|  |  |  |
| --- | --- | --- |
|  | CONTENTS |  |
|  |  |  |
|  |  | Page |
|  | Certificate | I |
|  | Acknowledgment  | II |
|  | Contents | III |
|  | List of Figures | VII |
|  | List of Tables  | VIII |
|  | Abstract (English) | IX |
|  | Abstract (Arabic)  | X |
|  | **CHAPTER ONE** |  |
|  | **INTRODUCTION** |  |
| 1.1 | Introductory Remarks | 1 |
| 1.2 | Outline of the Project Report | 1 |
|  | **CHAPTER TWO** |  |
|  | **PRODUCTION SYSTEMS** |  |
| 2.1 | Introduction  | 2 |
| 2.2 | Job Shop Production | 2 |
| 2.3 | Flow Line Production | 4 |
| 2.4 | Flexible Manufacturing | 4 |
|  |  |  |
|  | **CHAPTER THREE** |  |
|  | **SOME ASPECTS OF SIMULATING MANUFACTURING SYSTEMS** |  |
| 3.1 | Introduction | 5 |
| 3.2 | Approaches of Simulating Manufacturing Systems | 5 |
|  | 3.2.1 Discrete event simulation | 5 |
|  | 3.2.2 Object-oriented simulation | 5 |
|  | 3.2.3 Artificial neural network simulation | 6 |
|  | 3.2.4 Concluding remarks | 6 |
| 3.3 | Manufacturing Systems Analysis Using MANUPLAN | 6 |
|  | 3.3.1 The manufacturing decision diamond | 7 |
|  | 3.3.2 A manufacturing cell example | 8 |
|  | 3.3.4 Reports | 9 |
|  | 3.3.5 Limitation and restrictions | 9 |
| 3.4 | Using Physical Simulators for Design and Control of Manufacturing Systems | 9 |
|  | 3.4.1 Introductory remarks | 9 |
|  | 3.4.2 Advantages of physical simulators | 10 |
|  | 3.4.3 Objectives of manufacturing systems physical simulators | 10 |
|  | 3.4.4 Structure of some elements of the physical simulator | 10 |
| 3.5 | Pitfalls to Avoid in the Simulation of Manufacturing Systems | 11 |
|  | 3.5.1 Pitfalls in the process of building and validating a simulation model | 12 |
|  | 3.5.2 Pitfalls in the selection of simulation animation software | 12 |
|  | 3.5.3 Pitfalls in modeling system randomness | 12 |
|  | 3.5.4 Pitfalls in experimental design and analysis | 13 |
|  | **CHAPTER FOUR** |  |
|  | **SIMULATION OF FLOW LINES** |  |
| 4.1 | Introduction | 14 |
| 4.2 | Characteristics of the Program | 14 |
| 4.3 | Input to the Program | 14 |
| 4.4 | Output of the Program | 15 |
|  | **CHAPTER FIVE** |  |
|  | **EVALUATION OF A PRODUCTION FLOW LINE BY SIMULATION** |  |
| 5.1 | Introduction | 16 |
| 5.2 | Input Data | 16 |
|  | 5.2.1 Operation times | 16 |
|  | 5.2.2 Buffer capacities between machines | 17 |
|   | 5.2.3 Maintenance characteristics | 17 |
| 5.3 | Cases Considered for Simulation | 18 |
| 5.4 | Output of Program Runs | 18 |
|  | 5.4.1 Case of fixed Operation times value | 19 |
|  | 5.4.2 Case s of Variable Production Time Value | 20 |
|  | **CHAPTER SIX** |  |
|  | **SUMMARY, CONCLUSIONS AND****RECOMMENDATIONS** |  |
| 6.1 | Summary | 21 |
| 6.2 | Conclusions | 22 |
| 6.3 | Recommendations for Future Work | 22 |
|  | **REFERENCES** | 24 |
|  | **APPENDIX I** | 25 |
|  | LIST OF SIMULATION PROGRAM AND AN EXAMPLE OF OUTPUT |  |

**LIST OF FIGURES**

|  |  |  |
| --- | --- | --- |
| **NO.** | **Title** | **Page** |
| 2.1 | Job Shop or Batch Production Floor Plan | 3 |
| 3.1 | The Relative Relationship of MANUPLAN in the System Simulation Approach | 7 |
| 3.2 | Operations Routing for DISC.01 | 8 |
| 3.3 | Schematic Layout of the Robotic loader Model | 11 |
| 3.4 | Schematic Layout of DNC System Model | 11 |

**LIST OF TABLES**

|  |  |  |
| --- | --- | --- |
| **NO.** | **Title** | **Page** |
| 5.1 | Operations Times, min | 16 |
| 5.2 | Buffer Capacities m Unit | 17 |
| 5.3 | Maintenances Characteristics | 17 |
| 5.45.55.65.7 | Data Input for Simulation RunsAverage Production and Down Time / Buffer ChangesAverage Production and Down Time / Maintenances ChangesEffects of Changing the Buffer Capacity on Production and Down Time for Variable Operating Time Cases   | 18191920 |

**ABSTRACT**

Flow line production systems are designed such as to result in, among other objectives, high production rates and low down times. Use of buffer storages between work stations/machines and consideration of scheduled maintenance are two areas to investigate to achieve the design objectives.
The purpose of this project work is to analyze a simple flow line production system of varying characteristics through a simulation approach to check on the effects of the above factors on production and down time.
 For the cases considered in this work, the results indicated a diminishing effect of increasing buffer size and decreasing maintenance time, which points to the necessity of analysis of such systems.

**الخلاصة**

يتم تصميم خطوط الإنتاج المستمر لكي ينتج عنها , من ضمن ما يجب أن يتحقق , مستوي عال من الإنتاج ومنخفض من وقت التعطيل .

وإن وضع أماكن التخزين بين محطات الإنتاج / الآلات والأخذ بالاعتبار وقت الصيانة المبرمجة وسيلتان لتحقيق أهداف التصميم .

والغرض من هذا العمل هو تحليل , عن طريق برمجة المحاكاة , لخط إنتاج مستمر بسيط له خصائص مختلفة , لبحث تأثير العاملين السابق ذكرهما علي الإنتاج ووقت التعطيل .

وتبين من الحالات التي تمت دراستها أن هناك تأثيرا متناقضا لزيادة حجم مكان التخزين و تقليل وقت الصيانة , ويوضح ذلك ضرورة تحليل هذه النظم.