

PRODUCT DEVELOPMENT BEST PRACTICES AND ASSESSMENT

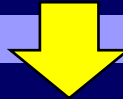
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BEST PRACTICES

- Multi-year effort by consortium to identify best practices of product development
- Consortium led by DRM Associates
- Effort involved:
 - On-site visits to top companies
 - Research and attendance at over 100 conferences & meetings



Became the basis for a product development assessment methodology

BEST PRACTICES CATEGORIES

Strategy (28)

Business & product strategy (9)

Product & pipeline management (8)

Technology management (11)

Organization (43)

Management & leadership (11)

Early involvement (9)

Product development teams (12)

Organizational environment (11)

Process (88)

Process management (10)

Process improvement (9)

Understanding the customer(6)

Requirements & specifications management (9)

Development process integration (7)

Supplier/subcontractor integration (7)

Product launch (9)

Configuration management (9)

Design assurance (11)

Project & resource management (11)

Design Optimization (64)

Design for manufacturability (12)

Product cost management (13)

Robust design (15)

Integrated test design & program (14)

Design for operation & support (10)

Technology (52)

Product data (10)

Design automation (12)

Simulation and analysis (10)

Computer-aided manufacturing (7)

Collaborative tools & technology (8)

Knowledge management (5)

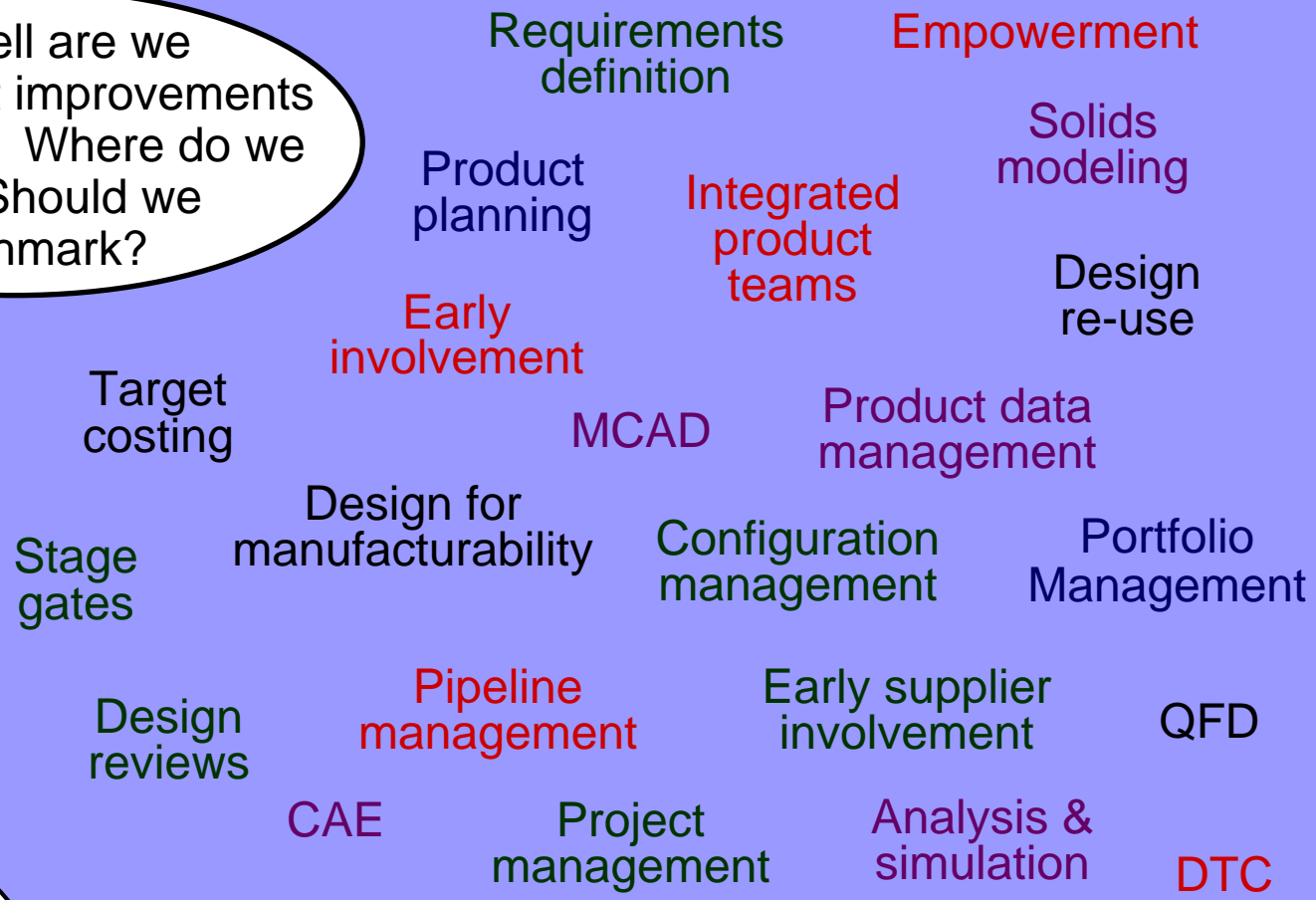
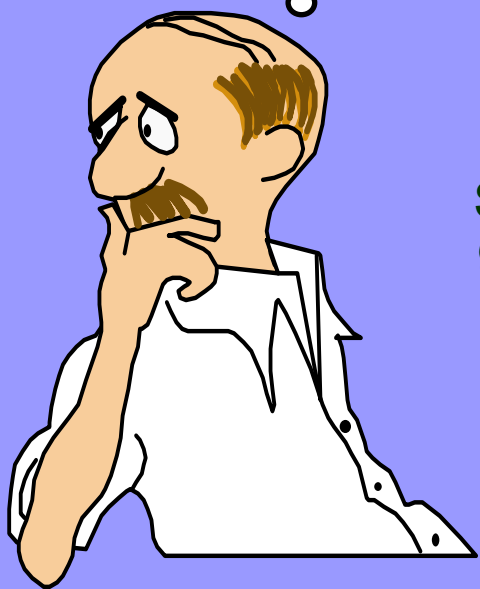
() Number of best practices / questions

BEST PRACTICE SOURCES



IMPROVING PRODUCT DEVELOPMENT

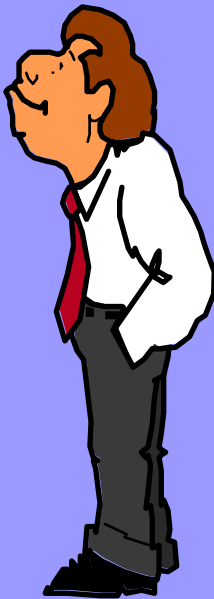
How well are we doing? What improvements are needed? Where do we start? Should we benchmark?



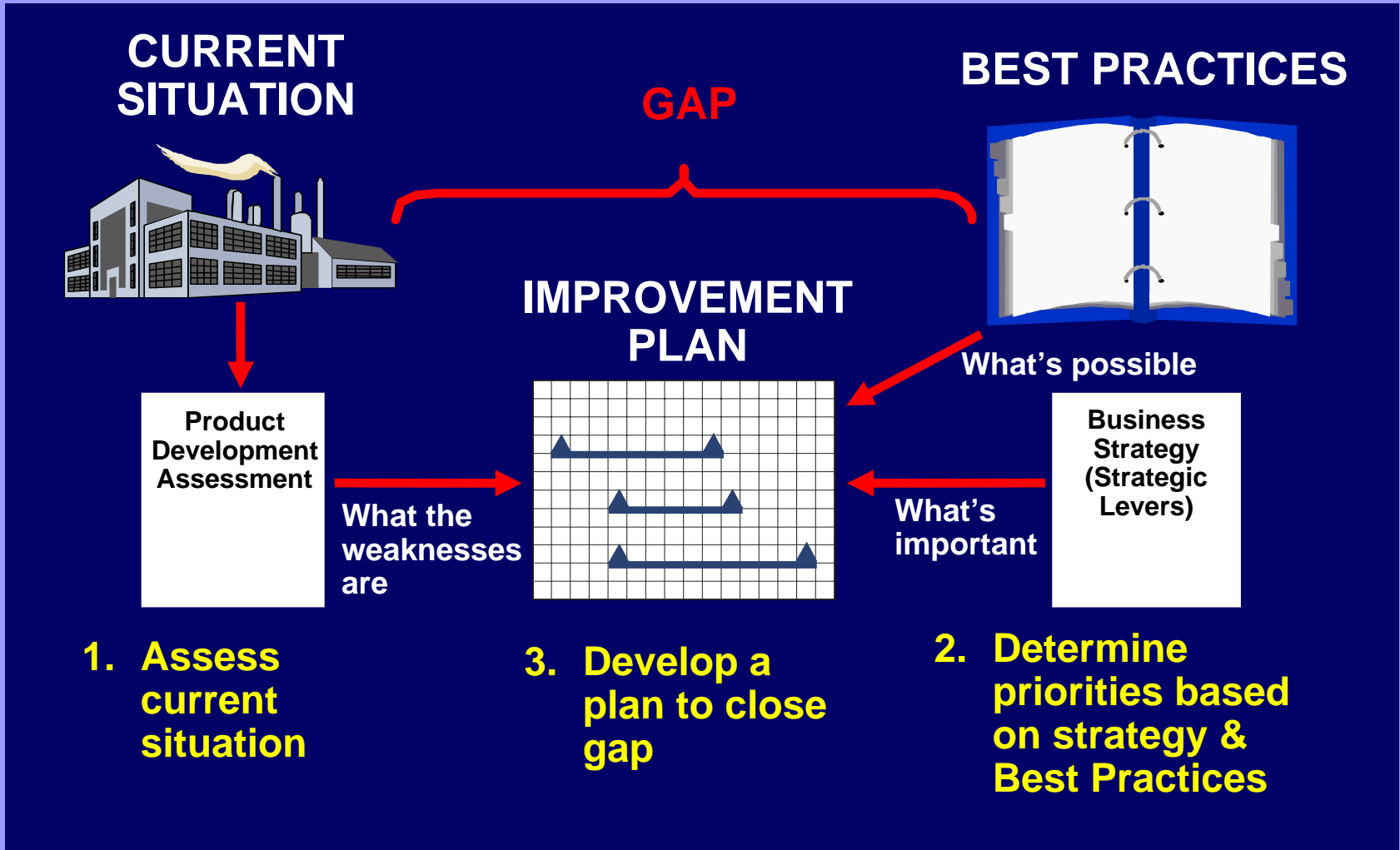
The Product Development Best Practices and Assessment software and methodology provide an objective way for identifying opportunities and planning improvements

WHY DO AN ASSESSMENT

- Benchmark the company's product development process against best practices and industry performance
- Determine the extent that new product development best practices are being utilized
- Identify high-payoff improvement opportunities for improvement
- Establish a metric to measure progress in improving product development



DEVELOPING AN IMPROVEMENT PLAN



BEST PRACTICES AND ASSESSMENT

14.0 PRODUCT LAUNCH		EVALUATION SCALE		
Traditional (0)	Developing (3)	Committed (7)	Best Practice (10)	
Product launch & transition to production addressed when drawings are released. No pre-planning exists. New equipment, tooling & process documentation acquired or developed after release. Engineering involvement to other departments for resolution of issues.	Manufacturing involved prior to release to plan transition, but transition not actively managed. The need for potential new process equipment not identified until after release. Engineering involvement to move on to stable production prior to stable production.	Transition plans & schedules developed, but still not actively managed. New process equipment acquired to support product transition - some delays in transition. Engineering involvement & support to resolve issues.	Extensive monitoring of process acquisition plans to support transition. Tooling decisions made to manage risk & schedule. Early manufacturing involvement & continuing engineering support to resolve issues.	
<p><i>Best practice statements & assessment questions</i></p> <p><i>Description of evolution towards best practices to aid evaluation</i></p>				
			Importance	Performance
14.1	Prepare a product launch plan. Are formal plans and schedules developed for launching new products, transitioning new products into production, or ramping up production? Are facility, production equipment, tooling, computer system, manpower, and training requirements adequately identified and acted upon early in the process to avoid impacting scheduled production/launch dates?		10	0
14.2	Plan and coordinate production/launch requirements. Are formal systems such as MRP II / ERP used to construct a manufacturing bill of material, plan production, schedule material requirements and acquire materials for both prototype/pilot product and regular production? For services, are resource planning systems used to determine manpower, training, facility and equipment requirements? Are realistic forecasts provided to plan requirements considering launch? Is there close coordination with material and production planning to plan efficient procurement processes for acquisition of prototype, pilot production, and materials?		10	0
14.3	Verify process design in realistic setting. Are pre-production prototypes and pilot production/process validation runs used to verify manufacturability, process plans, tooling, and costs? Are production status parts used to demonstrate production readiness and support reliability testing? Is intended production equipment and processes used for this purpose? Are manufacturing personnel (versus engineering technicians) involved in the building of pre-production prototypes, pilot production or process validation builds? Are problems or feedback during prototype, pilot production or process validation builds captured and corrective action taken?		10	0

Assessment worksheets provides structure & a framework for feedback

Best practice statements & assessment questions

Description of evolution towards best practices to aid evaluation

Importance of each criteria to the organization

Performance relative to criteria/question

BEST PRACTICES AND ASSESSMENT

Assessment worksheets for each of the 28 categories

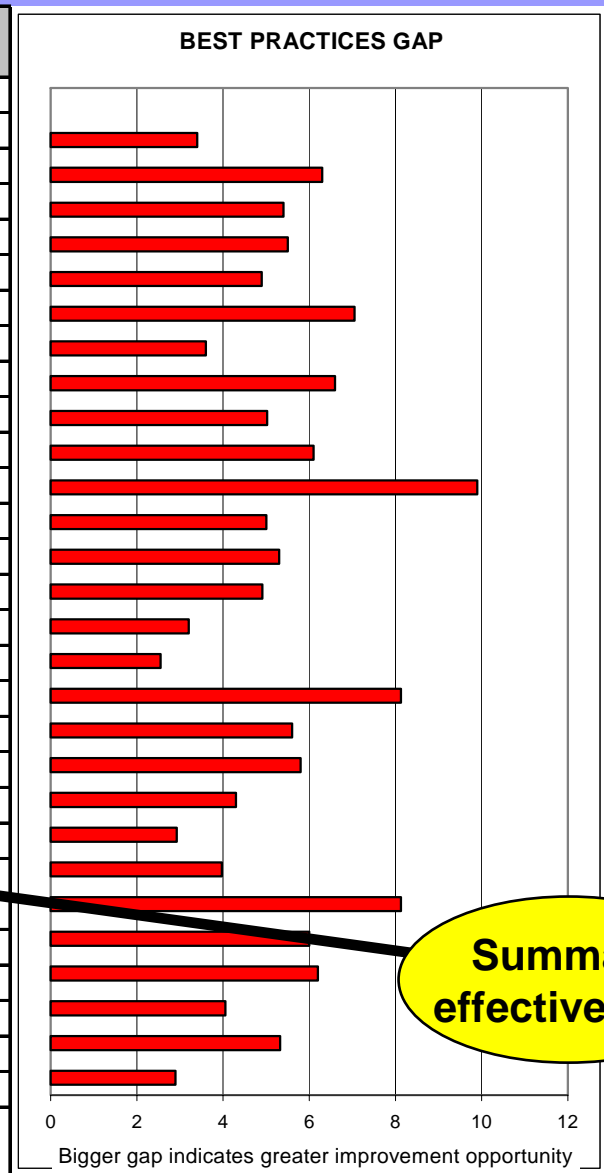
14.4	Prepare instructions and manufacturing programs thoroughly. Are adequate process plans, work instructions, or procedures prepared? Is training provided to manufacturing/service personnel? Are computer-aided manufacturing programs (e.g., NC programs, insertion programs, robotic programs, test vectors, dimensional inspection programs, etc.) effectively debugged and tested before production start-up?	5	0
14.5	Coordinate product launch with Manufacturing and other functions. Is there effective coordination with manufacturing management regarding transition to production/ramp-up and the impact on existing products? Is there adequate communication, coordination and involvement with remote manufacturing locations?	5	0
14.6	Resolve product launch problems quickly. Are problems quickly identified and acted upon? Are yields, defects, documentation or equipment programming errors, service problems, and manufacturing "squawks" formally tracked and closed out? Is there a sufficient level of engineering/product development support to address product launch problems?	10	0
14.7	Prepare to roll-out the product early. Is a marketing plan prepared to coordinate all pre-launch and launch activities? Are activities to roll the product out to the market (package design, advertising programs, establishing sales channels, planning distribution, setting inventory levels, etc.) done in parallel with the development of the product to minimize time-to-market? Are the functional disciplines such as marketing, sales, advertising, distribution, logistics, etc. effectively involved early to support launch activities? Is early customer testing done and adjustments made in a way to minimize impact on launch?		0
14.8	Test market the product. Is the product or service test marketed to gauge customer reaction? Are results analyzed to determine market acceptance and validate or adjust sales forecasts? Are results analyzed to determine what changes may need to be made to the product or service? Are results analyzed to determine what changes may need to be made to market strategy, sales channels, advertising, packaging, related services, etc.?	10	0
14.9	Prepare to sell and support the product. Are sales, customer service and product support personnel trained to support the product in advance of its launch? Are they prepared to support a rapid ramp-up?	5	0
Product Launch Effectiveness Rating			0

Summary performance for the category

SUMMARY & GAP ANALYSIS

Assessment Category	Assessment Weight	Company Weight	Effectiveness
Business & Product Strategy	0.5	1	3.2
Product & Pipeline Management	1	1	3.7
Technology Management	0.75	1	2.8
Management Leadership	1	1	4.5
Early Involvement	1	1	5.1
Product Development Teams	1.5	1	5.3
Organizational Environment	1	1	6.4
Process Management	1	1	3.4
Process Improvement	0.75	1	3.3
Understanding the Customer	1	1	3.9
Requirements & Specifications Mgt.	1.5	1	3.4
Development Process Integration	1	1	5.0
Supplier/Subcontractor Integration	1	1	4.7
Product Launch	1	1	5.1
Configuration Management	1	1	6.8
Design Assurance	0.75	1	6.6
Project & Resource Management	1.25	1	3.5
Design for Manufacturability	1	1	4.4
Product Cost Management	1	1	4.2
Robust Design	1	1	5.7
Integrated Test Design & Program	0.75	1	6.1
Design for Operation & Support	0.75	1	4.7
Product Data	1.25	1	3.5
Design Automation	1.25	1	5.2
Simulation and Analysis	1	1	3.8
Computer-Aided Mfg.	1	1	4.6
Collaborative Tools	1	1	2.9
Knowledge Management	1	1	4.2
Weighted Total			4.5

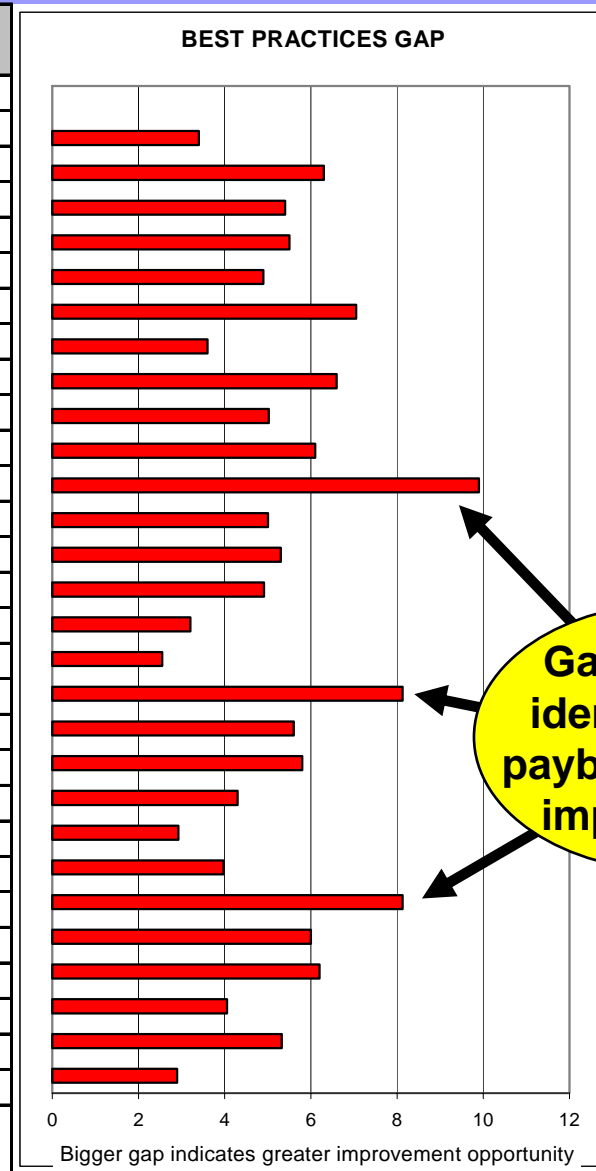
Category weight & effectiveness



Summary effectiveness

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Gap analysis identifies high payback areas of improvement

PRODUCT DEVELOPMENT STRATEGIES

***An organization cannot do everything superbly.
It must focus on only one or two strategic
objectives and be competent in the other areas.***



Product Development Strategic Objectives:

- Time to market /development schedule
- Low development cost
- Low product cost
- High product innovation and performance
- Quality, reliability and dependability (robustness)
- Service, responsiveness & flexibility to respond to new product opportunities & markets

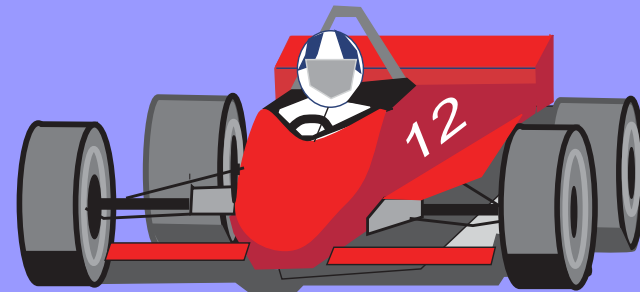
STRATEGIC LEVERS

- Strategic levers are best practices which have a major impact on achieving a product development strategy.
- Best practices are associated with strategies through a relationship factor of 0 (insignificant impact on strategy) to 3 (major impact on strategy) to assess strategic alignment.

	Simulation and Analysis	Imp.	Perf	Time-to-Mkt	Dev. Cost	Prod. Cost	Innov. /Perf.	Qual./Reliab	Service/Resp.
25.1	Simulate and analyze performance.	10	6	2	2	2	3	3	2
25.2	Simulate and analyze product designs early.	10	4	3	3	1	3	2	2
25.3	Use appropriate, easy-to-use CAE tools.	5	4	1	0	0	0	0	0
25.4	Use CAE to mature & optimize the design.	5	4	0	2	3	0	2	0
25.5	Tightly integrate analysis & simulation with design.	5	7	3	0	0	0	0	0
25.6	Simulate the logical & physical electrical design	10	6	0	0	0	0	3	0
25.7	Simulate manufacturing processes and process design.	5	2	0	0	2	0	0	0
25.8	Validate the analysis and simulation.	5	5	0	0	0	0	2	0
25.9	Re-use analysis and simulation models.	5	3	3	2	0	0	0	2

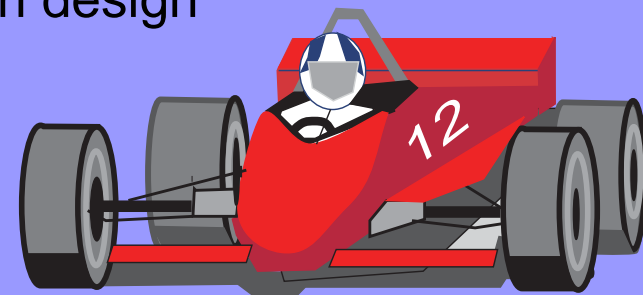
TIME-TO-MARKET STRATEGIC LEVERS

- 2.3 Prioritize development projects
- 2.7 Don't overload resources
- 5.4 Rapidly staff the project according to plan
- 8.9 Emphasize design re-use to minimize development cost & schedule
- 11.4 Capture and document requirements and specifications completely
- 11.8 Tightly manage requirements
- 12.3 Plan concurrent development
- 12.4 Tightly synchronize development activities
- 12.5 Learn to work with partial information
- 12.7 Prepare to roll out the product early
- 13.1 Involve subcontractors and suppliers in development
- 14.2 Plan and coordinate production requirements
- 14.6 Resolve production problems quickly
- 17.2 Create a comprehensive, realistic project plan

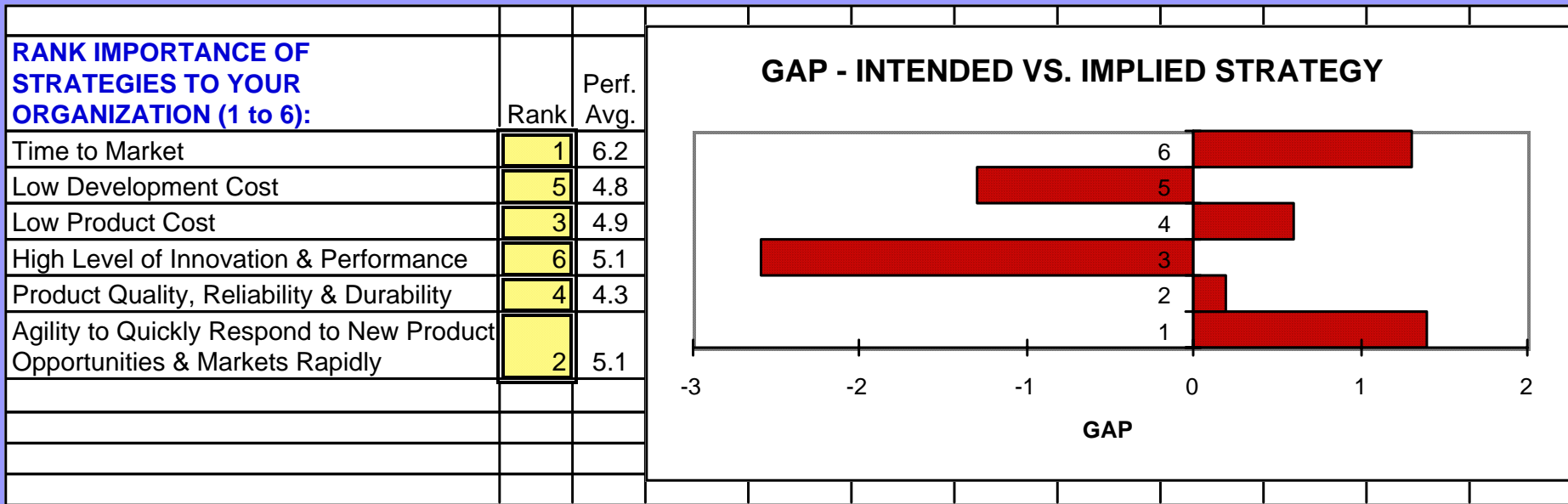


TIME-TO-MARKET STRATEGIC LEVERS

- 17.3 Obtain personnel's commitment to the project plan
- 17.4 Communicate project plans and responsibilities
- 17.4 Identify project staffing requirements
- 17.6 Plan development resource requirements
- 17.7 Allocate and manage resources
- 18.9 Use modular design approach
- 18.10 Standardize parts and materials
- 21.13 Balance testing and time-to-market considerations
- 24.4 Create electronic mock-up of the product
- 25.2 Simulate & analyze product designs early to minimize late iteration and physical prototypes.
- 25.5 Tightly integrate analysis & simulation with design
- 26.1 Use rapid prototyping technologies
- 27.1 Use collaboration systems to facilitate communication



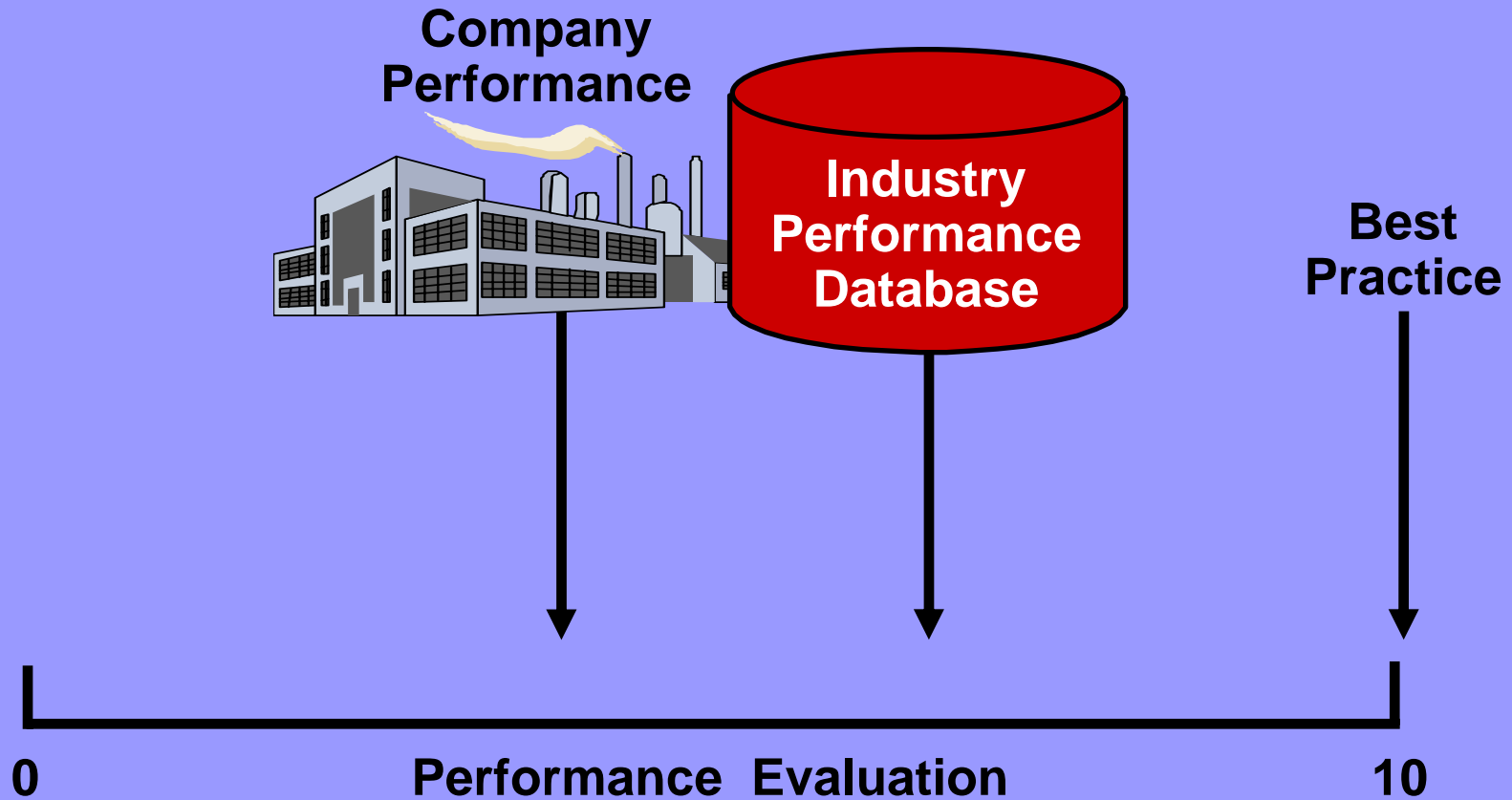
STRATEGIC ALIGNMENT



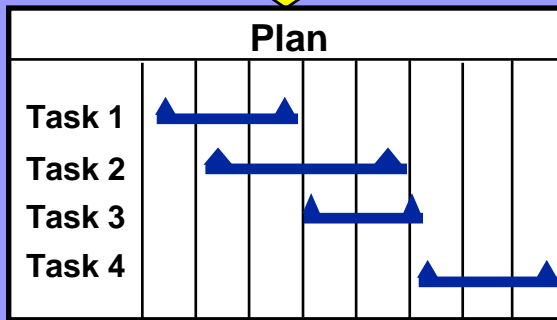
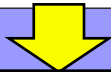
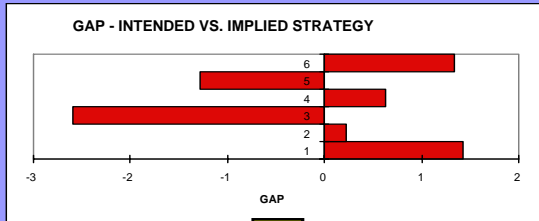
- High strategy ranking suggests that performance level of related practices should be higher than performance level of practices related to lower ranked strategies
- Positive gap suggests that practices related to this strategy require improvement; negative gap indicates over-emphasis on lower priority practices

EVALUATION FRAMEWORK

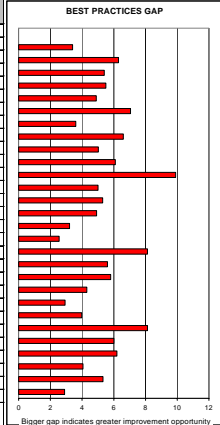
Database to compare company performance against



DEVELOPING THE ACTION PLAN



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Business & Product Strategy	0.5	1	3.2
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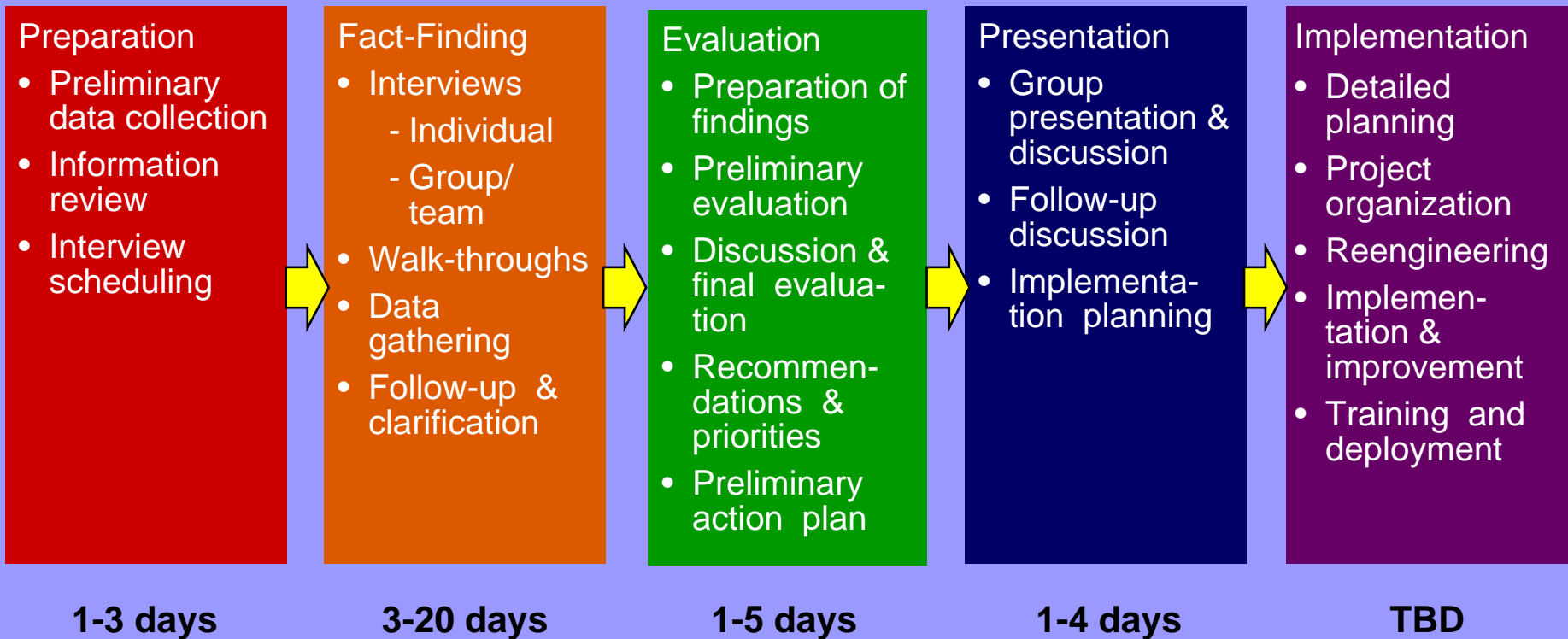
1. Identify performance gaps relative to categories
2. Identify strategy gaps and associated practices
3. Examine individual practices with low performance & high importance in large gap categories & strategies
4. Look for logical relationships & precedence among practices
5. Develop the action plan & gain consensus to the plan

ACTION / IMPROVEMENT PLAN

Based on the gap analysis, put together a plan for improvement

ID	Task Name	October	November	December	January	February
		Oct	Nov	Dec	Jan	Feb
1	PLAN & PREPARE	▶				
2	Create IPD Handbook	█				
3	Conduct Management Meetings	█				
4	Maintain Plan & Identify Additional Actions	█				
5	RESTRUCTURE ORGANIZATION	▶				
14	PLAN FACILITIES & COLLOCATE	▶				
24	ESTABLISH IPT's	▶				
25	Hire Facilitator	█				
26	Plan for Launching Teams	█				
27	Conduct Team Launch Process for Teams		█			
28	Implement & Support Teams		█	█		
29	Identify Issues and Follow-up Actions				█	
30	Implement PMT & SIT					▶
37	ESTABLISH BUSINESS PROCESSES				▶	
38	Develop Enterprise Plan				█	
39	Define Enterprise Processes					█
40	Develop Phased Implementation Plan					
41	Develop Tailored Program Process					

CONSULTANT ASSESSMENT PROCESS



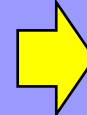
DELIVERABLES

Best Practices assessment templates

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		Importance	Performance
14.1 Prepare a product launch, transition to production or ramp-up plan. Are formal plans and schedules developed for launching new products, transitioning new products into production, or ramping up production? Are facility, production equipment, tooling and manpower requirements adequately identified and acted upon early in the process to avoid impacting scheduled production dates?		10	5
14.2 Plan and coordinate production requirements. Are formal systems such as MRP II / ERP used to construct a manufacturing bill of material, plan production, schedule material requirements and acquire materials for both prototype/pilot product and regular production? Are realistic forecasts provided to plan requirements considering production ramp-up? Is there close coordination with material and production planning to plan requirements? Are there efficient procurement processes for acquisition of prototype, pilot production, and initial production parts and materials?		5	4

Assessment summary & gap analysis

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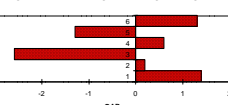
Action Plan

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39	Define Enterprise Processes					
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41	Develop Tailored Program Process					

Findings for each category

RANK IMPORTANCE OF STRATEGIES TO YOUR ORGANIZATION (1 to 5)	Rank	Avg
Time to Market	1	6.2
Low Development Cost	3	4.8
Low Product Cost	3	4.9
High Level of Innovation & Performance	2	5.1
Product Quality, Reliability & Durability	4	4.3
Ability to Quickly Respond to New Product Opportunities & Market Rapidly	2	5.1

GAP - INTENDED VS. IMPLIED STRATEGY



Priority recommendations

FINDINGS - Design Assurance

- Have not effectively integrated customer personnel in IPT's and moved to incremental design reviews
 - Traditional reviews with hundreds of customer personnel
- Controversy over whether product assurance should be part of the IPT or remain an independent function
 - Combination of both approaches needed
 - Quality engineering and reliability engineering resource should be provided to support the IPT's and budgeted by the IPT's
 - A central product assurance function is also needed
- While a "mini-" FRACAS system established, there has been inadequate emphasis on this tool and it may not be robust enough to meet future needs
- General culture appears to be reactive to design assurance problems rather than proactive
- Concern over how vendor off-the-shelf hardware is specified and how requirements are incorporated that are beyond the vendor spec.

RECOMMENDATIONS

- Fine-tune organization structure
 - Define composition, roles and responsibilities of the Program Management Team
 - Move toward a combination of "top down" and "bottom-up" integration responsibilities with WSEIT, Integration Teams & IPT's
 - Expand role of Missile Systems Integration group to include assembly modeling, assembly planning, and assembly process; include Courtland personnel as formal members of this team
 - Work with TPO to better align the two organizations structures and TPO involvement of IPT's
- Better define F&R's of teams and functional groups. Review team charters, once established, against F&R's to insure no holes, minimal redundancy, and effective integration
- Establish well-defined boundary conditions for each team

EXAMPLE - FINDINGS

- Findings developed for each of the 28 categories
- Describes strengths and weaknesses
- Typically 1 to 3 pages in length

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EXAMPLE - RECOMMENDATIONS

- Recommendations developed in detail
- Typically 5 to 9 pages in length

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CONSULTANT ASSESSMENT

BENEFITS

- Objectivity & consistency for comparison of effectiveness ratings
- More efficient use of company resources
- Comprehensive assessment report includes:
 - Assessment worksheets & summary
 - Detailed findings
 - Detailed recommendations & action plan
- Perspective & expertise to develop action plan
- Debriefing and discussion of opportunities

CASE STUDY - 1

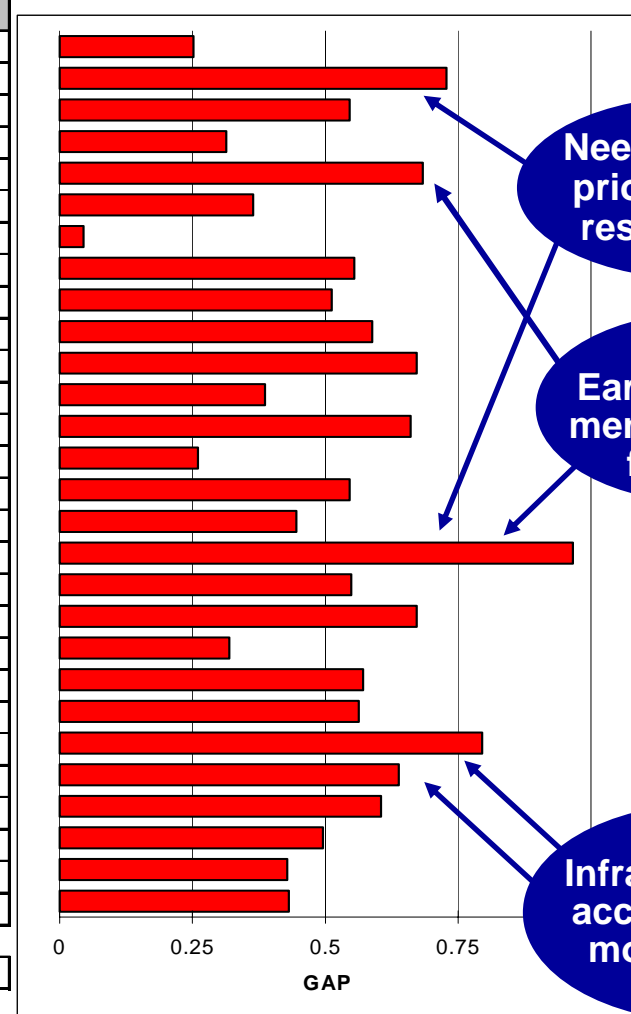
- \$100 million medical equipment company
- Many development projects and limited resources
- Very positive culture and management
- Active efforts to implement concurrent engineering
- Wanted to determine how well they were doing and what steps should undertaken next

CASE STUDY - 1

PRODUCT DEVELOPMENT ASSESSMENT SUMMARY

Assessment Category	Weight	Effectiveness
Business & Product Strategy	0.2	5.5
Product Planning & Management	0.5	4.8
Technology Management	0.3	3.5
Management Leadership	0.4	7.2
Early Involvement	0.4	3.9
Product Development Teams	0.5	7.4
Organizational Environment	0.4	9.6
Process Management	0.3	3.4
Process Improvement	0.3	3.9
Customer Orientation	0.6	6.5
Requirements & Spec. Mgt.	0.4	4
Development Process Integration	0.3	5.4
Supplier/Subcontractor Integration	0.4	4.1
Transition to Production	0.3	6.9
Configuration Management	0.3	3.5
Design Assurance	0.3	4.7
Project & Resource Management	0.5	3.1
Design for Manufacturability	0.4	5.1
Product Cost Management	0.4	4
Robust Design	0.3	6.2
Design for Testability	0.3	3.2
Design for Operation & Support	0.3	3.3
Product Data	0.4	2.9
Design Automation	0.4	4.3
Simulation and Analysis	0.3	2.8
Computer-Aided Manufacturing	0.3	4.1
Support Technology	0.3	4.9
Knowledge Organization	0.2	2.3

10	5
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Need 1 - Project prioritization & resource mgt.

Need 2 - Earlier involvement of support functions

Need 3 - Infrastructure to access product model & PDM System

FINDINGS & RECOMMENDATIONS

- Outstanding company culture and environment conducive to teams
- Most significant issue was product planning and managing resources
 - Too many projects in process at any time
 - Resources over-committed, delaying projects
 - Inhibited effective early involvement of support functions on teams
- Needed improved product planning process to prioritize projects, strategy of undertaking fewer projects, and implementing a resource management system in conjunction with project planning
- Continued effort required to expand number of CAD workstations and create infrastructure to access digital product model
- Needed to move away from managing paper to managing digital information with PDM system
- PDBPA provided an objective basis for planning improvement activities & identified the product planning/resource management issue that the company was not aware of

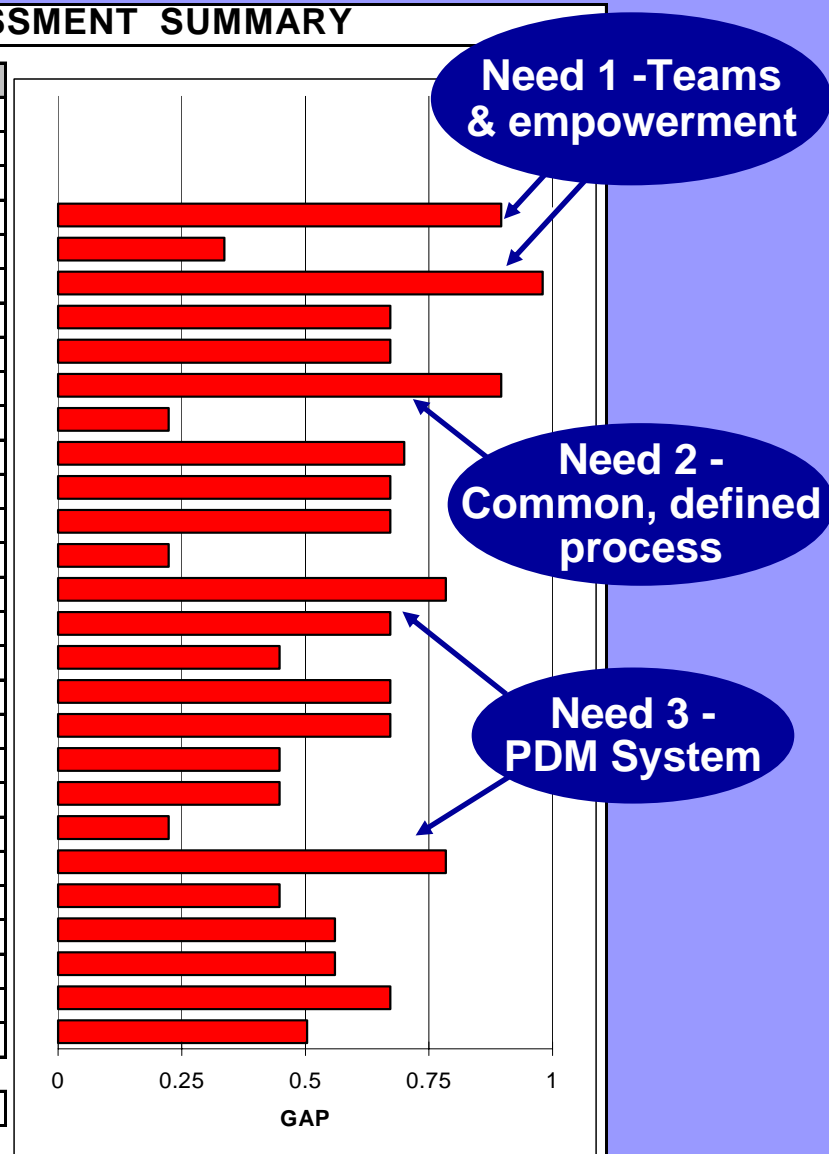
CASE STUDY - 2

- Defense contractor, \$600 million development program
- Thought the company was “doing concurrent engineering”, but little real experience with teams & very traditional management
- Customer wanted “integrated product & process development (IPPD)” approach
- Management perceived problems with the “structure” of the teams
- Significant budget shortfall required a different approach & forced budget cuts

CASE STUDY - 2

PRODUCT DEVELOPMENT ASSESSMENT SUMMARY

Assessment Category	Weight	Effectiveness
Business & Product Strategy	0	0
Product Planning & Management	0	0
Technology Management	0	0
Management Leadership	0.4	2
Early Involvement	0.4	7
Product Development Teams	0.5	3
Organizational Environment	0.4	4
Process Management	0.4	4
Process Improvement	0.4	2
Customer Orientation	0.4	8
Requirements & Spec. Mgt.	0.5	5
Development Process Integration	0.4	4
Supplier/Subcontractor Integration	0.4	4
Transition to Production	0.4	8
Configuration Management	0.4	3
Design Assurance	0.4	4
Project & Resource Management	0.4	6
Design for Manufacturability	0.4	4
Product Cost Management	0.4	4
Robust Design	0.4	6
Design for Test and Testability	0.4	6
Design for Operation & Support	0.4	8
Product Data	0.4	3
Design Automation	0.4	6
Simulation and Analysis	0.4	5
Computer-Aided Manufacturing	0.4	5
Support Technology	0.4	4
Knowledge Organization	0.2	1
	10	5



FINDINGS & RECOMMENDATIONS

- While programs were well-managed, concurrent engineering was minimally applied
- The “structure” problems with teams were the result of management attempting to create functional stovepipe organizations within a team environment
- Major issue was the authoritarian management style and lack of empowerment
- Customer personnel’s lack of understanding of IPPD also hindered the effectiveness of teams
- Issue of who should fund team training - the enterprise or the program?
- Total lack of understanding & focus on business processes
- Budget shortfall resulted in significant cut in configuration management - only solution to achieve budget & maintain control was to implement a product data management system

SUMMARY

- Companies need continuing effort to improve product development practices and process
- A product development strategy needs to be explicitly defined
- Product development practices and process need to be aligned with strategic objectives
- Benchmarking & best practice databases aid identification of best practices
- A self-critical approach and competitive imperative are needed as a basis for significant improvement
- Improvement efforts should be focused on areas that will have the greatest payback
- Improvement efforts should address organization, process and technology in a balanced way

PRODUCT DEVELOPMENT ASSESSMENT

If you would like more information on:

- Product Development Assessment
- Product Development Consulting & Training

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