Development and Integration Issues about Software Engineering, Systems Engineering and Project Management Processes

**Claude Y. Laporte - Process Engineering**

**AGENDA**
- Introduction
- Engineering Process Development
- Support Process Development
- Integration Facilitators
- Lessons Learned
- Conclusion
Oerlikon Aerospace

Turn Over OBH
1996
3.6 Billion SFr (US$3.0 B)
(15,543 Employees)

Oerlikon-Bührle Holding AG, Zürich/CH

Oerlikon-Contraves Defence

O-C Pyrotec AG
Zürich, CH
20-35 mm Ammunition

Oerlikon Aerospace Inc.
Montreal, CA
ADATS Missile System/
Surface-based Weapon Systems

Pilatus Aircraft & Components

Immobilien Real Estate

Various

Oerlikon Contraves AG
Zürich, CH
Air Defence Systems
Fire Control Systems
20-35 mm Cannons

Oerlikon Contraves S.p.A.
Rome, IT
Fire Control Systems
RADARS

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Development and Integration Issues

OERLIKON AEROSPACE

- System Integrator of an Air Defense System
- Certified as Level 2 - Software Engineering Institute in 1997
  - Has also met 8 of the 17 Level 3 Goals
- Peer Review
- Software Product Engineering
- ISO 9001 since 1993
- NATO Secret Organization
- Over 120 Systems and Software Engineers

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FIRST LEVEL OF THE PLANNING AND TRACKING PROCESS

- Software Project Planning Process for Proposal (Including Negotiation Phase)
- Software Project Planning Process (after Contract Award)
- Software Project Tracking Process

SECOND LEVEL OF THE PLANNING AND TRACKING PROCESS

- SPP-100 Plan the Proposal Activities
- SPP-110 Generate Project WBS/OBS
- SPP-120 Prepare Project Estimates and Schedule
- SPP-130 Perform Risk Assessment/Abatement
- SPP-140 Prepare Proposal
- SPP-150 Review Proposal, Risk Analysis, Estimates and Schedule
- SPP-160 Conduct Proposal Lessons Learned Review

TO SPP 200 After Contract Award
THIRD LEVEL OF THE PLANNING AND TRACKING PROCESS

STEP 120 - Prepare Estimates and Schedule

SPP-110

Inputs:
- RFP/SOW/SOR
- Project WBS/OBS
- Historical Data
- SDP Outputs (RTM)
- Procedure for Estimates
- Cost Data
- Assumptions
- Resource Availability

SPP-130

Outputs:
- Assumptions for Estimates
- Updated Historical Database
- Estimates
- Schedule
- List of Alternatives

Entry Criteria:
- Approved project WBS/OBS
- Proposal leader and functional Management approval

Exit Criteria:
- Effort
- SPP-130

Activities:

- Measures

Senior Management Commitment Fall 95

Assessment Fall 99

Self-Assessment Fall 95

Action Plan Winter 96

Need for Assessment Fall 95

Process Definition Technical Steps Spring 96

Systems Engineering Process

Final Process and Training Summer 97

Pilot Projects 1997

Process Definition Management Steps Fall 96
SYSTEMS ENGINEERING PROCESS

- Adapted from SPC’s Generic Systems Engineering Process (GSEP)
- Process integrates both technical and engineering management activities
- Tailorable process
- Supports incremental development

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**Step 120 - Analyze Risk**

- **Risk Management Plan**
  - **Risk Descriptions and Impacts**
    - Budget overrun, schedule delays, integration risks due to concurrency, new technologies
    - Documented, updated and stored in a database
  - **Mitigation Strategies**
    - Pilot projects, engineering models, mock-ups
    - Analyses
    - Component and subsystem modeling
    - Training
    - Reviews with stakeholders
A SEP INCREMENT (THE REAL LIFE)

- SEP-100 Manage Development Effort
  - Understand Context
  - Analyze Risk
  - Define Increment Development
  - Track Increment Development
  - Review Increment Plan

- SEP-200 Define System Increment
  - Analyze Issues
  - Define Requirements
  - Define Functional Architecture
  - Synthesize Allocated Architecture
  - Evaluate Alternatives
  - Select and Verify Solution
  - Validate and Verify Solution
  - Review Technical Issues

INTEGRATED SYSTEMS AND SOFTWARE ENGINEERING PROCESS
- Model developed by the SPC
- Addresses the problem of large, complex systems
- Decomposes the system such that parts can be independently developed and integrated
  - System Level (includes segment and subsystem parts)
  - Configuration Items (include software and hardware parts)
  - Components
INTEGRATION of PROCESSES

- Develop SW Configuration Item
- Develop HW Configuration Item
- Implement (Produce) System

Development and Integration Issues

Project Management Process

- Need for Management Process
  - Senior Management Commitment: Winter 97
  - Working Group Kickoff: Winter 97
  - Mandate Approved: Winter 97
  - Brainstorm Problems: Spring 97
  - Process Definition: Summer 97
  - Process Guides: Summer 97
  - Process Training: Summer 98
  - Process Guides: 1998

- Pilot Projects: Summer 98

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**PROJECT MANAGEMENT PROCESS**

- Adapted from the Project Management Institute

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**PROJECT MANAGEMENT AND ENGINEERING**

- Manage Development Effort
  - Define System Increment
  - Develop SW Configuration Item
  - Develop HW Configuration Item
  - Implement (Produce) System

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INTEGRATION FACILITATORS

- Common Process Development Approach
  - Define a process and bring it under management control.
  - Support the process with engineering methods appropriate to the application.
  - Support the process and engineering methods with tools integrated into a consistent environment.
  - Train personnel to use these processes, methods, and tools.

Integration Facilitators Processes

- Common Process Description
  - Policies, Standards and Procedures
  - Inputs and Outputs
  - Entry and Exit Criteria
  - Activities
  - Specified Roles
  - Measurements
  - Templates and Checklists
INTEGRATION FACILITATORS

- Common Process Notation
  - ETVX
- Common Vocabulary
  - e.g. prototype
- Common Processes
  - Documentation Management
  - Quality Assurance (Audits)
  - Configuration Management
  - Performance Management

Organizational Process Oversight

- Process Action and Coordination Team (PACT)
  - Functions
    - Establish objectives for organizational processes
    - Liaise with other executives
    - Provide support for process improvement activities
    - Review results of audits or assessments
    - Charter working groups
    - Monitor process performance
  - Members
    - Vice-Presidents (Project, Finance & Contract, HR)
    - Quality Assurance Manager
    - Process Coordinator
INTEGRATION FACILITATORS

Organizational Process Oversight

- Process Owners
  - Focal point for process improvement activities
  - Review project plan tailoring
    - If conflict between process owner and project manager, a senior manager or an executive will take decision
  - Prepare Annual Process Improvement Plans
  - Report progress to Process Action and Coordination Team

Common Methods

- Structured Analysis and Design (SADT)

Common Tools

- CORE
- Software through Pictures (StP)
- RTM
Integration Facilitators

- PROCESS ASSET LIBRARY
  - Policies
  - Process Descriptions
  - Guides, Forms and Templates
  - Examples of Documents Produced
    - Business Cases
    - Proposals
    - Engineering Plans
    - Specifications
  - Tailored Processes
  - Lessons Learned
  - Charter of Process Engineering Groups
  - Training Material
  - Metrics (Process and Product)
  - Historical Data

INTEGRATION ISSUES

- Activities performed differently in different processes
  - e.g. risk management, development plans (e.g. software, system and project plans)

- Activities mandated by different frameworks
  - e.g. subcontractor management
    - SW-CMM
    - SE-CMM
    - Body of Knowledge - Project Management Institute

- Processes called by other Processes
  - Need well defined interfaces between processes
PEOPLE ISSUES

To facilitate adoption
- Process developed by future users
- Process developed by multidisciplinary teams
- Training of all users and people affected by a process
  - e.g. for Systems Engineering Process
    - system engineers, software engineers, design engineers, logistic support, quality assurance and configuration management

To facilitate utilization
- Integration of people in a multidisciplinary team (IPT)

To facilitate collaboration
- Development of project charters
  - Common Vision
  - Common Objectives
  - Common Methods
  - Known Responsibilities
- Performance Management Process
  - Behaviors are promoted and rewarded
- Team development Approach
  - Combination of work product development and “soft skills” development
Development and Integration Issues

**PEOPLE ISSUES**
- **Team Development Workshops**
  - Why am I on this team?
  - Why are we on this team?
  - How do I contribute?
  - Who are our stakeholders and what are their needs and expectations?
  - How do we work together?
  - Who does what?
  - How do we prepare for success?
**PEOPLE ISSUES**

- Transition Plans to Facilitate Technology Deployment
  - Establish a Transition Team
  - Describe the Desired State
  - Baseline the Current State
  - Analyze the Gap
  - Develop a Transition Management plan
  - Roll Out the Solution(s)
  - Analyze Lessons Learned
Many of the problems or dysfunctions stem from operating out of the assumptions that parts, people, or departments are separate and unrelated.
Development and Integration Issues

INTEGRATION ISSUES

- A System Perspective of the Organization

LESSONS LEARNED

- Create common Vision for Management and Practitioners
  - Reduce Cycle Time
  - Increase Quality and Productivity

- Develop a Process Improvement Plan
  - Link Between Project Requirements and Process Activities
  - Multi-Year Plan to show long term commitment

- Use Pilot Projects
  - Members of Pilots have a Safety Net for “mistakes”
  - Success of Pilots facilitates adoption of technologies
LESSONS LEARNED

- **Fix the Process not the People**
  - Focusing on Process allows Practitioners to learn while using the new Process, Method or Tool.
  - Mistakes are Acceptable If we learn from them

- **The Management of the “Soft Issues” are as important as the “Hard Issues”**
  - It is 25% SW, 25% HW & 50% “Peopleware”

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LESSONS LEARNED

- **If Possible Start from the Top Level Processes**

- Integration of Processes should be planned for at the beginning of a process initiative

- Organizational Culture is like a “sleeping lion”. As soon as you start tampering with him, the lion will wake up and may start “showing his crows” to the challengers.
**NEXT STEPS**

- Integrating Engineering Processes with Project Management Process
- Electronic Process Asset Library on Local Area Network (INTRANET)
- Migration towards Integrated Product Teams
  - Modify Organizational Structure
  - Clarification of Roles and Responsibilities
  - Modification of Performance Management Process
    - e.g. moving from individual performance evaluation to team performance evaluation and reward

**CONCLUSION**

- OUR Organization is making substantial effort to define and improve both Engineering and Management Processes

- Significant Progress in Process Improvement also implies a Cultural Change in the organization:
  - A Shift From the NIH (Not Invented Here) to the NRH (Not Re-invented Here) resulting in mission-oriented teams.

- Systems and Software Engineering Processes need to be defined and integrated for EFFICIENCY and EFFECTIVENESS to get the “BANG FOR THE BUCK”