ABOR Research & Health Sciences Committee
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Senior Vice President for Research and Innovation
FY2022-26 TRIF investment will enable us to position Arizona as The Resilient State, capable of dealing with any threat and successfully operating through any challenge. Through TRIF, we will:

- Help create an agile state economy
- Produce a workforce that stays in Arizona and can adapt and acclimatize to any challenge
- Support a healthy entrepreneurial ecosystem
- Continue to develop the technical prowess, innovation, and discovery contained within the University of Arizona
TRIF FY2017-21 Impact & Expenditures

Total Expenditures by Initiative

- National Security Systems: 15%
- Improving Health: 39%
- Water, Environmental, Energy Solutions: 21%
- Space Exploration & Optical Solutions: 25%

Annual Expenditures by Initiative (in millions)

- FY 2017
  - National Security Systems: 15%
  - Water, Environmental, Energy Solutions: 24%
  - Space Exploration & Optical Solutions: 20%
  - Improving Health: 19%

- FY 2018
  - National Security Systems: 19%
  - Water, Environmental, Energy Solutions: 22%
  - Space Exploration & Optical Solutions: 15%
  - Improving Health: 21%

- FY 2019
  - National Security Systems: 20%
  - Water, Environmental, Energy Solutions: 21%
  - Space Exploration & Optical Solutions: 19%
  - Improving Health: 24%

- FY 2020
  - National Security Systems: 22%
  - Water, Environmental, Energy Solutions: 19%
  - Space Exploration & Optical Solutions: 15%
  - Improving Health: 21%

- FY 2021 (proj)
  - National Security Systems: 23%
  - Water, Environmental, Energy Solutions: 18%
  - Space Exploration & Optical Solutions: 15%
  - Improving Health: 24%
Initiative Overview of the FY2022-26 Focus Areas

Health Futures
- Wearable technologies and therapeutics
- Pandemic prediction, prevention, and preparedness
- Non-invasive imaging
- Therapies for age-related and neurodegenerative diseases

Resilience Science and Technology
- Vertical Farming
- Environment-health continuum
- Advancements and commercialization in energy-efficient water reuse and expanded wastewater epidemiology
- Climate and energy forecasting

Space Exploration and Optical Sciences
- Completion of future observing campaigns of the Event Horizon Telescope
- QISE systems engineering
- Underlying optical technologies

Health Futures
- Completion of future observing campaigns of the Event Horizon Telescope
- QISE systems engineering
- Underlying optical technologies

Access and Workforce Development
- Experiential, hands-on learning
- Partner with Arizona FORGE
- Increased recruitment from K-12 and Arizona community colleges
- Development of a mentoring program

National Security Systems
- Countermeasures and solutions
- Advances in human-computer interaction
- Advanced communications
- Development of energy systems

Innovative Technology for the Fourth Industrial Revolution
- Cyber-physical systems applications
- Continued aggregation of AR/VR, advanced materials, robotics
- Development of new approaches to AI
Solving Arizona Challenges: Health Futures

FY2017-21: Improving Health
COVID-19: How TRIF Investments Allowed Us to Pivot
- Key faculty supported (immunology, virology, epidemiology)
- Infrastructure supported (BSL3, labs, cores)
- Rapid turnaround seed grants
- 250-member collaborative faculty research working group
- $53M in new awards in one year targeting COVID-19
- $300M in new bids

FY2022-26
Aging Resilience: TRIF Will Enable Solutions to
- Understand the processes of normal and healthy aging
- Determine the causes of age-related diseases
- Develop and test drugs, devices, and behavioral interventions to minimize handicap and disease
- Maximize functionality and independence for a higher quality of life
- Make new discoveries related to the role of microbes in human health and disease
Solving Arizona Challenges: Space Exploration & Optical Sciences

FY2017-21: Space Exploration & Optical Solutions
Defining the Future Quantum Internet: TRIF Investments Drive a New Field

- Key faculty support (optics, engineering, law, business)
- Infrastructure support
- Grand Challenge seed grants
- ~$58M in new awards
- Results include the new Center for Quantum Networks (CQN), a 10-year, $50M NSF Engineering Research Center
- ~$100M in new bids

FY2022-26
UASI: How TRIF Will Enable Competition & Growth

- Allow us to develop common infrastructure for space exploration and optical science to truly scale our ability to compete
- Recent commercialization of the space sector – New Space – opened the door for new companies, technologies and partnerships with industry
- The future of space science is integrative, outcomes-driven, and executed through complex partnerships

- As of today, major bids planned:
  • 13 in FY21
  • 7 in FY22
  • 8 in FY23
  • 6 in FY24
Solving Arizona Challenges: National Security Systems

FY2017-21: National Security Systems
Space Situational Awareness: Adapting Space and Optical Science Prowess to National Security Missions
- Helped hire and start up critical laboratories in SSA
- Provided early support toward design and proof of concept for a multi-national satellite tracking system
- Federally funded follow-on research enabled successful ‘dead’ satellite track and build out of integrated global data system and ground monitoring capabilities
- $3.3M AFRL agreement
- ~$83M in new bids

FY2022-26
Resilient and Adaptive Cyber Capabilities
- Using the tools of the 4th Industrial Revolution to overcome ‘blind spots’ in our cyber defenses, and to assist Ft. Huachuca and other DoD stakeholders adapt, isolate, and heal at the speed of light
- Develop models to anticipate potential second- and third-order effects of system and data breaches in the cyber domain
- Create greater awareness in UArizona faculty of defense capabilities, interests, and needs, allowing them to propose more responsive solutions that can be built in Arizona
- Create an early connection to a technically competent and security-aware pipeline of talent
Solving Arizona Challenges: Resilience Science

FY2017-21: Water, Environmental & Energy Solutions
TRIF-driven Science-based Solutions to Arizona’s Water Challenges
- Key faculty supported
- Rapid turnaround seed grants, equipment, and lab grants
- Engaged >400 faculty in collaborative research
- ~$213M in new bids
- April 2020: Formation of the Arizona Institutes for Resilience, first of its kind in the US

FY2022-26
TRIF-Enabled Pivot to Prepare for Future Pandemics
- Build on wastewater successes of the Water & Energy Sustainable Technology (WEST) Center
- Integrate WEST into new center: CGAPS Collaborative Global Adaptive Pandemic Solutions
- Develop new technology to predict future pandemics
  - Shotgun viral metagenomics to detect new viral strains
  - WBE for advance detection of new viruses including SARS-CoV-2 variants
- Develop new technologies to defeat any new virus
- Innovative smart disinfectants
  - Virus inactivating materials for ventilation fabrics
  - Real-time detection of human pathogenic viruses via microfluidics and smart phone technology

Courtesy of John Taylor and Carter Hayek
Solving Arizona Challenges: Access & Workforce Development

FY2022-26

- We are expanding access to research experiences for undergraduates by 2x over where they are today
- We are creating course-based undergraduate research experiences (CUREs) to develop research skills
- We are developing programs to pair students with companies for skills development and project-based learning
- A minimum of 15 new CUREs will be developed by summer 2022; each will involve 25 students for a minimum of 375
- Other priority areas for investment:
  - raising pre-college and community college awareness of/interest in research
  - developing inclusive mentor training
Solving Arizona Challenges: Innovative Technology for the 4th Industrial Revolution

FY2022-26

- We are focusing these expenditures at the intersection of biology, engineering, and computers

- Our priorities for investment include:
  - Internet of Things
  - Data analytics
  - Cyber-physical systems (enabling autonomous systems)
  - Advanced manufacturing
  - Artificial intelligence

- An example is a new large-scale research focus on neuromodulatory medical devices for pain and addiction

- This team is made up of faculty from the Colleges of Engineering, Science, Optical Sciences, Social & Behavioral Sciences, Management, and Medicine
Enhancing Arizona’s Entrepreneurial Ecosystem: Tech Transfer

Since FY2014
- TRIF funding of ~$3M/year, covering portions of patent costs and asset development
- UArizona startups launched by TLA had an economic impact on Arizona of more than $500M, creating over 5,000 jobs and producing more than $25M in state and local taxes between 2016 and 2018
- Examples include SinfoniaRx and Neuro-ID
- Exclusive licenses have far reaching impact:
  - Tri-focal lens developed in the College of Optical Sciences, incorporated into vision health giant Alcon’s novel trifocal intraocular lens, PanOptix

FY2022-26
- TRIF funding remains a critical aspect of operations, allowing protection of vital intellectual property and investment in advancing nascent technology to a point of commercial interest
- Patent costs will continue to rise, with hundreds of new patents filed every year, and issued patents approaching 100/year
- TLA vets patent investments, keeping us among the lowest spent on patents vs. research expenditures, but among the top five universities in our peer group for startups launched and licenses executed, and rising in the ranks for license revenue
Solving Arizona Challenges

- Innovative Tech for 4th IR: 18%
- Access and Workforce Development: 2.5%
- Space Exploration and Optical Sciences: 16%
- National Security Systems: 16%
- Resilience Science: 16%
- Health Futures: 20.5%
- Tech Transfer: 11%
Projecting Research Growth

HERD by Select Discipline 2011-2021

Proposal size v. Expenditures

Industrial Engagement in Research
Thank you

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Backup Slides

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Solving Arizona Challenges: Health Futures

FY2017-21 Successes

- ~$10M per year invested
- Recruited 35 leading faculty members
- Secured $423M in grants/contracts (ROI of ~8X)
- Spun out 11 companies
- Issued 53 patents
- Undergrad/grad/postdocs supported: 2,885/2,461/810
- Close clinical trial partnerships with the Banner Health Network

Pivot FY2022-26:

Key Investment Criteria:
- Focus on translational science at the intersection of biology, medicine, engineering
- State-of-the-art facilities
- Target interdisciplinary faculty support
- High-risk, high-reward seed grants
- Focus on synergizing around Grand Challenges, including infectious disease, aging, precision medicine, health technologies
- Expand workforce development programs
- Increase engagement with industry

Measures of Success:
- National funding, to study the interactions between aging brain and aging body in health and diseases
- Development of therapeutics to target age-related diseases
- Innovations in brain science that lead to precision therapeutic treatments for neurodegenerative diseases
- Use of big data and meta-omics to develop individualized treatment
- Development of accurate, rapid, and inexpensive tests for infectious diseases
- Trials to show effect of potential therapies for respiratory illnesses
- Obtain a Clinical and Translational Science Award with partners across Arizona
- Expand clinical trials
- Increased industry engagement with faculty and students
- Increase in technology transfer activities in sensors and imaging technology
- New funding to study wearable technology, home health, and telemedicine
- Increased number of well-trained personnel from bachelors to doctoral levels available to work with and/or be hired by our Arizona biosciences industry
Solving Arizona Challenges: Space Exploration & Optical Sciences

FY2017-21 Successes

- ~$7M per year invested
- Recruited 19 leading faculty members
- Secured $388M in grants/contracts (ROI of 11X)
- Spun out 25 companies
- Issued 69 patents
- Undergrad/grad/postdocs supported: 190/450/111
- Leveraged additional $20M per year for astronomy

Pivot to FY2022-26

Key Investment Criteria:
- Focus on large, complex proposal opportunities that drive workforce and startups that will stay in Arizona
- Focus on higher “hit rates” – compete more effectively
- Create state-of-the-art facilities – example, Applied Research Building
- Scale up seed grant programs and involve students at all levels
- Increase engagement with industry – seek to drive entirely new markets

Measures of Success:
- UASI: projected to produce more than a 20x ROI, including growth in the number of multi-million-dollar spacecraft mission and instrument contracts and an increased number of positions in a highly skilled workforce capable of designing, building, and operating spacecraft hardware and missions
- Facilities for astronomical research: will result in more than 700% ROI, through external funding, on the funds provided to support and upgrade our facilities
- Quantum initiative: will produce more than a 10x ROI through establishing applications-driven collaborative research teams
  - Will generate large amount of new IP
- Generate ~3 new startups per year
Solving Arizona Challenges: National Security Systems

FY2017-21 Successes

- ~ $4M per year invested (total ~$21M)
- Recruited 15 leading faculty members
- Secured over $20M in grants/contracts
- Resulted in 19 invention disclosures, 6 licenses/options, 1 startup
- Undergrads/grad students/postdocs supported: 126/148/36

Pivot to FY2022-26

Key Investment Criteria:
- Competitively awarded
  - Contributes directly to DoD, DHS, or Intel mission(s)
  - Includes undergraduate research experiences
  - Directly supports Ft. Huachuca or other Arizona DoD installations
  - Must include development of externally funded proposal(s)
  - Strong emphasis on proof of principle and prototype development

Measures of Success:
- Develops integration-ready solutions across DoD, DHS, or Intel systems-of-systems
- Develops a highly skilled workforce
- Makes substantial progress in fundamental materials development, testing, and evaluation
- Develops countermeasures and solutions to phishing, ransomware, advanced persistent threat, and more subtle attack mechanisms
- Delivers techniques, software, and improved instruction in methods to ensure the safe and continuous operation of threatened systems
- Reduces errors in the use of our defense systems, reduces training burden as users transition to new systems, and reduces human stress in the use of these systems
Solving Arizona Challenges: Resilience Science

FY2017-21 Successes

- ~$6M per year invested (total ~$31M)
- Recruited 14 leading faculty members
- Secured over $165M in grants/contracts (ROI of ~5X)
- Resulted in 84 invention disclosures and 2 startups
- Issued 12 patents
- Undergrad/grad/postdoc supported: 580/996/238

Pivot to FY2022-26

Key Investment Criteria:
- Position UArizona for rapid response to federal initiatives in rebuilding infrastructure, job creation, renewable energy, and climate adaptation
- Focus on relationship among the natural environment, the built environment, and public health to address pandemics
- Nurture relationship with DoD for facility resilience
- Work with Indigenous leaders to supply science-based FEWS solutions and technologies

Measures of Success:
- Become globally recognized as the place for science-based resilience solutions and educational opportunities
- Solve the extreme energy-water-food challenges on Arizona tribal lands
- Secure >$300M in external grants and philanthropic gifts
- Formation of new partnerships with industry, communities, and government, including water managers and policymakers
- Formulation of policy or decisions influenced by university-community partnerships
- Development of new forecasting and threat warning and evaluation tools
- Increased opportunities for resilience-focused experiential learning and training for students through courses and internships
- Establishment of a new Hydroclimate Modeling Center
# Solving Arizona Challenges: Access & Workforce Development, FY2022-26

## Key Investment Criteria:
- Prioritize opportunities for the broad spectrum of learners who enter UArizona but often are underprepared for post-secondary study in the STEM fields that lead to research careers
- Address barriers to an academic career in STEM and the high-tech workforce pipeline
- Connect students to degree programs and research that will allow them to return to their own communities with the skills and knowledge necessary to help address the most relevant and urgent grand social, scientific, and technological challenges
- Leverage and support UArizona programs and infrastructure that expand awareness, interest, preparedness, and participation in research and research-rich experiences
- Paid experiential learning opportunities for undergraduate and graduate student researchers
- Professional development and mentoring opportunities to support research teams

## Measures of Success:
- Increased transfer and retention of community college students in STEM to graduation
- Increased diversity and representation among UArizona students who have access to research experiences and research-rich curriculum
- Increased number of research-rich courses and other research opportunities targeted to first- and second-year students
- Increased number of awarded proposals that incorporate scaled-up research experiences in their education plans
- Overall increased retention in STEM of underserved and underrepresented students
- Overall increased enrollment in graduate research programs among historically underserved and underrepresented students necessary to realize Arizona’s workforce challenges
- More underrepresented students persist year-to-year in research-intensive fields, developing the skills to succeed in the high-tech workforce
- Increased number of faculty and staff trained in research mentoring
Solving Arizona Challenges: Innovative Technology for the 4th IR, FY2022-26

Key Investment Criteria:

- Focus on investigating and developing technologies that address unmet needs and Grand Challenges
- Multidisciplinary and inclusive of multiple colleges, including ENGR, COM, COM-P, CALS, COS, CAST, CAPLA, Optical Sciences, Management, Law, SBS, and Vet Med
- Supportive of state-of-the-art facilities
- Raise extramural funding competitiveness of best research across the University
- Synergistic with other thrust areas like Health Futures, when appropriate/possible
- Increase engagement with industry
- Expand workforce development programs, especially in STEM and particularly those that focus on underserved, diverse, and/or disadvantaged populations
- Evolve the entrepreneurial ecosystem toward investable technologies and startups with high potential for commercialization, outside investment, job creation, and economic development in the region

Measures of Success:

- Increased funding and scholarly output
- Increased number, size, and scope of both industry and government partnerships
- Expand base of sponsors of 4IR-related research beyond NSF
- Growth in the number of investigators and colleges engaged in 4IR-related research
- Development of new research centers of excellence with federal center support
- Creation of intellectual property in all research focus areas of 4IR
- Increased outside investment in UA startups
- Increased licensing of UArizona IP
- Integration with other thrust areas like digital health technologies
- Greater participation of undergrad STEM students in on-campus research, co-op, internships, and co-curricular programs in entrepreneurship