Contoh kasus tambahan 1:

Tabel L1.1
Urutan Penjadwalan Metode Perusahaan Kasus 1

| | M1 (3) | M2 (4) | M3 (5) | M4 (2) | M5 (3) |
|---|---|---|---|---|---|
| job 1 (5) | 6 | 5 | 4 | 5 | |
| job 2 (3) | | 5 | | 5 | 3 |
| job 3 (4) | 6 | | 4 | 5 | 3 |
| job 4 (3) | 6 | 5 | 4 | | 3 |

Hasil *makespan* dapat dilihat pada Tabel L1.2 berikut ini:

Tabel L1.2
Perbandingan *Makespan* Kasus 1

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 46 | 43 | 3 | 7% |

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.3 berikut ini:

Tabel L1.3
Perbandingan Utilisasi Kasus 1

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu Search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 24 | 48.98% | 24 | 55.81% |
| | 2 | 24 | 48.98% | 24 | 55.81% |
| | 3 | 24 | 48.98% | 24 | 55.81% |
| M2 | 1 | 15 | 30.61% | 15 | 34.88% |
| | 2 | 15 | 30.61% | 15 | 34.88% |
| | 3 | 10 | 20.41% | 10 | 23.26% |
| | 4 | 15 | 30.61% | 15 | 34.88% |
| M3 | 1 | 12 | 24.49% | 12 | 27.91% |
| | 2 | 12 | 24.49% | 12 | 27.91% |
| | 3 | 12 | 24.49% | 12 | 27.91% |
| | 4 | 8 | 16.33% | 8 | 18.60% |
| | 5 | 4 | 8.16% | 4 | 9.30% |
| M4 | 1 | 30 | 61.22% | 30 | 69.77% |
| | 2 | 30 | 61.22% | 30 | 69.77% |
| M5 | 1 | 12 | 24.49% | 12 | 27.91% |
| | 2 | 9 | 18.37% | 9 | 20.93% |
| | 3 | 9 | 18.37% | 9 | 20.93% |

Kesimpulan: Metode *Tabu Search* lebih baik.

Contoh kasus tambahan 2:

Tabel L1.4
Urutan Penjadwalan Metode Perusahaan Kasus 2

| | M1 (3) | M2 (4) | M3 (2) | M4 (2) | M5 (3) |
|---|---|---|---|---|---|
| J1 (4) | | 5 | 3 | 2 | 4 |
| J2 (2) | 4 | 5 | | 2 | |
| J3 (5) | 4 | 5 | 3 | | |
| J4 (3) | 4 | | 3 | 2 | 4 |

Hasil *makespan* dapat dilihat pada Tabel L1.5 berikut ini:

Tabel L1.5
Perbandingan *Makespan* Kasus 2

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 31 | 24 | 7 | 23% |

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.6 berikut ini:

Tabel L1.6
Perbandingan Utilisasi Kasus 2

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu Search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 16 | 51.61% | 16 | 64.00% |
| | 2 | 12 | 38.71% | 12 | 48.00% |
| | 3 | 12 | 38.71% | 12 | 48.00% |
| M2 | 1 | 15 | 48.39% | 15 | 60.00% |
| | 2 | 15 | 48.39% | 15 | 60.00% |
| | 3 | 15 | 48.39% | 15 | 60.00% |
| | 4 | 10 | 32.26% | 10 | 40.00% |
| M3 | 1 | 18 | 58.06% | 18 | 72.00% |
| | 2 | 18 | 58.06% | 18 | 72.00% |
| M4 | 1 | 10 | 32.26% | 10 | 40.00% |
| | 2 | 8 | 25.81% | 8 | 32.00% |
| M5 | 1 | 12 | 38.71% | 12 | 48.00% |
| | 2 | 8 | 25.81% | 8 | 32.00% |
| | 3 | 8 | 25.81% | 8 | 32.00% |

Kesimpulan: Metode *Tabu Search* lebih baik.

Contoh kasus tambahan 3:

Tabel L1.7
Urutan Penjadwalan Metode Perusahaan Kasus 3

| | M1 (3) | M2 (4) | M3 (2) | M4 (2) |
|---|---|---|---|---|
| Job 1 (5) | | 4 | 5 | |
| Job 2 (4) | 3 | | 5 | 5 |
| Job 3 (3) | 3 | 4 | | 5 |

Hasil *makespan* dapat dilihat pada Tabel L1.8 berikut ini:

Tabel L1.8
Perbandingan *Makespan* Kasus 3

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 39 | 28 | 11 | 28% |

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.3 berikut ini:

Tabel L1.9
Perbandingan Utilisasi Kasus 3

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu Search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 9 | 23.08% | 9 | 32.14% |
| M1 | 2 | 6 | 15.38% | 6 | 21.43% |
| M1 | 3 | 6 | 15.38% | 6 | 21.43% |
| M2 | 1 | 12 | 30.77% | 12 | 42.86% |
| M2 | 2 | 8 | 20.51% | 8 | 28.57% |
| M2 | 3 | 8 | 20.51% | 8 | 28.57% |
| M2 | 4 | 4 | 10.26% | 4 | 14.29% |
| M3 | 1 | 25 | 64.10% | 25 | 89.29% |
| M3 | 2 | 20 | 51.28% | 20 | 71.43% |
| M4 | 1 | 20 | 51.28% | 20 | 71.43% |
| M4 | 2 | 15 | 38.46% | 15 | 53.57% |

Kesimpulan: Metode *Tabu Search* lebih baik.

Contoh kasus tambahan 4:

Tabel L1.10
Urutan Penjadwalan Metode Perusahaan Kasus 4

| | M1 (3) | M2 (3) | M3 (4) | M4 (4) | M5 (2) |
|---|---|---|---|---|---|
| J1 (7) | 6 | | 3 | 4 | |
| J2 (4) | 6 | 7 | 3 | | 3 |
| J3 (2) | | 7 | 3 | 4 | 3 |
| j4 (3) | 6 | | 3 | 4 | 3 |

Hasil *makespan* dapat dilihat pada Tabel L1.11 berikut ini:

Tabel L1.11
Perbandingan *Makespan* Kasus 4

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 48 | 43 | 5 | 10% |

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.12 berikut ini:

Tabel L1.12
Perbandingan Utilisasi Kasus 4

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu Search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 30 | 62.50% | 30 | 62.50% |
| M1 | 2 | 30 | 62.50% | 30 | 62.50% |
| M1 | 3 | 24 | 50.00% | 24 | 50.00% |
| M2 | 1 | 14 | 29.17% | 14 | 29.17% |
| M2 | 2 | 14 | 29.17% | 14 | 29.17% |
| M2 | 3 | 14 | 29.17% | 14 | 29.17% |
| M3 | 1 | 18 | 37.50% | 18 | 37.50% |
| M3 | 2 | 12 | 25.00% | 12 | 25.00% |
| M3 | 3 | 9 | 18.75% | 9 | 18.75% |
| M3 | 4 | 9 | 18.75% | 9 | 18.75% |
| M4 | 1 | 20 | 41.67% | 20 | 41.67% |
| M4 | 2 | 16 | 33.33% | 16 | 33.33% |
| M4 | 3 | 12 | 25.00% | 12 | 25.00% |
| M4 | 4 | 0 | 0.00% | 0 | 0.00% |
| M5 | 1 | 12 | 25.00% | 12 | 25.00% |
| M5 | 2 | 15 | 31.25% | 15 | 31.25% |

Kesimpulan: Metode *Tabu Search* lebih baik.

Contoh kasus Tambahan 5 (terdapat mesin Bottleneck):

Tabel L1.13
Urutan Penjadwalan Metode Perusahaan Kasus 5

| | M1 (4) | M2 (3) | M3 (5) | M4 (3) | M5 (3) | M6 (4) | M7 (2) | M8 (3) |
|---|---|---|---|---|---|---|---|---|
| J1 (12) | | 3 | 5 | 6 | | 7 | 3 | 4 |
| J2 (6) | 4 | 3 | | 6 | 5 | | 3 | |
| J3 (7) | 4 | 3 | | 6 | 5 | | 3 | 4 |
| J4 (5) | | 3 | 5 | 6 | 5 | | 3 | |
| J5 (5) | 4 | | 5 | 6 | | 7 | | 4 |
| J6 (4) | 4 | | 5 | 6 | | 7 | | 4 |
| J7 (3) | 4 | 3 | | 6 | 5 | | 3 | 4 |
| J8 (2) | 4 | | 5 | 6 | | 7 | | 4 |

Hasil *makespan* dapat dilihat pada Tabel L1.14 berikut ini:

Tabel L1.14
Perbandingan *Makespan* Kasus 5

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 283 | 283 | 0 | 0% |

Dari hasil *makespan* kedua metode didapat hasil yang sama. hal ini dikarenakan terjadinya *bottleneck* pda 1 mesin yang menyebabkan lintasan kritis terpaku di mesin tersebut. Hal ini menyebabkan penukaran operasi hanya terjadi di mesin yang mengalami *bottleneck* tersebut.

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.15 berikut ini:

Tabel L1.15
Perbandingan Utilisasi Kasus 5

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 28 | 9.89% | 28 | 9.89% |
| | 2 | 28 | 9.89% | 28 | 9.89% |
| | 3 | 28 | 9.89% | 28 | 9.89% |
| | 4 | 24 | 8.48% | 24 | 8.48% |
| M2 | 1 | 33 | 11.66% | 33 | 11.66% |
| | 2 | 33 | 11.66% | 33 | 11.66% |
| | 3 | 33 | 11.66% | 33 | 11.66% |
| M3 | 1 | 35 | 12.37% | 35 | 12.37% |
| | 2 | 30 | 10.60% | 30 | 10.60% |
| | 3 | 25 | 8.83% | 25 | 8.83% |
| | 4 | 25 | 8.83% | 25 | 8.83% |
| | 5 | 25 | 8.83% | 25 | 8.83% |
| M4 | 1 | 264 | 93.29% | 264 | 93.29% |
| M5 | 1 | 105 | 37.10% | 105 | 37.10% |
| | 2 | 0 | 0.00% | 0 | 0.00% |
| | 3 | 0 | 0.00% | 0 | 0.00% |
| M6 | 1 | 84 | 29.68% | 84 | 29.68% |
| | 2 | 77 | 27.21% | 77 | 27.21% |
| | 3 | 0 | 0.00% | 0 | 0.00% |
| | 4 | 0 | 0.00% | 0 | 0.00% |
| M7 | 1 | 99 | 34.98% | 99 | 34.98% |
| | 2 | 0 | 0.00% | 0 | 0.00% |
| M8 | 1 | 132 | 46.64% | 132 | 46.64% |
| | 2 | 0 | 0.00% | 0 | 0.00% |
| | 3 | 0 | 0.00% | 0 | 0.00% |

Dari Tabel L1.13 dan Tabel L1.15, kedua metode memberikan nilai yang sama sehingga tidak ada metode yang lebih baik.

Contoh kasus tambahan 6:

Tabel L1.16
Urutan Penjadwalan Metode Perusahaan Kasus 6

| | M1 (4) | M2 (3) | M3 (4) | M4 (5) | M5 (3) | M6 (4) | M7 (2) | M8 (3) |
|---|---|---|---|---|---|---|---|---|
| J1 (12) | | 3 | 5 | | | 7 | 3 | 4 |
| J2 (6) | 4 | 3 | | 6 | 4 | | 3 | |
| J3 (7) | 4 | 3 | | 6 | 4 | | 3 | 4 |
| J4 (5) | | 3 | 5 | 6 | 4 | | 3 | |
| J5 (5) | 4 | | 5 | | | 7 | | 4 |
| J6 (4) | 4 | | 5 | 6 | | 7 | | 4 |
| J7 (3) | 4 | 3 | | 6 | 4 | | 3 | 4 |
| J8 (2) | 4 | | 5 | | | 7 | | 4 |

Hasil *makespan* dapat dilihat pada Tabel L1.17 berikut ini:

Tabel L1.17
Perbandingan *Makespan* kasus 6

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 78 | 72 | 6 | 8% |

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.18 berikut ini:

Tabel L1.18
Perbandingan Utilisasi Kasus 6

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 28 | 35.90% | 28 | 38.89% |
| | 2 | 28 | 35.90% | 28 | 38.89% |
| | 3 | 28 | 35.90% | 28 | 38.89% |
| | 4 | 24 | 30.77% | 24 | 33.33% |
| M2 | 1 | 33 | 42.31% | 33 | 45.83% |
| | 2 | 33 | 42.31% | 33 | 45.83% |
| | 3 | 33 | 42.31% | 33 | 45.83% |
| M3 | 1 | 35 | 44.87% | 35 | 48.61% |
| | 2 | 30 | 38.46% | 30 | 41.67% |
| | 3 | 25 | 32.05% | 25 | 34.72% |
| | 4 | 25 | 32.05% | 25 | 34.72% |
| | 5 | 25 | 32.05% | 25 | 34.72% |
| M4 | 1 | 42 | 53.85% | 42 | 58.33% |
| | 2 | 36 | 46.15% | 36 | 50.00% |
| | 3 | 36 | 46.15% | 36 | 50.00% |
| | 4 | 36 | 46.15% | 36 | 50.00% |
| M5 | 1 | 35 | 44.87% | 35 | 48.61% |
| | 2 | 35 | 44.87% | 35 | 48.61% |
| | 3 | 35 | 44.87% | 35 | 48.61% |
| M6 | 1 | 42 | 53.85% | 42 | 58.33% |
| | 2 | 42 | 53.85% | 42 | 58.33% |
| | 3 | 42 | 53.85% | 42 | 58.33% |
| | 4 | 35 | 44.87% | 35 | 48.61% |
| M7 | 1 | 51 | 65.38% | 51 | 70.83% |
| | 2 | 48 | 61.54% | 48 | 66.67% |
| M8 | 1 | 48 | 61.54% | 48 | 66.67% |
| | 2 | 44 | 56.41% | 44 | 61.11% |
| | 3 | 40 | 51.28% | 40 | 55.56% |

Kesimpulan: metode *Tabu Search* lebih baik.

Contoh kasus tambahan 7 (*job Shop* murni):

Tabel L1.19
Matriks *Routing*

| Job | Operation | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| J1 (5) | 1 | 2 | 3 |
| J2 (3) | 2 | 3 | 1 |
| J3 (2) | 2 | 1 | 3 |
| J4 (3) | 1 | 3 | 2 |

Tabel L1.20
Matriks Waktu

| job | operation | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| J1 (5) | 5 | 6 | 4 |
| J2 (3) | 6 | 4 | 5 |
| J3 (2) | 6 | 5 | 4 |
| J4 (3) | 5 | 4 | 6 |

Jumlah mesin:

M1 = 2, M2 = 3, M3 = 2

Hasil *makespan* dapat dilihat pada Tabel L1.21 berikut ini:

Tabel L1.21
Perbandingan *Makespan* kasus 7

| | Metode perusahaan | Metode Tabu Search | Selisih | % selisih |
|---|---|---|---|---|
| Makespan | 54 | 34 | 20 | 37% |

Persentase utilisasi tiap mesin dapat dilihat pada Tabel L1.22 berikut ini:

Tabel L1.22
Perbandingan Utilisasi Kasus 7

| Mesin | MesinKe | Metode Perusahaan | | Metode Tabu Search | |
|---|---|---|---|---|---|
| | | Used Time | % Used Time | Used Time | % Used Time |
| M1 | 1 | 30.00 | 55,56% | 30.00 | 88,24% |
| M1 | 2 | 25.00 | 46,30% | 25.00 | 73,53% |
| M2 | 1 | 30.00 | 55,56% | 30.00 | 88,24% |
| M2 | 2 | 18.00 | 33,33% | 18.00 | 52,94% |
| M2 | 3 | 18.00 | 33,33% | 18.00 | 52,94% |
| M3 | 1 | 24.00 | 44,44% | 24.00 | 70,59% |
| M3 | 2 | 20.00 | 37,04% | 20.00 | 58,82% |

Rangkuman hasil *makespan* dari 7 kasus diatas dapat dilihat pada Tabel L1.23 berikut ini:

Tabel L1.23
Rangkuman Hasil *Makespan*

| Metode | Makespan | | | | | | |
|---|---|---|---|---|---|---|---|
| | kasus 1 | kasus 2 | kasus 3 | kasus 4 | kasus 5 | kasus 6 | kasus 7 |
| Merode Perusahaan | 46 | 31 | 39 | 48 | 283 | 78 | 54 |
| Metode Tabu Search | 43 | 24 | 28 | 43 | 283 | 72 | 34 |
| Selisih | 3 | 7 | 11 | 5 | 0 | 6 | 20 |
| % Selisish | 7% | 23% | 28% | 10% | 0% | 8% | 37% |

Dari hasil rangkuman tersebut, persen selisih terbesar terdapat pada kasus 7, dimana pada kasus 7, *routing* tiap *job* berbeda (tidak searah). Hal ini menyebabkan performansi *Tabu Search* lebih terlihat daripada menggunakan kasus 1 sampai 5 (*routing* tiap *job* berbeda namun searah).

# KOMENTAR DOSEN PENGUJI

| | | |
|---|---|---|
| Nama Mahasiswa | : | Arifin Suandy |
| NRP | : | 0923027 |
| Judul Tugas Akhir | : | Usulan Penerapan Penjadwalan dengan Menggunakan Metode *Tabu Search* di PT. Gistex Textile Division |

Komentar-Komentar Dosen Penguji:

1. Peningkatan utilisasi mesin dengan penerapan metode usulan hanya 1%, sehingga tidak memecahkan masalah.
2. Waktu komputasi terlalu lama.
3. Penerapan di perusahaan tidak mudah.
4. Penghematan *makespan* hanya 1%, apakah sebanding untuk diterapkan?

# DATA PENULIS


| | |
|---|---|
| Nama | : Arifin Suandy |
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| Alamat email | : A_suandy@yahoo.com |
| Pendidikan | : SMA Santa Maria 1, Cirebon |
| | Jurusan Teknik Industri Universitas Kristen Maranatha. |
| Nilai Tugas Akhir | : A |
| Tanggal USTA | : 18 Februari 2013 |