Product Development

Specification to Field Trial Prototype

Supplementary Information v1

Ignys | The Embedded Electronics Lab

Introduction

Ignys has distilled our experience of hundreds of product development projects into a structured six-stage process. This delivers your product from concept through to a proven prototype efficiently and consciously reducing risk as early as possible to take away any concerns of technical viability so that you can focus on sales, marketing, distribution and profitability.

We start with your approved requirements and progress these into system, hardware, and software requirements specifications. Compliance considerations are addressed early in the process, enabling proactive design decisions that aim to prevent costly rework. Subsequent stages involve the build and bring-up of hardware and software, culminating in a fully functional prototype ready for real-world testing and field trials. The outcome is a validated design with a clear path to production and a continuously decreasing risk profile.

Each requirement defined in the **Product Requirements Specification (PRS)** is fully traceable through every stage of the process. This ensures that the prototype encompasses all required features and that each has been demonstrably verified. The PRS should capture both product functionality and compliance obligations. Where the PRS is incomplete or not yet formalised, **Pre-Development Stage A: Requirements Refinement** is recommended. This stage establishes a solid foundation by defining clear, achievable requirements before detailed engineering begins.

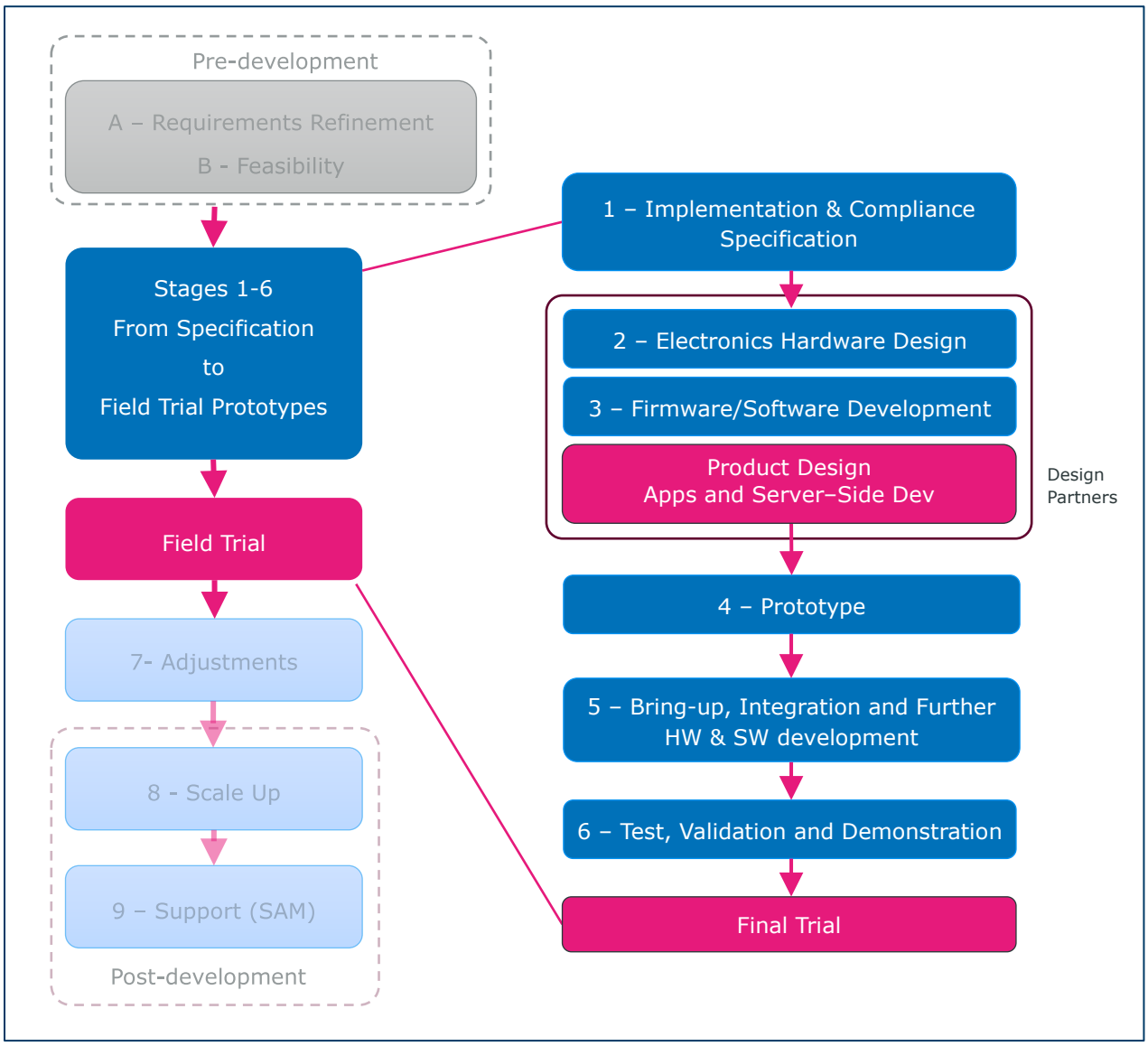
For projects involving novel technology, unproven concepts, or critical performance uncertainties, **Pre-Development Stage B: Feasibility** is strongly advised. This stage may commence with analytical exercises such as calculations, modelling, and simulation, followed by a proof-of-concept prototype that demonstrates key principles under real-world conditions. Addressing technical challenges early in this way de-risks the remainder of the project, ensuring that investment is focused on delivering a viable, production-ready product.

This supplementary information pack has been written to add detail to the proven six stage electronics product development process, taking you from product specification to verified prototype, ready for you to field trial.

Field trials are primarily for product validation, checking that the product meets your customers' needs. You may want to make adjustments to your product to respond to customer feedback before progressing into the final product development stages.

After any required adjustments we can support you through the full journey into volume production through CE marking and other compliance, production test setup and through New Product Introduction.

Full Development Process Context



Specification to Field Trial Demonstrator

Acronym / Term	Definition
BoM	Bill of Materials
CR	Change Request
CRRS	Compliance and regulatory requirements summary
EMC	Electromagnetic Compatibility
Firmware/FW	Low-level software interacting directly with hardware
HWRS	Hardware Requirements Specification
HW	Hardware
ICD	Interface Control Document
PCB	Printed Circuit Board
PCBA	PCB with components soldered to it
PRS	Product Requirements Specification
SRS	System Requirements Specification
SWRS	Software Requirements Specification
VTP	Verification test plan

Tools and libraries

To reduce risk and accelerate delivery, Ignys will use our proven in-house toolchains, frameworks, and libraries where appropriate.

Third-party or open-source components used will be disclosed, appropriately licensed, and selected to meet project quality and compliance needs.

Document and project change control

The **Project Reference Documents** form the foundation and blueprint of the project. They represent a shared understanding of the work to be undertaken, the required level of quality, acceptance criteria, and the basis for verification.

Requests to add to or deviate from the **Project Reference Documents** will be recorded in a Change Request (CR) and will follow the formal change control process, see Appendix B.

Supply chain issues arising during the project result in a Change Request as these are outside of Ignys control.

Stage 1	Implementation & Compliance Specifications
Purpose	To create product foundational project specific documentation for seamless delivery through the project stages.
Key Activities	Translate PRS into SRS, HWRS and SWRS. Produce High-level VTP with full requirements traceability. Document regulatory compliance details in CRRS, ensuring requirements are covered in above specifications for delivery.
Receivables	Product Requirements Specification (PRS), including use cases and constraints Relevant feasibility findings, research data, and prior proofs of concept Software security certificates/keys/endpoints
Deliverables	System Requirements Specification (SRS) Electronics Hardware Requirements Specification (HWRS) Software Requirements Specification (SWRS) Compliance and regulatory requirements summary (applicable standards and target markets) (CRRS) Verification test plan with objective pass criteria mapped to requirements (VTP)

Quality & Traceability	PRS requirements have project unique ID numbers and all are measurable. These numbered requirements are carried through into each of the HWRS
Assumptions	PRS is approved and stable Scientific principles, algorithms, and approaches referenced in the PRS have been validated through a successful feasibility study (or equivalent evidence), ensuring development is grounded on proven foundations. Any gaps or conflicts identified during this stage will be highlighted with recommended resolutions and, where needed, change requests for approval.

Stage 2	**Electronics Hardware Design**
Purpose	To produce a development kit prototype for early software development and deliver initial, A-model, electronics design that implements the approved requirements, is manufacturable at prototype scale, and is ready for bring-up, and verification.
Key Activities	Determine HW architecture Select major components with documented lifecycle status and obsolescence policy Create development kit prototype for **Stage 3 – Software Development** using evaluation kits/reference boards that are functionally representative of the target A-model hardware, where available Review space claim collaboration with mechanical to agree PCB outline, keep-outs, height limits, and connector locations Design calculations, breadboarding and critical simulations (as appropriate: power integrity, basic signal integrity for key nets) captured in a schematic

	PCB stack-up definition, layout constraints, and component placement strategy for electronics integrity PCB layout including critical-net routing, impedance control, and controlled clearances for EMC and creepage/clearance where applicable Design for manufacture and test (DFM/DFT) checks; prototype BOM optimisation to minimise production reel count Generation of manufacturing data pack for the first PCB spin Update VTP with implementation-specific details
Receivables	Mechanical envelope, mounting scheme, connector apertures, and thermal assumptions Any preferred suppliers and mandated components
Deliverables	Space claim pack showing outline, keep-outs, heights, and connector placement Major component report Space claim pack showing outline, keep-outs, heights, and connector placement Schematic CAD files PCB layout files and documented constraints/stack-up Prototype BOM Manufacturing data pack: Gerbers, drill, fab/assy drawings, pick-and-place, netlist, controlled impedance table, test points, read-me build notes Hardware Verification Plan mapped to requirements
Quality & Traceability	Peer reviews at each gate (schematic, pcb and manufacturing pack) with logged actions and resolutions for best practice and against PRS Library parts created/updated with provenance, versioning, and 3D models where available
Assumptions	HWRS is available and stable

	Mechanical reference data supplied in a usable exchange format (STEP, DXF, drawings) Altium Designer is used for schematics and printed circuit board designs

Stage 3	Software Development
Purpose	To deliver software, initially on development kit prototypes, then migrate to the target hardware when A-model boards are available. This compresses timelines without adding technical risk. Code to support prototype bring-up is prioritised.
Key Activities	Define the embedded software architecture and boundaries (boot, drivers, services, application) Select and configure RTOS (if required), HAL/BSP approach, and middleware (e.g., comms stacks, filesystems) Develop using the development kit prototype evaluation kits/reference boards that are functionally representative of the target A-model hardware Implementation of the driver and application features as required by the SWRS Define and implement update strategy (bootloader and secure firmware update/DFU/OTA as applicable) Prepare for A-model port
Receivables	Access to vendor SDKs, licenses, and documentation Test data and access to any cloud or third-party services used
Deliverables	Config/calibration framework and non-volatile data layout documentation Logging/diagnostics, timestamped events

	Update mechanism design and implementation (bootloader/DFU/OTA) with rollback/recovery where applicable Source code repository (branch strategy, tags), release notes, and versioning scheme Build and flash instructions; golden images for bring-up; PC utilities/scripts used in test API/Protocol documentation (message formats, timing, retry/back-off rules)
Quality & Traceability	Requirements-to-tests mapping maintained in the verification plan Peer reviews at key gates (architecture, driver layer, feature complete, release candidate) with logged actions and resolutions
Assumptions	Target A-model PCB is not available until the first spin; initial development proceeds on agreed dev kits/reference hardware that adequately represent target peripherals and performance Vendor SDKs, licenses, and secure assets (keys/certs) are provided in a timely manner Cloud/third-party services, if used, provide sandbox credentials and documented rate limits; throttling/back-off policies are acceptable for test use

Stage 4	**Prototyping**
Purpose	To arrange manufacture of prototype PCBAs, manage supplier engagement and quotation, support technical queries/adjustments, and perform incoming inspection.
Key Activities	Prepare and issue RFQs to approved manufacturers

	Support quotation with technical clarifications and adjustments (DFM notes, substitutions, alternates, panelisation, stencil spec) Supplier selection and placement of build order Incoming inspection and triage (visual, label/part checks, x-ray on request, workmanship spot checks to IPC-A-610 class as agreed) Defect/issue capture with supplier feedback loop (RMA/rework coordination if required)
Receivables	None anticipated
Deliverables	Incoming inspection report (photos, spot checks, any x-ray/AOI results if procured) Prototype PCBAs (5 off) for Ignys bring-up, development and test
Quality & Traceability	PCBA inspection of prototypes
Assumptions	Lead times and costs are market-dependent; approved alternates may be used to meet schedule Five (5) PCBAs on standard manufacture and shipping times included The 'A model' prototypes are not intended as final product and are ultimately expected to be scrapped after the second PCB iteration has been verified. These can be sent to you at project close if required.

Stage 5	**Bring-up, Integration and Further HW & SW Development**
Purpose	Complete A-model bring-up and integration, run EMC pre-compliance checks, port code from development kits to

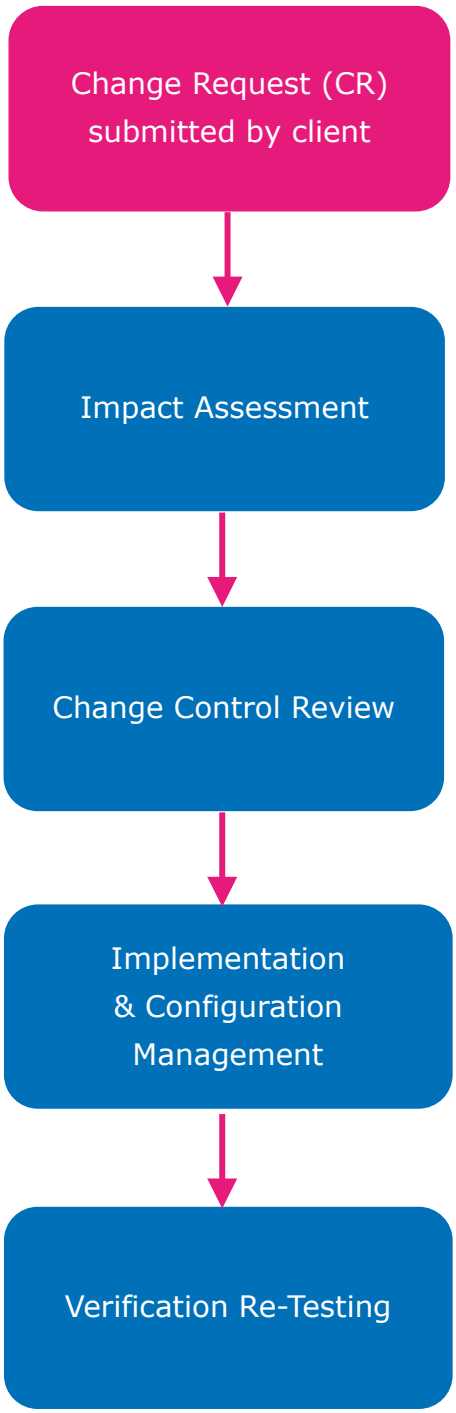
	target hardware, implement and order B-model hardware updates.
Key Activities	Perform safe board bring-up on A-model boards including power and power sequencing, clocks, programming, interfaces, sensors, actuators, storage, and comms paths Issue triage: capture defects with rapid rework where practical. All modifications to be recorded. Complete feature set per SWRS; implement safe states, watchdogs, and error handling EMC pre-compliance on A-model Translate A-model findings into B-model ECOs (schematic/layout) for function, EMC, SI/PI, thermal, robustness DFM/DFT improvements: test access, labelling, keep-outs, panelisation guidance, stack-up refinements Generate B-model manufacturing data pack Prepare and issue RFQs; support supplier queries (DFM notes, substitutions, alternates, panelisation, stencil spec) Order B-model prototypes
Receivables	None anticipated
Deliverables	A-model Bring-Up Report (checklist results, measurements, issues, resolutions) Ported and finalised software baseline for A-model with release notes EMC Pre-Compliance Report (set-up, conditions, results, recommended mitigations) B-model ECO pack: change list, updated schematics/layout, rationale, and design notes B-model manufacturing data pack: Gerbers, drill, fab/assy drawings, centroid, netlist, controlled-impedance table, test points, read-me/build notes

Quality & Traceability	Peer reviews at key gates: B-model data pack update completion, release-candidate software, EMC pre-compliance results Configuration management: repo branches/tags, versioned data packs
Assumptions	A-model units available; major faults preventing porting will be addressed via ECO or rework Vendor SDKs/licences, certificates/keys, and test endpoints are provided on time Compliance targets (EMC/safety/radio) confirmed to inform B-model updates Excludes test fixtures, full compliance lab fees Prototypes limited to 5 PCBAs

Stage 6	**Verification and Field Trial Preparation**
Purpose	To ensure prototypes demonstrably meet all PRS requirements with any concessions agreed. Deliver field-trial-ready prototypes with documentation.
Key Activities	Incoming B-model inspection and triage (visual, label/part checks, orientation and soldering) B-model bring up testing focussed on areas of change Prototype verification against VTP Field Trial Readiness Pack: golden firmware image(s), programming and recovery procedures, quick-start guide, safety notes, known-issues list, and data/log collection method Operator/installer briefing materials (as agreed) Handover of issue tracker and support plan for trial phase
Receivables	None anticipated

Deliverables	Incoming inspection report and B-model bring-up log Verified B-model software release notes and signed artefacts Verification Test Report with requirements traceability, results, defects, and recommendations Field Trial Readiness Pack (golden images, flashing scripts/instructions, recovery steps, quick-start, known issues)
Quality & Traceability	VTP requirements-to-test matrix with objective pass criteria, results, and residual risk notes
Assumptions	Field trial limited to 2 PCBAs

Change Control Overview



Logged with project unique ID including rationale

Engineering team review to evaluate impact on functionality, compliance, schedule, cost and risk. Findings documented.

Client, Project Manager, Lead Engineer(s) review and decide to approve, reject or request clarification.

Approval record and cost approved, implantation owner assigned

Perform approved changes to hardware, firmware, and/or documentation with version control

Record all changes with references to CR ID and version numbers

Re-test affected functions and confirm no regressions.

Conduct compliance re-evaluation where required

Record verification outcomes and link to CR record

If conflicts arise, the most recent Customer-approved specification takes precedence unless otherwise agreed in writing

We are The Embedded Electronics Lab that cuts risk, accelerates delivery, and gets your product to market with confidence.

Citation ISO Certification — Environmental management — ISO 14001: 2015 — REGISTERED
Certificate No:470522024

British Assessment Bureau — UKAS MANAGEMENT SYSTEMS 8289 — ISO 9001 QUALITY MANAGEMENT

Citation ISO Certification — Information security management — ISO 27001: 2022 — REGISTERED
Certificate No:463682024

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Raspberry Pi Design Partner

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