UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2017/2018

May/June 2018

EPM 322 – Industrial Engineering
[Kejuruteraan Industri]

Duration : 3 hours
Masa : 3 jam

INSTRUCTIONS TO CANDIDATE:
ARAHAN KEPADA CALON:

Please check that this paper contains **? (?)** printed pages and **FIVE (5)** questions before you begin the examination.
*Sila pastikan bahawa kertas soalan ini mengandungi **?(?)** mukasurat bercetak dan **LIMA (5)** soalan sebelum anda memulakan peperiksaan.*

Answer **ALL FIVE (5)** questions.
Jawab **KESEMUA LIMA (5)** *soalan.*

You may answer all questions in **English** OR **Bahasa Malaysia** OR a combination of both.
*Calon boleh menjawab semua soalan dalam **Bahasa Malaysia** ATAU **Bahasa Inggeris** ATAU kombinasi kedua-duanya.*

Answer to each question must begin from a new page.
Jawapan untuk setiap soalan mestilah dimulakan pada mukasurat yang baru.

In the event of any discrepancies, the English version shall be used.
Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.

The following EXHIBIT 1 case study is for Q4 and Q5. You are appointed as a consultant, thus your task will involve solving all the questions pertaining to the operation of the Lean Sdn. Bhd. plant. Read the case study to gather information/data before answering the questions.

Kajian kes berikut EXHIBIT 1 adalah untuk S4 dan S5. Anda telah dilantik sebagai perunding maka, tugas anda adalah untuk menyelesaikan semua persoalan tentang operasi loji Lean Sdn. Bhd. Baca kajian kes bagi mengumpul maklumat/data sebelum menjawab soalan.

EXHIBIT 1

OVERVIEW

Lean Sdn. Bhd. (LSB) produces bicycle for major brand names. The process of assembling the bicycles area carried out manually. ***Figure 1*** shows the production flow at LSB.

The demand of bicycle had increased tremendously and the most affected section is *Painting Section* because of the delay in waiting for the paint to dry before it can be sent to the next assembly section.

LSB also has the problem of inconsistency to meet its daily production output and the company has high overtime to complete their daily production schedule.

Based on the report from Marketing/Sales Department, the trend of bicycle order will keep on increasing hence this will affect LSB to meet the customer demand.

CURRENT OPERATION

LSB runs only 1 shift/day for 8 hours/shift with 1 operator for each production section. Work starts at 8.00 am and ends at 4.00 pm for 5 days a week. LSB has no work-in-process (WIP) at the end of the shift. All the WIP will be processed by doing overtime.

Each assembly section will request the parts from *Sub-Assembly Store* in the beginning of the shift except for *Painting Section*. Since it is an assembly process, the subsequent section will have to wait for the sub-assembled bicycle from the previous section.

WIP i.e. sub-assemblies parts and finished assembled bicycle are moved from one section to another section in a batch of 10 using manual trolley by a dispatch worker. The dispatch worker function is to move and take parts/sub-assemblies from *Sub-Assembly Store* to all the assembly sections and right up to *Warehouse*.

In order to meet the demand LSB requires their workers to work overtime. Constraint in overtime is that a worker can only work up to 16 hours per day. The labour law had stated that a worker must have minimum 8 hours of rest before commencing work after a continuous 16 hours of work.

OBSERVATION AND FINDINGS

- Based from SWAG estimation historical data;
  - ❖ Current output for LSB is 150 units of bicycle per day.
  - ❖ Cycle time for sub-assembly task for each section is 1 minute.

- ❖ Painting requires 0.5 minute and paint drying is 2 minutes.
- ❖ Bicycle testing run requires 0.5 minute.

- Bottleneck occurs at *Painting Section* because *Frame Assembly Section* will complete all the 150 units of frame assembly.

- The high idling time at *Wheel Assembly Section* is due to the waiting time for the paint to dry and also at the *Frame Assembly Section* after they had completed the frame assembly.

- Although the working hours is 8 hours/shift, the productive man-hours available per shift is only 7 hours because of the 1 hour lunch break.

- The working environment is not well lighted and ventilation of the plant is not properly addressed hence it is quite hot and humid for an average worker to work in the current condition.

- You conducted a time study for each section in order to determine the actual cycle time and their performance rating. Following are the data collected:
  - ❖ *Frame Assembly Section*: 1 minute observation time at 100% performance rating.
  - ❖ *Painting Section*: 0.25 minutes observation time at 150% performance rating.
  - ❖ *Wheel Assembly Section*: 0.75 minutes observation time at 80% performance rating.
  - ❖ *Bicycle Testing Section*: 0.75 minutes observation time at 80% performance.
  - ❖ The paint drying time is similar to the SWAG data i.e. 2 minutes.

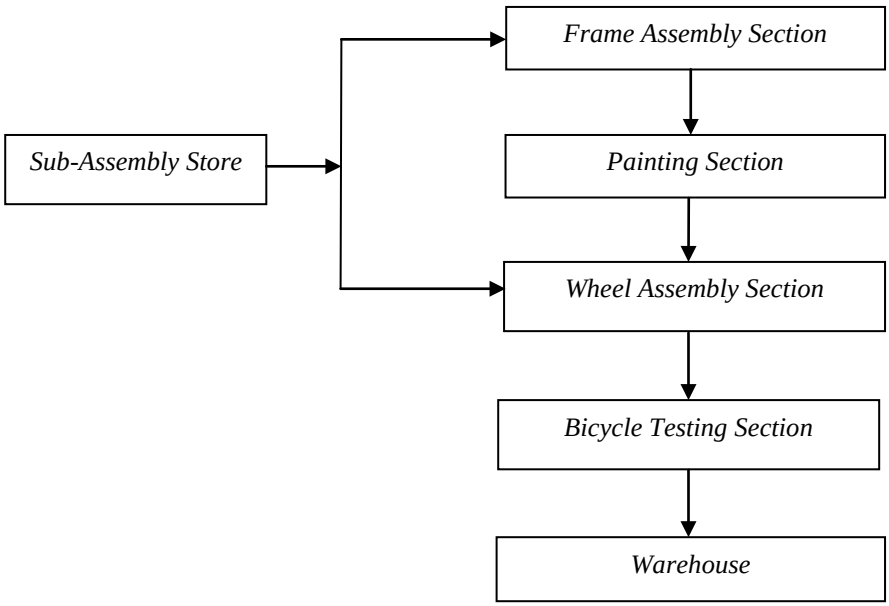

Figure 1: LSB Bicycle Assembly Production Flow

Q4. [a] Based from the information and data of the case study;

Berdasarkan maklumat dan data kajian kes;

(i) Construct a <u>detailed</u> "Process Flow Chart" for LSB with reference to Figure 1 and include the time required for each assembly section. For any task/activity where the time is not given, assume it negligible.

Bina satu "Carta Aliran Proses" LSB yang <u>lengkap</u> dengan merujuk kepada "Figure 1"dan sertakan masa yang diperlukan untuk setiap seksyen pemasangan. Untuk kerja/aktiviti di mana masa tidak dinyatakan, sila anggap boleh diabaikan.

(50 marks/*markah)*

(ii) Calculate the total time (in minutes) to complete the LSB current output of bicycle assembly per day from the SWAG estimation data.

Kira jumlah masa (dalam minit) yang diperlukan untuk LSB menyiapkan keluaran terkini untuk pemasangan basikal sehari daripada data anggaran SWAG.

(15 marks/*markah)*

(iii) Calculate the <u>total</u> productive man-hours available for one (1) shift and one (1) day for LSB.

Kira <u>jumlah</u> waktu produktif pekerja-jam untuk satu (1) shift dan satu (1) hari bagi LSB.

(10 marks/*markah)*

[b] In the case study mentioned that LSB had to do overtime to complete their daily production schedule. Use the SWAG estimation data for calculation purposes.

Di dalam kajian kes ada dinyatakan LSB perlu membuat kerja lebih masa untuk menyiapkan jadual pengeluaran harian. Sila guna data anggaran SWAG untuk tujuan pengiraan.

(i) Required total overtime (in hours).
Jumlah kerja lebih masa yang diperlukan (dalam jam).

(10 marks/*markah)*

(ii) Cost of overtime per month if the rate is RM20.00 per hour.
Kos lebih masa sebulan sekiranya kadar ialah RM20.00 sejam.

(15 marks/*markah)*

Q5. [a] From the time study data collected in the case study, calculate;

Daripada data kajian masa yang dikumpulkan dalam kajian kes, kirakan;

(i) Normal time for one completed bicycle assembly.
Masa normal pemasangan satu basikal yang lengkap.

(ii) Standard time for one completed bicycle assembly, given PFD allowances are 15%.

Masa piawai pemasangan satu basikal yang lengkap, di mana kelegaan PFD diberikan adalah 15%.

(iii) Explain briefly THREE(3) criteria or situations that require PFD allowances.

Terangkan secara ringkas TIGA(3) kriteria atau keadaan yang memerlukan kelegaan PFD.

(50 marks/*markah)*

[b] Based on the calculated standard time in Q5[a](ii), calculate the total time to complete the daily output.

Berdasarkan masa standard yang telah dikira dalam S5[a](ii), kirakan jumlah masa untuk menyiapkan pengeluaran harian.

(10 marks/*markah)*

[c] Based on Industrial Engineering approach, give TWO (2) suggestions that will improve the LSB overall performance. State your reasoning for each suggestion.

Berdasarkan pendekatan Kejuruteraan Industri, berikan DUA (2) cadangan untuk meningkatkan prestasi keseluruhan LSB. Nyatakan alasan anda untuk setiap cadangan.

(40 marks/*markah)*

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