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Transitioning New Microsystems Technology into Products

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Product Development is different than R&D

The Challenge

Technology development

- Unique, innovative, first of a kind
- High technical risk
- Not particularly application specific
- One working device with a rack of support electronics in a lab is acceptable
- OK if not everything works perfectly – new knowledge is the driver

Product development

- Reliable, repeatable, easy to use, low risk
- Target a particular customer & application
- 100% functionality required
- Satisfying customer needs (requirements, schedule, & cost) drives project

Successful transition requires a more rigor than typical technology development

Understand Tech Readiness

RL1 Basic Research - Experimental data revealing useful information about the basic principles observed

RL2 Applied Research - Model that explains underlying science and how it could be applied to an application

RL3 Research Result - Experimental or analytical demo that shows feasibility

RL4 Research Demonstration (Lab demo)

RL5 Research Prototype (Demo Unit) – Product look but hand-built by PhDs, breaks a lot

RL6 Engineering Prototype (Alpha Unit) - Rugged, repeatable research prototype

RL7 Flight / Field Prototype (Beta Unit) – Reliable, manufacturable engineering prototype

RL8 WR / Hi-Rel (Production Unit) – Qualified & production costs addressed

RL9 Proven Product – adaptation of successful product to new but similar use

Product Delivery Checklist

- Effectiveness – demostrated functionality over expect environment
- Repeatability
- Reliability – how long before it breaks, catastrophic or graceful, what are the failure mechanisms?
- Manufacturability – consider cost, ease, repeatability, required expertise & tools
- System Interface - user interface well understood; system integration issues addressed?
- Operating Concept – documented; fault tolerance of controller software
- Calibration – Required? Easy and cost effective from the user's viewpoint?
- Ease-of-Use - Is the device easy enough to use that failures are not caused at next assembly?
- Personnel Safety – requirements addressed?
- EMI & Pwr Supply - compatibility addressed?
- Supplier Issues – development & issue resolution
- Test & Certification Plan – product, organizations & key equipment
- Handling/Transportation Issues - can be more severe than the use environment.

Organized Product Development Strategy

Rigor can be adjusted to the specific project

Organize project status information in a set of documents that

- Compels the identification and filling of technical and programmatic gaps, and
- Clearly documents and communicates "a snapshot in time" of what the project "looks like"
- Builds buy-in by through discussion and iteration of the documents until consensus is reached.

Keep the project documents updated – Use TBDs to make sure that nothing has been forgotten.

- More important to first identify and document what the needed information is than to get the information.
- TBDs will be used liberally to point out what we need to know that we don't currently know.

Change Control – The document set will be date stamped and the whole set copied, modified, and re-stamped whenever it is changed. This ensures use of a familiar communication tool and self-documents project progress.

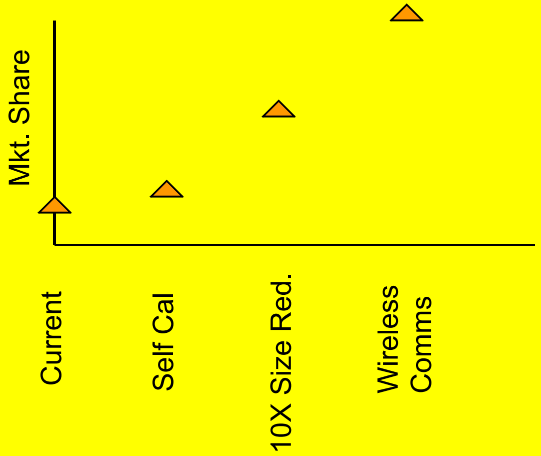
Questions We Will Always Ask – 1) Is this right? 2) Did we forget anything? The intention here is to draw out additional information and refine existing information while building consensus and buy-in as we go.

Project documents include…

- Business Case & Value Analysis
- Current State / Future State
- Project Goals & Objectives
- Interface Block Diagram
- 3D Models of Conceptual Design Options
- Concept of Operation
- Process, Assembly, & Test Flow with Technology Readiness Rating
- Interface Specification Sheets
- Product Readiness Analysis
- Risk Dependencies, & back-up Options
- Project Plan
- Resource Gaps

Project Documents

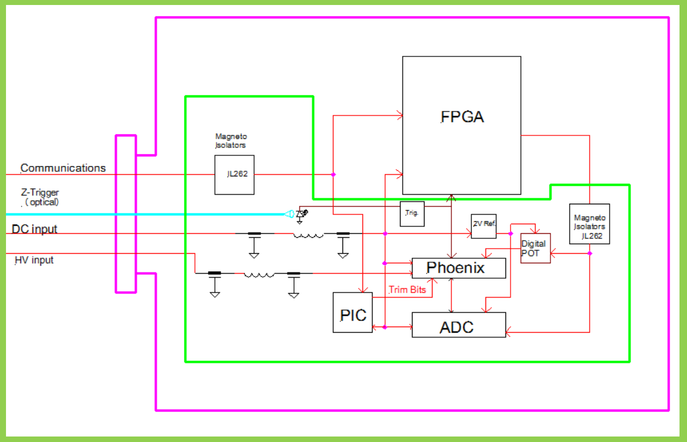
- **Business Case & Value Analysis** - key technical parameters and how they affect market share.



- **Current State/Future State**

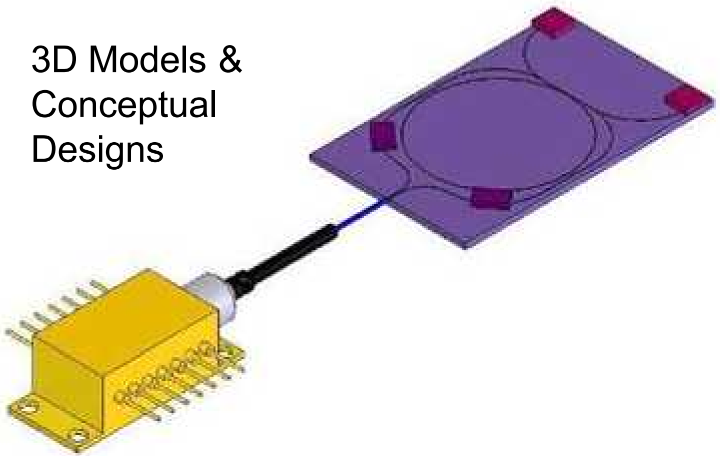
- **Goals & Objectives**
  - What is the deliverable?
  - What is the problem being addressed?
  - By when and to whom?
  - How will they use it?
  - What will it do?/What will it not do?
  - Intermediate deliverables
  - Review when expectations change, new team members join, …

Interface Block Diagram



Project Documents

3D Models & Conceptual Designs



Concept of Operation (CONOP)

- Step-by-step description of operation
- Initial conditions, start up, shut down, timing, …
- Required fault tolerance
- Defines spec sheet for microsystem controller/processor software

Process, Assembly & Test Flow with Readiness Rating

Interface Specification Sheets

- Owner & team members
- Next assembly, deliver to whom by when
- Operational, assembly/transportation/handling, and test environments
- Pinouts, mechanical footprint, weight, volume,…
- Power, electrical, optical, fluidic requirements

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Project Documents

Product Readiness Analysis, Risk Dependencies & Backup Options -

- Identify high risk issues are for each deliverable, process, and test procedure and what the impact will be to other parts of the project if one part fails to make delivery
- Keeps a running list of backup options that may be invoked if a block looks like it will fail to meet its interface specifications or will be delivered too late to be used
- Provides an assessment of product readiness using the Product Assessment Scale

Project Plan

- Major milestones, durations, dependencies
- Realistic estimates are crucial
- Work schedule/cost/requirement tradeoffs

Resource Gaps

- What's needed that's not available & the impact?
- How could additional resources enhance the probability of project success?