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# *Scientific Collaboratories: Challenges & Solutions*

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# *Recent & Ongoing Projects*

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- Understanding collaboration in command & control
- ➔ • Designing & evaluating the nanoManipulator Collaboratory System
- ➔ • Facilitating collaboration in a distributed science center
- Exploring the potential of 3D telepresence technology for collaboration in emergency medical care
- Investigating new forms of collaboration in library and information science
  - Among practitioners
  - Among practitioners & researchers

# *Facilitating Collaboration*

## In a Distributed Science Center

- Background of center
- Research conducted
  - Collaboration in the large
  - Center re-organization
  - Collaboration in the small
  - Collaboration among different types of universities
  - Theory development
- Personal reflections



# 'Green Chemistry' Center

- Created late 1999
  - 5 year initial commitment + additional 5 years
  - \$15 million from national scientific funding agency
  - Financial commitments from universities, foundations, & corporations
- Membership
  - Yr 1: 30 scientists, 82 students, 3 full-time staff
  - 77% had *never* interacted previously
  - Yr 2: 45 scientists, 70 students, 3 full-time staff
- Location
  - 4 universities in the US; later 5
  - 3 within same state

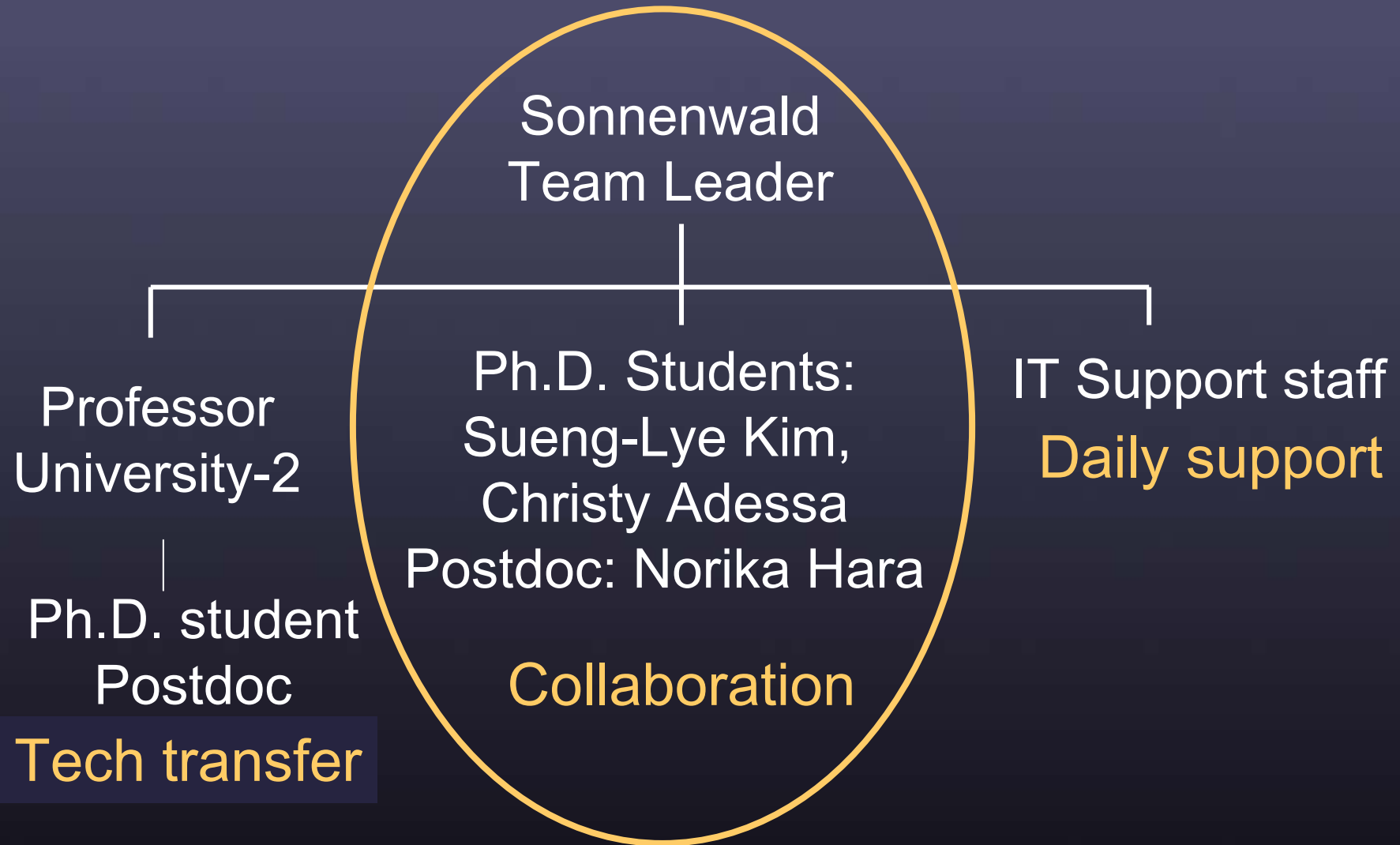
# *Foundation for Our Participation*

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- Previous study on collaboration
- National report: Centers' barriers to development
  - “Inadequate communication between industry, government & academia”
  - “Collaboration problems between the disparate cultures of scientists & engineers”
  - “Need greater engineering creativity”
  - “Lack of new chemistries”

# Social Science Team



# Collaboration Research Focus



To identify organizational, social & technical factors & processes which facilitate and/or impede collaboration across disciplinary, organizational & geographic boundaries

# *Collaboration in the Large*

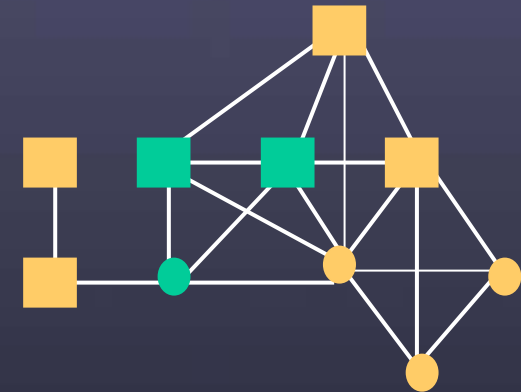
- Need for center-wide meetings across universities
- Created the social and technical video-conferencing infrastructure
- Installed new video-conferencing technology
- Established new operational procedures with technical staff at all universities
  - Operations paradigm shift
- Developed new meeting practices
  - Explicitly re-introduced informality
  - Technical problem-solving protocol
- Reconciled meetings with university structures





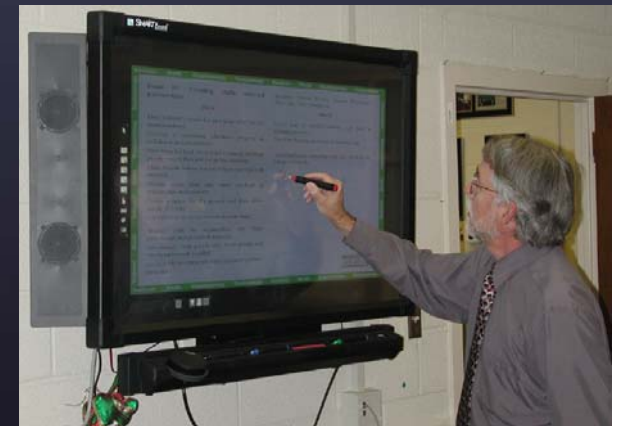
# Center Reorganization

- Year 1: Research groups not working well, but why?
- Social network analysis
  - Mapped center interaction patterns
  - 75% of all current interaction occurring outside formal groups
- Re-thinking of scientific vision, goals & group structure
  - 75% interaction within formal group structure
- Monitored the evolution of the center's social network
- Discovered & documented factors that lead to emergence of collaboration



# Collaboration in the Small

- Supporting collaboration between small, remote groups
  - Large plasma screens with Smartboard overlay
  - Speakerphone & video over the Internet
  - Turn-key setup
- Relative advantages
  - New possibility of capturing outcomes of meetings
  - Savings on travel & parking time
- Patterns of use
  - Watching basketball games....
  - Students helped others
  - Creative uses emerged over time
- Technology enhanced existing collaborations
  - Did not cause collaborations to start



# *HBU-Research University Collaboration*

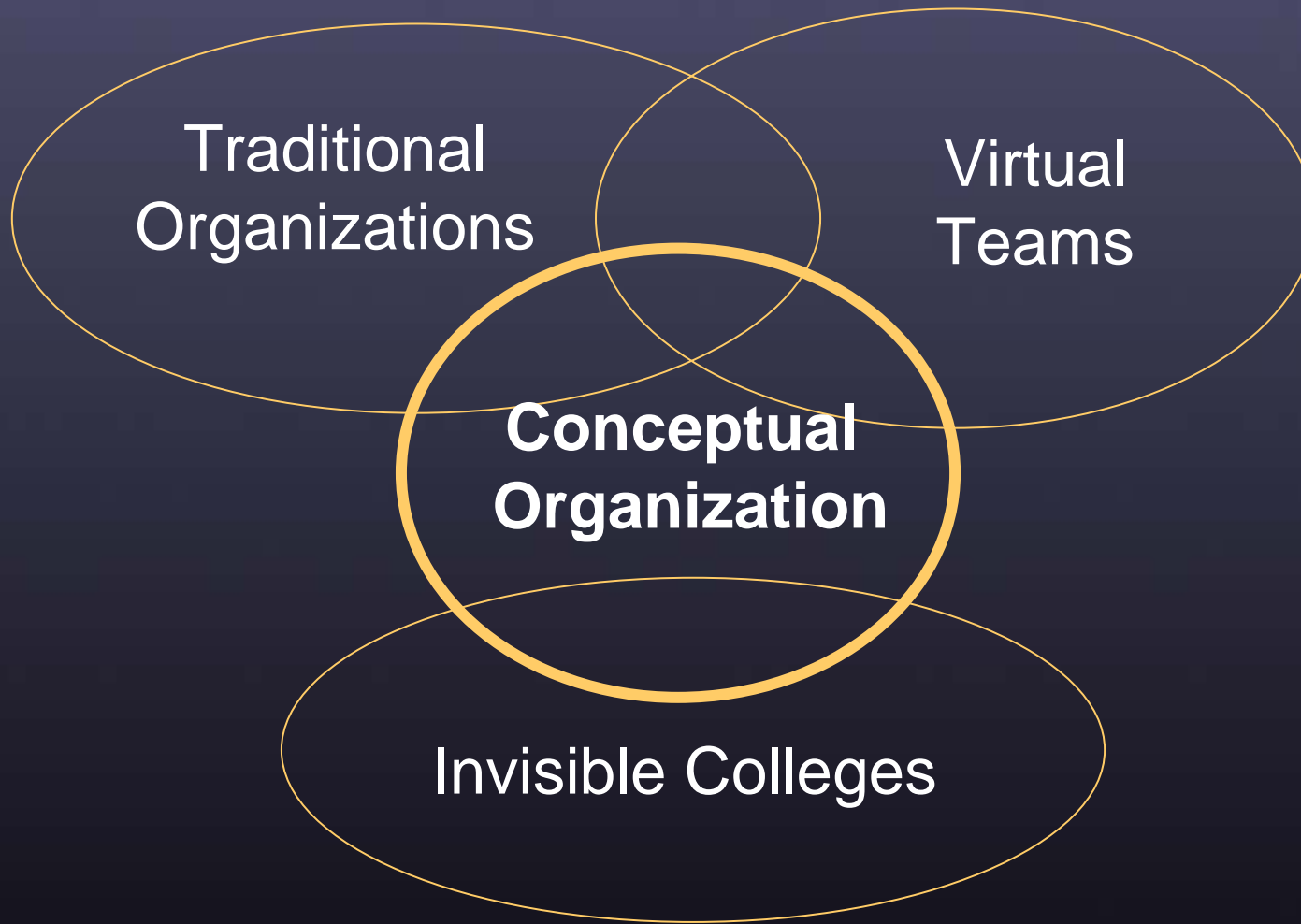
- Investigated challenges in historic black university (HBU) & Research-intensive university collaboration



- An appropriate, not necessarily equal, allocation of multiple types of resources is needed
- Planning for alignment is linked to success

# *Theory Development*

## A New Understanding of Distributed Research Centers



# *The Conceptual Organization*

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## Four Primary Components

- Conceptual infrastructure
  - Vision, mission, goals
  - Mechanisms to achieve vision
- Physical infrastructure
  - Shared physical facilities
  - I&CT
- Management leadership & membership
  - Paradigm creators & pioneers
  - Participation from disciplines & locations
- Activities to achieve vision
  - R&D
  - Education

Woven across other existing organizations & activities

# *Conceptual Structure*

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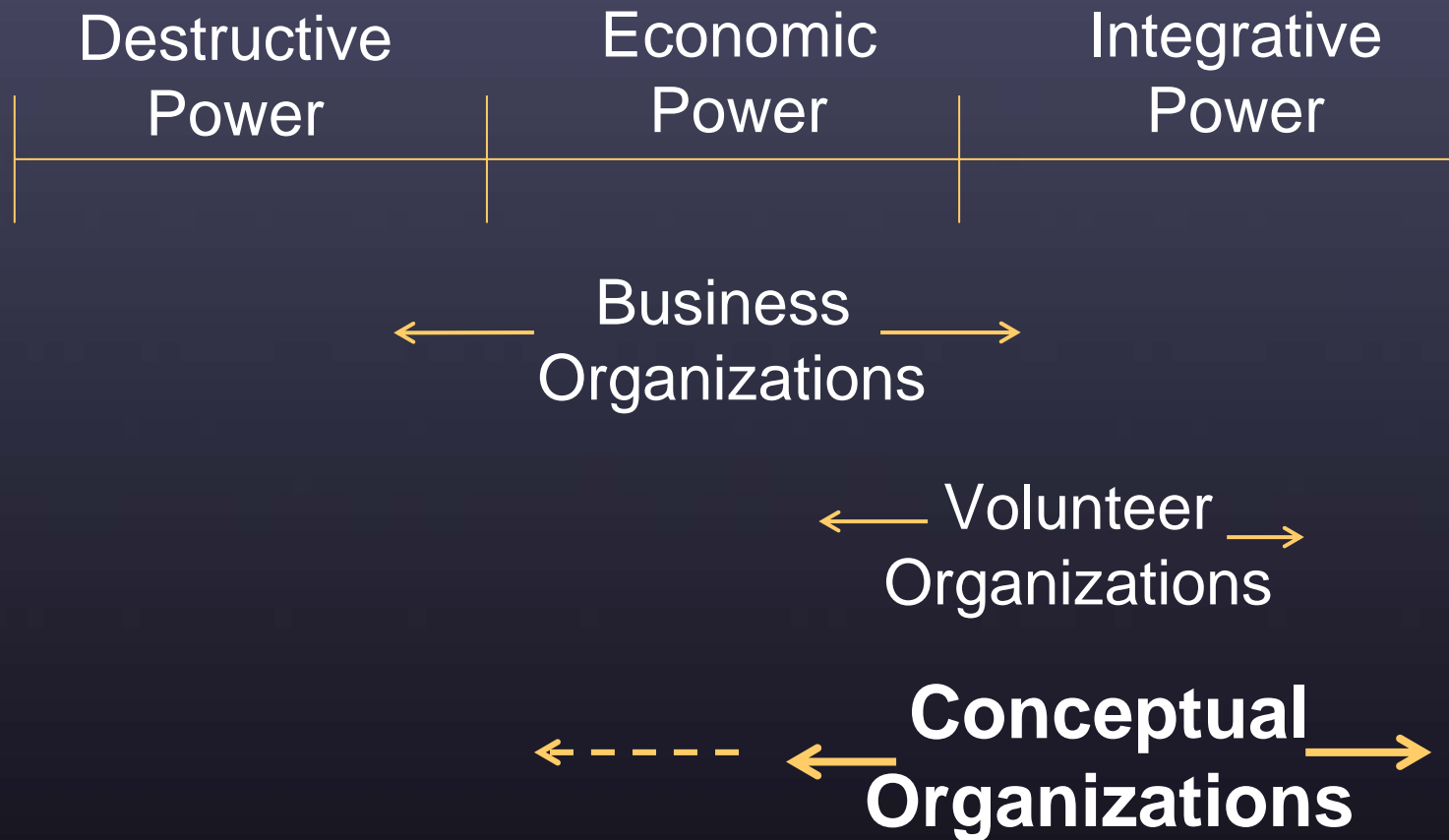
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## Vision, Mission & Goals

- Addresses long-term, complex problem of national & global importance
- Developed through leadership & consensus
- Aligned with stakeholders' interests
- Motivation for scientists to participate
- Strategic coordination mechanisms
  - Pre-proposal review
  - Proposal review

# Organizational Power

Boulding, 1989



# *Benefits of a Conceptual Organization*

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- Ability to dynamically respond to needs for new knowledge
  - “Easy” incorporation of experts in emerging relevant areas
  - Info sharing and knowledge building among members through socio-technical mechanisms
- Relatively low capitalization/start-up cost
  - Additional use and re-use of existing physical spaces
  - Limited term & partial commitment to members
  - Inclusion of students & postdocs
- Ability to meet diverse stakeholders’ & members’ needs
  - Activities driven by non-profit & for-profit concepts
  - Use of integrative power



# *Challenges for a Conceptual Organization*

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- Reconciliation with existing academic cultures
  - Criteria for promotion & tenure (individual vs. group effort)
  - Support for local university vs. conceptual org
  - Publication forums for inter-disciplinary research
- Managing competition
  - Sharing information earlier
  - Perceived infringements on research areas
  - New requirements for trust management

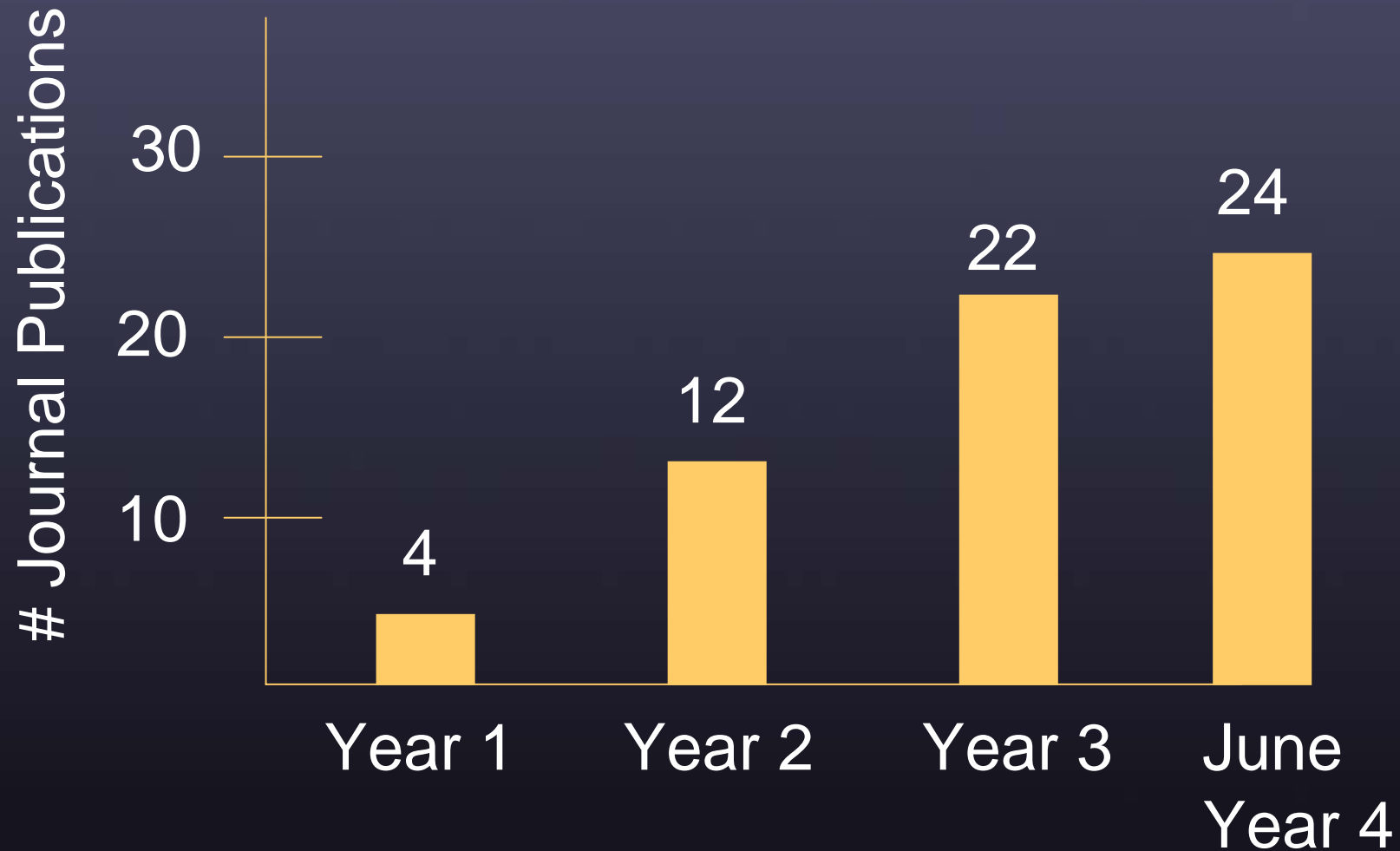
# *Growth in Collaboration*

## Reported Collaborations

	After 1 year		After 2 years		% change
	Total	Per scientist	Total	Per scientist	
Among all scientists	71	2.37	148	3.36	+41.7
At the same university	37	1.23	69	1.57	+27.6
At different universities	34	1.13	80	1.82	+61.1

# *Growth in Collaboration*

## Journal Co-authorship



# *Personal Reflections*

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- Outstanding learning opportunity...for everyone
- Importance of funding agency support
  - Requirement to increase my budget
  - Justification for center award (vs. 'a tax')
  - Personal motivation
  - Ongoing support
- Identification & attempted alignment of department differences
  - Research support services
  - Department & teaching responsibilities
  - Tenure requirements

# *Personal Reflections*

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- Disciplinary differences
  - What is research? theory?
  - Scholarly communication practices
  - Postdoc traditions
  - Working understanding
- 'Always on' phenomena
  - 3 center-wide external reviews per year
  - Expectations of new results
  - Social science always highlighted
  - Chemistry: 35 professors; social science: 2

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# For More Information

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