A DECISION SUPPORT SYSTEM
FOR THE DETERMINATION OF CONCESSION
PERIOD IN TRANSPORTATION PROJECT
UNDER BUILD-OPERATE-TRANSFER
CONTRACT

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A Decision Support System for the Determination of Concession Period in Transportation Project under Build-Operate-Transfer Contract

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ABSTRACT

The determination of the concession period length is one of the most important decisions undertaken during the life span of a Build-Operate-Transfer project. The concession period length directly affects both the involved government and private investors' financial returns and risks, and offers significant economic and social benefits. In existing methods, the concession period is usually determined by the concessionaire, depending on their expected investment return using the payback period method or it is predicted without comprehensive analysis of the influential factors. In view of this, a Decision Support System for concession period length determination (CPLD) was developed and, as demonstrated herein provides a possible way of solving the concession period problem, especially under the impact of various influential factors.

In the proposed Decision Support System, an overall model for CPLD, and two sub-models for predicting the key variables of CPLD were developed. Since the length of the concession period is under impact from various factors, an in-depth investigation of the influential factors was firstly conducted, in which the selection, classification, and ranking of the influential factors were concerned. Thus the input variables for the models involved in this system were generated. Then two sub-models were developed to predict the key variables (Traffic flow and Toll fee) of concession period length, so as to make the overall model for CPLD reliable and perform smoothly. Additionally, a Variable Evaluation System was constructed. The input variables involved in the model were tested in this section. Thus the degree of importance of each variable was obtained. Finally, the overall model for CPLD was developed. The
established model does not mean to achieve the highest profit for any side (either the government or the private sector); rather it means a balance of the two extreme sides within the same decision-making process.

Two datasets of tunnel projects in Hong Kong were constructed to verify the prediction models. A dataset of a simulated highway project was employed for training the overall model of CPLD. The experimental results show that the proposed method and system can provide the decision makers with a set of alternatives, among which an optimal one can be selected after balancing the interests of both the government and private sectors. Thus the Decision Support System was developed. It is expected that the proposed DSS can assist the decision-making process of concession period length determination, and finally contribute both theoretical and practical knowledge for academics and practitioners in the field.

**Keywords:** Decision Support System, Concession period length determination, Traffic flow prediction, Toll fee prediction, Variable Evaluation
TABLE OF CONTENTS

Abstract i
Acknowledgement iii
Declaration Form iv
Publications v
Table of Contents vi
List of Tables x
List of Figures xv
List of Symbols xviii
List of Abbreviation xx

CHAPTER 1 INTRODUCTION 1
1.1 Background of the Research 1
   1.1.1 Define the research problem 2
   1.1.2 Significance of the research 4
1.2 Research Aim and Objectives 6
   1.2.1 Research aim 6
   1.2.2 Research objectives 6
1.3 Research Methodology 8
   1.3.1 Research scope 8
   1.3.2 Research methods and procedures 9
1.4 Summary 14

CHAPTER 2 LITERATURE REVIEW 19
2.1 General Aspects of A Concession Period Length Determination of Build-Operate-Transfer Projects 19
2.2 Previous Research Studies on Build-Operate-Transfer Projects and Concession Period Length Determination 21
   2.2.1 Previous research studies on Build-Operate-Transfer projects 21
   2.2.2 Previous research studies on concession period length determination 26
2.3 Influential Factors 31
   2.3.1 Influential factors for concession period length determination 31
   2.3.2 Sub-factors for traffic flow and toll fee prediction 38
2.4 Mathematical Methods

2.4.1 Variable ranking methods
2.4.2 Prediction methods
2.4.3 Simulation method

CHAPTER 3 THEORY

3.1 Build-Operate-Transfer and Concession Period Length Determination

3.1.1 Build-Operate-Transfer
3.1.2 Concession period length determination

3.2 Decision Support System

3.2.1 Selection of the decision support technology
3.2.2 Design of the Decision Support System

3.3 Critical Mathematical Methods

3.3.1 Variable ranking methods
3.3.2 Prediction methods
3.3.3 Simulation method

CHAPTER 4 DEVELOPMENT OF THE INFLUENTIAL FACTORS

4.1 Research Framework for Influential Factors of CPLD

4.2 Identify the Influential Factors for CPLD

4.3 Identify the Influential Factors for Traffic Flow and Toll Fee

4.3.1 Identify the factors for Traffic flow
4.3.2 Identify the factors for Toll fee
4.3.3 Illustration to the identified factors

4.4 Qualification of the variables

CHAPTER 5 DECISION SUPPORT SYSTEM I - DEVELOPMENT OF THE SYSTEM AND THE OVERALL MODEL

5.1 Decision Support System of the Research

5.1.1 The design process of the Decision Support System
5.1.2 Decision Support System of the research

5.2 The Overall Model for Concession Period Length Determination

5.2.1 Development of the overall model for concession period length determination
5.2.2 Model design
5.2.3 Implementation of the model 176

CHAPTER 6 DECISION SUPPORT SYSTEM II - PREDICTION MODELS FOR TRAFFIC FLOW AND TOLL FEE 178

6.1 Significances and Problems of the Prediction 179
   6.1.1 Significance of the prediction for Traffic flow 179
   6.1.2 Significance of the prediction for Toll fee 179
   6.1.3 Problems of the prediction 180

6.2 Model Design 183
   6.2.1 Objective function and modeling principles 184
   6.2.2 Model design for prediction 188

CHAPTER 7 CASE STUDY 215

7.1 Case Study I - Verification of the Prediction Model for Traffic Flow 217
   7.1.1 Background of case study I 217
   7.1.2 Input variables of case study I 220
   7.1.3 Results analysis and discussion (Case study I) 224
   7.1.4 Evaluation of the variables of Traffic flow 235

7.2 Case Study II - Verification of the Prediction Model for Toll Fee 237
   7.2.1 Case background 237
   7.2.2 Input variables of case study II 238
   7.2.3 Results analysis and discussion (Case study II) 242
   7.2.4 Evaluation of the variables of Toll fee 247

7.3 Case Study III - Verification of the Overall Model for Concession Period Length Determination 249
   7.3.1 Case background 249
   7.3.2 Results analysis and conclusion of case study III 250

CHAPTER 8 CONCLUSIONS AND FURTHER STUDIES 261

8.1 The Developed Decision Support System for Concession Period Length Determination 262

8.2 Limitations and Further Research 265

REFERENCES 271

BIBLIOGRAPHY 288
APPENDIX A - EXTENSIVE LITERATURE REVIEW 294
APPENDIX A.I – Summary of the Concession Period of BOT Project in Hong Kong and Other International Cities 295

APPENDIX B - QUESTIONNAIRE SURVEY 297
APPENDIX B.I - The Questionnaire Design 298
APPENDIX B.II - An Example of the Response 302
APPENDIX B.III - Result Analysis by Principal Component Analysis (Main Variables) 306
APPENDIX B.IV - Result Analysis by Principal Component Analysis (Sub-Variables) 310

APPENDIX C - DATA 321
APPENDIX C.I - Datasets for Traffic Flow Prediction 322
APPENDIX C.II - Datasets for Simulation 332
APPENDIX C.III - Datasets for Toll fee prediction 335

APPENDIX D - NORMALIZATION OF THE VARIABLES 340

APPENDIX E - COMPUTING PROGRAMME 350
APPENDIX E.II - Computer Code of Multiple Kernel Learning for Prediction 355
APPENDIX E.III - Computer Code of Monte Carlo for Simulation 359

APPENDIX F - RANKING OUTCOME 365
APPENDIX F.I - Summary of the Ranking Result of Each Variable for Traffic Flow by Entropy 366
APPENDIX F.II - Summary of the Ranking Result of Each Variable for Toll Fee by Entropy 378

APPENDIX G - VARIABLE EVALUATION 387
APPENDIX G.I - Evaluate the Relationship between the Influential Factors and the Key Variables of Concession Period Length 388

APPENDIX H - PUBLISHED PAPER 391
APPENDIX H.I - Recent Advances and Improvements for the Determination of Concession Period Length of Build-Operate-Transfer Project. (“Excellent Paper” Prize) 392
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.1</td>
<td>Comparison of three tunnel projects in Hong Kong</td>
<td>20</td>
</tr>
<tr>
<td>Table 2.2</td>
<td>Summary of previous research studies on Build-Operate-Transfer</td>
<td>24</td>
</tr>
<tr>
<td>Table 2.3</td>
<td>Summary of previous research studies on concession period length determination</td>
<td>27</td>
</tr>
<tr>
<td>Table 2.4</td>
<td>Summary of influential factors for Build-Operate-Transfer project</td>
<td>36</td>
</tr>
<tr>
<td>Table 2.5</td>
<td>Summary of influential factors under financial category</td>
<td>37</td>
</tr>
<tr>
<td>Table 2.6</td>
<td>Factors affecting the revenue level and the traffic flow of transportation project under BOT contract</td>
<td>39</td>
</tr>
<tr>
<td>Table 2.7</td>
<td>Summary of the ranking methods</td>
<td>42</td>
</tr>
<tr>
<td>Table 2.8</td>
<td>Comparison of the prediction methods</td>
<td>47</td>
</tr>
<tr>
<td>Table 2.9</td>
<td>Summary of research studies on Artificial Neural Network for prediction</td>
<td>50</td>
</tr>
<tr>
<td>Table 2.10</td>
<td>Summary of research studies on Support Vector Machine for prediction</td>
<td>53</td>
</tr>
<tr>
<td>Table 3.1</td>
<td>Comparison of single-period and two-period concession design</td>
<td>63</td>
</tr>
<tr>
<td>Table 3.2</td>
<td>Attributes of the major computerized support systems</td>
<td>69</td>
</tr>
<tr>
<td>Table 3.3</td>
<td>Categories of models</td>
<td>79</td>
</tr>
<tr>
<td>Table 3.4</td>
<td>The advantages and disadvantages of Neural Networks</td>
<td>84</td>
</tr>
<tr>
<td>Table 3.5</td>
<td>Boundary of feasible regions for regression</td>
<td>90</td>
</tr>
<tr>
<td>Table 4.1</td>
<td>Summary of influential factors for Traffic flow and Toll fee</td>
<td>107</td>
</tr>
<tr>
<td>Table 4.2</td>
<td>Summary of the quantitative and qualitative factors</td>
<td>108</td>
</tr>
<tr>
<td>Table 4.3</td>
<td>Inflation rate of each year in Hong Kong</td>
<td>113</td>
</tr>
<tr>
<td>Table 4.4</td>
<td>Classification of factors affecting the traffic flow</td>
<td>118</td>
</tr>
<tr>
<td>Table</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.5</td>
<td>Daily traffic volumes by vehicles Category</td>
<td>120</td>
</tr>
<tr>
<td>4.6</td>
<td>The timeline of the toll fee adjustment</td>
<td>121</td>
</tr>
<tr>
<td>4.7-1</td>
<td>The actual toll level of the eight vehicles from year of 1997 to 2008</td>
<td>122</td>
</tr>
<tr>
<td>4.7-2</td>
<td>Summary of the actual toll level of the eight vehicles (1997 to 2008)</td>
<td>123</td>
</tr>
<tr>
<td>4.8</td>
<td>Trend division of these vehicles</td>
<td>124</td>
</tr>
<tr>
<td>4.9</td>
<td>Classification of the vehicles</td>
<td>125</td>
</tr>
<tr>
<td>4.10</td>
<td>Daily average vehicles of private cars (PC), taxi, goods vehicles and buses</td>
<td>126</td>
</tr>
<tr>
<td>4.11</td>
<td>Qualification of the variables</td>
<td>134</td>
</tr>
<tr>
<td>4.12</td>
<td>Scaling assumption for the factor of Capacity of the service</td>
<td>135</td>
</tr>
<tr>
<td>4.13</td>
<td>Scaling assumption for the factor of Maintenance cost</td>
<td>136</td>
</tr>
<tr>
<td>4.14</td>
<td>Scaling assumption for the factor of Capacity of the service</td>
<td>136</td>
</tr>
<tr>
<td>4.15</td>
<td>Scaling assumption for the factor of Network links</td>
<td>138</td>
</tr>
<tr>
<td>4.16</td>
<td>Scaling assumption for the factor of Competition of alternative service</td>
<td>139</td>
</tr>
<tr>
<td>4.17</td>
<td>Scaling assumption for the factor of Economic growth</td>
<td>140</td>
</tr>
<tr>
<td>4.18</td>
<td>Scaling assumption for the factor of Economic growth</td>
<td>140</td>
</tr>
<tr>
<td>4.19</td>
<td>the Number of private car licensed from 1997 to 2009</td>
<td>142</td>
</tr>
<tr>
<td>4.20</td>
<td>Scaling assumption for the factor of Private car growth</td>
<td>142</td>
</tr>
<tr>
<td>4.21</td>
<td>The population growth from 1997 to 2009</td>
<td>143</td>
</tr>
<tr>
<td>4.22</td>
<td>Scaling assumption for the factor of Demographic/population growth</td>
<td>144</td>
</tr>
<tr>
<td>4.23</td>
<td>The indicator of V/C from 1997 to 2009</td>
<td>145</td>
</tr>
<tr>
<td>4.24</td>
<td>Scaling assumption for the factor of Willingness to pay</td>
<td>144</td>
</tr>
<tr>
<td>4.25</td>
<td>The actual traffic flow from 1997 to 2009</td>
<td>146</td>
</tr>
<tr>
<td>4.26</td>
<td>Scaling assumption for the factor of Traffic flow</td>
<td>146</td>
</tr>
<tr>
<td>4.27</td>
<td>Scaling assumption for the variables</td>
<td>147</td>
</tr>
</tbody>
</table>
Table 5.1 Total variance explained 169
Table 5.2 Component score coefficient matrix 170
Table 5.3 Correlation matrix of the seven variables 171

Table 6.1 Total variance explained 191
Table 6.2 Component score coefficient matrix 192
Table 6.3 Correlation matrix of the 12 variables 193
Table 6.4 The key variables for Traffic flow 196
Table 6.5 The key variables for Toll fee 197
Table 6.6 A format of the calculation process of Entropy 197
Table 6.7 A format of the priority ranking of variables 198
Table 6.8 A format of the normalization for each variable 213
Table 6.9 A format of the dataset for modeling 213
Table 6.10 A format of the formalized dataset for computing 213

Table 7.1 Details of the project (Tunnel C) 218
Table 7.2 The actual revenue (year ending 31 July) 219
Table 7.3 Summary of the input variables for traffic flow prediction 220
Table 7.4 The original data and normalization process of the variable of Capacity of the service 222
Table 7.5 Ranking results of the variables of Traffic flow 223
Table 7.6 Priority ranking of variables for Traffic flow 225
Table 7.7 Summary of the Traffic flow prediction results by SVM 231
Table 7.8 Comparison of Support Vector Machine and Multiple Kernel Learning for prediction 234
Table 7.9 The accuracy change in terms of different distribution of the variable 235
Table 7.10 Details of the project 237
Table 7.11 Summary of the input variables for traffic flow prediction

Table 7.12 The original data and normalization process of the Private car growth

Table 7.13 The ranking results of Entropy for Toll fee

Table 7.14 Priority ranking of variables for Toll fee

Table 7.15 The prediction results by SVM

Table 7.16 Summary of the Toll fee prediction results by SVM

Table 7.17 The accuracy change in terms of different distribution of the variable

Table 7.18 Details of the project

Table 7.19 A set of alternatives of the concession period length

Table 7.20 The value of NPV under different risk confidential levels
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1</td>
<td>Framework of the research</td>
<td>10</td>
</tr>
<tr>
<td>Figure 1.2</td>
<td>Outline of the Thesis</td>
<td>18</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>Project financing flow chart of BOT</td>
<td>59</td>
</tr>
<tr>
<td>Figure 3.2</td>
<td>the Annual traffic flow of CHT, EHC, and WHC in Hong Kong</td>
<td>65</td>
</tr>
<tr>
<td>Figure 3.3</td>
<td>Phases in building a DSS</td>
<td>71</td>
</tr>
<tr>
<td>Figure 3.4</td>
<td>Definition of mode with respect to significance</td>
<td>78</td>
</tr>
<tr>
<td>Figure 3.5</td>
<td>The modeling process</td>
<td>80</td>
</tr>
<tr>
<td>Figure 3.6</td>
<td>Basic Back Propagation in pattern learning</td>
<td>82</td>
</tr>
<tr>
<td>Figure 3.7</td>
<td>Network architecture for prediction</td>
<td>83</td>
</tr>
<tr>
<td>Figure 3.8</td>
<td>Architecture of a regression machine constructed by the Support Vector Machine algorithm</td>
<td>85</td>
</tr>
<tr>
<td>Figure 3.9</td>
<td>A fixed pattern of Monte Carlo method</td>
<td>97</td>
</tr>
<tr>
<td>Figure 3.10</td>
<td>The basic principle behind Monte Carlo simulation</td>
<td>98</td>
</tr>
<tr>
<td>Figure 3.11</td>
<td>The logic of a simple Monte Carlo simulation</td>
<td>100</td>
</tr>
<tr>
<td>Figure 3.12</td>
<td>Monte Carlo simulation of distribution (Triangular [1,4,8])</td>
<td>101</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Flowchart of variable investigation</td>
<td>105</td>
</tr>
<tr>
<td>Figure 4.2</td>
<td>comparison of operation cost and annual traffic flow</td>
<td>111</td>
</tr>
<tr>
<td>Figure 4.3</td>
<td>Annual percentage change of Inflation rate in Hong Kong</td>
<td>112</td>
</tr>
<tr>
<td>Figure 4.4</td>
<td>The annual change of inflation rate and annual volume (tunnel A)</td>
<td>114</td>
</tr>
<tr>
<td>Figure 4.5</td>
<td>The annual change of inflation rate and annual volume (tunnel B)</td>
<td>114</td>
</tr>
<tr>
<td>Figure 4.6</td>
<td>The annual change of inflation rate and annual volume (tunnel C)</td>
<td>115</td>
</tr>
<tr>
<td>Figure 4.7</td>
<td>The actual toll level of the eight vehicles (1997 to 2008)</td>
<td>123</td>
</tr>
</tbody>
</table>
**Figure 4.8** Daily average vehicles of private cars (PC), taxi, goods vehicles and buses  
126

**Figure 4.9** Actual toll of the vehicles in category I from 1997 to 2008  
127

**Figure 4.10** The comparison of volume change of CHT, EHT and GDP change  
131

**Figure 5.1** The design process of the Decision Support System in this research  
150

**Figure 5.2** Schematic Structure of the proposed Decision Support System  
153

**Figure 5.3** The overall model for CPLD in the proposed Decision Support System  
157

**Figure 5.4** Flowchart of Variable Investigation  
168

**Figure 5.5** The Simulation process for concession period length determination  
172

**Figure 5.6** Simulation cycle for concession period length determination  
175

**Figure 6.1** The local minimum problem of Artificial Neural Network  
182

**Figure 6.2** Proposed decision support model for prediction  
183

**Figure 6.3** Network architecture for traffic flow forecasting system  
186

**Figure 6.4** Architecture of a regression machine constructed by the Support Vector Machine algorithm  
186

**Figure 6.5** Framework for prediction of Traffic flow and Toll fee  
188

**Figure 6.6** The Back Propagation algorithm  
200

**Figure 6.7** Flow chart of Support Vector Machine Model  
204

**Figure 6.8** Process of parameter optimization for Support Vector Machine  
206

**Figure 6.9** Flow chart of the prediction model by Multiple Kernel Learning  
208

**Figure 6.10** Data Collection  
212

**Figure 7.1** The comparison of population growth and traffic flow change  
(source: Appendix C)  
226

**Figure 7.2** The comparison of private car licensed and traffic flow change  
(source: Appendix C)  
226
Figure 7.3 The comparison of operation cost and traffic flow change (source: Appendix C) 227

Figure 7.4 The comparison of GDP and traffic flow change (source: Appendix C) 227

Figure 7.5 Prediction result by (a) SVM and (b) ANN 229

Figure 7.6 The accuracy change in terms of different distributions of the variable 236

Figure 7.7 The accuracy change in terms of different distribution of the variable (toll fee) 248

Figure 7.8 The distribution value of NPV from year 1 to 3 252

Figure 7.9 The distribution value of NPV from year 4 to 16 253

Figure 7.10 The distribution value of NPV from year 17 to 31 254

Figure 7.11 The NPV of a random time 258

Figure 7.12 The net present value of the private sector at a random time under different confidence levels 259
LIST OF ABBREVIATION

The following abbreviations are used in this research:

AHP: Analytic Hierarchy Process

ANN: Artificial Neural Network

ARIMA: Autocorrelation Regressive Integrated Moving Average

BDOT: Build-Develop-Operate-Transfer

BLT: Build-Lease-Transfer

BOO: Build-Own-Operate

BOT: Build-Operate-Transfer

BP: Back Propagation

BTO: Build-Transfer-Operate

CHT: Cross Harbour Tunnel

CPI: Consumer Price Index

CPLD: Concession Period Length Determination

CSFs: Critical Success Factors

DBFO: Design-Build-Finance-Operate

DBM: Design-Build-Maintain

DBO: Design-Build-Operate

DSS: Decision Support System

EHT: Eastern Harbour Tunnel

EIS: Executive Information System
EM: Eigenvalue Method

ES: Expert System

GDP: Gross Domestic Product

GV: Goods Vehicles

IRR: Internal Rate of Return

KKT: Karush- Kuhn- Tucker

LLSM: Logarithmic Least Squares method

MIS: Management Information System

MKL: Multiple Kernel Learning

MRA: Multiple Regression Analysis

NNs: Neural Networks

NPV: Net Present Value

PC: Private Cars

PCA: Principal Component Analysis

PDF: Probability Density Function

PPP: Public-Private-Participant

QP: Quadratic Programming

RBF: Radial Basis Function

RKHS: Reproducing Kernel Hilbert Space

SARS: Severe Acute Respiratory Syndrome

SRM: Structural Risk Minimization
SVM: Support Vector Machine
SVR: Support Vector Regression
V/C: Actual traffic flow/the capacity design
VC: Vapnik and Chervonenkis
VES: Variable Evaluation System
WACC: Weighted Average Cost of Capital
WHC: Western Harbour Crossing