NSCA®
NATIONAL STRENGTH AND CONDITIONING ASSOCIATION

2022 NSCA TACTICAL ANNUAL TRAINING

#NSCATactical22

CONFLICT OF INTEREST STATEMENT

We do not have any conflicts of interests surrounding this presentation.

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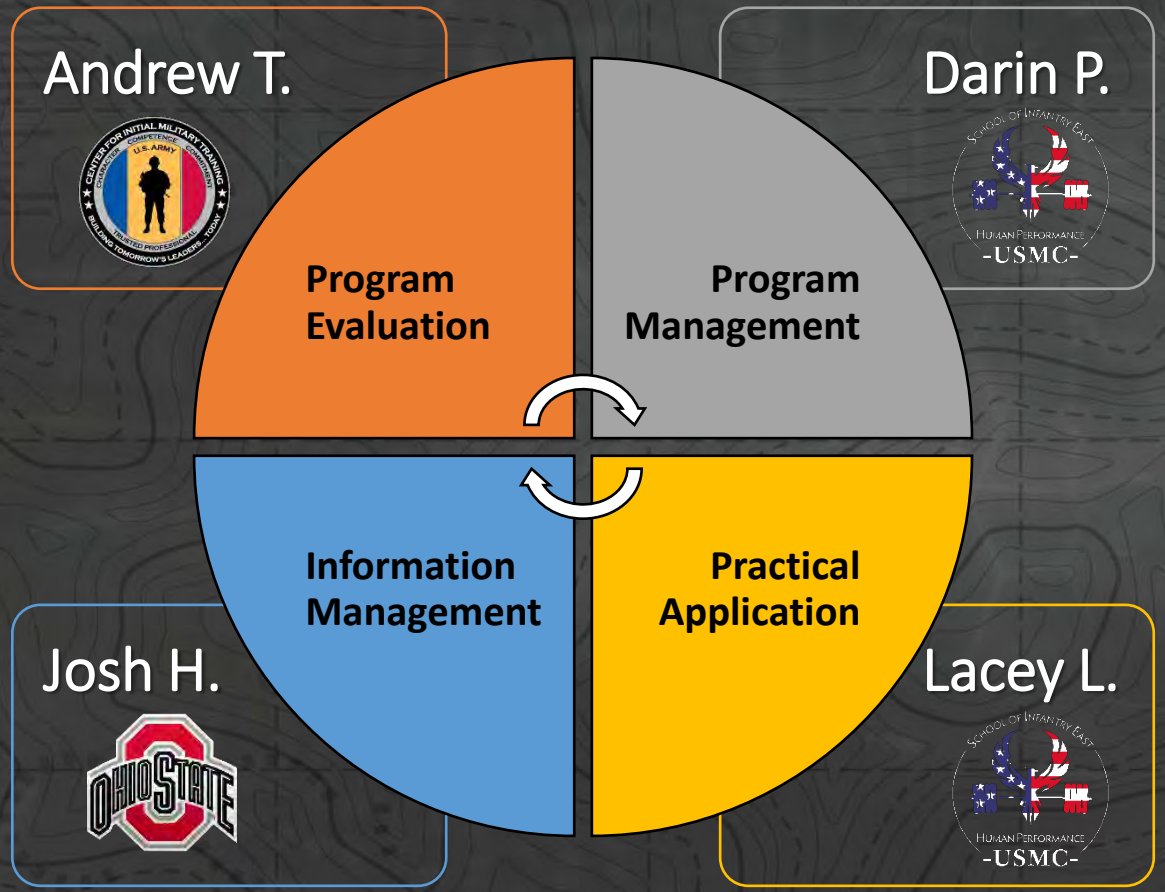
Presentation of any products or devices does not constitute endorsement by the authors, NSCA, or United States' Government.

COLLABORATION IS CRITICAL

We do have significant collaborative relationships that have helped enable the efforts within this presentation

INTRODUCTION TO OUR TALK

Speakers

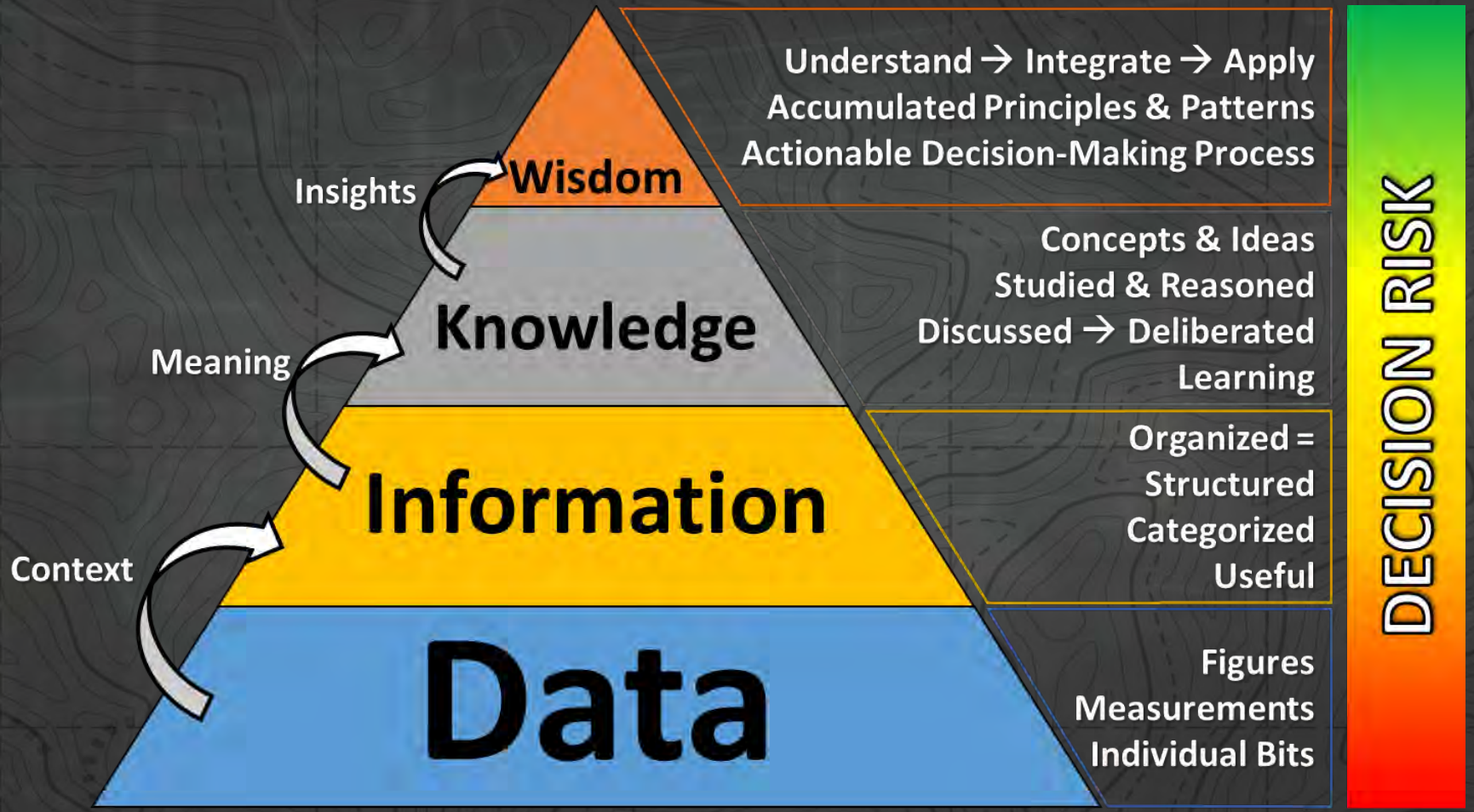


Agenda

A) Intro Data → Wisdom
D) Leveraging Programmatic Support
L) Executing for the Performer
A) Planning for Data-driven Decisions
J) Forward Leaning Tools & Technologies
J) Demonstrating AMS Theory
A) Understanding and Learning from Data
L) Evolving the Standard of Practice
D) Enterprise ROI & Way Forward

DATA IS THE FOUNDATION FOR DECISION MAKING

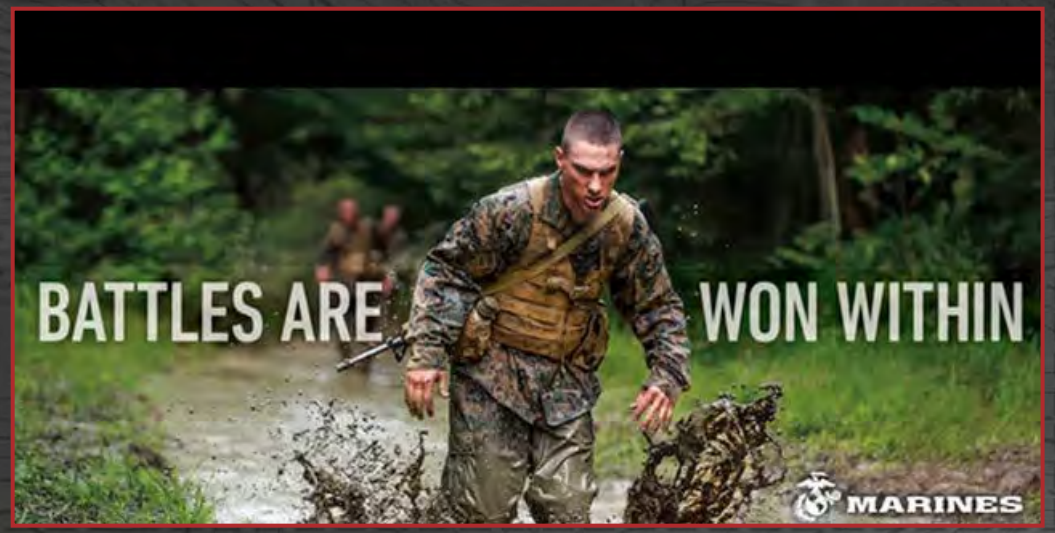
Program Management, Application, & Evaluation

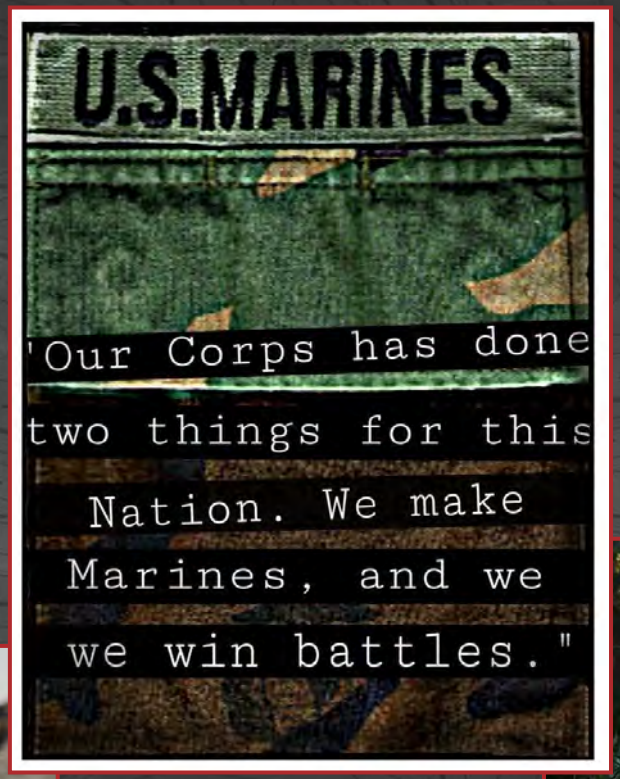


Cleveland, H. (1982). Information as a resource. Futurist, 16(6), 34-39. | Ackoff, R. L. (1989). From data to wisdom. Journal of applied systems analysis, 16(1), 3-9.

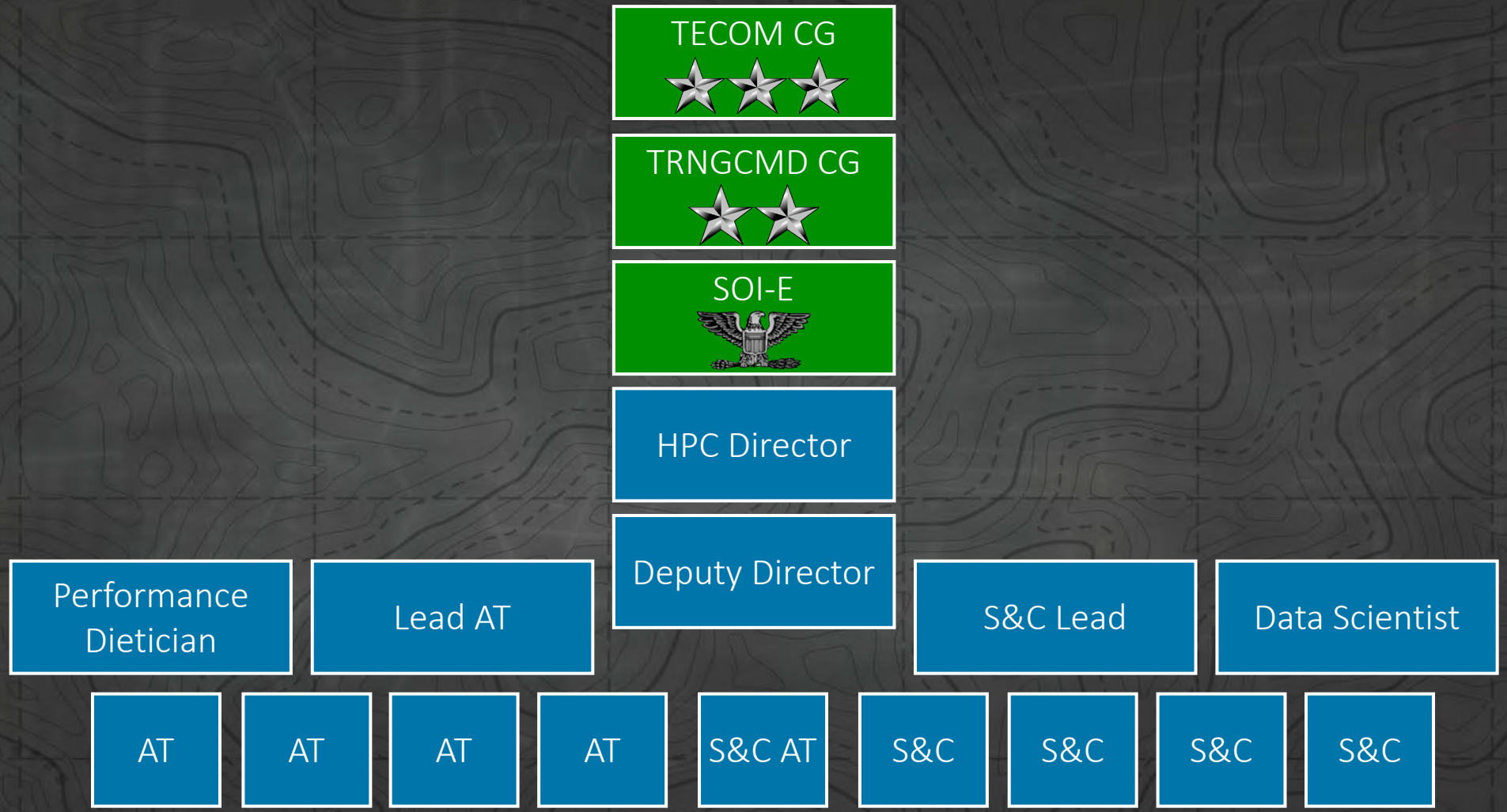
CULTURE & MINDSET

What if your team has never lost?





STRUCTURE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TRNGCMD CG
SOI-E
HPC Director
Deputy Director
Performance Dietician
Lead AT
S&C Lead
Data Scientist
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SOI-E HPC Growth Timeline

Human Performance Community of Interest

- Best Practices
- Testing Protocols & Results
- Information Sharing







2008 2015 2017 2018 2023

DO SOMETHING NOW!

Don’t Wait.

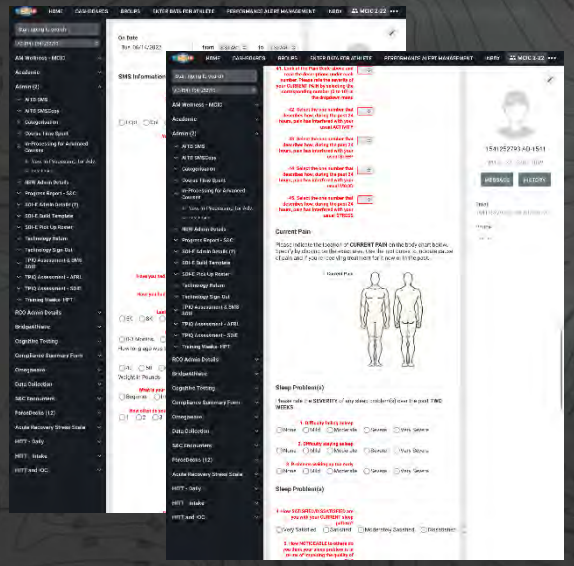
It will never be the perfect time.

Who has what we need? How do we get some of it?

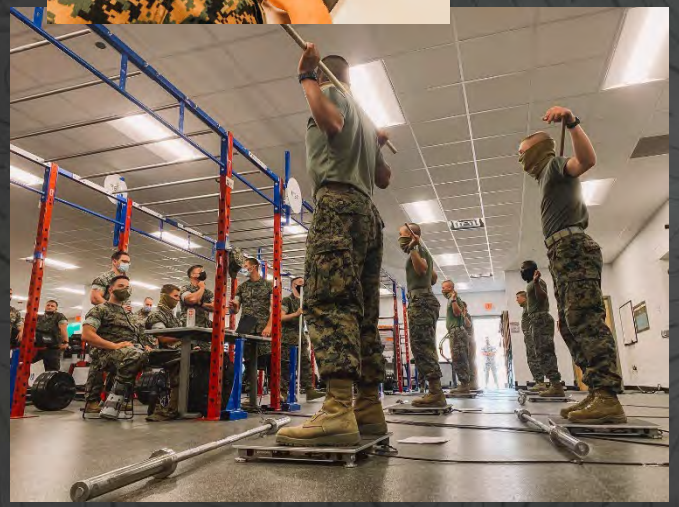
COLLABORATIVE EFFORTS

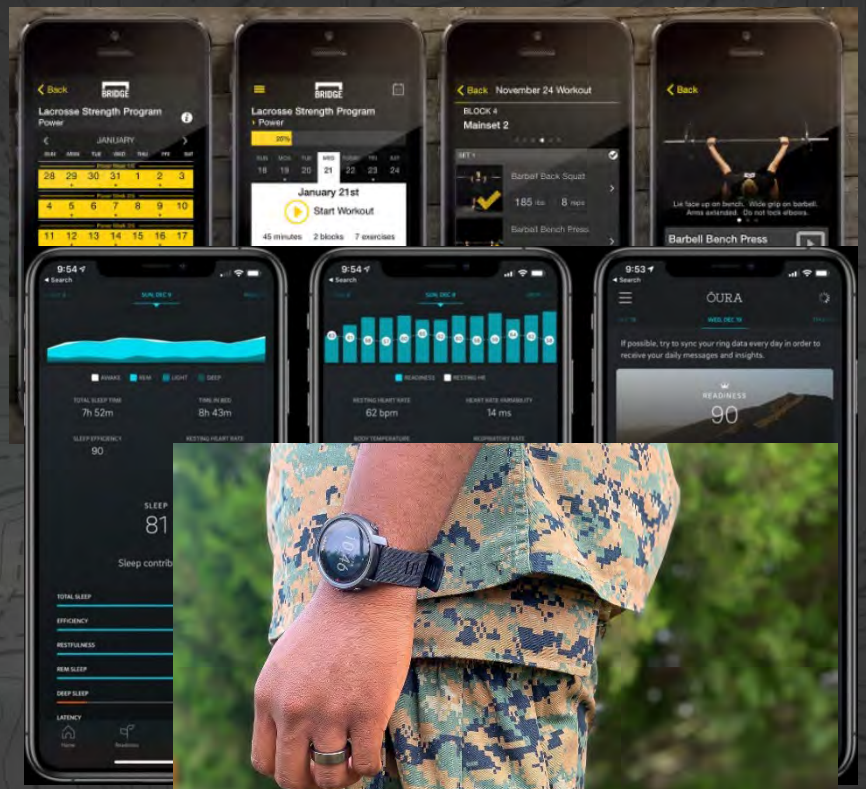
Outside vs Internal

PRACTITIONERS' POV: ASSESSMENT & MONITORING



IMPLEMENTING TOOLS AND TECHNOLOGIES





ASSESSMENT & MONITORING WITH TOOLS & TECH

CATEGORY SCORES

Auto Sorted by Overall Score. Click on any header to sort by Category. Green = well above class average, Red = well below class average.

MARINE	OVERALL RATING	Upper Body Strength Rating	Lower Body Strength Rating	Lower Body Power Rating	Aerobic Capacity Rating	CFT Rating	PFT Rating
	83	84	75	P	100	63	92
	82	93	86	P	100	70	77
	80	82	86	78	84	59	79
	80	76	100	80	100	68	86
	78	72	100	79	100	70	68
					93	68	80
					64	62	67
					100		
					65		
					79		

NORMS

1RM DEADLIFT GROUP AVERAGE (lbs)

269

1RM PULLUP GROUP AVERAGE (lbs)

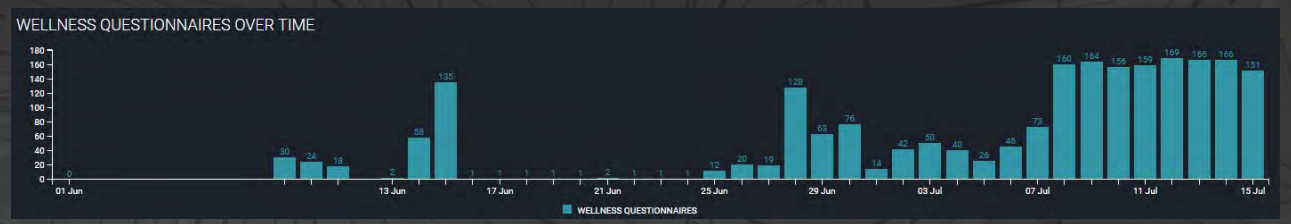
36

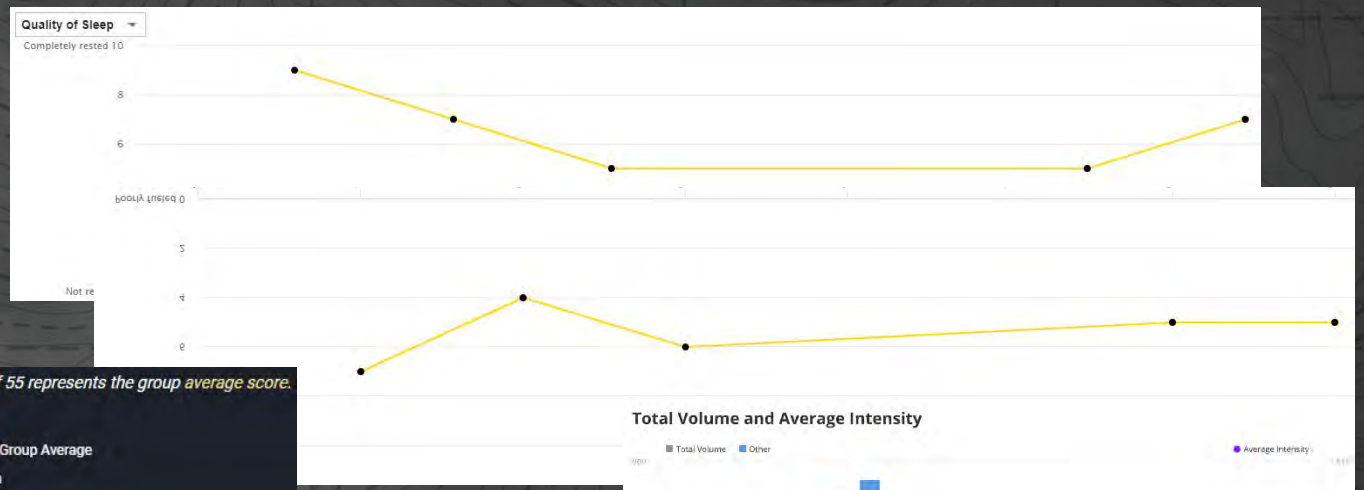
PFT RUN TIME (min)

21.53

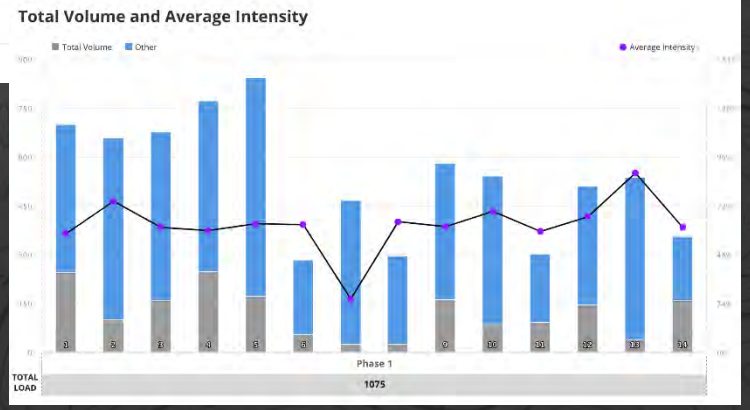
PFT RUN TIME (min) SD

1.59





The larger the size of the blue circle the better. A value of 55 represents the group average score.



Peterson (MS, ATC), Lyrla (MS, RSCC), Thompson (PhD, MS), Hagen (PhD, MS)

Evolution through Evaluation

COLLABORATION: S&T + R&D → O&M

STARTED FROM THE BOTTOM

NOW WE ARE HERE

WVU Rockefeller Neuroscience Institute

Human Performance Applied Science Team

PEOPLE ARE THE MOST IMPORTANT PART OF YOUR DATA INFRASTRUCTURE

FITNESS TESTING

FIELD EXERCISES

TRAINING PLANS

DIGITAL EVALUATION

TOOLS & TECHNOLOGIES

DISCOVER

Research Scientist

To design and lead innovative science and technology to ASSESS, UNDERSTAND, and IMPROVE performance, fitness, and health

ANALYZE

Statistician

To analyze data investigations and answer hypotheses

EXPLAIN

Technical Writer

To disseminate technical information throughout defense, government, and academic communities

BUILD

Biomedical Engineer
Data Architect

To integrate data sources, efficient extraction, signal processing, and backend management

SOLVE

Data Scientist

To develop models, algorithms, and solve BIG DATA problems

CONVEY

Graphic Designer

To streamline visual information for easy communications

DEVELOP

Frontend Full Stack Developer

To create capabilities and interfaces for data transfer to and from performers, staff, instructors, and command

INFORMATION AGE DECISION MAKING

Requires a Data Driven Architecture

PROFILING

Movement Competency
Occupational Skills
Mindset

Power
Strength
Endurance

Aerobic Capacity
Anaerobic Capacity
Buffering

Training Age
Nutrition
Recovery

MONITORING

Baseline → Daily/Weekly → Post POI

PROGRAM EVALUATION

General Group Effects

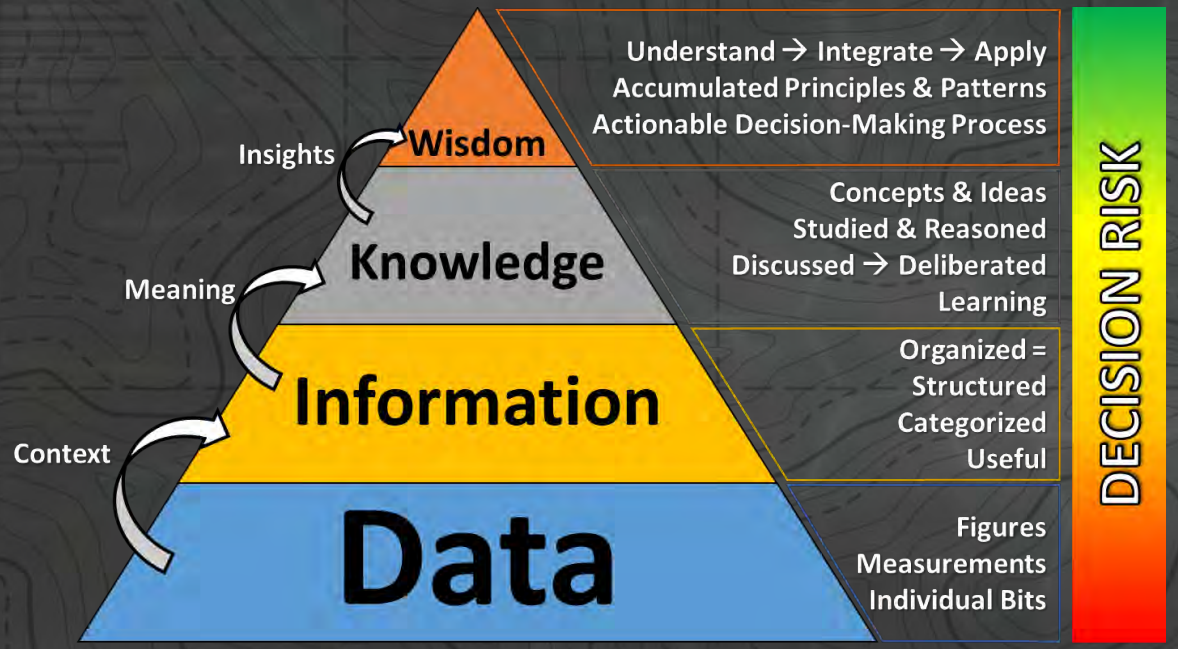
- Subjective Wellness
- Compliance
- Fitness Scores
- MSKI

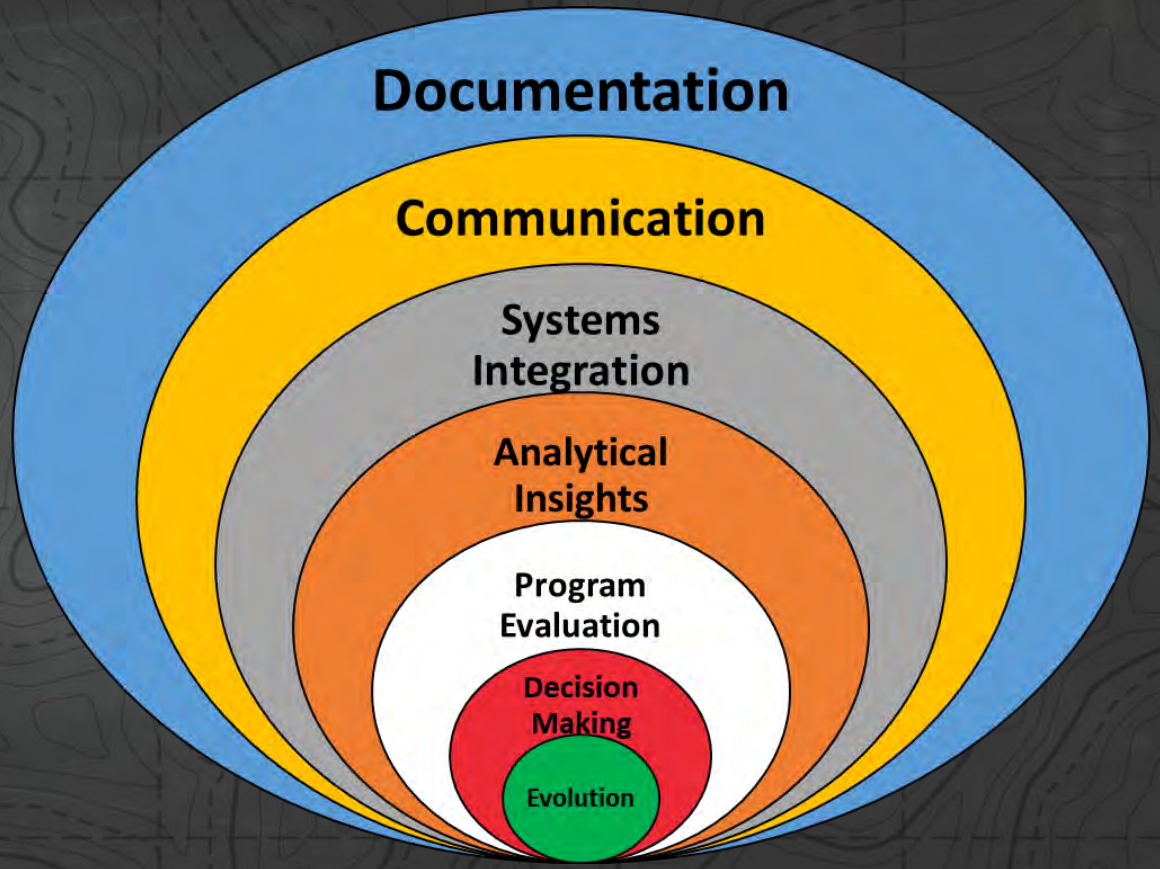
Specific Group Effects

- Improved Aerobic Capability
- Increased Self Use of Recovery Tools
- Decreased Limited/Light Duty Days

DO I REALLY NEED A DATA DICTIONARY?

PURPOSE

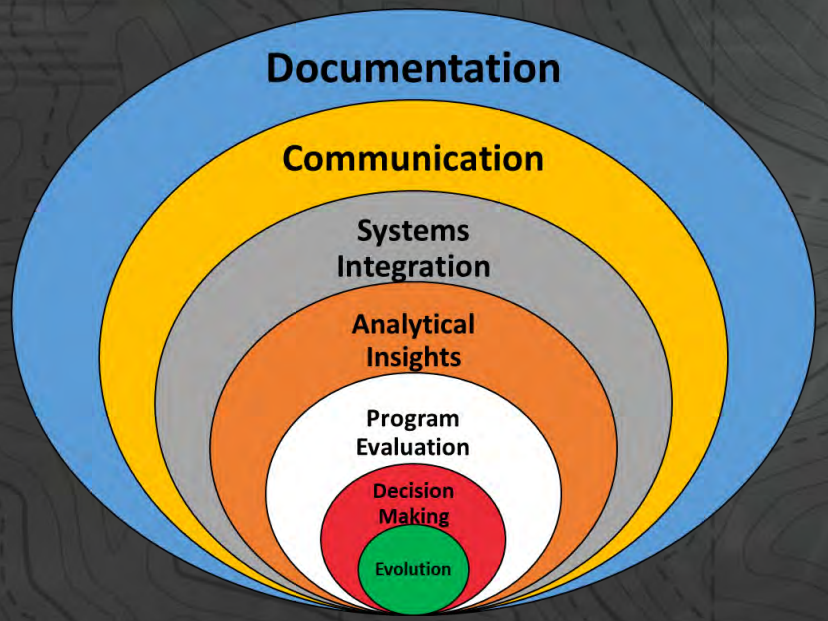




Yes, You Do

HOW DO I CREATE A DATA DICTIONARY?

PURPOSE



PROCESS

Start General

- Data Element/Field Name
- Definition, Description, Example
- Who, What, When, Where

Progress to Specific

- Application/Why/To What End
- Data Type, Format, Accepted Values
- System Relationships, Quality Indicator Coding
- Calculations, Citations, Hyperlinks

SUGGESTIONS

Define Nomenclature Upfront

Each Data Element = 1 Row

No Blanks

Make a Visual Taxonomy

DATA DRIVEN ARCHITECTURE

DATA NOMENCLATURE

- List of terminology for filling out data dictionary

	A	B	C	D	E	F	G	H	I	J
1	Domain		Application		Timepoint/Phase		Setting		Source	
2	URN	Name	URN	Characteristic	URN	Category	URN	Name	URN	Category
3	1	Physical	1	Training Load	1	Baseline	1	HP Center	1	Participant Tablet
4	2	Cognitive	2	Acute Load	2	Re-Baseline	2	Field	2	Staff Tablet Entry
5	3	Psychological	3	Chronic Load	3	Monitoring	3	Laboratory	3	Stopwatch/Timing
6	4	Psychophysiological	4	Metabolic	4	Mid POI	4	Clinic	4	Participant Feedba
7	5	Spiritual	5	Sleep/Recovery	5	Post POI	5	Classroom	5	Hand Measuremer
8	6	Nutritional	6	Power (Muscular)	6	Injury Evaluation	6	Record	6	Training Record
9	7	Environmental	7	Strength (Muscular)	7	Rehabilitation	7	N/A	7	Polar H10
10	8	Behavioral	8	Endurance (Muscular)	8	N/A			8	Smartabase
11	9	Demographic Info	9	Aerobic					9	FD Forceplates
12	10	Metabolic	10	Anaerobic					10	HT Motion Capture
13	11	N/A	11	Motor Skill					11	RNI Health App
14			12	Cognition					12	Oura Ring

DATA DICTIONARY

- Organized structure of applicable data elements

	A	B	C	D	E	F	G	H	I
1	Element Display Name	Element Field Name	Description	HP Domain	Application	Timepoint/Ph	Setting	Source	
2	Date of Entry	DateEntry	Date on entry intro database	Metadata	Data Tagging	Baseline	Record	Smartabase	
3	Participant ID	PID	8 digit participant identificatior	Metadata	Data Tagging	Baseline	Record	Participant Feedback	
4	Date of Birth	DOB	Date of birth ddmmmyyyy	Demographic I	Multi-characteristic	Baseline	Record	Training Record	
5	Height	Ht	Height in boots (cm)	Demographic I	Multi-characteristic	Baseline	HPC	Hand Measurement	
6	Weight	Wt	Body weight in boots and utes	Demographic I	Multi-characteristic	Baseline	HPC	FD Forceplates	
7	Body Fat%	Bf	Jackson & Pollock 3-site skinfol	Demographic I	Multi-characteristic	Baseline	Laboratory	Hand Measurement	
8	GCT Total	GCT_Total	General classification test total	Cognitive	Cognition	Baseline	Classroom	Training Record	
9	Psychomotor Vigilance	PVT_Score	Composite score from PVT resp	Cognitive	Cognitive Performa	Monitoring	Field	Participant Tablet Entry	
10	Inhibitory Control	Flanker_Score	Composite score from Flanker a	Cognitive	Cognitive Performa	Monitoring	Field	Participant Tablet Entry	
11	Working Memory	OSPAN_Score	Composite score from OSPAN t	Cognitive	Cognitive Performa	Monitoring	Field	Participant Tablet Entry	
12	Sleep Efficiency Score	Oura_Efficiency	Oura provided sleep time/time	Behavioral	Sleep/Recovery	Monitoring	Field	Oura Ring	
13	Subjective Readiness	AM_ARSS	Composite score from Acute Re	Behavioral	Sleep/Recovery	Monitoring	Field	Oura Ring	
14	Average Resting RMSSD	Avg_Rest_RMSSD	Resting HRV (ms) from supine 5	Psychophysiol	Training Load	Monitoring	HPC	Polar H10	
15	Average Resting HR	Avg_Rest_HR	Resting HR (bpm) from supine 5	Psychophysiol	Training Load	Monitoring	HPC	Polar H10	
16	Overhead Squat Composite score	OHS_Comp	Composite score of feet, knees	Physical	Movement Compet	Baseline	HPC	HT Motion Capture	
17	V-Sit Average	VSit_Avg	Average reach distance (in cm)	Physical	Movement Compet	Baseline	HPC	Hand Measurement	
18	Loaded CMJ Height	L_CMJ_Height	20 kg loaded countermovemen	Physical	Power (Muscular)	Rehabilitation	HPC	FD Forceplates	
19	Loaded CMJ Modified Reactive Stren	RSIMod	Jump height divided by total gr	Physical	Power (Muscular)	Rehabilitation	HPC	FD Forceplates	
20	Pullup 1RM Allometric Scaled	PullUp_1RM_Allo	Maximal pullup weight divided	Physical	Strength (Muscular	Mid POI	HPC	Smartabase	
21	Deadlift Est 1 RM Allometric Scaled	Deadlift_1RM_Allo	Estimated 1 rep maxmium deac	Physical	Strength (Muscular	Mid POI	HPC	Smartabase	
22	CFT 880 Time	CFT_880	Time to complete CFT 880 (ss.m	Physical	Anaerobic	Post POI	Field	Training Record	
23	CFT Anaerobic Power	CFT_AnaerobicPower	Running mass in kg x 9.81 m/s^	Physical	Anaerobic	Post POI	Field	Smartabase	
24	CFT ACL Number	CFT_ACL	Number of ammo can lifts com	Physical	Endurance (Muscul	Post POI	Field	Training Record	
25	PFT Pushup Number	PFT_Pushup	Number of completed pushups	Physical	Endurance (Muscul	Post POI	Field	Training Record	
26	PFT Crunches Number	PFT_Crunches	Number of completed crunche	Physical	Endurance (Muscul	Post POI	Field	Training Record	
27	PFT PullUps Number	PFT_PullUps	Number of completed pull ups	Physical	Endurance (Muscul	Post POI	Field	Training Record	
28	PFT Plank Time	PFT_Plank	Plank time in seconds (ss.ms)	Physical	Endurance (Muscul	Post POI	Field	Training Record	
29	PFT 3 Mile Time	PFT_3Mile	Time to complete 3 mile run in	Physical	Aerobic	Post POI	Field	Training Record	
30	PFT Aerobic Capacity	PFT_AerobicCapacity	Estimate VO2 max from 3 mile	Physical	Aerobic	Post POI	Field	Smartabase	

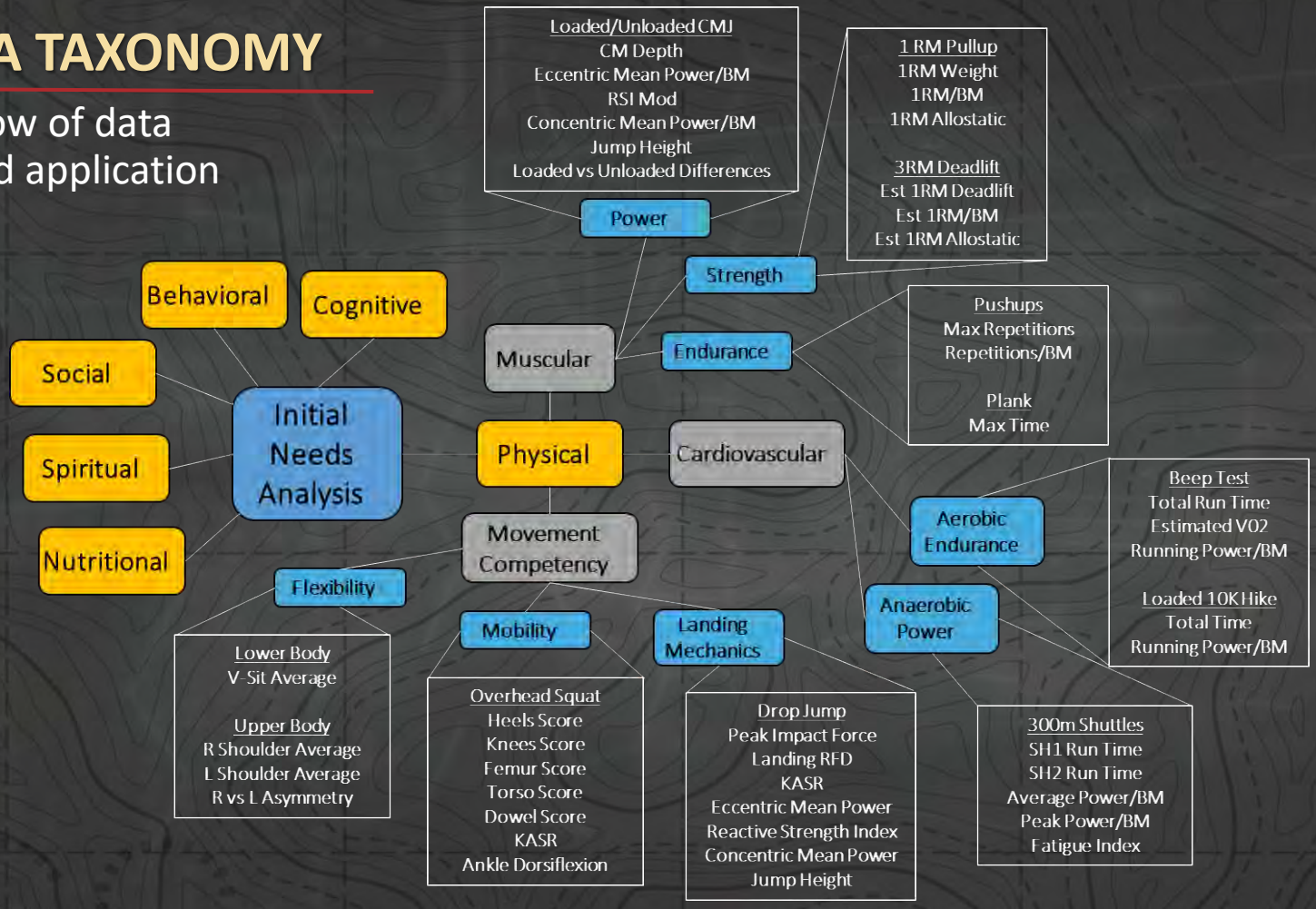
TSAC 2022_Nomenclature | TSAC 2022_Data Dictionary | TSAC 2022 Taxonomy

The First Component is ALWAYS Personnel

DATA DRIVEN ARCHITECTURE

DATA TAXONOMY

- Visualized flow of data elements and application



Mission Demands + Performer Profile

Training Needs

Programming

Monitoring

The First Component is ALWAYS Personnel

NEEDS ANALYSIS

COMMAND OBJECTIVES	PRACTITIONER OBJECTIVES	TACTICAL ATHLETE OBJECTIVES
*Examples for spurring ideas **Unit Readiness** • Training Records • Injury Status • Pillar Status **Practitioner Utilization** • Time to service • Cost of service • Facility/Provider Usage	**Injury Status** • History of Evaluations / Rehab • Progression to RTD **Training Load Monitoring** • Training evolution tracking • Mileage / Caloric Expenditure **Progression Over Time** • Strength / Cardio Adaptations • Force Development Progression	**Performance Over Time** • Strength / Power Production • Body Composition **Meaningful Training Load / Recovery** • Understanding daily training load in context • Interaction between TL and Recovery **Historical Records** • Record of provider encounters over time for post-separation

HAVE A PURPOSE. DO NOT COLLECT DATA FOR THE SAKE OF COLLECTING DATA.

Q1 Q2 Q3 Q4

2020 2021

PHASE ONE
- **-DIVE** INTO HISTORICAL DATA
- **-ASSESS** READINESS/RESILIENCY
- **-WEEK 0: IOC** | **WEEK 12:** SOFT-PILOT WEARABLES FOR LOGISTICS

PHASE TWO
- **-ASSESS** READINESS/RESILIENCY
- **-GRADUATION** FROM TBS
- **-WEEK 0: IOC** | **WEEK 12:** ROLL OUT WEARABLES TO ENTIRE CLASS
- **-CAPTURE** IOC DYNAMICS & IDENTIFY EMPIRICAL MARKERS OF SUCCESS

PHASE THREE
- **- ASSESS** READINESS/RESILIENCY
  TBS MOS SELECTION, GRADUATION, IOC WEEK 0, WEEK 12
- **- EDUCATE AND SUPPORT** @ MOS SELECTION
  TACTICAL STRENGTH & CONDITIONING, RECOVERY OPTIMIZATION
- **- HOLISTIC** READINESS
- **- CAPTURE** IOC DYNAMICS

PHASE FOUR
- **-REPEAT** ACROSS MULTIPLE ITERATIONS
- **-COLLATE & REPORT** ANALYTICS
- **-PROVIDE** DATA-DRIVEN PROCESS OPTIMIZATION

SMARTABASE DASHBOARD

01 END-USER -> EDUCATE ON OWN DYNAMICS

02 SUPPORT STAFF -> DAILY TRIAGE AND CORRECTIVES

03 COMMANDER -> TOTAL FORCE READINESS STATUS

PROGRAM GOALS

- IDENTIFY MARKERS OF IOC SUCCESS VS. FAILURE
- QUANTIFY WORKLOAD / RECOVERY DYNAMICS
- DEVELOP DATABASE DRIVEN PREDICTIVE ALGORITHMS
- PREPARE LIEUTENANTS THROUGH EDUCATION AND PROGRAMMING

END STATE

AN OPTIMIZED SELECTION AND TRAINING PIPELINE

HANDS ON BASELINE ASSESMENT

HANDS-OFF DAILY WORK LOAD/RECOVERY MONITORING

TACTICAL DEMANDS → QUANTIFIABLE MEASURES

ISOMETRIC MID-THIGH PULL

Lifting equipment or body drag - peak forces i.e. maximal strength

DROP JUMP

Landing from elevated terrain - landing forces and reactive strength index

COUNTER MOVEMENT JUMP

Jumping over a high obstacle - scaled power modRSI, jump height

SELECTING THE RIGHT TOOLS

ACCURACY

Raw Data

- High-resolution non or lightly processed data. I.E. Beat to beat heart rate

Summary Data

- Session or test-based metrics. I.E. Jump height, AVG heart rate, Caloric Expenditure

Common Measures

- LCC = Lin's Concordance Correlation
- MAPE = Mean Absolute Percentage Error
- Histograms w/ % Errors

RELIABILITY

Measure Repeatability

- Does each device give you the same results?
- Does each test/repetition give the same results?

Common Measures

- CV = Coefficient of Variation
- MAPE = Mean Average Percent Error
- ICC = IntraClass Correlation Coefficient

LOGISTICS

Cost

- Cost per unit (if hardware)
- Licensing costs (if software). Per user? Per seat? Both?

Data to Decisions

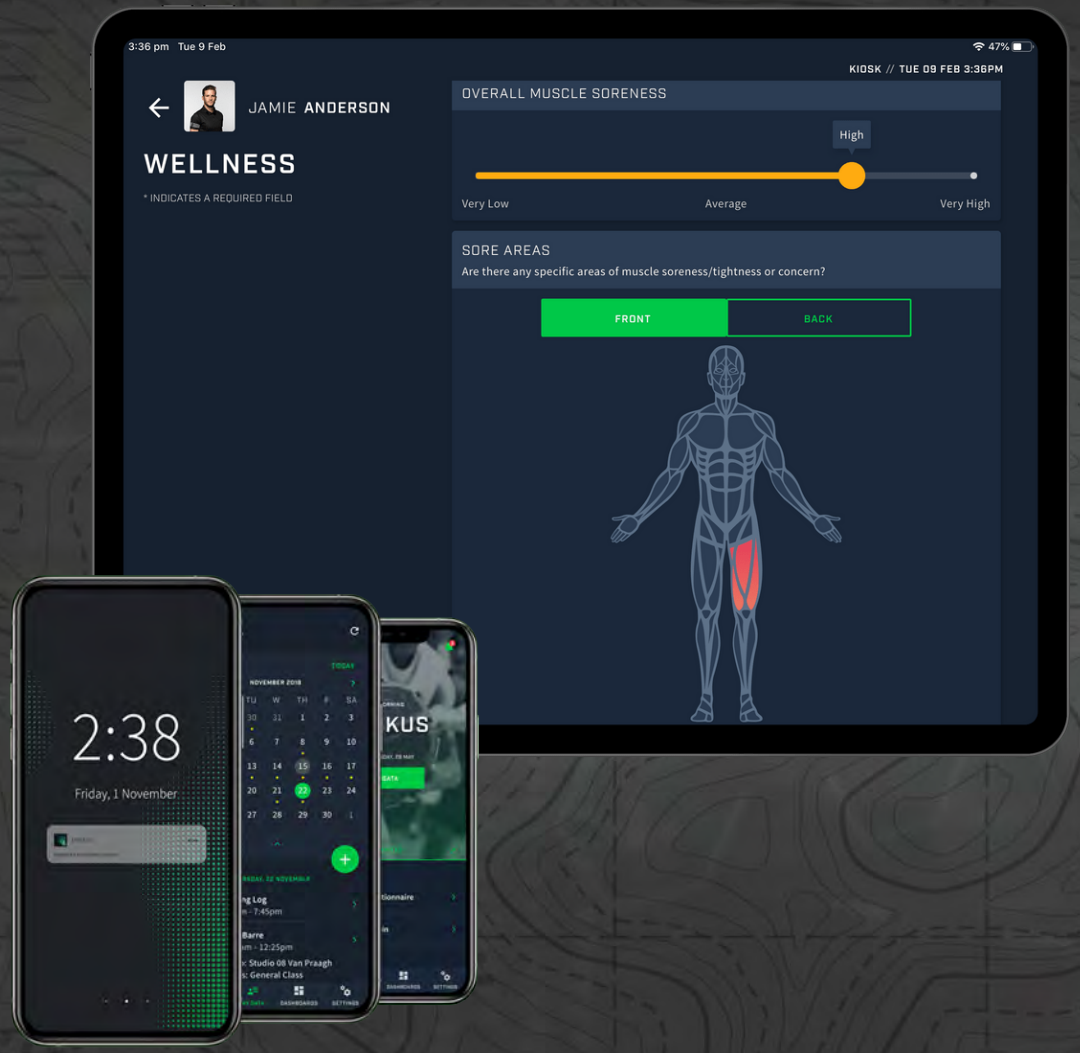
- Time to setup, run test(s)
- Time to process data – manual or automated?
- Time to final visualization and/or export

Reliability (Hardware, Software)

- How likely is the hardware to be faulty, software to crash?
- This will be a live and learn – reach out to your network

GARBAGE IN = GARBAGE OUT

SUBJECTIVE INSIGHTS



Subjective Wellness: Measurement of key indicators of personal health and wellness. Can be custom designed to fit Unit needs

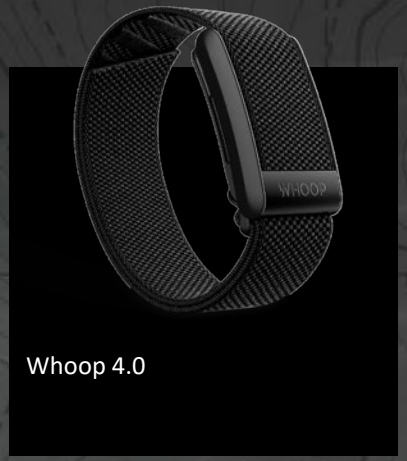
- **SORENESS / PAIN** = Body area diagrams to identify areas and pain ratings for each. Can identify both acute and chronic issues
- **FATIGUE / ENERGY** = Rating overall energy and/or fatigue state
- **SLEEP QUALITY** = Understanding how restorative sleep was, which can add insight even with a sleep wearable
- **STRESS / MOOD STATE** = While some wearables can accurately measure stress indicators like HRV, this type of question helps to tease out the mental component of stress/recovery
- **INJURIES** = Way to communicate with HP staff about any new or nagging injuries
- **RECOVERY TRACKING** = Tally of what recovery modalities/interventions were completed the day before. Allows for potential analysis for prescriptive recovery based on individual physiological and subjective needs

TRAINING LOAD / RECOVERY


Oura GEN 3 Ring


Garmin Fenix / Tactix


Polar GritX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iWatch

TRAINING LOAD: Quantification of physiological and/mechanical workload from training and all-day activity

- **INTERNAL** = Physiological cost of producing the work accomplished in training and daily activity
  - Heart Rate
  - Subjective Rate of Perceived Exertion
- **EXTERNAL** = Mechanical work done by the body during training and daily activity
  - Distance (miles or steps)
  - Speed / Pace

SLEEP/RECOVERY: Objective measurements of sleep quantity/quality, and physiological indicators of recovery

- **SLEEP** = Quantify the amount of sleep
  - Quantity: Hours actually asleep
  - Quality: Total Time Asleep / Total Time in Bed
  - Circadian Rhythm: Timing of sleep
- **SLEEP PHYSIOLOGY** = Indication of overall physiological stress/recovery through cardiac and autonomic nervous system measures
  - Heart Rate
  - Heart Rate Variability
  - Respiration Rate, Temperature

When selected and used properly, wearables can provide objective insight into Training Load and Recovery

status

- data collection underway
- preliminary analysis available

- data collection underway
- preliminary analysis available

- started Mar 7
- pilot analysis available

publication in draft

data collection underway started Feb 1

pilot testing underway

01 Body Composition Devices

> Bio-impedance (BIA) scales are cheaper and faster alternatives to DXA for body composition

> **Is BodyFat % comparable across popular BIA commercial scales?**

> Can BIA adequately assess hydration status?

02 SpO2 Wearables

> New versions of wearables are including blood oxygen levels (SpO_2)

> While applicability of SpO_2 data in healthy servicemembers is not well understood, we need to know how accurate this new trend is in commercial wearables

> **Is SpO_2 accurate in wrist-based wearables?**

03 "R Scores" in Wearables

> Multiple consumer wearables have proprietary single scores, like "Readiness", "Recovery", "ReCharge" etc.

> **Do these scores correlate with each other across devices?**

> **Are these scores indicative of performance, both objective and subjective?**

04 Heart rate devices – Tactical Movements

> While validation studies on heart rate devices are common in literature, almost no work has been published for tactically relevant movements

> Direct validation of multiple consumer heart rate devices, both strap and wrist based, in tactical movements

> **Can consumer heart rate devices provide accurate data for tactically relevant movements? If so, which ones and what types?**

05 Heart rate devices – Crowd Sourced

> New hardware and firmware upgrades are constantly being released in consumer HR devices

> The speed of traditional research does not match the speed of device upgrades

> 10-15 subjects will continuously wear multiple devices, workout 5-7x per week

> **Continually report out HR accuracy of popular devices**

06 Sleep Devices – Crowd Sourced

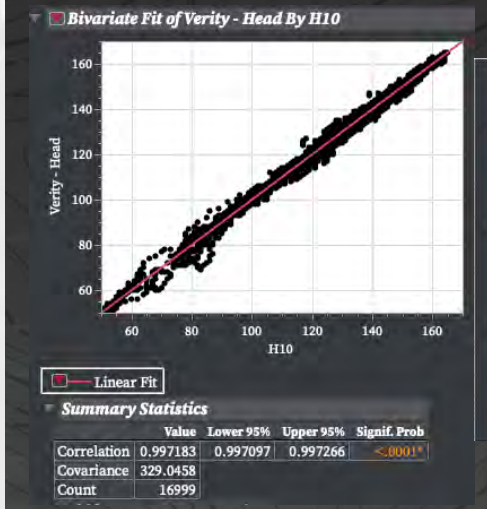
> New sleep algorithms are constantly being released in consumer trackers

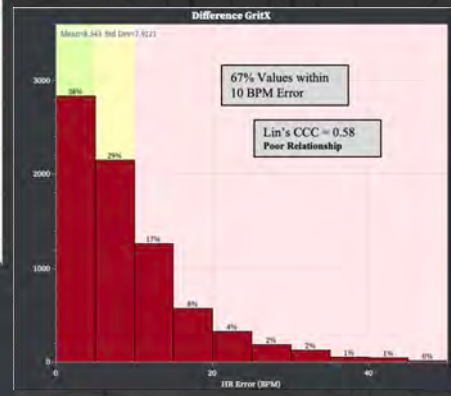
> Same concept as 05 - this requires continuous data acquisition to keep up with speed of hardware, firmware, algorithm upgrades

> **Continually report out sleep accuracy of popular devices**

Gold Standard Validation Projects

Objective: Communicate project goals and progress on all Human Performance device validation projects from AFRL STRONG Lab





Updates – Mar 28, 2022

- Non-Human Subjects Research approval IRB in place (AFRL)
- Eight projects started data collection
- One project completed: HR Tactical Movements

IT STARTS WITH ACCURACY

started Mar 7

- testing started mid-Feb
- preliminary analysis available

- testing started Dec
- preliminary analysis available

- testing started preliminary analysis available

07 Motion Capture Devices

> New markerless motion capture technologies are being released that provide mobility / movement assessments

> Traditionally this has been done using expensive and highly complicated marker-based camera systems

> **Can markerless mo-cap systems provide accurate mobility / movement assessments?**

08 Heart Rate – Pool based training

> Pool based tactical training is prevalent across the DoD

> Little work has been done to understand the accuracy of consumer heart rate devices in pool training

> **What heart rate devices can provide accurate information in pool training?**

09 Activity (HR, calories) - STRONG

> Wearables provide both real time heart rate and session-based data (calories, avg/min/max HR)

> Subjects in STRONG Lab cohort studies will wear multiple activity wearables and compare against a Polar H10 reference

> **How do various activity wearables compare against each other?**

> **How accurate is heart rate across various wearables?**

> *Complimentary to Crowd Sourced HR study. N = 50, 5 days/week training

10 Polar/Garmin watch additional features

> Polar watches have some additional features such as VO2 Max and Jump Height assessments built in

> **How do Polar and Garmin VO2 Max assessment compare to metabolic cart?**

> **How does Polar jump assessment compare to force plate?**

11 Oura Gen 2 v Gen 3

> Oura released Generation 3 ring hardware in late 2021

> Marketed upgrades include: Improved sleep algorithm, all day heart rate, session-based heart rate, SpO2

> **Are these new features functional?**

> **What data quality differences exist between Gen 2 and 3?**

12 Sleep Physiology

> Several commercial sleep devices (Oura, Polar, Whoop) measure sleep physiology (heart rate, heart rate variability, respiration rate.

> Few to no studies have been done to assess these sleep physio metrics

> **Is HR reliable/accurate across the devices**

> **Is HRV reliable/accurate across the devices**

> **Is Respiration Rate reliable/accurate across the devices**

RELIABILITY AND PROCEDURES

CONDITIONS	CONTEXT	PROCEDURES
Testing Location • For field testing – take factors like temperature into account • If technology, take location into account (i.e. indoors vs. outdoors for GPS devices, floor types for force plates etc.)	**Time of Day** • Early AM vs. Late PM – impact of current day training if PM **Recent Training Profile** • What was training like day/week before? **CONSISTENCY** • For repeated measures, whether measuring same tactical athletes over time, or comparing groups – KEEP IT CONSISTENT	**Warm-Ups** • Consistent Tactical Athlete WarmUp procedures **Equipment Set-Up / Running** • Some equipment needs to "Warm Up" • Consistent set up areas when possible • Trained personnel running equipment **Documentation** • Proper labeling and note taking during data collections. I.E. bad reps need to be noted and removed

ACCURATE TOOLS CAN PROVIDE INACCURATE RESULTS