CHAPTER - 8
RESULTS AND DISCUSSIONS

8.1 Introduction

In an Automated Manufacturing Shop Floor the integration of process planning and scheduling activities, depends on number of features, number of alternative process plans and the manufacturing resources. In order to solve complex problems several decisions factors like technical, economical, time constraints, geometrical shape and quality related conditions, manufacturing methods, scheduling priorities, dispatching rules and algorithms are implemented.

Concept towards the integration of process planning and scheduling functions is a paradigm shift for most manufacturing organizations. The deployment of the integration methodology requires organizational changes. The question here is what kind of changes is needed to facilitate the transition from conventional isolated process planning and scheduling functions to an integrated decision functions.

In this work, the problem has been modeled using Petrinet and Hybrid Algorithm approach respectively to generate the optimum process plans effective schedules. And also the relevant data of manufacturing resources for the program are stored in MS - Excel sheets and the concerned program is developed dynamically (Machine Time calculation formulas) using MATLAB to generate the optimum process plans and schedules.

8.2 Results of Petrinet and Hybrid Algorithm Models

The results of the Petrinets and Hybrid Algorithm approach for the three part drawings shown in Figs. 5.8, 5.13 and 5.17 are discussed in the following:

Optimized process plan for part drawing -1

Petrinet

- Operations sequence: 1 5 3 18 2 4 17 7 8 9 6 12 13 19 20 10 14 15 16 11
- Total cost: 3339
Hybrid Algorithm
• Operations sequence: 1 3 5 6 2 18 11 12 13 17 7 8 9 19 14 20 10 4 15 16
• Total cost: 3422

Alternative process plans of part drawing -1

Petrinets
• No of operations: 20
• No of process plans: 4
• Process plan 1 sequence: 1 5 3 18 2 4 17 7 8 9 6 12 13 19 20 10 14 15 16 11
• Total cost: 3339

Hybrid Algorithm
• No of operations: 20
• No of process plans: 5
• Process Plan 1 sequence: 1 3 5 6 2 18 11 12 13 17 7 8 9 19 14 20 4 15 16 10
• Total Cost: 3612

Petrinets
• No of operations: 20
• No of process plans: 4
• Process plan 1 sequence: 1 5 3 18 2 4 17 7 8 9 6 12 13 19 20 10 14 15 16 11
• Total cost: 3339

Hybrid Algorithm
• No of operations: 20
• No of process plans: 5
• Process Plan 1 sequence
• 1 3 5 6 2 18 11 12 13 17 7 8 9 19 14 20 4 15 16 10
• Total Cost: 3612

Petrinets
• Process plan: 2 sequence: 1 5 3 2 18 4 17 7 8 9 6 12 13 19 20 10 14 15 16 11
• Total cost: 3339

Hybrid Algorithm
• Process plan 2 sequence: 1 5 3 6 2 18 11 12 13 17 19 14 20 15 16 4 7 8 9 10
• Total cost: 3802
Petrinets
- Process plan 3 sequence: 1 5 3 2 18 4 17 7 8 9 6 10 12 13 19 20 14 15 16 11
- Total cost: 3509

Hybrid Algorithm
- Process plan 3 sequence: 1 18 3 5 6 2 11 12 13 17 19 14 20 15 16 4 7 8 9 10
- Total cost: 3822

Petrinets
- Process plan 4 sequence: 1 5 3 2 18 4 17 8 9 6 19 12 13 10 20 14 15 16 11
- Total cost: 3539

Hybrid Algorithm
- Process plan 4 sequence: 1 3 5 6 2 18 11 12 17 7 8 9 19 20 10 4 13 14 15 16
- Total cost: 3852

Optimized Process Plan of Part Drawing - 2

Petrinets
- No of operations: 20
- No of process plans: 5
- Process plan 1 sequence: 1 6 11 19 15 17 14 16 20 18 2 3 4 5 7 8 9 10 12 13
- Total Cost: 1884

Hybrid Algorithm
- No of operations: 20
- No of process plans: 5
- Process plan 1 sequence: 1 9 7 8 10 14 2 4 5 6 11 12 13 15 16 17 19 20 18 3
- Total cost: 3347.41

Petrinets
- Process plan 2 sequence: 1 6 11 19 15 17 14 16 20 18 4 5 2 3 7 8 9 10 12 13
- Total Cost: 1884

Hybrid Algorithm
- Process plan 2 sequence: 1 11 6 7 19 20 8 12 13 2 3 4 5 9 10 15 16 17 18 14
- Total Cost: 3437.41

Petrinets
- Process plan 3 sequence: 1 6 11 19 15 17 14 20 16 18 2 3 4 5 7 8 9 10 12 13
- Total cost: 1884
Hybrid Algorithm
- Process plan3 sequence: 1 17 7 6 15 19 8 9 10 18 14 20 16 2 4 5 11 12 13 3
- Total cost: 3677.41

Petrinets
- Process plan4 sequence: 1 6 11 19 15 17 14 20 16 18 4 5 2 3 7 8 9 10 12
- Total cost: 1884

Hybrid Algorithm
- Process plan4 sequence: 1 4 5 11 12 13 2 3 6 7 8 9 15 17 18 19 20 16 10 14
- Total cost: 3717.41

Petrinets
- Process plan5 sequence: 1 6 11 19 17 15 14 16 20 18 2 3 4 5 7 8 9 10 12 13
- Total cost: 1884

Hybrid Algorithm
- Process plan5 sequence: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
- Total cost: 3737.41

OPTIMIZED PROCESS PLAN OF PART 3

Petrinets
- No of operations: 13;
- No of process plans: 5
- Process plan1 Sequence: 3 7 8 13 12 9 4 5 10 11 1 2 6
- Total Cost: 1749

Hybrid Algorithm
- No of operations: 13;
- No of process plans: 5
- Process plan1 Sequence: 12 9 3 6 13 8 1 7 10 11 2 4 5
- Total Cost: 1936.5

Alternative Process Plans of Part drawing – 3

Petrinets
- Process plan2 sequence: 3 7 8 13 12 9 10 11 1 2 4 5 6
- Total Cost: 1749

Hybrid Algorithm
- Process plan2 sequence: 6 9 12 13 1 4 3 7 8 5 2 10 11
- Total Cost: 1986.5
Petrinets
- Process plan 3 sequence: 3 7 13 8 12 9 4 5 10 11 1 2 6
- Total cost: 1749

Hybrid Algorithm
- Process plan 3 sequence: 7 3 9 8 13 1 6 10 11 4 5 2
- Total cost: 2026.5

Petrinets
- Process plan 4 sequence: 3 7 13 8 12 9 10 11 1 2 4 5 6
- Total cost: 1749

Hybrid Algorithm
- Process plan 4 sequence: 1 9 8 13 12 6 7 4 2 5 10 11 3
- Total cost: 2186.5

Petrinets
- Process plan 5 sequence: 7 3 8 13 12 9 4 5 10 11 1 2 6
- Total cost: 1749

Hybrid Algorithm
- Process plan 5 sequence: 13 9 7 6 12 1 3 2 8 10 11 4 5
- Total cost: 2306.5

**Part drawing -1**

| PN cost: | 3339 | 3339 | 3339 | 3509 | 3539 |
| GA and SA cost | 3422 | 3612 | 3802 | 3822 | 3852 |

**Fig 8.1** Cost Comparison Graph of Part drawing -1
Part drawing- 2

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Fig 8.2 Cost Comparison Graph of Part drawing -2

Part – 3

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Fig 8.3 Cost Comparison Graph of Part drawing -3
The above three graphs are drawn between alternative process plans and machining cost for Petrinets and Hybrid algorithm models. It is observed that the process planning cost obtained from Petrinets is lower than Hybrid algorithm. Petrinets model gave better results than Hybrid algorithm, because Petrinets is deterministic tool. Whereas Genetic Algorithms and Simulated Annealing Approaches are considered as non-deterministic techniques, which are used whenever exact solutions are not possible to derive.

8.3 Summary

In this chapter the results for various part drawings are shown in Figs 8.1, 8.2 and 8.3. From the results, it is observed that the modeling cost associated with Petrinets is lesser when compared with the Hybrid algorithm.