ADVANCED TECHNOLOGY PROGRAM

Materials Technology Opportunities in the NIST Advanced Technology Program

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Advanced Technology Program

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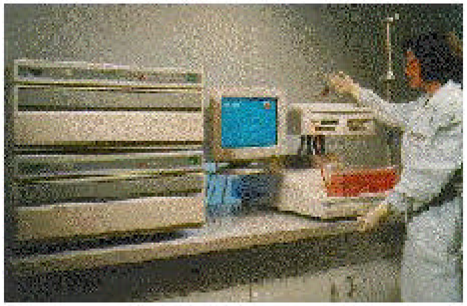
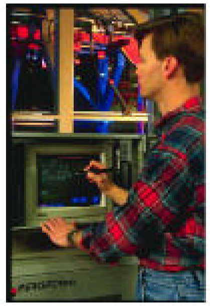
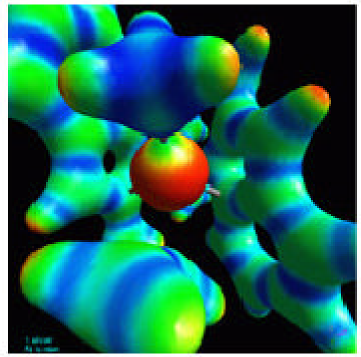
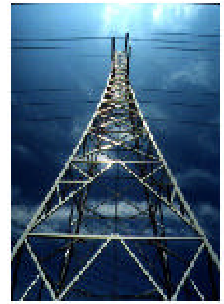
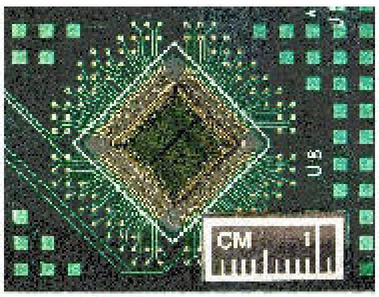
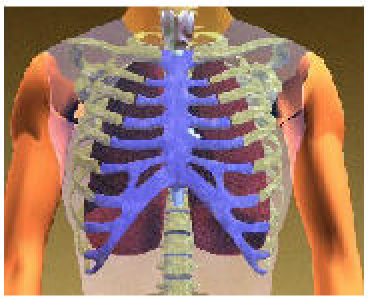
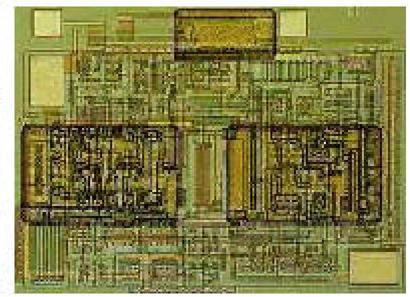
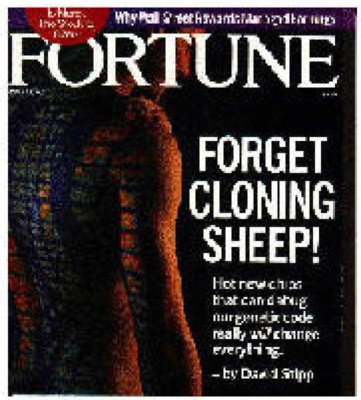
Outline

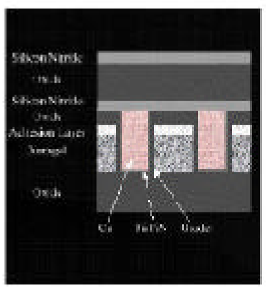
- Advanced Technology Program
  - Update
- Materials Processing
  - Engineered Surfaces
  - Innovative Forming Techniques
  - Future topics
- Opportunities for emerging technologies & applications

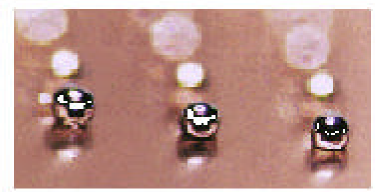
Advanced Technology Program



Bridging the Gap Between the Laboratory and the Marketplace

National Institute of Standards and Technology • Technology Administration • U.S. Department of Commerce

ATP Stimulates Industry

To tackle the R&D challenges of the 21st Century

- ATP Mission:
  - Accelerate the development of innovative technologies
  - For broad national benefit
  - Through partnerships with the private sector

Investments in Innovative Technologies

Electronics and Photonics ($329 M)

- Microelectronics
- Optoelectronics
- Optics Technologies
- Power Technologies
- Wireless Electronics
- Organic Electronics

Biotechnology ($254M)

- DNA Technologies
- Tissue Engineering
- Drug Discovery Methods
- Proteomics
- Medical Devices & Imaging
- Microfluidics

Manufacturing ($180 M)

Information Technology ($389 M)

- Advanced Learning Systems
- Component-Based Software
- Digital Video
- Information Infrastructure for Healthcare
- Electronic Commerce
- Dependable Computing Systems
- Technologies for the Integration of Manufacturing Applications

Chemistry and Materials ($344 M)

- Chemical Processing
- Sensors
- Metabolic Engineering/Catalysis
- Combinatorial Methods
- Separations/Membranes
- Materials Processing
- Advanced Materials
- Nanotechnology
- Material Interfaces

The Difference ATP Makes

- Higher risk
- Leap-frog technology
- Multiple applications
- Expanded company & national competencies
- Broad diffusion

ATP

A Decade of Innovation

- The Program is celebrating its 10th Year
- 468 projects co-funded with 1,067 participants and 1,027 subcontractors (157 Joint Ventures)
- $3 billion of advanced technology development funded
  - –ATP Share = $1.496 billion
  - –Industry Share = $1.499 billion
- Small businesses are thriving
  - –> 50% of projects led by small businesses
- More than 145 Universities participate
- Nearly 20 national laboratories participate

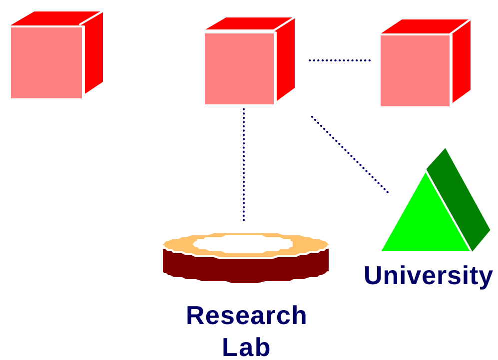
What ATP Can Do for You

- Early financial support
  - Reduced risk for R&D investment
- Research support
  - Information on assembling a JV
  - Links to additional technical resources
- Recognition
  - Leverage for additional financing
  - External validation
- Independence
  - Companies retain their intellectual property rights

ATP Eligibility

SINGLE COMPANIES

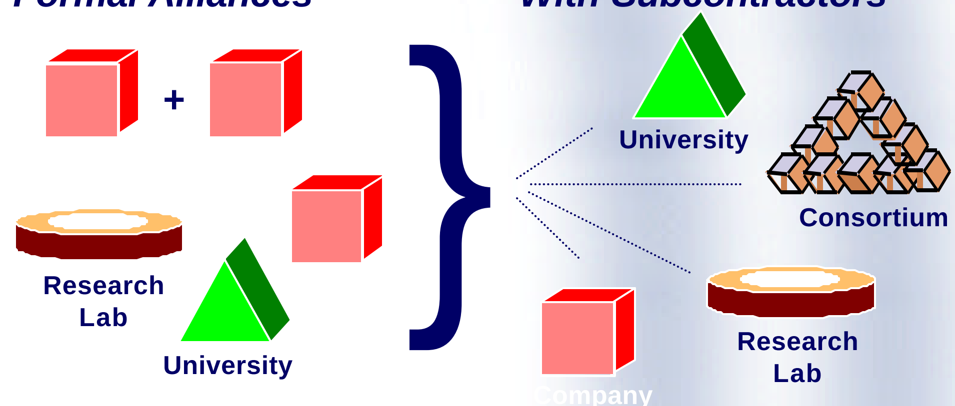
Alone *With Subcontractors*



- For-profit company
- 3-year time limit
- $2M award cap
- Company pays indirect costs
- Large companies cost share >60% of project cost

JOINT VENTURES

Formal Alliances *With Subcontractors*



- At least 2 for-profit companies
- 5-year time limit
- No limit on award amount
- Industry share >50% total cost

- Intellectual property is owned by the for-profit companies
- ATP encourages teaming arrangements - most projects involve alliances

Is ATP Right for You?

- ☑ Broad Economic Benefits to U.S.?
- ☑ Path-Changing R&D?
- ☑ ATP Necessary?

PROJECT CONCEPT

PROPOSAL TO THE ATP

Should You Apply to the ATP?

Winning involves ...

- Consistent commitment to higher-risk R&D
- Early and continuous commitment to commercialization
- Cost-sharing
- ATP cooperative agreement requirements
- Impact assessment requirements

Proposal Development the ATP Way ...

- Identify an opportunity
- Identify technical barriers to realizing the opportunity
- Relate technical barriers to specific R&D objectives
- Plan research to eliminate barriers
  - Innovative
  - Feasible
- Present details of R&D plan
  - ✓ Coherent
  - ✓ Integrated
- Develop commercialization strategy
  - Target applications
  - ✓ Plan for broader diffusion

Setting the Stage: Today's Technology

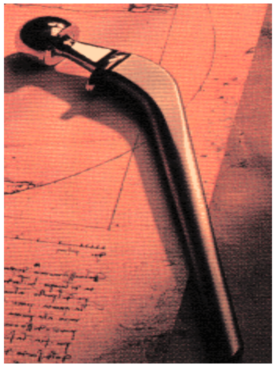
Automotive/ Construction Equipment ($359.5B)

Carburizing
Heat Treating

Power Generation ($22.6B)

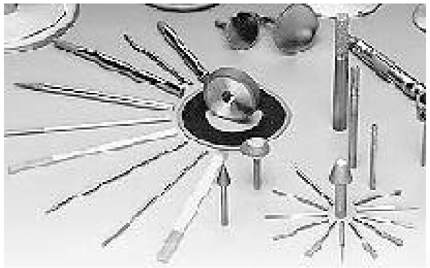
Thermal Spray
PVD

Implants ($1.9B)



PVD, CVD

Cutting Tools ($6.0B)



CVD, PVD

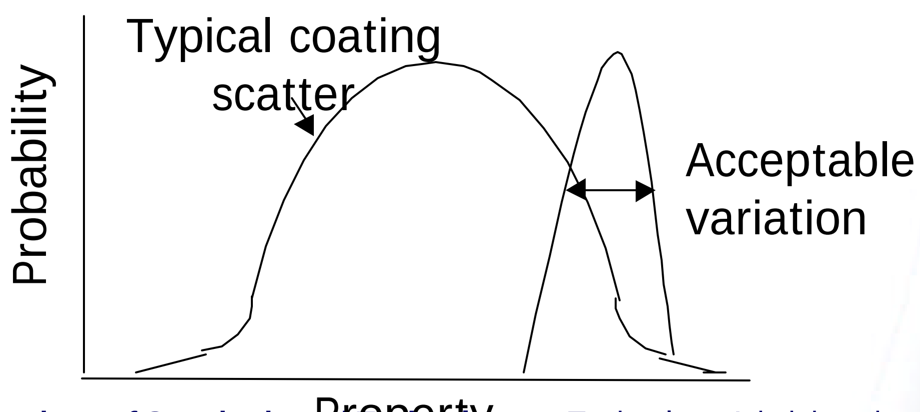
Tomorrow's Technology: Sans ATP

- Point solutions continue
  - Specific materials / design /component combinations
  - Emphasis on empirical approach
- Incremental improvements continue
  - Design, material compositions
  - Cost reduction through increased volume
- Critical applications: life enhancement continues without major change

Tools for Engineered Surfaces: Goal

Extreme Reliability & Predictability

- Predictable material system properties which allow design and reliable operation at levels significantly beyond current practice (vs. life enhancement)



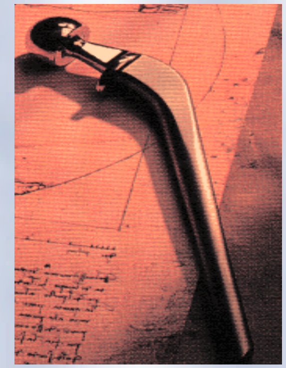
Technical Ideas

- Broadly applicable tools leading to prime reliance
  - Diagnostics for Process Development and Control
    - Example: sensors
  - Life / performance prediction
    - Example: innovative modeling and simulation; condition monitoring
  - Equipment design and development
    - Example: plasma gun models
- Validation of tool on a specific material, process, and/or component

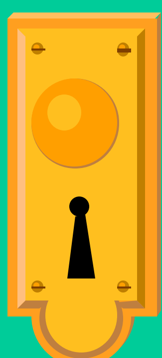
Tomorrow's Technology: The ATP Difference

Higher Power Density: Smaller gears for light weight/high payload vehicles

Longer lasting Joints

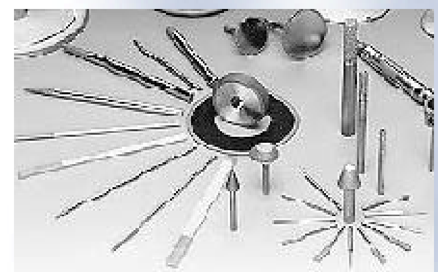


Why not today?



Reliability
Predictability
Complex shapes
Cost
Uniformity

Higher Temp Turbine Blades for Higher Efficiency Turbines

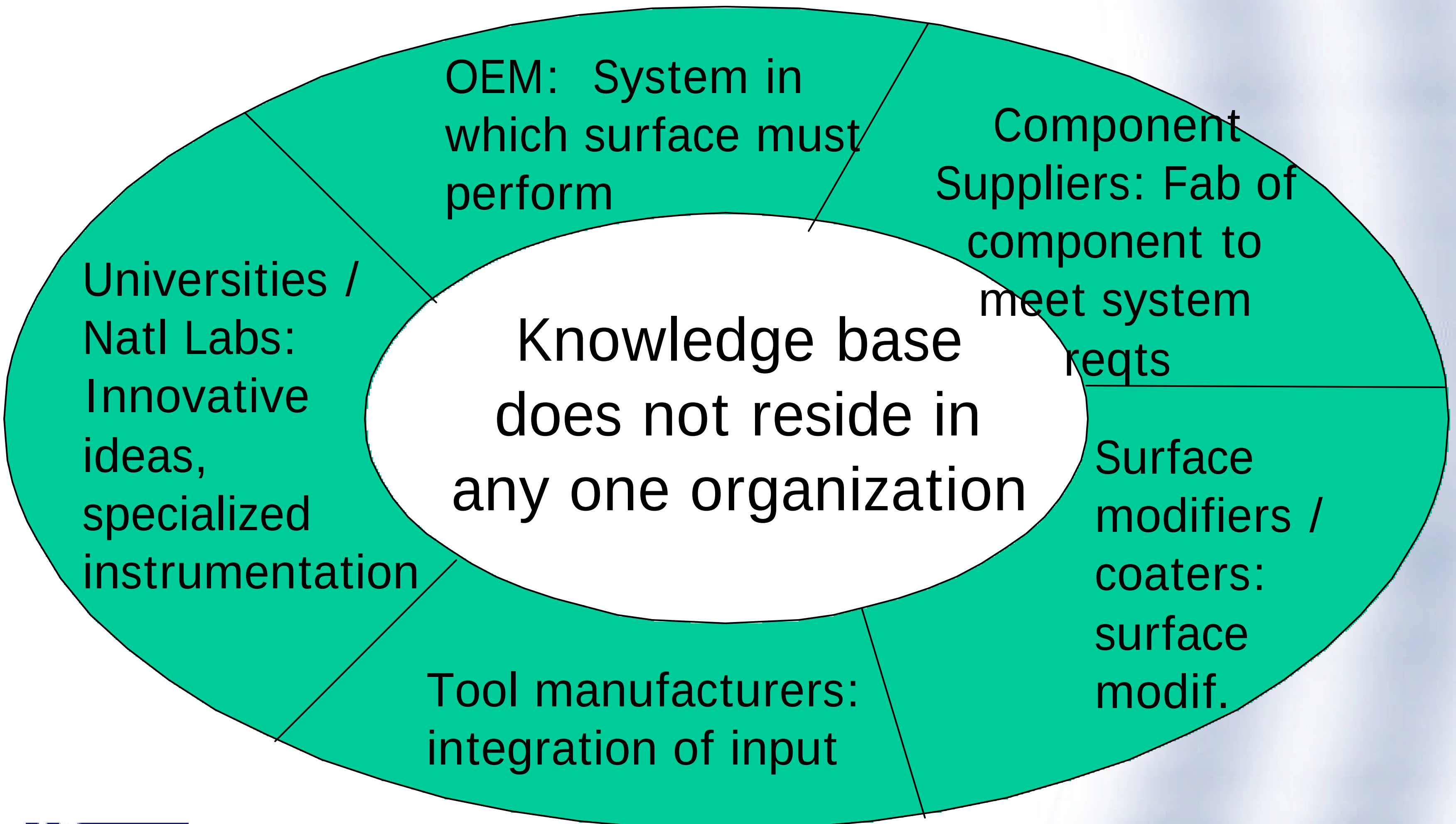


Reduced Mfg. Costs due to longer tool life

Economic Benefit of Prime Reliancy: Power Generation

- Approximately 3000 large gas turbines will be manufactured in the U.S. from 2000-2019
  - Prime reliant TBC's would increase engine efficiency by 1%
    - $15M savings in power plant operation cost
    - 3000 engines x $15M = $45B over 20 years, or **$2.25B/year**
- Thousands of small engines will see similar benefits

Why ATP?


OEM: System in which surface must perform
Component Suppliers: Fab of component to meet system reqts
Surface modifiers / coaters: surface modif.
Tool manufacturers: integration of input
Universities / Natl Labs: Innovative ideas, specialized instrumentation
Knowledge base does not reside in any one organization

ATP Awards in Engineered Surfaces

- Functionally gradient materials (3 yr/2.0M ATP/3.6M Total)
  - Caterpillar: transmissions, gear boxes
- Engineered surfaces (3 yr/$2.8M ATP/$6.5M Total)
  - Caterpillar/Timken/GM Gear: bearings, gears, fuel injection components
- Linear magnetron sputtering (3 yr/$.79M ATP/$1.2M Total)
  - Praxair: hydraulic cylinders, other internal cylindrical surfaces
- Chemical vapor deposition (3 yr/$1.8MATP/$3.6M Total)
  - Crystallume/GM/Ford/Hughes/Boeing/Rogers Tool Works: rotating cutting tools
- Intelligent processing (3 yr/$1.6M ATP / $3.3M Total)
  - GE: thermal barrier coatings for turbine blades

ATP Awards in Engineered Surfaces (cont.)

- Combinatorial chemistry (3 yr/$3.13M ATP / $6.33M Total)
  – GE: automotive and information display coatings
- Accelerated Commercialization of Diamond-Coated Round Tools and Wear Parts (2 yr/$2M ATP/$4.2M Total)
  – Norton Diamond Film and Kennametal, Inc.
- Diamond-Like Nanocomposite Technology (2 yr/$2M ATP/$3.7M Total)
  – Advanced Refractory Technologies, Inc.
- Plasma-Based Processing of Lightweight Materials for Motor-Vehicle Components and Manufacturing Applications (3 yr/$7.7M ATP/$15.544M Total)
  – Environmental Research Institute of Michigan
- Film Technologies to Replace Paint on Aircraft (5 yr/$5.2M ATP / $10.5M Total)
  – 3M

Innovative Forming Techniques (IFT)

Net-shape and near net-shape forming:

- Ceramics and their composites
- Metals and their composites
- Solid freeform fabrication / rapid prototyping

Innovative Forming Techniques: Common Themes

- Reliability
- Reproducibility
- Scalability
- Predictability
- Accuracy
- Specifiability

ATP Awards in Innovative Forming of Ceramics

- Aqueous injection molding of ceramic components (3 yr/$1.2M ATP/$2.6M total)
  - AlliedSignal Ceramic Components
- Gelcasting of ceramic components (3 yr/$2.0M ATP/$4.1M total)
  - AlliedSignal
- Intelligent process control for electroconsolidation (3 yr/$2.0M ATP/$2.4M total)
  - Superior Graphite
- Hybrid ceramic matrix composites (3 yr / $3.55M ATP / $7.24M Total)
  - Siemens-Westinghouse/Solar Turbines/Engineered Ceramics Inc.

ATP Awards in Innovative Forming of Metals

- Die casting neural network advisor
- Rapid solidification powder metallurgy for high-Nitrogen stainless steels
- Intelligent process control for electroconsolidation
- Nanoencapsulated powder metallurgy
- Casting technology for large superalloy castings for industrial applications
- Low cost investment cast technology for microturbines

ATP Awards in Innovative Forming of Metals (cont.)

- 3D Printing Process for direct fabrication of automotive tooling for lost foam castings
- Cost-effective blade manufacturing through transient liquid phase bonding
- Low-cost, near-net shape Aluminum casting for processes for automotive and truck components
- Cost-effective, near net-shape, superalloy forgings for power generation

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The Future

- Open Solicitation Likely
- Engineered Surfaces
  - Workshop: Nov 15-16 (San Jose, CA)
- Innovative Forming Techniques
  - Workshop: Nov 16-17 (San Jose, CA)
- Need more information
  - Clare Allocca, Program Manager
    - 301-975-4359, clare.allocca@nist.gov
  - Website: www.atp.nist.gov

Supporting Slides

ATP Alliance Network Website

- (new!) Anonymously look for R&D partners through the ATP Collaboration Bulletin Board
- (new!) List-serve about R&D alliances
- (new!) University and non-profit participation in ATP projects
- Advantages of collaborative R&D through an ATP award
- Administrative guide for ATP Joint Ventures

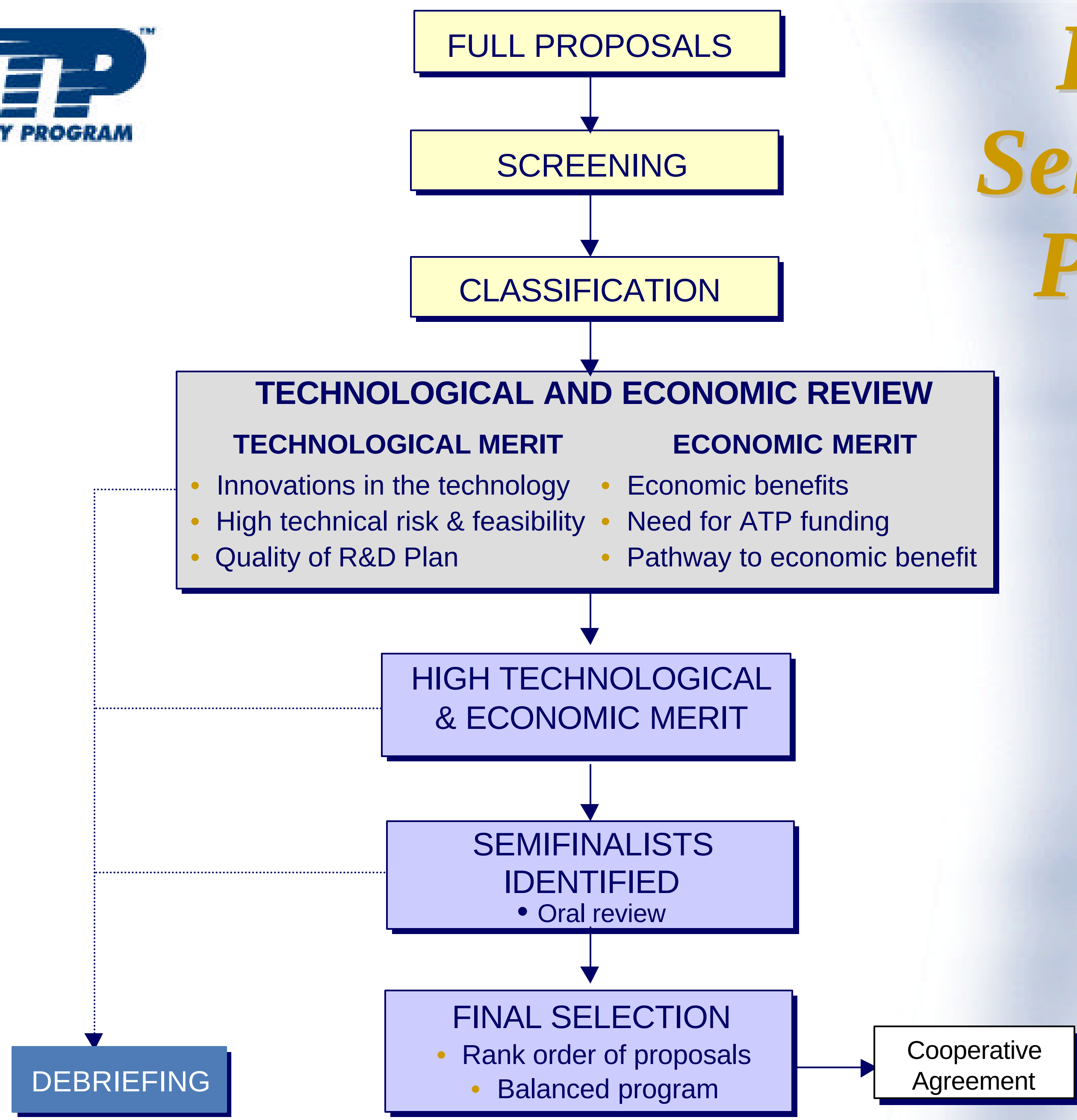
www.atp.nist.gov/alliance

Pre-Proposals

Year-round submission ...

- Written feedback in approximately 2 weeks
- Pre-proposals can be submitted twice
- 4 pages plus cover
- 5 questions on technical and economic merit

Project Selection Process



ATP Criteria

Critical Elements of a Proposal ...

- **Scientific and Technological Merit (50%)**
  - ✓ Innovations in the Technology
  - ✓ High Technical Risk & Feasibility
  - ✓ Quality of R&D Plan
- **Broad-Based Economic Benefits (50%)**
  - ✓ Economic Benefits
  - ✓ Need for ATP Funding
  - ✓ Pathway to Economic Benefits

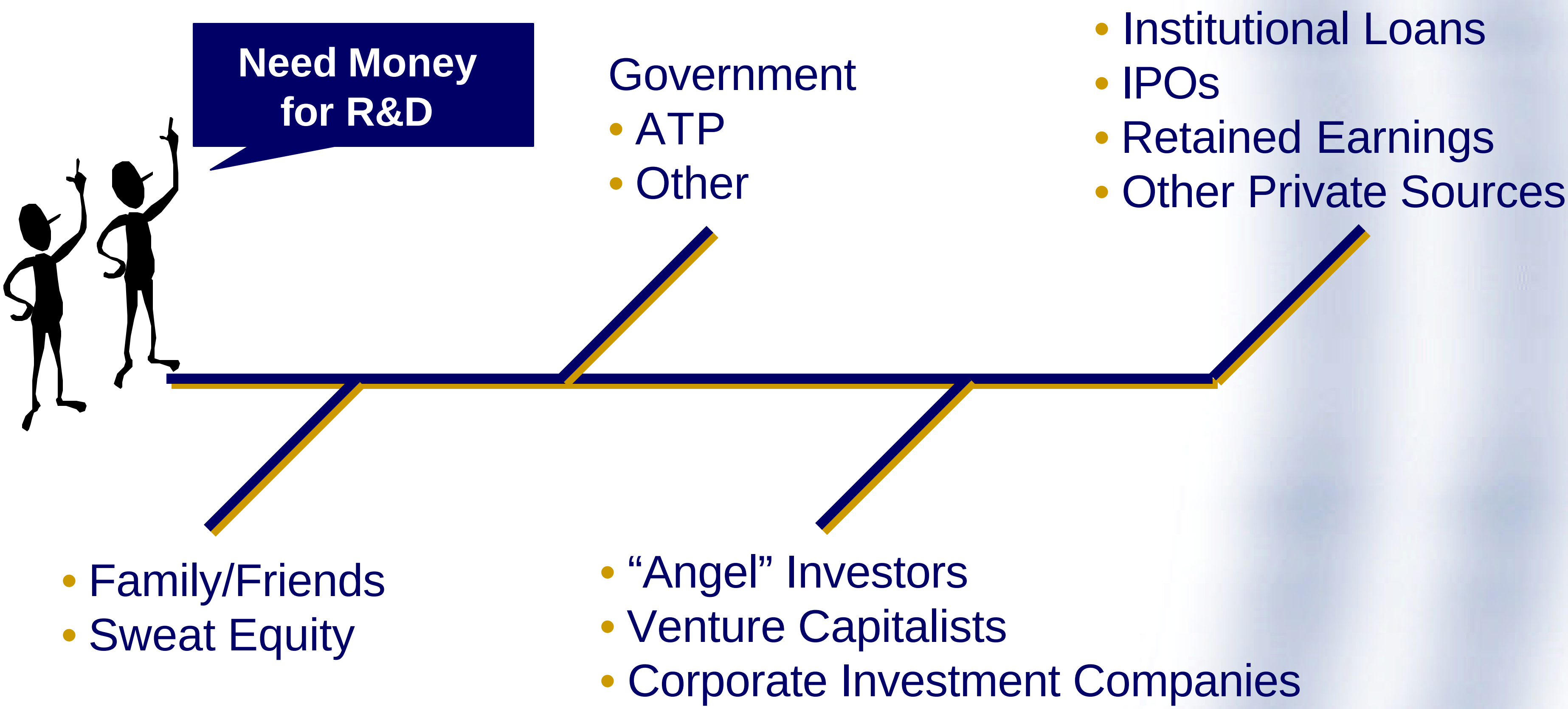
Need for ATP Funding

What difference will ATP make?

- Broader scale of R&D?
- Broader scope of R&D?
- Increased speed of R&D?
- Expanded collaborative efforts?

Need for ATP Funding

Why is ATP Funding Needed?



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Scientific and Technological Merit

- Innovation
- High Technical Risk
- R&D Plan

Path Changing R&D

Innovation

- R&D Goals or Technical Approach
  - Comparison to state of the art
  - Unique with respect to current practice
  - Quantifiable objectives
  - Key technical barriers
  - Key innovations
- Technical leverage
  - Impact on knowledge base
  - Impact on other areas and applications

Innovation: R&D Goals or Technical Approach

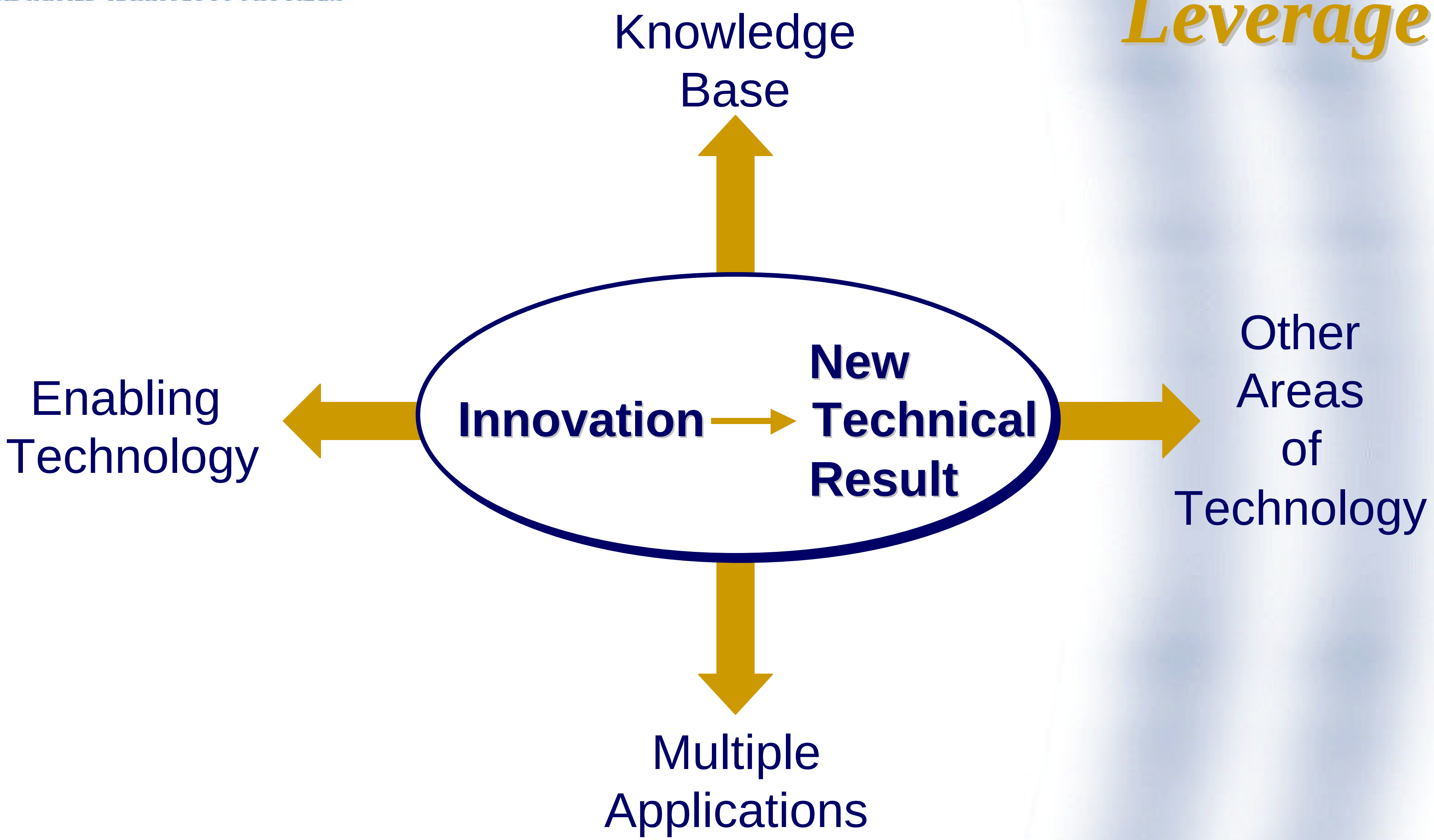
What are the objectives?
What innovation is needed? Why?

Quantifiable Objectives for New Technology

Your Innovation

Baseline: State of the Art Today

Innovation: Technical Leverage



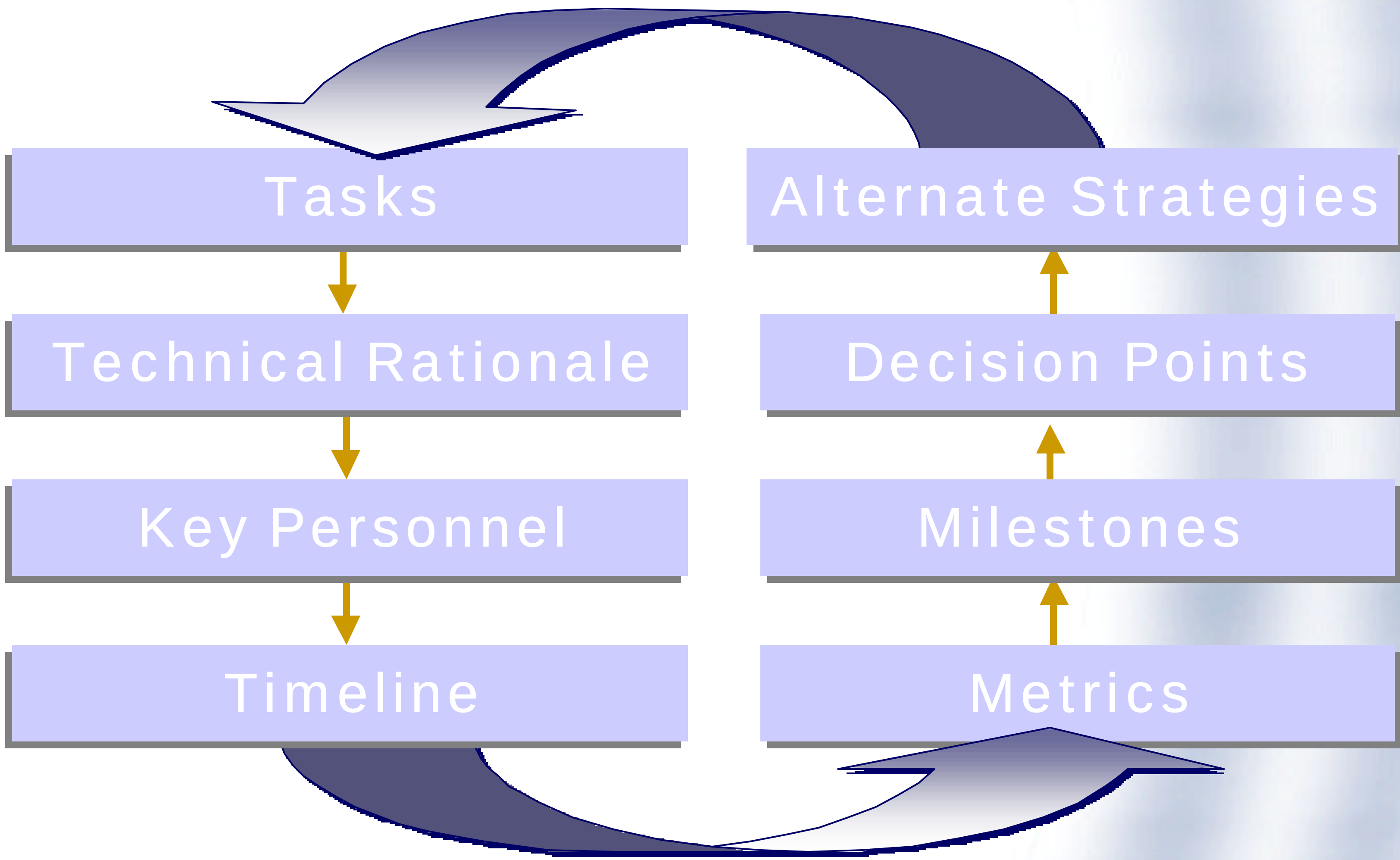
High Technical Risk and Feasibility

Technical Risk:
- Technical challenges
- Significant uncertainty of success
- Risky innovation or integration

Potential Payoff:
- Dramatic change in future direction of technology

Feasibility: Sound Scientific Foundation

Research Activities



R&D Plan

Implementation

- Cross-disciplinary team
- Team strategies and communications
- Technical experience/qualifications
- Budget matches plan
- Major task timeline
- Go / No-Go decisions
- Contingencies

Common Proposal Weaknesses

- Lack of sufficient detail for peer review
  - How you will reach technical objectives
  - What's innovative about the approach
  - Why a risky technical approach is needed
- Unsupported assertions that project meets ATP's criteria
- Misses ATP's niche
  - Low risk - product development, good engineering practice
  - Lacks demonstrated feasibility - Basic research