Improving Technical Success in Projects at DuPont

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DUPONT

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Improving Technical Success in Projects Agenda

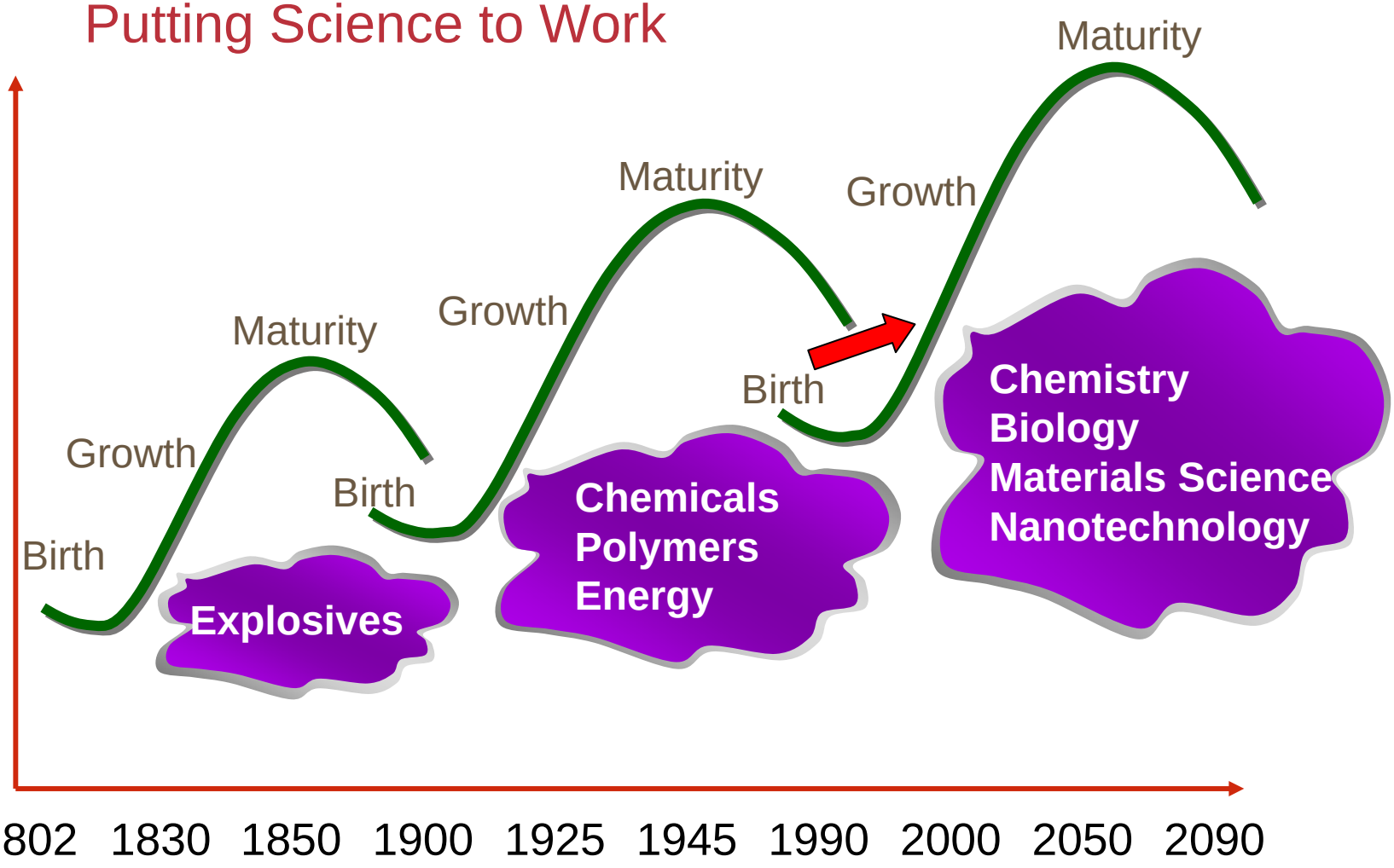
- Purpose and Corporate Background
- DuPont Experience
- Keys to Success
- “High Technology” Definition
- A Call to Action
- Third-Party Reviews
- Details/Accountability
- Findings thus Far
- Questions/Discussion

Purpose of Today's Discussion

- **Specifically, to share changes made in our approach to managing technology risk in all of our projects in the hopes that this interaction may help us and others learn how to improve our processes.**
- **To share DuPont culture, history, perspective, and processes around bringing new technology to commercialization.**

DuPont Innovation Over Two Centuries

Putting Science to Work



Innovation Across 3 Centuries at DuPont

Hagley Powder Mills

"Birthplace of DuPont"

DuPont Chemicals & Polymers

- Nylon, Spandex, Teflon®,Tyvek®, Kevlar®, Nomex®, Sontara®, Corian®, TiO_2, Suva®, etc.
- Engineering Resins – Delrin®, Zytel®, Rynite® Surlyn®
- Elastomers - Neoprene, Viton®, Hypalon® ,Kalrez®

DuPont Leadership in Industrial Biotechnology

- Seeds: Pioneer®
- BioFuels
- Biomaterials: PDO, Sorona®, Hytrel®

Five Growth Platforms

DuPont Electronic & Communication Technologies

$3.8 B

- Electronic Technologies
- Displays Technologies
- Imaging Technologies
- Fluoroproducts

DuPont Performance Materials

$6.9 B

- Engineering Polymers
- Packaging & Industrial Polymers
- DuPont-Teijin Films
- Performance Elastomers

DuPont Coatings & Color Technologies

$6.3 B

- Performance Coatings
- Titanium Technologies

DuPont Safety & Protection

$5.6 B

- Advanced Fiber Systems
- Chemical Solutions
- Nonwovens
- Safety Resources
- Surfaces

DuPont Agriculture & Nutrition

$6.3 B

- Pioneer Hi-Bred
- Crop Protection
- Nutrition & Health
- Qualicon

2006 Segment Sales

Improving Technical Success in Projects

DuPont Experience

- Long history of technical innovation.
- Long history of economic success based on discovery and/or development of new technology.
- Today's marketplace demands continued technological advances and the ability to bring them to commercialization faster. There can be no tolerance for major failures.

Improving Technical Success in Projects

DuPont Experience in 1999-2001

- **Four major projects totaling greater than $600MM were not performing or under performing.**

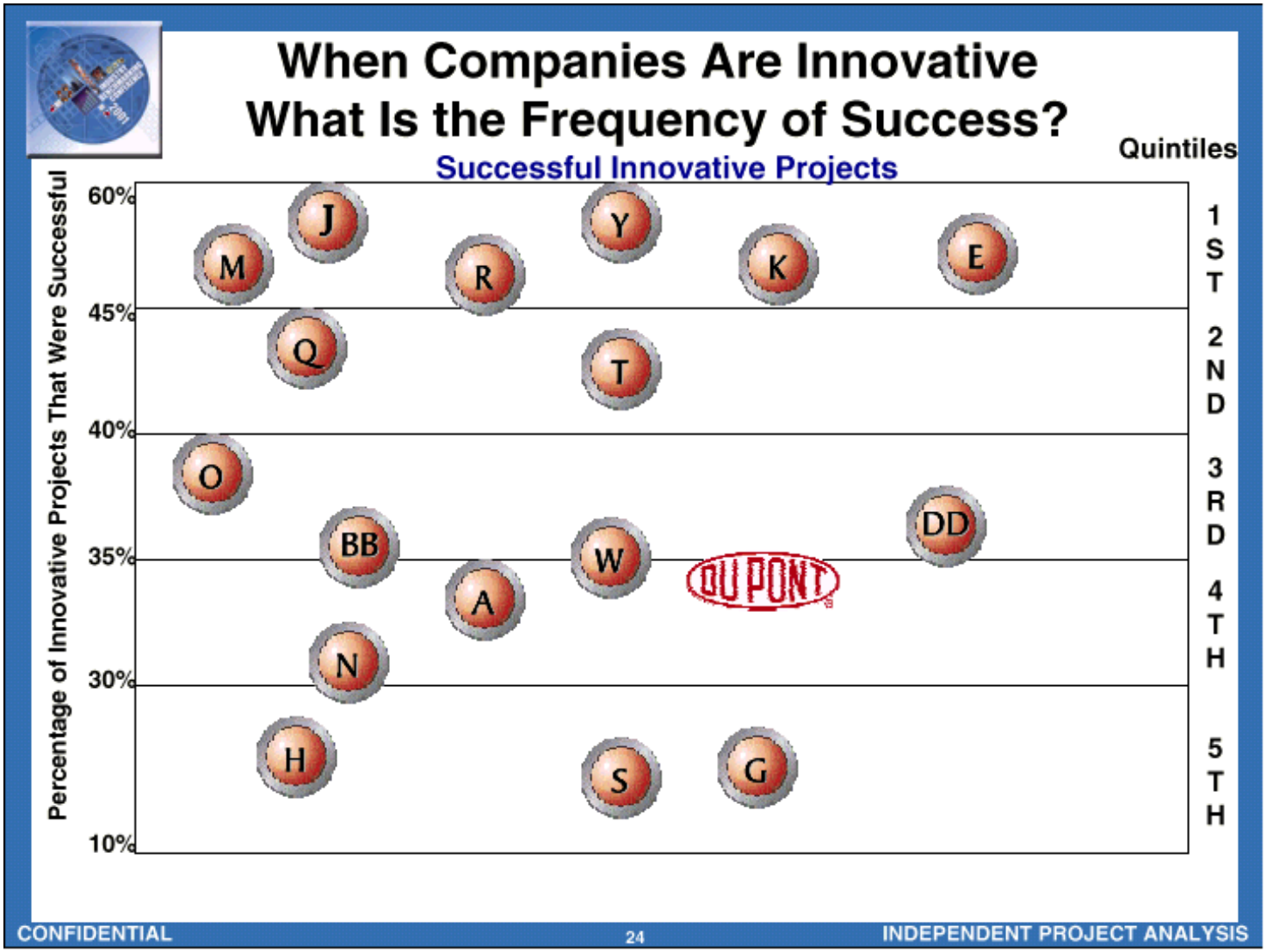
- **Our overall success rate in implementation of new technology projects was not satisfactory as evidenced by Independent Project Analysis benchmark data.**

Consequences of Poor Technology Choices

Consequences of Poor Technology Choices

After

Track Record Per IPA (2001)



Improving Technical Success in Projects

Keys to Success

- **Per Independent Project Analysis' study "Successful Commercialization of New Technology," there are four key practices critical to controlling innovation risk:**
  - **Recognizing innovation is present**
  - **Scheduling by accomplishment**
  - **Thoroughly defining innovation projects**
  - **Developing effective teams**

Improving Technical Success in Projects

Keys to Success

Reflection within DuPont

Those projects where teams actively pursued input from outside the natural work group rarely encountered major failures.

First Step is to Recognize the True Level of Technical Difficulty in a Project

- If the technology is complex or difficult, then the challenges will be greater, plan accordingly:

  Staffing, adequate timing, realistic milestones

- Look for the signs of high technology content

Signs of a High Technology Project

- High degree of new technology, including;
  - Process is new to the world, the industry or your company
  - Major process modification in 2 or more steps - especially primary reactor
  - Unit operations are known to company but not practiced in that specific sequence

Signs of a High Technology Project (cont.)

- Process has more than 4 major complex steps
- Process has one or more recycle streams
  - impurity build-up, enough purge points?
- Process involves solids handling - especially moving solids
- Tough material of construction issues
- Technology knowledge makes it a “Product by Process” facility
- Specifications are complex and significant - customer qualification requirements exist

High Technology Projects will likely have a Tough Time when:

- Flowsheets not generated/converged or
- Process only simulated on computer or
- Process only piloted at bench scale or
- Process piloted but not with integrated recycle streams
- R&D is still occurring during production design
- Market development quantities not tested with customers
- Impurities not well characterized
- Poorly understood Vapor/Liquid Equilibria
  - Tight separations, foaming potential

High Technology Projects will likely have a Tough Time when:

- Inadequate corrosion testing if exotic materials used
  - Don’t forget seals, gaskets, etc
- Significant solids handling issues
- Complex waste handling issues
- Feedstock quality is critical,
- Process uses a new catalyst or an improved catalyst
- Tough to control dynamically
- Business demands a tight timeline so R&D is compressed

Common Outcome on High Technology Projects

- R&D takes twice as long as estimated
- Project costs 33% more than estimate
- Start-up takes 15 months longer
- Production in first year less than 50% of design
- Over 40% of moderate and high innovation projects were outright failures
- Fewer than 20% of them delivered all that was promised at authorization time – but many created great profits anyway!

Improving Technical Success in Projects
A Call to Action!

- Team sponsored in early 2001 by the CEO and Chief Technology Officer to address technical success in capital projects at DuPont
- Coordinated by VP Engineering and directors of R&D, Operations and Engineering
- Initiated a two-stage approach

  1) Interim containment plan

  2) Longer term approach using Six Sigma methodology

Improving Technical Success in Projects

Third-Party Reviews

- After review of history and input from many involved people, the interim containment team decided to concentrate on Third-Party Reviews.
  - Gatekeeping process by knowledgeable people outside of the business and project team
- To be utilized at minimum of two stages during the project process:

  Technology selection

  Final Basic Data review

Improving Technical Success in Projects

Third-Party Reviews

The team developed:

- **Detailed process for third-party reviews along with formal audit process.**
- **Accountability definition for technology and basic-data development.**
- **List of potential reviewers across DuPont.**

Improving Technical Success in Projects

Third-Party Reviews

Third-Party Review Definition

A review by knowledgeable people not associated with the project or business unit that can assess:

- Stage of technology development and readiness to proceed
- Potential pitfalls for project teams to address

For a major project, typically involves 6-8 people spending a day or more reviewing the state of the technology with the project team at various stages of the project.

Process Development Mantras

- Time is your Enemy
- If they actually give you enough time then:

  All Questions Will Be Answered in Every Case

  In enough time to plan?

  Just in time to survive?

  When doing the work over?

- Since nothing is a “given”, the name of the game is prudent risk management

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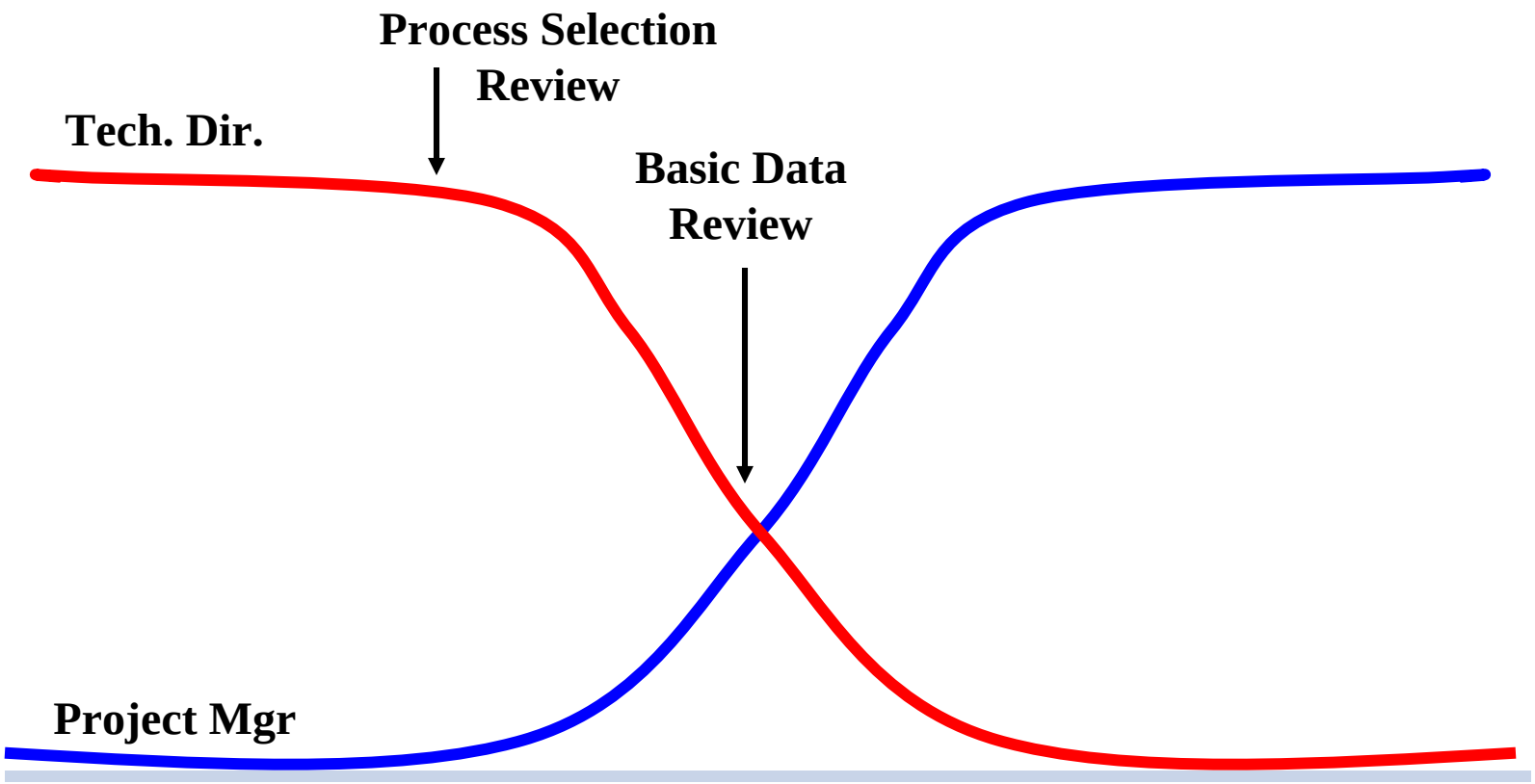
Third-Party Reviews

Guidelines

- Should be held early and often
- First review "before you're ready"; at least before Pre-Project Authorization (PPA)
- Final review completed after basic data and before project authorization
- More reviews for larger, complex projects
- Representation from Central Research and Central Engineering Technology organizations required

Improving Technical Success in Projects

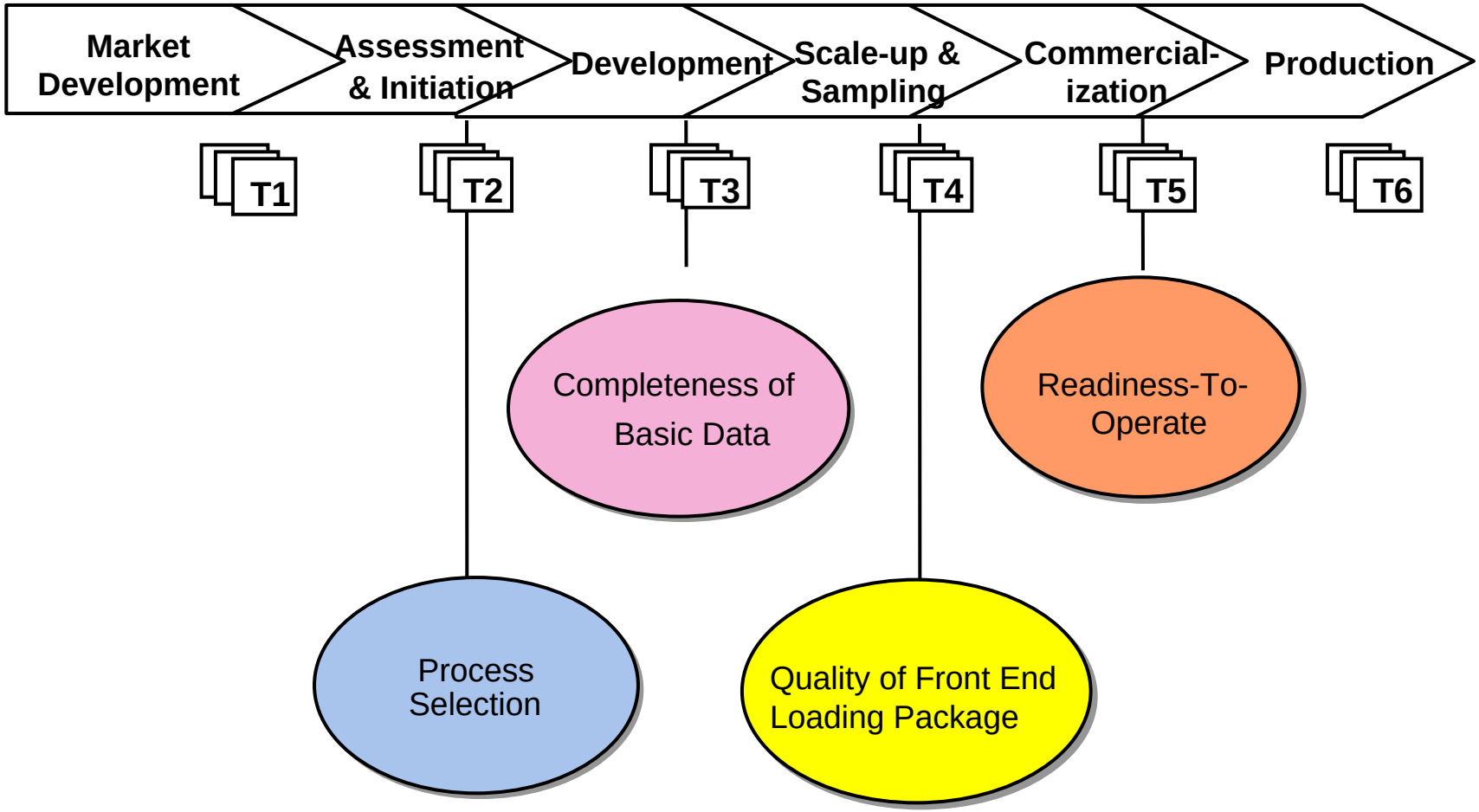
Accountability – Technology Vs Implementation



GPI	FEL 1		FEL 2	FEL 3	
PACE	PHASE 1 (IDEA)	PHASE 2 (CONCEPT)	PHASE 3 (DEVELOPMENT)	PHASE 4 (READINESS)	PHASE 5 (SCALE-UP)

Third Party Review Timing

Integrated Application Development, Process & Product Design



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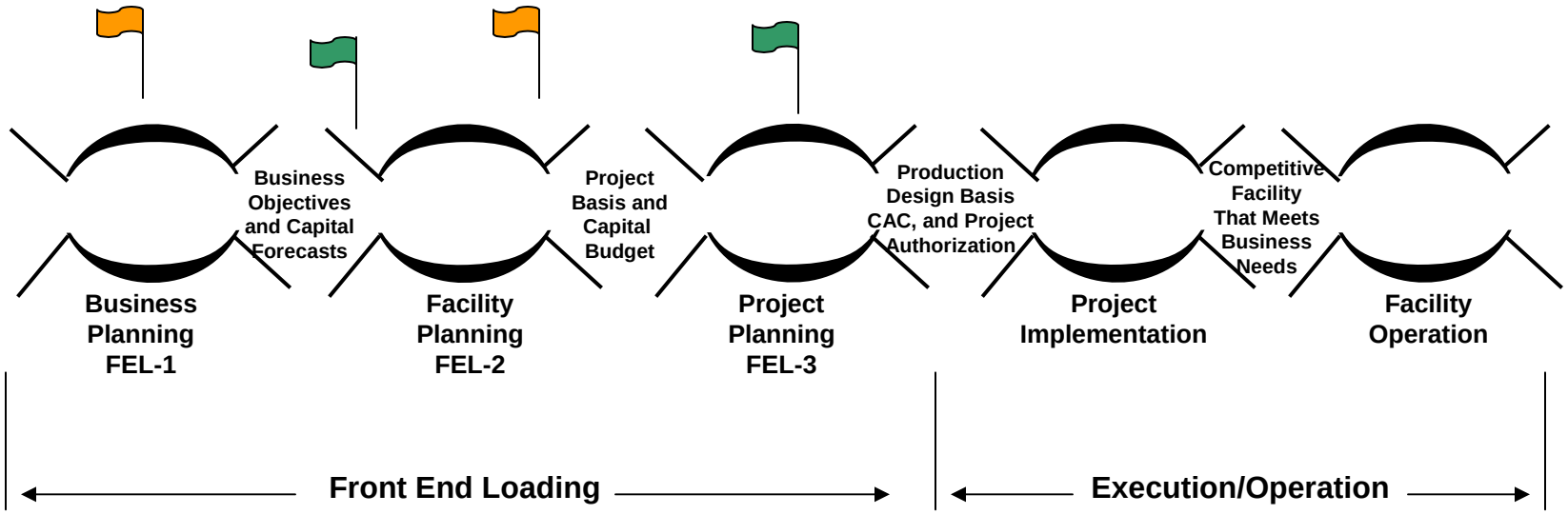
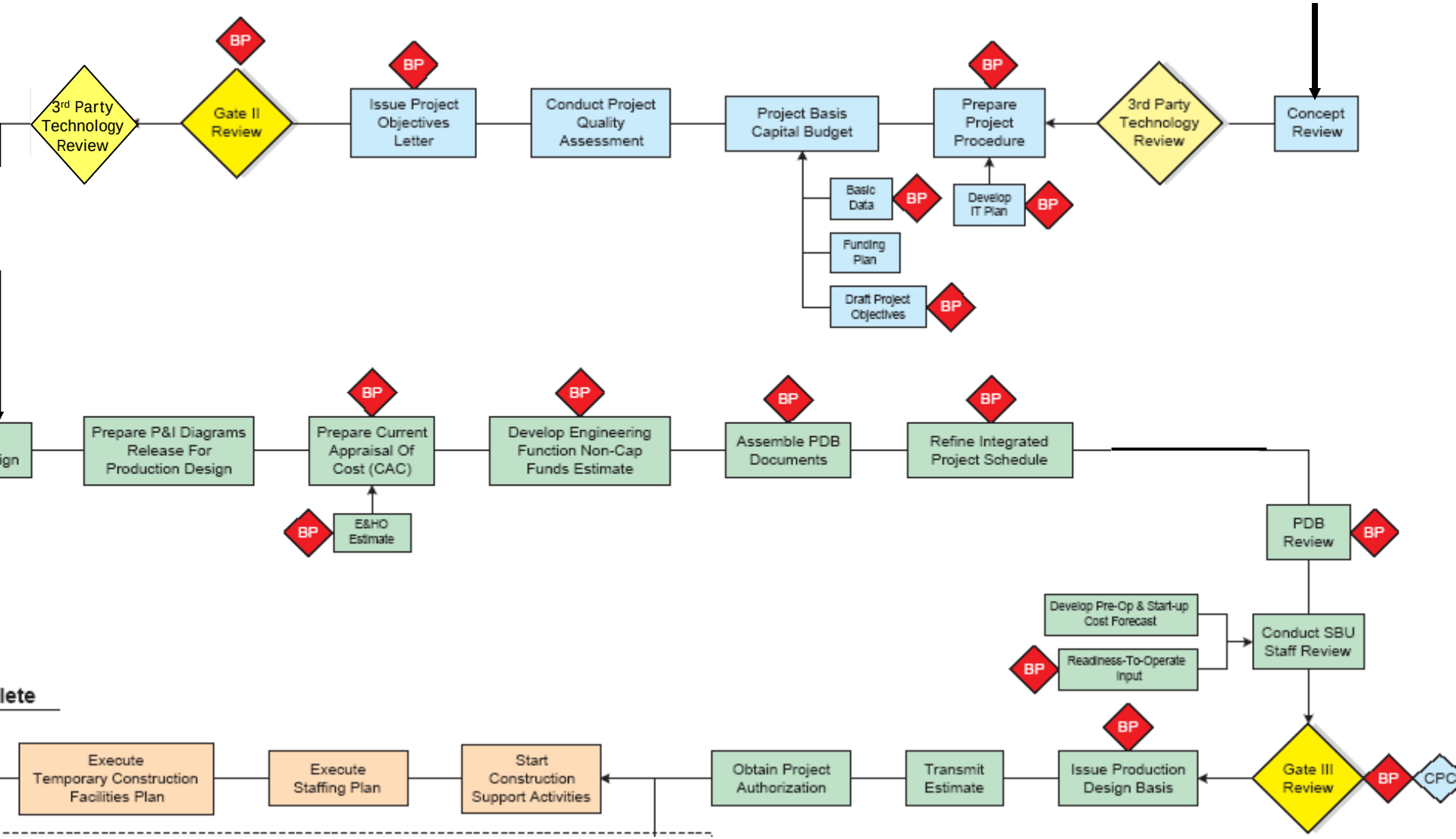
Third-Party Reviews



Minimum third-party review requirements

Additional reviews as needed for larger/more complex projects

3rd Party Review Positioning



Improving Technical Success in Projects

Third-Party Reviews

Incorporated into our project process and documentation

Audit process defined requiring formal review prior to authorization:

- **Engineering Technology Director for projects greater than $5MM**
- **Engineering VP, Chief Technology Officer for projects greater than $10MM**

Improving Technical Success in Projects

- **Typical Output**
  - **Summary report with "Likelihood of Occurrence" versus "Severity of Consequence" analysis.**
- **Typical Findings**
  - **Usually identify one or two new technical issues.**
  - **By holding reviews earlier in the commercialization process, teams have time to manage the new issues.**

Typical 3rd Party Review Ouput

Concern Number	XXX Expansion 3PR BMP 23/1212 May 9, 2006 Concerns	Business Objective Impacted	Likelihood Ranking High/Medium/ Low	Severity Ranking High/Medium/Low	Mitigation Strategy to reduce Severity and/or Liklihood
1		DCP operations	high	low	
2		shea	medium	high	
3		SHEA	low		
4		Cost	low		
5		SHEA, Capacity	medium	medium	
7		SHEA, PTO	low	high	
8		SHEA, PTO	medium	high	
9		Cost, Schedule	medium	medium	
10		Schedule	high	high	

CONCERN'S FORMAT: IF this were to happen, THEN what is the consequence

Key Roles in 3rd PR Gatekeeping

- **Central Engineering Director**
  - Ensures quality 3rd PR process is in place
  - Authorizes variance via same decision-makers
- **Business Technology Director**
  - Ensures basic data is adequate and timely
  - Initiates & justifies variance, as appropriate
  - Directs follow-up work to mitigate risk
- **Business Engineering Manager**
  - Ensures all projects follow the process
  - Ensures basic data meets needs of project
  - Schedules more reviews if technology changes

Roles & Accountability

3rd Party Review Process for New Technology Projects - RACI Diagram -

TASKS/Deliverables	PROJECT LEADER	3RD PARTY REVIEW FACILITATOR	TECHNOLOGY DIRECTOR	BUSINESS ENGINEERING MANAGER	DuET MANAGER LINK TO SBU	DuET OPERATIONS MANAGER	DuET DIRECTOR		
Gatekeeping for 3rd PR Process									
Quality process maintained in GPI, appropriately resourced			C,I	C,I	R	R	**A**		
Ensure new technology projects follow 3rdPR process	R	R	R	**A**	R	C,I	C,I		
Ensure adequate project basic data is available for 3rdPR	R		**A**	R	C,I	I	I		
or, Request for variance and documentation of basis	R		**A**	C,I	C,I	I	C,I		
Authorization of variance			C,I	C,I	R	I	**A**		
Conduct 3rd Party Reviews of New Technology Projects									
3rdPR in FEL schedule or variance requested	R	C.I	C,I	**A**	C,I	R	C,I		
Preparations completed to ensure quality review	R	**A**	C	C	R	I			
Review conducted & minutes issued	**A**	R	R	R	R	I	I		
Documentation of review, i.e. prioritized risks, followup plans	**A**	R	I	I	C,I	I	I		
Follow-up on 3rd PR Findings									
Review with business re risks & mitigation plans	**A**	C,I	C,I	C,I	C,I				
Go/no go decision on project re technical risk	R		**A**	R	C,I	I	I		
3rdPR findings to IPA - for use to set contingency, S/U timing	**A**	I	I	I	R	R			
Followup work on technology risk mitigation plans	R		**A**	C,I	C,I				
Require followup 3rdPR if change technology basis after FEL3	R		C,I	**A**	R	I	I		
Get feedback on effectiveness of 3rd PR process on project	C	I	C	C	**A**	I	I		

Improving Technical Success in Projects

Findings thus Far

Current Status

- Practice has been in place for 6 years
- Has been utilized on 70+ projects
- Business units by and large have been receptive; some enthusiastic about incorporating this into the process
- Usually find 3+ issues that require addressing
- Three projects significantly slowed/stopped once business better understood the risks.

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