



# Naval Information Warfare Center Pacific

## *Human Factors Engineering in Rapid Prototyping*

*March 12, 2025*

Lily Zeman, MSSCIA, CISSP

Deputy C2 Lead Systems Engineer

[lydia.e.zeman.civ@us.navy.mil](mailto:lydia.e.zeman.civ@us.navy.mil)

John Wood, PhD

C2 Lead Systems Engineer

[john.n.wood.civ@us.navy.mil](mailto:john.n.wood.civ@us.navy.mil)

# Agenda

---

- About Us
- Why Human Factors Engineering (HFE)
- What is Rapid Prototyping
- The Implicit Danger
- What is HFE
- Systems Engineering and HFE
- Sample HFE Tools and Techniques

# About Us: Relentless Warfighter Advocates



Lily Zeman, MSSCIA, CISSP  
Deputy C2 Lead Systems Engineer  
lydia.e.zeman.civ@us.navy.mil

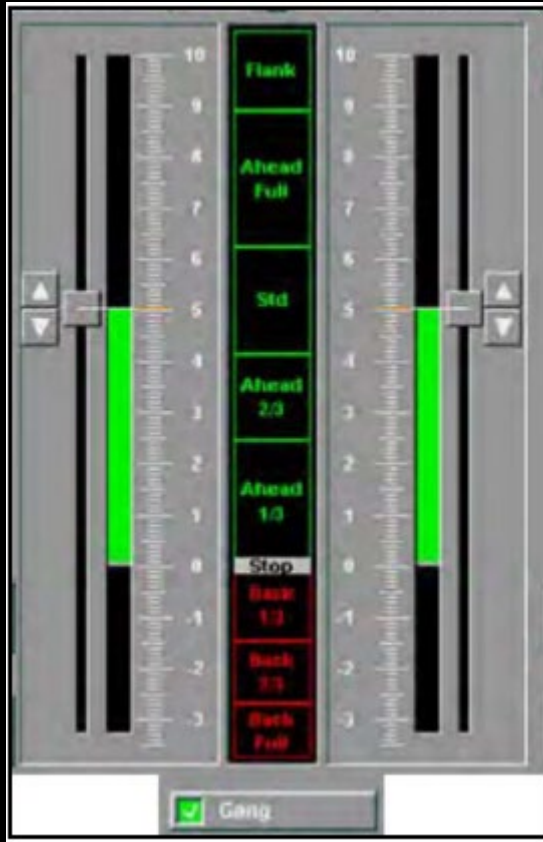


John Wood, PhD  
C2 Lead Systems Engineer  
john.n.wood.civ@us.navy.mil

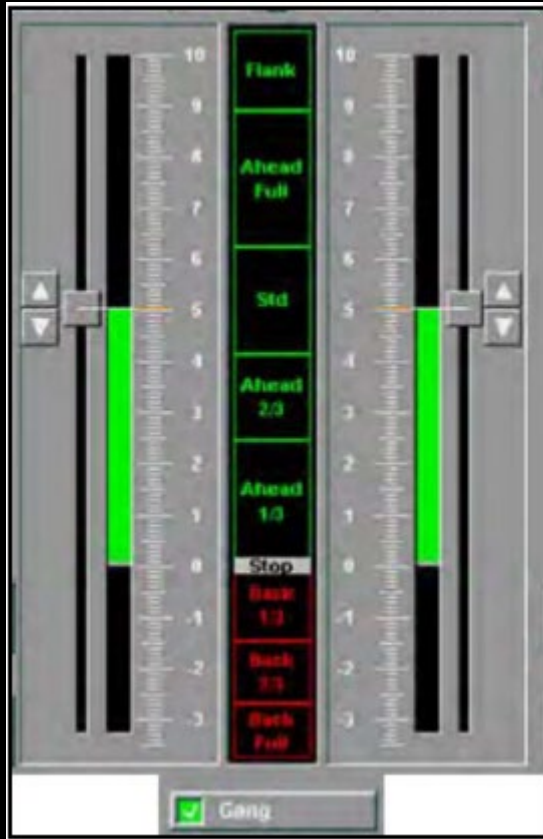
- Lily Zeman
  - BS Electronics & Computer Engineering
  - MS Cybersecurity and Information Assurance
  - Navy Veteran
- John Wood, PhD
  - EE Electrical Engineering
  - PhD Systems Engineering
  - Marine Corps Veteran
- NIWC Command & Control
  - 850 Scientists & Engineers
  - 110 Projects

# Why Human Factors Engineering?

# Does anyone know what this is?



# Does anyone know what this is?





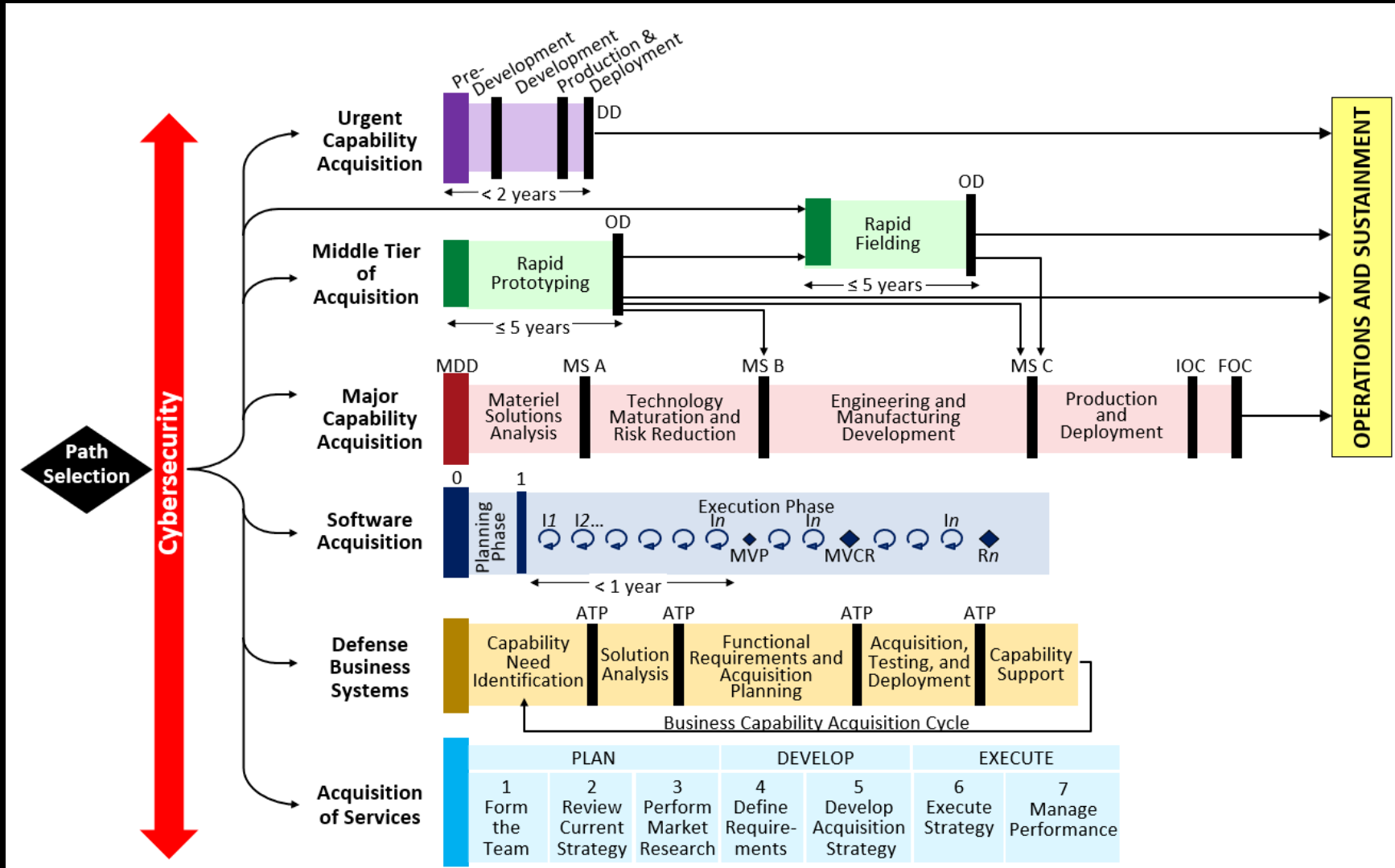
# Does anyone know what this is?



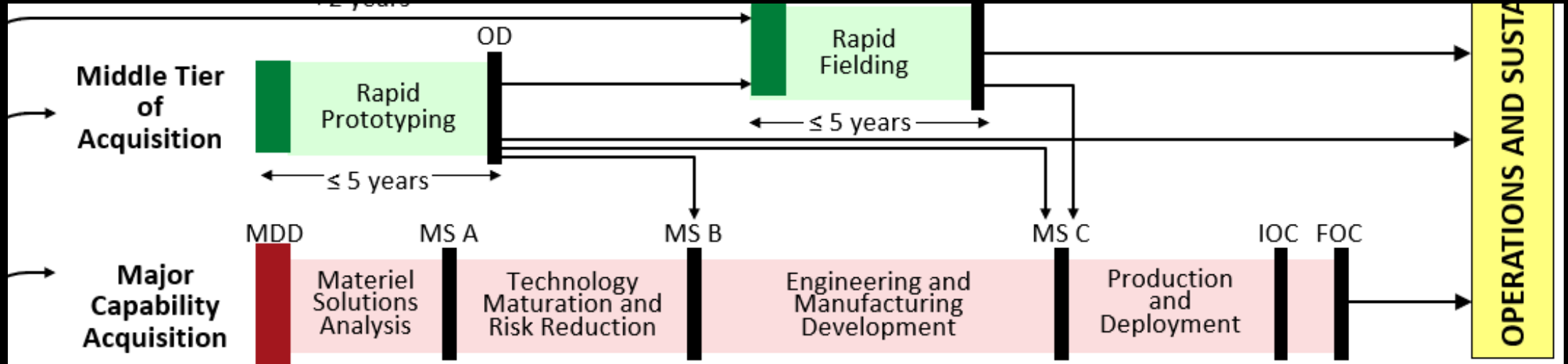
# What is Rapid Prototyping?



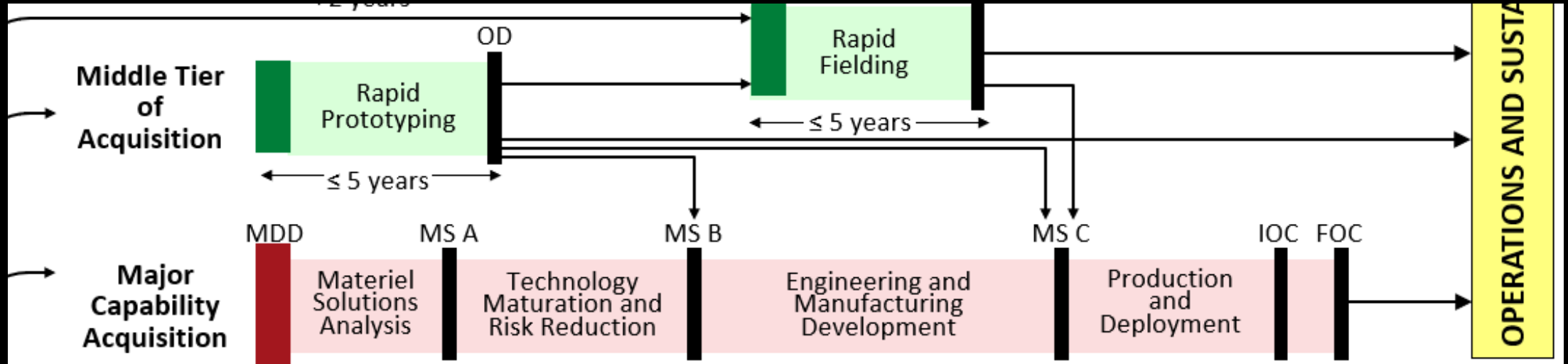
# Adaptive Acquisition Framework Pathways



# Adaptive Acquisition Framework Pathways



# Adaptive Acquisition Framework Pathways

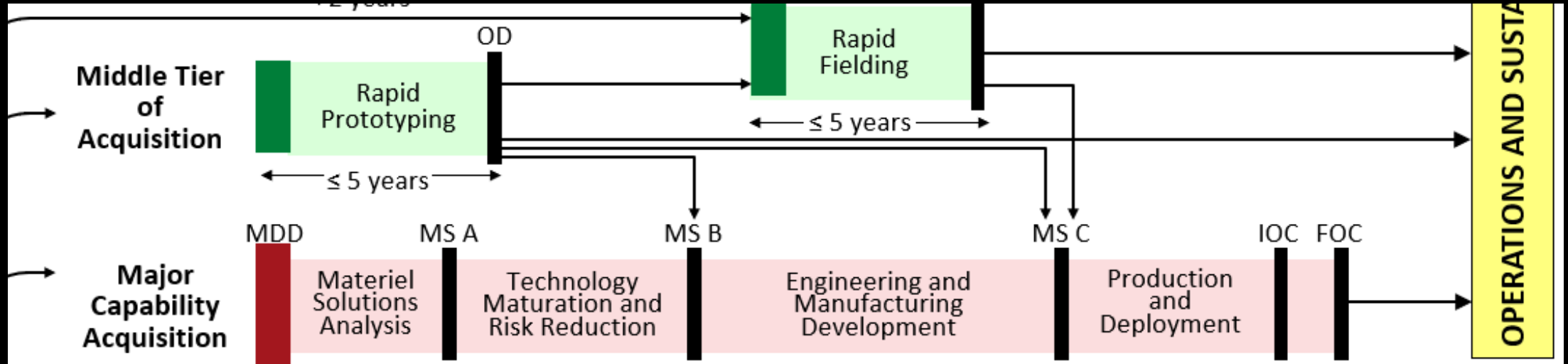


## Rapid Prototyping Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.c

The **rapid prototyping path** provides for the use of innovative technologies to rapidly develop fieldable prototypes to demonstrate new capabilities and meet emerging military needs.

# Adaptive Acquisition Framework Pathways



## Rapid Prototyping Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.c

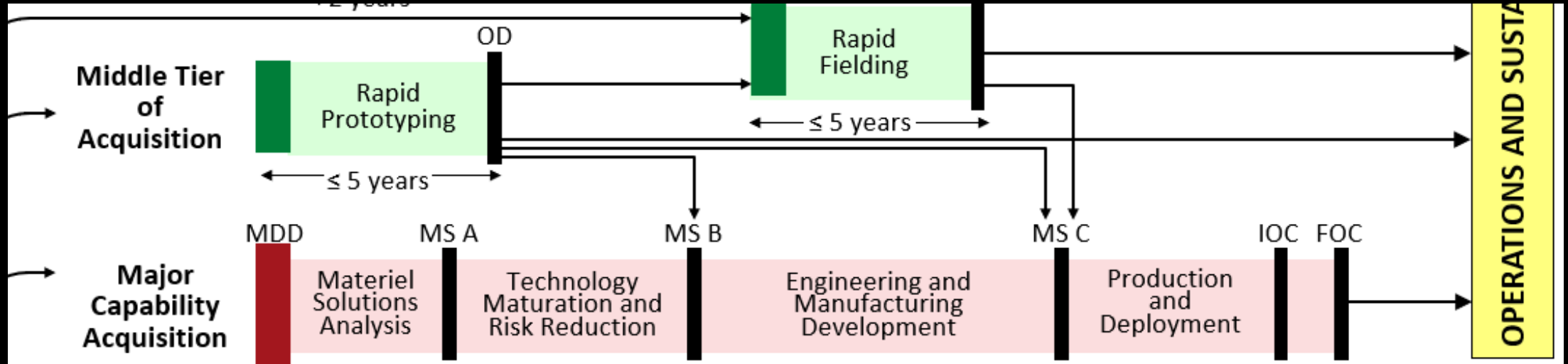
The **rapid prototyping path** provides for the use of innovative technologies to rapidly develop fieldable prototypes to demonstrate new capabilities and meet emerging military needs.

## Rapid Fielding Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.d

The **rapid fielding path** provides for the use of proven technologies to field production quantities of new or upgraded systems with minimal development required.

# Adaptive Acquisition Framework Pathways



## Rapid Prototyping Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.c

The **rapid prototyping path** provides for the use of innovative **technologies** to rapidly develop fieldable prototypes to demonstrate new capabilities and meet emerging military needs.

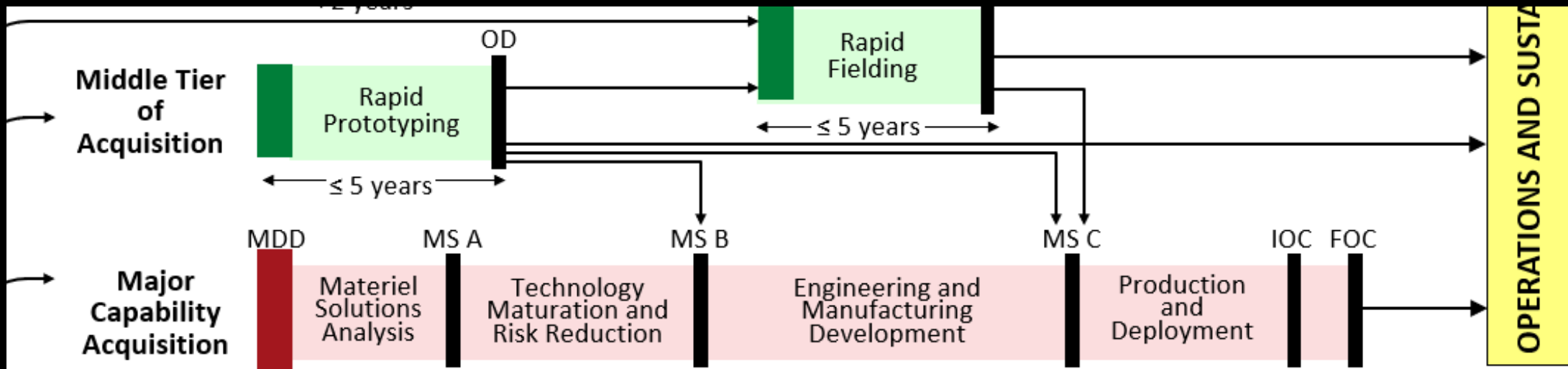
## Rapid Fielding Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.d

The **rapid fielding path** provides for the use of proven **technologies** to field production quantities of new or upgraded systems with minimal development required.



# Adaptive Acquisition Framework Pathways



## Rapid Prototyping Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.c

The **rapid prototyping path** provides for the use of innovative **technologies** to rapidly develop fieldable prototypes to demonstrate new capabilities and meet emerging military needs.



**DANGER**

## Rapid Fielding Path

Reference Source: [DoDI 5000.80](#), Paragraph 1.2.d

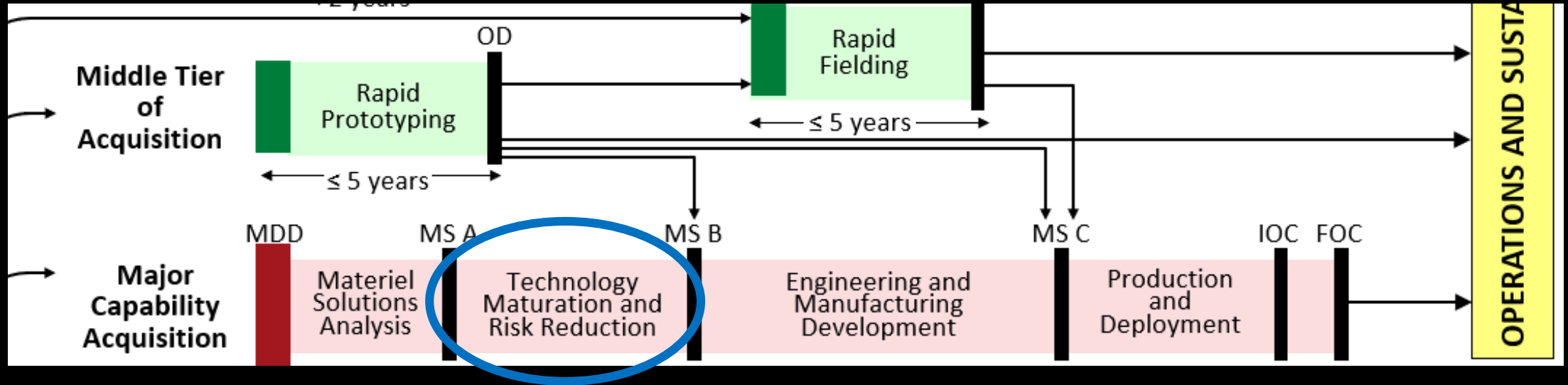
The **rapid fielding path** provides for the use of proven **technologies** to field production quantities of new or upgraded systems with minimal development required.

# These Technologies Worked!



# The Implicit Danger

# Adaptive Acquisition Framework Pathways



- You can call it a different name, but you must still:
  - Mature the technology
  - AND -
  - Reduce risk

# Risk Categories

---

- Technical
- Programmatic
- Business

<https://www.dau.edu/cop/risk/resources/risk-categories>



# Risk Categories

---

- Technical
  - Technology – Risks associated with the transition of technical advances out of the laboratory, through prototyping, and into engineering.
  - Engineering – Risks associated with the multidisciplinary application of engineering principles to translate stakeholder requirements into effective and affordable systems.
  - Integration – Risks associated with the engineering and management activities to interface system elements within systems (internal integration) as well as systems with other systems (external integration).
- Programmatic
- Business

<https://www.dau.edu/cop/risk/resources/risk-categories>

# Risk Categories

- Technical
  - Technology – Risks associated with the transition of technical advances out of the laboratory, through prototyping, and into engineering.
  - Engineering – Risks associated with the multidisciplinary application of engineering principles to translate stakeholder requirements into effective and affordable systems.
  - Integration – Risks associated with the engineering and management activities to interface system elements within systems (internal integration) as well as systems with other systems (external integration).
- Programmatic
- Business

<https://www.dau.edu/cop/risk/resources/risk-categories>

# Risk Categories

- Technical
  - Technology – Risks associated with the transition of technical advances out of the laboratory, through prototyping, and into engineering.
  - Engineering – Risks associated with the multidisciplinary application of engineering principles to translate stakeholder requirements into effective and affordable systems.
  - Integration – Risks associated with the engineering and management activities to interface system elements within systems (internal integration) as well as systems with other systems (external integration).
- Programmatic
- Business

*What types of engineering might be included?*

<https://www.dau.edu/cop/risk/resources/risk-categories>

# What is HFE?

# Human (Factors) Engineering

- The application of knowledge about human capabilities and limitations to system or equipment design and development to achieve efficient, effective, and safe system performance at minimum cost and manpower, skill, and training demands.
- Human engineering assures that the system or equipment design, required human tasks, and work environment are compatible with the sensory, perceptual, mental, and physical attributes of the personnel who will operate, maintain, control and support it.

<https://www.dau.edu/acquimedia-article/human-factor-engineering-hfe>



# Human (Factors) Engineering

- The application of knowledge about human capabilities and limitations to system or equipment design and development to achieve efficient, effective, and safe system performance at minimum cost and manpower, skill, and training demands.
- Human engineering assures that the system or equipment design, required human tasks, and work environment are compatible with the sensory, perceptual, mental, and physical attributes of the personnel who will **operate, maintain, control and support** it.

<https://www.dau.edu/acquimedia-article/human-factor-engineering-hfe>

# Common HFE Tasks

- Task analysis
- Workload analysis
- Task allocation
- Human performance analysis
- Human error analysis
- Anthropometric analysis
- Display design
- Control design

<https://www.dau.edu/acquimedia-article/human-factor-engineering-hfe>

# Systems Engineering and HFE

# A Rapid Prototyping Tip You Should Heed!

**Rigor in systems engineering and planning is key to success.**

<https://aaf.dau.edu/aaf/mta/tips/>

# Mapping of HFE to INCOSE Technical Processes

Number	INCOSE Technical Process	Example HFE Activities and Artifacts
1	Business or Mission Analysis Process	CONOPS User persona
2	Stakeholder Needs and Requirements Definition Process	User interviews SME interviews Initial task analysis
3	System Requirements Definition Process	Updated task analysis
4	Systems Architecture Definition Process	
5	Design Definition Process	Front end analysis UX specifications Expanded task analysis (steps and times)
6	System Analysis Process	Workload assessment
7	Implementation Process	Training materials Technical documentation
8	Integration Process	
9	Verification Process	Heuristic analysis Usability testing
10	Transition Process	<i>Enjoy the results of HFE!</i>
11	Validation Process	Validate products from #s 1, 2, 3, 4, 5, 6, 7, and 8 with users, maintainers, etc.
12	Operation Process	<i>Enjoy the results of HFE!</i>
13	Maintenance Process	<i>Enjoy the results of HFE!</i>
14	Disposal Process	<i>Enjoy the results of HFE!</i>

# Tools and Techniques

# Consider All Potential Personas



LtCol Michael Radigan checks on the 3D printing of a medical cast aboard an MV-22 Osprey during a training flight. The demonstration marked the first successful in-flight demonstration of 3D printing capability in a U.S. military aircraft.  
<https://nps.edu/-/camre-helps-marines-take-3d-printing-to-new-heights>



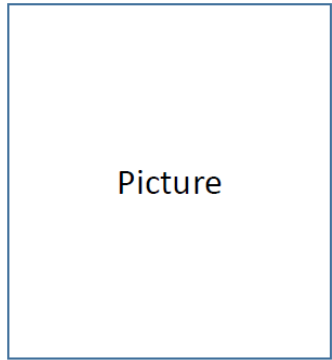
# Consider All Potential Personas

*How many  
personas  
can you name?*



LtCol Michael Radigan checks on the 3D printing of a medical cast aboard an MV-22 Osprey during a training flight. The demonstration marked the first successful in-flight demonstration of 3D printing capability in a U.S. military aircraft.  
<https://nps.edu/-/camre-helps-marines-take-3d-printing-to-new-heights>

# User Persona Template



[Placeholder]

[Placeholder]

Rate: [Placeholder]

Rank: [Placeholder]

Number of years in the Navy:

[Placeholder]

Age: [Placeholder]

[Placeholder]

[Placeholder]

About \_\_\_\_\_

[Placeholder]

Frustrations

[Placeholder]

Goals

[Placeholder]

Behavioral Considerations

[Placeholder]

Tasks

[Placeholder]

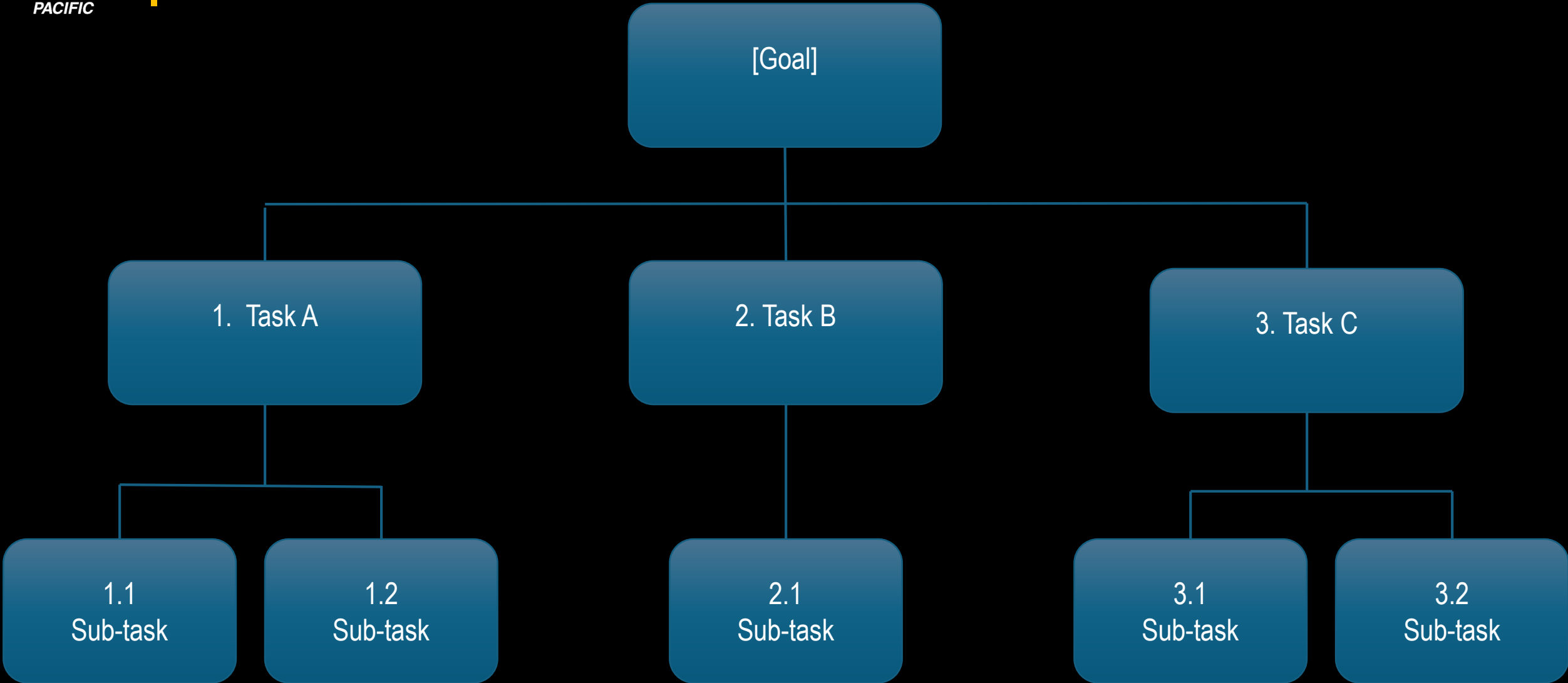


# User Analysis





# Task Analysis



# Heuristic Evaluation



Evaluator: \_\_\_\_\_ Date: \_\_\_\_\_  
 Product: \_\_\_\_\_ User Group: \_\_\_\_\_  
 Task: \_\_\_\_\_

Heuristic Principle	Usability Deficiency that violates the heuristic
1. Visibility of System Status	
2. Match between System and the Real World	
3. User Control and Freedom	
4. Consistency and Standards	
5. Error Prevention	
6. Recognition Rather than Recall	
7. Flexibility and Efficiency of Use	
8. Aesthetic and Minimalist Design	
9. Recognize, Diagnose, and Recover from Errors	
10. Help and Documentation	

# Usability Testing

- What to test?
  - Ability to perform in austere environment
  - Ability to accomplish tasks
  - Ergonomics
  - Cognitive load
  - Ability to perform under stress



# What are your questions?





“Design for people the way they are, not  
for how you want them to be.”

~Don Norman

Co-founder of the Nielsen/Norman Group

**BRINGING THE POWER OF  
INFORMATION TO THE FIGHT!**

