Lessons Learned in the Engineering of Process Performance Models on the Journey to Higher Maturity Levels

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Critical Program Performance Challenges…. 

- Obtaining a realistic understanding and managing internal and external customer requirements.
- Lacking verified and validated techniques of measuring, controlling and balancing cost and performance requirements.
- Hiring the “right staff” in time to evaluate and implement emerging technologies.
- Maintaining ever-increasing program profitability goals due to the impact of emerging administration and technical issues, risk, and changing customer environments.
- Sustaining multi-year technical service and product support levels is impacted by increases in costs, staff transitions and changing customer requirements.
Background of Journey

Rationale for Initiating Journey
Faced with extreme challenges of maintaining profitability while managing increasing performance costs and concurrently responding to a dynamically changing customer environment.

Organization Overview
Organization supported customer by performing on-site and off-site engineering and scientific services and product development for a wide assortment of space based platforms.

Kick-Off Activity
Multi-domain leadership team assembled to plan the multi-year journey to higher maturity levels. The initial version of the plan launched pilot projects in the small software development organization followed by support functions of finance, procurement and HR.

Obstacles
The organization faced initial obstacles of resources to construct a framework to integrate key program and technical functions as well as staff training in the CMMI®.
Engineering Approach to Developing a Program Performance Model

The leadership team, composed of engineers, developers and scientists, constructed the framework for the program performance model using SE Vee life cycle model.

Application of the practices in the CMMI® Process Areas (PAs) were used across the program and projects to implement the relevant phases in the SE Vee model.

Program Performance Model

- Functioned as a risk management tool
- Balanced cash flow, staff size, product quality and customer satisfaction
- Sustained service levels and technical performance at planned costs
Challenges in Developing the Program Performance Model

**Time Factors**
- Realistic understanding of continually evolving customer environments
- Developing and implementing validated techniques to balance cost and performance
- Availability of global rapidly emerging technologies
- Impact of operational changes
- Life cycle planning
- Staffing

**Cost Factors**
- Exponential increase in costs downstream
- Mismatch in technical performance requirements versus program budget
- Inflexible, non-scalable designs
- System requirements obsolete
- O&M infrastructure costs vs. service levels
- Unfilled positions lower revenue
About the SE Vee Model


- The phases in the Vee are traditionally applied to engineering products and services such as weapons systems, communications networks and technical support.

- In any program, phases in the Vee may not be performed or applicable or may exist in numerous projects at different times.

- Key infrastructure functions, such as finance, contracts, and HR benefit from implementing the same engineering discipline and activities as technical projects.
Engineering of Program Performance Models

“Vee” Activity  Example Critical Support Functions

Operation  Resources (space, accounting, BP systems)
Concept  Business goals performance intervals
Architecture  Structure of business performance interfaces (receivables, quality measures, inventory, growth)
Design  Performance constraints for cash flow, service level performance, staff size
Development  Increments to support planned site expansion
Engineering of Program Process Performance Models

CMMI Process Area Categories

Project Management

Process Management
(Organizational Process Focus, Organizational Process Definition, Organizational Training, Organizational Process Performance, Organizational Innovation and Deployment)

Engineering
(Requirements Management, Requirements Development, Technical Solution, Product Integration, Verification, Validation)

Support
(Configuration Management, Process & Product Quality Assurance, Measurement & Analysis, Causal Analysis & Resolution, Decision Analysis & Resolution, Organizational Environment for Integration)
## Engineering of Support Function Framework

<table>
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<tr>
<th>“Vee” Phase</th>
<th>Example Key Support Functions</th>
<th>Key CMMI PAs</th>
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<tr>
<td>Operations</td>
<td>Resources (space, BP systems, staffing levels)</td>
<td>M&amp;A, PP, RSKM</td>
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<tr>
<td>Concept</td>
<td>Business goals performance intervals</td>
<td>M&amp;A, RD</td>
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<tr>
<td>Architecture</td>
<td>Structure of business performance interfaces (cash flow, quality measures, inventory, growth, etc.)</td>
<td>M&amp;A, TS, PI</td>
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<tr>
<td>Design</td>
<td>Performance constraints for cash flow, service performance, staffing</td>
<td>M&amp;A, RD, RM, TS</td>
</tr>
<tr>
<td>Development</td>
<td>Builds to support planned market and program expansion</td>
<td>M&amp;A, RD, PP, RSKM</td>
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</table>
“Vee” Phase   |   Examples Key Support Functions   |   Key CMMI PAs
--- | --- | ---
Test   |   Finance test scenarios and databases   |   M&A, VER, VAL
Integration   |   New interfaces of components (acquisitions) for growth goals, finance and HR functions   |   TS, PI
Verification   |   Invoicing and staffing processes   |   M&A, VER, VAL
Deployment   |   Perfective and adaptive maintenance of support functions   |   PP, PMC, TS
Operations   |   Forecasting of staffing and facilities costs   |   PP, PMC, QPM, OPP, OID
Overview of the SE Vee, CMMI Process Areas and Business Goals

Key Process Areas
Measurement & Analysis, Project Planning, Project Monitoring & Control, Risk Management, Quantitative Project Management, Organizational Innovation & Deployment, Causal Analysis & Resolution, Decision Analysis & Resolution…

CMMI Product Suite

Program Business Goals
Support
Invoicing
Procurement
Contracts
Staffing

Technical
Latent Defects

Customer Satisfaction
Customer Satisfaction

SE Vee
Operations
Concept
Architecture
Design
Development
Integration
Test
Deployment
Verification
Operations
Example of Balancing Cost and Technical Performance in a Small Setting

Key CMMI Process Areas
Measurement & Analysis, Project Planning, Project Monitoring & Control,
Risk Management, Quantitative Project Management, Organizational Innovation & Deployment,
Causal Analysis & Resolution, Decision Analysis & Resolution…

Program Business Goals

Support
Invoicing
Procurement
Contracts
Staffing

Technical
Latent Defects

Customer Satisfaction
Customer Satisfaction

Key Measurements

Process Performance Intervals

Staff size
Invoice accuracy
Catches/Escapes
Customer Satisfaction

Practices
Case Study Example of Balancing Cost and Technical Performance in a Small Setting (Continued)

Program Business Goals

Support

Technical

Customer Satisfaction

Key Measurements

Invoicing
Procurement
Contracts
Staffing

Latent Defects

Customer Satisfaction

Process Performance Intervals

-6.0% ≤ Staff Size Accuracy ≥ 9.0%
-8.1% ≤ Invoice Accuracy ≥ 6.5%

0 ≤ Latent Defects ≥ 3
4.5 ≤ Customer Satisfaction ≥ 5.0
Lessons Learned During the Journey

- Focus on defining business goals and related measurements for the organization for the entire period of program performance.

- Plan and implement the applicable CMMI PA practices in projects across the organization sooner rather than later as retrofitting is difficult.

- Measurement processes should focus on forecasting yearly costs, required technical performance levels, quality goals and program support levels.

- Apply SE tools and techniques, such as alternative evaluations, performance simulations, requirements definition and risk analysis across the infrastructure functions as well as technical services using practices in the CMMI.

- Provide CMMI training to classes with diverse backgrounds to enhance team building.
Lessons Learned (Continued)

- The phases in the SE Vee provide a useful and applicable life cycle model for engineering of a framework to integrate management and technical practices across a program.

- The SE Vee is very adaptable to small settings and applies to support services, such as finance, contracts and HR.

- The practices in the current version of CMMI Process Areas cover a large percentage of the phases in the Vee.

- Customer advocacy and participation in an appraisal is very advantageous for all.

- For best results, focus on first defining business goals and relevant measurements to implement continuous process improvement to achieve a program performance model to balance cost and technical performance via the CMMI.

- Expect multi iterations during the measurement and analysis activities before key sub-processes are controlled.