**Integration Management**

**Case Study: Materials Management and Controlling**

*Alexander Prosser, 2024*

*Institute of Production Management, WU Vienna*

## 1 Introduction
## 1.1 The Case

Our company produces communication systems for air traffic control (ATC). Figure 1 shows the product structure. Each system consists of a central unit and a number of workstations. A central unit consists of a certain number of switches depending on the size of the system. These units are responsible for the connection between different communication partners (pilots, other air traffic controller, etc.) using different means of communication (radio, ISDN, etc.).

The air traffic control workstations are connected to these switches with a switch being able to serve up to 8 workstations. The switches are interconnected to assure a failsafe speech connection with the communication partners.

A workstation consists of a touch screen, where flight objects are marked using a greasy pencil resulting in an immediate connection with the communication partner, a headset, some twisted-pair (TP) cables and a panel. The panel mainly consists of a keyboard and two boards are responsible (i) for the control of the workstation and (ii) the workstation – panel interconnection.
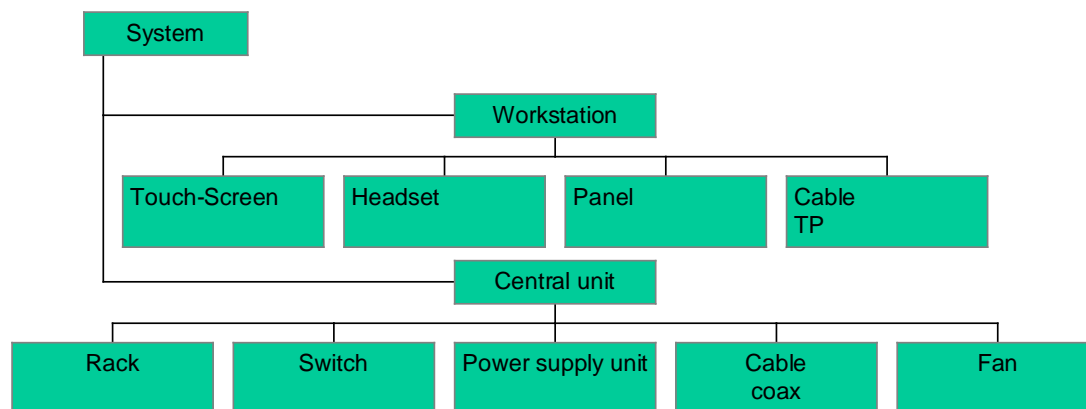


Fig. 1 : Product structure – overview

Panel and Switch are made to stock (they are also the technological core of the system), the workstations and the central unit are assembled individually for each ATC centre, all other parts in Figure 1 are externally procured. Panel and switch are semi-finished products, only the system itself is a finished product.

**1.2 The "Sydney System"**

Sydney Airport ordered such an ATC system with 20 workstations, which yields the following parts list derived from Figure 1:

| System | Number |
|---|---|
| Workstations | 20 |
| Central unit | 1 |

| Workstation | Number |
|---|---|
| Touch-Screen monitor | 1 |
| Headset | 1 |
| Panel | 1 |
| Cable TP | 30m |

| Central Unit | Number |
|---|---|
| Rack | 1 |
| Switch | 3 |
| Power supply unit | 2 |
| Fan | 2 |
| Cable coax | 10m |

**1.3 Your Task**

You have been assigned as a consultant to introduce SAP ECC for materials management and cost center accounting. You have to enter the master data and test the case study given according to customer needs. As usual in real-world projects, a prototype is used to test and verify the implementation, production of the Sydney system is used as the test project to verify the SAP ECC system you prepared.

The job will be done by a group of 2 consultants/students. Each group works in a unique plant grxx. All materials etc. start with the prefix grxx-. Cost centres start with prefix grxx.

Each plant has a purchasing organization whose name is identical to the plant.

All prices indicated in EUR.

## 2   Cost Centre Planning

We have three types of cost centers (s. Fig. 3):

- Direct cost centers.
- Supervisor and Building are indirect cost centers whose costs are allocated to the direct cost centers and the remaining indirect cost centers.
- Storage and Production Planning (PP) are further indirect cost centers whose costs are attributed to the cost objective by an overhead (OH) surcharge.

Figure 3 shows the performance flow among the cost centers. Building comprises the depreciation for the building, possible maintenance and repairs to it as well as energy costs which cannot be attributed directly to any of the other cost centres, such as lights outside the building or in the corridors.

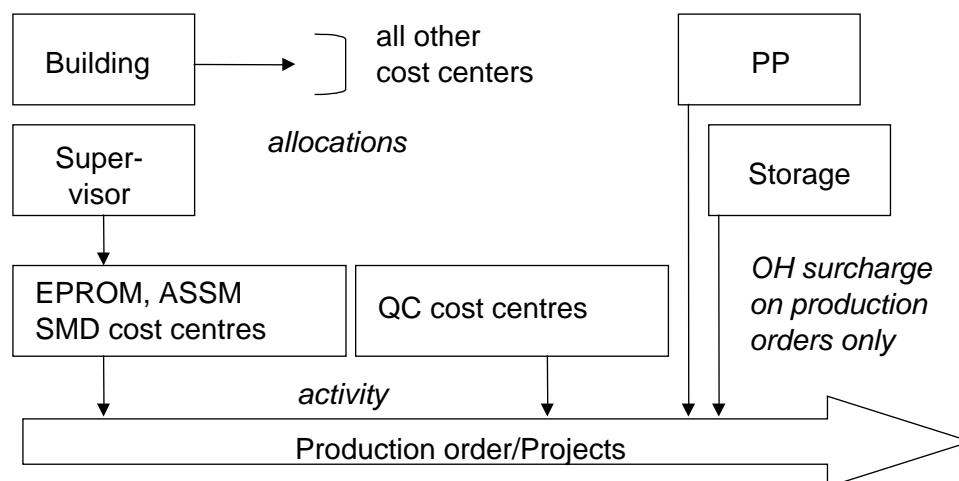The supervisor is in charge of the EPROM and SMD loader and the assembly line.



Figure 3: The cost centers involved

## 2.2 Primary Costs

Let us first consider primary costs (**annual values**):

**Wages and salaries:**

|  | No. of people | Total wages EUR | Fixed EUR | Variable EUR |
|---|---|---|---|---|
| Assembly | 2 | 40.000,00 | 32.000,00 | 8.000,00 |
| EPROM Loader | 0 | 0,00 | 0,00 | 0,00 |
| SMD | 0 | 0,00 | 0,00 | 0,00 |
| Q-Control | 1 | 45.000,00 | 36.000,00 | 9.000,00 |
| Storage | 2 | 65.000,00 | | |
| PP | 1 | 85.000,00 | | |
| Supervisor | 1 | 60.000,00 | | |

**Social Security:**

|  | No. of people | Total wages EUR | Fixed EUR | Variable EUR |
|---|---|---|---|---|
| Assembly | 2 | 12.000,00 | 9.600,00 | 2.400,00 |
| EPROM Loader | 0 | 0,00 | 0,00 | 0,00 |
| SMD | 0 | 0,00 | 0,00 | 0,00 |
| Q-Control | 1 | 13.500,00 | 10.800,00 | 2.700,00 |
| Storage | 2 | 19.500,00 | | |
| PP | 1 | 25.500,00 | | |
| Supervisor | 1 | 18.000,00 | | |

The following table shows the basis for depreciation, whether the asset is depreciated by time or operating hours, and in case of time-dependent depreciation the annual value. The depreciation of the assembly line and the two loaders is considered 80% variable.

**Depreciation**

|  | Original investm. EUR | Useful life years/hours | Annual depr. EUR |
|---|---|---|---|
| EPROM | | | |
|     Loader | 60.000,00 | 5000 hours | |
| SMD | | | |
|     Loader | 750.000,00 | 5000 hours | |
| Assembly | | | |
|     assembly line | 2.000.000,00 | 10000 hours | |
|     tools | 40.000,00 | 5 years | 8.000,00 |
| Q-Control | | | |
|     Tools | 12.000,00 | 2 years | 6.000,00 |
| Building | | | |
|     Building | 300.000,00 | 25 years | 12.000,00 |
| Storage | | | |
|     storage system | 105.000,00 | 15,00 | 7.000,00 |
|     PC plus control software | 30.000,00 | 5,00 | 6.000,00 |
| PP | | | |
|     PC with PP software | 50.000,00 | 5,00 | 10.000,00 |
|  | 2.537.000,00 | | 49.000,00 |

The next table shows cost elements other than payroll and depreciation. The electricity in direct cost centers is considered 80% variable, all training costs are completely fixed. Minor assets in direct cost centres are considered 50% variable.

All cost elements used for primary cost planning and for allocating Supervisor and Building are combined in cost element group ATC-GROUP.

**Other costs:**

|  | Total Cost (EUR) | Comment |
|---|---|---|
| Assembly | | |
|     minor assets | 1.000,00 | can be depriciated in the first year |
|     electricity | 3.200,00 | each cost centre has a separate meter |
| Q-Control | | |
|     electricity | 500,00 | |
| EPROM Loader | | |
|     minor assets | 1.600,00 | can be depriciated in the first year |
|     electricity | 1.900,00 | |
| SMD Loader | | |
|     electricity | 4.850,00 | |
| Building | | |
|     Heating | 6.500,00 | |
|     Repairs | 1.500,00 | not activated |
|     electricity | 1.200,00 | general consumption which cannot be attributed |
| Supervisor | n/a | |
| Storage | | |
|     electricity | 3.450,00 | |
|     minor assets | 7.200,00 | can be depriciated in the first year |
| PP | | |
|     electricity | 400,00 | |
|     training | 2.000,00 | |
| Sum | 35.300,00 | |

## 2.3 The Service Flow

Fig. 3 shows the main service flow between the cost centres. Cost allocation of the two indirect cost centers which are allocated is done by operating hours (Supervisor) and surface in $m^2$ (Building) per year. The individual values for the cost centers are shown in the following table. The operating hours indicated are also the basis for activity pricing in the direct cost centers. There is only one activity type in the direct cost centres: production hour (MANU-H). Please assume that all direct cost centers are planned to capacity.

**Basis for cost allocation and activity planning:**

|  | Operating hours | m2 |
|---|---|---|
| Assembly | 1.500,00 | 140,00 |
| Q-Control | 1.400,00 | 100,00 |
| Eprom Loader | 1.500,00 | 100,00 |
| SMD Loader | 1.600,00 | 160,00 |
| Building | - | - |
| Supervisor | - | 70,00 |
| Storage | - | 380,00 |
| PP | - | 50,00 |
|  | 6.000,00 | 1.000,00 |

## 3 Materials
## 3.1 Externally Procured Materials for the Final Assembly

As already mentioned, panel and switch are produced on stock, all other materials used for the final assembly of the system as depicted in Figure 1 are externally procured:

| Material | Price Control* | MRP** |
|----------|----------------|-------|
| Rack | MVA 65,- | VM/5, HB/10 |
| Cable TP | MVA 2,-/m | VM/200, FX/10000 |
| Cable coax | MVA 30,-/m | VM/20, FX/100 |
| Headset | MVA 80,- | VM/25, HB/100 |
| Touch screen | S-Price 3500,- | PD, EX |
| Fan and power supply unit are also used for switch and panel. | | |

\* moving average or standard price
\*\* MRP parameter standard code

The materials needed for the production of panel and switch are listed in Section 4 on production data.

- All purchased items have a delivery time of 4 days and a goods receipt processing time of 1 day.

- All materials belong to industry "m".

### 3.3 Purchasing

After streamlining purchasing, all parts are purchased from two sources only, Electronic Supplies, plc and Techno, plc. with the latter delivering the frame, both types of cables, the headset, the circuit board, the keyboard, and the fan. All other parts are bought from Electronic Supplies, plc.

Please capture the necessary master data for purchasing, but allow for the prices entered at the materials master. Please also note the data indicated below, which are relevant to purchasing.

### 4. BOM Structure

### 4.1 General Hint:

Since there is no sales plan for switch and panel, independent requirements have to be entered manually via the following menu path: Logistics/Production/MRP => Planned order/create. Order type LA, stock order. Please indicate the material (ATC system), the desired quantity (=1), and the basic dates of the planned order. They will serve as input for the MRP run. (See the video on the ERP homepage).

## 4.2 Boards/Circuit Boards

All boards used in panel and switch basically consist of the same parts which are listed below; all parts are purchased items:

| Part | MRP | MVA/Piece |
|---|---|---|
| Circuit board incl. pins | VM/25St., FX/500St. | 10,- |
| EPROM | VM/30St., FX/500St. | 20,- |
| Diode type A | VM/250St., FX/3000St. | 1,50 |
| Diode type B | VM/250St., FX/3000St. | 1,20 |
| DSP | PD/EX | 199,- |
| Resistance type A | VM/250St., FX/3000St. | 9,- |
| Resistance type B | VM/250St., FX/3000St. | 6,- |
| 32 GB storage module | VM/250St., FX/2000St. | 290,- |

All parts stem from a reliable supply chain and are ndQC.

Hint for purchasing procedures: diodes, resistances, and storage modules can only be ordered in portions of 1000 pieces, circuit boards and EPROM's only in 100 piece lots. DSPs can be ordered by the piece.

In addition, EPROM's are loaded with software developed by the company; this is done before the components are mounted on the circuit boards. The standard software modules are represented by a materials master with a standard price.

| Software Module | Price of License |
|---|---|
| Software for central switch | 1200,- |
| Software for workstation hub | 500,- |
| Panel control software | 430,- |
| Panel – switch communication software | 300,- |

The standard price indicated can be derived from the following considerations:

After finishing the development of a new standard software module, the business case indicates how many times such a module (software license) may be sold to a customer (1000 for each module). The costs accrued in the R&D project are then attributed to the software licenses.

The BOM of the boards are as follows:

Workstation hub

| Part | No. |
|---|---|
| Circuit board | 1 |
| EPROM | 1 |
| Software for workstation hub | 1 |
| Diode type A | 9 |
| Diode type B | 1 |
| DSP | 0 |
| Resistance type A | 0 |
| Resistance type B | 6 |
| 32 GB storage module | 2 |

Central switch

| Part | No. |
|---|---|
| Circuit board | 1 |
| EPROM | 1 |
| Software for central switch | 1 |
| Diode type A | 4 |
| Diode type B | 2 |
| DSP | 11 |
| Resistance type A | 14 |
| Resistance type B | 16 |
| 32 GB storage module | 2 |

Panel control board

| Part | No. |
|---|---|
| Circuit board | 1 |
| EPROM | 1 |
| Panel control software | 1 |
| Diode type A | 10 |
| Diode type B | 0 |
| DSP | 0 |
| Resistance type A | 1 |
| Resistance type B | 3 |
| 32 GB storage module | 1 |

Panel-switch communications board

| Part | No. |
|------|-----|
| Circuit board | 1 |
| EPROM | 1 |
| Panel – switch communication software | 1 |
| Diode type A | 11 |
| Diode type B | 2 |
| DSP | 1 |
| Resistance type A | 7 |
| Resistance type B | 0 |
| 32 GB storage module | 1 |

The routings of all boards are basically identical comprising of the same steps (provided, components of a certain type are mounted). All production steps are done on the SMD loader, except for the loading of the EPROM.

EPROM-loader:
•   Loading EPROM's with software (set-up time 30 min, processing time 1 min. per piece).

SMD loader:
•   Mounting of the components and burn-in of conductor paths (set-up 15 min, processing 5 seconds plus 1 second per piece to be mounted).

A quality check (using the quality assurance work centre) concludes the processing:
•   Quality check (no set-up time, 3 min. processing per piece).

There is a minimum waiting time between the application of the conductor paths and the quality check of 30 min. According to past experience an average scrap of 5% in production can be expected in those steps.

Please consider where flow production or partial overlap may be sensibly used.

## 4.3 Switch

The BOM of the switch is:

| Part | No. | Purchased Item/In-process | Price Control | MRP |
|------|-----|---------------------------|---------------|-----|
| Power supply unit | 1 | purchased | MVA 19,- | VM/100St., FX/500 St. |
| Fan | 3 | purchased | MVA 26,- | VM/100St., FX/200 St. |
| Frame | 1 | purchased | MVA 65,- | VM/30 St., FX/500 St. |
| Workstation hub | 1 | in-process | MVA ? | PD, EX |
| Central switch | 1 | in-process | MVA ? | PD, EX |

Please initialize the moving average prices in a meaningful way.

The routing for the switch is:

| Work centre | Step | Duration |
|---|---|---|
| grxx-ass | locking the frame | Set-up 45 min Processing 5 min |
| grxx-ass | mounting the workstation hub | Set-up – min Processing 15 min |
| grxx-ass | mounting the central switch | Set-up – min Processing 10 min |
| grxx-ass | mounting power supply unit | Set-up – min Processing 5 min |
| grxx-ass | mounting fans | Set-up – min Processing 3 min |
| grxx-qa | quality check | Set-up – min Processing 30 min |

**4.4 Panel**

The BOM of the panel is:

| Part | No. | Purchased Item/In-process | Price Control | MRP |
|---|---|---|---|---|
| Frame | 1 | as above | | |
| Panel keyboard | 1 | purchased | MVA 230,- | VM/10St., FX/200 St. |
| Panel control board | 1 | in-process | MVA ? | PD, EX |
| Panel-switch communication board | 1 | in-process | MVA ? | PD, EX |
| Power supply unit | 2 | as above | | |
| Fan | 3 | as above | | |

The routing is given as:

| Work centre | Step | duration |
|---|---|---|
| grxx-ass | lock frame | Set-up 45 min<br>Processing<br>5 min |
| grxx-ass | mounting power supply units | Set-up – min<br>Processing<br>5 min |
| grxx-ass | mounting fans | Set-up – min<br>Processing<br>3 min |
| grxx-ass | mounting the panel control board | Set-up – min<br>Processing<br>10 min |
| grxx-ass | mounting the panel-switch communication board | Set-up – min<br>Processing<br>10 min |
| grxx-ass | add keyboard | Set-up – min<br>Processing<br>5 min |
| grxx-qa | quality check | Set-up – min<br>Processing<br>20 min |

### 4.5 Workstation, Central Unit, ATC System

The BOM for the remaining elements of the ATC system can be found in Section 1.2.

The routing of the workstation is given as:

| Work centre | Step | duration |
|---|---|---|
| grxx-ass | assemble panel and touch screen | Set-up - min<br>Processing<br>60 min |
| grxx-ass | add headset and TP cables | Set-up – min<br>Processing<br>10 min |
| grxx-qa | quality check | Set-up – min<br>Processing<br>20 min |

The routing of the central unit is given as:

| Work centre | Step | duration |
|---|---|---|
| grxx-ass | lock rack | Set-up 45 min<br>Processing<br>5 min |
| grxx-ass | mount switches, power supply units and fans | Set-up – min<br>Processing<br>5 min |
| grxx-ass | add coax cables | Set-up – min<br>Processing<br>3 min |
| grxx-qa | quality check | Set-up – min<br>Processing<br>20 min |

The routing of the ATC system's final assembly is given as:

| Work centre | Step | duration |
|---|---|---|
| grxx-ass | final assembly | Set-up – min<br>Processing<br>20 min |
| grxx-qa | final quality check | Set-up – min<br>Processing<br>60 min |