Organizational Change
Maintain Strategic Capability
Revise the Business Structure

Massachusetts Institute of Technology
SDM Conference

October 19 2007
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Agenda

• Introduction
  – Global Service Partners (GSP)
  – Kyiv, Ukraine
  – Pratt & Whitney-Paton JV
  – Products, State of the Business

• The Challenge
  – Transition
  – Refocus

• Application of Enterprise Architecture
GSP Network

**East Hartford, CT**
- Turbine Airfoils
- Combustors
- HPC Stators, Seals
- Drums, Disks, Shafts
- Cases (Military)

**North Berwick, ME**
- LPC Stators, Stators (Military), Seals, BOAS, Bearing Housings, Carbon Seals

**Columbus, GA**
- V2500-A5, -D5

**Cheshire, CT**
- PW4000, PW2000, F117, JT9D

**Dallas, TX**
- Turbine Airfoils
- IGT
- Serviceable Material

**Indianapolis, IN**
- Tubes, Ducts and Manifolds

**Columbus, GA**
- V2500-A5, -D5

**Springdale, AR**
- Cases, Gear Boxes, Bearing Housings
- Engine Mounts

**New Zealand**
- V2500 (2004), JT8D (All Models), Dart

**Ukraine**
- Coating (Airfoils)
- EB PVD Equipment
- Ingots
- R&D
- Airfoil Repair

**Japan**
- Turbine Airfoils, BOAS

**Taiwan**
- HPC Stators, Seals, Variable Vanes

**San Diego, CA**
- Composites
- Thrust Reversers
- Nacelles
- Exhaust Nozzles
- Inlets/Pylon Fairings

**Lansing, MI**
- Composites
- Thrust Reversers
- Nacelles
- Bulkhead Doors
- Flight Control Surfaces

**Singapore**
- PW4000, CFM56-5C, JT9D

**Singapore**
- Turbine Airfoils, HPC Blades
- Combustors, Fuel Nozzles
- HPC Stators, Seals, Variable Vanes
- Tubes, Ducts and Manifolds
- Fan Blades

**San Antonio, TX**
- Combustors (Military)
- IGT

**New Zealand**
- V2500 (2004), JT8D (All Models), Dart

**Engine Overhaul**
- Part Repair

**Engine Overhaul**
- Part Repair

**PW-Paton**
- Member of PW’s Worldwide Network
Ukraine
**Introduction PW-Paton**

- PW-Paton – Located Kyiv Ukraine
  - 1992 Start of JV, 2004 renewed for 25 years
- Highly Skilled Work Force
  - 130 Employees, Access to Larger Network
  - 75 % of Workforce College Degreed
  - 18 % Advanced Degreed, PhD
- Two Facilities, 68K square feet

**PW-Paton, JV between United Technologies, Pratt & Whitney and Paton Welding Institute of the National Academy of Sciences of Ukraine**
State of the Business, 2006 Transition

- Business was Operating in the Red
- Workforce Very Unsure about their Future
- Core Business had fallen away
- PW Leadership Considered Closing or Compressing the Business

2006 Business in Disarray – Complete Revitalization Needed
State of the Business, 2006 New Business Plan

• Re-focus the business on core competency
  – Three Key Elements
    • Sustained Business - Turbine Coating Services
    • Equipment Manufacturing
    • Research & Development

The Challenge:

• Transition from Largely R&D focus to Production
  – R&D with commercial application
  – PW-Paton’s Role is an Enabler for PW Network
• Maintain Technical Excellence
• Establish: Trust, Hope, Focus, Change

New Business Plan – Sustained Business to Support R&D
PW-Paton, People
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Coating Services</th>
<th>Engineering and R&amp;D</th>
<th>Repair</th>
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<tr>
<td><img src="image1" alt="Equipment Image" /></td>
<td><img src="image2" alt="Coating Services Image" /></td>
<td><img src="image3" alt="Engineering and R&amp;D Image" /></td>
<td><img src="image4" alt="Repair Image" /></td>
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Equipment Manufacturing

- EB PVD, electron beam physical vapor deposition
- Vacuum technology, EB guns super heat ceramic or metallic compounds to form vapor
- Turbine blades are introduced to the vapor forming protective coating
- EB PVD coating process capable of generating desirable physical properties
  - Morphology
  - Crystalline structure
  - Metallic Bonding
Production - Equipment

Metallic Alloy Coater - UE193

• Single Sting modern coater
• UE193 has innovative main chamber allowing for optimized layout of EB guns and crucibles
• Advanced high rate vacuum system
• High capacity ingot feeders have 670 mm capacity
• Advanced Control system and automated mechanical system

Example of PWP Product Offering
Production - Equipment

EB Melter for Metal ingot production – UE194

- Electron Beam Melting machine is used for MCrAlY, CoCrAlY and Ti ingots melting and refining

- UE194 is equipped with 4 EB-guns and an intermediate reservoir

- UE194 can produce 1 – 2 500 mm long ingots per shift
Engineered Coatings

EBPVD Coatings: - High temperature corrosion resistant metal overlay

EB Metallic overlay: CoCrAlY, CoNiCrAlY

Products:
- 1st stage turbine blades and nozzles of 131-9 APU – in production
- 1st / 2nd stage turbine nozzles and SX 2nd blades of 331-500 – in progress

PWP Capable of Engineering Coatings to Specific Applications
Engineered Coatings

Overaluminized

Superalloy

Overlay – MCraLY

EB PVD TBC

2 layer TBC – MCraLY+ YSZ (ZrO\textsubscript{2}-Y\textsubscript{2}O\textsubscript{3})

Material Science PWP Core Competency
Engineering - Qualifications

Industrial Turbomachinery, Dual System
Metallic and Thermal Barrier Coating

- Coating system designed to meet customer requirements
- Metallic Base coat with tailored chemistry
- Thermal Barrier Ceramic Coating enhances part life and allows increase in engine efficiency
- PWP posses agency certifications enabling the business to offer solutions to customers

PWP Offers Customers Tailored Solutions
Engineering – MCrAlY & TBC System

Overlay & 2-layer EB-PVD TBC for Russian customers

AVIADVIGATEL
PS 90 GP - IGT. 16 MW Gas Turbine
PS-90 A2 - Aircraft Advanced Engine

Perm Motor
PS 90-A Aircraft Engines

PWP Supplies Advanced Coatings to Local Industry
Organizational Capability

PWP has the Full Range of Capability to Meet Customer Needs
Customers

Global Customer Base Necessary to Secure Coating Services and Equipment Business
Applications of Enterprise Architecture

• Best Practices
  – Alignment
  – Organization

• Wrap Up Discussion
  – Systems Engineering Principles
  – Cultural Learning’s
Best Practices: Alignment, Rigor and Discipline

- Actively Manage Systems Architecture
- Use Standard Processes Consistently
- Implement System Engineering as a Unique Discipline
- LEADERSHIP
  - Common yet Flexible Toolsets
  - Manage Workforce by Common Competencies
  - Manage Infrastructure Corporately
  - Adequate IR&D Investment
  - Program/Project Management Rigor & Flexibility
  - Integrated Workforce Strategy
  - Consistent Organizational Structures

Applications of EA
J.C. Duh, Russ Wertenberg
Applications of EA: Alignment

4 Point Focused Business Strategy

- **Equipment**
- **Coating Services**
- **Engineering and R&D**
- **Repair**

**Applications of EA: Alignment**

- Transition from Largely R&D focus to Production
  - R&D with commercial application
  - PW-Paton’s Role is an Enabler for PW Network
- Maintain Technical Excellence
- Establish: Trust, Hope, Focus, Change

**Simple Focused Strategy – Build on PWP Core Competency**
Applications of EA: Alignment

- Equipment – Links us to P&W
  - Applies our core competency
  - Generates a need for PW-Paton
  - PW-Paton Enabler for PW
- Coating Services – Sustained Business
  - Our steady income – our survival
    - Support P&W network
    - New money – International Customers
  - Applies our core competency
- Engineering and R&D – Continued New Birth
  - Building blocks for our future
- Repair – Potential Business, Local Customers
  - Additional source of income for us
  - P&W wants us to build local customer base

• 4 Point Strategy (FPS)
  Strategic Content Lays out Foundation for the Enterprise's Systems Architecture
  - Focused
  - Manages Systems Architecture

Strategic Content of the FPS Aligns to System Architecture of PW-Paton
Applications of EA: Alignment

Master Plan

Product Lines
- Equipment
- Coating
- Engineering & R&D
- Repair

2007 Production Volumes

Departments
- Each Department Works to the Master Plan - Only
- Department is Responsible for:
  - Help Create MP
  - Understand MP
  - Resource to achieve MP
  - Support MP

Actively Manage Systems Architecture
Alignment
Program/Project Management Rigor & Flexibility
Integrated Workforce Strategy
Consistent Organizational Structures
Manage Workforce by Common Competencies
Adequate IR&D Investment
Manage Infrastructure Corporately
Common yet Flexible Toolsets

LEADERSHIP

- All Current Product lines on MP are Aligned to 4 Point Strategy (FPS)
- All New Product Aligned to MP and FPS
- DISCIPLINE – Only items on MP get Worked

Actively Manage Systems Architecture
Alignment, Rigor, Discipline
Applications of EA: Organization

- Restructured PWP to Drive Focus on Coating Services & Equipment Manufacture
  - New Operations Organization
    - Production – Technology Support – Facilities
  - Coating Services – Sustained Business
    - Highly skilled team
- Engineering & R&D
  - Merged Technical Functions to better Support Production
    - Equipment Design
    - Production Support
    - Process Improvement
    - Coating Technology
- EB Equipment Manufacture is PW-Paton’s Unique Core Competency
  - New Equipment Keeps PWP current and Defines our Future
  - Production Operations - Coating Services is PWP’s Sustained Business

PWP’s Operational Focus - Coating Services & Equipment Manufacture
Applications of EA: Organization

- Resource Alignment to 4 Point Strategy
- Heavy Focus on Operations
- New Cooperative Approach

Revised Traditional Functional Organization Aligned Resources & Competencies to 4 Point Strategy
Applications of EA: Organization

P&W Lessons Learned:

Strong Engr. & Opps. Teams are Keys to Sustained Success
Applications of EA: R&D Investment, Infrastructure

- **Applied R&D**
  - Funding Available – Commercial Applications

- **Material Science**
  - Proceeds Based on Success of Applied Research

- **Infrastructure**
  - Ownership Clearly Defined
  - Structured Tasking - Master Plan

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**Material Research Proceeds based on the Success of Applied R&D**
Applications of EA: Systems Architecture, Systems Engineering

Current State:
- Business Operating with Positive EBIT
- Currently Manufacturing 2 New Advanced EB coaters
- Coating Services Business Restored
- 2008 Technology R&D plan

Systems Architecture & Systems Engineering, New Disciplines for PW-Paton
Wrap Up Discussion

• Systems Architecture Principles
  – Alignment
  – Organization

• Cultural Learning’s
  – Trust – not to be underestimated
  – Easy Things are not Easy
  – Western Time Schedule, Something Foreign
    • Understood but Considered not a Best Practice
  – Western Approach – Be Careful
  – Eastern Education
    • Philosophy Important
    • Increasing State of Knowledge is Accomplishment
  – Singularity - Survival