

Team Assembly and Scientific Collaboration on NanoHub

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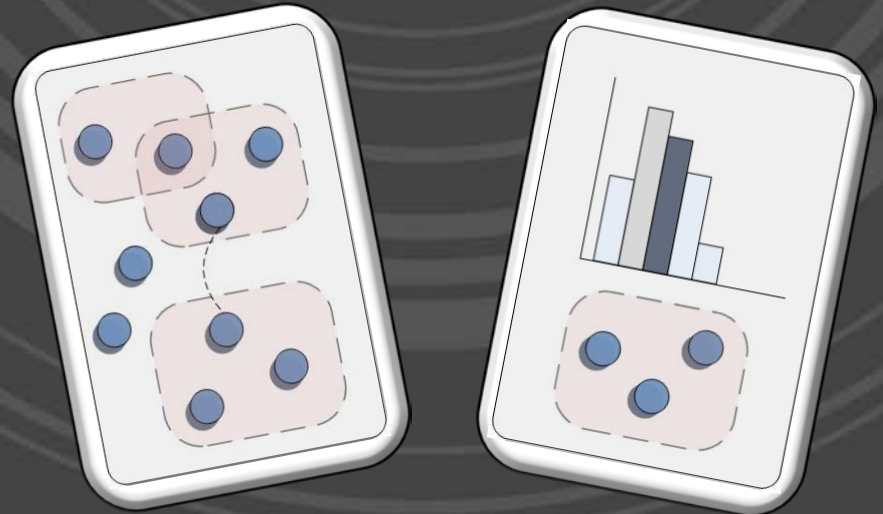


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VOSS Project: Background

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



The Nanohub Platform

nanoHUB.org
an *NCN* project

ONLINE SIMULATION AND MORE FOR NANOTECHNOLOGY

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Carbon nanotube based fixed-fixed NEMS

By Pradeep Kumar Gudla, Aswin Kannan, zhi tang, Narayan Aluru
University of Illinois at Urbana-Champaign

Version 1.0.1 - published on 20 Oct 2009
DOI: 10254/nanohub-r3932.2 cite this
This tool is closed source.

Launch Tool

10.0 RANKING
Intermediate-Advanced
NCN Supported
199 user(s), detailed usage
1 question (Ask a question)
0 review(s) (Review this)
0 wish(es) (Add a new wish)
0 Citation(s)

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RECOMMENDATIONS

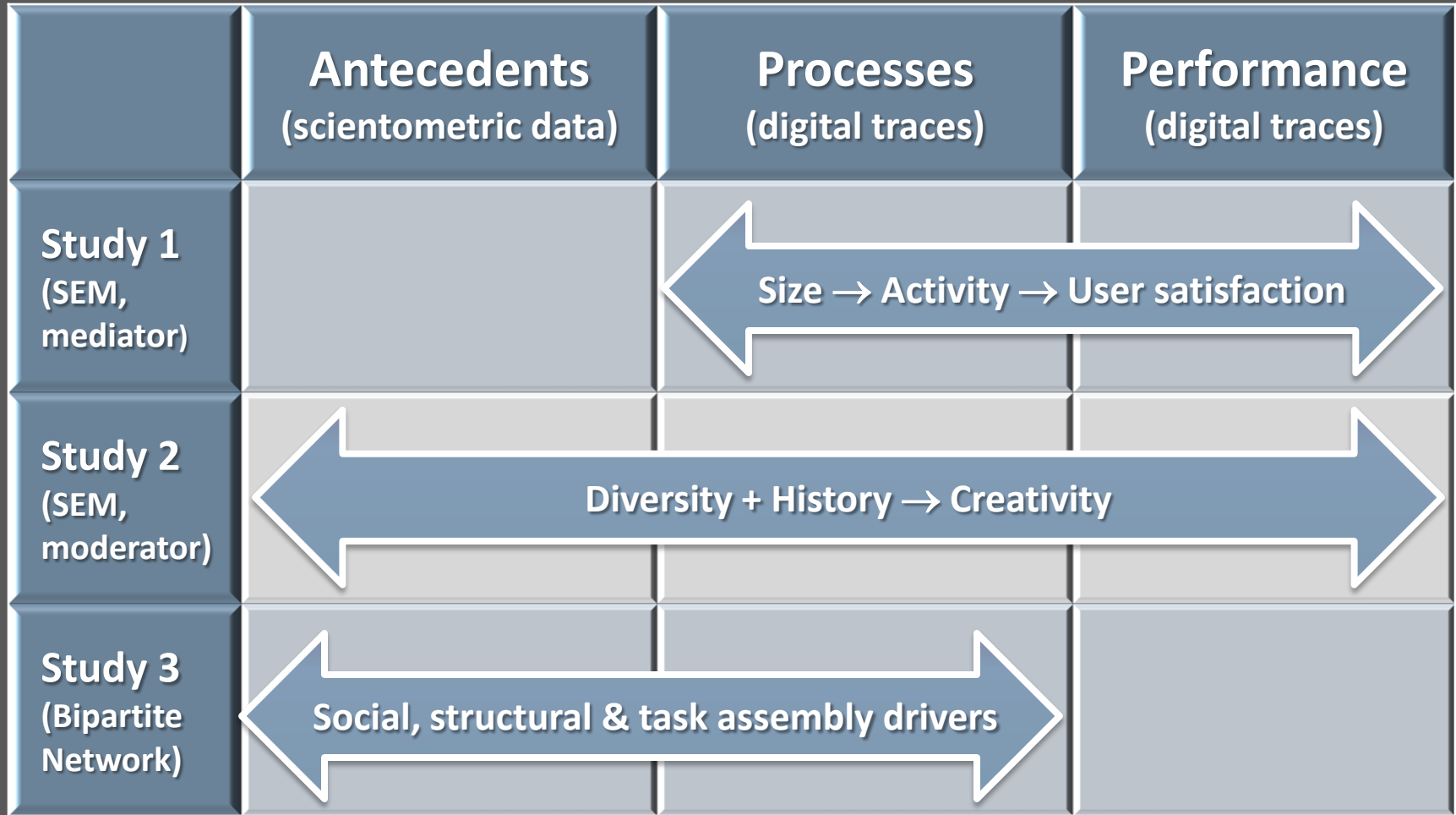
- carbon nanotube fixed-fixed NEMS
- Carbon nanotube based NEMS with cantilever structure

Powered by ...

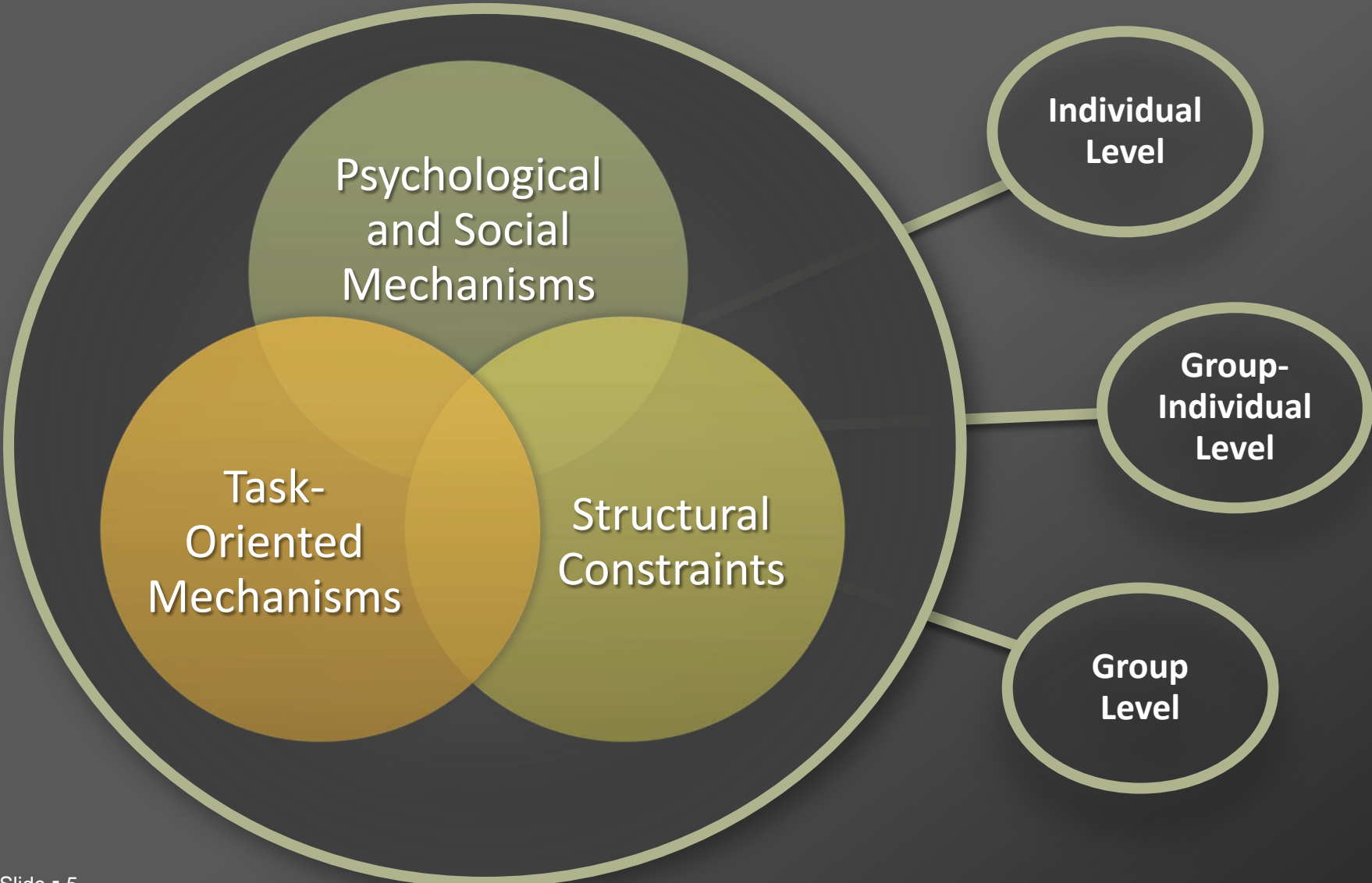
132,302 total users (unique IP)
10,600 registered users
4,401 users with over 10 simulation runs
170 users creating software tools

Description Nanoelectromechanical systems (NEMS) are microelectromechanical systems (MEMS) with dimensions in the submicron region. Carbon nanotubes, whose dimensions can be several nanometers, are good examples of nanostructures that can be used in NEMS.

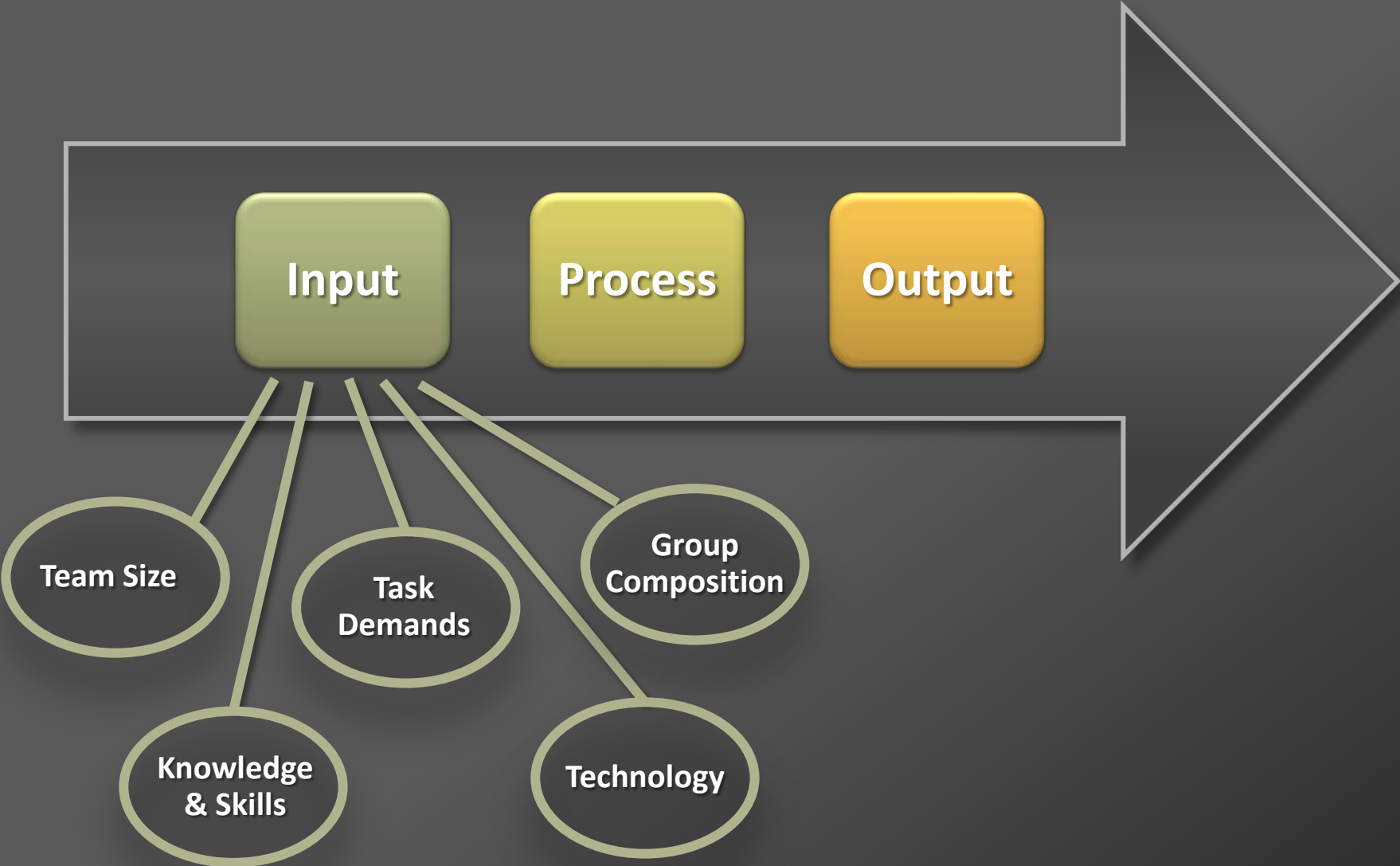
NanoHub Team Studies - Overview



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

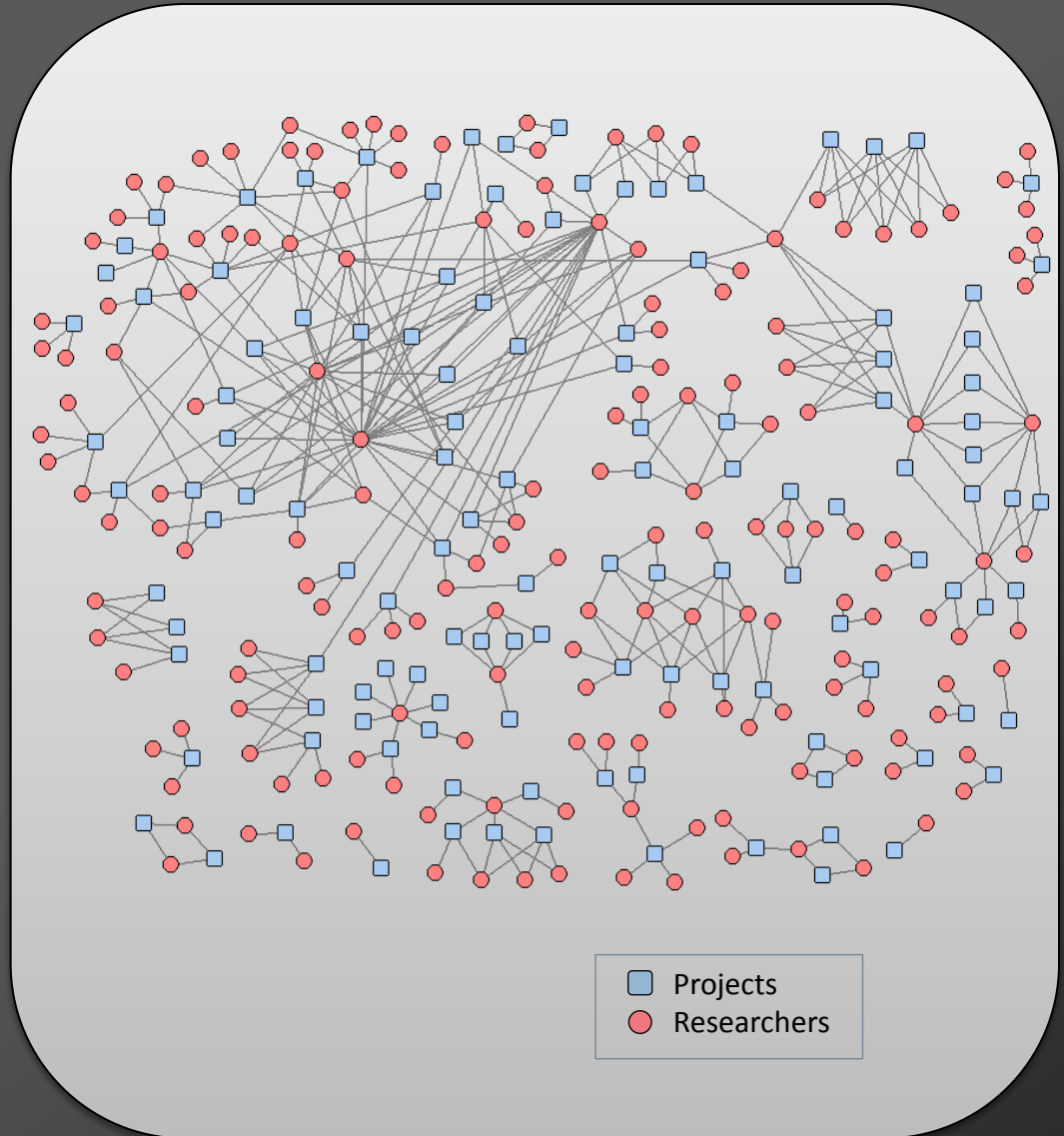
- **170 Researchers**
 - 161 male : 9 female
 - Coming from 9 countries
- **124 Teams**
 - Sizes vary from 1 to 8

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

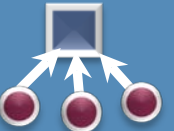
Effects	Estimates	SD	t-Ratio	Hypothesis
Edge	-2.797 *	0.490	-0.011	
Researcher alt-k-star	0.166	0.275	-0.025	C1
Project alt-k-star	-0.876 *	0.276	-0.002	H1 control
Researcher alt-k-2-path	-0.217	0.118	-0.004	C2
Researcher expert	0.125	0.139	0.009	H2
Researcher female	0.234	0.269	0.039	C3
Researcher Purdue	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				
Researcher alt-k-star				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
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Researcher Purdue				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
Project alt-k-star	-1.180 *	0.384	-0.078	H1 control
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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	0.400	0.125	0.064	C4
Expert Collaboration	0.000	0.221	0.061	RQ1
Expert Matching	-0.350	0.221	0.061	RQ1
Project difficulty	0.292 *	0.136	0.013	H1
Project difficulty -> Member Expertise	-0.000	0.136	0.013	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.