Implementing Systems Engineering Processes to Balance Cost and Technical Performance

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Continuous and Effective Program Performance Sustainment in Multi-Year System Engineering Programs

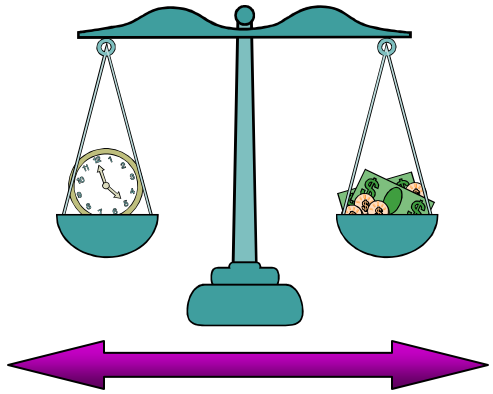
Critical Program Performance Challenges….

- Large scope technical services and products programs are intended to provide wide range of service levels and product maintenance support over 5 – 10 years.
- Sustaining multi-year technical service and product support levels is impacted by increases in costs, staff transitions and changing customer requirements.

Candidate Engineering Solution…..

- Sustaining service levels and technical performance at planned costs is facilitated by applying SE Vee life cycle model to engineer a support framework across the program.
- This support framework is used to balance the costs of maintaining program infrastructure functions and technical resources with the costs of achieving program performance goals.
- Application of the practices in the CMMI® Process Areas (PAs) are used across the program and projects to implement the relevant phases in the SE Vee model.

Challenges in Balancing Cost and Technical Performance



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

Cost Factors

Exponential increase in costs downstream

Mismatch in technical performance requirements versus program budget

Inflexible, non-scalable designs

System requirements obsolete before deployment

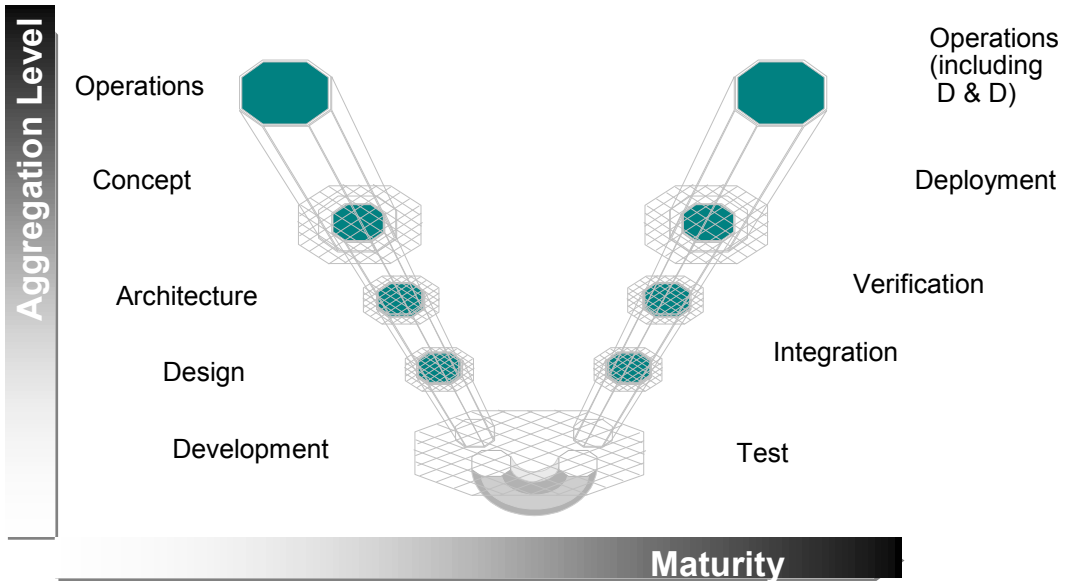
O&M infrastructure costs vs. service levels

Constructing the Program Performance Framework Using the SE Vee and CMMI Practices

Guidance….

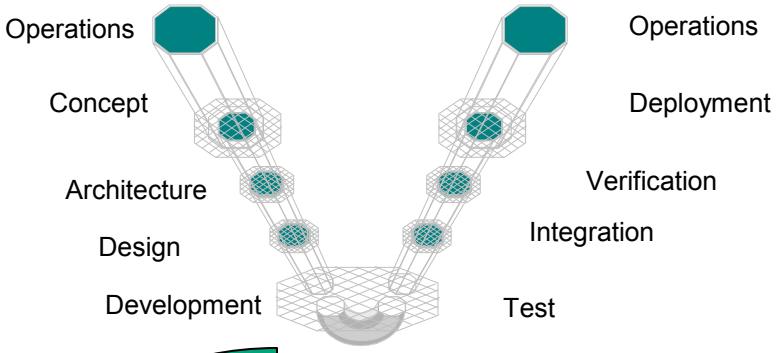
- Focus on defining business goals and related measurements for the **entire** period of program performance.
- Plan and implement SE Vee model in projects across the organization sooner rather than later as retrofitting is difficult.
- Focus on measurement processes on forecasting yearly costs, required technical performance levels and program support levels.
- Engineer a process performance framework using the set of SE activities represented in the SE Vee.
- 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.

About the SE Vee Model



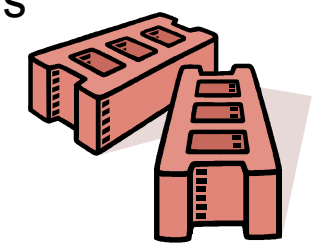
- The SE Vee Life Cycle Model presented to the Texas Board of Professional Engineers, 1999, by Arunski, Martin, Brown and Buede.
- The phases in the Vee are traditionally applied to engineering products and services such as weapons systems, communications networks and technical support.
- In any program, 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 Process 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
Development	Increments to support planned site expansion

Engineering of Program Process Performance Models



SE Vee Phases

Operations

Concept

Architecture

Design

Development

Test

Integration

Verification

Deployment

Operations

CMMI Process Area Categories

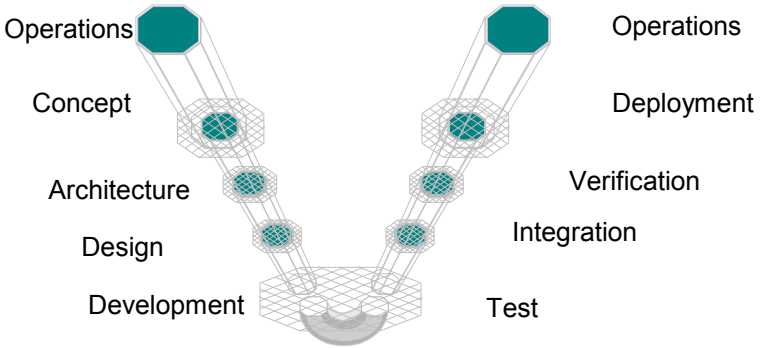
Project Management
(Project Planning, Project Monitoring & Control, Risk Management, Integrated Project Management, Integrated Teaming, Integrated Supplier Management, Quantitative Project Management)

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)

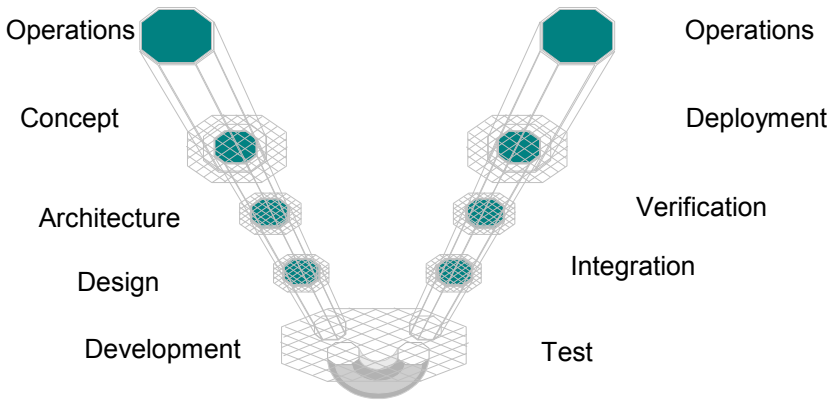
Engineering of Support Function Framework

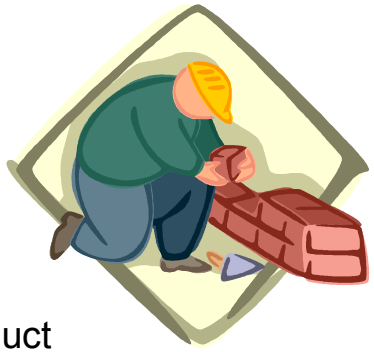


CMMI Product Suite

"Vee" Phase	**Example Key Support Functions**	**Key CMMI PAs**
Operations	Resources (space, BP systems, staffing levels)	M&A, PP, RSKM
Concept	Business goals performance intervals	M&A, RD
Architecture	Structure of business performance interfaces (cash flow, quality measures, inventory, growth, .etc.)	M&A, TS, PI
Design	Performance constraints for cash flow, service performance, staffing	M&A, RD, RM, TS
Development	Builds to support planned market and program expansion	M&A, RD, PP, RSKM

Engineering of Support Function Framework (Continued)



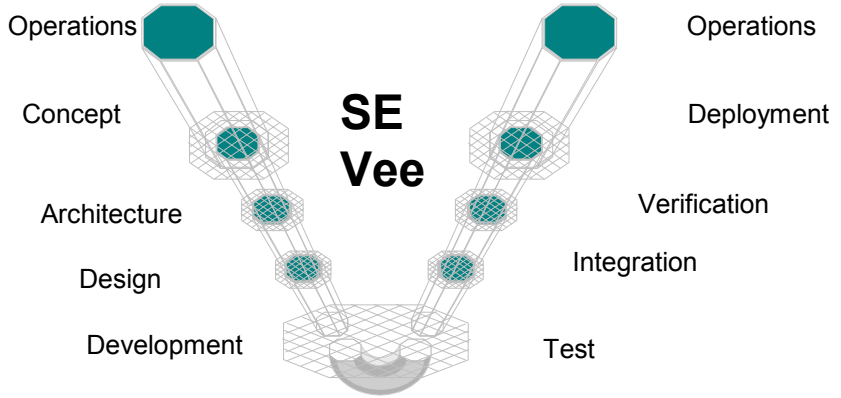


CMMI Product Suite

"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

CMMI
Product Suite



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

Practices

Program Business Goals

Support → **Technical** → **Customer Satisfaction**

Invoicing	Latent Defects	Customer
Procurement		Satisfaction
Contracts		
Staffing		

Case Study 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…

Practices

Program Business Goals

Support → **Technical** → **Customer Satisfaction**

Key Measurements

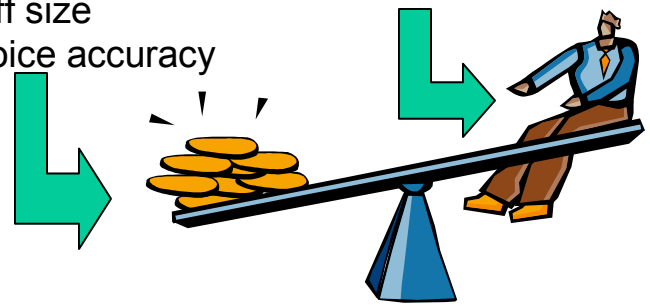
Support	Technical	Customer Satisfaction
Invoicing Procurement Contracts Staffing	Latent Defects	Customer Satisfaction

Process Performance Intervals

Staff size
Invoice accuracy

Catches/Escapes

Customer Satisfaction



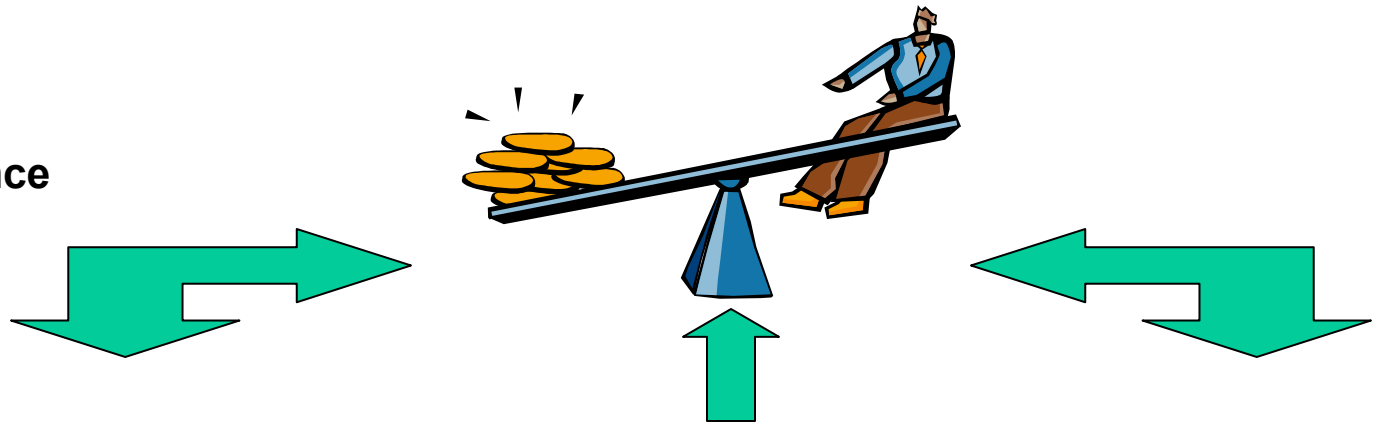
Case Study Example of Balancing Cost and Technical Performance in a Small Setting (Continued)

Program Business Goals

Support → **Technical** → **Customer Satisfaction**

	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

Summary

Lessons Learned……

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