Impact of Agile Process in Systems Engineering

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imagination at work

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System of Systems with Moving Parts

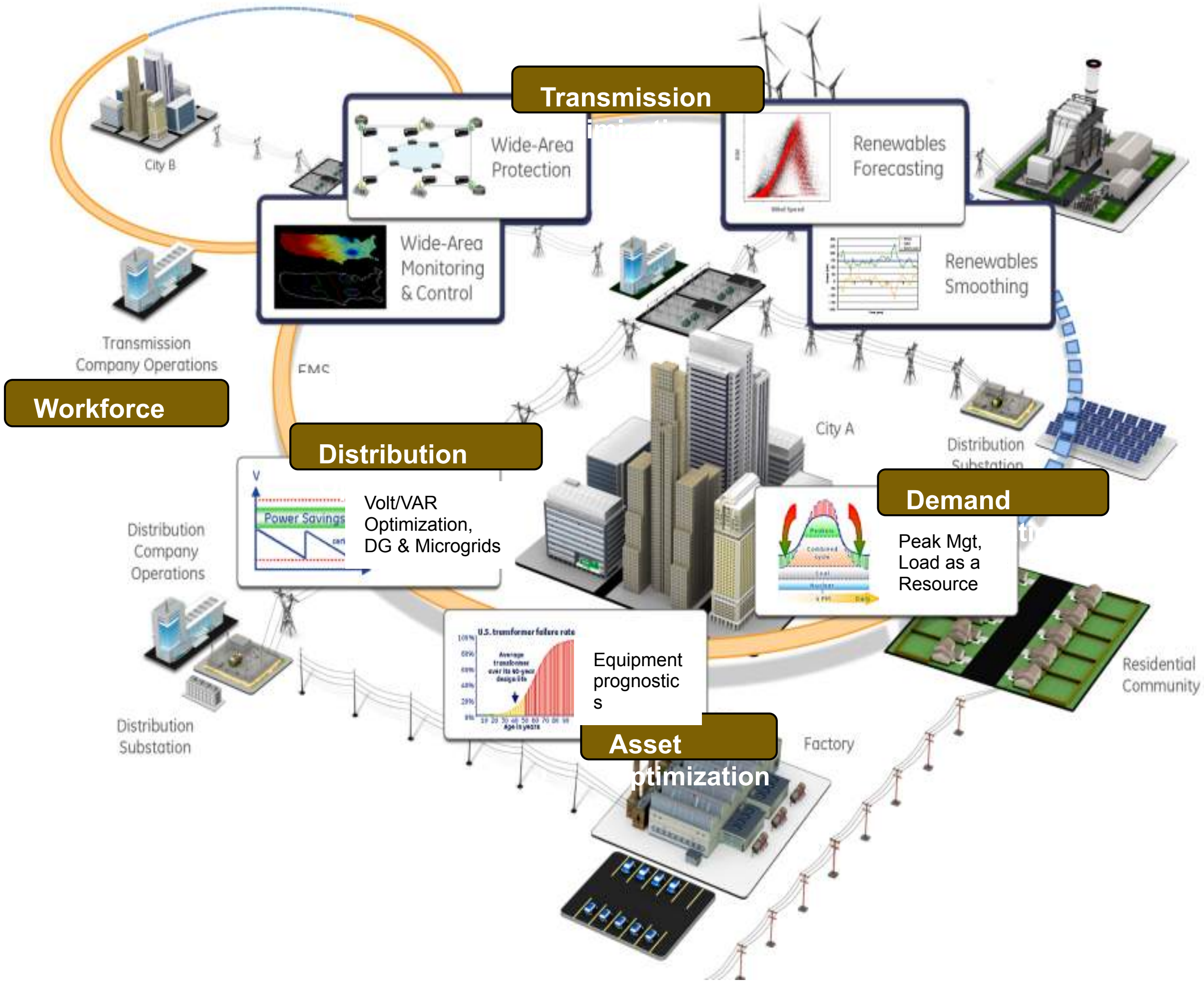
Interconnected systems managed by multiple entities

Millions of data sources

Monitoring Systems:

- Outage Management Systems
- Energy Management Systems
- Distribution Management Systems
- Demand Response Management Systems
- Advanced Metering Infrastructure

Smart Grid Story . . . = Complexity



Transmission

Workforce

Distribution

Volt/VAR Optimization, DG & Microgrids

Demand

Peak Mgt, Load as a Resource

Equipment prognostic s

Asset ptimization

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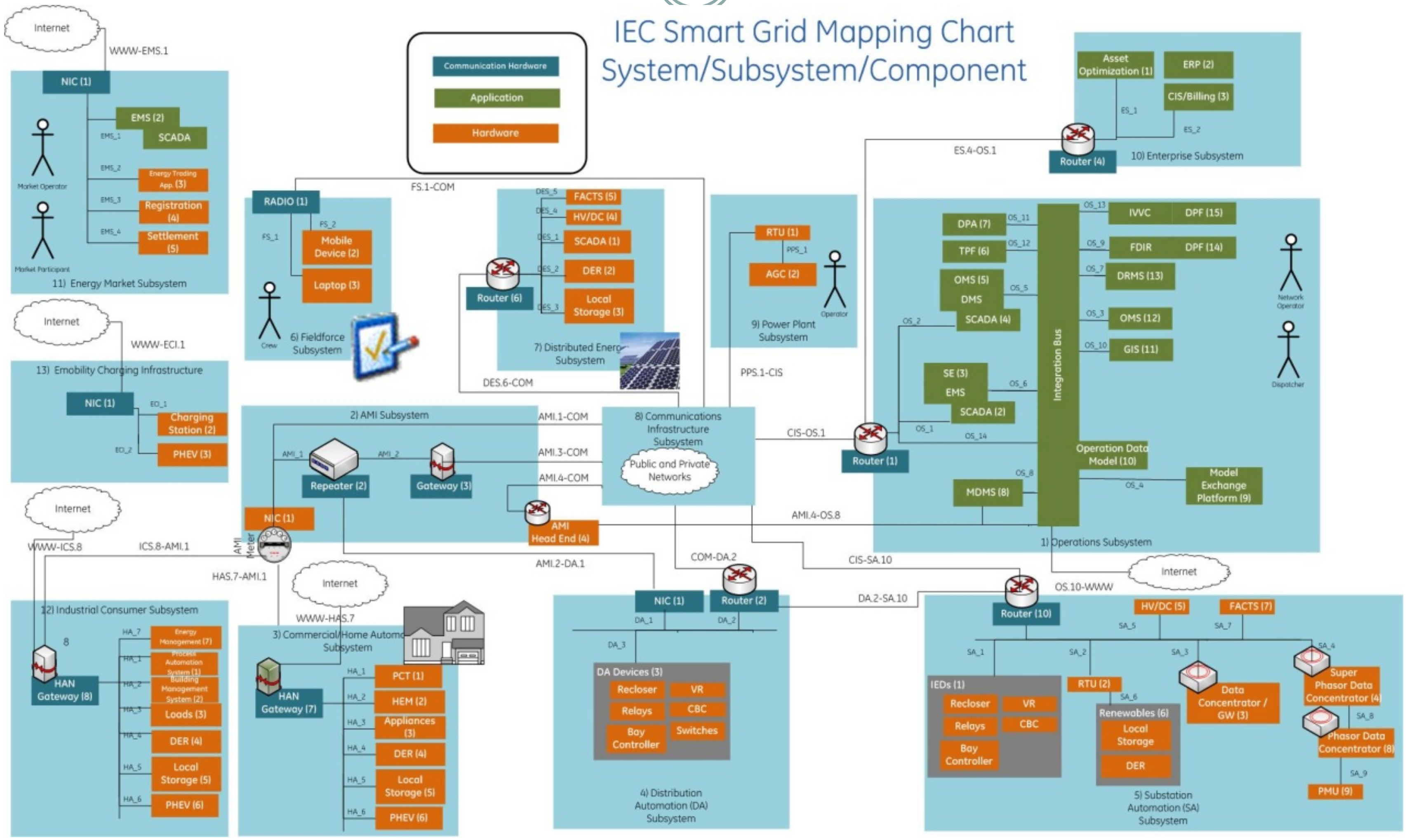
Smart Grid Boundary Architecture



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Two Approaches Merged into One

Agile Software Development

- Reduce "work in progress" (common in a waterfall methodology)
- Deliver products in useable increments.
- Methods include (Adopted from Software):
  - Prototyping
  - peer reviews
  - design reviews
  - continuous integration
  - customer working groups
- Principals:
  - Non-solo development
  - parallel independent testing
  - end of iteration demos
  - static code analysis.
- High emphasis on quality & functionality

Systems Engineering Development

- Here system refers to the collection of different products (software and/or hardware) that together produce a unique result that cannot be obtained by an individual product.
- Emphasizes end capability
- Solution agnostic at early stages
- Integrated Product Teams
- Engaging with customer early and often
- Intended value described in view of customer/end-user

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Description of Project of Interest

Project Name	Project Alpha	Project Beta	Project Charlie	Project Delta (SoS)
Deliverable	Product 1	Product 2&3	Product 4	Product 1, 2, 3, &4 (SoS)
New/Existing Product	Existing (adding new features)	Integrate an existing prod. (prod 2) and a new product (prod 3)	Create a ne packaged solution	New (system integration of all products)
Development Process	Agile	Agile	Agile	SE & Agile
Level of process knowledge	Good	Novice	Transitioning to Agile	Transitioning to Agile
Knowledge of Product	Sound	Sound	Sound	Limited
Funding Source	Business	Business	Engineering	Engineering
Team Location	Co-Located	Co-Located	Global	Global
Product Manager Committed	Yes	Yes	Partial	No*

* Note: product Managers of A & B are acting as "SoS" Product Manager

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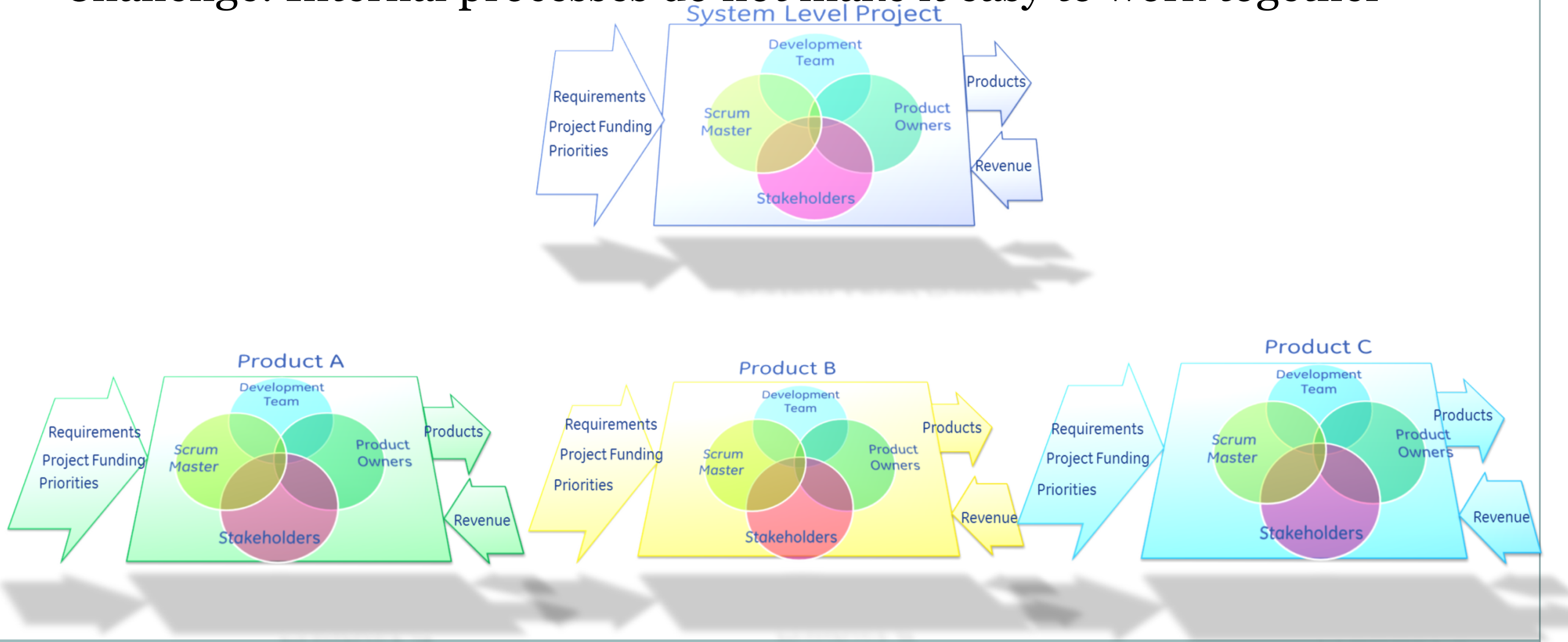
Lesson Learned:
Team structure and team priorities matter!

- Challenge: Each team creates profitable products
- Challenge: Integrating the products creates an additional revenue stream
- Challenge: Internal processes do not make it easy to work together



System Level Project
Requirements
Project Funding
Priorities
Development Team
Scrum Master
Product Owners
Stakeholders
Products
Revenue

Product A
Requirements
Project Funding
Priorities
Development Team
Scrum Master
Product Owners
Stakeholders
Products
Revenue

Product B
Requirements
Project Funding
Priorities
Development Team
Scrum Master
Product Owners
Stakeholders
Products
Revenue

Product C
Requirements
Project Funding
Priorities
Development Team
Scrum Master
Product Owners
Stakeholders
Products
Revenue

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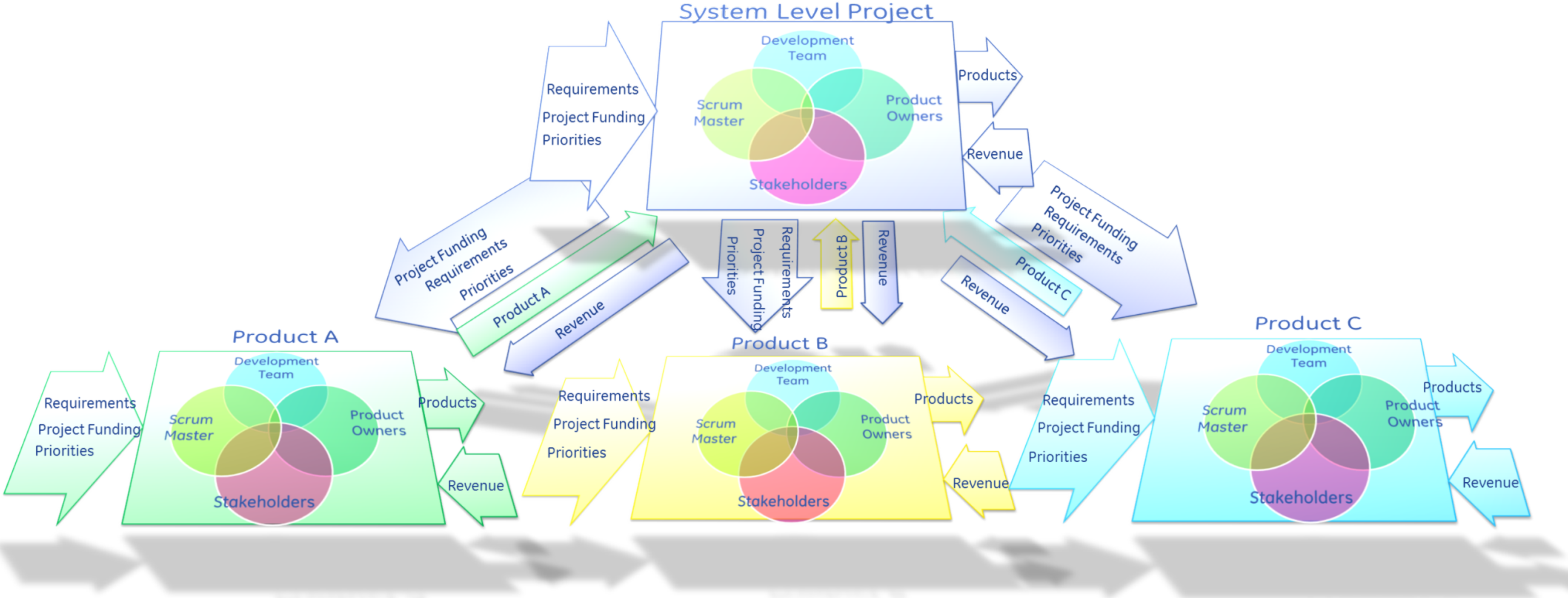
Lesson Learned:
Team structure and team priorities matter!

- Solution: Create System level project = internal customer
  - Funding, requirements and priorities can be incorporated by product teams
  - Product exchange
  - Internal "revenue" stream



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Lesson Learned:
Invest in Unified Methods and Tools

- Enable collaboration & information sharing between teams
- Align project schedules

	Project Alpha	Project Beta	Project Charlie	Project Delta
Sprint Timeline	2 Weeks	2 Weeks	3 Weeks	3+ Weeks
Requirements Tool	Rally	Excel	n/a	Doors, Excel
Architecture Tool	Rational Rose	Internal Tools	Enterprise Architect	Enterprise Architect
Bug Capturing	HP Quality Center	Rally	BugZilla	HP Quality Center
Validation Tool	HP Quality Center			HP Quality Center
Time Zones	India, US MST	Canada MST	USA EST – 2 locations	USA EST – 2 Locations

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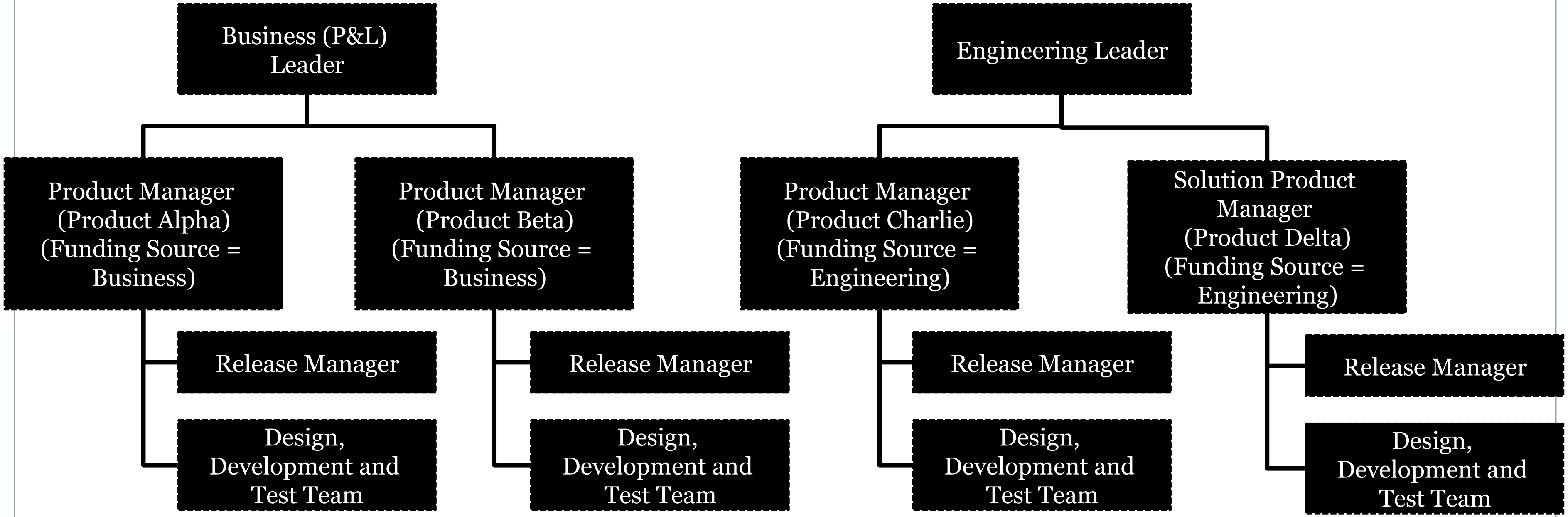
Lesson Learned:
Manage the Matrix

- Communication was key:
  - Networking, Influencing, Coaching and Facilitation was essential in managing in Matrix organization
  - Goals, objectives, and performance metrics for managers and staff should be aligned with products and projects


Business (P&L) Leader
Engineering Leader
Product Manager (Product Alpha) (Funding Source = Business)
Product Manager (Product Beta) (Funding Source = Business)
Product Manager (Product Charlie) (Funding Source = Engineering)
Solution Product Manager (Product Delta) (Funding Source = Engineering)
Release Manager
Design, Development and Test Team
Release Manager
Design, Development and Test Team
Release Manager
Design, Development and Test Team
Release Manager
Design, Development and Test Team

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Lesson Learned: Engage Leadership

- "Solutions Program Manager" was assigned to the project
  - Created single point of contact responsible for solution delivery
  - Raised issues regarding priorities to upper level management
  - Worked with product managers to align project schedules
- Upper-Level management engagement is key
  - Without a senior champion, none of the lessons learned would be possible

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Lessons Learned Summary

- ❑ Knowledge Sharing Across Stakeholders
- ❑ Leverage and Mange Global Teams
- ❑ Clearly Identify Funding Sources
- ❑ Manage Schedule and Resources
- Communicating Priorities is Key
- Unify Processes and Tools
- Leverage Matrix Organization Structure
- Engage Leadership!

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Conclusions

- Principles applied from SE and Agile
  - SE Use- Case
  - SE Requirements
  - UML/ SysML modeling (boundary architecture & Dataflow)
  - SE validation
- Enterprise multi-product development poses challenges to text-book development methods
  - Acquisition transition
  - Customer requirements
  - Business priorities
- Documenting lessons learned will aid in educating the community to arrive at best practices

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Thank You

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The Scenario

- In energy utility companies today, SoS projects are extremely challenging to complete successfully, due to the number of stakeholders, the duration of the projects, and the number of data points being converted into usable information.
- Today, utilities are exploring more tightly coupling these systems to provide more functionality and improved robustness.
- systems engineering scenario where three products are being produced by independent product teams, typical in a large commercial environment with multiple priorities and customers. These products have customers, requirements and funding. In many cases, these are existing sellable solutions in and of themselves. The scenario is where there is a new customer asking for an integrated solution of all three complete solutions. In this case, there is an additional product that is to be created in response to the emerging customer needs in order for the solution to work robustly. For the company, this will be an additional revenue stream for the individual products. However, in many corporations, “profit and loss” (P&Ls) centers have been established to align with existing, segmented customers. These are typically aligned around a particular product or product-line.

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