BREAKING THE LEARNING/DEVELOPMENT CURVE

Jim Peterka, Boeing Satellite Systems
2016 Project Management Symposium
702SP
Breaking the Development Cycle

James J. Peterka
Program Manager
Commercial Satellite Systems

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Satellite 101

- High-value assets – typically $100M+ per spacecraft
- Perform for 15+ years with no human intervention except for periodic Radio Frequency (RF) telemetry/command – everything else is autonomous
  - International application for telephony, high data-rate transmission over large regions – Connectivity, Information, Business Support
  - Continuous operation 24/7 with NO interruptions to customer business case
- Typically 6 years from start of development to delivery on orbit
  - 702SP accomplished this in 4 years
- Typically 2 to 3 years from contract start to launch of a satellite
  - 702SP can do in <2 years and with >20 years propellant life while meeting power/payload objectives – two at a time!

Satellites are a critical asset to customer business
Quality and Mission Assurance are #1
Spacecraft Subsystem Description
“10” Major Subsystems

**Propulsion**
- Orbit raising, momentum & orbit control
  - Xenon thrusters
  - Positioning mechanisms
  - Switches
  - Controllers
  - Valves
  - Flow control
  - Xenon tank
  - Pressure sensors

**Attitude Control**
- Attitude determination and control
  - Reaction Wheels
  - Inertial Reference Units
  - Star Trackers

**Power**
- Power generation (Solar Arrays)
- Energy storage (Batteries)
- Controllers
- Distribution
- Monitors
- Switches

**Avionics (Spacecraft Control Processors and Software)**
- Attitude and orbit control
- Processing & control sequences
- Data storage & status
- Payload & platform control
- Command distribution
- Telemetry collection

**Structure**
- Hardware mounting
- Static and dynamic loads
- Release mechanisms

**Payload**
- Comm repeater
- Instruments

**Antenna**
- Reflectors
- Pointing mechanisms
- Hemi antennas

**Launch Vehicle Interface**
- Power
- Separation status
- T&C

**Telemetry and Command**
- Transmitters
- Receivers
- Data bus

**Thermal**
- Temperature control and monitoring
  - Heat pipes
  - Blankets
  - Heaters
  - Temperature sensors

*BLUE denotes new developments/technologies

Challenge is balancing performance, cost, risk and meeting the plan

Program Manager and Chief Engineer needed a strong team!

Maintain a symbiotic relationship amongst disparate technologies
Overview of our newest 702 satellite design

- **Evolution of 702 Product Line**
  - Began as Feb 2011 IRAD study
  - Built upon 702MP and 702HP flight heritage

- **Change the value proposition for the customer**
  - All-electric propulsion to reduce launch costs
  - Provide increased payload telemetry points
  - Reduce overall processing cycle time

- **Adaptable spacecraft architecture that allows a common bus to accommodate various payloads**

- **Dual-manifest on Falcon 9 with Industry Standard Separation Systems**
  - Launch vehicle integration, spacecraft stacking, separation within Boeing experience

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### 702SP Development and ABS / Satmex "4-Pack" Flight Schedule

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**Parallel Development and Flight Program**
Market Based Demand

- **What was the situation before change?**
  - Minimal orders won in this payload/power class (<7 kW)
  - Marketplace “stagnant” on liquid propellant technology and capability for new payload types and new rockets

- **What was the challenge?**
  - Reduced cost by >20%
  - Marketable within 1 year, developed within 2 years and deployed by 4th year
  - Product life cycle from contract sign to launch in <2 years
  - Able to build (at least) 6 per year on the various launchers

- **What was the situation after change?**
  - Any customer is able to receive economics of dual launch and all-electric propulsion design
  - Most competitors have now entered into the electric propulsion market

*Satellite industry calling for technology and capability refresh*
Method and Approach

- **Strategize for Innovation**
  - Apply “stretch goals (30% less cost, 50% increase in “production velocity,” >50% performance improvement, etc.)”
  - Have the courage to create and introduce new product

- **Build on success – All-electric propulsion is evolutionary**
  - Took the 702HP from c1999 and “threw off the bi-propellant” to go all Xenon Ion Propulsion (XIPS)

- **Assemble small team (20-25 people) of experienced + early career Hi-Po’s* to work in a “crucible of innovation”**
  - Challenge team outside of comfort zone
  - Foster new ideas, drive innovation to get surprising results

- **Strong Executive support**
  - “Steering Committee” to review cost/schedule/performance bogies
  - Experts for internal non-advocate review, and a constant mission assurance presence

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The result – **dual-stacked high-capacity satellites in one launch package**

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*High-potential employees
Assessment of Program Performance

- **Good**
  - Met development cost goals
  - Retired risk of new technologies and processes per the plan
  - Sold 6 customers in 1st year of marketing
  - 1st pair launched on plan and performing well

- **Challenges**
  - Difficult to find willing partners to align to common build and launch schedule
  - Finding the “sweet spot” of performance, price-point and industry acceptance – delicate balance

*Successful launch and deployment of two high-value assets in record time*
Flawless Execution of a New Product Line

- Four years to develop
- Three years from contract to launch
- Two satellites on orbit on a single launch
- One dedicated and motivated satellite team at Boeing

Present Day

Times 2!

1 March 2015
Questions?