	Introduction .....	48
3.2	Research design.....	48
3.3	Methodological paradigm.....	50
3.3.1.	The research paradigm adopted .....	52
3.4	Research strategy.....	53
3.4.1.	Qualitative research strategies.....	53
3.4.2.	Quantitative research strategies.....	53
3.4.3.	Mixed method strategies .....	54
3.4.4.	The adopted research strategy .....	54
3.5	Research method .....	57
3.5.1.	Phase 1: Background study .....	58
3.5.2.	Phase 2: Literature review and the pilot study .....	58
3.5.3.	Phase 3: Main survey .....	59
3.5.4.	Phase 4: Data analysis.....	69
3.6	Research validity .....	79
3.7	Summary .....	80



4.	DATA ANALYSIS AND FINDINGS .....	81
4.1	Introduction .....	81
4.2	The responsive sample .....	81
4.3	Reliability analysis of data .....	82
4.4	Data analysis and discussion .....	83
	4.4.1    Unsafe acts .....	83
	4.4.2    Influential factors .....	86
	4.4.3    ANN predictive model .....	88
4.5	Discussion .....	107
4.6	Summary .....	110
5.	CONCLUSIONS.....	111
5.1	Introduction .....	111
5.2	Conclusions .....	111
5.3	Contribution to knowledge.....	118
5.4	Contribution to the industry .....	118
5.5	Research limitations .....	119
5.6	Future research directions .....	120
	REFERENCES.....	121
	Appendix 1: Interview guidelines of the pilot study .....	156
	Appendix 2: Main survey questionnaire .....	159
	Appendix 3: The Kessler K6.....	165
	Appendix 4: Health & safety climate survey tool by HSE .....	166
	Appendix 5: Training dataset.....	168
	Appendix 6: List of publications.....	182

## LIST OF FIGURES

Figure 1-1: Steps of BBS .....	4
Figure 1-2: Research work plan .....	7
Figure 1-3: Chapter breakdown .....	8
Figure 2-1: An illustration of the domino theory .....	13
Figure 2-2: Contributing causes to construction accidents .....	16
Figure 2-3: Unsafe acts of construction workers .....	20
Figure 2-4: Literature review briefing.....	21
Figure 3-1: Framework for research design .....	49
Figure 3-2: Research process .....	57
Figure 3-3: Scoring of unsafe acts .....	61
Figure 3-4: Sample selection.....	67
Figure 3-5: Data analysis techniques adopted.....	69
Figure 3-6: Theoretical model of unsafe behaviour of construction workers.....	72
Figure 3-7: Calculation of expected USBS .....	73
Figure 3-8: ANN structure .....	75
Figure 3-9: Sensitivity analysis of ANN predictive model.....	78
Figure 4-1: Expected USBS of the responsive sample .....	85
Figure 4-2: Total network error graph of the optimum network.....	90
Figure 4-3: Structure of the optimum network of ANN predictive model .....	91
Figure 4-4: Architecture of the ANN predictive model.....	93
Figure 4-5: Network outputs for model validation set.....	106

## LIST OF TABLES

Table 2-1: Construction accident causation studies .....	14
Table 2-2: Influential factors of construction workers' unsafe behaviour .....	37
Table 3-1: Contrasting implications between positivism and interpretivism.....	51
Table 3-2: Ways of thinking about research philosophy .....	52
Table 3-3: Pilot study interviewee profile.....	59
Table 3-4: National registration & grading scheme for construction contractors.....	66
Table 3-5: Values of Cronbach's alpha .....	70
Table 4-1: Responsive sample .....	82
Table 4-2: Results of reliability analysis.....	82
Table 4-3: Unsafe acts-Mean rating of occurrence .....	83
Table 4-4: Factors influencing unsafe behaviour of construction workers in Sri Lanka .....	86
Table 4-5: ANN training results.....	89
Table 4-6: Results of the sensitivity analysis .....	92
Table 4-7: Reported unsafe behaviour of the validation set .....	104
Table 4-8: Predictive model validation results.....	106
Table 4-9: Influential factor values of Case 4 & Case 6 .....	107

## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
ANN	Artificial Neural Networks
BBS	Behaviour Based Safety
BLS	Bureau of Labour Statistics
CIDA	Construction Industry Development Authority
EU-OSHA	European Agency for Safety and Health at work
HSE	Health and Safety Executive
ILO	International Labour Organization
IOSH	Institution of Occupational Safety and Health
MAE	Mean Absolute Error
RoSPA	Royal Society for the Prevention of Accidents
SMI	Serious Mental Illness
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
USA	United States of America
USBS	Unsafe Behaviour Score