# Costing for 2000 Machines

1. **Hardware Specification**

The hardware specification is listed in the Bill Of Materials (BOM). This shows the design time to be allocated to the Hardware Architect (HA) for each component, alongside the unit price when purchased in multiples of 1000. The table shows the components selected for the machine.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Design Staff** | **Design Cost** | **Model** | **Spec** | **Unit Price £ (qty thousand)** | **Quantity per board** | **Component Design Cost (person weeks)** |
| CPU2 |  |  | 68k8 | 5Mhz, 8/32, 1MB Max Ram | 5.5 | 1 | - |
| ULA1 | HA | £5,000.00 | G1 | glue IOP-CPU | 5 | 1 | 4 |
| ULA2 | HA | £5,000.00 | G2 | glue RAM-CPU | 5 | 1 | 4 |
| ULA3 | HA | £5,000.00 | G3 | glue DISP-CPU | 5 | 1 | 4 |
| ULA4 | HA | £5,000.00 | G4 | glue SYSTEM | 5 | 1 | 4 |
| ROM3 | HA | £5,000.00 | 32K | 32 KB ROM chip | 4 | 1 | 4 |
| RAM2 |  |  | 128Kb | 8/16 bit, 100ns | 2.5 | 4 | - |
| INTSND1 |  |  | i8042 | mono snd, 2 8-bit ports | 1.5 | 1 | - |
| NVRAM |  |  | M48T08 | 8KB RAM, battery backed | 25 | 1 |  |
| BOARD-SLDR | HA | £10,000.00 | A83 | CPU, IOP, G1-4, XXKb RAM SERPORT, INTSND | 15 | 1 | 8 |
| Storage1 |  |  | disk | 3.5" floppy | 7.5 | 2 | - |
| CASE2 | HA | £12,500.00 | LUGGABLE | ext keyboard, 4 ext ports (+exp) | 35 | 1 | 10 |
| KEYB2 |  |  | ext | ext keyboard for system | 7.5 | 1 |  |
| IOP-S1 |  |  | 16550 UART | 1 ch serial port | 5 | 1 | - |

1. **Software Specification**

The software specification is listed in the Bill Of Materials (BOM). This shows the design time to be allocated to the Software Architect (SA) for each component. The items in the table below form the minimum software applicable to the core system. There is no coding cost associated with these items.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Design Staff** | **Design Cost** | **Component2** | **Producer** | **Code Size** | **Design Cost (person weeks)** |
| S1 | SA | £3,000.00 | Boot ldr & HWcfg | In House |  | 2 |
| S2 | SA | £12,000.00 | Sys: Kernel | In House/ HB/OS |  | 8 |
| S3 |  |  | SYS: Libraries | In House/ HB/OS |  |  |
| S4 |  |  | SYS: Drivers | In House/ HB/OS |  |  |
| S9 | SA | £12,000.00 | BAS: Kernel | In House/ HB OS |  | 8 |
| S10 |  |  | BAS: core lib&I/O | In House/ HB OS |  |  |
| S11 | SA | £3,000.00 | BAS: fs libs | In House/ HB OS |  | 2 |
| S26 | SA | £3,000.00 | McROM | bt ldr, knlcfg, debug |  | 2 |
| S27 | SA | £9,000.00 | Boot Disk Env | 3rd party |  | 6 |
| S28 |  |  | Libraries | 3rd party |  |  |
| S29 |  |  | Drivers | 3rd party |  |  |
| S38 | SA | £6,000.00 | CPM+BIOS | 3rd party |  | 4 |
| S39 |  |  | Libs & CLI | 3rd party |  |  |
| S40 | SA | £6,000.00 | 68kBASIC | 3rd party |  | 4 |

1. **Licenses**

A Unix license is required at a cost of £10,000 for each machine designed with a different CPU. A BSD copy license is required at £500 per version of the design. These represent a fixed cost during the design stage of £10,500.

In addition, each machine is bundled with EZ-SUITE. A licence is required at a cost of £25 per machine in the production phase.

1. **Design Cost**

The specification outlined above indicates a design cost of:

* Hardware – 38 weeks (190 days)
* Software – 36 weeks (180 days)

The company has one HA (£250 per day) and one SA (£300 per day). The time in the design phase can be reduced, using agency staff (HA - £400 per day; SA - £450 per day). Some of this time may be offset against the Project Manger’s (PM) time, as this could reduce the overall timeline.

1. **Production Cost**

The production cost can be considered in 4 elements:

1. Hardware components - £128.53 per machine
2. Case production - £8.75 per machine\*
3. Board production - £7.00 per machine\*
4. 3 Software disks - £15.00 per machine

\*The case and board production can be conducted simultaneously as the company has two in-house Hardware Engineers (HE) costing £175 per day. The cost per machine is based on a maximum build capacity of 20 cases and 25 boards per day. However, the production cost can be reduced through agency staff. While agency HEs will cost £275 per day (an additional £100), each agency staff employed will reduce the production phase and, therefore, reduce the cost associated with the PM.

1. **Testing Cost**

Hardware and software testing is conducted by the HE and SE respectively at cost of £175 and £195 respectively when using internal staff. Agency staff can be used at an additional cost of £100 per day. However, the additional cost can be offset against the time saving from the PM as the project is shortened.

1. **Project Management Cost**

The PM has a daily cost of £275 per day and will be employed daily throughout the project. While an additional PM can be employed from the agency, there is no financial benefit to do so.

1. **Model A – No Agency Staff**

The table below shows the costs associate with the project

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **Role** | **Units** | **Fixed Cost** | **Wks** | **Days** | **Agency Staff (Wks)** | **Agency Staff (Days)** | **Agency Cost** | **Internal Staff (Wks)** | **Internal Staff (Days)** | **Internal Cost** | **Total Cost** |
| Hardware Design | HA | 1 |  | 38 | 190 | 0 | 0 | £0.00 | 38.0 | 190 | £47,500.00 | £47,500.00 |
| Software Design | SA | 1 |  | 36 | 180 | 0 | 0 | £0.00 | 36.0 | 180 | £54,000.00 | £54,000.00 |
| Unix License |  | 1 | £10,000.00 |  |  |  |  |  |  |  |  | £10,000.00 |
| BSD copy license |  | 1 | £500.00 |  |  |  |  |  |  |  |  | £500.00 |
| Case Build | HE1 | 2000 |  | 0.01 | 0.05 | 0 | 0 | £0.00 | 0.0 | 0.05 | £8.75 | £17,500.00 |
| Board Production | HE2 | 2000 |  | 0.008 | 0.04 | 0 | 0 | £0.00 | 0.0 | 0.04 | £7.00 | £14,000.00 |
| Case Build - Agency | HE1 | 0 |  | 0.01 | 0.05 | 0.01 | 0.05 | £13.75 | 0.0 | 0 | £0.00 | £0.00 |
| Board Production - Agency | HE2 | 0 |  | 0.008 | 0.04 | 0.008 | 0.04 | £11.00 | 0.0 | 0 | £0.00 | £0.00 |
| Hardware Components | | 2000 | £128.53 |  |  |  |  |  |  |  |  | £257,060.00 |
| EZ-Suite License |  | 2000 | £25.00 |  |  |  |  |  |  |  |  | £50,000.00 |
| Disk |  | 2000 | £15.00 |  |  |  |  |  |  |  |  | £30,000.00 |
| Testing - HW | HE1 | 1 |  | 2.0 | 10 | 0 | 0 | £0.00 | 2.0 | 10 | £1,750.00 | £1,750.00 |
| Testing - SW | SE1 | 1 |  | 2.0 | 10 | 0 | 0 | £0.00 | 2.0 | 10 | £1,950.00 | £1,950.00 |
| Project Management | PM | 1 |  | 60.0 | 300 | 0 | 0 | £0.00 | 60.0 | 300 | £82,500.00 | £82,500.00 |

The total cost of the project is **£566,760**. The project would take 60 weeks to complete. In this model the project over-runs and is over budget.

1. **Model B – 50% Agency Staffing**

The table below shows the costs when the agency staff are used for 50% of the design and 50% of the production and testing phases.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **Role** | **Units** | **Fixed Cost** | **Wks** | **Days** | **Agency Staff (Wks)** | **Agency Staff (Days)** | **Agency Cost** | **Internal Staff (Wks)** | **Internal Staff (Days)** | **Internal Cost** | **Total Cost** |
| Hardware Design | HA | 1 |  | 38 | 190 | 20 | 100 | £40,000.00 | 18.0 | 90 | £22,500.00 | £62,500.00 |
| Software Design | SA | 1 |  | 36 | 180 | 18 | 90 | £40,500.00 | 18.0 | 90 | £27,000.00 | £67,500.00 |
| Unix License |  | 1 | £10,000.00 |  |  |  |  |  |  |  |  | £10,000.00 |
| BSD copy license |  | 1 | £500.00 |  |  |  |  |  |  |  |  | £500.00 |
| Case Build | HE1 | 1000 |  | 0.01 | 0.05 | 0 | 0 | £0.00 | 0.0 | 0.05 | £8.75 | £8,750.00 |
| Board Production | HE2 | 1000 |  | 0.008 | 0.04 | 0 | 0 | £0.00 | 0.0 | 0.04 | £7.00 | £7,000.00 |
| Case Build - Agency | HE1 | 1000 |  | 0.01 | 0.05 | 0.01 | 0.05 | £13.75 | 0.0 | 0 | £0.00 | £13,750.00 |
| Board Production - Agency | HE2 | 1000 |  | 0.008 | 0.04 | 0.008 | 0.04 | £11.00 | 0.0 | 0 | £0.00 | £11,000.00 |
| Hardware Components | | 2000 | £128.53 |  |  |  |  |  |  |  |  | £257,060.00 |
| EZ-Suite License |  | 2000 | £25.00 |  |  |  |  |  |  |  |  | £50,000.00 |
| Disk |  | 2000 | £15.00 |  |  |  |  |  |  |  |  | £30,000.00 |
| Testing - HW | HE1 | 1 |  | 1.0 | 5 | 1 | 5 | £1,375.00 | 0.0 | 0 | £0.00 | £1,375.00 |
| Testing - SW | SE1 | 1 |  | 1.0 | 5 | 1 | 5 | £1,475.00 | 0.0 | 0 | £0.00 | £1,475.00 |
| Project Management | PM | 1 |  | 29.0 | 145 | 0 | 0 | £0.00 | 29.0 | 145 | £39,875.00 | £39,875.00 |

The project is completed much quicker (29 weeks) and at a lower cost **£560,785.** However, this is still over-budget. The cost savings are minimal and there is an added risk regarding quality control when using agency workers. In addition, there is a net gain to the design phase as the additional spend of £300 per day is more than the saving of the PM time of £250 per day.

1. **Model C – Optimum Agency Deployment**

The optimum agency deployment could be to invest 2 weeks of HA agency time, so that the hardware and software development finish simultaneously at 36 weeks while not increasing cost. The production and testing savings through 50% agency staff remain in place.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **Role** | **Units** | **Fixed Cost** | **Wks** | **Days** | **Agency Staff (Wks)** | **Agency Staff (Days)** | **Agency Cost** | **Internal Staff (Wks)** | **Internal Staff (Days)** | **Internal Cost** | **Total Cost** |
| Hardware Design | HA | 1 |  | 38 | 190 | 2 | 10 | £4,000.00 | 36.0 | 180 | £45,000.00 | £49,000.00 |
| Software Design | SA | 1 |  | 36 | 180 | 0 | 0 | £0.00 | 36.0 | 180 | £54,000.00 | £54,000.00 |
| Unix License |  | 1 | £10,000.00 |  |  |  |  |  |  |  |  | £10,000.00 |
| BSD copy license |  | 1 | £500.00 |  |  |  |  |  |  |  |  | £500.00 |
| Case Build | HE1 | 1000 |  | 0.01 | 0.05 | 0 | 0 | £0.00 | 0.0 | 0.05 | £8.75 | £8,750.00 |
| Board Production | HE2 | 1000 |  | 0.008 | 0.04 | 0 | 0 | £0.00 | 0.0 | 0.04 | £7.00 | £7,000.00 |
| Case Build - Agency | HE1 | 1000 |  | 0.01 | 0.05 | 0.01 | 0.05 | £13.75 | 0.0 | 0 | £0.00 | £13,750.00 |
| Board Production - Agency | HE2 | 1000 |  | 0.008 | 0.04 | 0.008 | 0.04 | £11.00 | 0.0 | 0 | £0.00 | £11,000.00 |
| Hardware Components | | 2000 | £128.53 |  |  |  |  |  |  |  |  | £257,060.00 |
| EZ-Suite License |  | 2000 | £25.00 |  |  |  |  |  |  |  |  | £50,000.00 |
| Disk |  | 2000 | £15.00 |  |  |  |  |  |  |  |  | £30,000.00 |
| Testing - HW | HE1 | 1 |  | 1.0 | 5 | 1 | 5 | £1,375.00 | 0.0 | 0 | £0.00 | £1,375.00 |
| Testing - SW | SE1 | 1 |  | 1.0 | 5 | 1 | 5 | £1,475.00 | 0.0 | 0 | £0.00 | £1,475.00 |
| Project Management | PM | 1 |  | 47.0 | 235 | 0 | 0 | £0.00 | 47.0 | 235 | £64,625.00 | £64,625.00 |

This model is completed in 47 weeks and costs **£558,535** which is still over budget.

**Summary**

The 3 models show that it will be challenging to bring the cost of producing the machine on budget. Savings will have to be made in terms of either hardware or software specifications. Savings could be made in the form-factor or with reducing the EZ-Suite or Unix licenses. There is an optimisation for the use of agency staffing to ensure that the project completes on time, while reliability and quality is not compromised. There are minimal savings using agency worker in the design phases and more saving in the production and testing phases.