SynPuter Business Proposal

Group 1

December 01, 2025

Contents

1. Methodology

The proposed methodology is the Spiral Model, which uses multiple cycles with each cycle progressing through the same sequence of steps: determining objectives and constraints, evaluating alternatives and resolving risks, developing and validating the product, and planning the next phase (Boehm, 1988). This method was chosen due to its risk-driven focus, a factor determined to be of significant relevance within this particular business context. For example, the model facilitates iterative risk analysis based on component availability, supplier reliability, and evolving market conditions. The cyclical nature of the approach also ensures that external factors changing throughout the development lifecycle can be re-evaluated at each iteration, validating that previous decisions remain appropriate or identifying when course corrections are needed.

Figure 1 demonstrates the proposed spiral implementation with associated actions for each iteration.

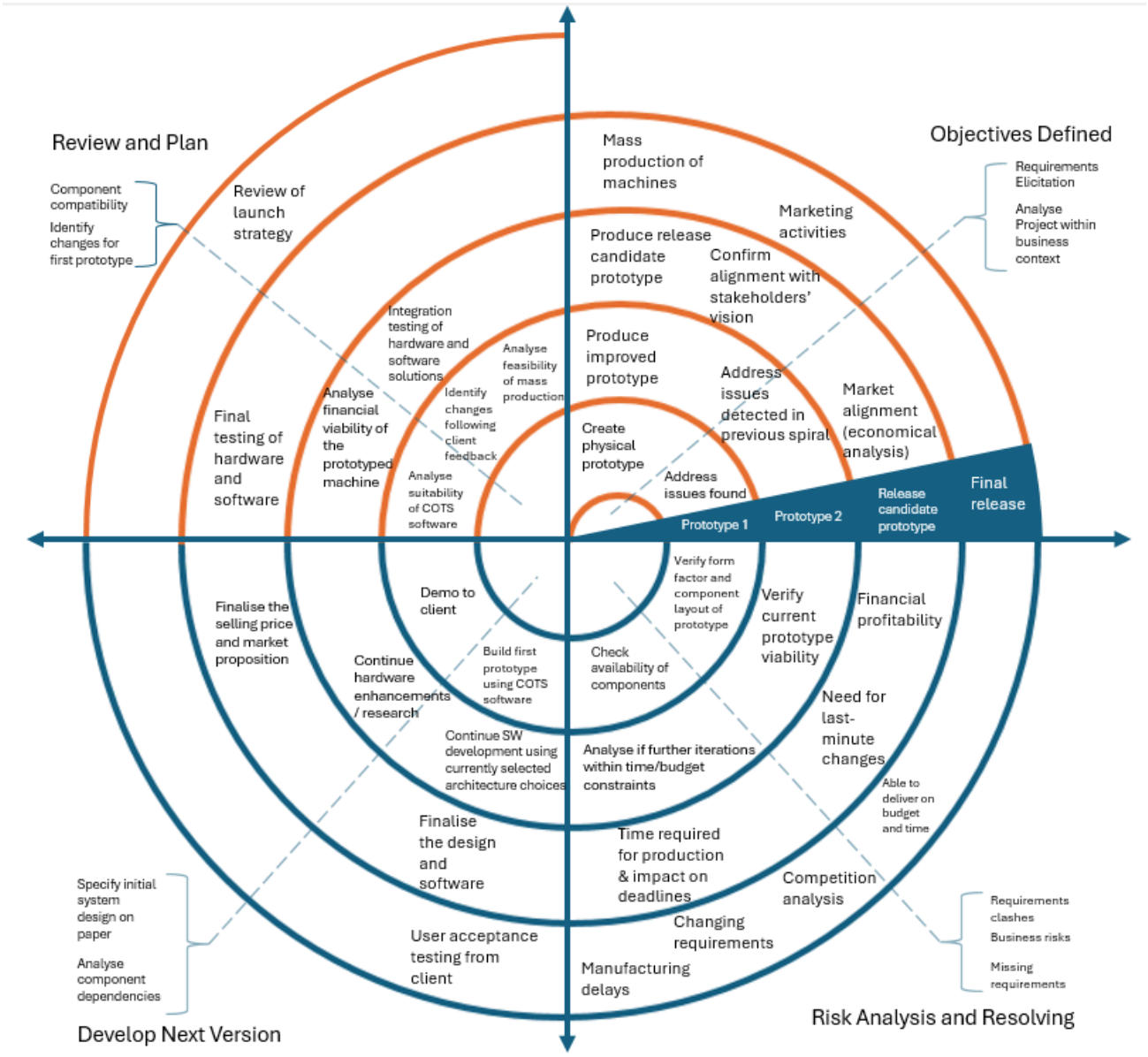

Figure 1: Spiral Methodology Plan

2. Requirements

2.1. High Level Requirements

A requirements gathering exercise has been undertaken to identify key requirements to ensure the final system meets EDC's expectations. The Easy Approach to Requirements Syntax (EARS) has been used in order to standardise the natural language approach to written requirements, thereby reducing or even eliminating confusion over intended meaning and ensuring unambiguous communications between stakeholders (Mavin, no date).

Table 1 describes these requirements along with associated priorities and a "Stakeholder" column to highlight differences between the plan and the initial requirements, or between disputing/contradictory requirements, where applicable.

Requirement ID	Requirement Text	Stakeholder	Priority	Compliance
R-001	The system shall use a Motorola 68k series CPU	SYN	Medium	
R-002	The system shall provide forward compatibility	EDC	High	
R-003	The system shall provide at least 512 KB of RAM	SYN	Low	
R-004	The system shall have a maximum total unit weight of 2kg including computer, batteries, screen and peripherals.	SYN	Low	
R-005	The system shall provide at least 2 hours of battery life.	SYN	Low	
R-006	The system shall have a built-in screen.	SYN	Medium	
R-007	The system shall have built-in storage.	SYN	Medium	
R-008	The system shall use a solid-state storage medium	SYN	Low	
R-009	The system shall provide storage compatibility for floppy disks	EDC	High	
R-010	The system shall support mouse, keyboard and storage hardware extensions	EDC	High	
R-011	The system shall include a bundled business applications suite	SYN	High	
R-012	The system shall provide industry-compatible software	EDC	High	
R-013	The system shall support execution of clients' pre-existing code without modification.	EDC	Medium	
R-014	The system shall provide connectivity for peripheral devices including Centronics printers, serial ports, keyboard connector, and SCSI	EDC	High	
R-015	The system shall support external keyboard connectivity	EDC	High	
R-016	The system shall provide network connectivity.	EDC	High	
R-017	The system shall support multiple simultaneous serial connections	EDC	Low	
R-018	The system shall support gaming through joystick port and game emulation capabilities	SYN	Medium	
R-019	The system shall have a target cost price of £250	EDC	High	
R-020	The system shall support an initial production volume of 2000 machines for EDC	EDC	High	

Table 1: Key Requirements

The following requirements have been deferred, with justifications below for why the proposed system is not compliant.

- R-004: It is stated that the batteries weigh 1.9kg and that the board, components, drives and screen weigh 0.65kg in total. Since both are required, it is therefore not possible to stay under 2kgs.
- R-005: It is stated that the longest observed battery life for systems using available components was 20 minutes.
- R-006: The need for a built-in screen was only ever proposed by Syn and brought the estimated cost in excess of the available budget.

2.2. Assumptions

A list of assumptions have been made in relation to the business context, described below in Table 2

ID	Assumption	Risk if Invalid	Mitigation
A-001	Motorola 68k series CPUs will remain available for procurement throughout the project duration	**High**	Identify alternative suppliers; evaluate compatible CPU alternatives early
A-002	Component suppliers can support rapid prototyping timelines to enable technical risk evaluation before production commitment	**High**	Establish relationships with multiple suppliers; maintain component inventory for critical items
A-003	EDC's £500k funding is available throughout multiple spiral iterations, not restricted to upfront allocation	**High**	Establish clear funding release milestones aligned with spiral cycles; negotiate payment terms
A-004	EDC can participate in iteration reviews and provide timely feedback within each spiral cycle	**Medium**	Schedule reviews well in advance; establish clear communication protocols and decision timelines
A-005	Manufacturing partners possess prototyping capabilities in addition to mass production facilities	**Medium**	Pre-qualify manufacturing partners for prototyping capability; identify alternative prototyping facilities

Table 2: Key Project Assumptions and Risk Mitigation Strategies

2.3. Gherkin Specifications

Cucumber is a tool used for creating and communicating automated acceptance tests that are written in natural language, which allows for greater accessibility as they can be read by anyone within a project team (The Cucumber Open Source Project, no date). Gherkin is the language used to write such tests, supporting a Behaviour Driven Development (BDD) workflow. BDD is a collaborative software development methodology that employs structured dialogue centred on concrete examples and counterexamples to facilitate a shared understanding of business requirements and expected system behaviour among all stakeholders (Smart, Molak and Terhorst-North, 2023).

Gherkin specifications have been written for the 10 requirements we feel are of highest priority. These can be seen in Appendix E.

3. Project Plan

The below project costing plan has been created with the following constrains in mind; £500,000 budget, production of 2000 units and a unit cost of £250 per machine (including required resource costs).

See Appendix B and C for a complete breakdown of the proposed system costs.

This results in a total system cost for hardware and software of £160.05. With a target of 2000 machines this results in £320,100. This leaves £179,900, of which £176,425 has been estimated for total labour costs, shown below in Table 3.

Role	Total number of days (Internal and Agency)	Total cost
Hardware Architect	75	£18,750
Software Architect	75	£22,500
HW Engineer	265	£52,625
SW Engineer	190	£41,050
Project Manager	110	£30,250
Project Analyst	45	£11,250
Total Resource Cost (£)		**£176,425**

Table 3: Resource costs

Total resource costs for the projected plan fall within the remaining budget of £179,900. This results in a total expenditure of £496,525, or £248.26 per unit. A full breakdown of project resourcing costs can be found in Appendix A.

Testing times for each project stage were determined by assessing system complexity, hardware-software integration points and risk exposure. In line with Project Management Body of Knowledge's (PMBOK) Control Quality and Validate Scope processes, testing is embedded throughout the plan to ensure continuous verification and stakeholder acceptance (Project Management Institute, 2021).

Early spirals focus on unit testing and design validation, requiring minimal time due to low technical risk. As hardware prototypes are produced, dedicated periods are allocated for hardware unit testing, followed by integration and system testing once software and hardware components converge.

Later spirals require increased testing time due to greater architectural complexity, including emulator behaviour, ROM configurations and full-system interactions. User Acceptance Testing is scheduled near project completion to confirm alignment with EDC's requirements. The proportional allocation of testing effort is supported by research indicating that testing typically accounts for 25-40% of development activity in hardware-software projects (López-Martín, 2022; Engel and Barad, 2003). A detailed breakdown of design, build and testing durations is provided in Appendix D.

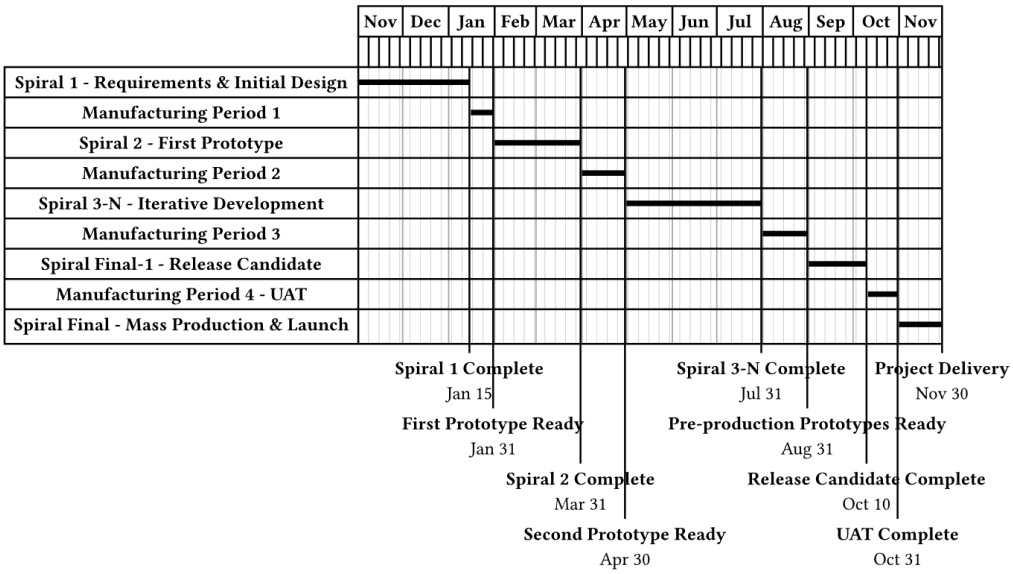

Figure 2: Project timeline Gantt chart

3.1. Sell Price

The machine's selling price depends on both production costs and prevailing market conditions. Section 3 establishes the unit cost at £248.26.

The IBM PC, previously identified as the primary competitor, offers specifications comparable to the proposed design (IBM, 1983). This system retailed for £2,890 in the UK during 1982 (*IBM advert: The IBM Personal Computer, from £2,890*, 2012).

The BBC Microcomputer System, launched in 1981, presents another point of comparison, with its premium configuration priced at £399 despite lacking internal storage and offering substantially less RAM (*Acorn BBC Microcomputer System*, 2020).

The Camputers Lynx 128, released in 1982 at £345, represents closer competition to the proposed design, though it still provides less RAM and possesses limited audio capabilities (The Centre for Computing History, no date; *Retro Isle - Camputers Lynx*, no date).

Given this competitive landscape, a retail price of £400 would position the proposed machine as both profitable and competitively viable in the marketplace.

Should all 2000 units be sold at the proposed price and the project runs to schedule, a total profit of £303,480 can be expected.

4. References

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The Cucumber Open Source Project (no date) *Cucumber*. Available at: https://cucumber.io/° (Accessed: 1 December 2025).

5. Appendices

5.1. Appendix A. Project Resourcing Costs Breakdown

Synputer Project Resource Plan

RATE TABLE

Role	Internal Cost (Day)	Agency Cost (Day)	Available in Syn
Hardware Architect	£250	£400	1
Software Architect	£300	£450	1
HW Engineer	£175	£275	2
SW Engineer	£195	£295	2
Project Manager	£275	£450	1
Project Analyst	£175	£250	0

SPIRAL 1: REQUIREMENTS & INITIAL DESIGN (3-4 weeks)

Role	Internal	Agency	Days	Cost	Notes
Hardware Architect	1	0	15	£3,750	Requirements elicitation and design
Software Architect	1	0	15	£4,500	System architecture design
Project Manager	1	0	15	£4,125	Project planning and management
HW Engineer	2	0	10	£3,500	Component analysis and dependencies
Spiral 1 Subtotal				**£15,875**	

MANUFACTURING PERIOD 1: Prototype 1 Build (3-4 weeks)

Role	Internal	Agency	Days	Cost	Notes
HW Engineer	1	0	5	875	Prototype assembly and testing, part time
Project Manager	1	0	5	1375	Vendor coordination, part-time
Manufacturing Period 1 Subtotal				**£2,250**	*Team reduced: No SW Arch, SW Eng, Analyst needed*

SPIRAL 2: FIRST PROTOTYPE (6-8 weeks)

Role	Internal	Agency	Days	Cost	Notes
Hardware Architect	1	0	15	3750	Physical prototype design
Software Architect	1	0	20	6000	COTS software integration
HW Engineer	2	0	25	8750	Build first prototype
SW Engineer	2	1	20	13700	Software development and testing
Project Manager	1	0	25	6875	Project management and client demos
Project Analyst	0	1	5	1250	Resource planning and cost tracking
Spiral 2 Subtotal				**£40,325**	

MANUFACTURING PERIOD 2: Prototype 2 Build (3-4 weeks)

Role	Internal	Agency	Days	Cost	Notes
HW Engineer	1	0	10	1750	Prototype build and validation
SW Engineer	1	0	5	975	Bug fixes during testing
Project Manager	1	0	5	1375	Part-time coordination
Manufacturing Period 1 Subtotal				**£4,100**	*Team reduced: Architects, Analyst released*

SPIRAL 3-N: ITERATIVE DEVELOPMENT (e.g. 6 x 2 weeks)

Role	Internal	Agency	Days	Cost	Notes
Hardware Architect	1	0	20	5000	Hardware refinement and troubleshooting
Software Architect	1	0	20	6000	Software architecture and OS development
HW Engineer	2	1	25	15625	Hardware enhancements and testing
SW Engineer	2	0	25	9750	Software development and debugging
Project Manager	1	0	15	4125	Project management and stakeholder coordination
Project Analyst	0	1	15	3750	Resource tracking and replanning
Spiral 3-N Subtotal				**£44,250**	

MANUFACTURING PERIOD 3: Pre-Production Prototypes (4-5 weeks)

Role	Internal	Agency	Days	Cost	Notes
HW Engineer	2	0	15	5250	Prototype build and validation
SW Engineer	1	0	10	1950	Bug fixes during testing
Project Manager	1	0	5	1375	Part-time coordination
Manufacturing Period 1 Subtotal				**£8,575**	*Reduced team during manufacturing*

SPIRAL FINAL-1: RELEASE CANDIDATE (4-6 weeks)

Role	Internal	Agency	Days	Cost	Notes
Hardware Architect	1	0	15	£3,750	Final design verification
Software Architect	1	0	20	£6,000	Software finalisation
HW Engineer	2	1	20	£12,500	Final testing and verification
SW Engineer	2	1	20	£13,700	Final software testing
Project Manager	1	0	20	£5,500	Market alignment and financial analysis
Project Analyst	0	1	15	£3,750	Final costing and resource planning
Spiral Final-1 Subtotal				**£45,200**	

MANUFACTURING PERIOD 4: UAT & Final Testing (2-3 weeks)

Role	Internal	Agency	Days	Cost	Notes
HW Engineer	1	0	10	1750	Prototype build and validation
SW Engineer	1	0	5	975	Bug fixes during testing
Project Manager	1	0	5	1375	Part-time coordination
Manufacturing Period 1 Subtotal				**£4,100**	*Reduced team during manufacturing*

SPIRAL FINAL: MASS PRODUCTION & LAUNCH (3-4 weeks)

Role	Internal	Agency	Days	Cost	Notes
Hardware Architect	1	0	10	£2,500	Production support
Project Manager	1	0	15	£4,125	Launch strategy and coordination
HW Engineer	1	0	15	£2,625	Production setup and UAT support
Project Analyst	0	1	10	£2,500	Final reporting
Spiral Final Subtotal				**£11,750**	

TOTAL PROJECT COST

HW Cost	£135.05
SW Cost	£25.00
Total Unit Cost	£160.05
2000 Units cost	£320,100.00
Resource Budget	£179,900.00
Spiral 1 Total	£15,875
Manufacturing Period 1 Total	£2,250
Spiral 2 Total	£40,325
Manufacturing Period 2 Total	£4,100
Spiral 3-N Total	£44,250
Manufacturing Period 3 Total	£8,575
Spiral Final-1 Total	£45,200
Manufacturing Period 4 Total	£4,100
Spiral Final Total	£11,750
TOTAL LABOUR COST	**£176,425**
Available Budget	£179,900
Budget Variance	£3,475 (Negative = Over Budget)

Figure 3: Resource costs for project duration

5.2. Appendix B. Hardware Cost Breakdown

Component	Model	Qty per Unit	Unit Cost (£)	Subtotal (£)
CPU	68k0	1	8.00	8.00
RAM (128 KB chips)	128Kb	4	2.50	10.00
ROM – Bootloader	8K ROM	1	1.50	1.50
ROM – HB/OS	32K ROM	1	4.00	4.00
ULA – G1 (I/O)	G1	1	5.00	5.00
ULA – G2 (RAM)	G2	1	5.00	5.00
ULA – G3 (Display)	G3	1	5.00	5.00
ULA – G4 (System)	G4	1	5.00	5.00
Sound Interface	I8042	1	1.50	1.50
Serial Port	16550 UART	2	5.00	10.00
Joystick Port	J6100	1	5.00	5.00
Expansion Interface	SCSI (IOP-X)	1	5.00	5.00
Storage	Mixed (floppy + cartridge)	1	12.50	12.50
Main board	A83-S Socketed	1	25.00	25.00
Case	DESKTOP	1	25.00	25.00
Keyboard	External (KEYB-ext)	1	7.50	7.50
Misc.	Resistors, Capacitors, etc	100	0.50 (thousand)	0.05
Total Component Cost (£)				**135.05**

Table 4: Bill of Materials - Hardware Component Breakdown

5.3. Appendix C. Hardware Cost Breakdown

Component	Source	Licence Cost per Unit (£)
HB/OS	In-house	0
HyperBasic Interpreter & Libraries	In-house	0
EZ-Suite (Writer, Sheet, DB, Graph)	Third-party	25.00
HWCFG Utility	In-house	0
Bootloader	In-house	0
HBConv (TeleBasic Converter)	In-house	0
Legacy emulator	In-house	0
HB/OS Drivers	In-house	0
File System & Media handlers	In-house	0
Total Software Cost per Unit (£)		**25.00**

Table 5: Software Licensing Costs

5.4. Appendix D. Build, Design and Testing Timeline

Phase	Design Time	Build Time	Testing Time	Testing Activities
Spiral 1 (Nov–Dec)	2 weeks	N/A	3 days	Requirements validation and feasibility reviews. Build not applicable as no prototyping occurs in this phase.
Build 1 (Dec–Jan)	N/A	3 weeks	2 weeks	Hardware unit testing: CPU, RAM, ROM, ULA. Design not applicable as this phase focuses solely on manufacturing and verification.
Spiral 2 (Jan–Mar)	3 weeks	3 weeks	3 weeks	Unit & integration testing (HW+SW), system testing on first prototype.
Build 2 (April)	N/A	2 weeks	2 weeks	Regression and bug-fix validation. Design not applicable as this phase is dedicated to hardware refinement and assembly.
Spiral 3–N (Apr–Jul)	6 weeks (iterative)	6 weeks	5 weeks	Full stack testing: emulator, EZ-Suite, ROM configurations and integration across hardware and software.
Spiral Final-1 (Aug–Oct)	3 weeks	3 weeks	4–6 weeks	Final system testing, performance verification, and compliance checks.
UAT Build (Oct)	N/A	1 week	2–3 weeks	User Acceptance Testing by EDC. Design not applicable; this phase prepares and delivers final prototype for evaluation.
Mass Production (Nov)	N/A	Rolling basis	5–10% of output	Quality control testing, batch sampling, and ROM/boot verification. Design not applicable in production phase.

Table 6: Development Phases Timeline

5.5. Appendix E. Gherkin Specifications

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Feature: Forward Compatibility (Req 1-002)
As a business project manager at EDC
I want forward-compatible hardware architecture
So that software and hardware investments remain viable as technology evolves

Scenario: CPU architecture supports future software versions
Given the system can run software
And resources are spent on developing software for existing machines
And new hardware is released regularly
When new generation of hardware is purchased
Then existing applications should continue to function on upgraded systems

Scenario: Expansion capabilities accommodate future technologies
Given the system has expansion slots
And expansion cards are purchased and used by business
When new generation of hardware is purchased
Then the existing expansion cards are supported by it
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And users should be able to upgrade without replacing the entire system


Feature: Storage Compatibility (Req 1-009)
As a business project manager at EDC
I want industry-standard removable storage
So that users can exchange data with other business systems

Scenario: System supports industry standard removable storage
Given system supports removable storage media
When users save their data on removable storage
Then the system should support at least one industry standard removable drive format
And media should be readable by other industry standard systems

Scenario: Storage media is commercially available
Given system supports data storage
When users need replacement or additional storage media
Then they should be able to purchase industry standard media from multiple suppliers
And not be locked into proprietary storage formats


Feature: Hardware Extension Support (Req 1-010)
As a business project manager at EDC
I want expandable hardware architecture
So that functionality can be expanded to meet evolving business needs

Scenario: System includes functional expansion slots
Given the system provides expansion capabilities
And technology rapidly evolves
When users need to add functionality to the computer
Then the system should provide accessible expansion slots
And the expansion slots standard must be future-proof
And both native and third-party expansion cards should be supported

Scenario: SCSI expansion capability is provided
Given I am a business project manager at EDC
When I need to connect external storage or peripherals
Then the system should provide SCSI expansion capability
And support standard SCSI peripherals


Feature: Bundled Business Applications (Req 1-011)
As a business project manager at EDC
I want a comprehensive business applications suite included
So that users have immediate productivity tools upon purchase

Scenario: Complete office suite is included
Given business users depend on business applications suite
When the system is delivered
Then it should include a word processor application
And it should include a spreadsheet application
And applications should be production-ready and fully featured


Feature: Industry-Compatible Software (Req 1-012)
As a business project manager at EDC
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I want industry-compatible software
So that the system integrates with existing business infrastructure

Scenario: System is compatible with existing software
Given the system can run software
And resources are spent on developing software for existing machines
And consumers need their existing software to run on the system
When consumers purchase the system
Then the system should run an OS compatible with existing business software
And the OS should support standard development tools and programming languages

Scenario: Software compatibility enables data exchange
Given I am a business project manager at EDC
When users need to exchange files with other business systems
Then the system should support common business file formats
And enable data portability between systems

Feature: Peripheral Connectivity (Req 1-014)
As a business project manager at EDC
I want comprehensive peripheral support
So that the system integrates with standard business equipment

Scenario: Centronics printer port is available
Given consumers use Centronics printers
When consumers need to connect their printers
Then the system should provide Centronics printer port connectivity
And support industry standard parallel printing

Scenario: Serial ports support communication and peripherals
Given consumers use serial ports for networking and communications
When consumers install the system
Then the system should provide serial port connectivity
And support standard serial communication protocols

Scenario: Keyboard connector enables external keyboard
Given the system will sell in European markets
And keyboard layouts differ across countries
When consumers purchase the system
Then the system should provide a keyboard connector
And support external keyboard attachment

Scenario: SCSI port supports storage and peripherals
Given I am a business project manager at EDC
When connecting external storage or peripherals
Then the system should provide SCSI port connectivity
And support SCSI protocol standards

Feature: External Keyboard Support (Req 1-015)
As a business project manager at EDC
I want external keyboard connectivity
So that different regional keyboard layouts can be accommodated

Scenario: External keyboard can be connected
Given the system is intended for multiple European markets

When users require country-specific keyboard layouts
Then the system should provide an external keyboard connector
And changing keyboards should not require internal modifications

Feature: Network Connectivity (Req 1-016)
As a business project manager at EDC
I want network connectivity capability
So that systems can be integrated into networked business environments

Scenario: Serial ports support networking standards
Given future systems will be network-integrated
When systems need to be networked together
Then serial ports should support RS422 or RS485 networking standards
And enable departmental server connectivity

Scenario: Multiple serial ports enable dedicated networking
Given system supports networking
And one serial port is dedicated to networking
When system is connected to a network
Then at least one additional serial port should be available
And support modem connections or other serial peripherals

Feature: Cost Price Target (Req 1-019)
As a business project manager at EDC
I want cost-effective manufacturing
So that the purchase order remains economically viable

Scenario: System meets cost price target
Given EDC has agreed to purchase 2000 machines at cost price
When the final system specification is costed
Then the manufacturing cost should not exceed £250 per unit
And all specified features should be included within this budget

Scenario: Cost overruns are identified early
Given the development of the system is financed by EDC
And the purchase price is fixed per the agreement with EDC
When component selection or design changes occur
Then cost impact should be calculated immediately
And alternatives should be proposed if the £250 target is exceeded

Feature: Production Volume Support (Req 1-020)
As a business project manager at EDC
I want scalable production capability
So that EDC's order commitment is fulfilled

Scenario: Production capacity supports initial order
Given EDC has placed an order for 2000 units
When production planning is finalised
Then manufacturing capacity should accommodate 2000 machines
And delivery timeline should be established and communicated

Scenario: Production schedule is realistic
Given the production plan is created for 2000 units

Then component availability should be confirmed for full production run
And manufacturing constraints should be identified and addressed
And a realistic delivery schedule should be provided to EDC

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