# Contents

1. **INTRODUCTION**  
   1.1 Fire safety in buildings  
   1.2 Psychonomics and fire safety  
   1.3 Wayfinding and evacuation behaviour  
   1.4 Objective and scope  
   1.5 Research approach and thesis outline  

2. **BUILDING SAFETY AND HUMAN BEHAVIOUR IN FIRE: A LITERATURE REVIEW**  
   2.1 Introduction  
   2.2 Overview of considerable research into human behaviour in a fire  
   2.3 Fire response performance  
   2.4 Summary and conclusions  

3. **FIRE RESPONSE PERFORMANCE ANALYSIS: A CASE STUDY**  
   3.1 Introduction to the FRP model  
   3.2 Qualitative analysis with the FRP model  
   3.3 Application of the FRP model in a case study  
   3.4 Observations  
   3.5 Conclusions  

4. **METHODOLOGY FOR RESEARCH INTO FIRE SAFETY PSYCHONOMICS**  
   4.1 Introduction  
   4.2 Analysis tools for fire safety engineering  
   4.3 Research methods for collecting data on human behaviour in fire  
   4.4 Arguments for and against the use of specific research methods  
   4.5 Summary and conclusions  

5. **EXPERIMENTAL RESEARCH DESIGN**  
   5.1 Introduction  
   5.2 Test scenarios  
   5.3 Test sessions  
   5.4 Test activities  
   5.5 Types of analyses  
   5.6 Design of the experimental research  


5.7 Research design for validation of ADMS-BART 128
5.8 Methods of data gathering 133
5.9 Participants, invitation and compensation 142

6. DEVELOPMENT OF THE SERIOUS GAME ADMS-BART 149
6.1 Need for a new research method 150
6.2 The Advanced Disaster Management Simulator 151
6.3 Design of the Behavioural Assessment and Research Tool (BART) 155
6.4 Results of user convenience analyses of tests with BARTtrial 157
6.5 Implications of the user convenience test for the development of ADMS-BART 163
6.6 Results of user convenience analyses of tests with ADMS-BART 164
6.7 Summary and conclusions 171

7. WAYFINDING DURING FIRE EVACUATION IN A HOTEL: AN EXPERIMENTAL STUDY 177
7.1 Introduction 178
7.2 Experiments in real environment 180
7.3 Experiments in virtual environment (ADMS-BART) 210
7.4 Comparison of findings in literature with experimental findings in the real environment 221
7.5 Conclusions 223

8. VALIDATION OF ADMS-BART 237
8.1 Introduction 238
8.2 STEP 1: Findings on group compositions 240
8.3 STEP 2: Results of the absolute validation analysis 246
8.4 STEP 3: Results of the relative validation analysis 252
8.5 Further analysis of potential explanatory variables 254
8.6 STEP 4: Assessment of a potential influence of game control skills 269
8.7 Summary and conclusions 271
9. SUMMARY WITH CONCLUSIONS AND RECOMMENDATIONS 279

9.1 Introduction 280
9.2 Results of the literature review 282
9.3 Case study with use of the FRP model 284
9.4 Methods for research on building fire safety 287
9.5 Development of serious game ADMS-BART 288
9.6 Experimental study on wayfinding during fire evacuation in a hotel 291
9.7 Validation of serious game ADMS-BART 298

SAMENVATTING MET CONCLUSIES EN AANBEVELINGEN 301

DANKWOORD 325

ACKNOWLEDGEMENTS 329

ABOUT THE AUTHOR 333