

**Prioritizing Process
Improvement Strategies
in CMMI to Optimize
Business Objectives**



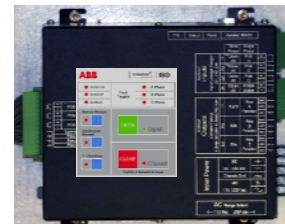
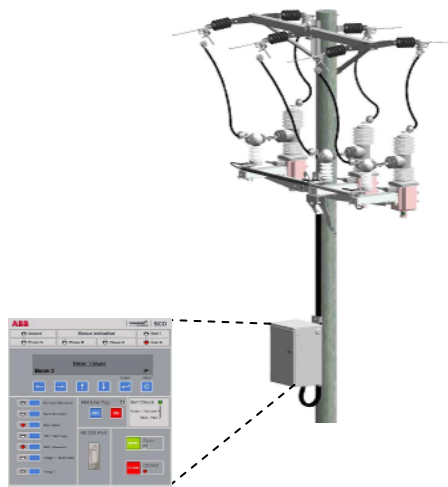
Aldo Dagnino

**ABB Inc.
US Corporate
Research Center
Raleigh, NC**

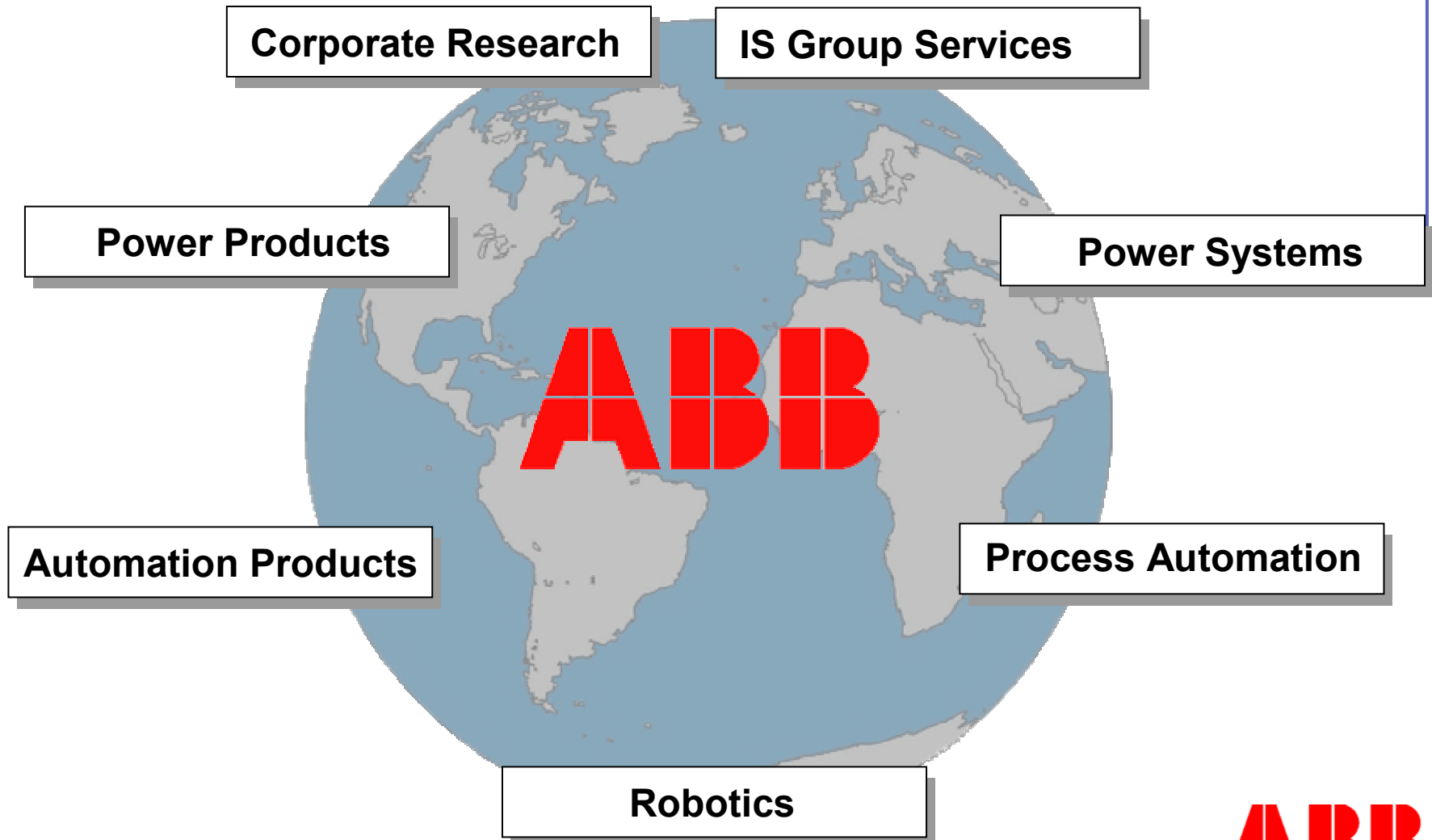


ABB Overview

- Leader in power and automation technologies
- Enable utility and industry customers to improve performance while lowering environmental impact
- ABB's products help operate Utilities, process industries, manufacturing plants, and other industries
- Present in over 120 countries and employs 110,000 people
- First company in the world to sell 100,000 robots
- A vast majority of ABB products have software & hardware components



ABB's Organizational Structure



Organizational Structure of ABB

■ Power Technologies Segment

- Power Systems
- Medium-Voltage Products
- High Voltage Products
- Transformers
- Utility Automation Systems



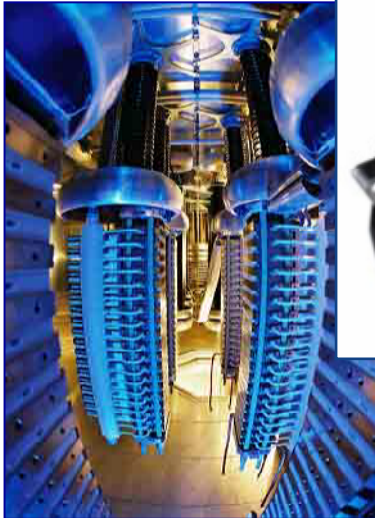
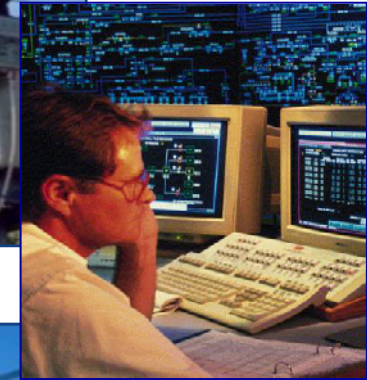
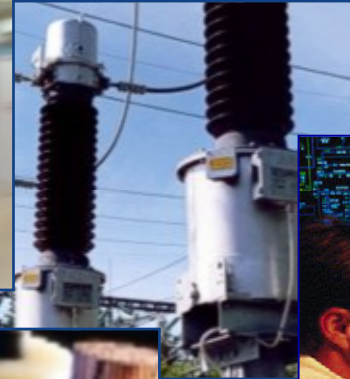
■ Automation Technologies Segment

- Automation Products
- Manufacturing Automation
- Process Automation



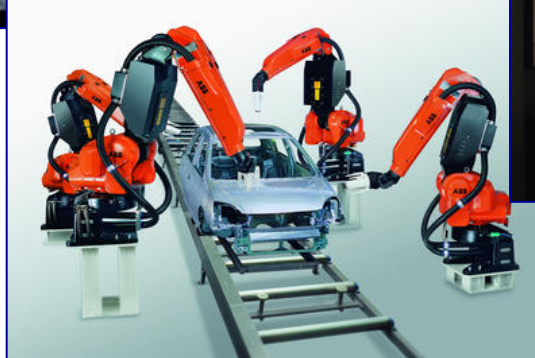
ABB's Products

- Power Products
- Power Systems



ABB's Products

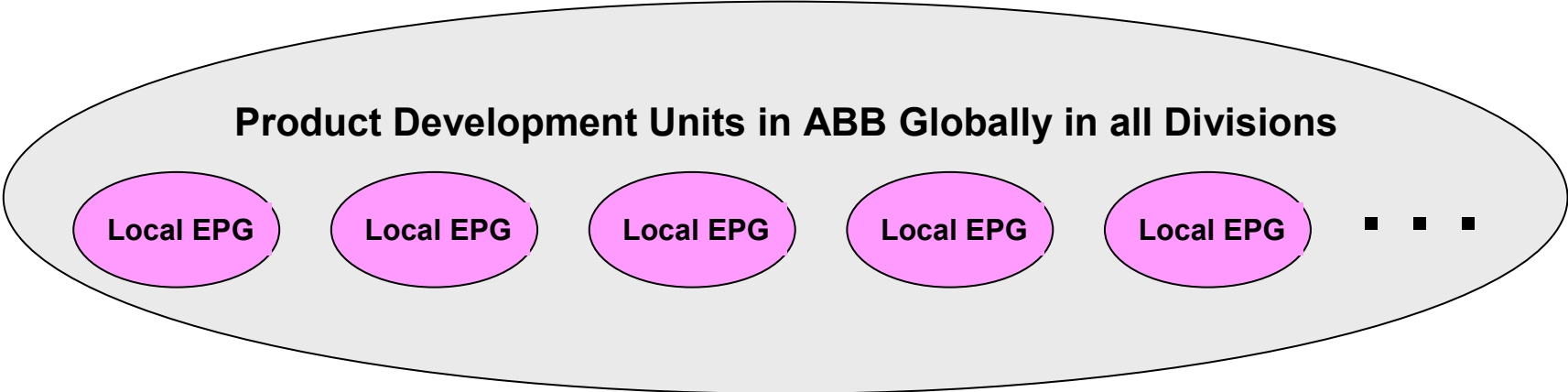
- Automation Products
- Process Automation
- Robotics



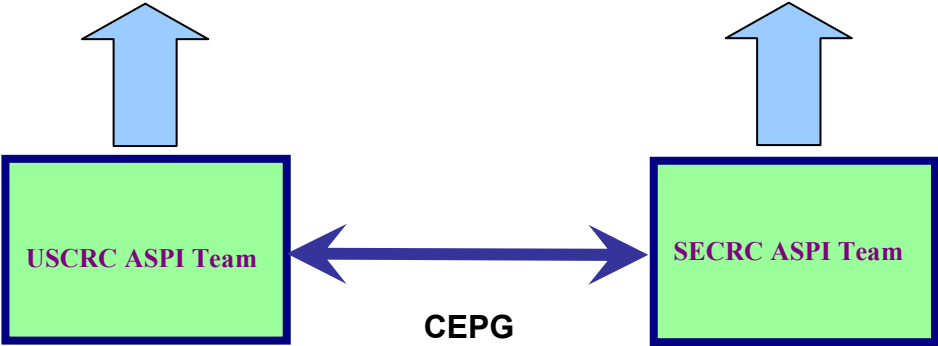
- ABB Software Process Initiative (ASPI) acts as the Corporate Engineering Process Group
- ASPI is composed of members from 2 ABB Corporate Research Centers (CRCs):
 - United States: Raleigh
 - Sweden: Vasteras
- Responsible for:
 - Initiation activities
 - Performance of appraisals
 - Development of improvement methodologies,
 - Evaluation and deployment of pilots within ABB for CMMI transition, PSP/TSP, etc.
 - Assisting units in establishing improvement plans and acting
 - Collect lessons learned from process improvement activities



ABB Corporate EPG Support



Support ABB Development Units in their Continuous Improvement Efforts to establish a culture of product development excellence



Continuous Process Improvement Cycle

- Initiate Improvement activity
 - Define Medium/Long-term Strategic Improvement Plan (SIP) and identify organization's business goals
- Conduct internal CMMI Appraisal (Class B)
- Develop Process Improvement Plan (PIP)
 - **Prioritize process improvement activities using Business Objectives**
- Implement PIP
- Monitor ROI
- Re-Initiate



Results of Internal ABB Class B CMMI Appraisal

- Establishes a baseline in the organization
- Serves as a basis to identify process improvement activities
- Recommended to include the Measurement and Analysis Process Area

Practice	RD	ReqM	PP	PMC	MA	SAM	Ver	PPQA	CM
Specific Goal 1									
SP 1.1	Medium	Medium	High	High	High	High	High	High	High
SP 1.2	High	Medium	High	High	High	High	High	High	High
SP 1.3		High	High	High	High	High	High		High
SP 1.4		High	High	High	High				
SP 1.5		High		High					
SP 1.6				High					
SP 1.7				High					
Specific Goal 2									
SP 2.1	High		Medium	Medium	High	High	High	High	High
SP 2.2	High		High	High	High	High	High	High	High
SP 2.3	High		High	High	High	High	High		
SP 2.4			High		High	High			
SP 2.5			Medium						
SP 2.6			High						
SP 2.7			High						
Specific Goal 3									
SP 3.1	Medium		High				High		High
SP 3.2	Medium		High				High		High
SP 3.3	High		High						
SP 3.4	High								
SP 3.5	Medium								
Generic Goal 2									
GP 2.1	High	Medium	High	High	High	High	High	High	High
GP 2.2	Medium	High	High	High	High	Medium	High	High	High
GP 2.3	Medium	Medium	Medium	Medium	High	Medium	High	High	Medium
GP 2.4	High	High	High	High	High	Medium	Medium	High	High
GP 2.5	Medium	Medium	Medium	Medium	High	Medium	Medium	High	High
GP 2.6	Medium	High	High	High	High	Medium	High	High	Medium
GP 2.7	Medium	Medium	Medium	Medium	High	Medium	Medium	High	Low
GP 2.8	High	High	High	High	High	High	High	High	High
GP 2.9	High	High	High	High	High	High	High	High	High
GP 2.10	Low	Low	Low	Low	High	Low	Low	High	Low



GQM Definitions

- Define major goals of the process improvement activity



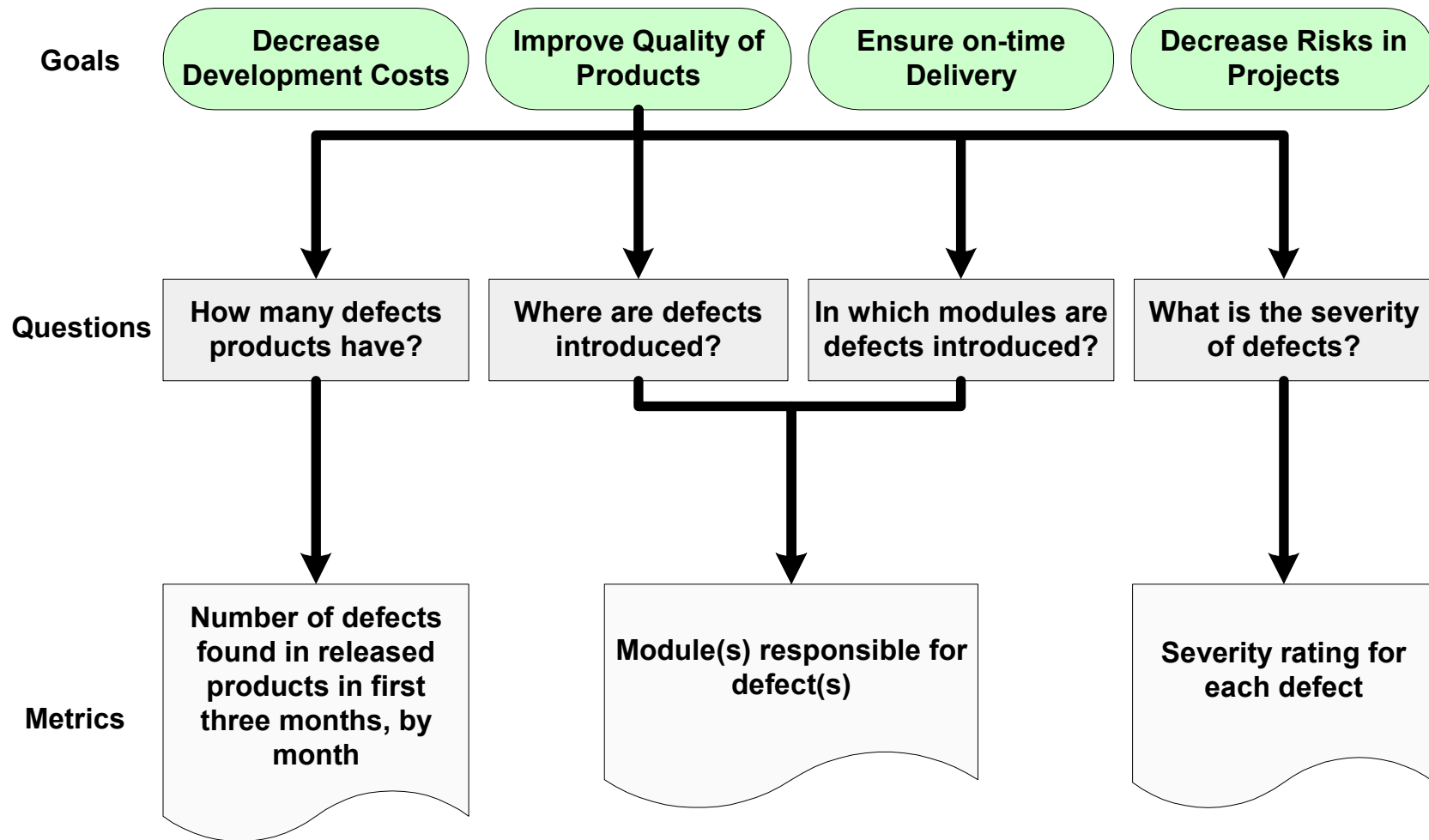
- Questions derived from goals that must be answered to determine if the goals are achieved



- Measurements that provide the most appropriate information for answering the identified questions



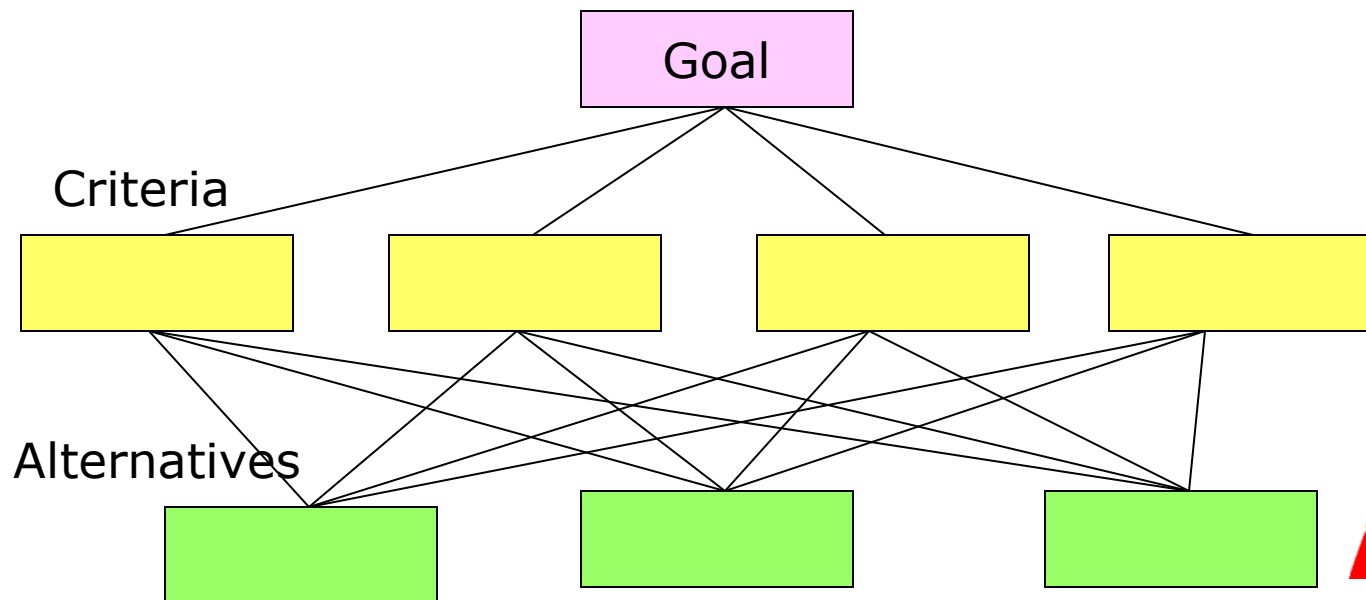
Example of GQM for Process Measurement



Using Analytical Hierarchy Process (AHP)*

- AHP provides a way to prioritize alternatives to satisfy an organization's business goals
- It represents a decision-making problem in hierarchical structure and consists of:
 - A business goal
 - Criteria to satisfy the business goal
 - Alternatives to select to achieve the business goal
- The GQM approach can be used to derive tree in AHP

* Golden, B. L., E.A. Wasil, P.T. Harker, "The Analytic Hierarchy Process", Springer-Verlag, 1989



AHP Steps

1. Setup criteria from cause of defects
2. Setup alternatives from specific practices
3. Assign weights to criteria
4. Perform pair-wise comparisons of alternatives for each criterion
5. Determine the priority of alternatives

Discussion of an Example at ABB

To follow Example please refer
to provided handouts

Determine Goal

- Reduce the Cost of Poor Quality



- Reduce the number of defects found at Integration Testing stage



- Reduce rework time



- Reduce cost associated with rework time by \$150 kUSD

Step 1: Set Up Criteria

- Couple of salient known recent issues to the organization include:
 - There have been issues with capturing and managing requirements properly – this issue has been noticed especially when requirements have been provided to supplier
 - Quality with primary software sub-contractor has been a problem lately as well
- Criteria then are developed
 - Supplier agreements do not always reflect requirements
 - Requirements not properly defined
 - Requirements not properly managed

... Step 1: Set Up Criteria

- Table of criteria

Criteria
Supplier Agreements do not always reflect requirements
Requirements not properly defined
Requirements not properly managed

Step 2: Set Up Alternatives

- From the appraisal conducted, the PAs identified at the site as “defect generation responsible” include:
 - RD, REQM, SAM, VER, and CM

- With the above issues in mind, and the appraisal results identified, the PAs that contribute most to the criteria identified are established:
 - SAM, RD, and REQM
 - MA will be a “must”

Practice	RD	ReqM	PP	PMC	MA	SAM	Ver	PPQA	CM
Specific Goal 1									
SP 1.1	Medium	Medium	High	High	High	High	High	High	High
SP 1.2	High	Medium	High	High	High	High	High	High	High
SP 1.3		High	High	High	High	High	High		High
SP 1.4		High	High	High	High				
SP 1.5		High		High					
SP 1.6				High					
SP 1.7				High					
Specific Goal 2									
SP 2.1	High		Medium	Medium	High	High	High	High	High
SP 2.2	High		High	High	High	High	High	High	High
SP 2.3	High		High	High	High	High	High		
SP 2.4			High		High	High			
SP 2.5			Medium						
SP 2.6			High						
SP 2.7			High						
Specific Goal 3									
SP 3.1	Medium		High				High		High
SP 3.2	Medium		High				High		High
SP 3.3	High		High						
SP 3.4	High								
SP 3.5	Medium								
Generic Goal 2									
GP 2.1	High	Medium	High	High	High	High	High	High	High
GP 2.2	Medium	High	High	High	High	Medium	High	High	High
GP 2.3	Medium	Medium	Medium	Medium	High	Medium	High	High	Medium
GP 2.4	High	High	High	High	High	Medium	Medium	High	High
GP 2.5	Medium	Medium	Medium	Medium	High	Medium	Medium	High	High
GP 2.6	Medium	High	High	High	High	Medium	High	High	Medium
GP 2.7	Medium	Medium	Medium	Medium	High	Medium	Medium	High	Low
GP 2.8	High	High	High	High	High	High	High	High	High
GP 2.9	High	High	High	High	High	High	High	High	High
GP 2.10	Low	Low	Low	Low	High	Low	Low	High	Low



. . . Step 2: Set Up Alternatives

- From the PAs identified as most likely contributors to the criteria, and referring to the findings after the appraisal was conducted, the description of recommendations associated with specific practices of the PAs identified are presented as shown in this slide

Practices	Description of Alternatives
RD SP1.1-1, -2	Consistently elicit and document customers needs and expectations
RD SP 1.2	Consistently develop and document MRS
RD SP2.1	Consistently document ERS and establish link between ERS and MRS
RD SP3.2	Consistently establish and maintain definition of required functionality in ERS
RD SP 3.3	Analyze completeness and sufficiency of requirements in a consistent fashion
RD SP 3.5	Consistently validate product requirements
RM SP1.4	Establish and maintain bi-directional traceability
RM SP1.5	Identify and document inconsistencies between work products and requirements
SAM SP1.2	Select Suppliers based on their ability to satisfy requirements
SAM SP 2.1	Review COTS products to ensure they satisfy requirements
SAM SP2.3	Accept acquired product verifying it meets requirements

Step 3: Assign Weights to Criteria

- Weights are assigned to the criteria identified in Step 1 and they are prioritized accordingly

Criteria	Weight
Requirements not properly defined	0.5
Supplier Agreements do not always reflect requirements	0.3
Requirements not properly managed	0.2

Step 4: Pair-wise Comparison of Alternatives for each Criteria

- Using the AHP method, and considering the criteria, selected PAs, and observations, a prioritization of practices per criteria is performed.
- Prioritization for “Requirements not properly defined criteria are shown below

Ranking for "Requirements not properly Defined"		
Practices	Description	Priority
RD SP 1.2	Consistently develop and document MRS	0.41
RD SP2.1	Consistently document ERS and establish link between ERS and MRS	0.32
RD SP3.2	Consistently establish and maintain definition of required functionality in ERS	0.1
RD SP1.1	Consistently elicit and document customers needs and expectations	0.07
RD SP 3.5	Consistently validate product requirements	0.06
RD SP 3.3	Analyze completeness and sufficiency of requirements in a consistent fashion	0.04

Step 5: Calculate Priority and Expected Economic Impact

- After prioritizing alternative solutions by criteria, the method allows to prioritize all alternatives analyzed.

Practices	Description of Alternatives	Priority	Estimated Cost Reduction
RD SP 1.2	Consistently develop and document MRS	0.22	\$33,000.00
RD SP2.1	Consistently document ERS and establish link between ERS and MRS	0.17	\$25,500.00
RD SP3.2	Consistently establish and maintain definition of required functionality in ERS	0.15	\$22,500.00
RD SP1.1	Consistently elicit and document customers needs and expectations	0.11	\$16,500.00
RD SP 3.5	Consistently validate product requirements	0.09	\$13,500.00
RD SP 3.3	Analyze completeness and sufficiency of requirements in a consistent fashion	0.08	\$12,000.00
RM SP1.5	Identify and document inconsistencies between work products and requirements	0.07	\$10,500.00
SAM SP1.2	Select Suppliers based on their ability to satisfy requirements	0.05	\$7,500.00
SAM SP2.3	Accept acquired product verifying it meets requirements	0.03	\$4,500.00
RM SP1.4	Establish and maintain bi-directional traceability	0.02	\$3,000.00
SAM SP 2.1	Review COTS products to ensure they satisfy requirements	0.01	\$1,500.00
	Total	1	\$150,000.00

Questions ?

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