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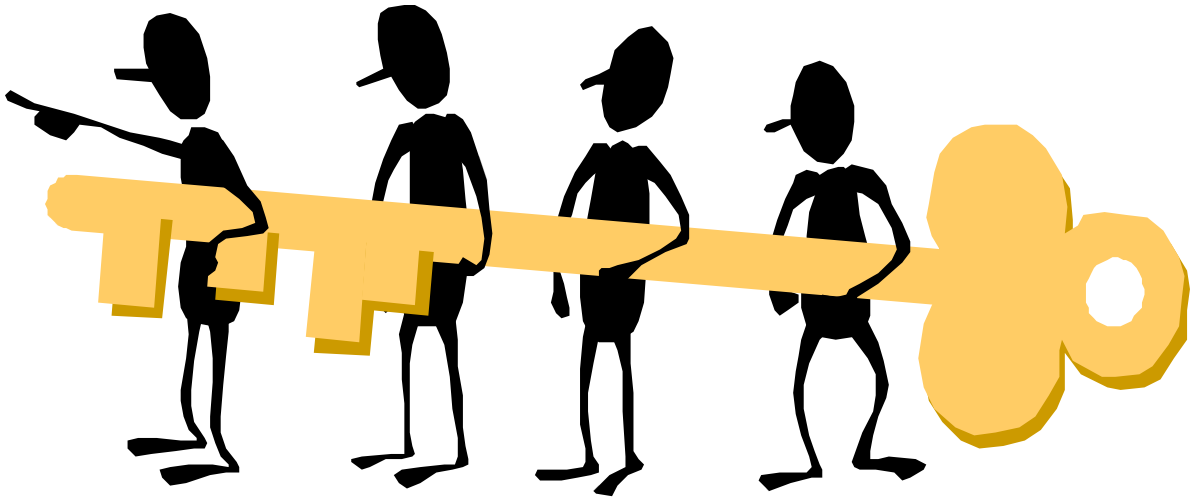

Team-of-Four

Powerful Mechanism for Deployment

November 2004

Raytheon

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Raytheon Organization and Accomplishments

Network Centric Systems, Fullerton, CA

- **SW CMMI Level 5 and SE CMMI Level 3 + in December 2003**
- **Second SW-CMM Level 5 in September 2002**
- **SW-CMM Level 5 in October 1998**
- **First SW-CMM Level 3 in world in 1990**

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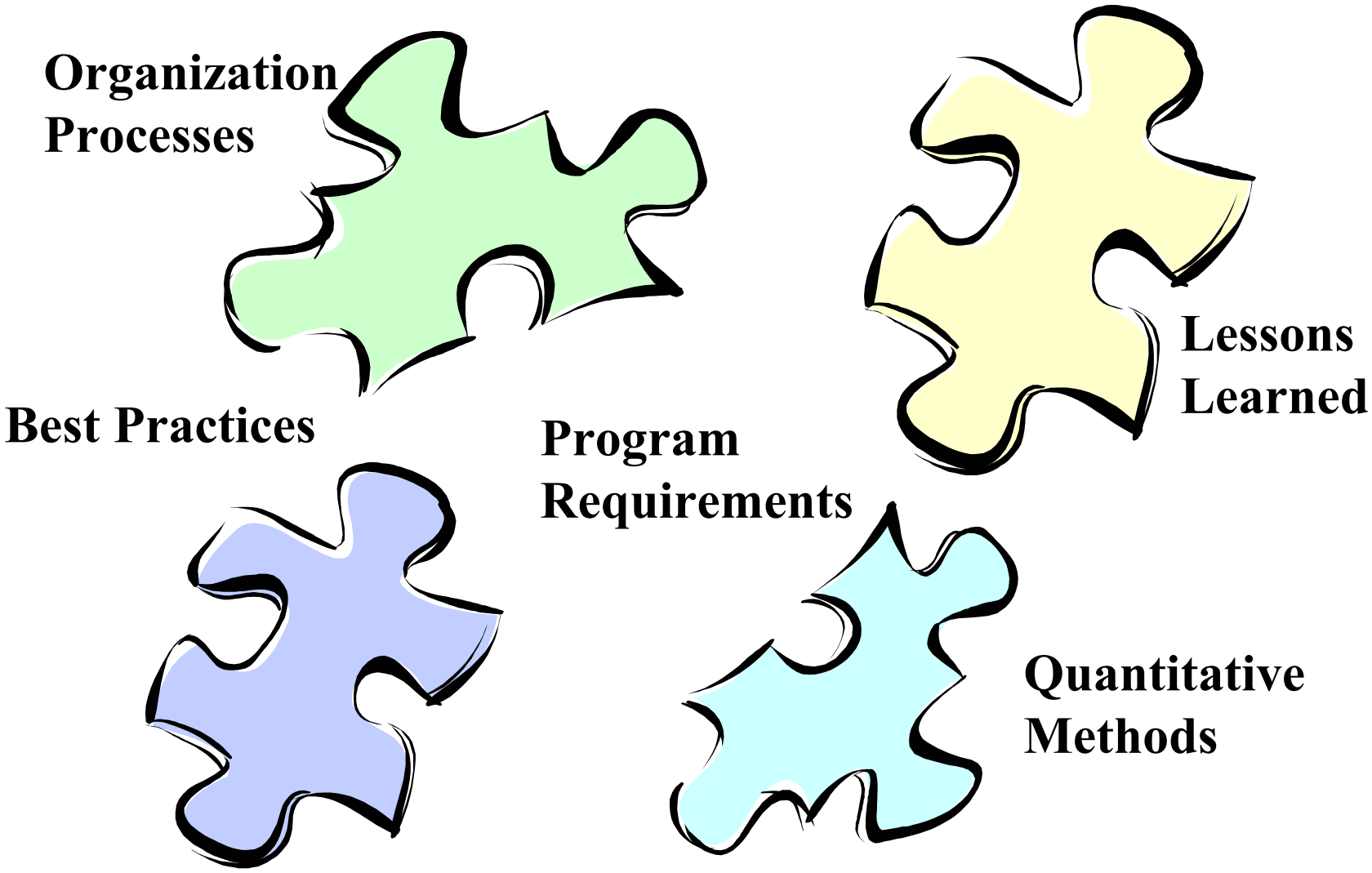
Many pieces to puzzle for organization and project success



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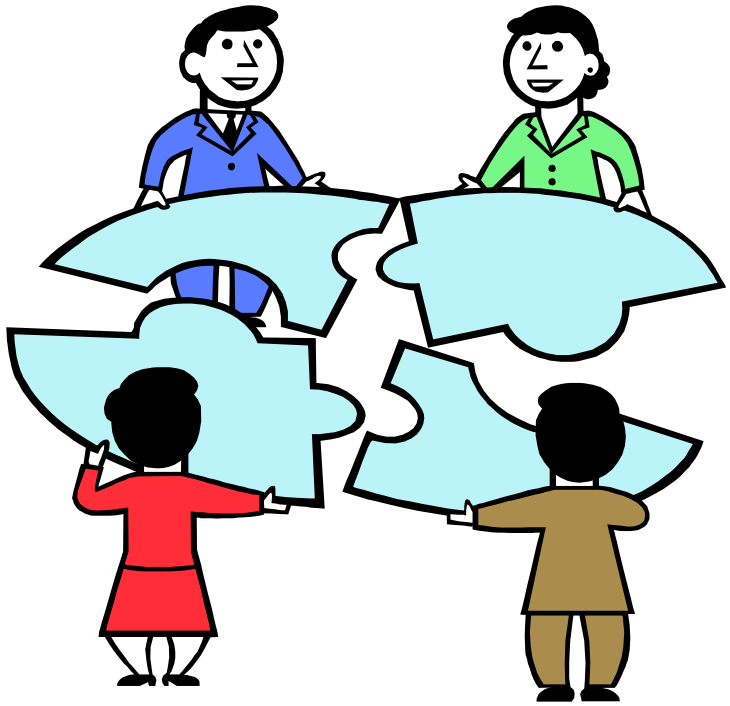
Process Improvement Requires Synergy between Organization and Programs

- **To achieve high levels of process maturity, the organization and programs must work closely together**
  - New process at the organization level need to be deployed to programs
  - Best practices and lessons learned from the program levels must be flowed to the organization and shared across programs
  - Quantitative management activities need infrastructure to facilitate metrics collection and analysis



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Team of Four (ToF) Concept

- **Team of Four Concept successful at other Raytheon sites**
- **Adopted the concept in Fullerton in 2001**
- **Consistent with integrated product team approach**
- **Very effective mechanism for process improvement**

Team of Four promotes synergy between organization and programs

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What is a Team-of-Four (ToF)?

- A teamed approach to project leadership and support
  - Team goal is to help ensure project success while helping the organization improve over time
  - The team members bring a broad perspective, can better facilitate sharing across projects and help the organization improve as a whole
- Also the primary mechanism for process deployment activities on projects
  - Supports the organization's process improvement efforts

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Who is on a SW Team-of-Four (ToF)??

Software Program Manager

Quality Assurance Rep

Engineering Management Rep

Engineering Process Group Rep

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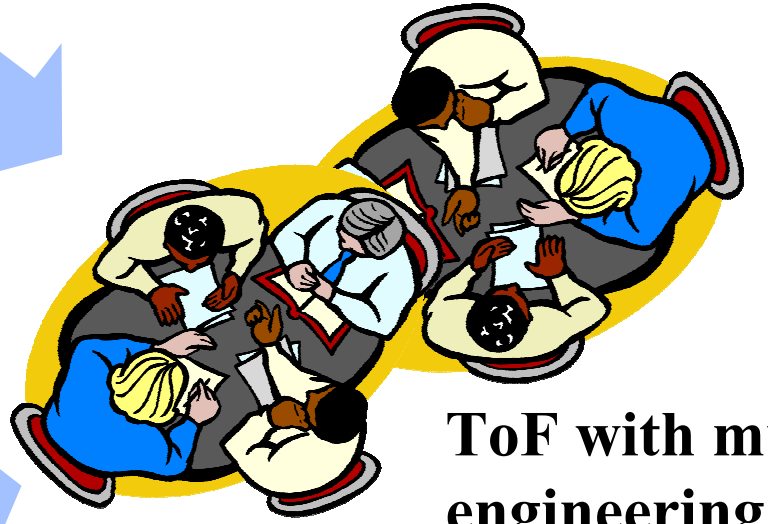
Morphing of SW ToF to ToX

SW ToF

SE ToF



ToF with multiple engineering disciplines

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Expanded Team of X

Functional Managers		
Software Engineering Manager	**Systems Engineering Manager**	**Hardware Engineering Manager**

Program Engineer

Engineering Process Group Rep

Quality Rep

Team of Four concept expanded beyond software to include other engineering disciplines

ToF adds Value

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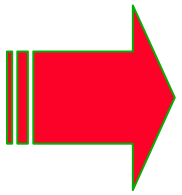
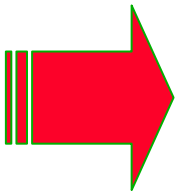
- **Better visibility of key drivers (e.g., Productivity and other measures)**
- **Collaborative risk mitigation**
- **Timely resolution of issues (more proactive, less reactive)**
- **Eliminates wasted activities (no "reinventing the wheel")**



- Improved Program Performance

- **Institutionalized processes**
- **In-Phase containment of defects**
- **Shared Lessons Learned and Best Practices**



- Improved Process/Product Quality

Stronger Tie between Programs and Functional Organizations

More Successful IPTs

More Predictable Programs

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ToF Effective at all Maturity Levels

- **Team of Four supports Level 1 through Level 5 programs**
  - **Less mature programs focus on improving measurements, configuration management, etc**
  - **More mature programs focus on quantitative management, process improvement**

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ToF Supports Program through Life Cycle

Team of Four supports programs during

-Start up

-Development

-Wrap up

-Maintenance

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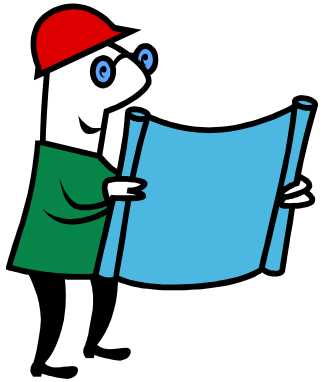
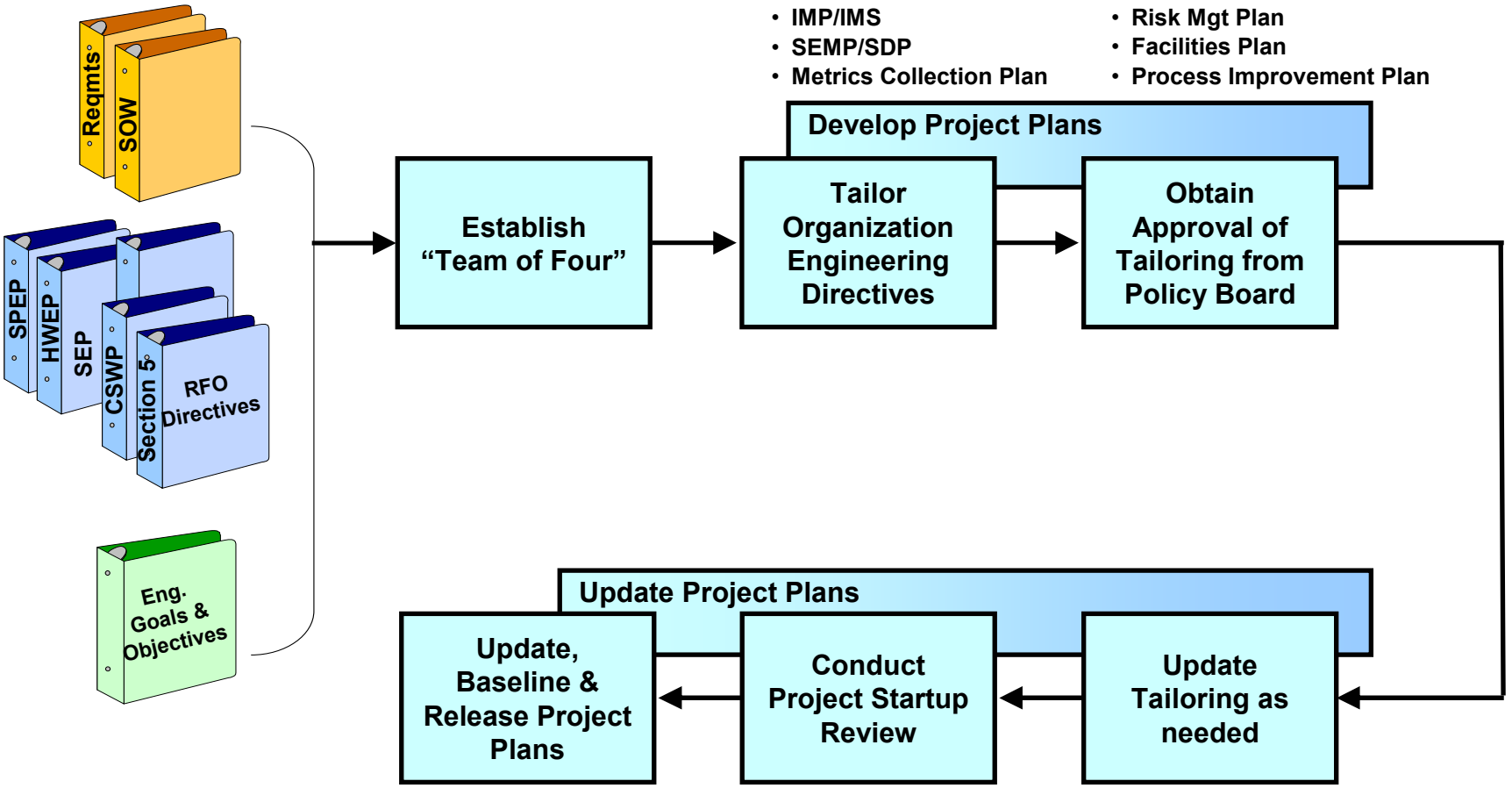
The Team-of-Four Process - Project Start-up

- **Team sets up plans, process and metrics**
  - Uses engineering startup checklist to plan for startup events
  - Develops plans for programs plans and procedures
  - Tailors program process to organization processes
  - Reviews plans including Software Development Plan/ Systems Engineering Management Plan, Metrics Plan, etc.
  - Develops and reviews the Process Improvement Plan (PIP)

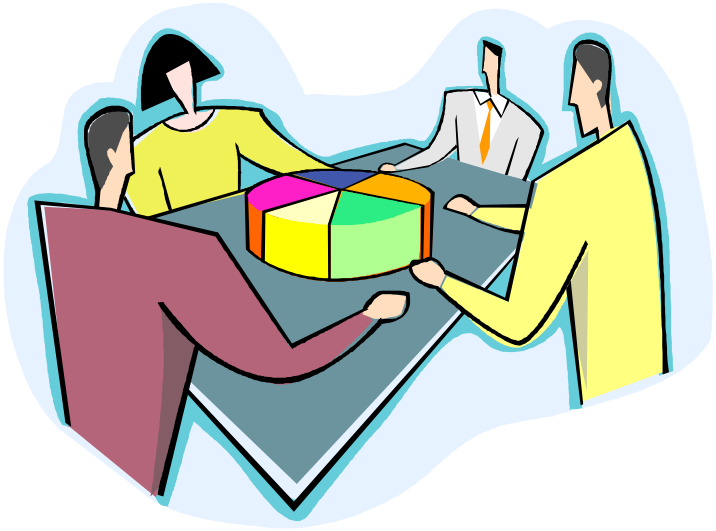


Process Deployment at Start up



The Team-of-Four Process-Development Phases

- During program development ToF focus is on:
  - Quantitative Management
  - Process Improvement



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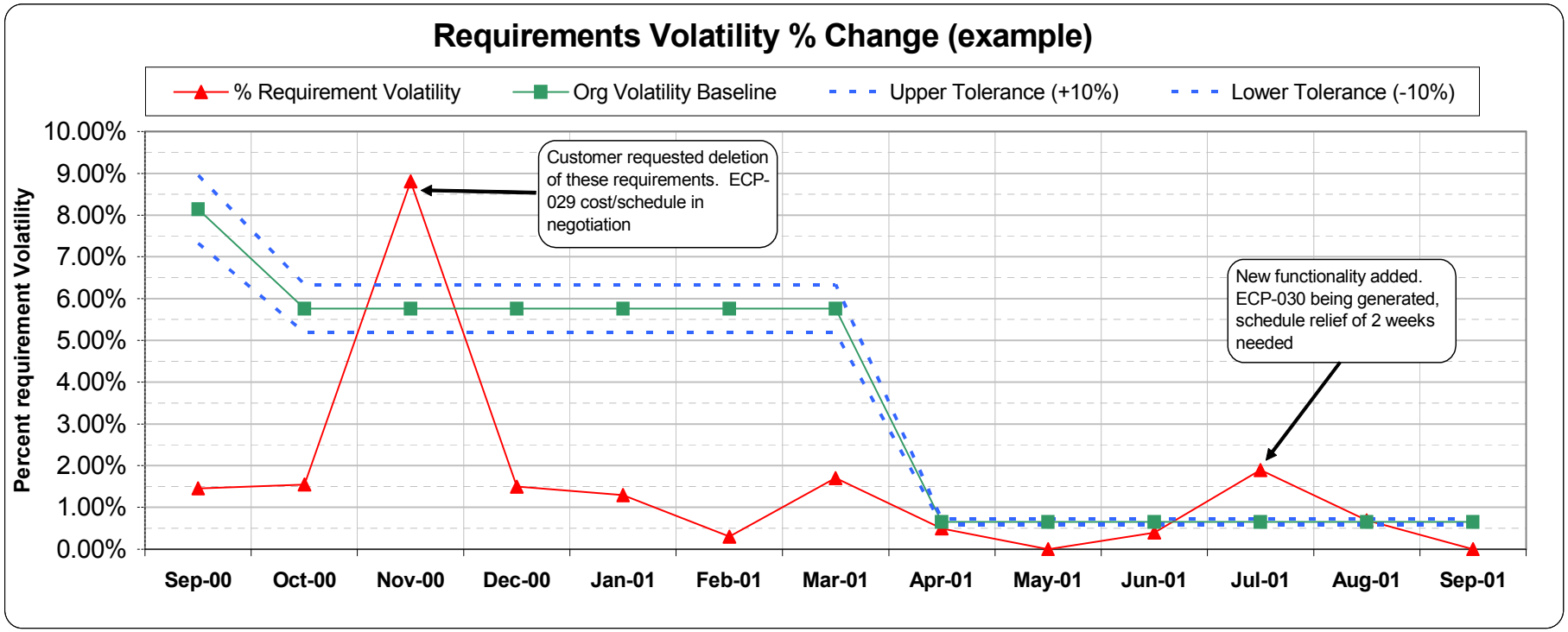
ToF Quantitative Management

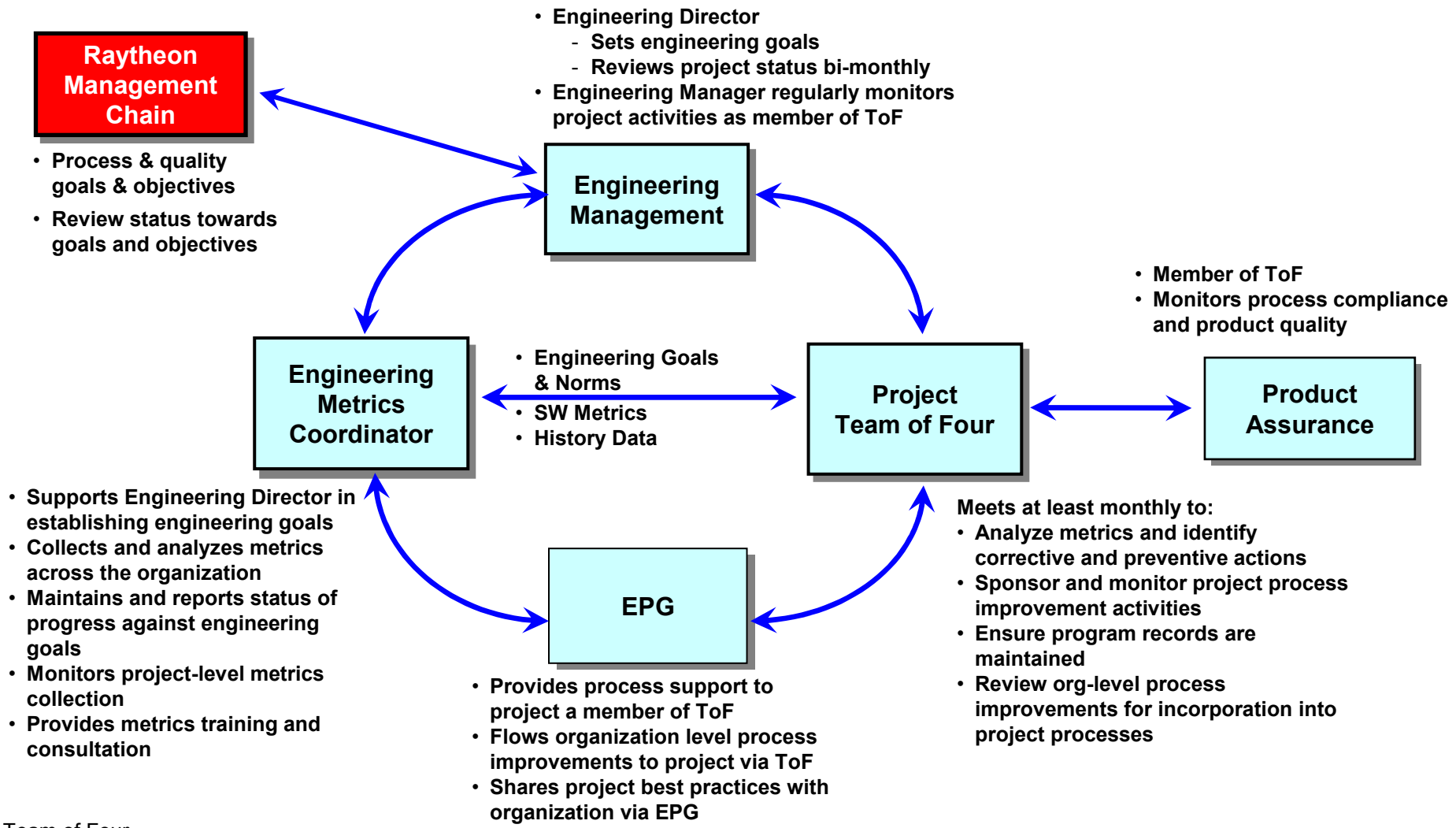
- Determine what metrics to collect
- Determine best method for collection
- Establish goals and thresholds for key metrics
- Analyze metrics
- Look for trends, compare to organization norms
- Identify areas of concern
- Do causal analysis
- Prepare for reviews with senior management

Sample Requirements Volatility Report



Totals	Sep-00	Oct-00	Nov-00	Dec-00	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01
Total # of Requirements	1100	1101	1004	1004	997	999	1006	1006	1006	1002	1011	1007	1007
# of Reqts Added	7	5	0	0	3	2	7	0	0	0	14	0	0
# of Reqts Modified	1	8	0	15	0	1	10	5	0	0	0	3	0
# of Reqts Deleted	8	4	97	0	10	0	0	0	0	4	5	4	0
Total # Reqts changed	16	17	97	15	13	3	17	5	0	4	19	7	0
% Requirement Volatility	1.45%	1.55%	8.81%	1.49%	1.29%	0.30%	1.70%	0.50%	0.00%	0.40%	1.90%	0.69%	0.00%
Org Volatility Baseline	8.14%	5.76%	5.76%	5.76%	5.76%	5.76%	5.76%	0.65%	0.65%	0.65%	0.65%	0.65%	0.65%
Upper Tolerance (+10%)	8.95%	6.34%	6.34%	6.34%	6.34%	6.34%	6.34%	0.72%	0.72%	0.72%	0.72%	0.72%	0.72%
Lower Tolerance (-10%)	7.33%	5.18%	5.18%	5.18%	5.18%	5.18%	5.18%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%
Program Lifecycle Phase		CDR						System Integration					

Project Monitoring and Control



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ToF Process Improvement

- Address activities identified in the program's process improvement plan
- Seek process improvements for areas identified in quantitative management
- Sponsor Six Sigma activities on the program
- Identify lessons learned and best practices to share with rest of organization
- Review other programs lessons learned and best practices and determine if they should be applied to this program
- Prepare for appraisals and audits

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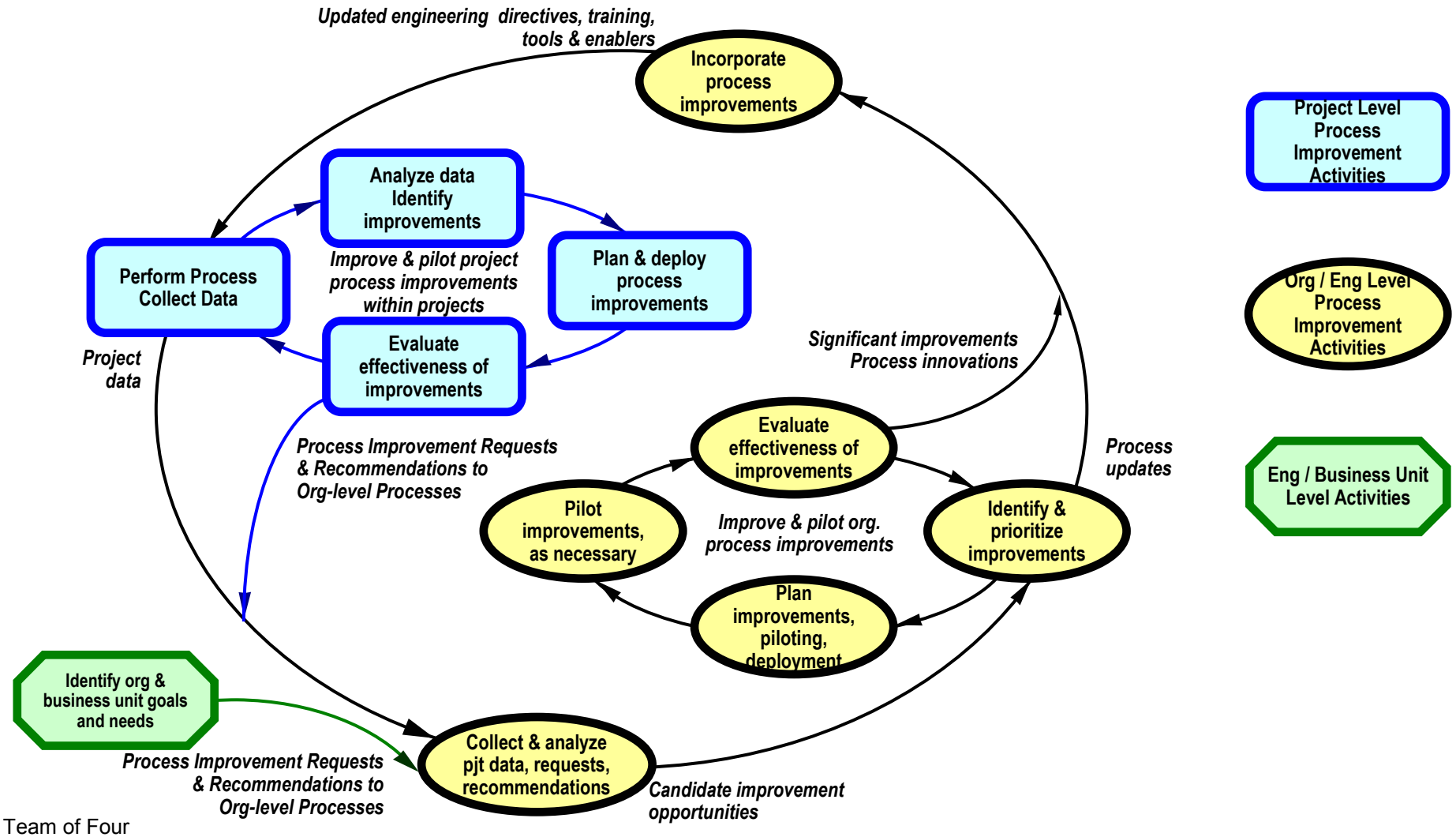
Process Improvement Cycle



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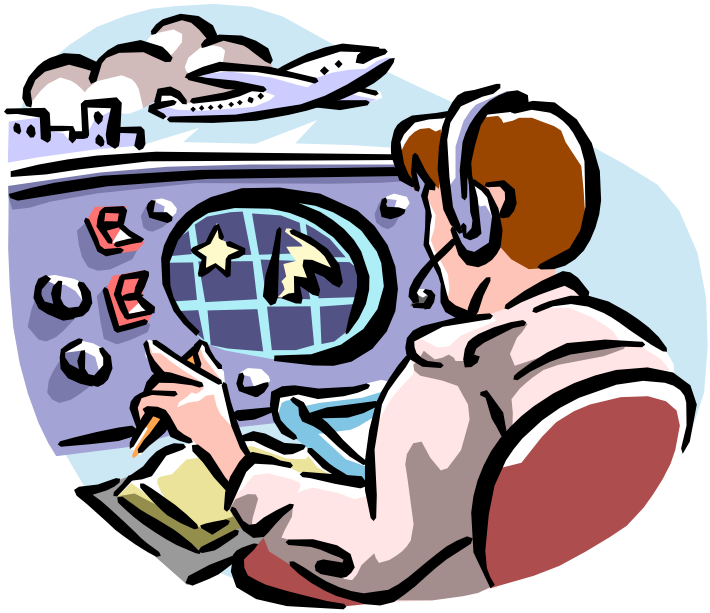
The Team-of-Four Process - Wrap-up Activities

- **At end of development:**
  - **Collect and review lessons learned for the entire project**
  - **Complete the end-of-project report and submit to the organization metrics team**
  - **Present a project shutdown/summary report at the Engineering Project Reviews**
  - **Determine if project is transitioning to maintenance and categorize the type of maintenance activity**

The Team-of-Four Process - Transition to Maintenance:

- Develop a Maintenance Plan
- Review and revise the Software Development Plan and Systems Engineering Development Plan.
- Update tailoring report as needed
- Review and revise other plans and process documents as applicable



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ToF Members Roles

Functional Managers		
Software Engineering Manager	**Systems Engineering Manager**	**Hardware Engineering Manager**

Program Engineer

Engineering Process Group Rep

Quality Rep

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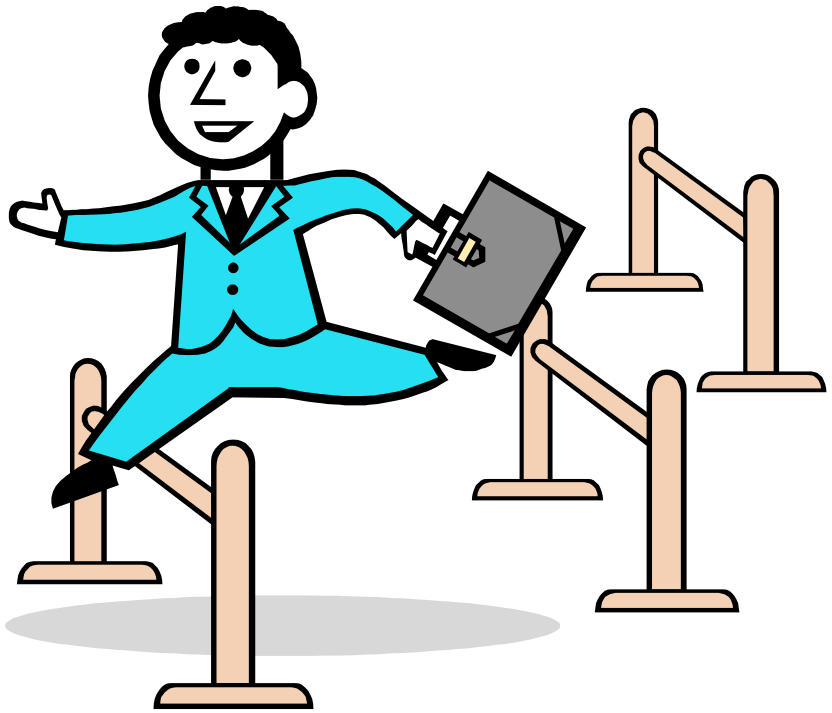
Program Engineer's Role

- Program Engineer responsible for all engineering activities on the program
- Chair of ToF
- Responsible for program reviews with senior management
- Looking out for overall project success
- Communicates to program members and to PMO



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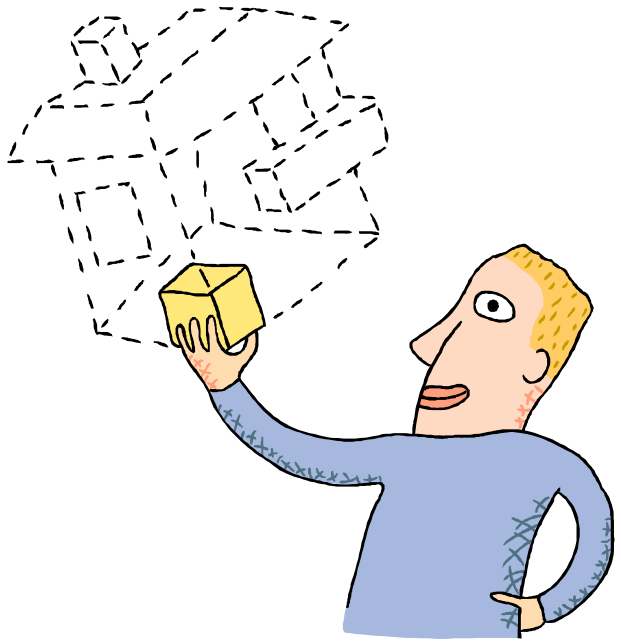
Functional Manager's Role

- Functional Manager includes SW, SE and/or HW program level manager
- Responsible for their discipline's activities
  - Processes
  - Monitoring progress
  - Training of their team members
- Provide inputs for tailoring, planning, risk identification, causal analysis, etc.



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Quality Engineer's Role

- Audit ToF Activities
- Participate
  - Identify process problems
  - Monitor deployment of new processes
  - Participate in solving problems

Engineering Process Group (EPG) Member's Role

- **Flow information between program and organization**
  - **Engineering goals**
  - **Lesson's learned**
  - **Best practices**
  - **Measurement data**
- **Facilitate**
  - **Set up meetings**
  - **Take minutes/track actions**

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Deploying Team of Four Concepts

- Team of Four procedure
  - Identifies responsibilities, roles, typical activities
- Team of Four Training conducted during meetings
  - Hour ToF training course
  - Training on metrics analysis, new processes, etc.
- EPG Liaison support team
  - To provide training for new EPG members
  - To ensure consistency in approach across teams

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Benefits of Effective Teams-of-Four

- Improved engineering processes
- Improved communication/collaboration
- More consistency across projects
- Shared lessons learned for use on other programs
- Better product quality
- Improved competitiveness
- Promotes higher maturity processes

"Working as a Team Fosters Program Success"

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Q & A

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Acronyms

CMMI	Capability Maturity Model Integration
EPG	Engineering Process Group
HW	Hardware
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IPT	Integrated Product Team
Mgmt	Management
PIP	Process Improvement Plan
PMO	Program Management Office
Rep	Representative
RFO	Raytheon Fullerton Operations
SDP	Software Development Plan
SE	Systems Engineering
SEMP	Systems Engineering ManagementPlan
SW	Software Engineering
ToF	Team of Four
ToX	Team of Many