
UNIVERSITI SAINS MALAYSIA

**Second Semester Examination
Academic Session 2008/2009**

*Peperiksaan Semester Kedua
Sidang Akademik 2008/2009*

APRIL/MAY 2009

**EPD 422/3 – MANUFACTURING SYSTEM DESIGN
REKABENTUK SISTEM PEMBUATAN**

**Duration : 3 hours
Masa : 3 jam**

INSTRUCTIONS TO CANDIDATE:

ARAHAN KEPADA CALON :

Please check that this paper contains **NINE** (9) printed pages and **SIX** (6) questions before you begin the examination.

*Sila pastikan bahawa kertas soalan ini mengandungi **SEMBILAN** (9) mukasurat dan **ENAM** (6) soalan yang bercetak sebelum anda memulakan peperiksaan.*

Question is divided into **TWO** (2) sections
Soalan terbahagi kepada **DUA** (2) bahagian.

SECTION A/BAHAGIAN A

CONTAINS THREE (3) CASE STUDY QUESTIONS AND IT IS OBLIGATORY FOR THE CANDIDATE ANSWER ALL QUESTIONS.

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

SECTION B/BAHAGIAN B

CONTAINS THREE (3) QUESTIONS AND IT IS OBLIGATORY FOR THE CANDIDATE ANSWER TWO (2) QUESTIONS ONLY.

*MENGANDUNGI TIGA (3) SOALAN DAN CALON DIKEHENDAKI MENJAWAB HANYA **DUA** (2) SOALAN SAHAJA.*

Candidate can answer all questions in **English** OR **Bahasa Malaysia** OR a combination of both.

*Calon boleh menjawab semua soalan dalam **Bahasa Inggeris** ATAU **Bahasa Malaysia** ATAU kombinasi kedua-duanya.*

Each answer must begin from a new page.

Setiap jawapan mestilah dimulakan pada mukasurat yang baru.

(Section A) *Bahagian 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.

**EM SDN. BHD.
MANUFACTURING OPERATION ANALYSIS**

1.0. BACKGROUND

EM Sdn. Bhd. produces various type of solder material used in electronic industry. The process of producing the solder material are carried out in the company from the initial stage i.e. melting and casting it into ingots before performing a secondary manufacturing processes which produces solder plumb. **Diagram 1** shows the manufacturing flow at **EM**.

The demand of solder product had increased tremendously and the only effected section is Section Solder Plumb (SSP) because that section had to do overtime and out-sourcing to meet the order. Based on the report from Marketing/Sales department the trend of demand will increased drastically.

The key competencies that **EM** needs to compete with the increasing demand are by utilising state of the art technology and manufacturing system redesign. Due to limited amount of capital to expand in term of manufacturing capacity such as equipment, machinery and manpower. The management of **EM** have decided to conduct a feasibility study before any new machines or equipments can be introduced at the production line.

General observation shows that "bottlenecking" occurs at the packing area in the SSP production line because SSP had the most work in progress (WIP) at the Storage Area compared to the other sections.

2.0. OBJECTIVES OF IMPROVEMENT

- To reduce the lead time
- To increase the throughput (kg/hour)
- To reduce the manpower and manning cost
- To reduce work in progress (WIP)

3.0. CURRENT OPERATION

SSP runs only one (1) shift per day (8 hours/shift) with 3 production operators. A total of 1500kg solder ingots which is equivalent to one (1) charge, are loaded into the furnace with the aid of manual crane. The maximum capacity of the furnace is 1600kg and according to the Standard Operating Procedure (SOP), one (1) charge of solder is 1500kg. During the remelting process, an agitator will stir the molten solder to ensure that there will be no segregation of the charge.

After complete remelting, the valve will be opened to transfer the molten solder charge via a pump to the casting area. The molten solder is cast into a mould to produce solder plumb (see **Exhibit 1**). Solidify solder plumbs are then ejected into the container beneath the mould. One container can hold approximately 500kg of plumbs. Full container will then be manually transferred using forklift truck to the Storage Area. The solder plumbs are placed at that area to allow it to be cool before packing process takes place. The Storage Area can store a maximum of ten (10) containers equivalent to 5000kg at any one time.

For packing operation, the container is transferred to the Packing Area. The solder plumbs are put inside a plastic packet and simultaneously weigh to obtain nett 2.5kg/packet. The packets are then sealed and arranged into a wooden box for shipment. **Exhibit 2** shows the schematic manufacturing process of the solder plumb.

In order to meet the demand SPP 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) Based from time study, the Furnace and the Casting equipment are under utilise because setting up the furnace i.e. heating and setting the process parameters will require 1 hour and loading of solder ingots for one charge into the furnace will take about 1 hour.
- b) For the solder ingots to melt, complete the casting process for one charge of the solder plumb and discharge it into the container beneath the mould, will take another 1.5 hours.
- c) Transferring container takes about 15 minutes from the Pouring & Casting area to the Storage Area. Another 15 minutes is required to transfer the container from Storage Area to the Packing Area.
- d) The cooling of the solder plumbs at the WIP Storage Area will take about 1 hour.
- e) Bottleneck occurs at the packing operation because currently it requires 15 hours to pack 1500kg of solder plumbs. To complete the packing of 1500kg on the same day, the operators have to do overtime.
- f) For the packing process, the operator will scoop the solder plumbs, do physical inspection and put into the plastic packet that is placed on the weighing scale. Plumbs are repeatedly handle because the operator need to remove and add to get the exact nett weight of 2.5kg/packet of plumb.
- g) The operator will then sealed the packet using a manual sealer. Time taken is 0.5 minute.
- h) Delay in packing process due to the same three (3) operators will share the tasks of remelting, casting, and transferring the container. It is also observed that beginning of shift, each operator was given a specific task i.e. One (1) operator X will take charge of remelting and casting, One (1) operator Y will handle all the material handling equipment i.e. the crane to load the solder ingots and the forklift to transfer the container to the storage area. One (1) operator Z will do the the packing. When operator X and Y have completed their task or have some idle time, they will help the packing.
- i) High WIP because in order to meet high demands, SSP will make 2 (two) continuous charge i.e. 3000kg in one shift to buffer for the packing process. Continuous charge will save 1 hour of setting-up time of the furnace.
- j) Productive man hours available per shift is only 7 hours (1 hour lunch break) and manpower efficiency is at 80%.

5.0. PROPOSED IMPROVEMENT

Utilised a semi-automated packing machine and place it directly beneath the casting mould with a holding tank and with cooling tank that can accommodate approximately 500kg of plumbs. With instant cooling, there will not be any delay and the plumbs will flow by the aid of a vibrator system that will separate the defective product before entering the weighing station. The vibrator will stop automatically when the weight reaches the preset value of 2.5kg/packet. Then it will seal the packet of plumb solder.

Total time taken is only 0.5 minute/packet. Machine efficiency is 95%. The packing machine will automate most of operation and the operator will only need to collect the sealed packet plumb and arrange it in the box before shipment. Budget required to buy the machine including commissioning and training is estimated at RM95, 000.00 per unit.

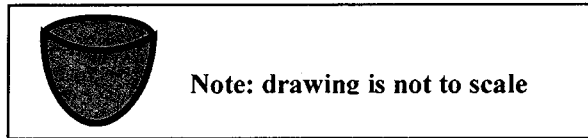


Exhibit 1: Solder Plumb

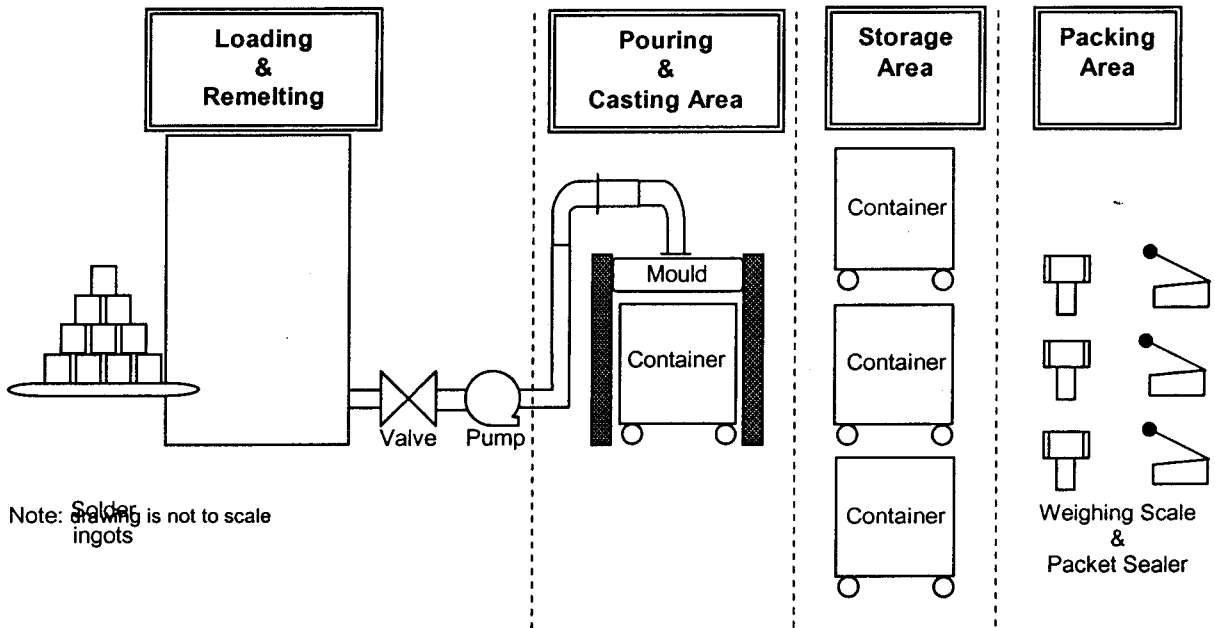


Exhibit 2: Solder Plumb Schematic Manufacturing Process

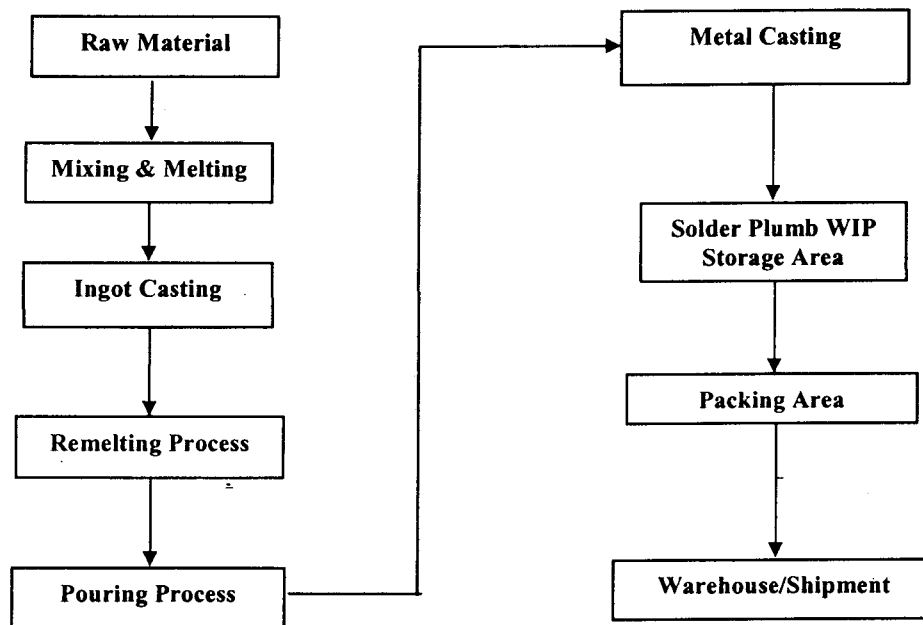


Diagram 1: Solder Plumb Manufacturing Flow

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 involve solving all the questions pertaining to the manufacturing system design, which is listed next page.

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 menyelesaikan semua persoalan tentang rekabentuk sistem pembuatan seperti yang disenaraikan pada muka surat sebelah.

- Q1. [a] Based from the information of the case study;**
- (i) What is the maximum smelting capacity for the SSP furnace.
 - (ii) Calculate the total time to complete the packing process for 1500kg of solder plumbs.
 - (iii) What is the total time save (in minutes) if SSP were to produce two charge without any delay.
 - (iv) State the production system that is currently employ by EM.
 - (v) Calculate the total productive man-hours available for SPP in a day?

Berdasarkan maklumat kajian kes;

- (i) *Apakah kapasiti peleburan maksima untuk relau SSP?*
- (ii) *Kira jumlah masa yang diperlukan untuk menyiapkan kerja pembungkusan untuk 1500kg solder plumb.*
- (iii) *Berapakah jumlah masa (dalam minit) yang akan dijimatkan sekiranya SSP menghasilkan dua "charge" tanpa henti?*
- (iv) *Nyatakan sistem pengeluaran yang sedang digunakan oleh EM.*
- (v) *Kira jumlah waktu produktif pekerja-jam sehari untuk SSP.*

(50 marks/markah)

- [b] Please give another FOUR (4) suggestions of improvement apart from what had been mentioned in the case study that will improve the EM productivity performance. State your reason for every suggestions that you proposed.**

Berikan EMPAT (4) cadangan selain daripada cadangan penambahbaikan yang telah dinyatakan dalam kajian kes untuk meningkatkan lagi prestasi produktiviti EM. Nyatakan alasan untuk setiap cadangan yang dinyatakan.

(50 marks/markah)

- Q2. [a] Construct a detail "Flow Process Chart" for SSP and state the time required for every process.**

Bina satu "Carta Aliran Proses" SSP yang lengkap serta nyatakan masa yang diperlukan untuk setiap proses.

(40 marks/markah)

- [b] What is the production lead time to complete an order of 6000kg with three (3) operators without any overtime? Please consider all the SPP constraint as per mentioned in the case study.**

Berapakah lama masa mendulu pengeluaran untuk menyiapkan satu tempahan plumb sebanyak 6000kg dengan menggunakan tiga (3) pekerja yang sedia ada tanpa kerja lebih masa? Sila ambil kira kesemua kekangan SPP sebagaimana yang telah dinyatakan dalam kajian kes.

(60 marks/markah)

- Q3. [a] Manpower cost is RM8.00 per man/hour whereas for overtime, the cost is RM20.00 per man/hour. Find the total man power cost for 3 worker to complete the process for an order of 1500kg with the shortest lead time after receiving the work order?**

Kos pekerja adalah RM8.00 seorang/jam manakala kos pekerja untuk kerja lebih masa adalah RM20.00 seorang/jam. Kira jumlah kos tiga (3) pekerja yang diperlukan untuk menyiapkan kerja untuk satu tempahan sebanyak 1500kg dengan masa mendulu yang paling singkat setelah arahan kerja di terima?

(20 marks/markah)

- [b] Based on the situation in question Q2[b], what is the percentage of lead time reduction achieved if SPP were to utilise one (1) semi automatic packaging machine?**

Berdasarkan situasi soalan S2[b], berapakah peratusan pengurangan masa mendulu dapat dicapai sekiranya SSP menggunakan satu (1) mesin pembungkusan separa automatik?

(40 marks/markah)

- [c] Based on the situation in question Q3[a] and Q3[b], what is the payback period if the order is at 4500kg per day?**

Berdasarkan situasi soalan S3[a] dan S3[b], apakah tempoh pulangan modal sekiranya jumlah tempahan adalah pada kadar 4500kg untuk satu hari?

(40 marks/markah)

Section B: Please answer *TWO (2)* questions only.
*Bahagian B : Sila jawab **DUA (2)** soalan sahaja.*

Q4. [a] List the FIVE (5) objectives of layout design?

Senaraikan LIMA (5) objektif rekabentuk susunatur?

(20 marks/markah)

[b] Before any work can be done on designing the layout for a manufacturing system, clear understanding of the information is needed. Discuss about the information from various sources that can be used in facilitating the layout design process.

Sebelum sebarang kerja boleh dilakukan bagi rekabentuk susunatur untuk satu sistem pembuatan, kefahaman yang jelas mengenai maklumat diperlukan. Bincangkan maklumat dari pelbagai sumber yang boleh digunakan dalam pemudahan proses rekabentuk susunatur.

(40 marks/markah)

[c] During the layout design process, various information is needed. Why information provided by the bill of material (BOM) is crucial in designing the layout?

Semasa proses rekabentuk susunatur, pelbagai maklumat diperlukan. Kenapa maklumat yang disediakan oleh "bill of material (BOM)" adalah penting di dalam merekabentuk susunatur?

(40 marks/markah)

Q5. A printer assembly company is proposing to introduce a new range of products. The existing shop floor is unable to cope with the increases of production rate if the new ranges of products are introduced. A team is formed to design and install a new layout on the shop-floor. You as a manufacturing engineer have been given a responsibility to lead the team to design and install the new layout.

Sebuah syarikat pemasangan mesin cetak mengusulkan untuk memperkenalkan beberapa rangkaian produk baru. Susunatur sedia ada tidak berupaya untuk menampung peningkatan kadar pengeluaran jika rangkaian produk baru diperkenalkan. Satu pasukan dibentuk untuk merekabentuk susunatur baru di dalam lantai-kerja. Anda sebagai seorang jurutera pembuatan telah dipertanggungjawabkan untuk mengepalai pasukan tersebut untuk merekabentuk dan memasang susunatur yang baru tersebut.

[a] List FIVE (5) factors that may affect the flow pattern of the layout that you going to design.

Senaraikan LIMA (5) faktor yang boleh mempengaruhi corak aliran susunatur yang akan anda rekabentuk.

(30 marks/markah)

- [b] Various decisions must be made during the design process. In order to achieve an optimal solution, a systematic method to decision-making is required. Therefore, you have to influence and show your group members by adopting the optimum decision-making procedure; they can achieve near or optimal solution. Discuss the method. You should relate your discussion to show how it will help them in gaining a competitive advantage through the design of layout.

Pelbagai keputusan perlu dibuat semasa proses merekabentuk. Supaya mendapatkan keputusan yang terbaik, kaedah yang sistematik untuk membuat keputusan diperlukan. Oleh itu anda perlu mempengaruhi dan memaparkan kepada ahli kumpulan yang lain dengan menggunakan kaedah keputusan optima mereka boleh mencapai satu keputusan yang boleh diterima pakai ataupun yang terbaik. Bincangkan kaedah tersebut. Anda dikehendaki menghubungkan perbincangan anda bagi menunjukkan bagaimana ia boleh membantu mereka untuk mendapat kelebihan berdayasaing dalam merekabentuk susunatur.

(70 marks/markah)

- Q6. You are an external consultant for a printer assembly company. Your first task is to analyse structurally the production layout of the company. From your study, a considerable number of changes will take place and you have decided to utilise the simulation procedure in your analysis.

Anda adalah seorang penasihat luar untuk sebuah syarikat produk pemasangan mesin cetak. Tugas pertama anda adalah untuk menganalisa secara teratur susunatur pengeluaran syarikat tersebut. Dari kajian yang dilakukan, terdapat banyak perubahan yang akan dilakukan dan anda telah membuat keputusan untuk menggunakan kaedah simulasi di dalam analisis anda.

- [a] What types of data that need to be collected and how can you categories it?

Apakah jenis-jenis data yang perlu dikumpulkan dan bagaimanakah anda boleh mengkategorikan data tersebut?

(30 marks/markah)

- [b] State the stages involve in adopting the simulation procedure in your analysis and discuss in detail each stages.

Nyatakan peringkat-peringkat yang terbahit semasa menggunakan kaedah simulasi di dalam analisis anda dan bincangkan secara terperinci setiap peringkat tersebut.

(70 marks/markah)