Applying Systems Engineering Practices To Project A

Eric Wild
05/06/2009

Organizational Layout

Types of Software Modes
- GMTI - Ground Moving Target Indicator – Such as cars, trucks, (Company A)
- Air to Air Mode – Other planes, missiles (Concurrent)
- SAR – Synthetic Aperture Radar – imaging stationary targets (Company B)

Overview Presentation
- Introduction and Overview
- Organization of Program
- Systems Engineering Principles
- Applying Principles
- Examples
- Lessons Learned

Radar System Functional Flow Diagram

Summary of Interfaces
- Hardware Interface
- Software Interface
- Organizational Interface
- Communication Interface
- Integration Interface

Functional Flow
- Airplane takes off towards the target area
- Radar transmits a high power microwave pulse
- Target returns signal to processor
- Processor analyzes signal
- Display shows target

Case Study: Next Gen Airborne Air-ground, Air-air radar program
- Two companies working together to integrate hardware and develop software for the next generation radar system.
- Higher resolution.
- Improvements made to collect ground and moving targets by using better algorithms and faster processing.
- Greater Reliability

Hardware Interface
- Structure Integrity
- Retrofits in the Antenna structure resulted in flight delays (schedule delay)
- Main subsystems
- No budget was allocated after the delivery of Receiver/Exciter (over budget).
Software Interface

- When one mode changed affected all the modes, resulted in drastic schedule and cost overruns.
- Two different companies working on own proprietary software.
- Coding Techniques from the 80s, instead of using modular design.
- Common problem of high turnover, as if someone retires, and bad bad code, can't just delete his stuff because it effects many other functions.

Organizational Interface

- Poorly staffed early on, lack of people with necessary skills.
- Two different companies working together to integrate different hardware and software with proprietary techniques.

Communication Interface

- Employees not happy, high turnover
- Lack of feedback during year
- Mistrust between two companies
- Proprietary information makes it harder to troubleshoot problems.

Integration Interface

- Prime and Sub using different database in requirements
- Software developers company A are on the East coast trying to communicate with testing with the West coast when they should be here.
- Necessary specs were not provided by vendors to complete test plans on time, this includes qual test, and environmental. (Schedule Delay)

Advantages of a Matrix Organization

- Project Manager maintains maximum project control (through the managers) over all resources, including cost and performance.
- Policies and Procedures can be setup independently for each project, provided that they do not contradict company policies and procedures.
- The project manager has the authority to provide guidance and control, however, does not manage the conflicts with other projects.
- Rapid response is possible to changes, conflict resolution, and project needs (via technology or sublets).
- Two people can be shared, the program cost is minimized.
- Stress is distributed with the team, and functional managers.

Disadvantages of Matrix Organization

- Dual reporting
- Difficulty in monitoring and control
- People do not feel they have control over their future when they are continuously reporting to multiple managers.
- Company wide not as cost effective, requires more people than necessary.
- Continuously changing priorities.

Key Risk Terms

- Risk: something that may cause deviation in the project's schedule, budget or performance (adverse impacts, disruption, or threats). It occurs when risk is not managed appropriately.
- Opportunity: something that may improve the project's schedule, budget, or performance. It occurs when risk is not managed appropriately.
- Mitigation: action to reduce risk and its impacts. It is threat of harm, reduction in risk to an acceptable level.
- Probability: a numeric value (usually a percentage) that represents the likelihood the risk or opportunity will occur.
- Consequence: a quantified value that represents the effect that the risk or opportunity (assuming it occurs) will have on the project's objective.
- Cost: a dollar amount representing the consequence in the project's objective.

Risk

- Risk is defined as potential loss beyond expected program execution.
- Risk Management is a continuous process, which captures new risks as they emerge while tracking the status of already identified risks.
- Virtually all projects do not do well, fail because of unidentified or unexpected risk.
Risk Management Process

Risk Problems

Talking To Risk Manager:
- We don't quantify risks correctly; we don't look at the big picture (time and money). We don't mitigate correctly. As Engineers we are too optimistic.
- When there is a problem, our company will place too many unqualified people to get the job done, instead of a few skilled employees. Vice versa is also true, assign problems to not enough resources.

Risk Problems Cont

- A huge problem we have in our company is that we don't mitigate the problem of someone who is in charge of many crucial tasks to a person leaving the company, or getting sick.
- What we should do is train employees to be able to fill in roles before the problem occurs.

Value:
- Customer: Air Force
- Stakeholders:
  Prime: Company A
  Subs: Company B
- Value: Done right the first time, no rework, on schedule, and at cost.

Currently: Blame Game, Huge Wastes

LEAN

There are five key principles of Lean:
- Value - What customer is willing to pay for
- Value Stream - The steps that deliver value
- Flow - Organizing the Value Stream to be continuous
- Pull - Responding to downstream customer demand
- Perfection - Relentless continuous improvement
**Current State**

- Waste game between Project A and Project B
- Extra work
- Massive waste when one mode gets changed, affects all other modes
- Bad design
- Lack of flexibility, where one employee does everything, skeptical

**Actions**

- No Bobbitt actions
- Huge waste when one mode gets changed, affects all other modes

**Future State**

- No waste
- Employees are trained, flexible
- Incremental improvements

**Ideal VSM: Better communications, better layout**

- Modes: Development, Mode Testing
- Flight Test
- Mode Developers: Development, Mode Testing

**Ideal State**

- Better communications
- Akio Ishikawa
- Assembly Skills
- Team work
- Honesty
- No waste
- Flexibility by top leadership
- No wait

**Future VSM**

- Increased Value
- Increased Efficiency
- Reduced waste

**Project Management**

- Earned Value Management System
  - With EVM, can see problems early
  - Later a problem is detected more expensive to repair

  **Technical Planning**
  - Fixed technical planning and management allows lead systems engineer to structure and monitor project plans so that they not only meet their objectives but also ensure that all their time, money, and resources are efficiently used.
  - Strategic inclusion helps ensure that everyone doesn’t run out of money, people, alignment, profit.
Hardware Interface
- Structure Integrity
  - Retrosis in the Antenna structure resulted in flight delays (schedule delays)
  - Main subsystems
    - No budget was allocated after the delivery of Receiver/Exciter (over budget)
Lessons Learned:
- When building program use trade studies how long it took a similar program to complete software modules, our program had an impossible schedule to meet

Software Interface
- When one mode changed affected all the modes, resulted in drastic schedule and cost overruns.
- Two different companies working on own proprietary software (incompatibility)
- Proprietary information makes it harder to troubleshoot problems.

Lessons Learned:
- Use modular design when integrating software.
- Provide training on latest software methods

Communication Interface
- Employees not happy, high turnover
- Lack of feedback during year
- Mistrust between two companies
- Proprietary information makes it harder to troubleshoot problems.

Lessons Learned:
- Use Co-locations - This would improve efficiency by having all work done in one site.
- Provide feedback and expectations to employees on a quarterly basis.

Integration Interface
- Prime and Sub using different database in requirements
- Software developers company A are on the East coast trying to communicate with testing with the West coast when they should be here.
- Necessary specs were not provided by vendors to complete test plans on time, this includes qual test, and environmental. (Schedule Delay)

Lessons Learned:
- Force suppliers to commit to specific time frames for delivery of specs, or financial penalty.

Lessons Learned Cont:
- Use EVMS to ensure program meets schedule and cost requirements. Train all managers in EVMS as well as have a monitoring process to ensure done correctly.
- Inaccurate Basis of Estimate – due to not taking into account risk, issues regarding the five interfaces – such as software, and hardware

Questions?