
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008
Peperiksaan Semester Kedua
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APRIL 2008

EPD 422/3 – MANUFACTURING SYSTEMS DESIGN
REKABENTUK SISTEM PEMBUATAN

Duration : 3 hours
Masa : 3 jam

ARAHAN KEPADA CALON :

Please check that this paper contains SEVEN (7) printed pages dan SIX (6) questions before you begin the examination.

Sila pastikan bahawa kertas soalan ini mengandungi TUJUH (7) mukasurat dan ENAM (6) soalan yang bercetak sebelum anda memulakan peperiksaan.

Soalan terbahagi kepada DUA (2) bahagian.

BAHAGIAN A

MENGANDUNGI TIGA (3) SOALAN KAJIAN KES DAN CALON WAJIB MENJAWAB SEMUA SOALAN.

BAHAGIAN B

MENGANDUNGI TIGA SOALAN DAN CALON DIKEHENDAKI MENJAWAB HANYA DUA (2) SOALAN.

*Bahagian A (Section A): Sila jawab **SEMUA** soalan pada bahagian ini.*

Sila baca fakta kajian kes dengan teliti dan kemudian jawab semua soalan dalam bahagian ini. Pastikan anda menjawab soalan secara berturutan.

**ANN ENGINEERING SDN. BHD.
MANUFACTURING OPERATION ANALYSIS**

1.0. BACKGROUND

ANN Engineering Sdn. Bhd. (ANN) is a company specialising in hydraulic and pneumatic pump. The utilisation of CNC machines had made ANN to have the competitive edge in producing high quality pumps. Based on the forecast report from ANN Marketing/Sales department, the trend of demand for pumps will increase 30% (from the 2007 year demand) in the year 2008. ANN intends to improve their capacity and operation efficiency to meet customer requirement. Based on the 2007 Annual Key Performance Index (KPI) report indicates that the Production Processing (PP) department is not able to meet the future demand. The management need to increase the PP capability so that ANN can take more orders in the year 2008. Although the key issue is centered to PP, but by tackling the problem it will give a positive impact towards ANN as a whole. The objective of improvement clearly indicates what can be achieved by resolving the PP issues.

2.0. OBJECTIVES OF IMPROVEMENT

- To reduce the lead time hence increasing the throughput
- To reduce work in progress (WIP) that will reduce high inventory
- To improve working technique and increase productivity
- To reduce the man power

3.0. CURRENT OPERATION

ANN runs only one (1) shift per day i.e. nine (9) hours per shift for twenty (20) days per month. Workers will only have one (1) hour break per shift. Following are the sections in the PP department.

SECTIONS	WORKFORCE
Mill Section – 5 milling machines	5 workers
Grind Section – 2 grinding machines	2 workers
Drill Section – 3 drilling machines	3 workers
Pack Station – Manual packing	2 worker

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

4.0. OBSERVATION AND FINDING

- a) From the year 2007 KPI report, the order of various models of hydraulic and pneumatic pumps per annum are 27,600 units and 32,400 units respectively. Production cost per pump is RM300.00 and the selling price is RM500.00 per unit for both hydraulic and pneumatic pumps.
- b) Production of pumps are carried out in batches in order to reduce the changeover time. The current capability of PP department only allow a maximum of 30 batches of pump to be produce daily. There are five (5) units of pumps in a batch. Set-up for hydraulic pump is three (3) minutes per unit, whereas pneumatic pump is two (2) minutes per unit for all machining operation.

- c) Production of both pumps require the used of milling, drilling and grinding machines. For hydraulic pumps the subsequent operation after milling is grinding. Pneumatic pumps requires drilling after the milling operation. Certain model of hydraulic and pneumatic pumps need additional machining operation as per shown in Figure 1. Figure 1 also simulate the current daily manufacturing flow of hydraulic and pneumatic pump.
- d) Based from the time study all pump model requires five (5) minutes of milling per pump, drilling requires three (3) minutes per pump and another two (2) minutes per pump for grinding operation. Therefore, a total of 10 minutes per pump is required to produce a pump.
- e) The pack station utilise manual packing and the current packing time per pump for all pump model is three (3) minutes per pump.
- f) PP department utilise FIFO scheduling technique and upon completion of each section, all WIP parts will be handed over to the subsequent section. This contributes to high WIP at drill, grind and pack station.
- g) It was also found that PP department cannot meet certain date line of order, due to bottleneck at the drill, section and pack station.
- h) From the study shows that to meet the total production of 60,000 pumps in year 2007, PP department had to do overtime which had reduce their profit margin significantly.
- i) Labour cost is RM10.00 per hour and overtime rate is RM25.00 per hour.

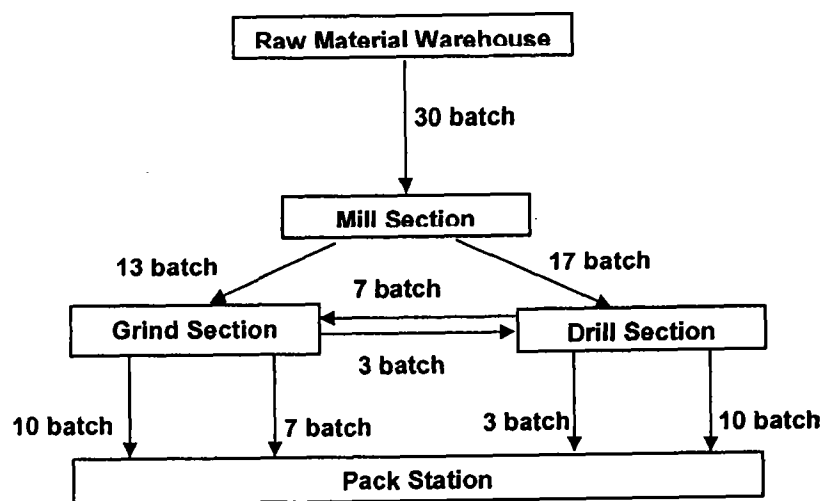


Figure 1: Hydraulic & Pneumatic Pump Manufacturing Flow

5.0. PROPOSED IMPROVEMENT

PP department is suggesting to utilise Laser Beam Machining (LBM) which will eliminate the need of drilling and grinding process. The cost to purchase the LBM is RM 355,000.00 per unit. Feasibility study in application of LBM process shows that the total machining time per pump is two (2) minutes for all pump models and the set-up time is reduced to one (1) minute per pump irrespective of the pump model.

Another improvement is the utilisation of Pack Station with automated packing machines that can pack a pump in thirty (30) seconds. The cost of the automated packing machine is RM105,000.00 per unit. One (1) operator can operate two (2) automated packing machine simultaneously.

You are appointed as a consultant to carried out the detail analysis and identifying the best solution to achieve the "Objective of Improvement". Thus, your task will involved in explaining and clarifying all the questions related to the manufacturing system design, which are listed below. For calculation purposes, please ignore the transfer time from one section to another section. Assumed Zero Defect for all the pumps produced.

Anda telah dilantik sebagai perunding untuk membuat analisa secara terperinci dan mengenalpasti langkah terbaik untuk mencapai "Objective of Improvement" yang telah disenaraikan. Maka, tugas anda adalah untuk menerangkan dan menjawab semua persoalan tentang rekabentuk sistem pembuatan seperti yang disenaraikan di bawah. Bagi tujuan pengiraan, sila abaikan masa penghantaran antara seksyen ke seksyen yang lain. Anggap Kecacatan Sifar untuk semua pam yang dihasilkan.

- Q1. [a] Based from the information of the case study;**
- i) Calculate the gross profit of ANN for year 2007.**
 - ii) Calculate the total demand of pumps for year 2008.**
 - iii) What is the daily number of the pumps produced based on the year 2007 performance?**
 - iv) State the production system that is currently employ by ANN.**
 - v) Calculate the productive working time for PP department in a day.**

Berdasarkan maklumat kajian kes;

- i) Kira berapakah untung kasar ANN bagi tahun 2007.*
- ii) Kira jumlah permintaan pam untuk tahun 2008.*
- iii) Berapakah jumlah harian pam yang telah dihasilkan berdasarkan prestasi tahun 2007?*
- iv) Nyatakan sistem pengeluaran yang sedang digunakan oleh ANN.*
- v) Kira jumlah waktu kerja produktif sehari untuk jabatan PP.*

(50 marks/markah)

- [b] Please give TWO (2) more suggestions that to improve the ANN performance. State your reason for the sugestions.**

Berikan DUA (2) lagi cadangan tambahan untuk memperbaiki prestasi ANN. Nyatakan alasan untuk cadangan tersebut.

(50 marks/markah)

- Q2. [a] The case study also mentioned that ANN produce several models of hydraulic and pneumatic pump.**
- i) How many model of hydraulic and pneumatic pumps are there?**
 - ii) Determine the amount of batches for each pump model stated in Q2[a]i).**

Kajian kes telah menyatakan ANN mengeluarkan beberapa jenis model pam hidraulik dan pam pneumatik.

- i) Berapa jenis model pam hidraulik dan pam pneumatik yang ada?*
- ii) Kenal pasti jumlah kelompok untuk setiap model pam yang dinyatakan pada S2[a]i).*

(40 marks/markah)

- [b] **If ANN operates with the current PP capacity, calculate;**
- i) **The lead time to complete all the batches for every pump model that you have identified in Q2[a]**
 - ii) **The overtime required to fulfill the demand of the hydraulic and pneumatic pump for 2008. Assume the quantity ratio for both pumps are as per year 2007.**

Sekiranya ANN menjalankan operasi menggunakan kapasiti PP yang sedia ada, kirakan;

- i) *Jumlah masa mendulu yang diperlukan untuk menyiapkan kelompok bagi setiap pam yang telah anda kenal pasti dalam soalan S2[a].*
- ii) *Jumlah kerja lebih masa yang diperlukan untuk memenuhi permintaan pam hidraulik dan pneumatik bagi tahun 2008. Sila anggap nisbah jumlah kedua-dua pam adalah seperti tahun 2007.*

(60 marks/markah)

- Q3. [a] **Based on the information in section "5.0. PROPOSED IMPROVEMENT", ANN has the intention to increase its production capacity to accommodate the year 2008 demand, hence calculate the payback period for the following purchase;**
- i) **ONE (1) LBM machine.**
 - ii) **ONE (1) automatic packaging machine.**
 - iii) **ONE (1) LBM machine together with ONE (1) automatic packaging machine.**

Berdasarkan maklumat kajian kes bahagian "5.0. PROPOSED IMPROVEMENT", ANN bercadang untuk meningkatkan kapasiti pengeluarannya untuk menampung permintaan tahun 2008, maka kirakan tempoh bayaran balik bagi pembelian berikut;

- i) *SATU (1) mesin LBM.*
- ii) *SATU (1) satu mesin pembungkusan automatik.*
- iii) *SATU (1) mesin LBM dan SATU (1) satu mesin pembungkusan automatik.*

(60 marks/markah)

- [b] **Based on the answer for question Q3[a] (i), (ii) and (iii), what is your choice to solve ANN problem dan why it is selected?**

Berdasarkan jawapan anda pada dalam soalan S3[a] (i), (ii) dan (iii) apakah pilihan anda untuk menyelesaikan masalah ANN dan mengapa ianya dipilih?

(40 marks/markah)

Bahagian B (Section B): Sila jawab DUA (2) soalan sahaja pada bahagian ini.

- Q4. [a] What are the tasks in designing manufacturing system? How it affects the overall performance of a manufacturing company?**

Apakah tugas untuk merekabentuk sistem pembuatan? Bagaimana ianya memberi kesan terhadap prestasi satu syarikat pembuatan?

(20 marks/markah)

- [b] Production management fundamentally consists of TWO (2) main procedures. Explain briefly the phases and issues that these procedures dealt with?**

Pengurusan pengeluaran pada asasnya merangkumi DUA (2) kaedah utama. Terangkan secara ringkas fasa dan isu yang di hadapi oleh kaedah utama tersebut.

(20 marks/markah)

- [c] What are the requirements of manufacturing system design from functional aspect perspective?**

Apakah keperluan rekabentuk sistem pembuatan dari perspektif aspek fungsi?

(30 marks/markah)

- [d] State and discuss briefly the basic problem concerning system design.**

Nyata dan bincangkan masalah asas yang membabitkan rekabentuk sistem.

(30 marks/markah)

- Q5. Layout design has a significant impact towards the performance of manufacturing system. Various approaches have been proposed and developed to determine the best layout plan. Systematic Layout Planning (SLP) is one of the procedural layout design approach developed by Muther.**

Rekabentuk susunatur memberi impak yang signifikan terhadap prestasi sistem pembuatan. Pelbagai pendekatan telah diusul dan dibangunkan untuk menentukan susunatur yang terbaik. "Systematic Layout Planning" (SLP) adalah salah satu prosidur merekabentuk susunatur yang dibangunkan oleh Muther.

- [a] List and discuss FIVE (5) basic elements related to SLP.**

Senarai dan bincangkan LIMA (5) unsur asas berkaitan dengan SLP.

(40 marks/markah)

- [b] Sketch the flow diagram of SLP procedure and briefly explain each steps involved.

Lakarkan rajah alir prosidur SLP dan terangkan secara ringkas setiap langkah yang berkaitan.

(60 marks/markah)

- Q6. Simulation method is considered for assisting in designing a new process and production layout. You have been asked to discuss how computer simulation can be use in the design and analyse of the new process and production layout. The discussion should include the following:

Kaedah simulasi telah dicadangkan bagi membantu semasa merekabentuk proses dan susunatur yang baru. Anda dikehendaki membincangkan bagaimana perkomputeran simulasi boleh digunakan bagi merekabentuk dan menganalisa proses susunatur pengeluaran baru tersebut. Perbincangan perlu merangkumi pekara-pekerja berikut:

- [a] Why problem and system definitions play an important role in simulation development?

Mengapa membuat definasi masalah dan sistem memainkan peranan yang penting di dalam pembangunan simulasi?

(35 marks/markah)

- [b] How computerised simulation can be performed in the design and analyse of process and production layout in term of advanced system planning approach?

Bagaimanakah simulasi berkomputer boleh dilakukan di dalam merekabentuk dan menganalisa bagi proses dan susunatur pengeluaran dari aspek kaedah perancangan sistem termaju?

(35 marks/markah)

- [c] Give the differences between verification and validation in the simulation study? Give examples.

Beri perbezaan di antara verifikasi dan validasi di dalam kajian simulasi? Berikan contoh.

(30 marks/markah)