Team Assembly and Scientific Collaboration on NanoHub

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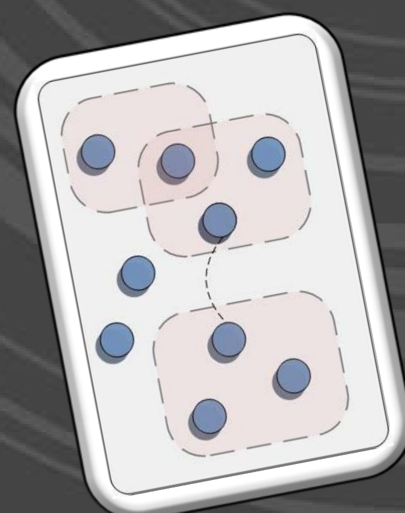


VOSS Project: Background

The Project

- Explore the socio-technical dynamics of scientific collaboration in a virtual space
- Team assembly mechanisms, impact on productivity
- NSF-funded effort, six scientific online communities.

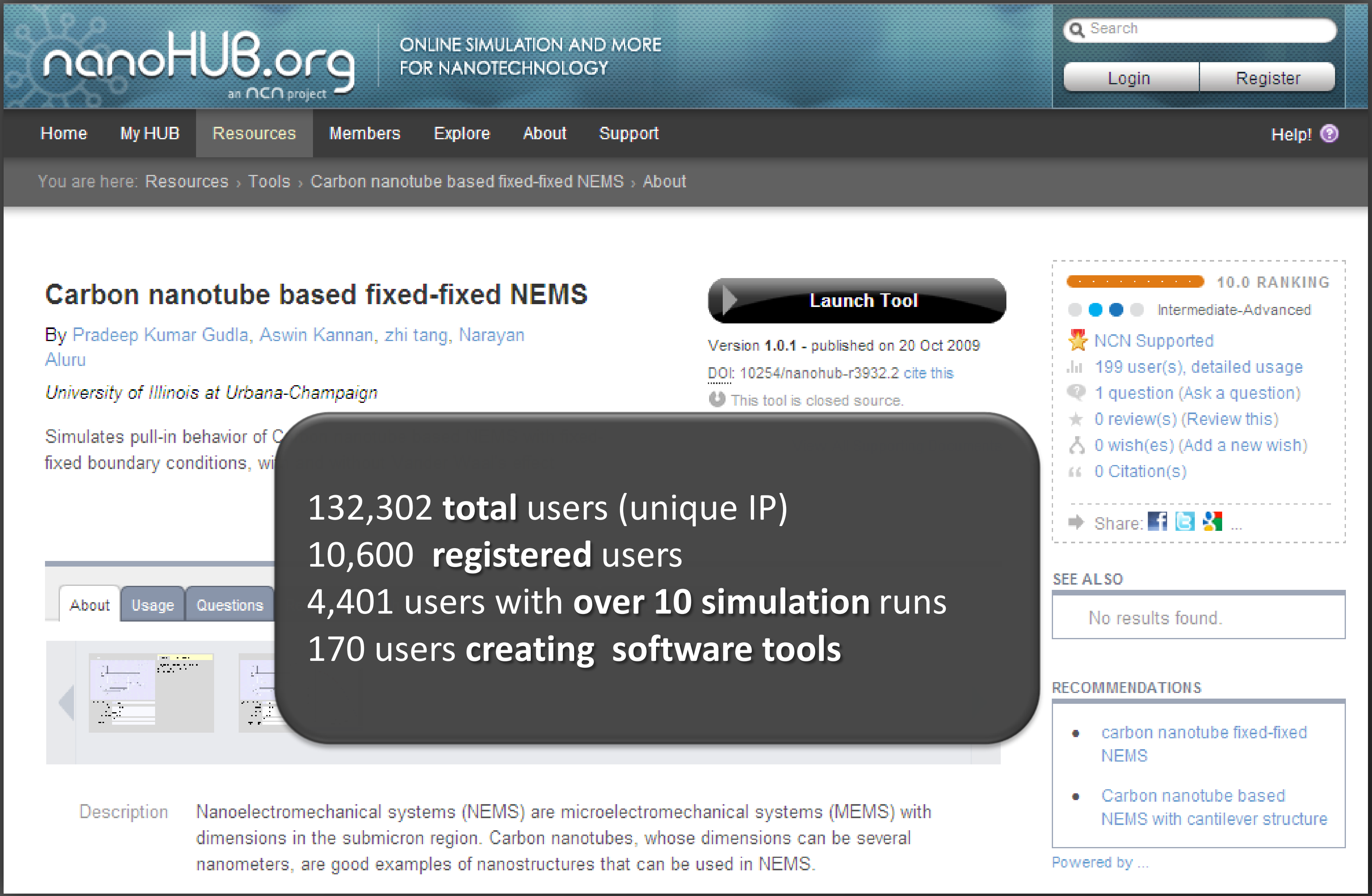
The people

- **SONIC Lab** @ Northwestern University
- **Annenberg Networks Network** @ USC

The Data

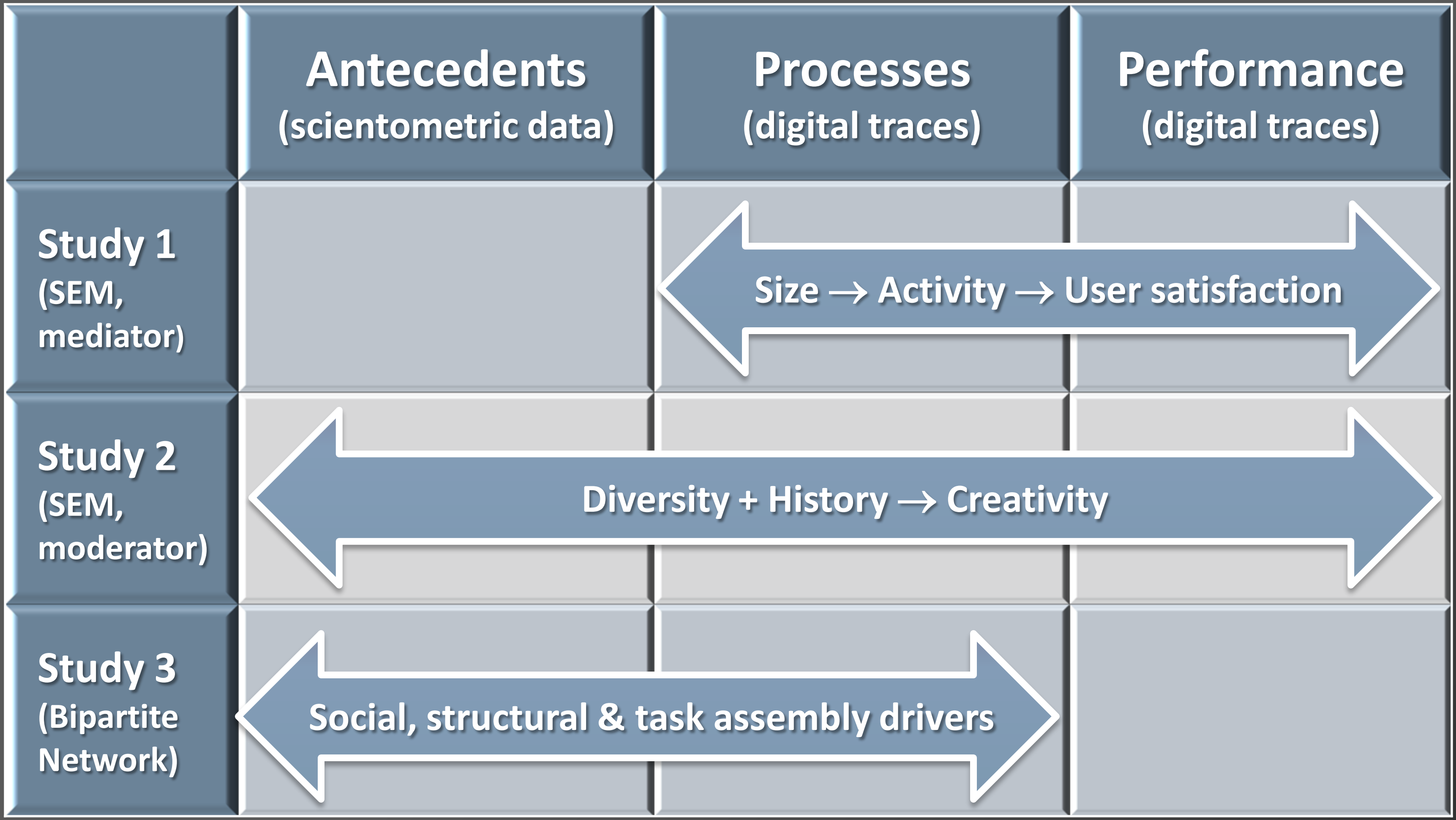
nanoHUB
online simulation and more
an NCN project

The Nanohub Platform

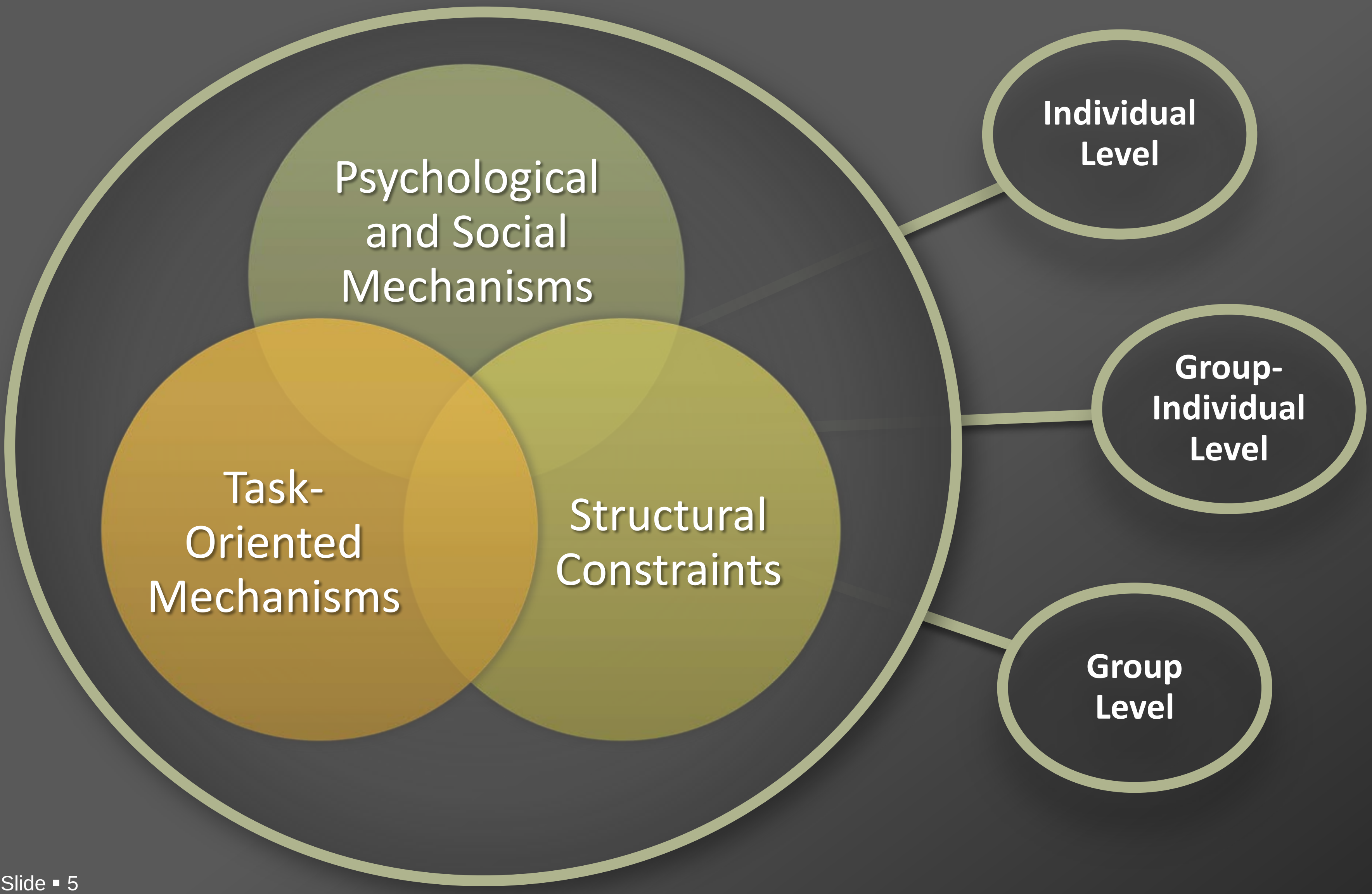


132,302 **total** users (unique IP)
10,600 **registered** users
4,401 users with **over 10 simulation** runs
170 users **creating software tools**

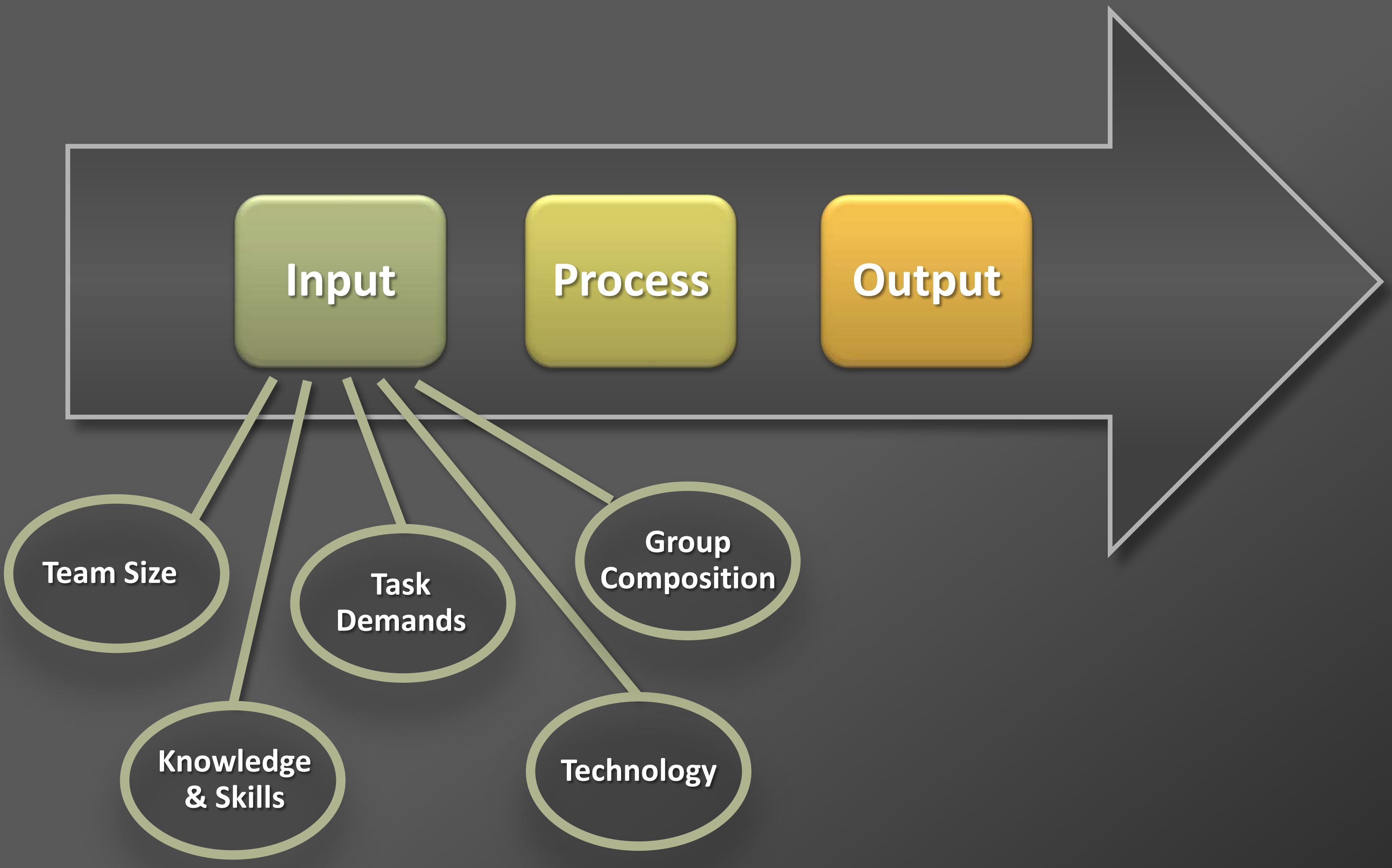
NanoHub Team Studies - Overview



Team Assembly Mechanisms



The I-P-O Model



Research Hypotheses

Team Size

H1: Controlling for popularity effects, teams working on more difficult projects will have a larger number of members.

Expertise Levels

H2: Experts will be more likely to join teams than non-experts.

H3: Difficult projects require expert team members.

RQ1: Do experts tend to work with other experts?

Controls

C1: Control for extraverted/popular individuals working on many teams.

C2: Control for concurrent collaboration driven by familiarity effects.

C3: Control for the effects of gender on the likelihood of joining teams.

C4: Control for the fact that researchers from the NCN network and Purdue University tend to be on a large number of teams.

Dataset: Nanohub, 2010

Bipartite Network

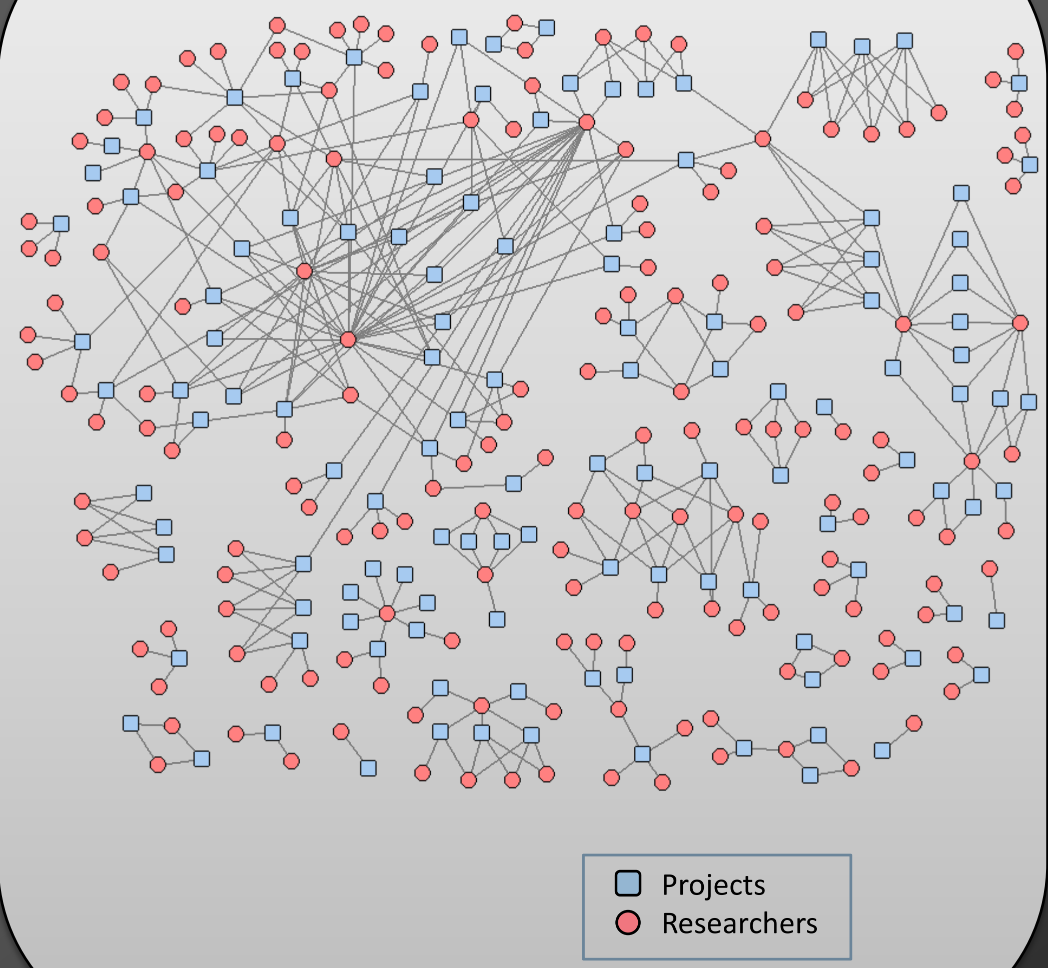
- **170 Researchers**
  - 161 male : 9 female
  - Coming from 9 countries
- **124 Teams**
  - Sizes vary from 1 to 8

Projects

- **124 Software tools** (education, computation, simulations)
- **Difficulty level (1-4)** (easy, intermediate, advanced, expert)
- **Difficult projects (level 3-4)**

Expertise

- **Number of publications** (Web of Science)
- Experts: top 25% of researchers (N=43)



Model 1: Team & Member Attributes + Network Structures

Effects	Estimates	SD	t-Ratio	Hypothesis
Edge	-2.797 *	0.490	-0.011	
Researcher alt-k-star	0.166	0.275	-0.025	C1
Project alt-k-star	-0.876 *	0.276	-0.002	H1 control
Researcher alt-k-2-path	-0.217	0.118	-0.004	C2
Researcher expert	0.125	0.139	0.009	H2
Researcher female	0.234	0.269	0.039	C3
Researcher Purdue	0.211	0.125	-0.019	C4
Researcher NCN	5.035 *	1.444	0.008	C4
Project difficulty	0.295 *	0.136	0.018	H1

Model 1: Team & Member Attributes + Network Structures

Effects	Estimates	SD	t-Ratio	Hypothesis
Edge	[illegible]	[illegible]	[illegible]	
Researcher alt-k-star	[illegible]	[illegible]	[illegible]	C1
Project alt-k-star	-0.876 *	0.276	-0.002	H1 control
Researcher alt-k-2-path	-0.217	0.118	-0.004	C2
Researcher expert	0.125	0.139	0.009	H2
Researcher female	[illegible]	[illegible]	[illegible]	C3
Researcher Purdue	[illegible]	[illegible]	[illegible]	C4
Researcher NCN	5.035 *	1.444	0.008	C4
Project difficulty	0.295 *	0.136	0.018	H1

Large teams are improbable, degrees are evenly distributed

Control: NCN-affiliated researchers more likely to be on teams

Difficult projects draw a larger number of team members

Model 2: Complete set of parameters

Effects	Estimates	SD	t-Ratio	Hypothesis
Edge	-2.486 *	0.606	-0.083	
Researcher alt-k-star	0.122	0.263	-0.075	C1
Project alt-k-star	-1.180 *	0.384	-0.078	H1 control
Researcher alt-k-2-path	-0.192	0.112	-0.036	C2
Researcher expert	0.011	0.256	0.045	H2
Researcher female	0.235	0.261	-0.068	C3
Researcher Purdue	0.200	0.125	-0.064	C4
Researcher NCN	4.711 *	1.406	0.015	C4
Expert Collaboration	0.205	0.106	0.011	RQ1
Expert Matching	-0.350	0.221	0.061	RQ1
Project difficulty	0.292 *	0.136	0.013	H1
Project difficulty -> Member Expertise	-0.053	0.221	0.015	H3

Model 2: Complete set of parameters

Effects	Estimates	SD	t-Ratio	Hypothesis
Edge	-2.486 *	0.606	-0.083	
Researcher alt-k-star	0.122	0.263	-0.075	C1
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Researcher female	0.235	0.261	-0.068	C3
Researcher Purdue	0.200	0.125	-0.064	C4
Researcher NCN	4[illegible]	[illegible]	[illegible]	C4
Expert Collaboration	0.[illegible]	[illegible]	[illegible]	RQ1
Expert Matching	-0.350	0.221	0.061	RQ1
Project difficulty	0.292 *	0.136	0.013	H1
Project difficulty -> Member Expertise	-0[illegible]	[illegible]	[illegible]	H3

Experts - likelihood to work with other experts. Negative but not significant.

Difficult tasks drawing expert team members - not supported

Results

V

H1: Controlling for popularity effects, teams working on more difficult projects will have a larger number of members.

X

H2: Experts will be more likely to join teams than non-experts.

H3: Difficult projects require expert team members.

RQ1: Do experts tend to work with other experts?

?

- **Team size:** Virtual environment lowers coordination costs allowing the formation of larger teams
  - No particularly large teams, degree is evenly distributed
  - But we do see more difficult task drawing more team members
- **The role of experts**: in a virtual space - lab effect or dream teams?
  - No support from the data for either direction. If anything, experts may be reluctant to work with other experts (not significant though)
- **Task difficulty :** Difficult tasks may require larger teams and/or more expert members on the team.
  - Difficult tasks do draw more members, but our model did not pick up on a difference in collective expertise for difficult tasks.

Next Steps

Improve the measures

- **Task difficulty**: look into the use of more comprehensive measures incorporating other data we have: CPU time (complexity), tags (multidisciplinarity), etc.
- **Member expertise**: improve the level of expertise measure; look into expertise complementarity - member areas of expertise will be based on academic department .
- **Co-authorship & co-citation**: covariate networks based on WoS data

Effect on team outcomes

Explore the way the assembly mechanisms we've uncovered affect the effectiveness and productivity of teams.
(outcome measures: popularity, user satisfaction, etc. – available on NH)

Virtual teams and Nanohub

- Separate Nanohub-specific effects from ones that can be generalized.
- Separate virtual collaboration effects from general team formation ones.
- Separate task-oriented, structural and social/psychological effects.