Documenting Workflow, Tasking, Tactical Information Process, and Collaboration Flow of Current Command and Control (C2) for Future C2

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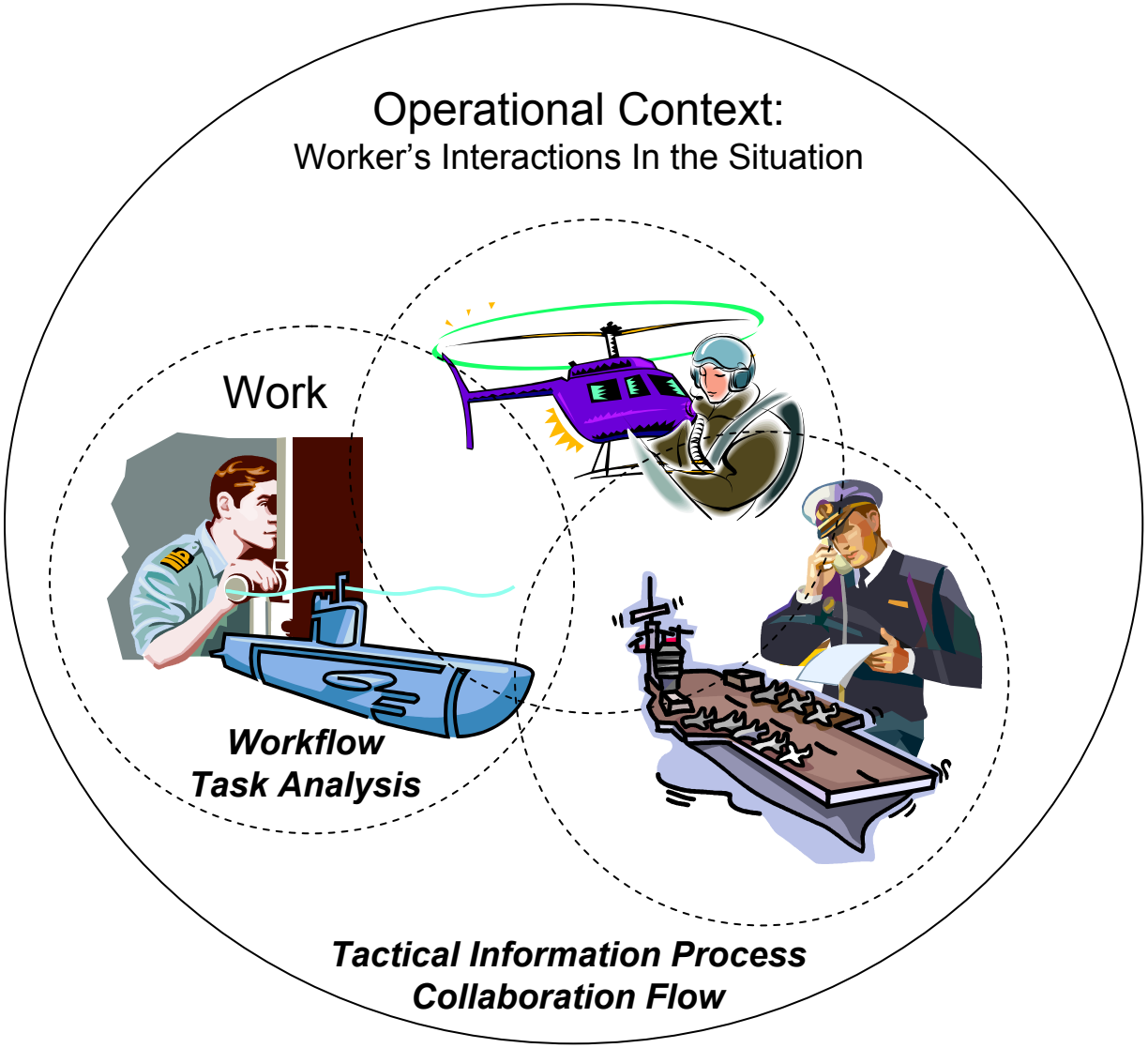
What We'll Be Talking About



Understand the Operational Context Early

Prerequisites to the Analyses

1. Identify users
   - Understand Knowledge, Skills, and Abilities (KSAs)
   - Create user groups

2. Obtain written documentation
   - Acquire Doctrine
   - Collect Operational scenarios

3. Establish fleet review team
   - Include Subject Matter Experts (SMEs)
   - Identify opportunities for the team to observe on-site (shipboard) to verify/validate the analyses

Document the Users & Operators, Including their Knowledge, Skills & Abilities

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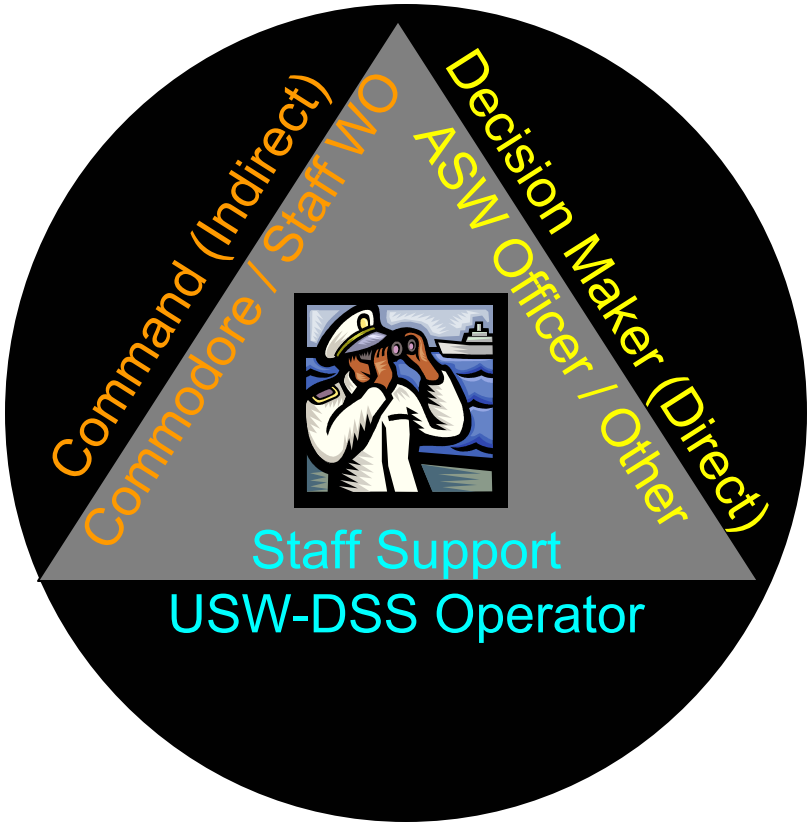
Command Cell



Sites

Written Documentation

- Navy Doctrine
  - Naval Warfare Publications (NWPs)
  - Navy Tactics Techniques and Procedures (NTTP)
  - Navy Tactical Reference Publications (NTRP)
  - Allied Tactical Publications (ATPs)
  - Tactical memos (TACMEMOs)
  - Instructions
- Personnel Qualification Standards (PQSs)
- Extended Personnel Qualification Standards (EPQSs)
- And more…

Assemble A Team of Teams

Design Teams:

- Subject Matter Expert (SME)
- Systems Engineer
- Human-System Integration (HSI) Specialist

Development Teams:

- Design Team Members
- Software Engineer / Developer
- Test & Evaluation Engineer
- Quality Assurance Engineer

Test & Evaluation Teams:

- SME & Operator
- Test & Evaluation Engineer
- Quality Assurance Engineer

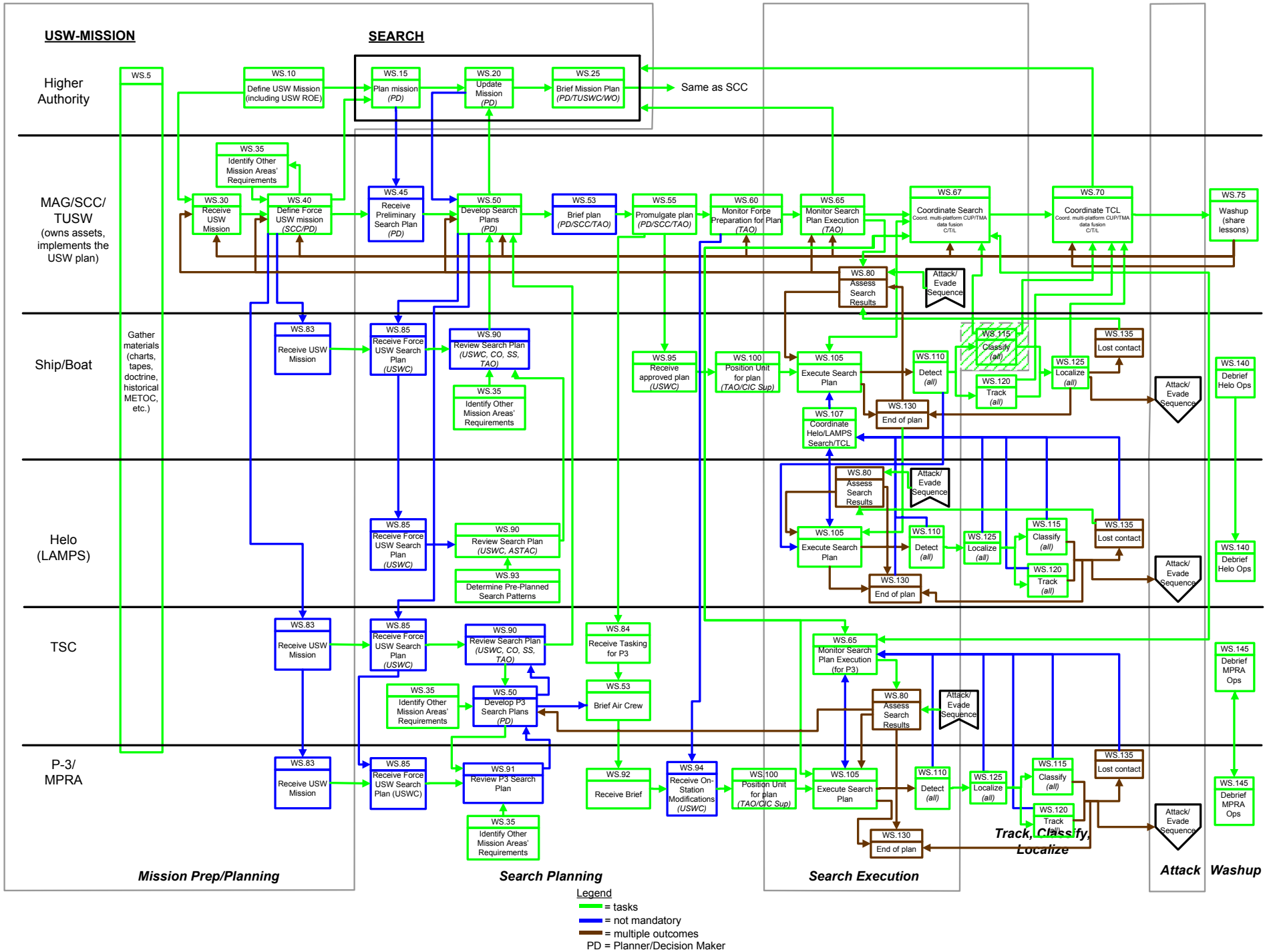
Workflow

What is a Workflow?

Workflow: the documentation of the work that is to be done by the human beings to successfully accomplish a goal or set of goals.

Focuses on:

- Mission & Mission Scenarios
- Command & Control of the Mission
- Communication Channels
- Flow of Work During a Mission
- Potential Bottlenecks
- Collaboration & Decision Points
- Hand-offs


USW-MISSION
SEARCH
Higher Authority
MAG/SCC/ TUSW (owns assets, implements the USW plan)
Ship/Boat
Helo (LAMPS)
TSC
P-3/ MPRA
WS.5
WS.10 Define USW Mission (including USW ROE)
WS.15 Plan mission (PD)
WS.20 Update Mission (PD)
WS.25 Brief Mission Plan (PD/TUSWC/WO)
Same as SCC
WS.35 Identify Other Mission Areas' Requirements
WS.30 Receive USW Mission
WS.40 Define Force USW mission (SCC/PD)
WS.45 Receive Preliminary Search Plan (PD)
WS.50 Develop Search Plans (PD)
WS.53 Brief plan (PD/SCC/TAO)
WS.55 Promulgate plan (PD/SCC/TAO)
WS.60 Monitor Force Preparation for Plan (TAO)
WS.65 Monitor Search Plan Execution (TAO)
WS.67 Coordinate Search Coord. multi-platform CUP/TMA data fusion C/T/L
WS.70 Coordinate TCL Coord. multi-platform CUP/TMA data fusion C/T/L
WS.75 Washup (share lessons)
WS.80 Assess Search Results
Attack/ Evade Sequence
Gather materials (charts, tapes, doctrine, historical METOC, etc.)
WS.83 Receive USW Mission
WS.85 Receive Force USW Search Plan (USWC)
WS.90 Review Search Plan (USWC, CO, SS, TAO)
WS.35 Identify Other Mission Areas' Requirements
WS.95 Receive approved plan (USWC)
WS.100 Position Unit for plan (TAO/CIC Sup)
WS.105 Execute Search Plan
WS.110 Detect (all)
WS.115 Classify (all)
WS.120 Track (all)
WS.125 Localize (all)
WS.135 Lost contact
WS.130 End of plan
WS.107 Coordinate Helo/LAMPS Search/TCL
WS.140 Debrief Helo Ops
WS.90 Review Search Plan (USWC, ASTAC)
WS.93 Determine Pre-Planned Search Patterns
WS.84 Receive Tasking for P3
WS.53 Brief Air Crew
WS.50 Develop P3 Search Plans (PD)
WS.65 Monitor Search Plan Execution (for P3)
WS.145 Debrief MPRA Ops
WS.91 Review P3 Search Plan
WS.92 Receive Brief
WS.94 Receive On-Station Modifications (USWC)
Track, Classify, Localize
Mission Prep/Planning
Search Planning
Search Execution
Attack
Washup
Legend
= tasks
= not mandatory
= multiple outcomes
PD = Planner/Decision Maker

Simplified Workflow: Search Planning

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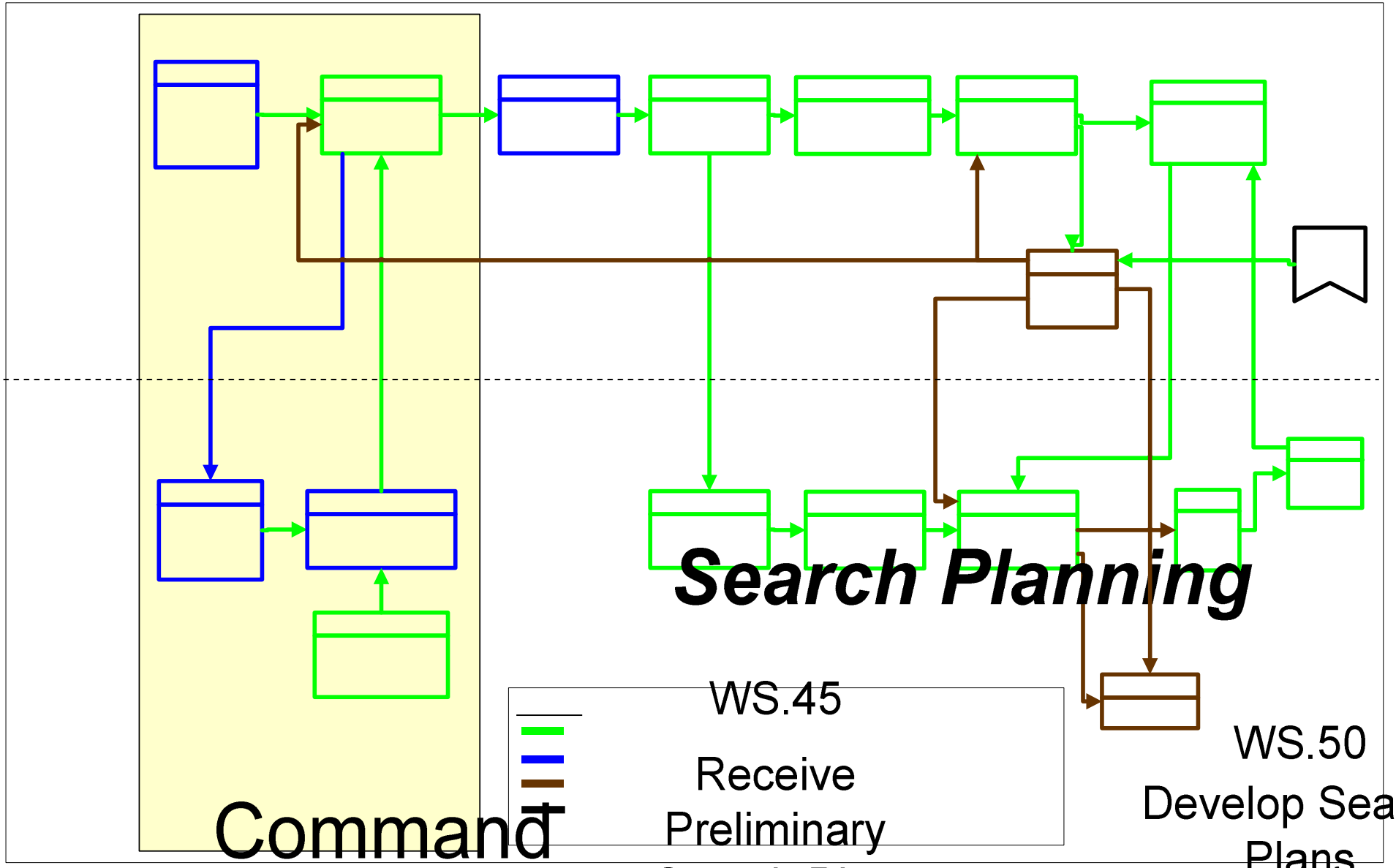


Workflow Compilation Activities

- Obtain/Use Mission Scenarios & Doctrine
- Define Work and Flow of Work
- Document Optional Work, Parallel/Serial Activities and Alternate Paths
- Identify Potential Bottlenecks
- Perform Fleet Verification & Validation
  - Round Table Discussion Format
  - Walk-through Using Mission Scenarios

Using Workflows

- Project scope & management
- System level specification
- System architecture
- Test, evaluation & measurement planning
- Training course outline & planning
- System operating outline & planning

Forms the Framework for the Task Analysis

Task Analysis & Task Allocation Matrix (TAM)

What is a Task Analysis?

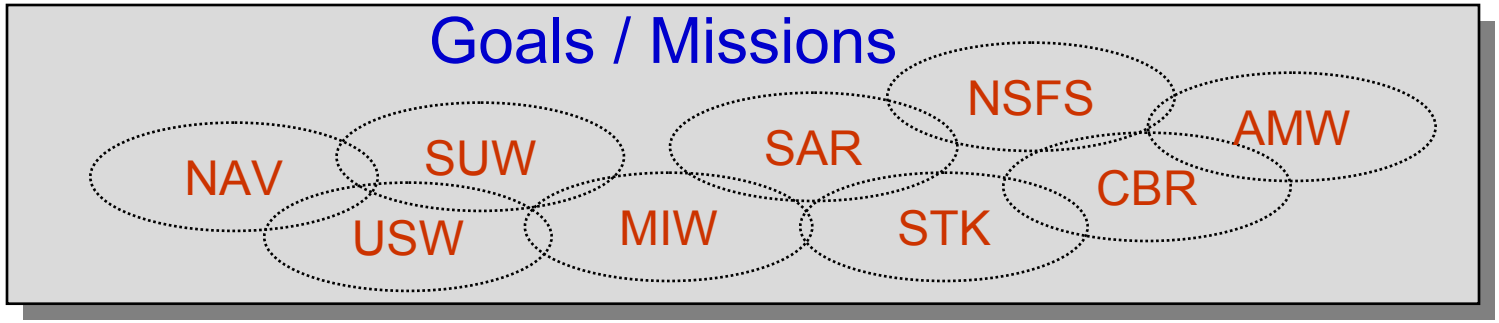
Task Analysis (TA): the systematic collection of requirements as tasks and subtasks performed by operators / decision-makers to achieve a system goal.

Focuses on:

- Task compilation and subtask identification
- Documenting the task/subtask order and attributes
- Determining the human attributes required: Sensory, Motor, Memory, Intellectual, Cognitive
- Documenting the tools and aids used
- Identifying data handling: Inputs, Outputs & Processes
- Concentrates on the <u>explicit</u> elements of performance

What is a Task Allocation Matrix?

Task Allocation Matrix (TAM): Provides a comprehensive, consolidated, ordered list of operator/decision-maker tasks that reflects user requirements.



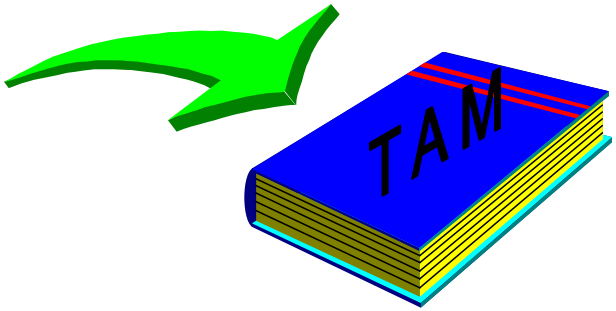
Tasks & Subtasks

People & Stations

Data & Processes

Tools & Materials

Number	Warfare Area Tasks	People	Data & Process	Tools	References



Sample TAM from Search Planning

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ID	Task	Users & Operators																											Type (TBS)					ALLOC (TBS)				Tools (TBS)	Notes	References
						DESRON			TSC			MIN-RON		Platforms																											
		IWS	TSCWO	SCC	SWO	CSO	SCC	ASWC	APO	CUS	SUBRON	MIWC	CSO	TACCO	ASTAC	TAO	ASWC	ASWE	Conn O	IUSS	TAGOS	CWC	SS	SO-sub	SO-surf	Plotter	TMA	FC	Motor	Visual	Aural	Oral	Cognitive	Human	System	HSI	Eliminate			
WS 50	Develop Search Plan			P																									√	√			√			√				
50.1	(U) Replan: SCC alternatives when search objectives are not attainable.			P																									√	√			√			√				SCC Employment Concept (U) 2-1, 2.2.1
50.1.1	(U) Modify/increase search asset availability			P																									√	√			√			√				SCC Employment Concept (U) 2-1, 2.2.1
50.1.2	(U) Reduce probability of detection within specified force defense areas			P																									√	√			√			√				SCC Employment Concept (U) 2-1, 2.2.1
50.1.3	(U) Reduce size of search areas			P																									√	√			√			√				SCC Employment Concept (U) 2-1, 2.2.1
50.2	(U) Define Specific Sea Combat Missions			P																									√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.3	(U) Assess Maritime ASW/SUW Threat Potential			P																									√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.3.1	(U) Assess relative to the existing AO and assigned subordinate mission areas			P																									√	√			√			√				SCC Employment Concept (U) 2-4, 2.3.1
50.4	(U) Develop SCC Plan and Branch Plans			P																									√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.4.1	Develop Pre-planned Responses			P																									√	√			√			√				TR CSG Optask
50.4.1.1	RADAR Riser/Sinker			P																									√	√			√			√				TR CSG Optask
50.4.1.2	ES Line of Bearing			P																									√	√			√			√				TR CSG Optask
50.4.1.3	HFDF Line of Bearing			P																									√	√			√			√				TR CSG Optask
50.4.1.4	EO/Visual (Ship)			P																									√	√			√			√				TR CSG Optask
50.4.1.5	EO/Visual (Aircraft)			P																									√	√			√			√				TR CSG Optask
50.4.1.6	Acoustic Active (Ship)			P																									√	√			√			√				TR CSG Optask
50.4.1.7	Acoustic Passive (Ship)			P																									√	√			√			√				TR CSG Optask
50.4.1.8	Flaming Datum			P																									√	√			√			√				TR CSG Optask
50.4.1.9	Hydrophone Effects/Emergency Tango			P																									√	√			√			√				TR CSG Optask
50.5.	(U) Prioritize Possible Targets			P																									√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.5.	(U) Define SCC ASW/SUW Surveillance Areas			P																									√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.5.	(U) Develop Surveillance Plan			P																									√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1

Close up of the Search Planning TAM (Under Development)

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ID (WS50)	Tasks (Develop Search Plan)	Users & Operators																											Type					ALLOC				Tools	Notes	References
						DESRON			TSC			MIN-RON		Platforms																										
		IWS	TSCWO	SCC	SWO	CSO	SCC	ASWC	APO	CUS	SUBRON	MIWC	CSO	TACCO	ASTAC	TAO	ASWC	ASWE	Conn O	IUSS	TAGOS	CWC	SS	SO-sub	SO-surf	Plotter	TMA	FC	Motor	Visual	Aural	Oral	Cognitive	Human	System	HSI	Eliminate			
50.3	(U) Assess Maritime ASW/SUW Threat Potential			P																								√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.3.1	(U) Assess relative to the existing AO and assigned subordinate mission areas			P																								√	√			√			√				SCC Employment Concept (U) 2-4, 2.3.1
50.4	(U) Develop SCC Plan and Branch Plans			P																								√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.4.1	Develop Pre-planned Responses			P																								√	√			√			√				TR CSG Optask
50.4.1.1	RADAR Riser/Sinker			P																								√	√			√			√				TR CSG Optask
50.4.1.2	ES Line of Bearing			P																								√	√			√			√				TR CSG Optask
50.4.1.3	HFDF Line of Bearing			P																								√	√			√			√				TR CSG Optask
50.4.1.4	EO/Visual (Ship)			P																								√	√			√			√				TR CSG Optask
50.4.1.5	EO/Visual (Aircraft)			P																								√	√			√			√				TR CSG Optask
50.4.1.6	Acoustic Active (Ship)			P																								√	√			√			√				TR CSG Optask
50.4.1.7	Acoustic Passive (Ship)			P																								√	√			√			√				TR CSG Optask
50.4.1.8	Flaming Datum			P																								√	√			√			√				TR CSG Optask
50.4.1.9	Hydrophone Effects/Emergency Tango			P																								√	√			√			√				TR CSG Optask
50.5.	(U) Prioritize Possible Targets			P																								√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.6.	(U) Define SCC ASW/SUW Surveillance Areas			P																								√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1
50.7.	(U) Develop Surveillance Plan			P																								√	√			√			√				SCC Employment Concept (U) 2-3, 2.2.1 Figure 2-1

TA/TAM Compilation Activities

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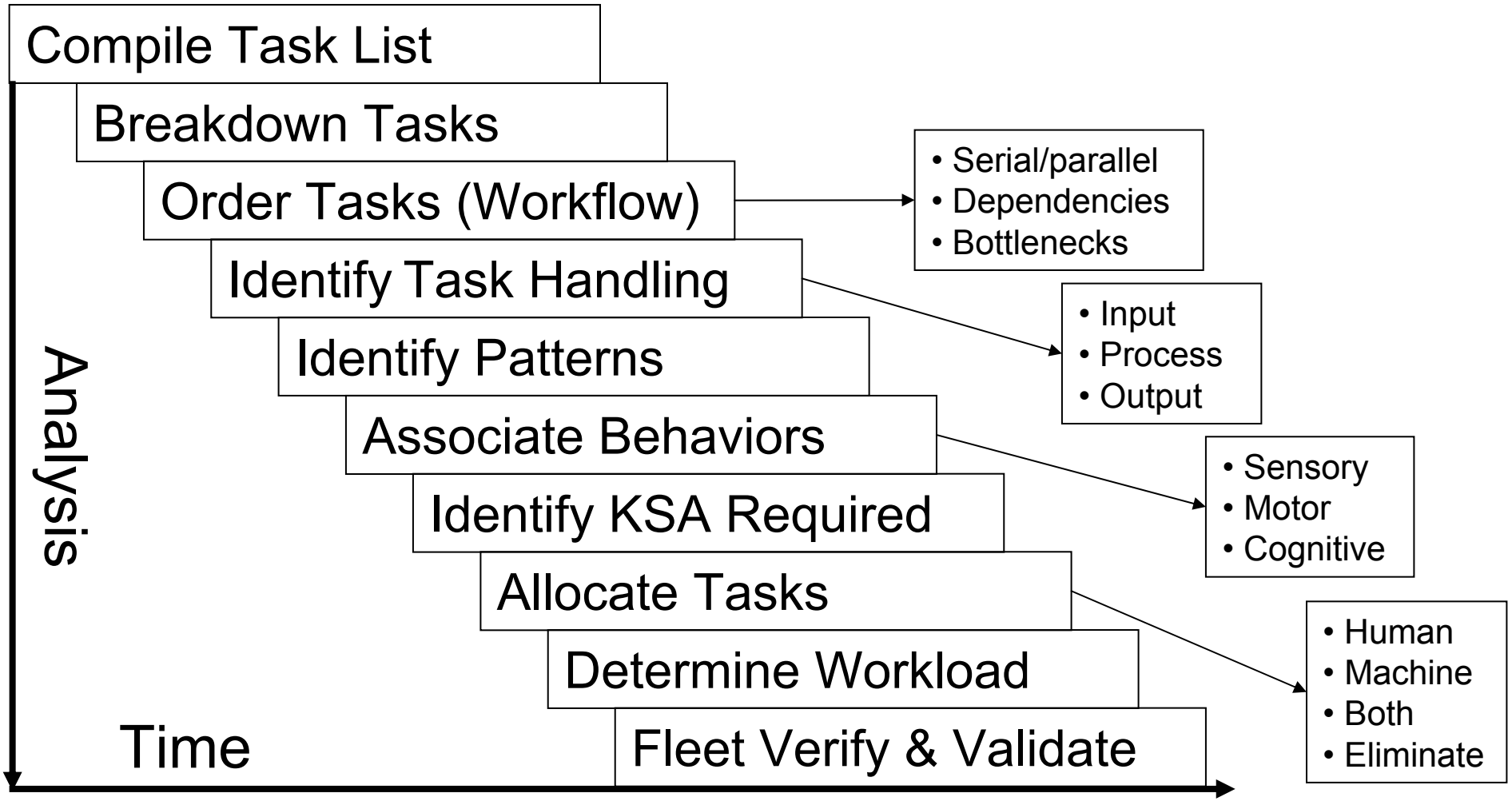

Using Task Analyses & TAMs

- Project management
- Software/hardware level specification
- Software architecture
- Storyboards & GUI development
- Use cases & activity diagrams
- Training course materials
- System operating manuals and guides
- Maintenance manuals

Provides Base for Cognitive Task Analysis, Decision Analysis & Storyboarding

Tactical Information Process (TIP)

What is a Tactical Information Process?

Tactical Information Process (TIP): a process for compiling the tactical information as a context vital to maintaining situation awareness (SA).

Focuses on:

- Static information at a given time (maintain)
- Dynamic changes to that information over time and space (monitor)
- Patterns present/absent in that dynamic movement (evaluate)
- Effects of those dynamics on the present and future plans and actions (command and control)

Levels of Situation Awareness

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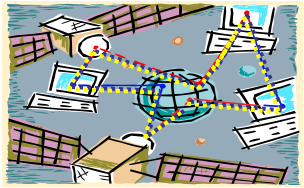

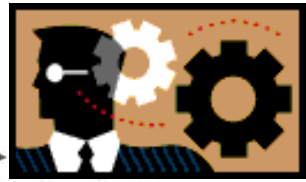

Technological Systems

Perceptual and Cognitive Systems

Lenses consist of local situation, OPORD, doctrine, experience

A

B

C

1
All data in the environment

2
Data detected by technological systems

3
Data available on local C2 system

4
Data perceived by decision maker

5
Comprehension of decision maker

6
Projection of decision maker

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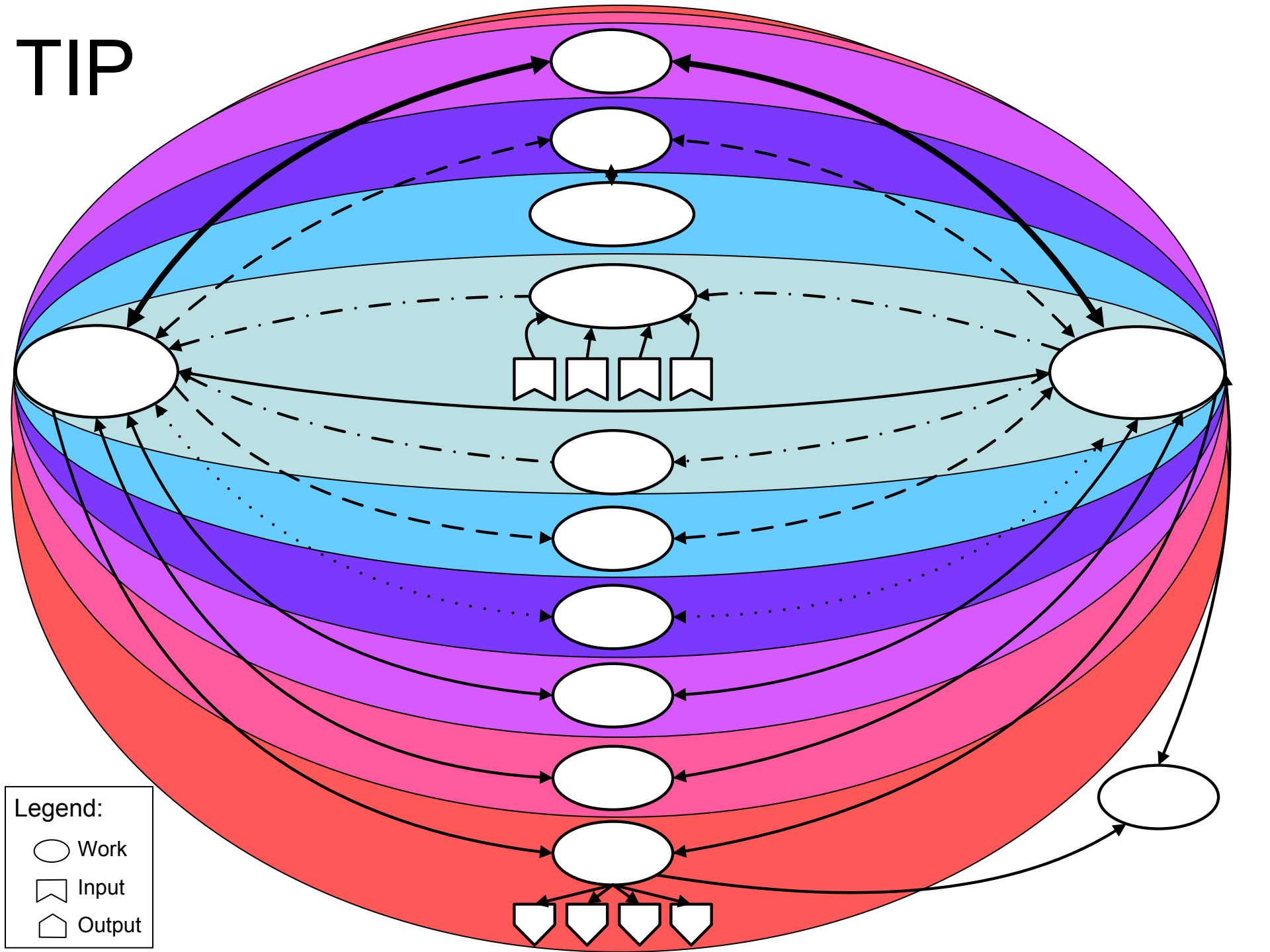
TIP
Legend:
Work
Input
Output

TIP Compilation Activities

- Define the levels of situation awareness as applied to the domain and task requirements:
  1. Perceive the current situation
  2. Track what is changing
  3. Understand how the changes impact the present situation
  4. Anticipate what will happen as the situation develops
- Leverage companion workflows and task analyses to identify the decision points
- Derive the SA input and output requirements

Using the TIP Context

Provides the Dynamic Contextual Framework Supporting Situational Awareness

Collaboration Flow

What is the Collaboration Flow?

Collaboration Flow: Captures the paths for exchanging information, the exchange tools and methods, and the intra/inter- platform and command interactions.

Focuses on:

- Communication paths & alternate communication channels
- Cueing points & bottlenecks
- Collaboration tools & methods
- Data/information exchanged, including its security
- Information handling per type of user

Example Collaboration Flow - Preliminary

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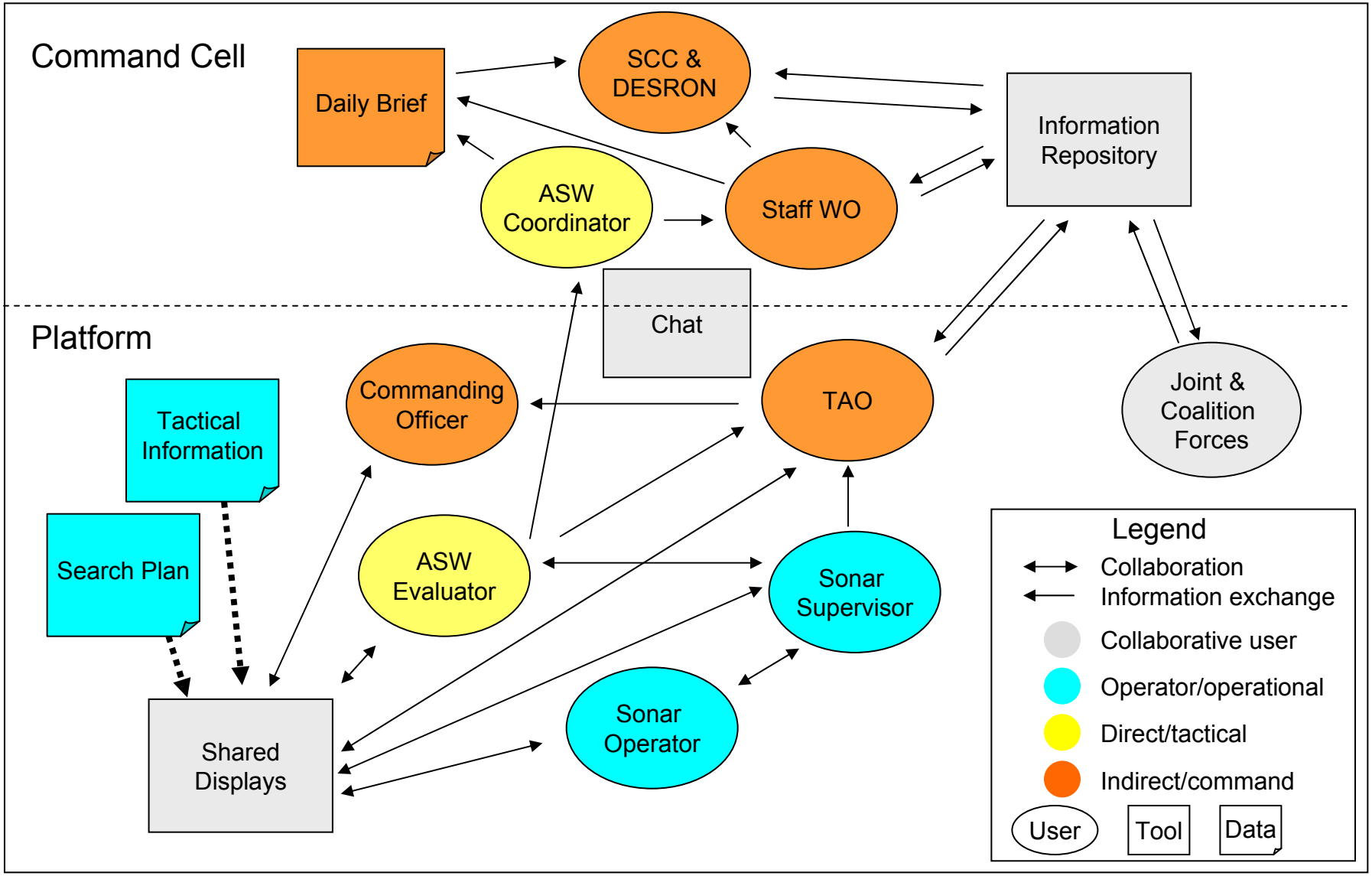

Collaboration Flow Compilation Activities

- Leverage prerequisite data defining the users and user groups
- Reference the workflow and TAM to identify collaboration and information exchange
- Verify & Validate with SMEs and in-situ testing

Using the Collaboration Flow

Provides the Interconnected Context Embedded in Collaborative Decision Making

Fitting the Analyses into an Existing System

Human System Integration Process

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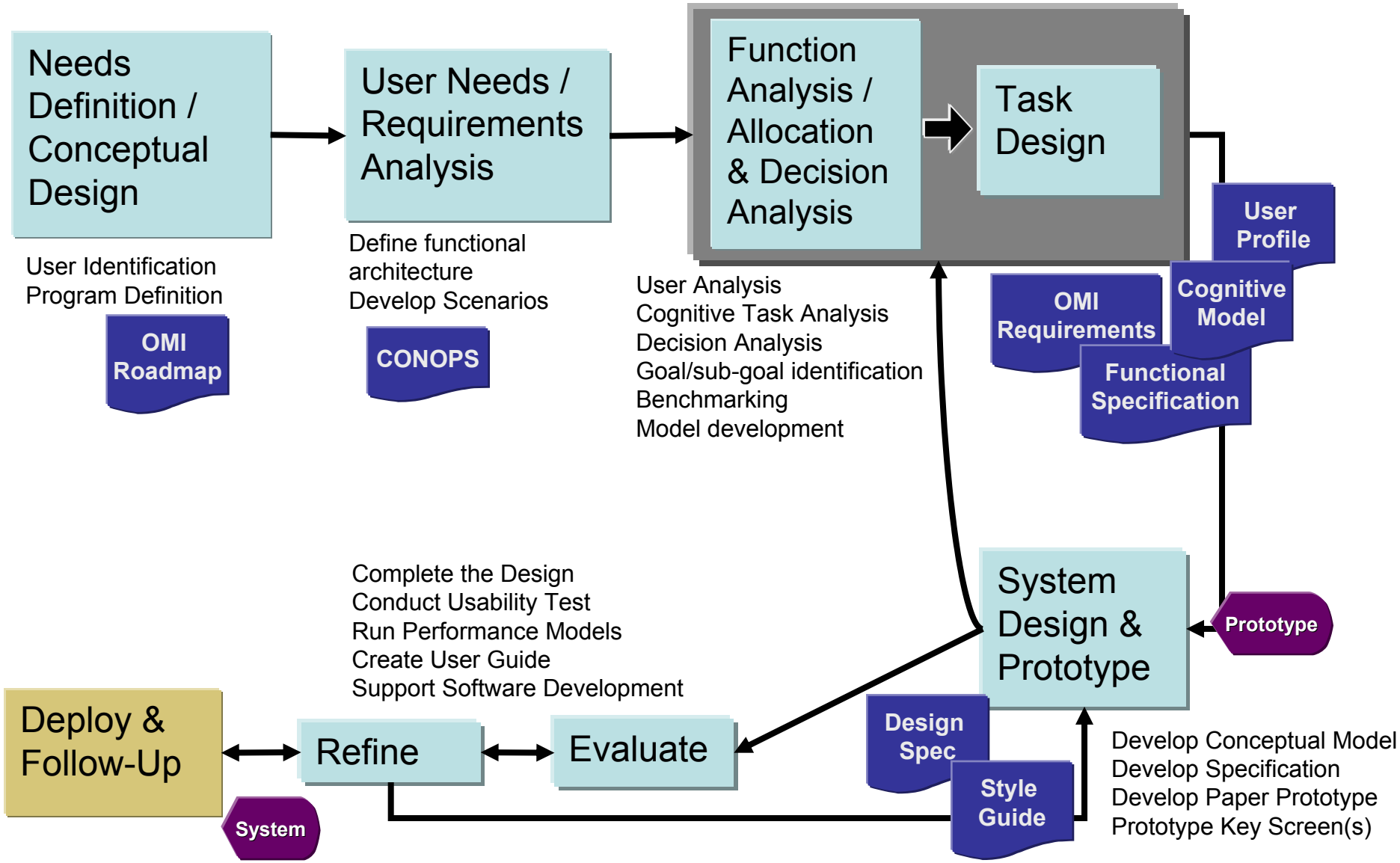

HSI Analyses in Spiral Development

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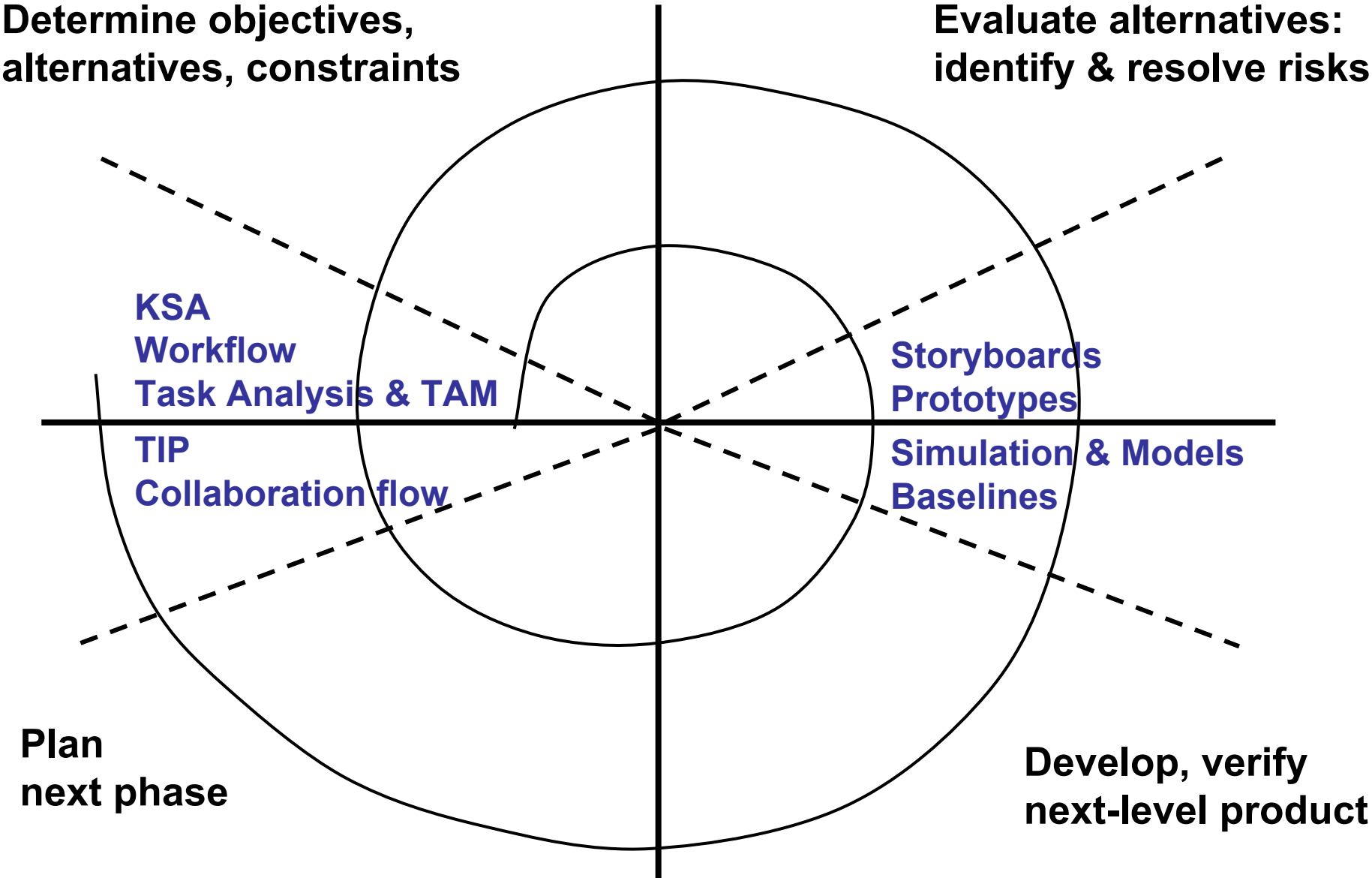

Lessons Learned & Relearned

1. The earlier that the correct requirements are documented, the less costly the product.
2. It's never too early to involve warfighters at all levels.
3. One trip to the field is worth a thousand requirements.
4. There are BIG differences between operators and subject matter experts.
5. A very large problem is easy to break into very manageable pieces… if you have the right tools.
6. Understanding the operational context early is critical.
7. Priorities can be obtained directly from the users.
8. Fleet involvement makes a better product!
9. An interdisciplinary team is vital.
10. HSI products have project wide and multi-phase impact!

Questions & Answers

Until we understand the current needs,
we cannot build for the future.

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and Mandy Iny

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Back-Up Slides

Data Sources for SA Assessment

Data Source	Answers Available	User & Usage
Background Survey	Who used it (rank/rate)? How much: • Training (classroom & on-the Job)? • Experience (at workstation, with computers)?	Ability to use (User Knowledge, Skills & Abilities)
Electronic data collection: charts & maps, sensor data, contacts, etc	What is available? When is it available? Where (workstation/platform) is it available? In what form is it available?	Available for use
Observer records	What appeared to be used? When was it used? How did it appear to be used? What problems were observed?	Observed use
Operator records, surveys & interviews	What was used? How was it used? What decisions were made? What difficulties/problems were encountered?	Reported use
Talk-aloud & situational awareness assessment	How were difficulties overcome? What were decisions based on? Why? What decisions were considered? Why? Was it used as intended?	Actual use

Human Systems Engineering Process

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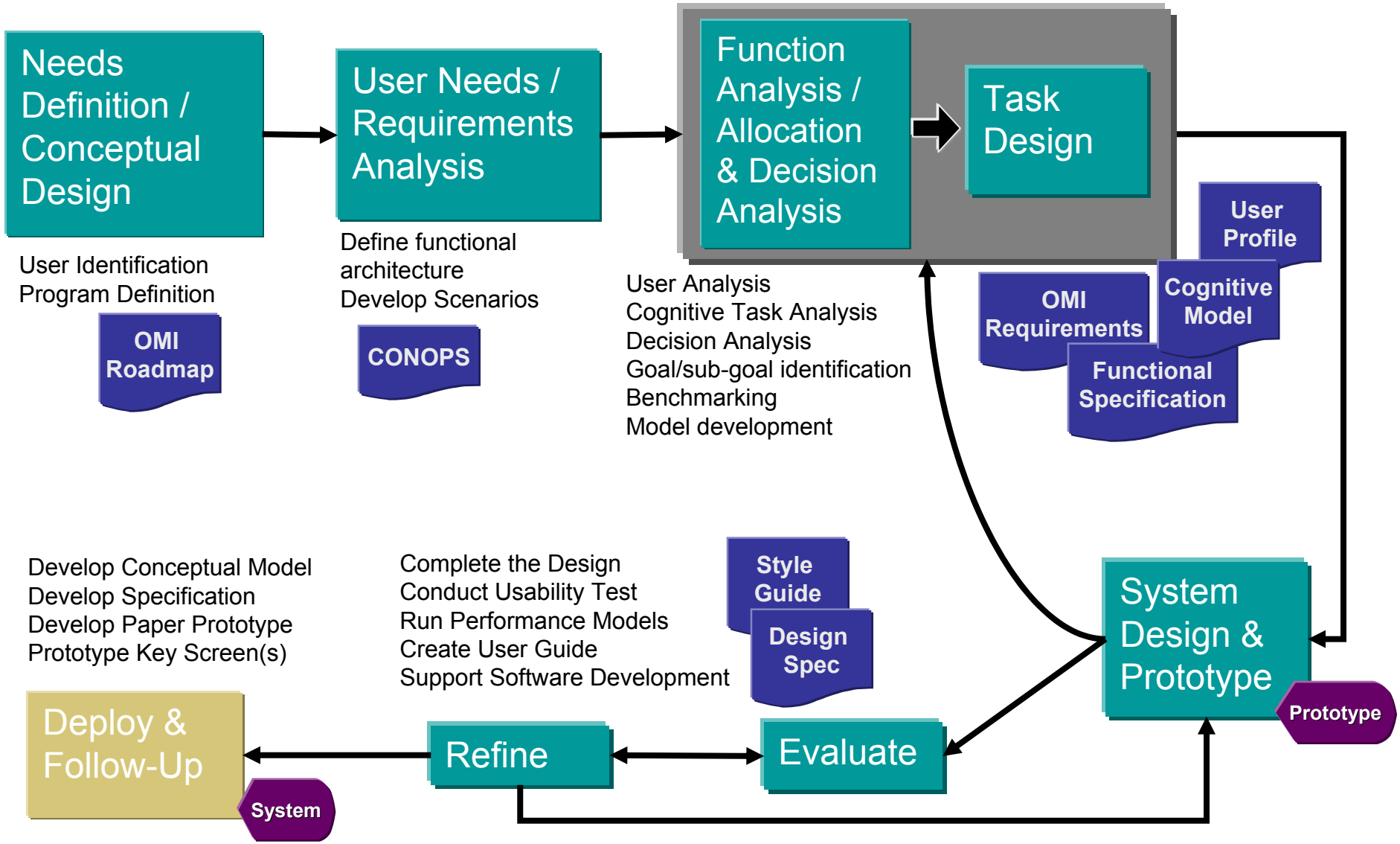

Priorities can be Obtained Directly from the Users

Instructions

- Purpose
- Length
- Composition
- Anonymity
- Classification
- If questions/concerns

Background

1. Rank/Rate
2. Watch station
3. Hours doing training
4. Hours using prototype
5. Hours using computers

Generic Questions

6. Importance in doing job
7. Frequency of use
8. Ease of use
9. Ease of learning to use
10. Responsiveness
11. Completeness
12. Adequacy of training
13. Confidence
14. Value-added
15. Overall ratings
16. Suggestions for future
17. Concerns
18. Anything else?

Building Confidence in the System

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SLB SOLUTION FOR CONTACT 106T0

Soln Time (hhmm)

SrA (kts):

$\dot{B}$ (deg/min):

R_{SLB} (kyds):

$R_{Max\ Error}$ (kyds

$R_{Min\ Error}$ (kyds

Displa

EKE SOLUTION FOR CONTACT 106T0

Soln Time (hhmm):

SoA1 (kts):

SoA2 (kts):

$\dot{B}1$ (deg/min):

$\dot{B}2$ (deg/min):

D^* (kyds):

R_{EKE} (kyds):

$R_{Max\ Error}$ (kyds):

$R_{Min\ Error}$ (kyds):

Display Ma

BD SOLUTION FOR CONTACT 106T0

$$R_{BD} = 65656 \frac{(c)(\dot{f})}{(\dot{B})^2 fo}$$

	Manual Solution	Computer Solution
Soln Time (hhmm):	2200	2200
c (ft/sec):	4920.00	4920.00
$\dot{f}$ (Hz/min):	-0.0657	-0.0657
$\dot{B}$ (deg/min):	0.3194 R	0.3194 R
fo (Hz):	3459.2014	3459.2014
R_{BD} (kyds):	60.2	60.2
$R_{Max\ Error}$ (kyds):	168.6	168.6
$R_{Min\ Error}$ (kyds):	0.0	0.0

Calculate

Display Manual Solution on Strip Plot

$\dot{f}$ >= .01 Hz/min
Normally inside 40 kyds
fr or fc can be used in place of fo
c is speed of sound through water

Close

DEKE SOLUTION FOR CONTACT 106T0

$$R_{DEKE} = \frac{fr\ (SoA1 \pm SoA2)^2}{90\ [sqrt(\dot{f}1) \pm sqrt(\dot{f}2)]^2}$$

	Manual Solution	Computer Solution
Soln Time (hhmm):	2202	2202
fr (Hz):	3461.1451	3461.1451
SoA1 (kts):	-8.0005	-8.0005
SoA2 (kts):	-8.0021	-8.0021
$\dot{f}1$ (Hz/min):	-0.066045	-0.066045
$\dot{f}2$ (Hz/min):	-0.066580	-0.066580
R_{DEKE} (kyds):		
$R_{Max\ Error}$ (kyds):		
$R_{Min\ Error}$ (kyds):		

Calculate

Display Manual Solution on Strip Plot

Close