

**TABLE OF CONTENTS**

| <b>CHAPTER</b> | <b>TITLE</b>                       | <b>PAGE</b> |
|----------------|------------------------------------|-------------|
|                | <b>DECLARATION</b>                 | <b>ii</b>   |
|                | <b>DEDICATION</b>                  | <b>iii</b>  |
|                | <b>ACKNOWLEDGEMENTS</b>            | <b>iv</b>   |
|                | <b>ABSTRACT</b>                    | <b>v</b>    |
|                | <b>ABSTRAK</b>                     | <b>vi</b>   |
|                | <b>TABLE OF CONTENTS</b>           | <b>vii</b>  |
|                | <b>LIST OF TABLES</b>              | <b>xii</b>  |
|                | <b>LIST OF FIGURES</b>             | <b>xiv</b>  |
|                | <b>LIST OF APPENDICES</b>          | <b>xv</b>   |
| <b>1</b>       | <b>INTRODUCTION</b>                |             |
|                | 1.1 Introduction                   | 1           |
|                | 1.2 Statement of Problems          | 4           |
|                | 1.3 Research Aim and Objectives    | 6           |
|                | 1.4 Research Scope and Limitations | 6           |
|                | 1.5 Research Significance          | 7           |
|                | 1.6 Research Methodology           | 8           |

|          |  |    |
|----------|--|----|
| <b>2</b> | <b>MARK-UP IN BIDDING SYSTEM</b>             |    |
| 2.1      | Introduction                                 | 11 |
| 2.2      | Bidding System                               | 12 |
|          | 2.2.1 Negotiation Bidding                    | 13 |
|          | 2.2.2 Competitive Bidding                    | 14 |
| 2.3      | The Challenges of Competitive Bidding System | 17 |
|          | 2.3.1 The Price-Cutter                       | 18 |
|          | 2.3.2 The “Bidding Fool”                     | 18 |
| 2.4      | Mark-up                                      | 19 |
|          | 2.4.1 Allowance for Overhead                 | 20 |
|          | 2.4.2 Allowance for Contingencies            | 22 |
|          | 2.4.3 Allowance for Profit                   | 23 |
| 2.5      | The Difficulty in Determining a Mark-up Size | 24 |
| 2.6      | “Right” Mark-up Size                         | 25 |
| 2.7      | Factors Affecting the Mark-up Size Decision  | 26 |
|          | 2.7.1 Project Characteristics                | 30 |
|          | 2.7.2 Project Documentation                  | 32 |
|          | 2.7.3 Company Characteristics                | 33 |
|          | 2.7.4 Bidding Situation                      | 35 |
|          | 2.7.5 Economic Situation                     | 37 |
| 2.8      | Summary                                      | 39 |
| <br>     |  |    |
| <b>3</b> | <b>BIDDING STRATEGIC IN THEORY</b>           |    |
| 3.1      | Introduction                                 | 40 |
| 3.2      | Bidding Model                                | 41 |
|          | 3.2.1 Friedman’s Model                       | 41 |
|          | 3.2.1.1 Bidding Strategy Objective           | 42 |
|          | 3.2.1.2 Probability of Winning               | 42 |
|          | 3.2.2 Gates’ Model                           | 44 |
|          | 3.2.2.1 Bidding Strategy Objective           | 44 |
|          | 3.2.2.2 Lone-Bidder                          | 45 |
|          | 3.2.2.3 Two-Bidder Strategy                  | 45 |
|          | 3.2.2.4 Many-Bidders Strategy                | 45 |

|         |   |    |
|---------|---|----|
| 3.2.2.5 | All-Bidders-Known Strategy                  | 46 |
| 3.2.3   | OPBID                                       | 46 |
| 3.2.4   | LOMARK                                      | 48 |
| 3.2.5   | Carr's Bidding Model                        | 48 |
| 3.2.5.1 | Impact of Number of Bidders                 | 48 |
| 3.2.5.2 | Competitive Bidding and Opportunity<br>Cost | 49 |
| 3.2.6   | Optimum Bid Approximation Model             | 49 |
| 3.2.7   | Bids Considering Multiple Criteria          | 50 |
| 3.2.8   | Winning over Key Competitors                | 50 |
| 3.2.9   | DBID  | 51 |
| 3.2.10  | Sequential Competitive Bidding              | 51 |
| 3.2.11  | Self-explanatory Artificial Neural Network  | 52 |
| 3.2.12  | Average-Bid Method Bidding Model            | 53 |
| 3.3     | Utilization of Bidding Models               | 54 |
| 3.4     | Summary                                     | 55 |

## 4

### RESEARCH METHODOLOGY

|         |                            |    |
|---------|----------------------------|----|
| 4.1     | Introduction               | 57 |
| 4.2     | Stage 1: Preliminary Study | 57 |
| 4.3     | Stage 2: Data Collection   | 58 |
| 4.3.1   | Primary Data               | 58 |
| 4.3.1.1 | Survey Questionnaires      | 59 |
| 4.3.2   | Secondary Data             | 59 |
| 4.4     | Stage 3: Data Analysis     | 60 |
| 4.4.1   | One-Sample <i>t</i> -Test  | 60 |
| 4.4.2   | Chi-Square Test            | 61 |
| 4.4.3   | Reliability Analysis       | 62 |
| 4.4.4   | Mann Whitney U Test        | 62 |
| 4.4.5   | Importance Index           | 63 |
| 4.5     | Stage 4: Writing-up        | 64 |
| 4.6     | Summary                    | 64 |

**DATA ANALYSIS**

|         |   |    |
|---------|---|----|
| 5.1     | Introduction  | 65 |
| 5.2     | Company Profile of Contractor   | 67 |
| 5.2.1   | Size and Grade of Contractor's Company  | 67 |
| 5.2.2   | Years and Project Taken by Contractors  | 69 |
| 5.2.3   | Type of Project Usually Undertaken By<br>Contractors                                      | 70 |
| 5.3     | Factors Affecting the Contractor's Mark-up Size Decision                                  | 71 |
| 5.3.1   | Project Characteristics   | 71 |
| 5.3.1.1 | One-sample T-Test   | 72 |
| 5.3.1.2 | Chi-Square Test   | 72 |
| 5.3.2   | Project Documentation   | 73 |
| 5.3.2.1 | One-sample T-Test   | 73 |
| 5.3.2.2 | Chi-Square Test   | 74 |
| 5.3.3   | Company Characteristics   | 75 |
| 5.3.3.1 | One-sample T-Test   | 75 |
| 5.3.3.2 | Chi-Square Test   | 76 |
| 5.3.4   | Bidding Situation   | 76 |
| 5.3.4.1 | One-sample T-Test   | 77 |
| 5.3.4.2 | Chi-Square Test   | 78 |
| 5.3.5   | Economic Situation  | 78 |
| 5.3.5.1 | One-sample T-Test   | 79 |
| 5.3.5.2 | Chi-Square Test   | 79 |
| 5.3.6   | Reliability Analysis  | 80 |
| 5.3.7   | Ranking of Significant Factors That Affecting<br>Mark-up Size Decision                    | 81 |
| 5.4     | The Importance of the Various Factors in Medium<br>and Large Size Contractor's Evaluation | 85 |
| 5.4.1   | Comparison of Factors between Medium and<br>Large Size Contractors                        | 87 |
| 5.5     | The Current Practice in Contractors' Mark-up Size<br>Decision                             | 90 |
| 5.5.1   | Mark-up Size Taken By Contractors   | 90 |
| 5.5.1.1 | Allocation of Components in Mark-up Size  | 91 |

|          |  |     |
|----------|--|-----|
| 5.5.2    | Utilization of Bidding Models in Mark-up<br>Size Decision. | 95  |
| 5.5.3    | Practices in Determining Mark-up Size Decision             | 96  |
| 5.5.3.1  | One Sample T Test  | 96  |
| 5.5.3.2  | Chi-Square Test  | 97  |
| 5.5.3.3  | Reliability Analysis                                       | 98  |
| 5.5.3.4  | Ranking of Practices in Determining<br>Mark-up Decision    | 98  |
| 5.5.4    | Reason of Non Utilization of Bidding Models                | 100 |
| 5.5.4.1  | One Sample T Test  | 100 |
| 5.5.4.2  | Chi-Square Test  | 101 |
| 5.5.4.3  | Reliability Analysis                                       | 101 |
| 5.5.4.4  | Ranking of Reason for Non Utilization of<br>Bidding Models | 102 |
| 5.6      | Summary  | 103 |
| <b>6</b> | <b>CONCLUSION AND RECOMMENDATIONS</b>                      |     |
| 6.1      | Introduction   | 105 |
| 6.2      | Summary of Finding   | 105 |
| 6.2.1    | Objective No. 1  | 106 |
| 6.2.2    | Objective No. 2  | 106 |
| 6.2.3    | Objective No. 3  | 107 |
| 6.3      | Conclusion   | 108 |
| 6.4      | Research Limitation  | 108 |
| 6.5      | Recommendations For Further Studies                        | 109 |
| 6.6      | Summary  | 109 |
|          | <b>REFERENCES</b>  | 110 |
|          | <b>APPENDICES</b>  | 114 |

## LIST OF TABLES

| <b>TABLES</b> | <b>TITLE</b>  | <b>PAGE</b> |
|---------------|---|-------------|
| Table 2.1     | Factors Affecting the Mark-up Size Decision                       | 28          |
| Table 5.1     | Size of Contractor's Company                                      | 68          |
| Table 5.2     | One Sample T-Test Result for Factors of Project<br>Characteristic | 72          |
| Table 5.3     | Chi-Square Test Result for Factors of Project<br>Characteristic   | 73          |
| Table 5.4     | One Sample T-Test Result for Factors of Project<br>Documentation  | 74          |
| Table 5.5     | Chi-Square Test Result for Factors of Project<br>Documentation    | 74          |
| Table 5.6     | One Sample T-Test Result for Factors of Company<br>Characteristic | 75          |
| Table 5.7     | Chi-Square Test Result for Factors of Company<br>Characteristic   | 76          |
| Table 5.8     | One Sample T-Test Result for Factors of Bidding<br>Situation      | 77          |
| Table 5.9     | Chi-Square Test Result for Factors of Bidding<br>Situation        | 78          |
| Table 5.10    | One Sample T-Test Result for Factors of Economic<br>Situation     | 79          |
| Table 5.11    | Chi-Square Test Result for Factors of Economic<br>Situation       | 80          |

|            |   |     |
|------------|---|-----|
| Table 5.12 | Reliability Test Result for Remained Factors  | 80  |
| Table 5.13 | Ranking of Significant Factors That Affecting Mark-up Size Decision                           | 82  |
| Table 5.14 | Ranking on the Importance of Various Factors in Medium and Large Contractor Size's Evaluation | 86  |
| Table 5.15 | Comparison Factors between Medium and Large Size Contractors                                  | 87  |
| Table 5.16 | One Sample T-Test Result for Practices in Determining Mark-up Size Decision                   | 97  |
| Table 5.17 | Chi-Square Test Result for Practices in Determining Mark-up Size Decision                     | 97  |
| Table 5.18 | Reliability Test Result for Practices in Determining Mark-up Size Decision                    | 98  |
| Table 5.19 | Ranking of Practices in Determining Mark-up Size Decision                                     | 99  |
| Table 5.20 | One Sample T-Test Result for Non Utilization of Bidding Models                                | 100 |
| Table 5.21 | Chi-Square Test Result for Non Utilization of Bidding Models                                  | 101 |
| Table 5.22 | Reliability Test Result for Non Utilization of Bidding Models                                 | 102 |
| Table 5.23 | Ranking of Reasons of Non Utilization of Bidding Models                                       | 102 |

## LIST OF FIGURES

| <b>FIGURES</b> | <b>TITLE</b>   | <b>PAGE</b> |
|----------------|--|-------------|
| Figure 1.1     | Flow Chart of Research Methodology                               | 10          |
| Figure 3.1     | Friedman's Method of Determining the Probability<br>of Winning   | 43          |
| Figure 3.2     | Summary Flow Chart for OPBID                                     | 47          |
| Figure 3.3     | Queuing Model Representation of Flow of Limited<br>Resources     | 52          |
| Figure 3.4     | Hierarchical Structure of the Artificial Neural Network          | 53          |
| Figure 5.1     | Sequence of Reliability Test                                     | 67          |
| Figure 5.2     | Size and Grade of Contractors                                    | 68          |
| Figure 5.3     | Years and Projects Taken by Contractor                           | 69          |
| Figure 5.4     | Type of Project Usually Undertaken by Contractors                | 70          |
| Figure 5.5     | Ranking of Significant Factors According To the Category         | 81          |
| Figure 5.7     | Overhead Cost with Different Mark-up Size                        | 91          |
| Figure 5.8     | Contingencies Cost with Different Mark-up Size                   | 92          |
| Figure 5.9     | Profit with Different Mark-up Size                               | 93          |
| Figure 5.10    | Others Cost with Different Mark-up Size                          | 94          |
| Figure 5.11    | Utilization of Bidding Models in Mark-up Size Decision           | 95          |
| Figure 5.12    | Practices in Determining Mark-up Size Decision by<br>Contractors | 99          |
| Figure 5.13    | Reasons of Non Utilization of Bidding Models                     | 103         |



**LIST OF APPENDICES**

| <b>LIST</b> | <b>TITLE</b>                     | <b>PAGE</b> |
|-------------|----------------------------------|-------------|
| A           | Survey Questionnaire             | 114         |
| B           | Confirmation Letter from Faculty | 123         |