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Readiness Assessment Framework (RAF): A Framework for Assessing Capability Readiness for Advanced Development

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BLUF

- This deck presents a framework to assess a Health Readiness and Performance System (HRAPS) capability's readiness for advanced development.
- Primarily, the framework is meant to provide decision support for the HRAPS Product Management; however, it also has broader applications.
- This holistic approach considers more than just Technology Readiness Levels (TRL) by incorporating maturity of the knowledge/research and user/human components of the capability into a single readiness score.
- This framework is not related to the capability maturity model (Humphrey, 1988) that is used to evaluate the process of software development.

Health Readiness and Performance System (HRAPS)

- HRAPS is a wearable system being developed by the U.S. Army Medical Materiel Development Activity (USAMMDA) that is capable of monitoring physiological data to assess real-time Warfighter health readiness and performance. HRAPS will provide actionable information to small unit leaders, which will enable data-driven decisions to maintain and improve Warfighter performance and safety.
- Structure of the program and terminology:
 - HRAPS itself is a *system*. Network protocols, security protocols, interoperability, etc. are addressed at this level.
 - HRAPS is composed of *capabilities*, each representing an area of readiness or performance that can be monitored via wearables.
 - Examples of capabilities include detection of heat/cold injury risk, acute mountain sickness risk, and monitoring of sleep quantity and quality.
 - Each capability consists of (1) hardware, (2) algorithms at the sensor level, and (3) predictive models to generate decisional outcomes.
 - **Note:** The term ‘capability’ is not used in a defense acquisitions sense.

Capability Readiness for Decision Making

- Problem: Identifying whether an HRAPS capability is ready to bring forward from S&T into advanced development requires:
 - An operational perspective.
 - A holistic evaluation of readiness for advanced development that goes beyond technology readiness and includes user readiness.
 - A lightweight and rapid decision-making framework.
- Solution: We designed the Readiness Assessment Framework (RAF), which employs multiple readiness level scales in a red, yellow, green format to generate a holistic score that reflects a capability's readiness for advanced development.

Readiness Assessment Framework (RAF) Overview

▪ Inputs:

- Technology Research Level (TRL) of all technical components within the capability.
- Knowledge Readiness Level (KRL) of research knowledge products.
- User Readiness Level (URL): Extent to which the capability fulfills end-user needs and can be culturally integrated into an operational environment.

▪ **Output:** Red, yellow, or green rating of the capability's candidacy for advanced development in terms of resources needed to reach fieldability.

- Red: Capability is not sufficiently mature; would take significant advanced development resources to mature it; send back to S&T for further technical and research development.
- Yellow: Capability is somewhat mature; would require some advanced development resources; candidate for advanced development, based on priorities.
- Green: Capability is mature; ready for advanced development; few resources needed from advanced development.

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HRAPS Capability Readiness Score Card Template

		Color Score	
Sensors (Technical)	Sensor A		Technical readiness score:
	Sensor B		
	Sensor C		
Feature Algorithms (Knowledge)	Feature Algorithm X		Knowledge readiness score:
	Feature Algorithm Y		
Predictive Models (Knowledge)	Model Z		
Utility (User)	Human readiness		User readiness score:
	Essential characteristics		
	Operational utility		
OVERALL CAPABILITY READINESS:			

Capability Readiness Scoring Guidelines for HRAPS

- Scores for technology, knowledge, and user readiness should be based on a consistent and consolidated set of information. For HRAPS these are the Concept of Operations (CONOPs) written for the capability.
 - Update the capability's CONOPs if needed, and then calculate readiness scores.
- If a component or readiness category score falls between two color scores, pick a color score.
 - Avoid giving “slash” scores of red/yellow or yellow/green.
- User readiness components do not vary by capability; the score card template contains all three user readiness components (human readiness, essential characteristics, operational utility).
- Assign a capability readiness score based on the technical, knowledge, and user readiness scores.
 - Use a “qualitative average.” If there are three sensors with scores of green, yellow, and yellow, assign the technical readiness score as yellow.

Step-by-Step Scoring Process

1. Identify the technology components of the capability. These are usually the sensors. Fill in the rows in the Technical area of the score card with the sensor names.
2. Identify the knowledge components of the capability. These are usually the algorithms and models. Fill in the rows in the Knowledge area of the score card with the feature algorithms and predictive models that are required.
3. Give each technical and knowledge component of the capability (each row) a red, yellow, or green maturity score based on content of the current version of the CONOPs. See following slides for score descriptions.
4. For user readiness, three components are pre-filled in the score card and do not change per capability. Score each component using the score descriptions on following slides.
5. Component scores are then rolled up into technical, knowledge, and user readiness scores (also red, yellow, green) using a “qualitative averaging” method.
6. Readiness category scores are then averaged to yield an overall capability readiness score.

Red, Yellow, Green Scoring Categories- TRLs

DoD Technology Readiness Levels	Red, Yellow, Green Alignment
1 Basic principles observed and reported	
2 Technology concept and/or application formulated	Red
3 Analytical and experimental critical function and/or characteristic proof of concept	
4 Component and/or breadboard validation in laboratory environment	
5 Component and/or breadboard validation in relevant environment	Yellow
6 System/subsystem model or prototype demonstration in a relevant environment	
7 System prototype demonstration in an operational environment	
8 Actual system completed and qualified through test and demonstration	
9 Actual system proven through successful mission operations	Green

“operational environment” = DoD training or operations

Red, Yellow, Green Scoring Categories- KRLs

Knowledge Readiness Levels (based on Engel et al., 2019; NOAA ORTA Readiness Levels)	Red, Yellow, Green Alignment
1 Basic, experimental, or theoretical work that generates initial or very early scientific knowledge without regard to or indication of a specific application	Red
2 Applied research undertaken to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives	
3 Process or knowledge product proof-of-concept; validates hypotheses that suggest applications	
4 Generates early knowledge for target domain use	Yellow
5 Tests a priori hypotheses using rigorous scientific design; successful evaluation of process or knowledge product in laboratory or other experimental setting	
6 Demonstration of prototype process or knowledge product in relevant or test environment (demonstrated potential)	
7 Functionality demonstrated in near-real world environment	
8 Tested and shown to function as expected in a user's operational environment; evidence of functionality in the context of interest	Green
9 Process or knowledge product deployed and used routinely	

“operational environment” = DoD training or operations

Red, Yellow, Green Scoring Categories- User Readiness

Essential Characteristics	Operational Utility	Red, Yellow, Green Alignment
Users have not defined essential characteristics; no validation	Capability cannot provide cadre or leader with needed information about service member status as it relates to the capability	Red
Users have fully or partially defined essential characteristics, but all or some of them have not yet been validated	Capability somewhat, but not fully, provides cadre or leader with needed information about service member status as it relates to the capability	Yellow
Essential characteristics have been fully provided by users and all ECs have been validated	Capability provides cadre or leader with needed information about service member status as it relates to the capability	Green

Red, Yellow, Green Scoring Categories- Human Readiness

Human Readiness Levels (Salazar et al., 2020)	Red, Yellow, Green Alignment
1 Relevant human capabilities, limitations, and basic human performance issues and risks identified	Red
2 Human-focused concept of operations defined and human performance design principles established	
3 Analyses of human operational, environmental, functional, cognitive, and physical needs completed, based on proof of concept	
4 Modeling, part-task testing, and trade studies of user interface design concepts completed	Yellow
5 User evaluation of prototypes in mission-relevant simulations completed to inform design	
6 Human-system interfaces fully matured as influenced by human performance analyses, metrics, prototyping, and high-fidelity simulations	
7 Human-system interfaces fully tested and verified in operational environment with system hardware and software and representative users	
8 Total human-system performance fully tested, validated, and approved in mission operations, using completed system hardware and software and representative users	Green
9 System successfully used in operations across the operational envelope with systematic monitoring of human-system performance	

“operational environment” = DoD training or operations

Intensity During Running- Sample Score Card

		Color Score	
Sensors (Technical)	EKG from chest wearable	GREEN	Technical readiness score: GREEN
Feature Algorithms (Knowledge)	Conversion from EKG to HR	GREEN	Knowledge readiness score: GREEN
Predictive Models (Knowledge)	HR to intensity via personalized HR zones	GREEN	
Utility (User)	Human readiness	GREEN	User readiness score: GREEN
	Essential characteristics	GREEN	
	Operational utility	GREEN	
OVERALL CAPABILITY READINESS: GREEN			

Other Anticipated Uses and Considerations

- This framework was formulated specifically for HRAPS, but it is anticipated to be useful for programs in other ways:
 - To analyze and inventory S&T.
 - To assess transition readiness from advanced development to a fully operational environment.
 - By programs that have similarly to HRAPS via complex capabilities, domains, or products that need to be assessed for readiness.
- If there is not one definitive source on which to base readiness ratings, documenting disparate sources could help to build a repository of information.
 - CONOPs may not serve as the source of readiness ratings, especially if a CONOPs document is broader than the capability to be assessed.
 - Certain acquisitions documents beyond CONOPs may serve as good sources for some programs.

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