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The teamology and dynamics of small product development tiger teams – a Californian perspective

martin @ kongsberg,
Høgskolen i Buskerud og Vestfold (HBV)

KSEE 2014, 12 June 2014

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Yes, but … YES, AND
that did not work … I LIKE, I WISH
teams fail because of human issues,
technology you can solve,
human conflicts … well

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TrollLABS

NTNU´s Living Lab Skunks works and Maker Space for Radical Engineering Concept Creation at IPM/IVT

*martin @ **NTNU***
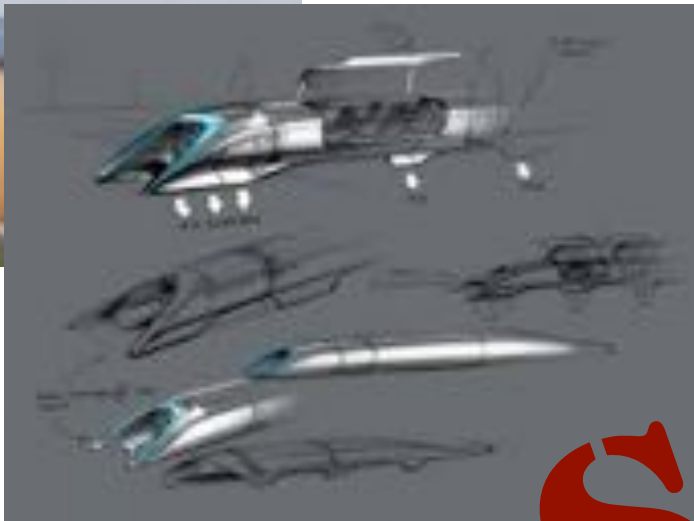
Trondheim 2014 - 2018

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two problems *for today*

1) **How should you set up a team?**
2) **How does internal team dynamic work**

Design Thinking Behavior

Design Thinking Behavior

Design Thinking Behavior

In-depth knowledge

In-depth knowledge

In-depth knowledge

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SpaceX

AND …
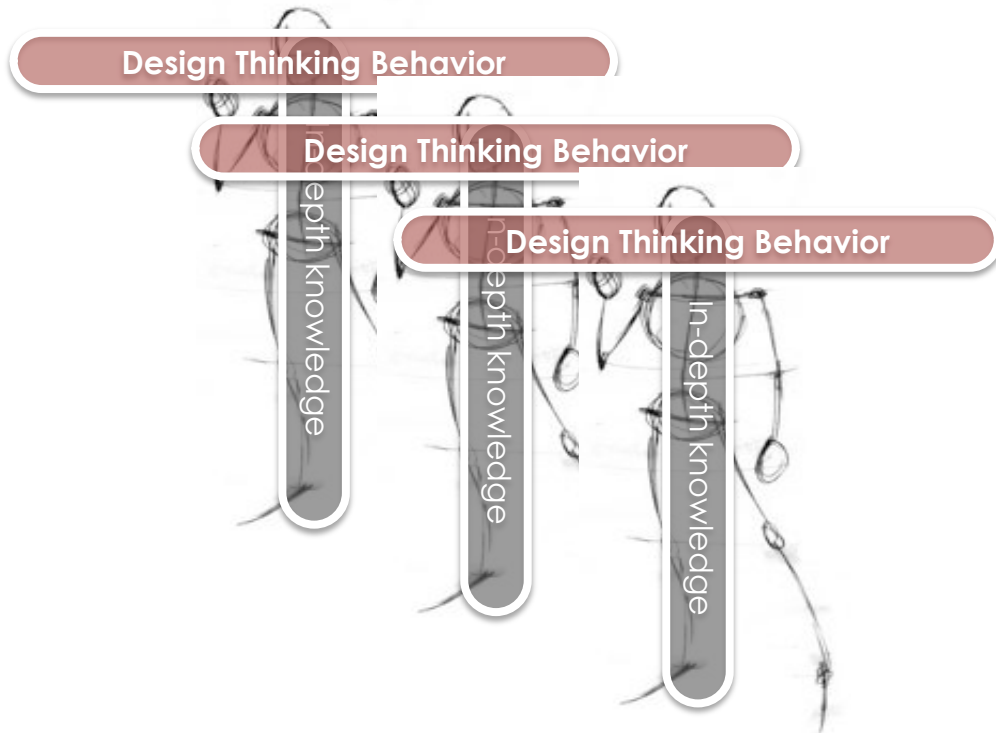
Skunk Works
Lockheed Martin's
Advanced Development
Programs (ADP)

PARC (Palo Alto
Research Center
Incorporated) formerly
Xerox PARC

Google X Labs

TOP SECRET

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Luckily
we have comparable academic spaces

Stanford d.school and Center for Design Research

MIT Medialab

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Center for
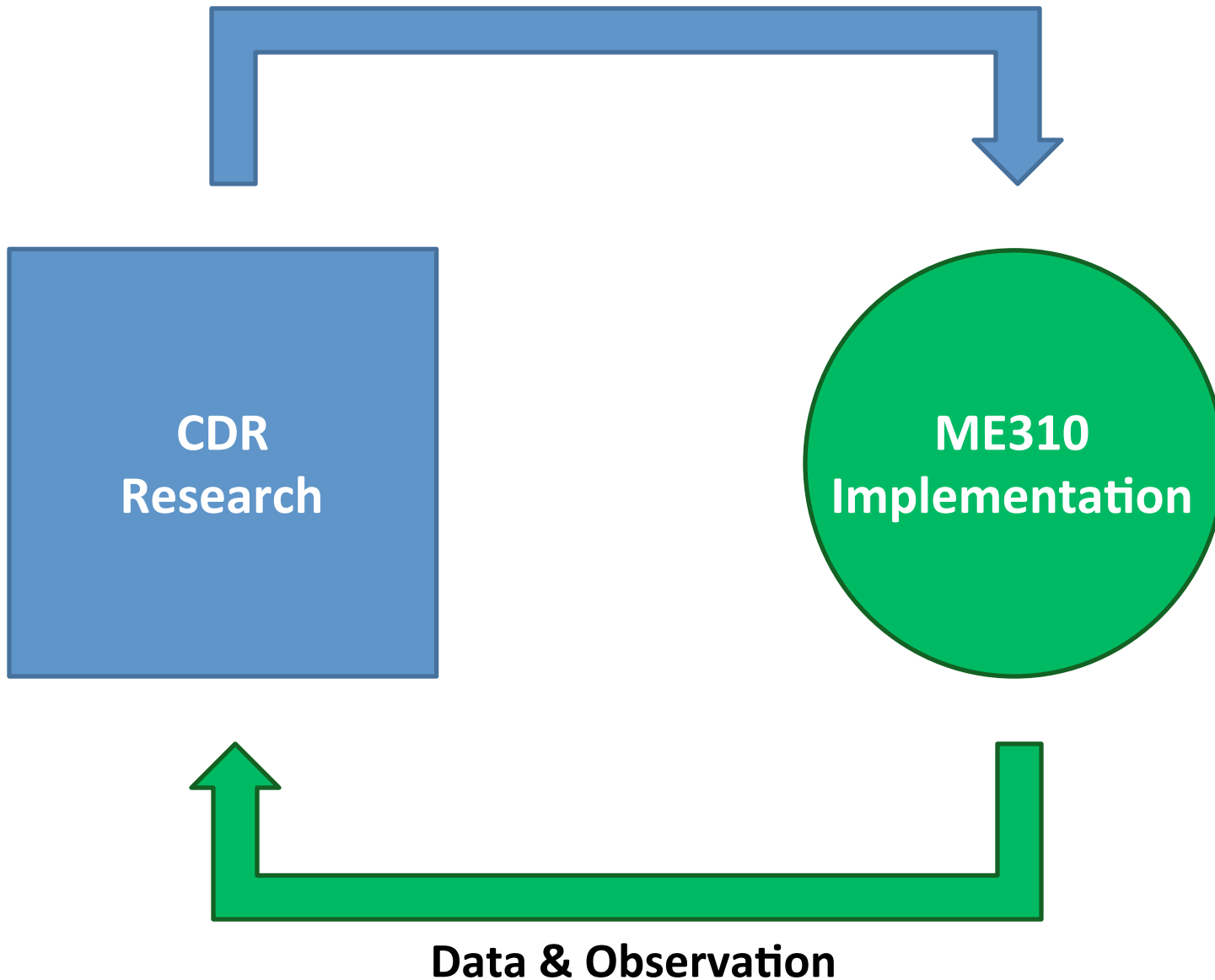Design Research

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**bldg. 560
(across the street)**
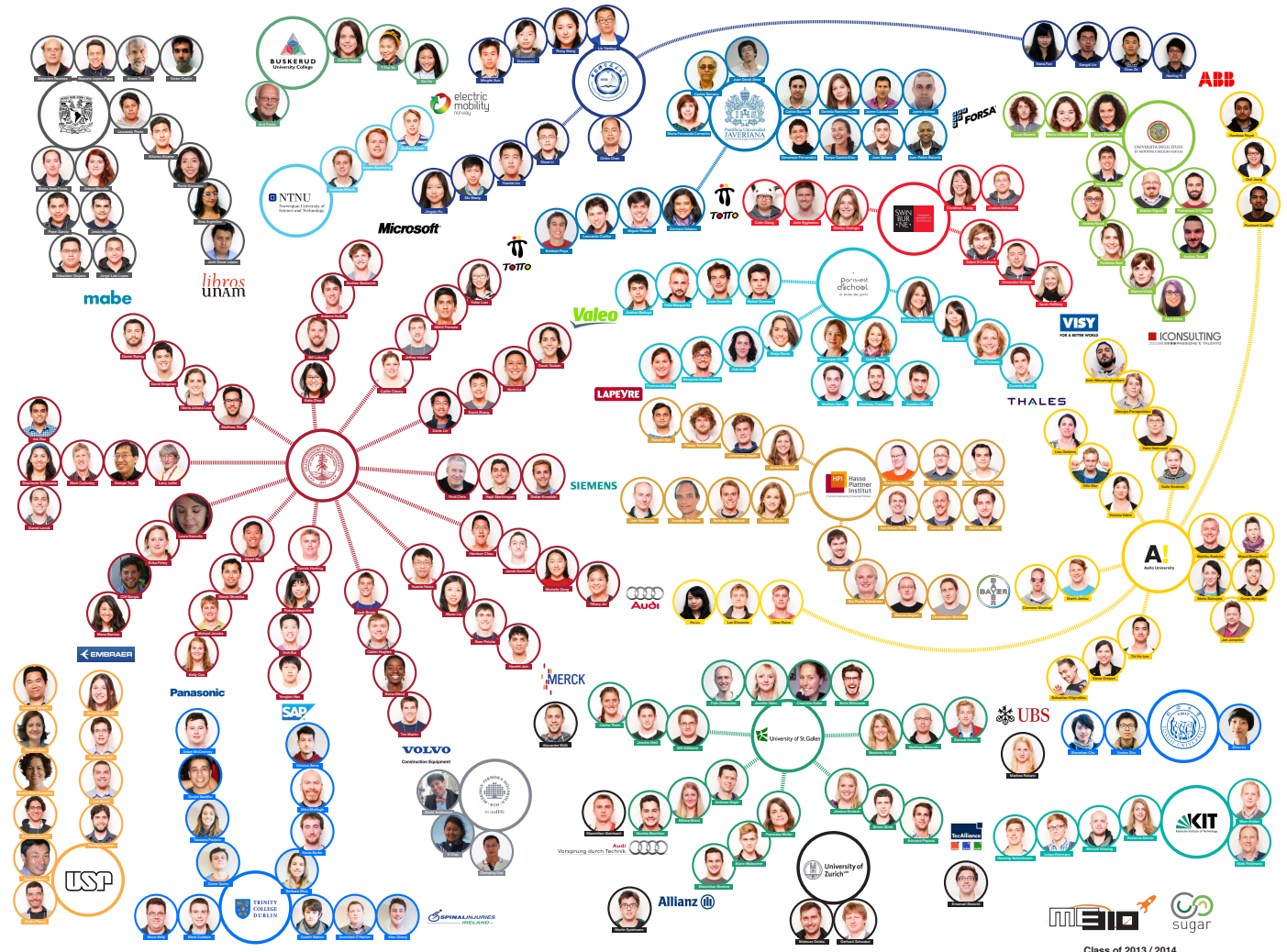
Setup 2013/2014 with HBV!

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THE EFFECTS OF TEAM MEMBER INTRINSIC DIFFERENCES ON EMERGENT TEAM DYNAMICS AND LONG-TERM INNOVATIVE PERFORMANCE IN ENGINEERING DESIGN TEAMS

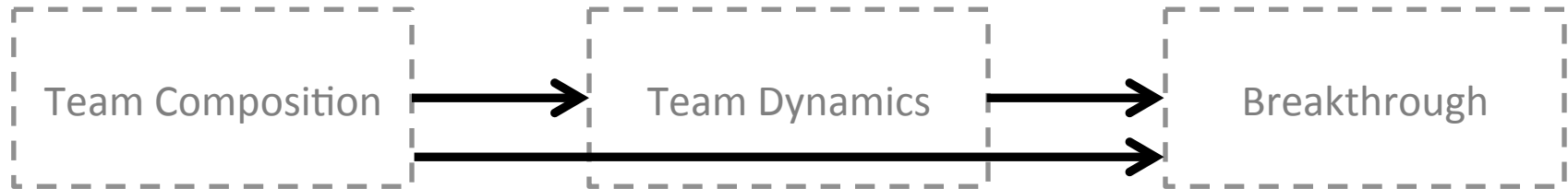Kress G. 2012 "The effects of team member intrinsic differences on emergent team dynamics and long-term innovative performance in engineering design teams"

Team Composition → Team Dynamics → Breakthrough
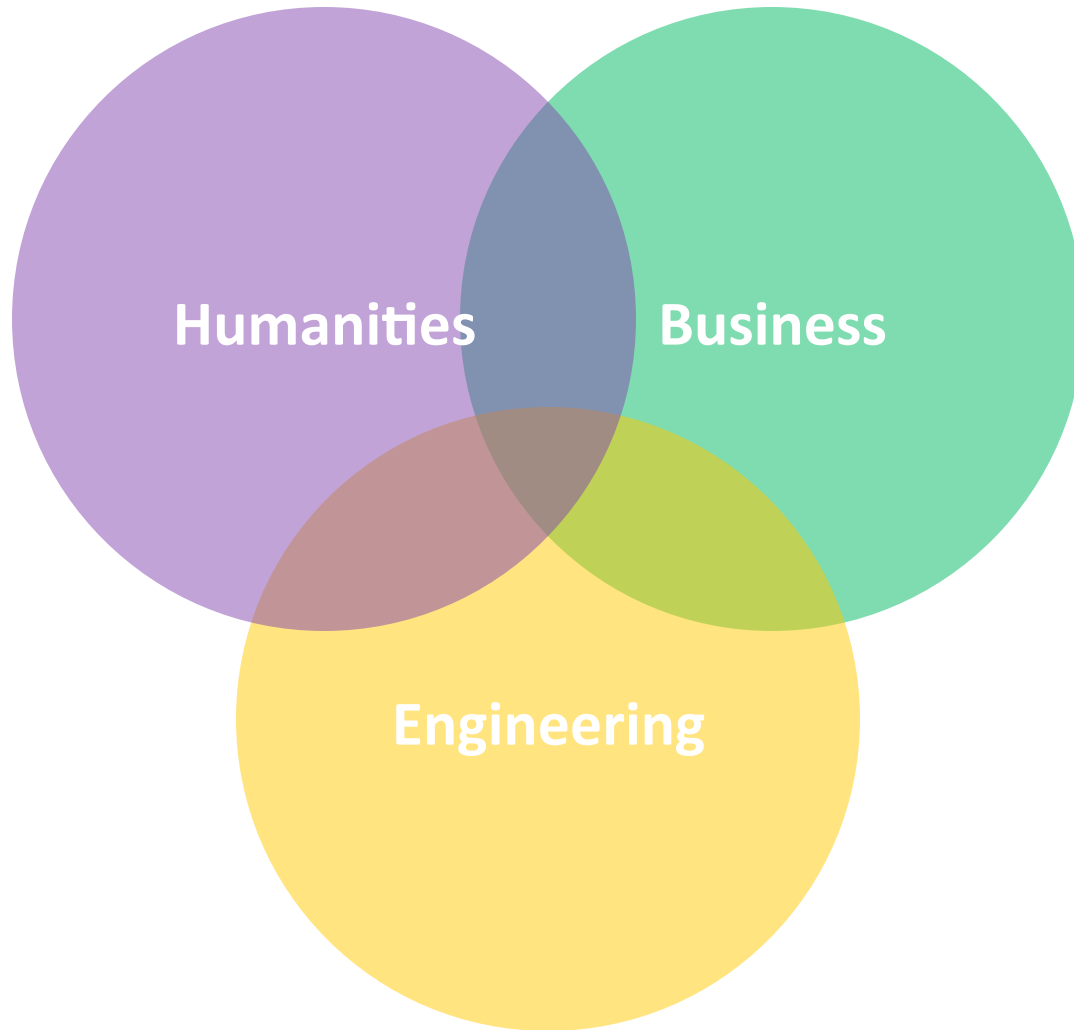
INDIVIDUAL DIFFERENCES (COMPOSITION)

- Personal level traits/characteristics
- Extrinsic (ethnographic) traits
- Intrinsic (cognitive) traits

EMERGENT TEAM DYNAMICS

- Team-level phenomena
- Conflict, communication, process
- Occur at local and global levels

LONG-TERM INNOVATIVE PERFORMANCE

- Team output
- Team learning

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Diversity drives innovation?

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Background

- Diversity creates conflict

- Conflict is sometimes productive

- Conflict is most often harmful

- Diversity has mixed – and most often negative – effects

- Intrinsic functional diversity is desirable in particular

Badke-Schaub, P., Goldschmidt, G. & Meijer, M. "How Does Cognitive Conflict in Design Teams Support the Development of Creative Ideas?" Creativity and Innovation Management Vol. 19 (2010): 119-133.
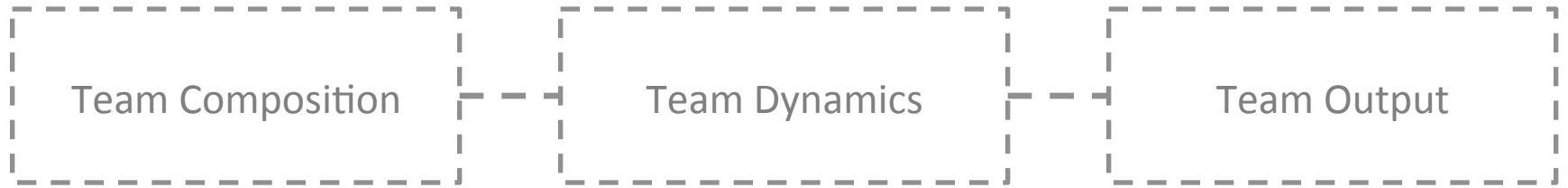
Jehn, K. "A Qualitative Analysis of Conflict Types and Dimensions in Organizational Groups." Administrative Science Quarterly Vol. 42 (1997): 530-557.

Jehn, K. et al. "Why Differences Make a Difference: A Field Study of Diversity, Conflict and Performance in Workgroups." Administrative Science Quarterly Vol. 44 (1999): 741-763.

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Experiment Design

Team Composition	Team Dynamics	Team Output

- Ethnographic data
- Personality type data
- Cognitive style data

- Closing survey
- SPAFF emotion coding*
- Team diagnostic survey*

- Project performance
- Team diagnostic survey*

Data Set

Local ME310 teams	n = 234 students	m = 54 teams	*(2007-2012)*
Global ME310 teams	n = 100 students	m = 15 teams	(2009-2010)
*Local ME310 teams	n = 33 students	m = 5 teams	(2008-2009)

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Diversity in the Literature
"What differences make a difference?"

Age	In-Group Memberships
Title	Affective Disposition
Race	Cultural Background
Gender	Sexual Orientation
Religion	Work-Related Ties
Ethnicity	Ideological Beliefs
Education	Physical Abilities
Friendship Ties	Community Ties

Mannix, E. & Neale, M. A. "What Differences Make a Difference? The Promise and Reality of Diverse Teams in Organizations." Psychological Science in the Public Interest Vol. 6 (2005): 31-55.

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Ethnicity	Ideological Beliefs
Education	Physical Abilities
Friendship Ties	Community Ties

Extrinsic characteristics are not reliable

Mannix, E. & Neale, M. A. "What Differences Make a Difference? The Promise and Reality of Diverse Teams in Organizations."
<u>Psychological Science in the Public Interest</u> Vol. 6 (2005): 31-55.

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Data Set: Independent Variables

Ethnographic Factors (3)

- Age
- Gender
- School

Gender Ratio

Team Size

Location

Project Difficulty

Wilde Type Indicator (4)

- Intuition (ENP)
- Sensing (ESP)
- Thinking (ETJ)
- Feeling (EFJ)

Herrmann Brain Dominance Indicator (4)

- Factual (A)
- Strategic (B)
- Interpersonal (C)
- Innovative (D)

NEO "Big Five" Personality Inventory (5)

- Extraverted
- Open
- Agreeable
- Conscientious
- Neurotic

Kirton Adaption-Innovation Inventory

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Data Set: Independent Variables

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Wilde Type Indicator (4)

Herrmann Brain Dominance Indicator (4)

NEO "Big Five" Personality Inventory (5)

Kirton Adaption-Innovation Inventory

7

14

↓

Reduced via Factor Analysis

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Performance Assessment

Usability   **Feasibility**   **Originality**   **Desirability**

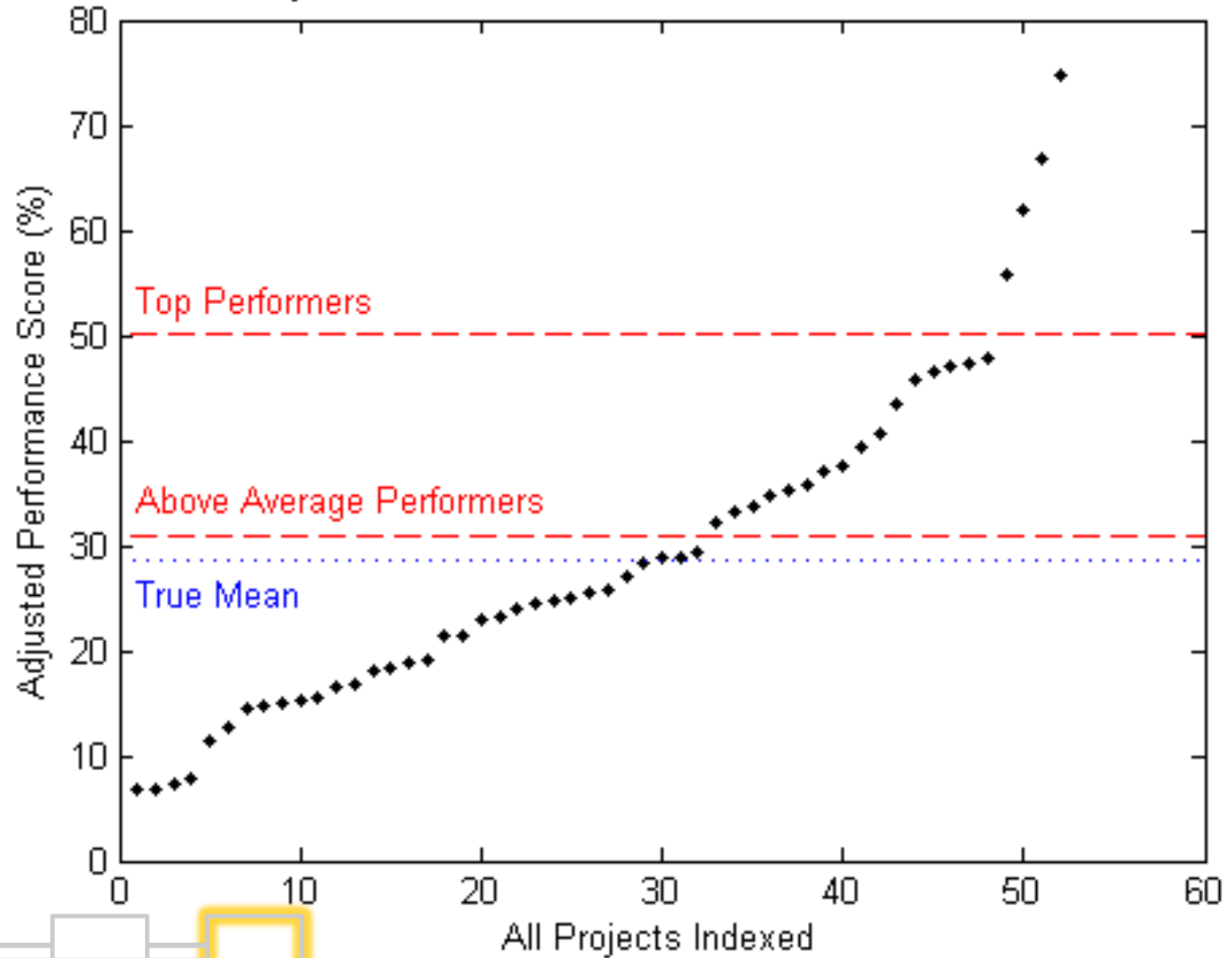**0**   **1**   **2**

Definitely Not   **Arguably**   **Definitely**

- Score is adjusted for difficulty by consensus ratings of ambiguity, scope and technical complexity of prompt

- Assessment performed by two impartial graders trained in agreement (>70% pre-revision and >95% post-revision)

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Adjusted Performance Scores - Sorted for All Teams

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WOW results are rare, and they are outliers
you will need multiple teams and rounds
(the failure issue again)

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Performance & Extrinsic Diversity

No consistent trend with gender

No consistent trend with age range

Team size (whole teams) $r = 0.714$, $p = 0.006$, $n = 13$

Team size (without top performers) $r = 0.812$, $p = 0.002$, $n = 11$

Result is not consistent at local levels $r = 0.033$, $p = 0.794$, $n = 66$

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Extrinsic diversity, gender, age etc. does not matter !!! AND the bigger the team the better (more brains are better but they create more conflict, human issue is central)

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Hypothesis 4

RQ4

There are reliable effects of team composition on long-term innovative performance, though these effects are heavily moderated by the team dynamic.

H4A   Intrinsic diversity (separation) and performance

H4B   Intrinsic diversity (variety) and performance

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Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.528	25.201	25.201	3.528	25.201	25.201
2	1.865	13.323	38.524	1.865	13.323	38.524
3	1.570	11.212	49.736	1.570	11.212	49.736
4	1.329	9.494	59.230	1.329	9.494	59.230
5	1.215	8.680	67.910	1.215	8.680	67.910
6	1.114	7.957	75.867	1.114	7.957	75.867
7	.746	5.332	81.198			
8	.644	4.597	85.795			
9	.542	3.871	89.667			
10	.417	2.977	92.644			
11	.344	2.457	95.101			
12	.292	2.086	97.187			
13	.260	1.859	99.046			
14	.134	.954	100.000			

Extraction Method: Principal Component Analysis.

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Performance & Intrinsic Diversity

Local only, 2008-2009 $\qquad$ $r = -0.501,\ p = 0.170,\ n = 9$

Local only, 2009-2010 $\qquad$ $r = -0.452,\ p = 0.121,\ n = 13$

All local teams $\qquad$ $r = -0.263,\ p = 0.034,\ n = 65$*

*Result is significant ($p < 0.05$)

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Component 2 Analysis

Component Matrix[a]

	Component					
	1	2	3	4	5	6
ENP_extraverted_intuitive	.583	.085	.132	.207	-.387	.166
ESP_extraverted_sensing	-.215	-.307	.086	-.470	.597	.403
ETJ_extraverted_thinking	-.609	-.157	.552	.142	.132	-.202
EFJ_extraverted_feeling	.310	.319	-.212	.565	.055	.447
KAIT_innovative	.694	-.059	.475	.034	-.115	-.056
NEO_extraverted	.216	-.231	.613	.388	.406	.287
NEO_agreeable	.126	.615	-.344	.076	.396	.007
NEO_conscientious	-.415	.456	.041	.120	.266	-.448
NEO_neurotic	.014	.740	.140	-.135	.201	.224
NEO_open	.592	.330	.462	.040	.100	-.276
HBDIA_factual	-.624	.280	.314	-.225	-.326	.402
HBDIB_planning	-.637	-.117	-.020	.519	.110	-.198
HBDIC_interpersonal	.528	-.491	-.371	.189	.298	-.010
HBDID_innovative	.730	.064	.063	-.423	.161	-.263

Extraction Method: Principal Component Analysis.

| 25.2% | 13.3% | 11.2% | 9.5% | 8.7% | 8.0% |

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Performance & Intrinsic Diversity

Global teams mean EFJ $r = 0.677,\ p = 0.011,\ n = 13*$

Global teams, no top performers $r = 0.490,\ p = 0.126,\ n = 11$

Global teams, outlier removed $r = 0.831,\ p = 0.001,\ n = 12**$

Local teams $r = 0.591,\ p = 0.002,\ n = 25**$

Local teams, outlier removed $r = 0.646,\ p = 0.001,\ n = 23**$

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Performance & Extraverted Feeling

Performance vs. Team EFJ - Whole Global Teams
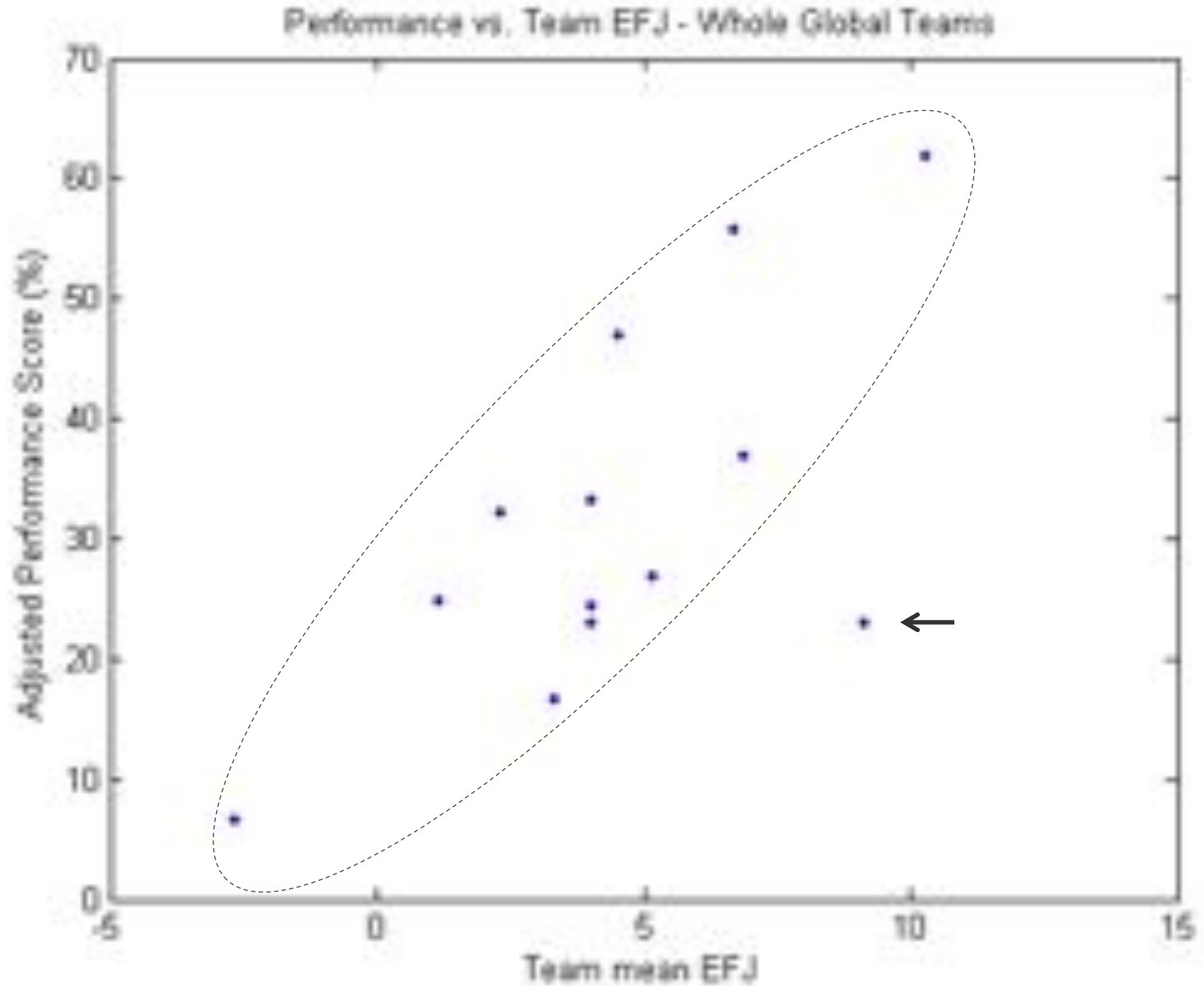
Conclusions: Performance

- Intrinsic diversity is consistently negatively correlated with team performance

- Extraverted Feeling is consistently positively correlated with team performance

- The compositional precondition has reliable effects on team performance that are both positive and negative

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intrinsic diversity creates problems, only some Extraverted Feeling variable has a positive effect.

so more brains are better but they create more conflict, the human issue is central

(some kind/enabler of open communication may be able to help … my take, do BBQ at the space, have joint beers and watch out if and when communication decreases or even stops, use coaches)

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Design Thinking Behavior

Design Thinking Behavior

Design Thinking Behavior

In-depth knowledge

In-depth knowledge

In-depth knowledge

two problems for today

1) How should you set up a team?

Big and intellectually divers – AND it comes at a prize so you must make sure dynamics work.

Do multiple teams and stop them ~~if~~ when they break.

Maybe create small self organizing units in a network composition.

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two problems for today

Design Thinking Behavior

In-depth knowledge

Design Thinking Behavior

In-depth knowledge

2) How does internal team dynamic work?

Too little time today, so only snapshot,
book me again for the full story

We analyze (video capture and frame by frame coding) facial muscle movement and body language during team interactions, such as pair programming, negotiations and tiger teams, and correlate the results to performance indicators

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AFFECTIVE DYNAMICS AND PERFORMANCE IN ENGINEERING DESIGN TEAMS

Ph.D. Oral Defense
Mechanical Engineering
Malte F. Jung
5/24/2011

INTRA-GROUP CONFLICT AND PERFORMANCE
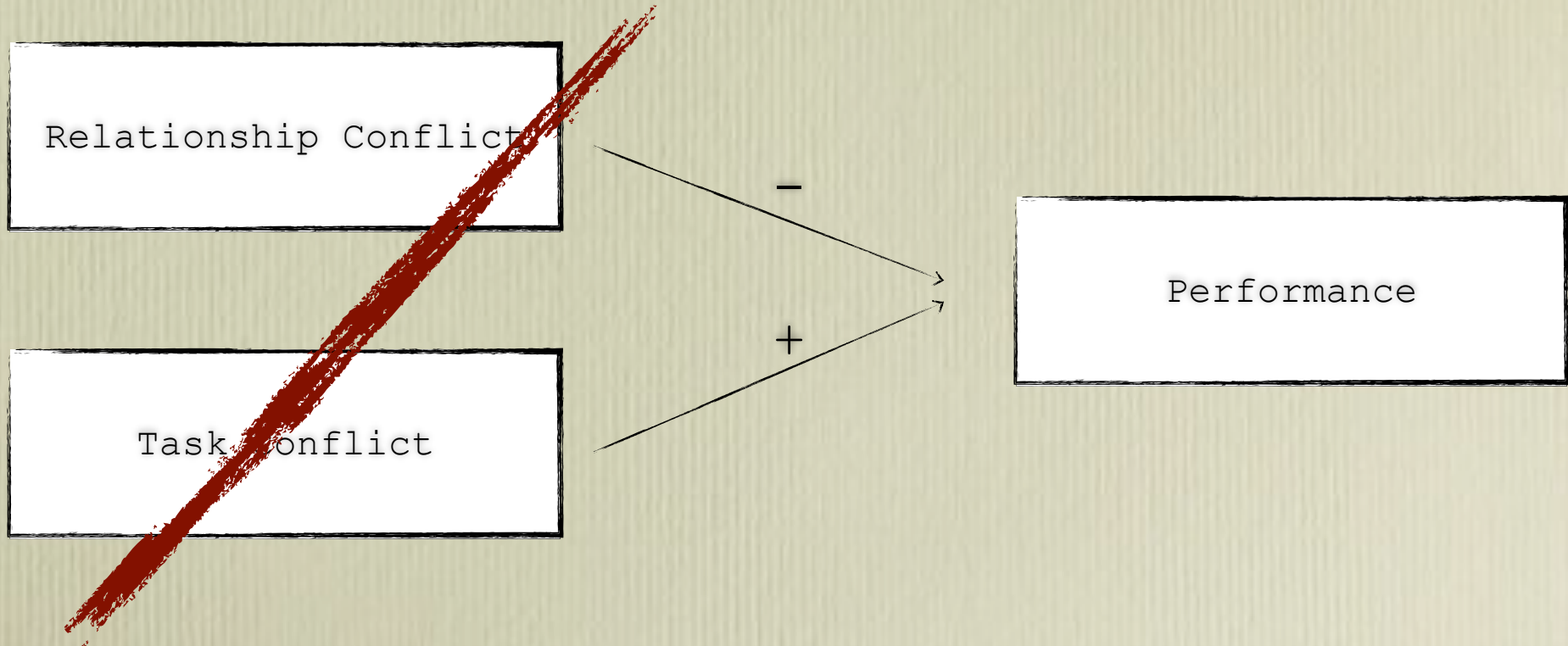
(DeDreu & Weingart, 2003)

MEASURING HEDONIC BALANCE

Cumulative
pos-neg affect

t
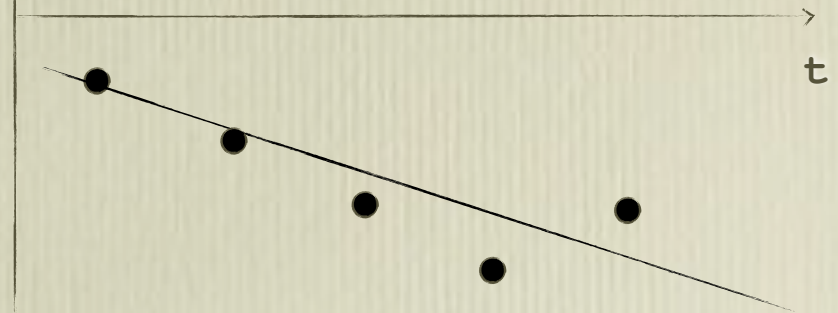
Hedonic Balance = Slope

RCISS CODING
(Krokoff, Gottman, & Haas, 1989)

SUMMARY

5 to 8 hours

5 minute hedonic balance — t1 — Team Performance t2

*

15 minute hedonic balance — t1 — ~3 months — t2 — ~3 months — Team Performance t3

*   **

CONTRIBUTIONS

A set of methods to study affect in engineering team interactions

Empirical evidence supporting a relationship between group hedonic balance and performance

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In a nutshell, any emotional communication must overall be more positive than negative. Mistrust, anxiety, anger etc. kills performance
… now how to deal with it ???
(let me tell you about MIT fatigue and the Stanford Duck syndrome)

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two problems for today

Design Thinking Behavior

In-depth knowledge

Design Thinking Behavior

In-depth knowledge

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We did not "love" each other but respected each others skills and contributions AND we never forced collaboration long term.

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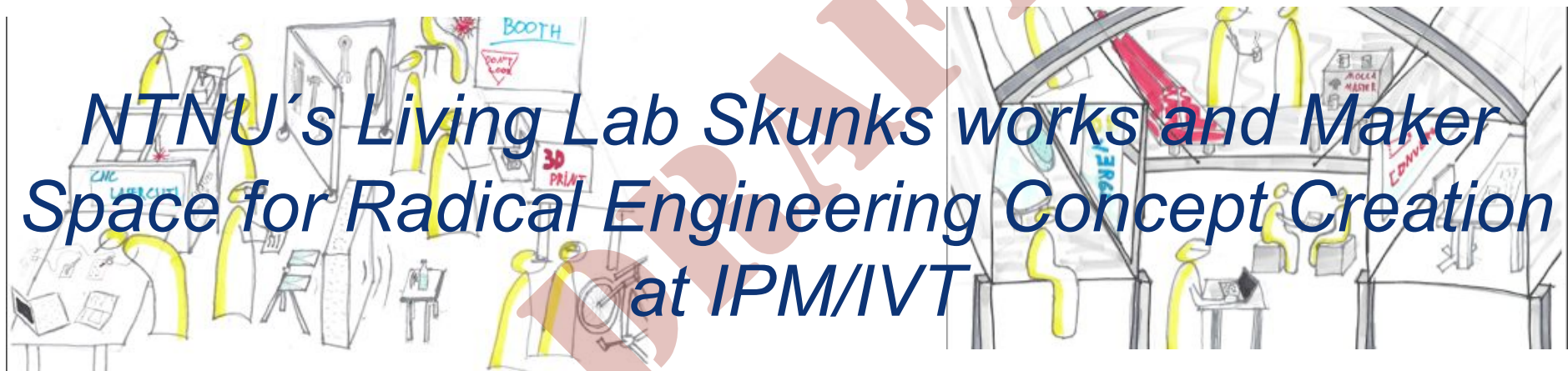STANFORD
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Takk for meg!

Questions?
Or ideas for TrollLABs experiments ;)

TrollLABS

NTNU´s Living Lab Skunks works and Maker Space for Radical Engineering Concept Creation at IPM/IVT

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Trondheim 2014 - 2018

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