How Virtual is Virtual:
Designing for Distributed Work in Research and Development

NATIONAL SCIENCE FOUNDATION GRANT

VOSS: VIRTUAL ORGANIZATIONS SOCIO-TECHNICAL SYSTEMS

CENTRAL RESEARCH QUESTION:

HOW DO VIRTUAL MODES OF COMMUNICATION INFLUENCE THE QUALITY OF DELIBERATIONS (KEY CONVERSATIONS) AT VARIOUS STAGES OF THE R&D CONTINUUM/ INNOVATION PROCESS?

Supported by NSF-VOSS Award #0943237

Grant Back-ground

- University of Illinois and STS Roundtable
- Seven member team: Doug Austrom, Betty Barrett, Betsy Merck, Bert Painter, Pam Posey and Ram Tenkasi
- In final year of 3 year grant

Desired Outcomes for this Session

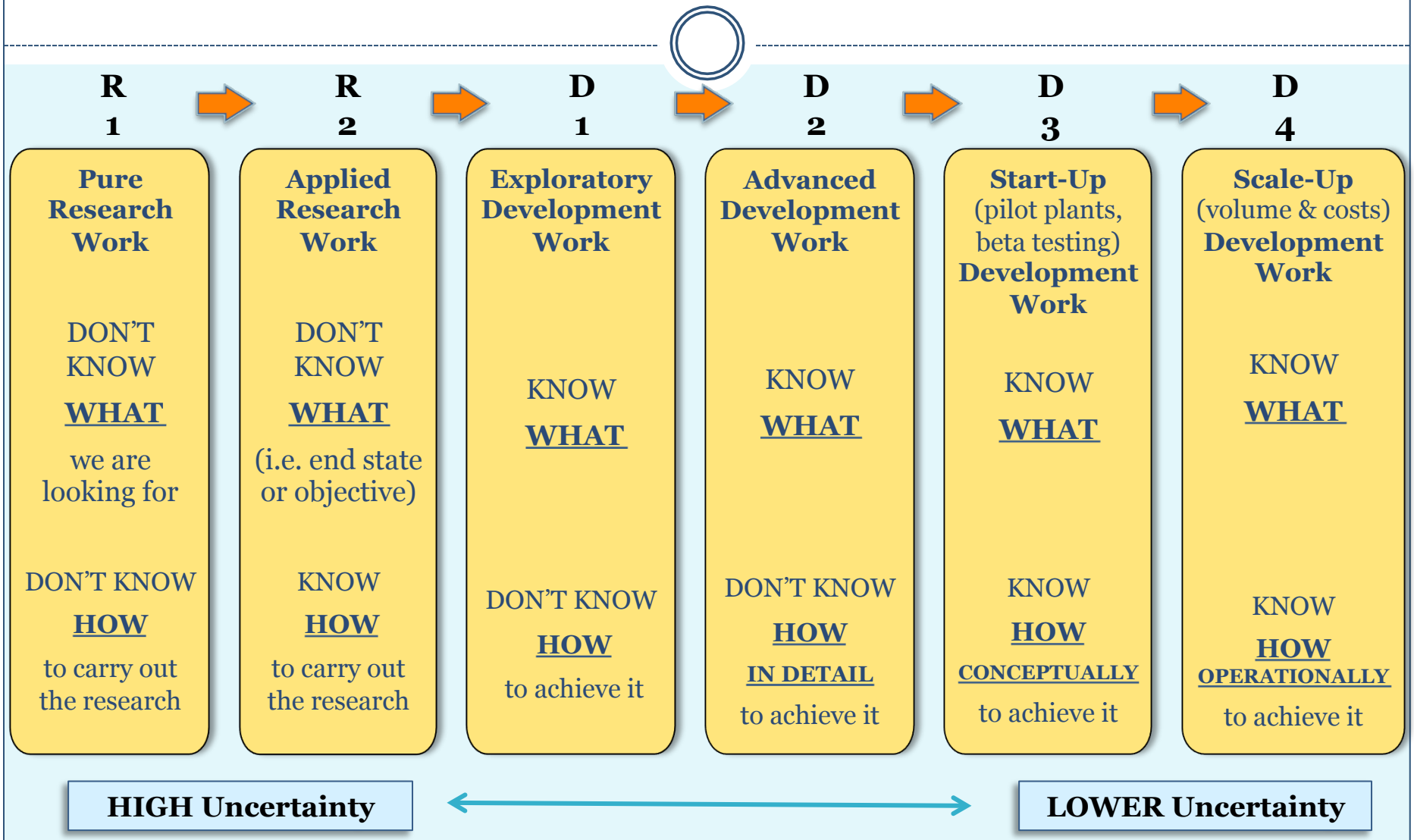
Through dialogue and exercises, we have the opportunity to …

1. Develop a shared understanding of the implications of virtuality on key conversations/deliberations across the innovation continuum
2. Consider how 'fixes' differ depending on the degree of uncertainty in the R&D task
3. Explore the value of coordination mechanisms employed differently across the innovation continuum, as ways to overcome the "coordination costs" of global projects and multi-university research
4. Discuss the renewed relevance of 'STS' for organization design in this age of virtual collaboration and global innovation

Evolution of Socio-Technical Systems!

- **STS v1.0**
  -Routine work in a single organization – e.g., coal mines, factories, oil refineries
  - Work groups with pooled identity
  -Unitary conversion process
  -Linear conversion sequence
- **STS v2.0**
  -Non-routine face-to-face knowledge work in single organizations – e.g., white collar office work, professional services firm, NPD and R&D
  -Individual performers, specialized expertise
  -Multiple, concurrent conversion processes
  -Nonlinear conversion flow
- **STS v3.0**
  -Virtual, non-routine work – e.g., R&D consortia, complex supply chains
  -Individual performers and work groups distributed across multiple locations and/or organizations
  -ICT enabled
  -Multiple, concurrent, independent, and interdependent conversion processes
  -Nonlinear conversion flows

Six Stage Continuum of the R&D Process

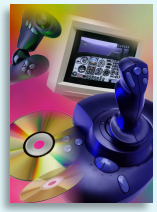


Three Research Sites

- **Caltech- Orchid Project:** fundamental research, R1
  - Optical Radiation Cooling and Heating in Integrated Devices
  - Tightly-Linked Collaboration for Design of Experiments & Device Fabrication among Laboratories using 3 Technology platforms
  - Pasadena, Switzerland and Austria
  - **Major challenge**: creative research and design and knowledge generation in a complex virtual setting

- **NACC:** a virtual R&D eco-system, D2-D4
  - Comprised of 29 NIA-funded Alzheimers Disease Centers (ADCs) and the National Alzheimers Coordinating Center Center (NACC)
  - **Major challenge:** Create Uniform Data Set agreeing upon and compiling data from the 29 different centers as the basis of research

- **LVG:** a large video game developer, D3-D4
  - Core team with distributed vendors in Philippines, China, India, Switzerland, North America and across the parking lot
  - **Major challenge:** Cost effective game development work with high quality and timeliness completed at a distance for art production, engineering and testing



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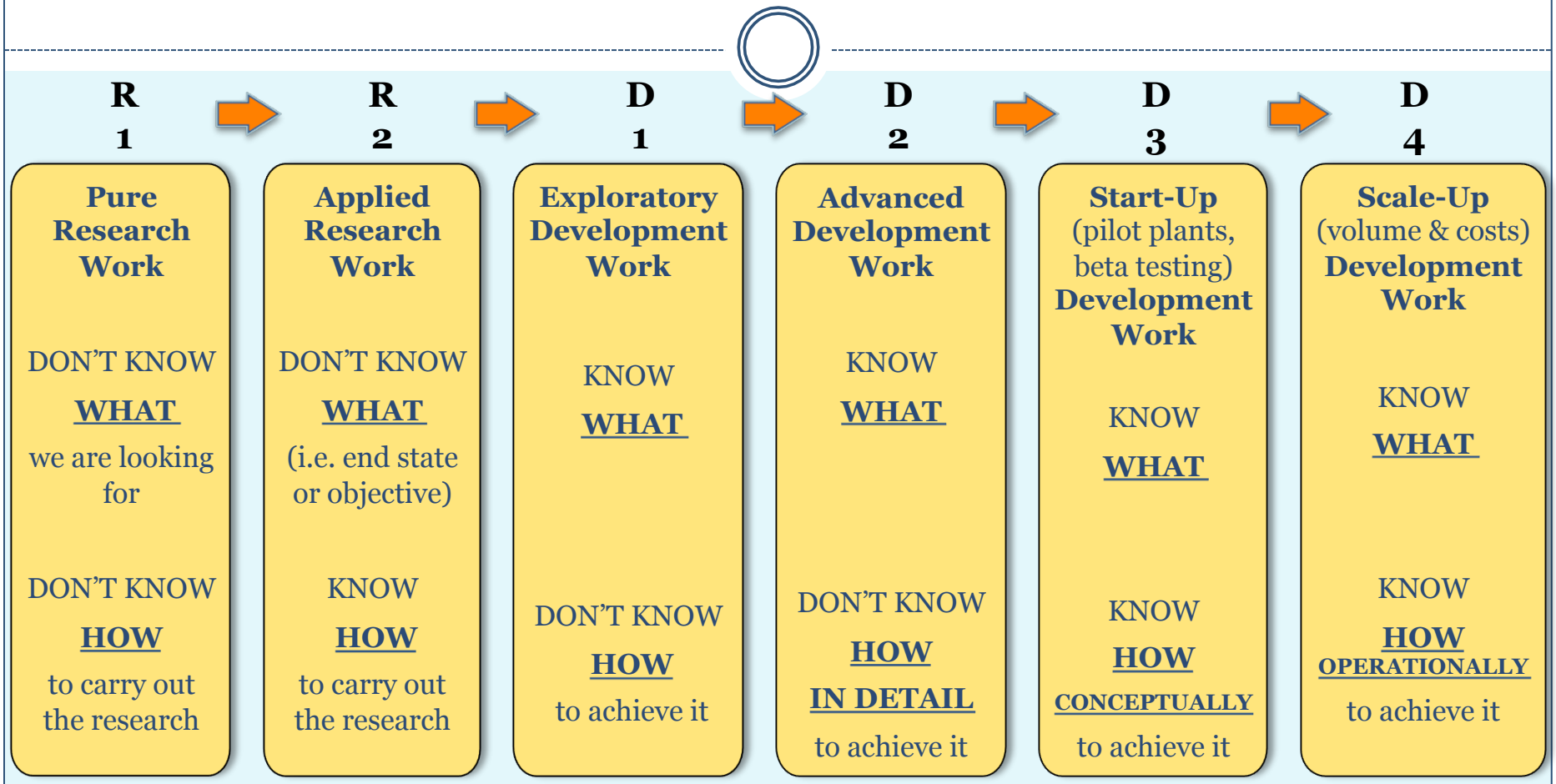

Key Conversations/*Deliberations*: Definition and Elements

- **Key Conversations** are patterns of exchange and communication in which people engage with themselves or others to reduce the equivocality of a problematic issue

- The salient elements of a *deliberation* include the …
  - **Topics** or problematic issues facing the social entity about which people reflect and communicate
  - **Forums** in which they occur which may be structured, semi-structured, unstructured or ad hoc
  - **Participants** - both those who are currently involved and those who ideally should be involved in the deliberation

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Examples of Key Conversations/*Deliberations*

- **Orchid**
  - What experiment shall we run?
  - How shall we design the experiment?
  - How shall we execute the experiment?
  - How do we make sense of the results?
- **NACC**
  - What data will go in the UDS?
  - What diagnostic instruments shall we use?
  - Who will have access to the data?
- **LVG**
  - What new features shall we develop?
  - What contractor shall we use for this work?
  - What is the scope and time/cost estimate for this work?

Exercise Part 1

- Directions: At your table, take 15 minutes to discuss the following question:
  - What might be potential barriers to effective conversations/deliberations?
  - Large group comments – 5 minutes

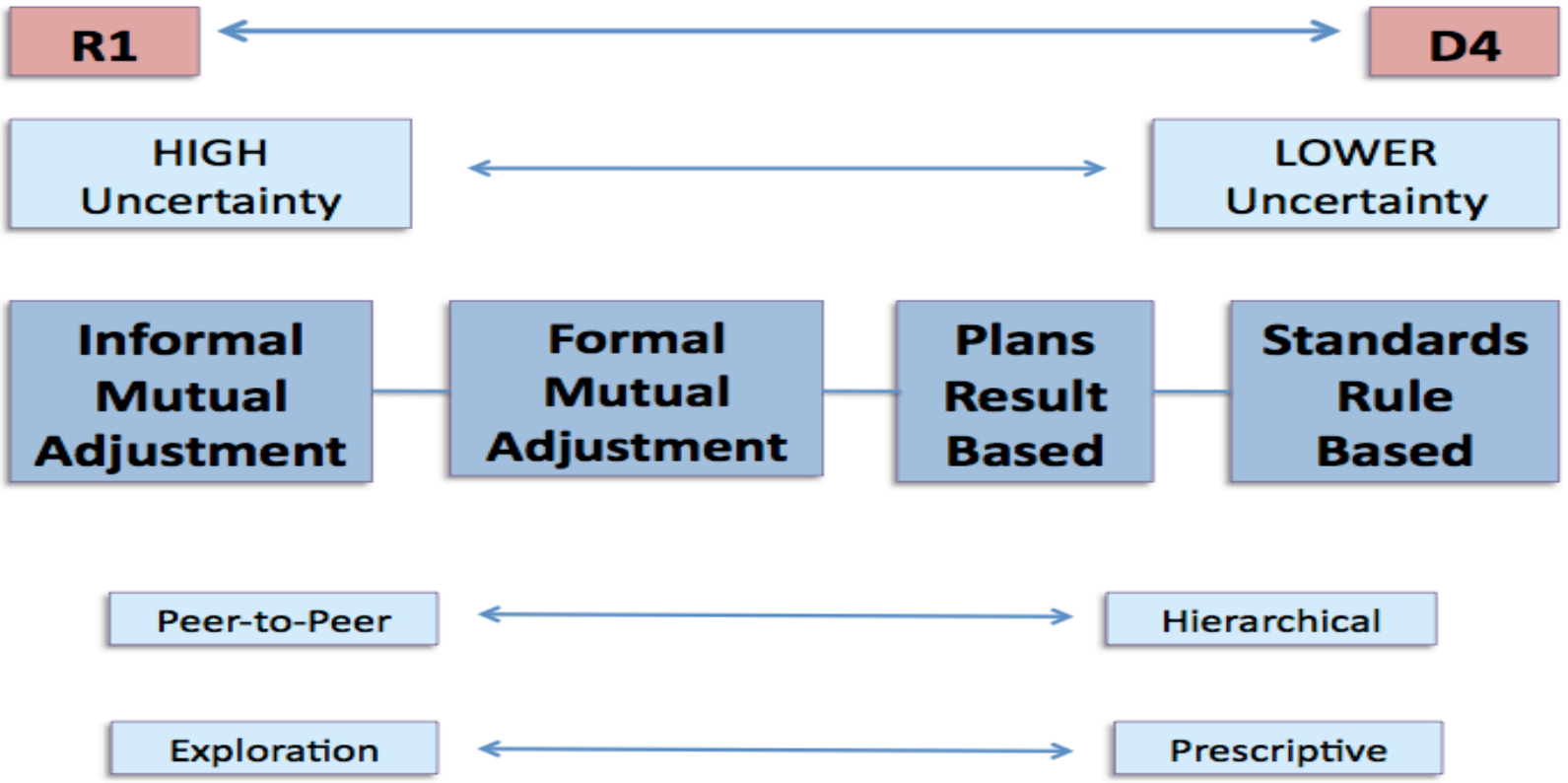
Examples of Knowledge Work Barriers

- **Lack of knowledge**
  - In the Orchid project, the technical procedures in two different laboratories were discovered to be incompatible and initially prevented development of inter-dependent experiments
- **Failure to utilize knowledge**
  - In LVG, corporate intelligence about particular vendor competencies was not initially utilized by an individual division in their vendor selection procedures
- **Failure to share knowledge**
  - In development of the NACC/UDS project, use of standardized data collection was seen by some researchers as an imposition over other data more suited to their own unique research interests
- **Lack of common frame of reference**
  - In LVG, the developers did not have a common frame of how to conduct tests of the game

Exercise Part 2

- Directions: At your table work for 10 minutes and revisit the issue related to distributed (team)work that you were asked to consider in Exercise 1
  - How, what would you design to minimize the knowledge barriers?
    - Select one or two barriers to think through
  - Table group report outs – a brief highlight from each table

Coordination across the R&D Continuum



Most Significant Coordination Mechanisms in Case Study *Virtual* R&D Projects

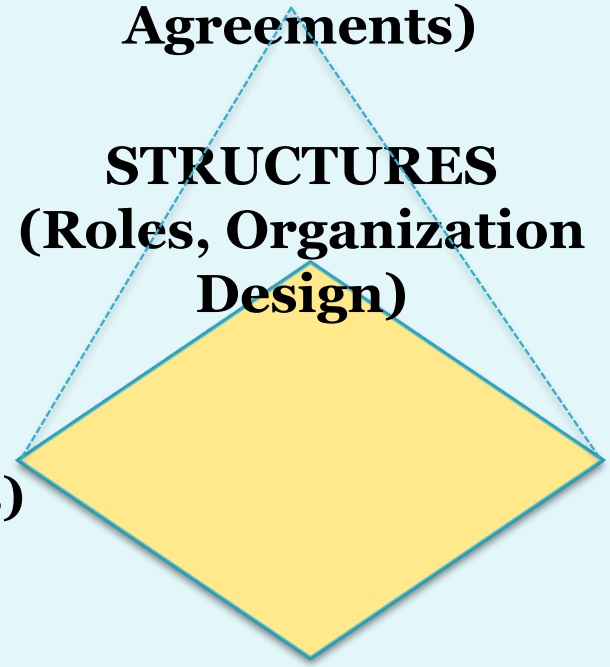
Coordination Category	Case Examples	'Orchid'	'UDS'		'LVG'	
		R1	D2	D3-D4	D3	D4
Coordination by **STANDARDS**	•Output Standardization—prototype, screen shots, visual targets					+
	•Skills Standardization/training			+	(+)	+
	•Standardization of Processes					+
	•Diagnostic instruments			+		
	•Data formats			+		+
	•Error-tracking procedures					+
Coordination by **PLANS**	•Delivery schedules			+	+	
	•Project milestones			+	+	
	•Requirement specifications			+	+	
	•Sign-offs				+	
	•Financial incentives			+		
	•Compelling 'mission'/goal	+	+			
Coordination by **FORMAL MUTUAL ADJUSTMENT**	•Site inspection/verification				+	+
	•Hierarchy/vertical communication				+	
	•Shared database/repository					
	•Formal meetings/status review	+	+		(+)	
	•Steering committees/task force		+			
	•Referent organization		+			
	•Facilitator/'Network Builder' role	+	+			
	•Liaison/'Straddler' role	+			(+)	
Coordination by **INFORMAL MUTUAL ADJUSTMENT**	•Impromptu communication	+	+			
	•Informal meetings	+	+			
	•Conferences, workshops	+	+			
	•Site visits	+				
	•Temporary co-location	+				

Sociotechnical Systems Framework for Designing Coordination of Virtual R&D

STRATEGIES
(Mission, Collaboration Agreements)

STRUCTURES
(Roles, Organization Design)

PEOPLE
(Skills, Relationships, Values, Communications)



TECHNOLOGY
(Collaboration Tools, Media)

PROCESSES
(Standards, Schedules, Plans)

Design Implications – Open Discussion