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Acquisition Community Team Dynamics: The Tuckman Model vs. the DAU Model

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Acquisition Community Team Dynamics
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Why Team Dynamics?

- 82% of organizations use teams
- Technical teams drive critically important decision-making processes
  - technical team is defined as a group of professionals with specific expertise that are assembled to complete a task which results in a product
- Major DoD Acquisition programs required to use teams
- Advances in understanding team dynamics may lead to better team performance and higher team member satisfaction

Verified Group dynamics Models

- No Group dynamics Model has been Empirically Validated to accurately predict group behavior in a general and consistent way

  – Many theories, few facts, mixed results

  – Reason: Difficult to measure rigorously. High cost (time & money) leads to use of small team-populations

- The immediate need for an effective model of team dynamics has lead to a wide acceptance of the Tuckman model.

The Tuckman Group Dynamics Model

Forming

Storming

Norming

Adjourning

**Performing**

Limitations of the Model

- Based entirely on literature review
- 37 of 50 studies involved therapy and human relations training groups
- Tuckman noted limitations
  - "it must be assumed that there is a finite range of conditions beyond which the sequence of development is altered"
- Noted issues
  - "The empirical testing of existing models of group stage development is virtually an untapped field…There is need to supply statistical evidence to the usefulness and applicability of the various models suggested in the literature" (Tuckman and Jensen 1977).
  - Essentially, until this research, nothing had changed since Tuckman and Jensen made this statement in 1977

Widespread Use of Tuckman Model

- Many studies assume the model is valid

- Often taught in Government classrooms

- Applied by consulting firms

- Used by corporations to assess and enhance team function

Bottom line: An unverified Tuckman Model has been used by default for so long that validation is often assumed to have taken place

Timeline of Previous Studies
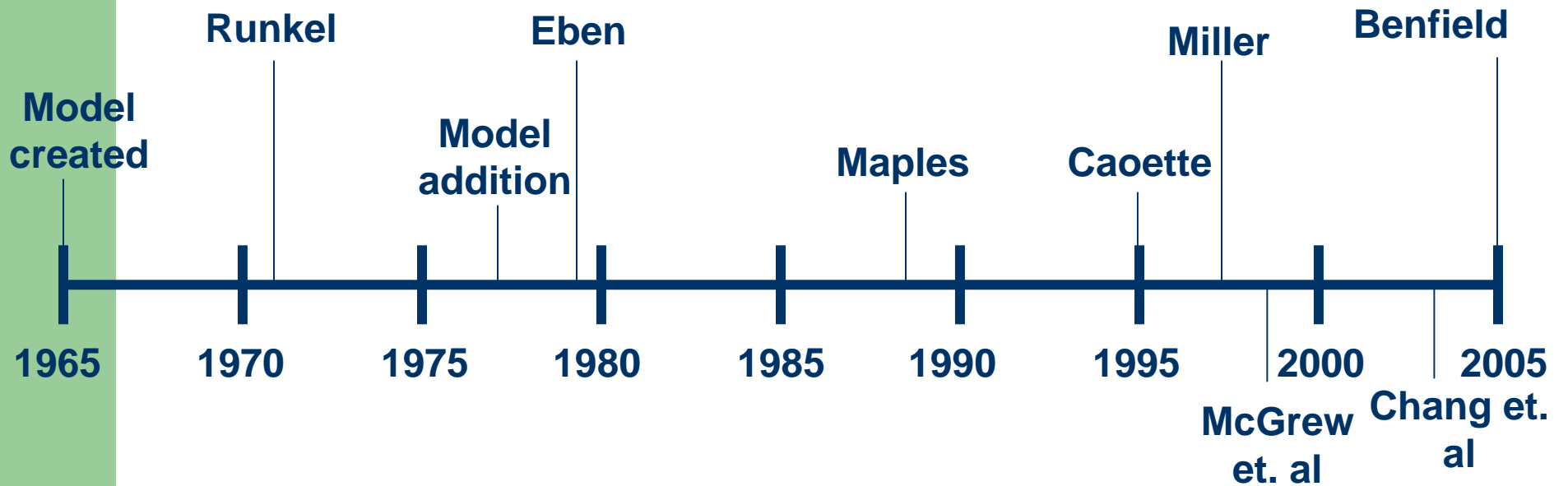
Issues with Previous Studies

- Only 1 of 10 studies found evidence of Tuckman validity (Runkel, 1971)
- Only 2 studies used methodology other than observation (Miller, 1997 & Benfield, 2005)
- Only 1 study included technical teams (Benfield, 2005)
- Limited number of groups were studied
  - 21 was the largest (Miller, 1997) until
  - Benfield, (2005) assessed 122 teams

Research Questions

1) Does the Tuckman model explain team dynamics in small, short duration, technical acquisition teams?

2) Are there any other sequences of Tuckman stages that successfully model team dynamics in small, short duration, technical acquisition teams?

Study Approach

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┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│     Select      │      │     Elicit      │      │   After first   │
│   appropriate   │ ───▶ │   cooperation   │ ───▶ │  major teaming  │
│   DAU classes   │      │    from DAU     │      │    exercise,    │
│                 │      │   instructors   │      │  complete web   │
│                 │      │                 │      │   based Survey  │
└─────────────────┘      └─────────────────┘      └─────────────────┘
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│     Survey      │      │   Researcher    │      │ Analysis engine │
│     results     │ ───▶ │  pastes results │ ───▶ │  automatically  │
│  automatically  │      │  into analysis  │      │    computes     │
│   emailed to    │      │     engine      │      │ aggregated final│
│   researcher    │      │                 │      │     results     │
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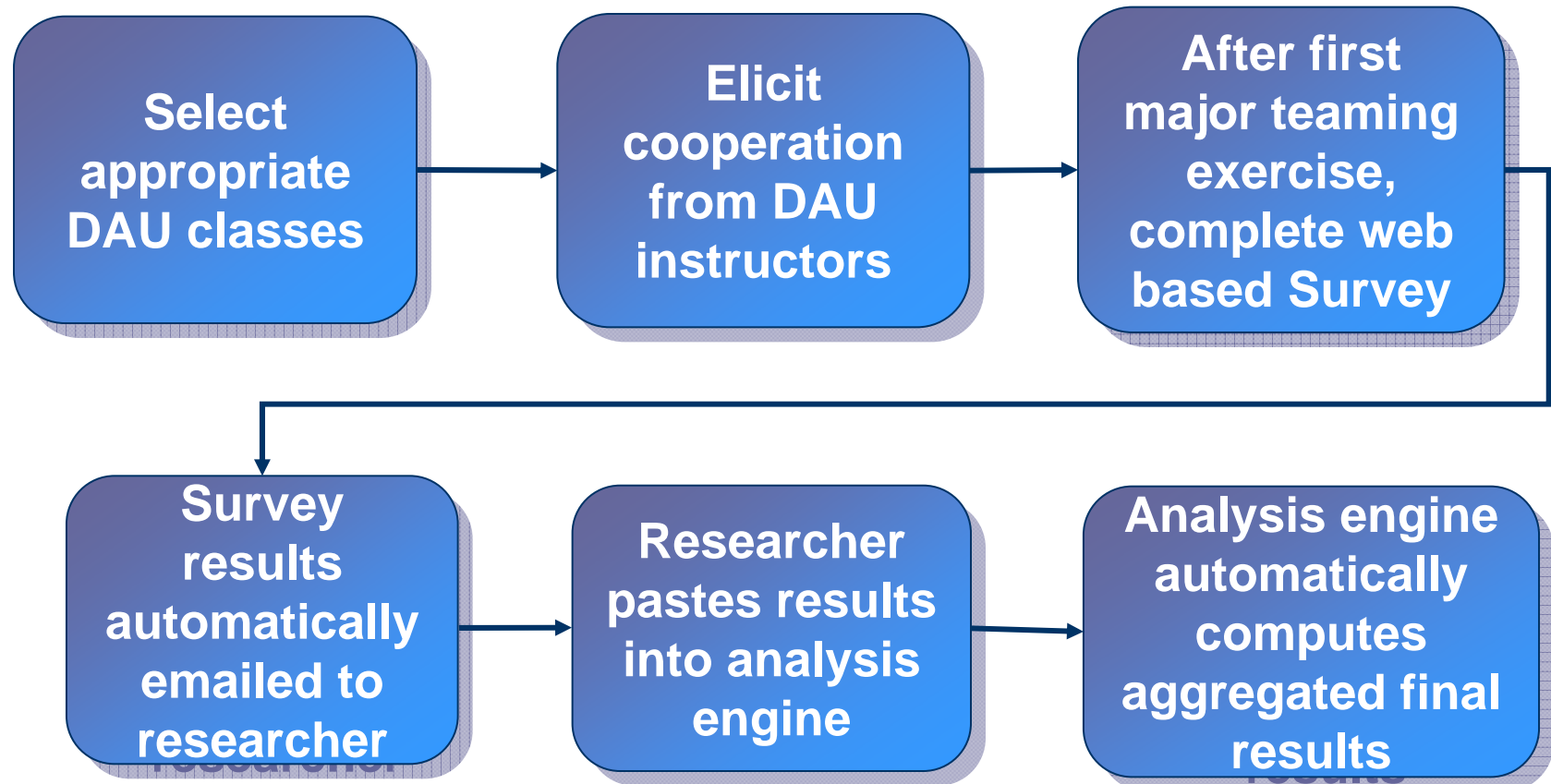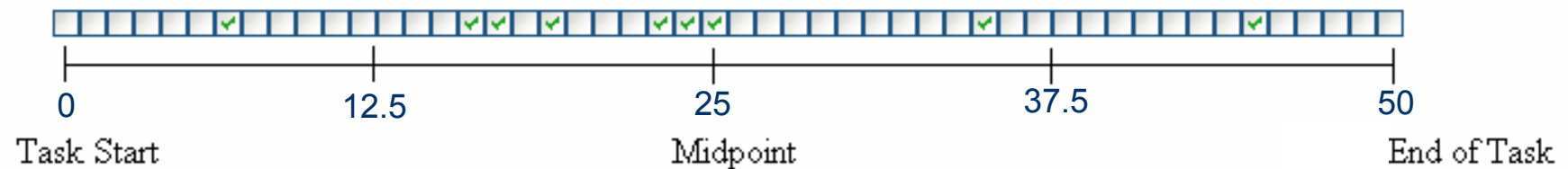
Surveys (Data Input)

- Team Member (Population) Demographics
  - DAU course, Duration of teaming activity, Team size, Teaming skills & experience, Gender, Age, Professional experience, Career background, DoD affiliation.
- Instructor Feedback -- Team Performance
- Group Process Questionnaire (GPQ)
  - Developed by Dr. Diane Miller (1996)
  - 31 questions; 15 related to Tuckman
  - 3 for forming, 4 for storming, 4 for norming, and 4 for performing
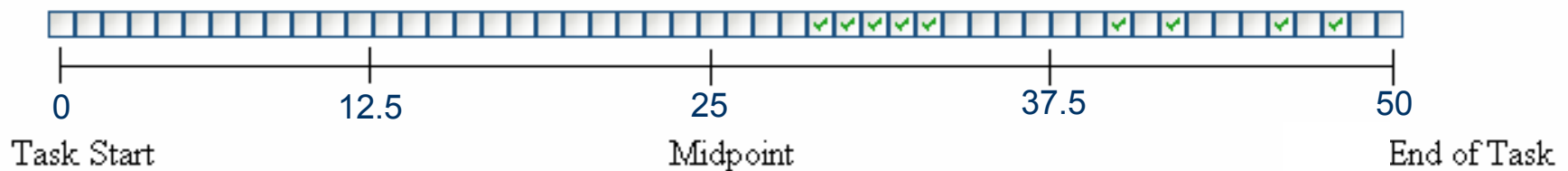 - All stages had above 0.6 reliability; two forms of validity tested.

GPQ Format

14) **The team attempted to discover what was to be accomplished**   ⊙ YES ○ UNCERTAIN ○ NO

0	12.5	25	37.5	50
Task Start		Midpoint		End of Task
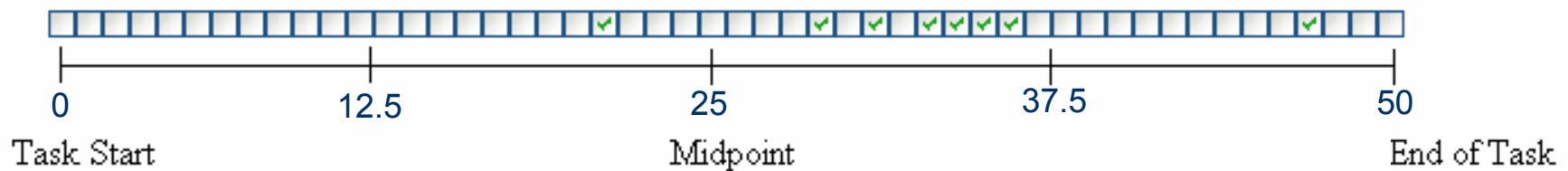
24) **Individuals tried to determine what was to be accomplished**   ⊙ YES ○ UNCERTAIN ○ NO

0	12.5	25	37.5	50
Task Start		Midpoint		End of Task

31) **The team tried to determine the parameters of the task**   ⊙ YES ○ UNCERTAIN ○ NO

0	12.5	25	37.5	50
Task Start		Midpoint		End of Task

Population Sample

- 368 teams, 1974 team members were surveyed

  – 1773 (89.8%) returned questionnaires

- Research Population:

  – Individuals = 1448

  – Teams = 321 populated by 1367 individuals

- 68% Male, 30% Female

- 12% High School, 50% Bachelor's, 36% Masters, 2% Doctorate

- Average Professional experience -- 12.3 years

Data Analysis for Teams and Individuals

- ## Raw Time-Of-Occurrence Data
  - Traditional approach
  - Incomplete, weak, or nonexistent statistical analysis
- ## Rigorous statistical and data quality analysis
  - Methodology to determine the signal to noise ratio delivered by GPQ Survey Instrument (Gen Applicable)
  - Data quality filtering eliminated noise, errors, and misinformation from the input data (Gen Applicable)
  - Statistical determination of stage discreteness
  - Sequence Analysis methodology developed to define statistically significant stage sequencing
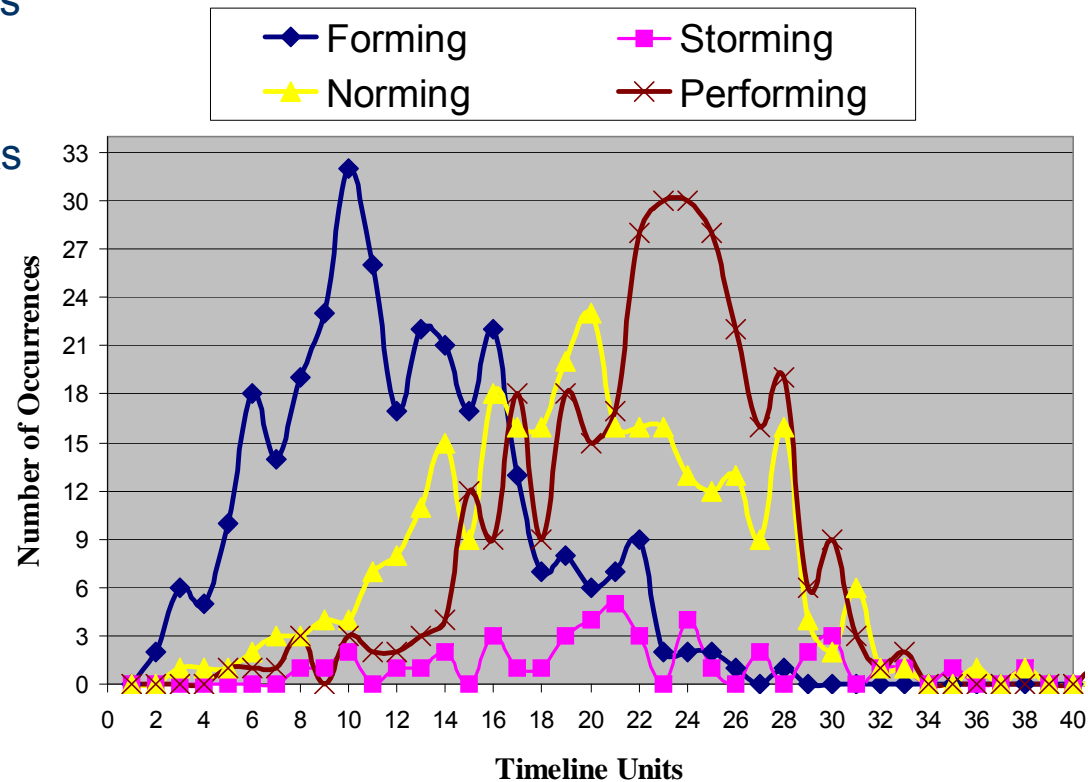
Raw Timing Data Sequences

Sequence	Teams %	Individuals %
FSNP	1%	3%
FNP	49%	26%
FPN	22%	20%
NFP	4%	8%
FNPS	2%	4%
FSPN	2%	5%
SFPN	1%	3%
SFNP	0%	1%
FPSN	0%	1%
FPNS	0%	2%
FNSP	1%	2%

DAU Team Timing: A Surprise

- All 321 Teams
- All Durations
- All Subjects/Tasks

Legend: Forming, Storming, Norming, Performing

Chart — Number of Occurrences vs Timeline Units

Forming	Norming	Performing
12.68 (25%)	20.19 (40%)	22.66 (45%)

Sequence Analysis (SA): (FSNP, FNP, F-N/P)

Measures the extent to which Tuckman sequences were experienced

F_1	F_2	F_3		3 Forming
S_1	S_2	S_3	S_4	4 Storming
N_1	N_2	N_3	N_4	4 Norming
P_1	P_2	P_3	P_4	4 Performing

Fifteen (3 + 4 +4 + 4) Questions Produce 192 (3 x 4 x 4 x 4) Possible Tuckman Sequences

SA Score = (# Tuckman sequences/192)100

Determining Sequence Analysis Significance (FSNP, FNP, F N/P)

- Generated Reference Distribution using random input
  - Random answers to GPQ: Yes, No, Uncertain
  - If Yes, random time-of-occurrence (1-50)
  - Monte Carlo Simulation Sequence Analysis Algorithm with random Inputs
  - Imposed an SA minimum stage separation (MSS = 3) requirement to ensure discrete stages ($\alpha \leq 0.05$)
- Integrated over Reference Distribution to generate Probability Curve
- Evaluate Curve to determine critical value for Tuckman Score (α=0.05)
- Compare DAU team or individual SA score to Tuckman score critical value (accepted only data with statistical significance $\geq$ 95% $\rightarrow$ 321 teams, 1367 individuals)

Sequence Analysis Results

1) **The Tuckman model, F<S<N<P, Does NOT explain team dynamics in DAU small, short duration, technical teams**

   - **Only 6 of the 321 Teams experienced a valid Tuckman sequence**

2) **Two other sequences of Tuckman stages were assessed: F<N<P and F<N/P**

Sequence	Teams %	Individuals %
FSNP	2%	6%
FNP	71%	44%
F N/P	90%	70%

Results Summary

Tuckman Model - FSNP		
Test	Teams	Individuals
Raw Time-of-Occurrence	1%	3%
Sequence Analysis	2%	6%

Tuckman Variant - FNP		
Test	Teams	Individuals
Raw Time-of-Occurrence	49%	26%
Sequence Analysis	71%	44%

Tuckman Variant – F N/P		
Test	Teams	Individuals
Raw Time-of-Occurrence	71%	46%
Sequence Analysis	90%	70%

Results – The Performance Connection

Sequence	Rating	Number	Percent
F<S<N<P	Above Average (145)	6	4.14%
	Average (151)	0	0
	Below Average (25)	0	0
F<N<P	Above Average (145)	114	78.62%
	Average (151)	102	67.55%
	Below Average (25)	13	52%
F<N/P	Above Average (145)	138	95.17%
	Average (151)	131	86.75%
	Below Average (25)	21	84%

Sequence	F<S<N<P	F<N<P	F<N/P
Correlation	0.95	0.99	0.95

Conclusions

1. Tuckman model does not explain the dynamic process in DAU small, short duration, technical acquisition teams

2. From Sequence Analysis, Tuckman model variants FNP (71%) and F N/P (90%) do fit the DAU technical team dynamics data to a significant extent

3. The data indicate a significant relationship between the FSNP, FNP or F N/P models and increased Team Performance – more research needed

4. DAU results compared to Benfield (2005) results indicate that "small" and "short duration" are less important than "technical"

Why No Tuckman?

- Norming and Performing stages not well separated in time
- Lack of Storming Data
  - Short Duration – No (Benfield 2005)
  - Small Team Sizes - No (Benfield 2005)
  - Academic Team Setting - No (Benfield 2005)
  - Technical Team Setting (as opposed to psychiatric therapy groups) – Yes
    - Professional team members with teaming experience
    - Product focused
    - Graded results with career impacts

- Create, test the reliability, and validate an improved questionnaire instrument that:
  - Redefines "Storming" with new storming questions
    - Less focused on personal conflict and emotive angst
    - More focused on cooperative challenging – brainstorming
    - Issue: Is there a discrete "storming" stage or a continuous storming background, or neither?
  - Has more than 15 questions relating to the Tuckman Model (25 to 35 would be optimal)
    - Would provide more data to support statistical treatments
  - More clearly differentiates between the norming and performing stages.
    - Better stage resolution

Recommendations for Future Work

- Enable team members to fill out GPQ in real time

  – Eliminates memory errors (error increases with team duration)

  – Improves time resolution by using natural time rather than a fixed number of time increments per team duration

- Apply analysis methodology developed by this effort to:

  – Determine how many teams must be measured before the results no longer change significantly

  – Study technical teams of varying size and duration

  – Study therapy groups to see if FSNP holds in that setting

  – Test other team settings (types of teams)

  – Test other group dynamics models

Advantages of Methodology

- Efficient process allows large numbers of teams to be studied economically
  - Few resources (time and money) needed to collect large amounts of data that support higher quality results
  - Web based data collection utilizing a validated, reliability tested survey rather than unavoidably biased real-time observation
- Analysis entirely automated
  - Once analysis engine is completed (Excel), paste in collected data as it arrives – done, Including all publishable result data, tables, and figures
  - Sensitivity analysis of each numerical assumption was assessed by parametric analysis
- Rigorous statistical and data filtering methods together with larger team populations produce highly credible results
- Methodology and analysis engine easily adjusted to fit modified GPQ and other experimental configurations

Where to Find Research Details

- http://www.dau.mil/pubs/misc/Duration_ Technical_Team_Dynamics.asp

- http://**www.teamresearch.org**

Questions?