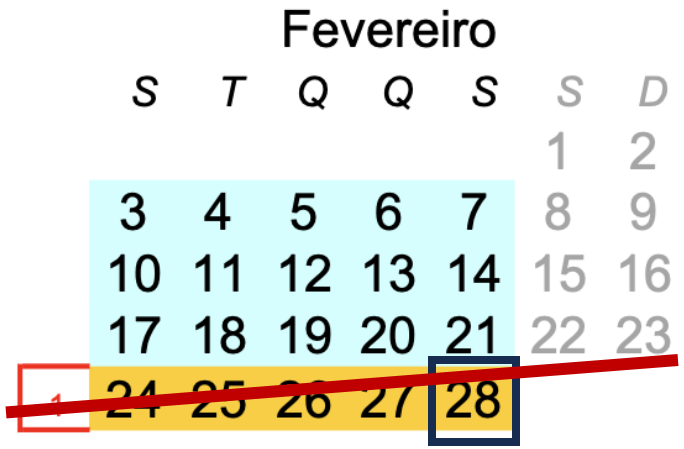
Life Cycle / CONOPs

ARP - Conceptual Aircraft/System Development

[2025]

Prof. Dr. Christopher S. Cerqueira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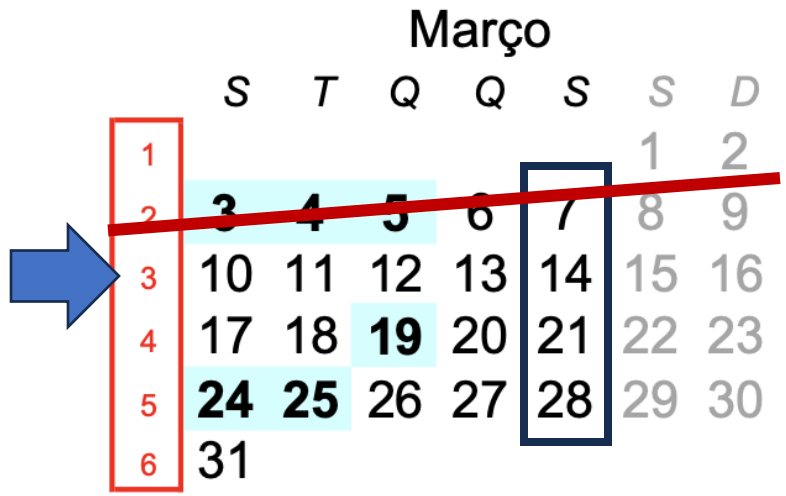
S T Q Q S S D
1 2
3 4 5 6 7 8 9
10 11 12 13 14 15 16
17 18 19 20 21 22 23
1 24 25 26 27 28


Março
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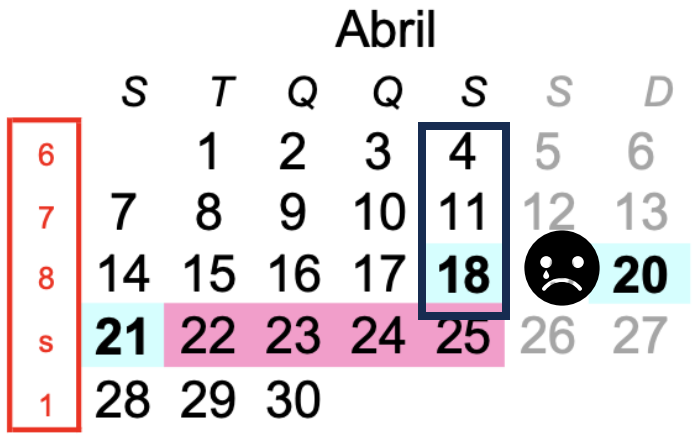
4 17 18 19 20 21 22 23
5 24 25 26 27 28 29 30
6 31


Abril
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7 7 8 9 10 11 12 13
8 14 15 16 17 18 20
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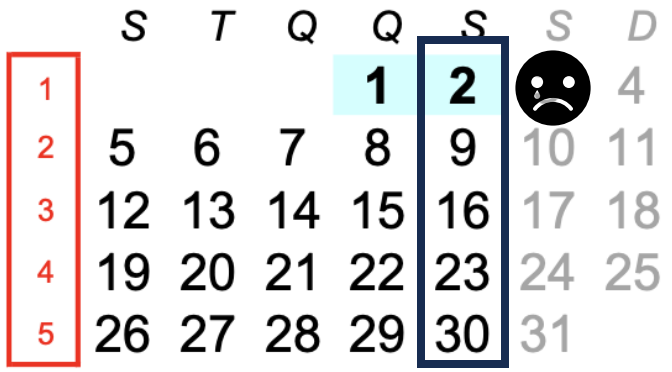
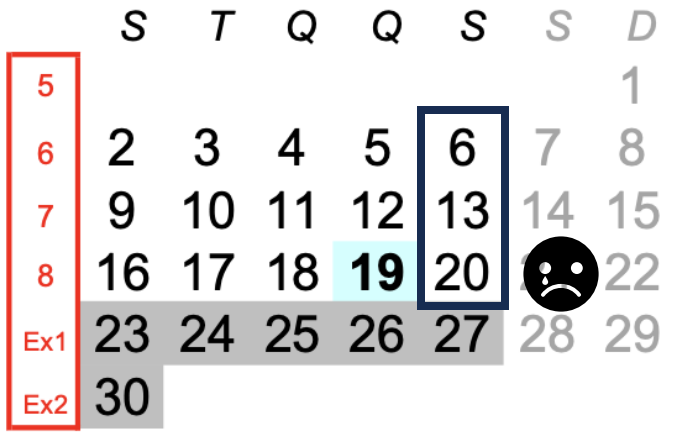
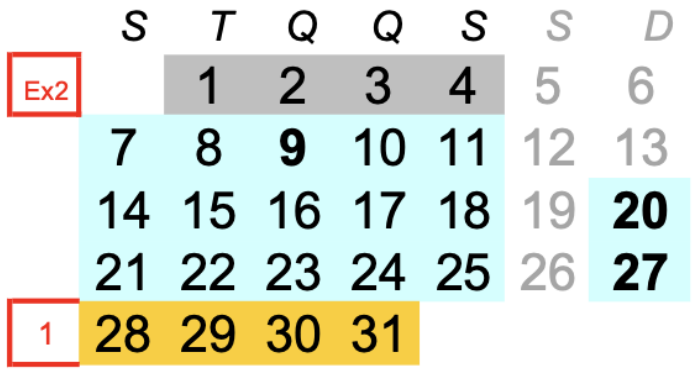
1 28 29 30


Maio
S T Q Q S S D
1 1 2 4
2 5 6 7 8 9 10 11
3 12 13 14 15 16 17 18
4 19 20 21 22 23 24 25
5 26 27 28 29 30 31


Junho
S T Q Q S S D
5 1
6 2 3 4 5 6 7 8
7 9 10 11 12 13 14 15
8 16 17 18 19 20 22
Ex1 23 24 25 26 27 28 29
Ex2 30


Julho
S T Q Q S S D
Ex2 1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
1 28 29 30 31

Learning the Theory

		Theory		Hands-on	
Week	Teory	Individual	W	Group exercises	W
1	Syllabus Introduction	Systems Engineer Mindset reading (10 questions)	5%		0%
24-Feb	System Thinking				
28-Feb	ARP4754 Introduction				
2	Stakeholders	Stakeholder and Metrics Reading (10 questions)	5%	Create a network from a problem following the paper instructions (4 stks)	10%
03-Mar	Mesures of Success				
07-Mar	Arcadia-Capella Introduction				
3	Life Cycle	Definition Readings (10 questions)	5%	Create a CONOPSs with 4 scenarios.	10%
10-Mar	CONOPs				
14-Mar	4.1 Conceptual Aircraft/System Development				
4	Functions	Definition Readings (10 questions)	5%		0%
17-Mar	Functional Architecture				
21-Mar	Functional Diagram / eFFBD				
5	Block Diagram	Definition Readings (10 questions)	5%	Create a functional architecture from the CONOPs (15fnc / 3 layers)	10%
24-Mar	Interfaces / N2				
28-Mar	4.2 Aircraft Function Development				
6	Statemachine Diagram	Definition Readings (10 questions)	5%	Exercises to create statemachines (4 systems)	10%
31-Mar					
04-Apr	4.3 Allocation of Aircraft Function to Systems				
7	Sequence Diagram	Definition Readings (10 questions)	5%	Exercise to create event sequence from the CONOPS scenarios	10%
07-Apr					
11-Apr	4.4 Development of System Architecture				
8	P1	Selection of 15 questions and apply into a context.	65%	One exercise with all steps.	50%
14-Apr					
18-Apr					
			100%		100%

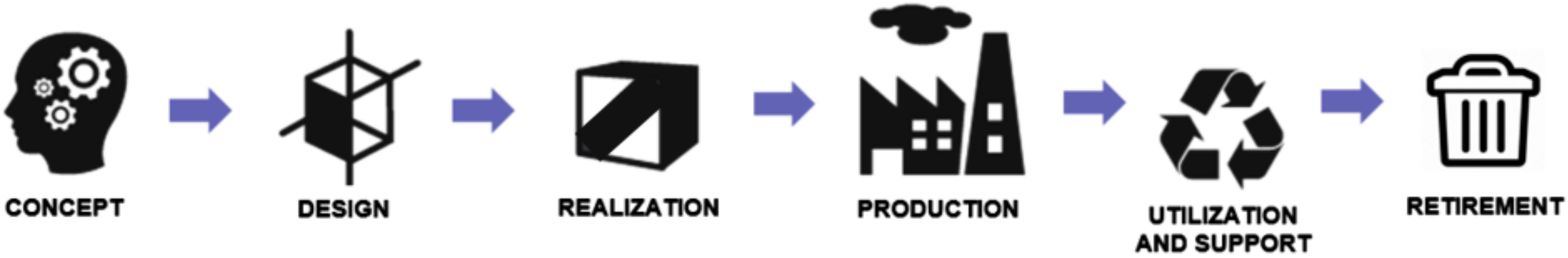
Life cycle

LIFE CYCLE

*"Life cycle is the **series of phases** through which **something** passes."*

LIFE CYCLE

- Engineered Systems have a **life cycle.**
  - Life cycle is a series of **stages through which a system passes** during its lifetime
  - Life cycle considers the evolution of a system **from conception through retirement**



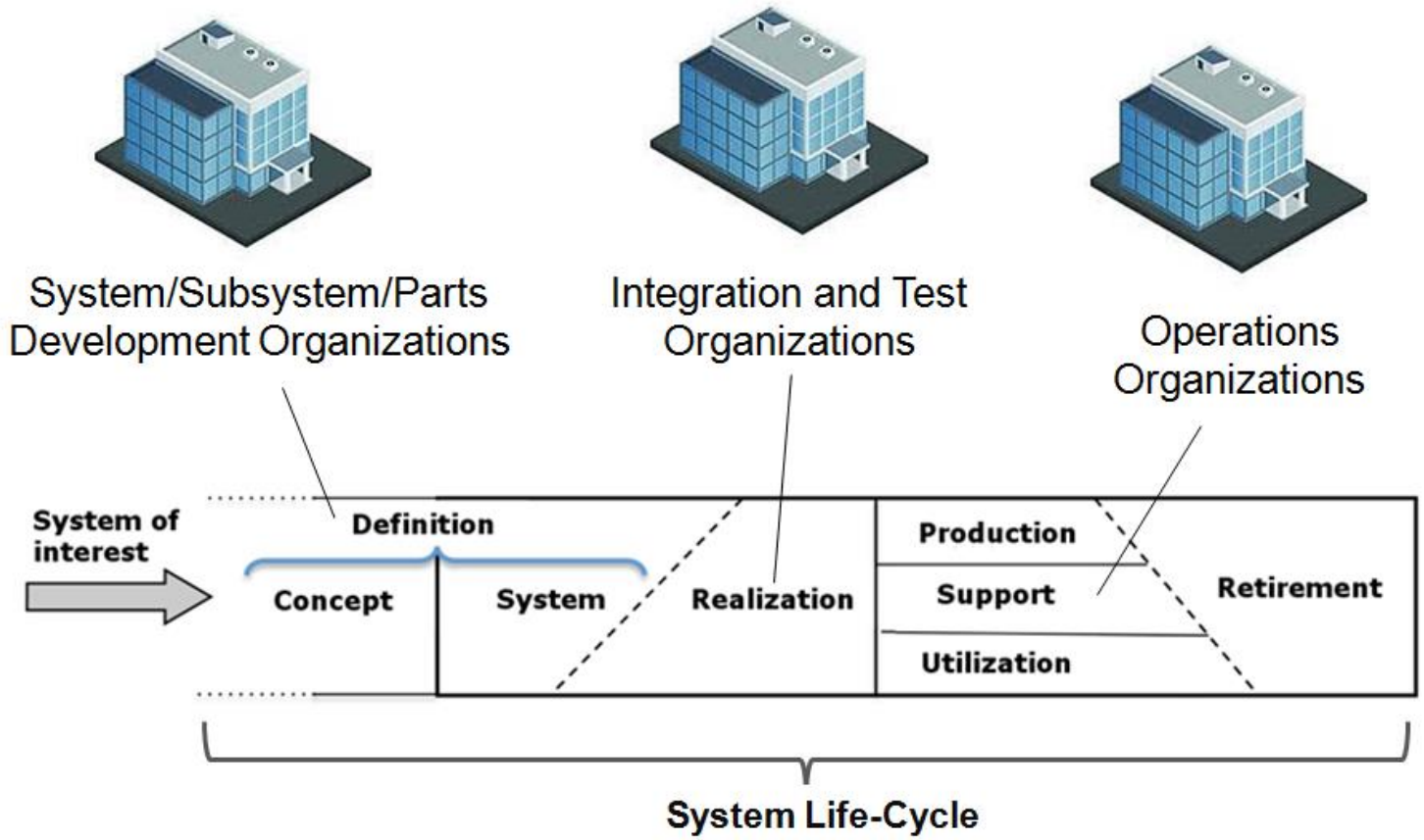
CICLO DE VIDA DO SISTEMA

- **ECSS-E-ST-10-06C**: A **time interval** between the **conceptual exploration** of the product introduction to its **withdrawal from service**.

- **ISO/IEC/IEEE 15288**: A system progresses through its life cycle as **the result of actions,** performed and **managed by people** in organizations, using processes for execution of these actions.

LIFE CYCLE CONCEPTS

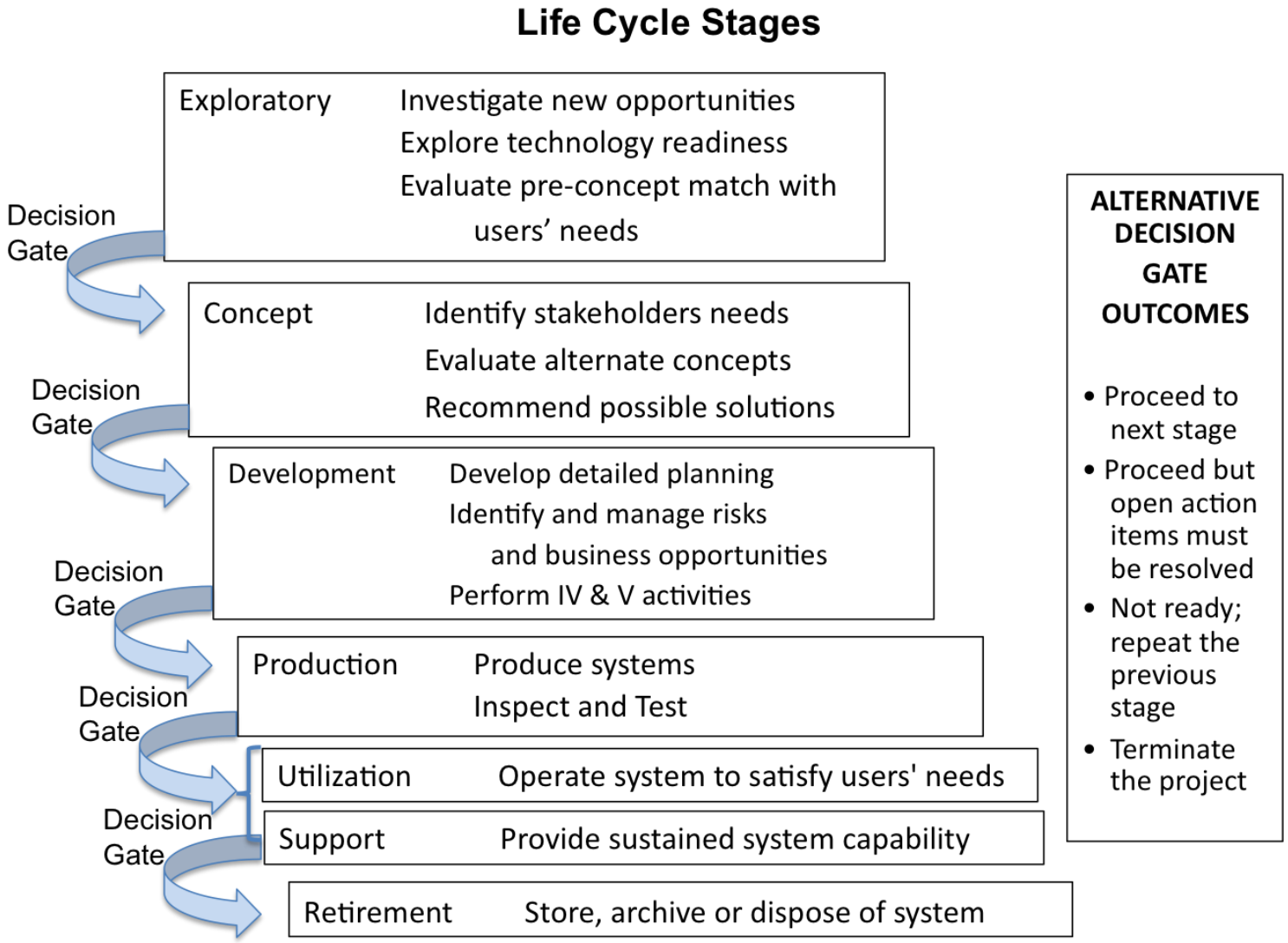
- The life cycle concept is a **description** of the expected system life cycle.
- Life cycle concepts focus on **defining solutions** for the system life cycle.



Types of lifecycle

https://sebokwiki.org/wiki/Systems_Lifecycle_Approaches

WATERFALL



https://sebokwiki.org/wiki/System_Lifecycle_Process_Models:_Vee

Generic life cycle (ISO/IEC/IEEE 15288:2015)

Concept stage	Development stage	Production stage	Utilization stage	Retirement stage
			Support stage	

Typical high-tech commercial systems integrator

Study period				Implementation period			Operations period		
User requirements definition phase	Concept definition phase	System specification phase	Acq prep phase	Source select. phase	Development phase	Verification phase	Deployment phase	Operations and maintenance phase	Deactivation phase

Typical high-tech commercial manufacturer

Study period			Implementation period			Operations period		
Product requirements phase	Product definition phase	Product development phase	Engr. model phase	Internal test phase	External test phase	Full-scale production phase	Manufacturing, sales, and support phase	Deactivation phase

US Department of Defense (DoD)

User needs / Tech opport resources	A	Pre-systems acquisition		B	Systems acquisition		C / IOC	FOC
		Materiel solution analysis	Technology development		Engineering and manufacturing development	Production and deployment		Sustainment: Operations and support (including disposal)

National Aeronautics and Space Administration (NASA)

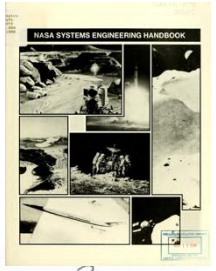
Formulation			Approval	Implementation		
Pre-phase A: concept studies	Phase A: concept & technology development	Phase B: preliminary design & technology completion	Phase C: final design & fabrication	Phase D: system assembly integration & test, launch	Phase E: operations & sustainment	Phase F: closeout
Feasible concept →	Top-level architecture →	Functional baseline →	Allocated baseline →	Product baseline →		As deployed baseline

US Department of Energy (DoE)

Project planning period			Project execution			Mission	
Pre-project	Preconceptual planning	Conceptual design	Preliminary design	Final design	Construction	Acceptance	Operations
Typical decision gates: New initiative approval	Concept approval		Development approval	Production approval		Operational approval	Deactivation approval

https://sebokwiki.org/wiki/System_Lifecycle_Process_Models:_Vee#/media/File:Comparisons_of_life_cycle_models.PNG

(CLÁSSICO) VEE MODEL



Draft 921116

Technical Aspect of the NASA Project Cycle (Generic)

Phase A: Mission Needs & Conceptual Studies
Phase B: Concept Definition
Phase C: Design & Development
Phase D: Fabrication, Integration, Test, & Certification
Phase E: Pre-Operations
Phase F: Operations/Disposal

Mission Needs Statement
Operational Requirements Document (ORD) put under change control at the User Requirements Review.
System/Segment Specification (SSS) put under change control after CoDR.
System/Segment Design Document (SSDD) put under change control at PRR.
"Design-to" specifications put under change control at CI PDRs.
"Build-to" documentation put under change control at CI CDR.
Post PDR changes to System Performance Specifications should be held for next system upgrade
System Verification Plan baselined at SDR; System tests performed after Sys TRR
CI Qualification specifications baselined at PDR; results of Qualification tests reviewed at CI FQR
Configuration Item Verification Plans baselined at PDR; CI tests performed after CI TRR
HW Assembly and CSC Test & Integration plans prepared for CI CDR.

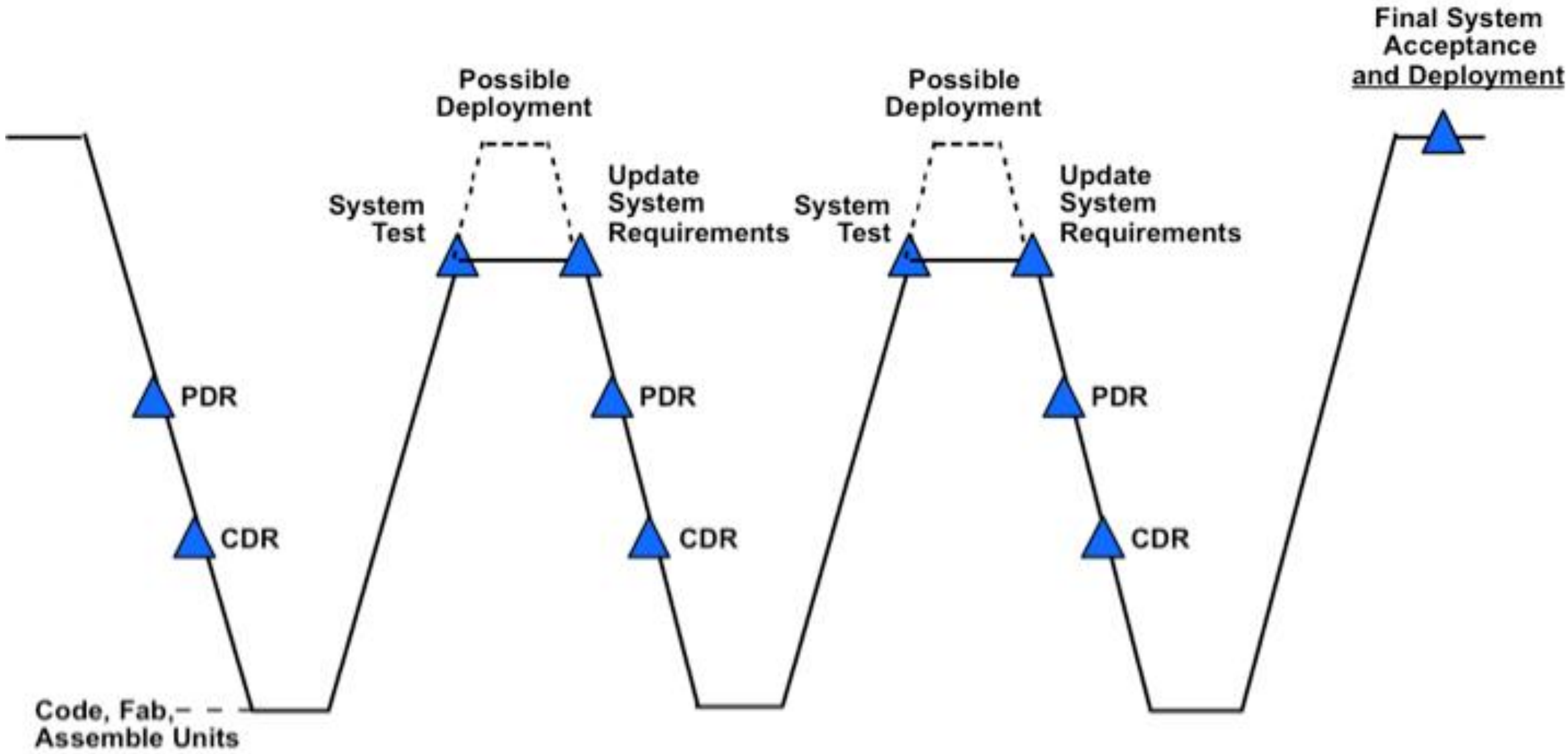
Decomposition & Definition
Integration & Verification
Time & Maturity

Control Gate Legend
AR – Acceptance Review
CDR – Critical Design Review
CoDR – Concept Design Review
FCA – Functional Configuration Audit
FQR – Formal Qualification Review
HSR – Hardware Specification Review
OAR – Operational Acceptance Review
ORR – Operational Readiness Review
PAR – Product Acceptance Review
PCA – Physical Configuration Audit
PDR – Preliminary Design Review
PRR – Project Requirements Review
SSR – Software Specification Review
TRR – Test Readiness Review

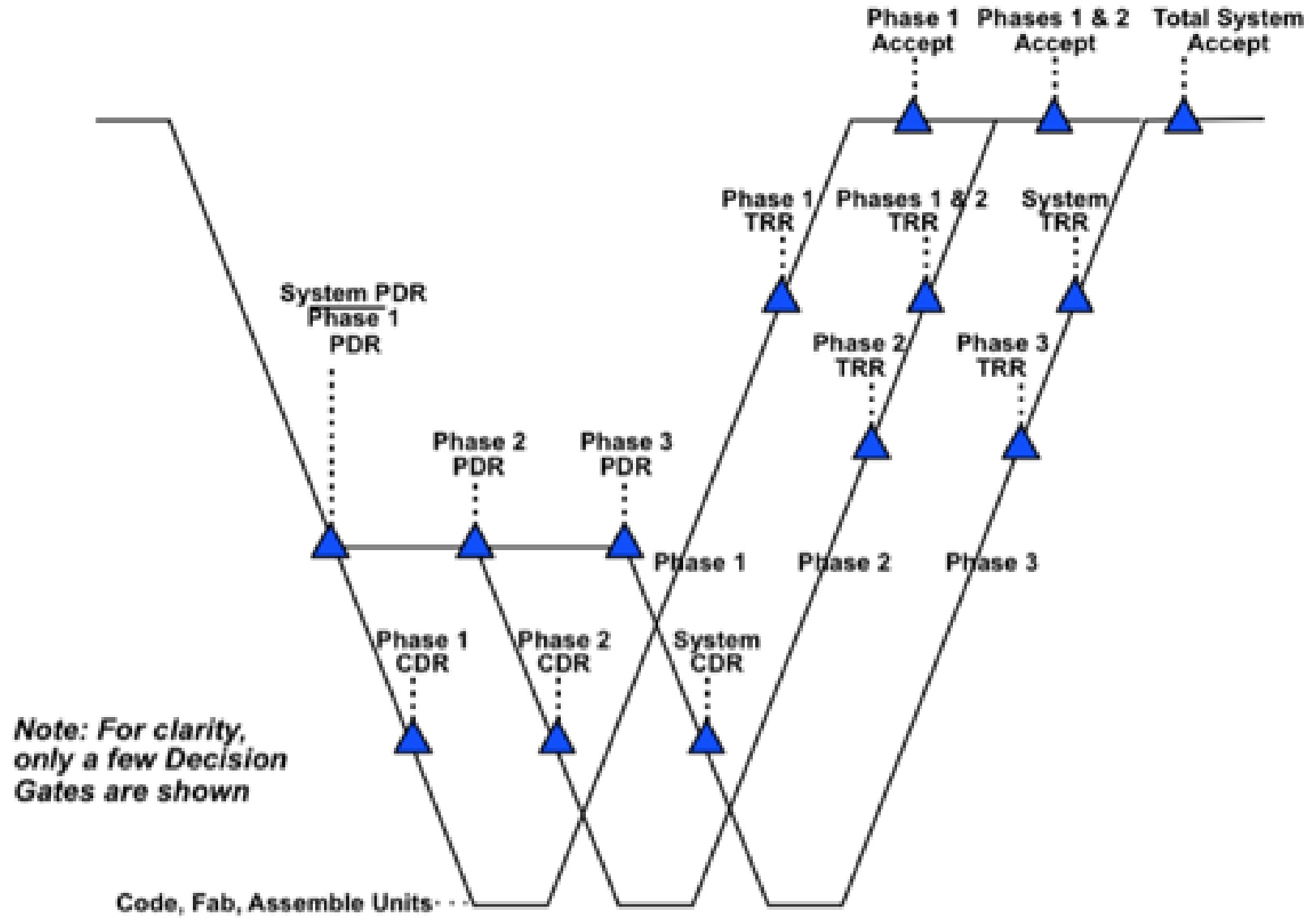
Abbreviations and Acronyms
Agree. – Agreement
Assy. – Assembly
Config. – Configuration
CI – Configuration Item
CSC – Computer Software Component
Des. – Design
Doc. – Document
HW – Hardware
IOC – Initial Operational Capability
Ops. – Operations
Perf. – Performance
Pkg. – Package
Prelim. – Preliminary
Qual. – Qualification
Reqmt. – Requirement
Spec. – Specification
SW – Software
SSS – Sys/Seg Spec.
SSDD – Sys/Seg Des. Doc.
Sys – System
Verif. – Verification

Forsberg, K., H. Mooz, and H. Cotterman. 2005. *Visualizing Project Management*. 3rd ed. New York, NY, USA: J. Wiley & Sons.

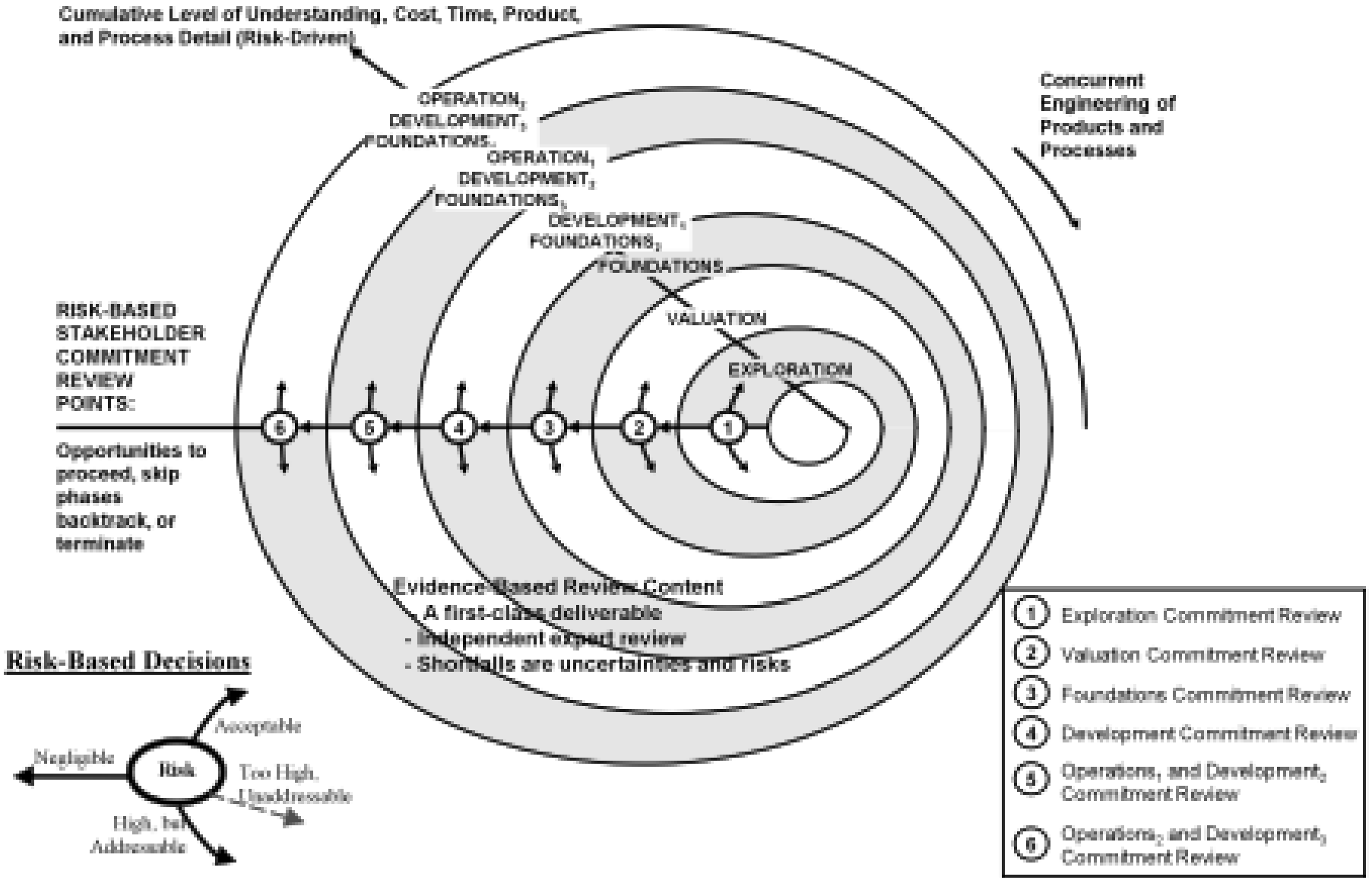
Evolutionary process



Incremental development with multiple deliveries



Spiral


Cumulative Level of Understanding, Cost, Time, Product, and Process Detail (Risk-Driven)
OPERATION$_1$, DEVELOPMENT$_1$, FOUNDATIONS$_1$
OPERATION$_1$, DEVELOPMENT$_2$, FOUNDATIONS$_2$
DEVELOPMENT$_1$, FOUNDATIONS$_2$
FOUNDATIONS
VALUATION
EXPLORATION
Concurrent Engineering of Products and Processes
RISK-BASED STAKEHOLDER COMMITMENT REVIEW POINTS:
Opportunities to proceed, skip phases backtrack, or terminate
Evidence-Based Review Content
- A first-class deliverable
- Independent expert review
- Shortfalls are uncertainties and risks
Risk-Based Decisions
Acceptable
Negligible
Risk
Too High, Unaddressable
High, but Addressable
1 Exploration Commitment Review
2 Valuation Commitment Review
3 Foundations Commitment Review
4 Development Commitment Review
5 Operations$_1$ and Development$_2$ Commitment Review
6 Operations$_2$ and Development$_2$ Commitment Review

Scrum

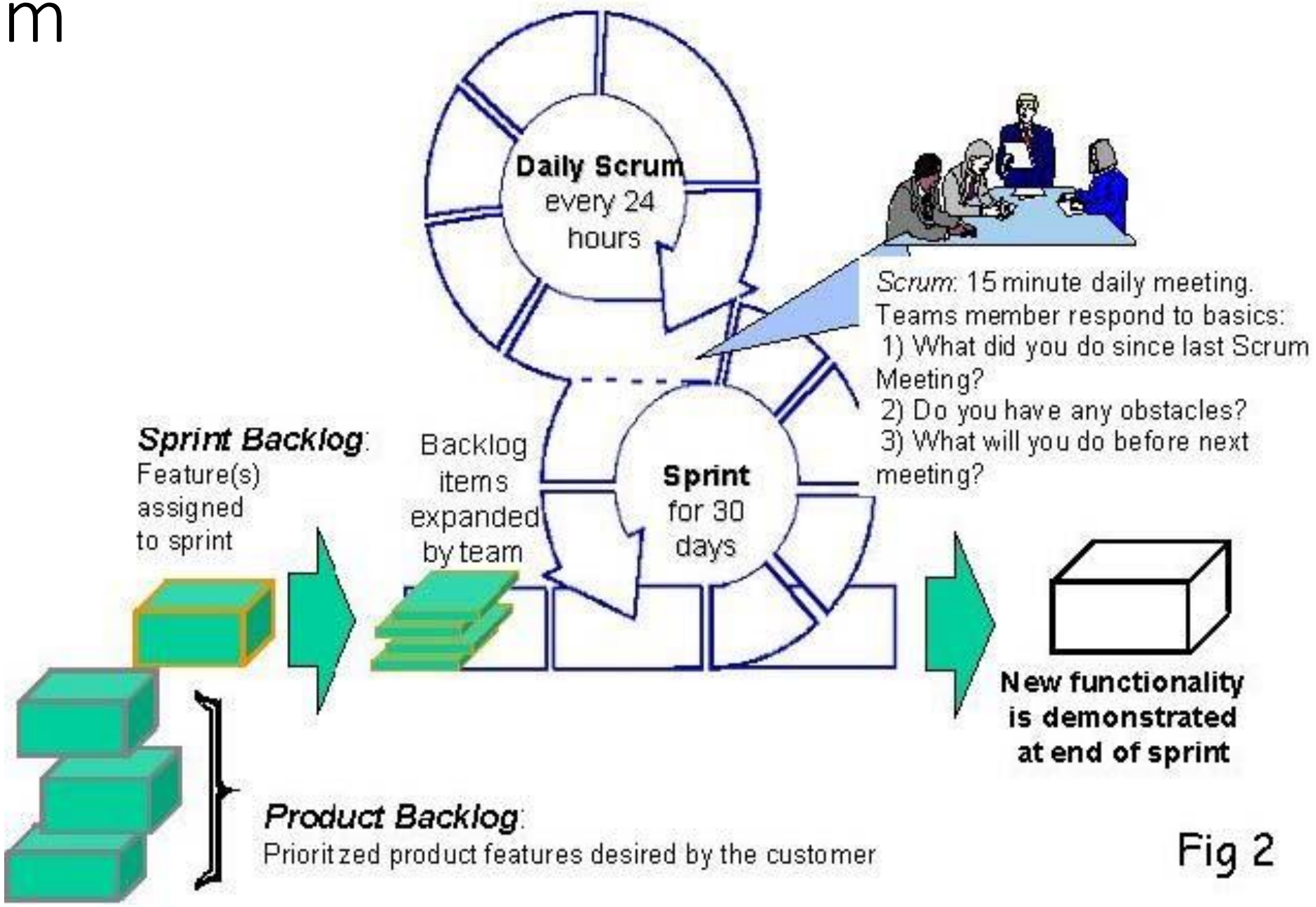
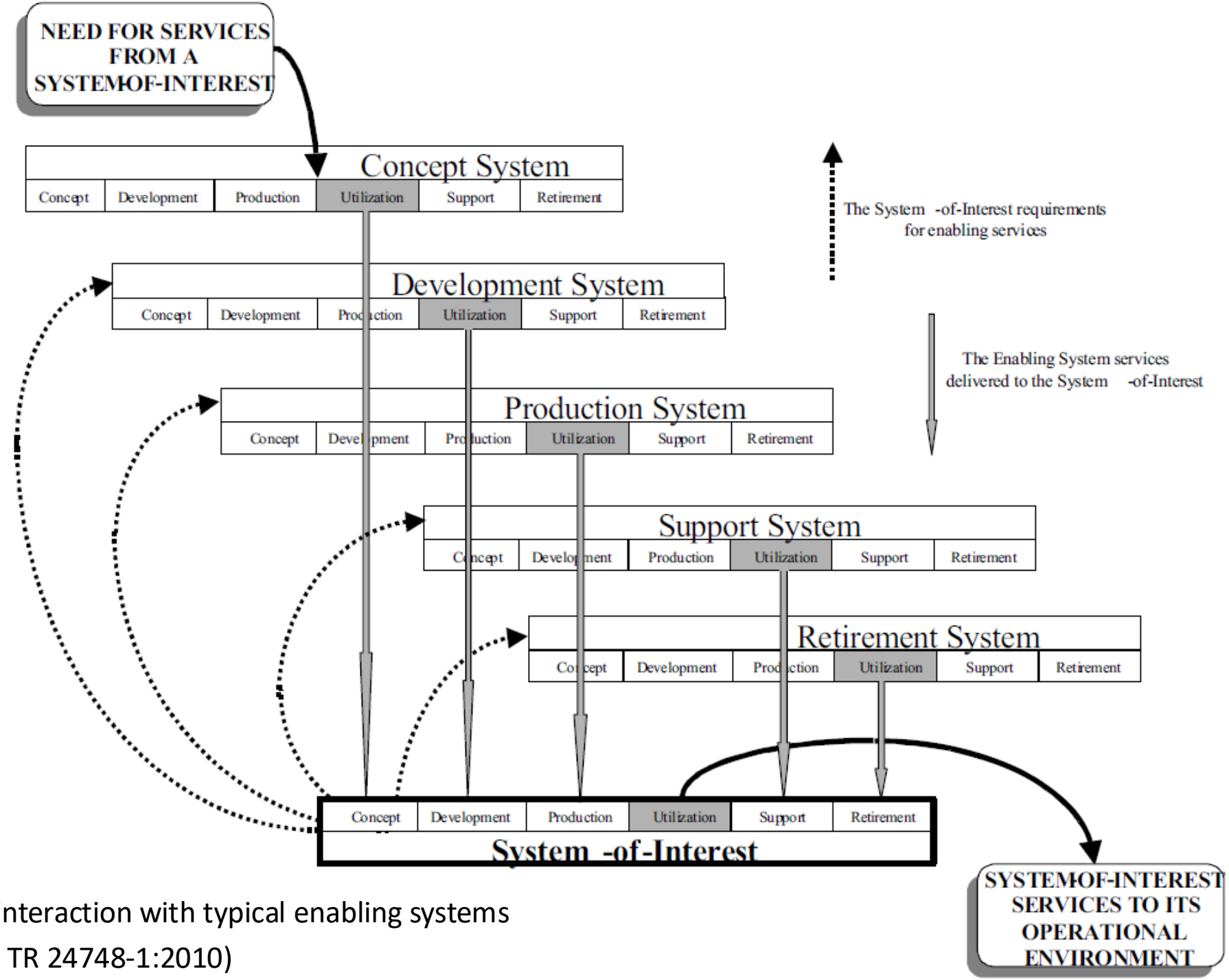

Daily Scrum
every 24
hours
Scrum: 15 minute daily meeting.
Teams member respond to basics:
1) What did you do since last Scrum Meeting?
2) Do you have any obstacles?
3) What will you do before next meeting?
Sprint Backlog:
Feature(s)
assigned
to sprint
Backlog
items
expanded
by team
Sprint
for 30
days
New functionality
is demonstrated
at end of sprint
Product Backlog:
Prioritzed product features desired by the customer

Fig 2



- System interaction with typical enabling systems
- (ISO/IEC TR 24748-1:2010)

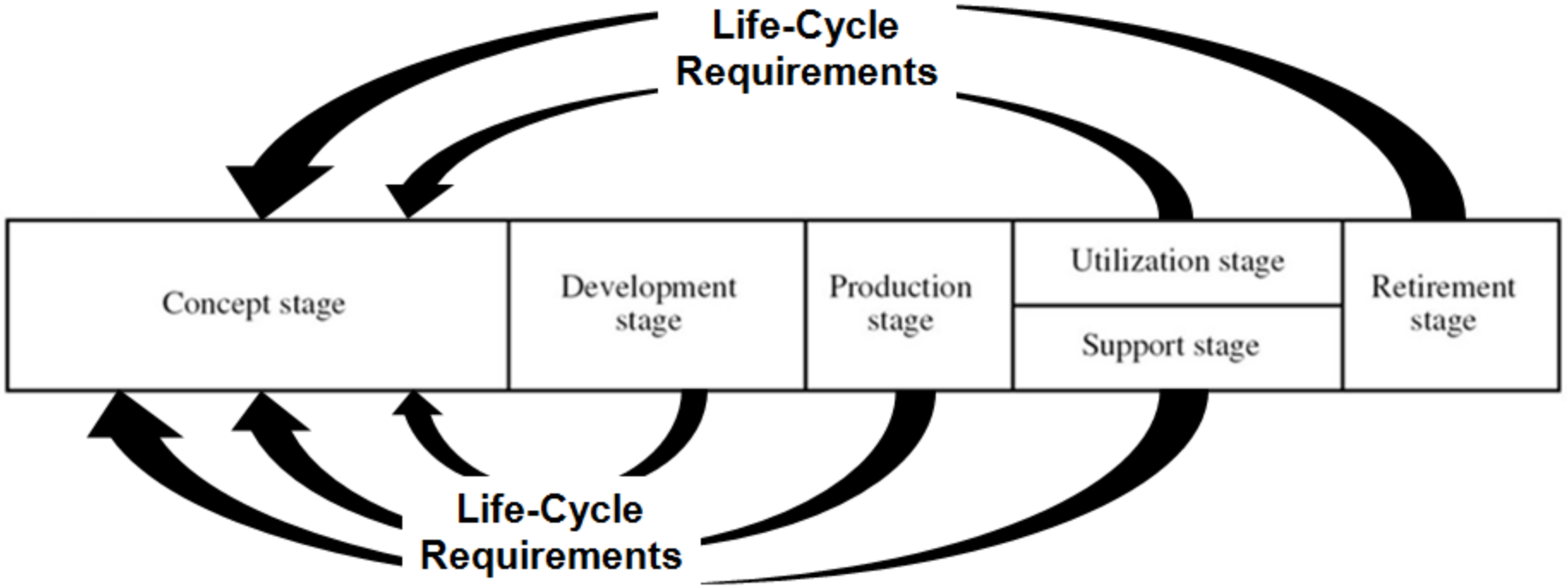
SYSTEM LIFE CYCLE OPTIONS

- Evaluate existing development organizations
  - Main contractors' organizations
  - Engineering organizations
  - Industry partners
  - Universities, and government agencies

- Evaluate existing infrastructure
  - System integration and test organizations
  - Ground operations organizations

LIFE CYCLE REQUIREMENTS

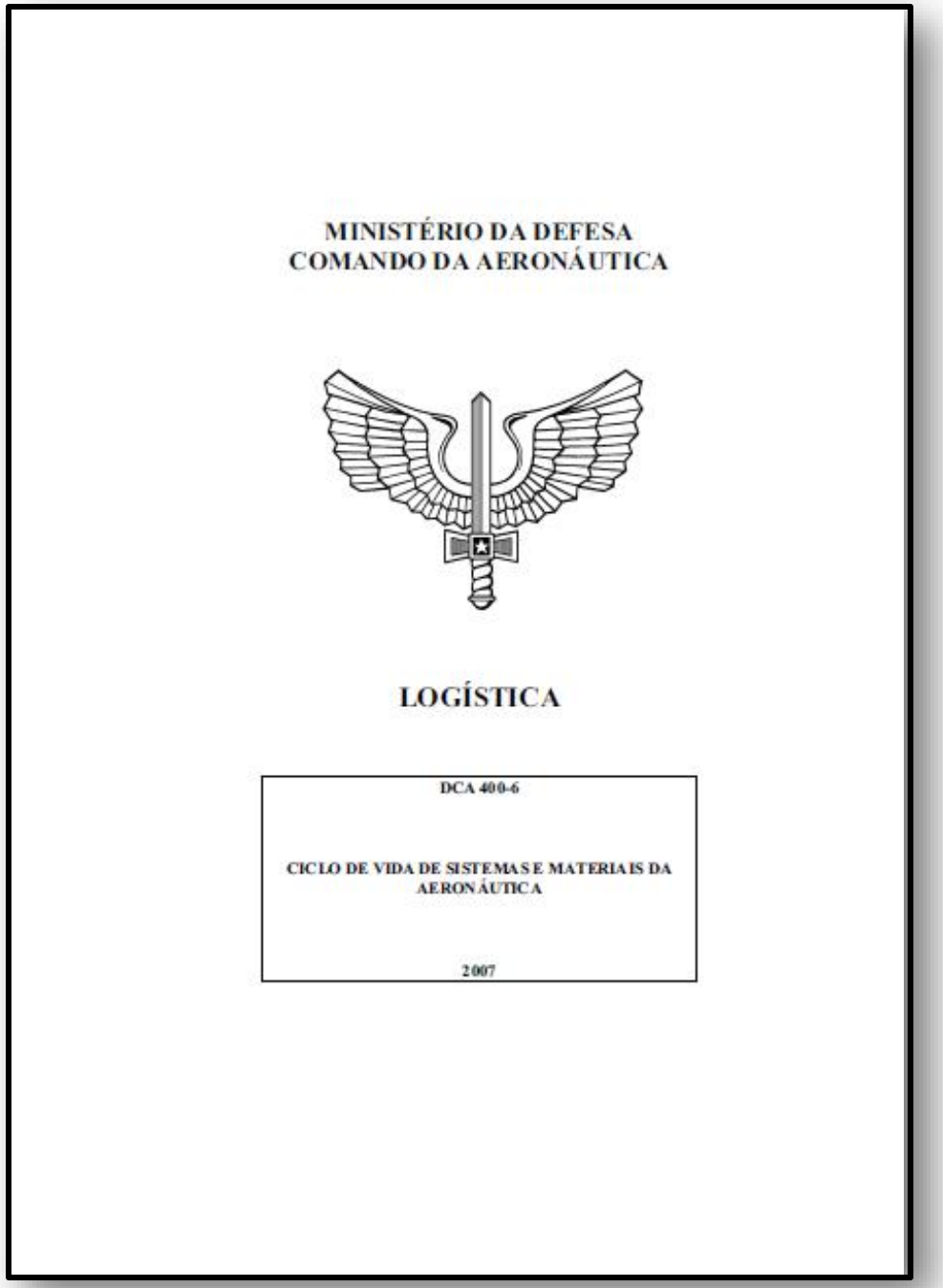
- Life cycle requirements promote the **anticipated understanding** about future system attributes



A WELL-DEFINED SYSTEM LIFE CYCLE STRATEGY

- A well-defined system life cycle strategy provides:
  - A **clear view** of the entire project, the organizations, the stakeholders involved, a defined timeline, and precise objectives to close each phase.
  - **Goals and deliverables** that meet design and development strategy for each step of the project
  - A **base for costs and decisions** on concrete information

DCA-400-6


MINISTÉRIO DA DEFESA
COMANDO DA AERONÁUTICA

LOGÍSTICA

DCA 400-6

CICLO DE VIDA DE SISTEMAS E MATERIAIS DA AERONÁUTICA

2007

- A presente Diretriz tem por finalidade **ordenar o planejamento e a execução das fases e principais eventos do Ciclo de Vida** de Sistemas e Materiais da Aeronáutica, bem como regular tecnicamente a atuação, a interação e a responsabilidade dos Órgãos e Sistemas do COMAER que intervêm no processo.

Tabela 1

FASES / SUBFASES / FUNÇÕES (ÓRGÃOS)	FASE DE CONCEPÇÃO
	SUBFASE INICIAL
DECISÃO **CMTAER**	
COORDENAÇÃO GERAL **EMAER**	AVAL. DA NOP FIXAÇÃO DE ROP 2
DESENVOLVIMENTO E ENGENHARIA **CTA/DECEA**	DETEÇÃO DE CARÊNCIA OU OPORTUNIDADE TEC/ECONÔM E ELABORACÃO DE NOP 1
ENSINO E TREINAMENTO **DEPENS**	DETEÇÃO DE CARÊNCIA OU OPORTUNIDADE TEC/ECONÔM E ELABORAÇÃO DE NOP 1
PROVISÃO E MANUTENÇÃO **COMGAP, COMGEP, DECEA**	DETEÇÃO DE CARÊNCIA OU OPORTUNIDADE TEC/ECONÔM E 1 ELABORAÇÃO DE NOP
UTILIZAÇÃO E OPERAÇÃO **ODSA PERTINENTES**	DETEÇÃO DE CARÊNCIA OU OPORTUNIDADE TEC/ECONÔM E ELABORAÇÃO DE NOP 1
ENGENHARIA E PRODUÇÃO **EMPRESAS E INDÚSTRIAS**	

Tabela 2

FASES / SUBFASES / FUNÇÕES (ÓRGÃOS)	FASE DE VIABILIDADE	
	SUBFASE DE PLANEJAMENTO DO CICLO DE VIDA	SUBFASE DE AVALIAÇÃO DO CICLO DE VIDA
DECISÃO **CMTAER**		
COORDENAÇÃO GERAL **EMAER**		
DESENVOLVIMENTO E ENGENHARIA **CTA/DECEA/ODSA RESPONSÁVEL**		
ENSINO E TREINAMENTO **DEPENS**		
PROVISÃO E MANUTENÇÃO **COMGAP, COMGEP**		
UTILIZAÇÃO E OPERAÇÃO **ODSA PERTINENTES**		
ENGENHARIA E PRODUÇÃO **EMPRESAS E INDÚSTRIAS**		

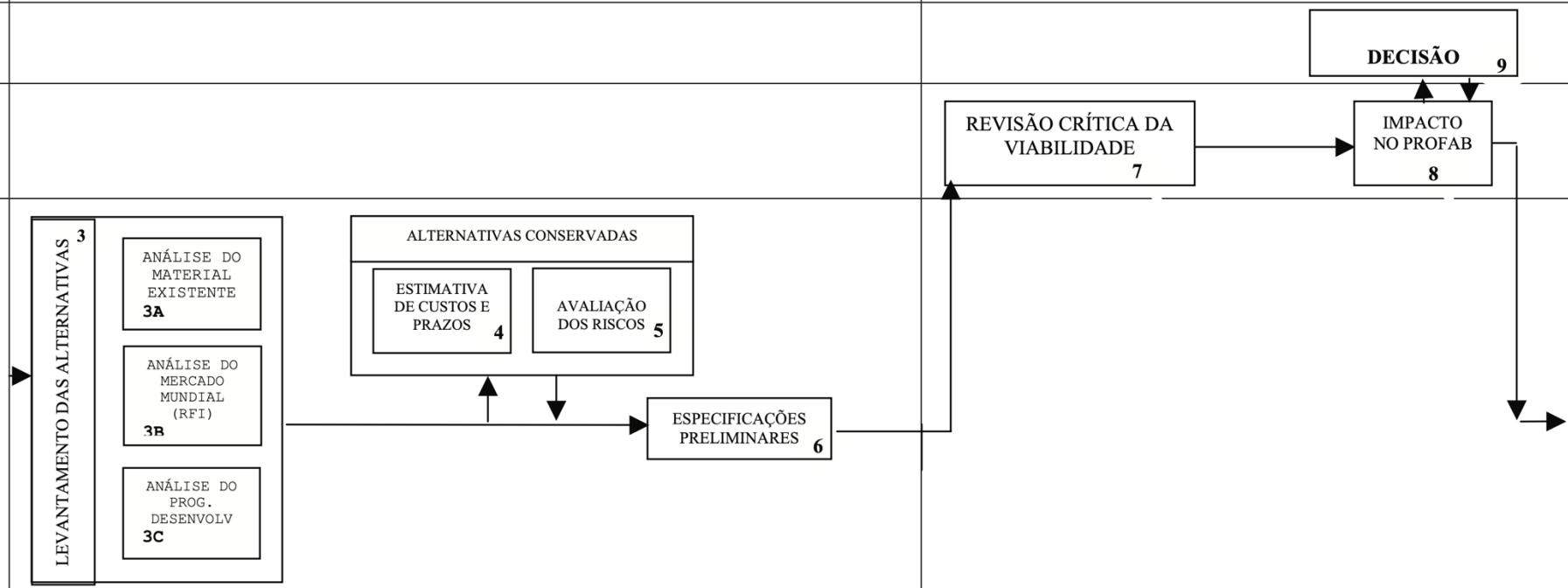
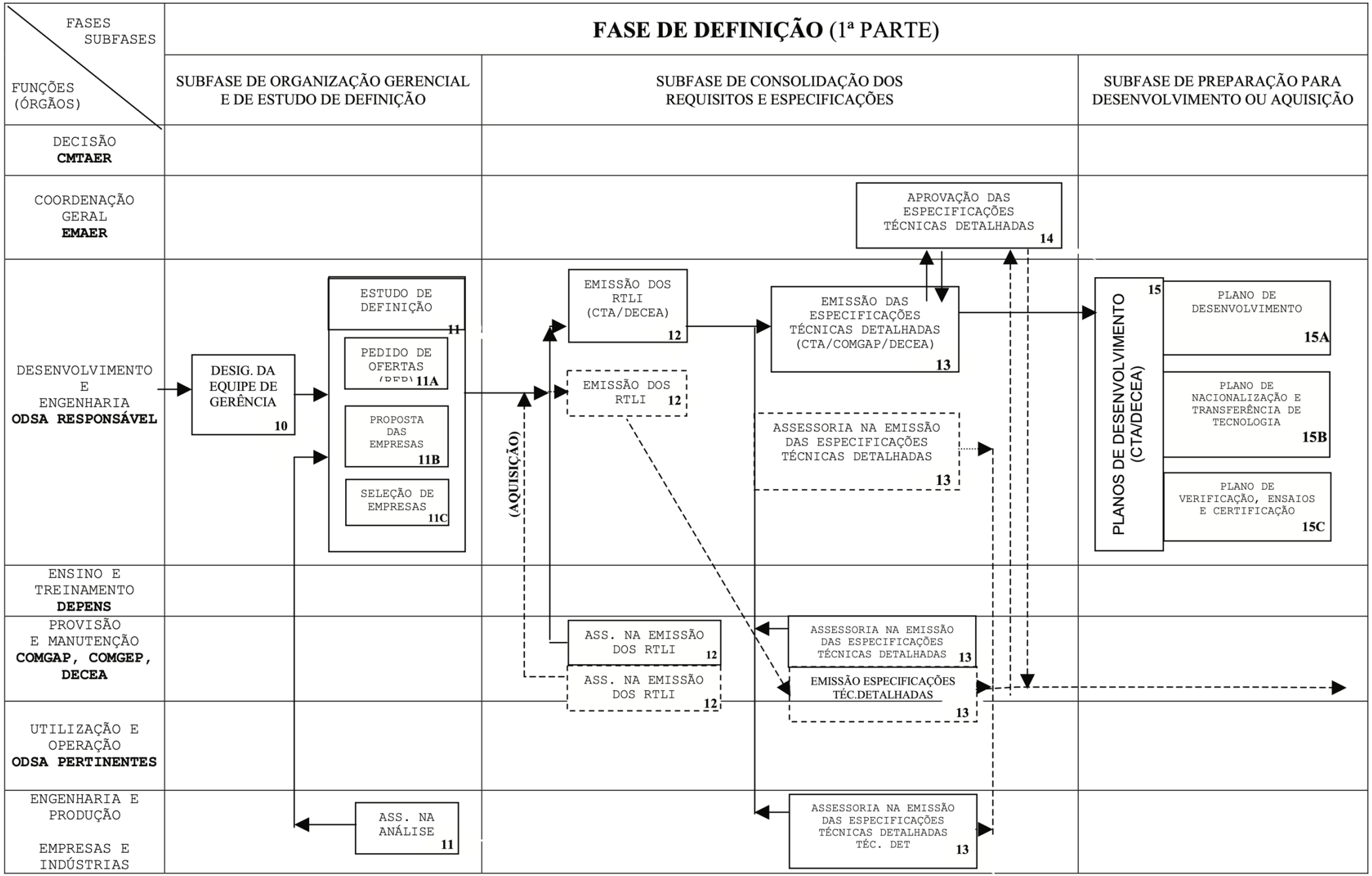
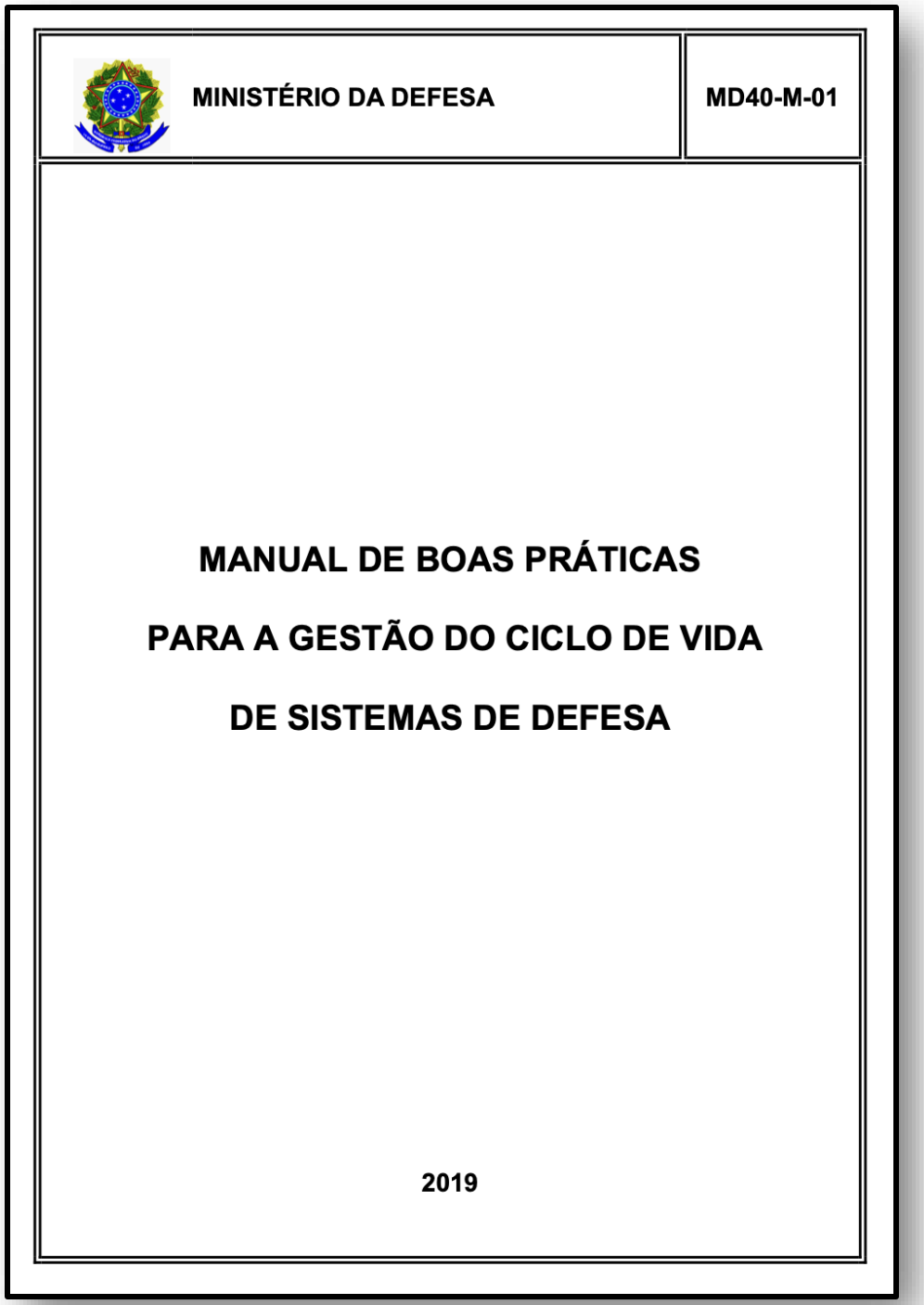


Tabela 3


FASES
SUBFASES
FUNÇÕES (ÓRGÃOS)
FASE DE DEFINIÇÃO (1ª PARTE)
SUBFASE DE ORGANIZAÇÃO GERENCIAL E DE ESTUDO DE DEFINIÇÃO
SUBFASE DE CONSOLIDAÇÃO DOS REQUISITOS E ESPECIFICAÇÕES
SUBFASE DE PREPARAÇÃO PARA DESENVOLVIMENTO OU AQUISIÇÃO
DECISÃO CMTAER
COORDENAÇÃO GERAL EMAER
DESENVOLVIMENTO E ENGENHARIA ODSA RESPONSÁVEL
ENSINO E TREINAMENTO DEPENS
PROVISÃO E MANUTENÇÃO COMGAP, COMGEP, DECEA
UTILIZAÇÃO E OPERAÇÃO ODSA PERTINENTES
ENGENHARIA E PRODUÇÃO
EMPRESAS E INDÚSTRIAS
APROVAÇÃO DAS ESPECIFICAÇÕES TÉCNICAS DETALHADAS 14
DESIG. DA EQUIPE DE GERÊNCIA 10
ESTUDO DE DEFINIÇÃO 11
PEDIDO DE OFERTAS (RFP) 11A
PROPOSTA DAS EMPRESAS 11B
SELEÇÃO DE EMPRESAS 11C
EMISSÃO DOS RTLI (CTA/DECEA) 12
EMISSÃO DOS RTLI 12
(AQUISIÇÃO)
EMISSÃO DAS ESPECIFICAÇÕES TÉCNICAS DETALHADAS (CTA/COMGAP/DECEA) 13
ASSESSORIA NA EMISSÃO DAS ESPECIFICAÇÕES TÉCNICAS DETALHADAS 13
PLANOS DE DESENVOLVIMENTO (CTA/DECEA) 15
PLANO DE DESENVOLVIMENTO 15A
PLANO DE NACIONALIZAÇÃO E TRANSFERÊNCIA DE TECNOLOGIA 15B
PLANO DE VERIFICAÇÃO, ENSAIOS E CERTIFICAÇÃO 15C
ASS. NA EMISSÃO DOS RTLI 12
ASS. NA EMISSÃO DOS RTLI 12
ASSESSORIA NA EMISSÃO DAS ESPECIFICAÇÕES TÉCNICAS DETALHADAS 13
EMISSÃO ESPECIFICAÇÕES TÉC.DETALHADAS 13
ASS. NA ANÁLISE 11
ASSESSORIA NA EMISSÃO DAS ESPECIFICAÇÕES TÉCNICAS DETALHADAS TÉC. DET 13

MD-40-M-01

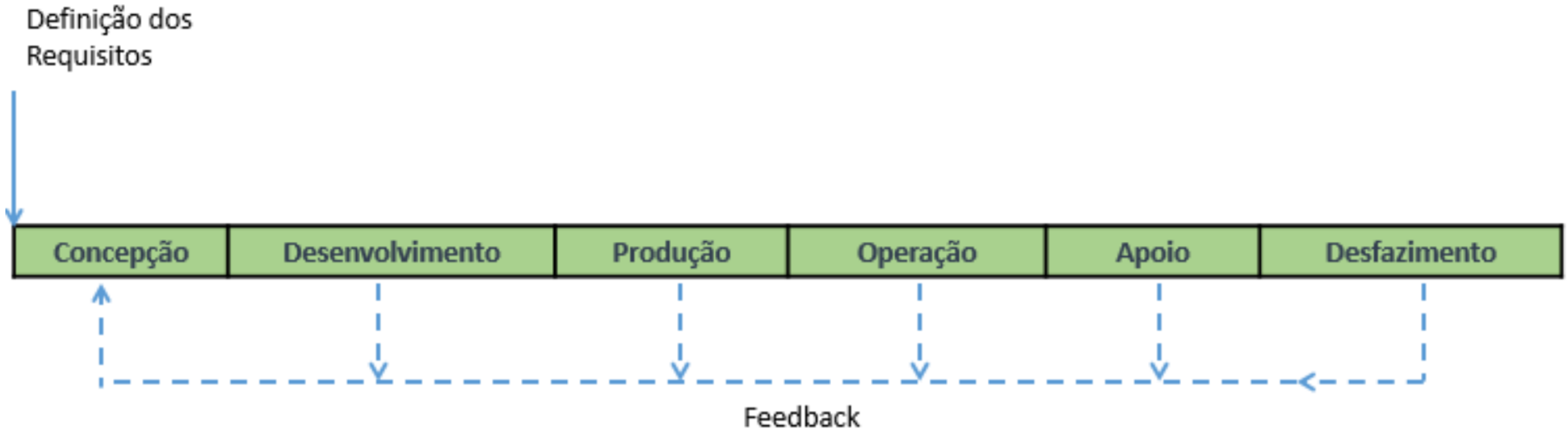


O presente Manual resulta do trabalho desenvolvido pela Subcomissão designada pela Portaria nº 2282/SECIL/MD, de 10 de novembro de 2016, alterada pela Portaria nº 2083/SECIL/MD, de 17 de maio de 2017, que foi composta por oficiais das três Forças Singulares (FS) e do Ministério da Defesa (MD) e teve como propósitos iniciais: **apresentar um conteúdo teórico sobre Gerenciamento do Ciclo de Vida de Sistemas de Defesa e obter, registrar e compartilhar as experiências de sistematizações** adotadas em cada Força Armada do Brasil para o Gerenciamento do Ciclo de Vida dos Produtos de Defesa (PRODE) e Produtos Estratégicos de Defesa (PED).

SUMÁRIO

SUMÁRIO – CONTINUAÇÃO

Visão da MD-40



Visão da MD-40

- **Fase de Concepção**: avaliar demandas por sistemas, oriundas de uma fase de pré-concepção, desenvolvendo estudos e modelos de engenharia que permitam estabelecer requisitos de sistema e propor uma solução conceitual viável;
- **Fase de Desenvolvimento**: desenvolver e validar completamente a solução técnica proposta na fase de concepção, mediante processo de projeto (design) de engenharia que deve conferir ao sistema características que o permitam ser produzido, testado, avaliado, operado, mantido e descartado. O desenvolvimento da solução técnica deve ser detalhado até o nível em que seja possível iniciar as atividades da fase de produção;

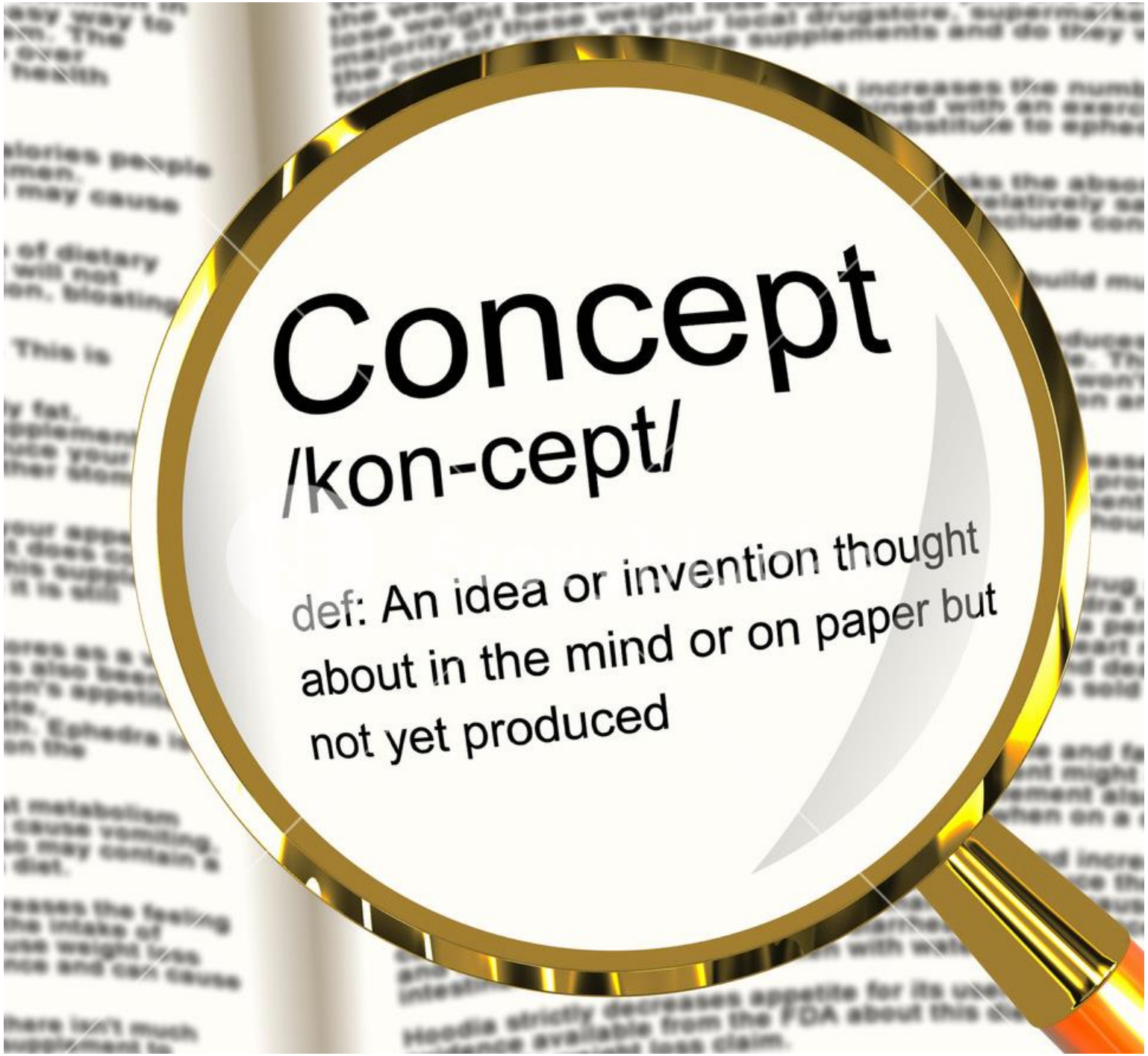
Visão da MD-40

- **Fase de Produção**: implementar, integrar, verificar e validar o sistema de interesse e seus sistemas de apoio, produzindo evidências objetivas do cumprimento dos requisitos relacionados ao CV. Ao final da fase é realizada a avaliação operacional do SD (sistema técnico + sistemas de apoio) preparando sua operação. Nessa fase insere-se também à obtenção de um SD já desenvolvido e disponível no mercado ou um item off the self;
- **Fase de Operação**: operar o sistema de interesse nos diversos ambientes operacionais planejados e garantir efetividade operacional continuada a um custo aceitável;

Visão da MD-40

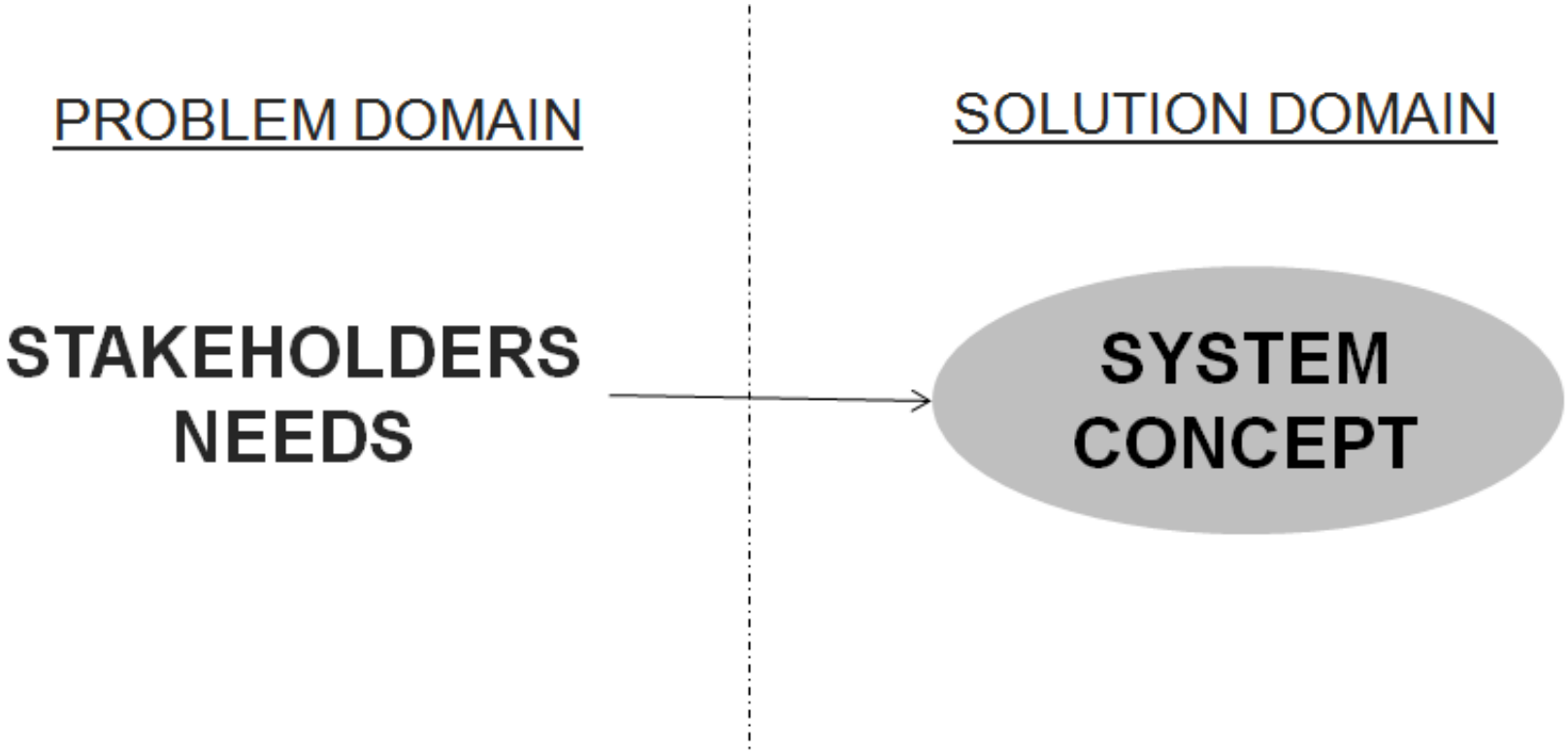
- **Fase de Apoio**: prover serviços de apoio logístico que possibilitem sustentar a capacidade de operação do SD (sistema técnico e sistemas de apoio); e
- **Fase de Desfazimento**: desmilitarizar e retirar o SD, ao final da sua vida útil, do seu ambiente operacional, e encerrar os serviços de apoio logístico e operacionais. Os requisitos para o desfazimento são especificados nas fases precedentes, e a inutilização ou o abandono deve ser realizado de acordo com os requisitos reguladores e legais relacionados à segurança física de mantenedores, operadores e prestadores de serviços em geral, à segurança nuclear, e à proteção do meio ambiente

CONCEPT OF OPERATIONS (CONOPs)


Concept
/kon-cept/
def: An idea or invention thought about in the mind or on paper but not yet produced

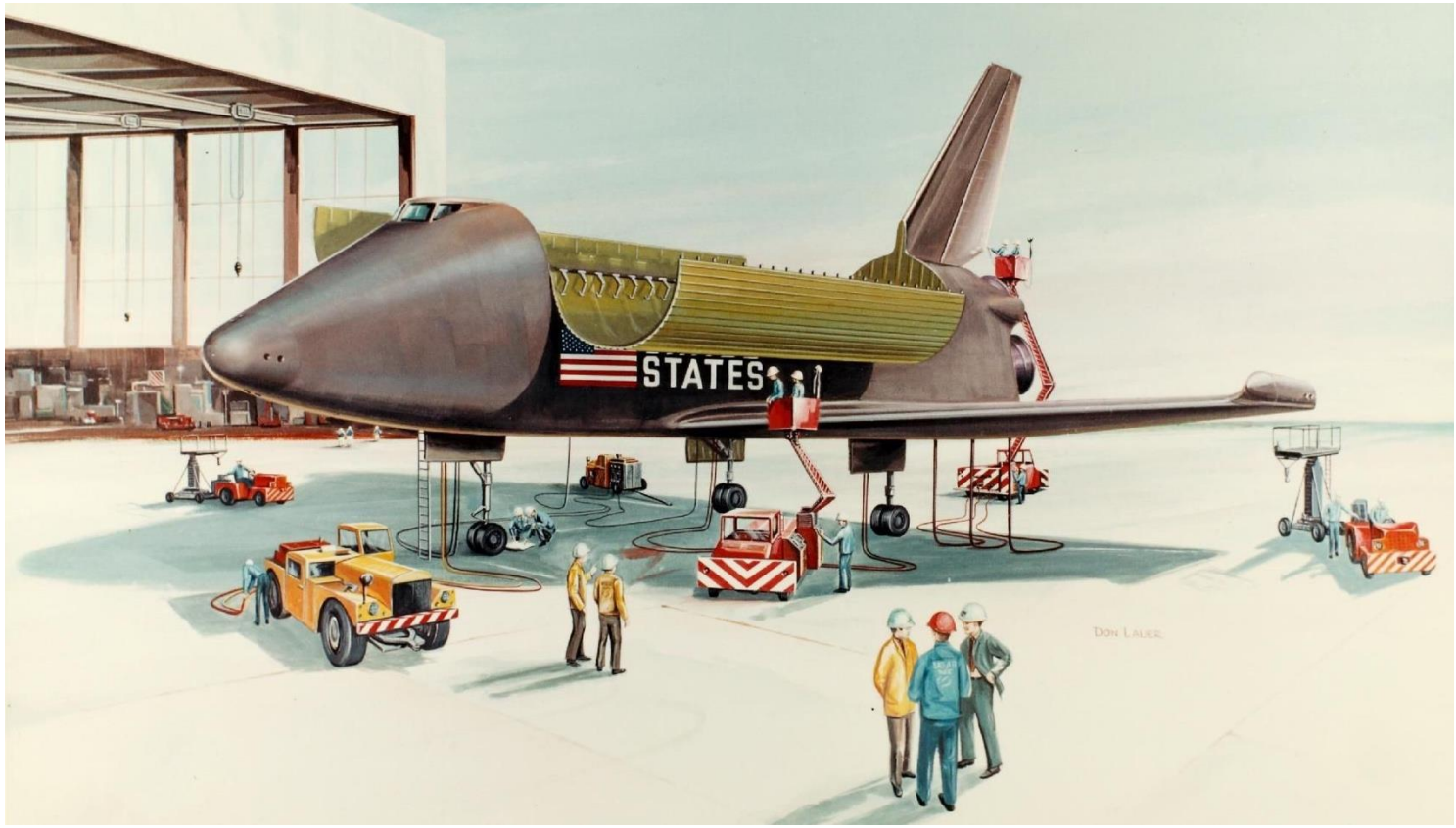
CONCEPT DEFINITION PHASE

- The conceptual design provides a **description of the proposed system** that **fulfills the stakeholders needs**.



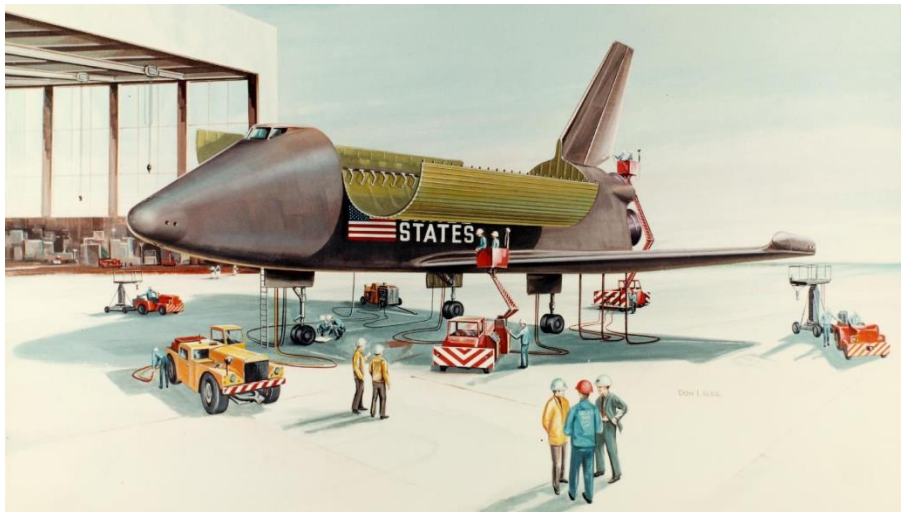
Concept

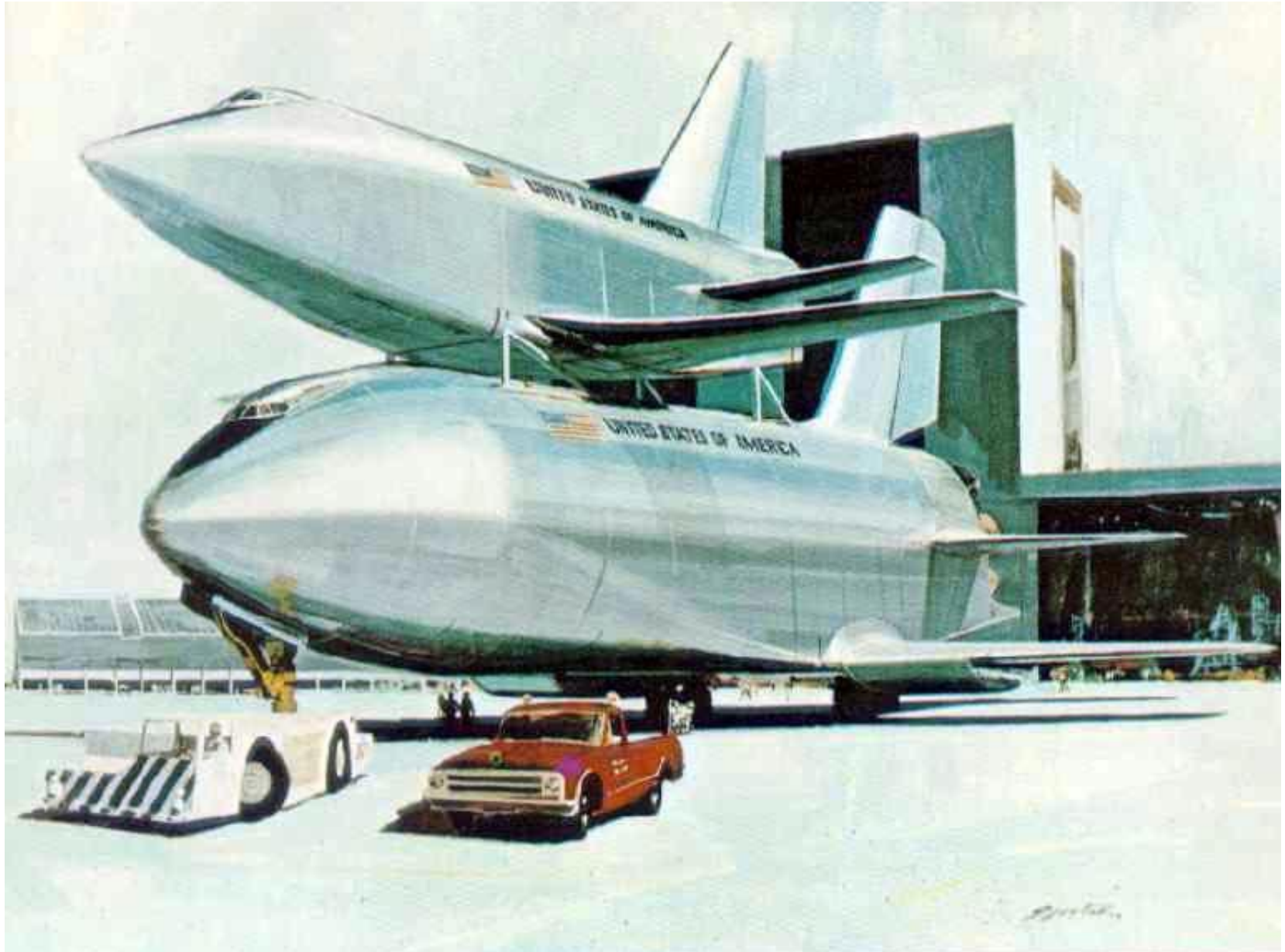
- At the beginning of the activity of system development, a system is conceptual in nature.



Concept

- As the development effort continues, the system becomes hardware, software, materials, personnel, facilities, and processes.




UNITED STATES OF AMERICA


Independence

WHAT IS A CONOPS?

- Description of **how** the System will be operated to meet stakeholder expectations
- Explains your system's characteristics from an operational perspective and helps facilitate an understanding of the **system's purpose**
- Illustrates a day in the life of your system's **intended use**

→NOT ONLY THE OPERATIONAL PHASE

→CONSUP – CONCEPT OF SUPPORT

WHY IS A CONOPS IMPORTANT?

- Drives **development of requirements**
  - Maintains the **context** of a requirement in everyday, informal language
  - Thinking through the ConOps and use cases **reveal requirements and design functions** that might otherwise be overlooked
- Gets everyone on the same page about **what the project is and what it will do**
- Identifies **user interface** issues early
- Identifies **key stakeholder needs** for defining, designing, and implementing the end product
- Provides **guidance** for the development of system definition documentation

The CONOPs contains, as a minimum, the following:

- **Operational goals** from the viewpoint of all stakeholders.
- **Overview of the System** of interest, including supporting systems.
- **Intended use** of the system during all life-cycle phases of the program/project, including but not limited to:
  - 1. Manufacturing and assembly / 2. Integration and test. / 3. Transportation and storage. / 4. Ground operations/launch integration. / 5. Launch Operations - launch, deployment, on-orbit checkout. / 6. Maintenance and disposal.
- Operational **timelines**.
- Command and data **architecture**.
- **End-to-end communication** strategy.
- **Integrated logistic** support (resupply, maintenance, assembly).
- Operational **facilities**.
- **Contingency and off-nominal** operations.

CONOPS VS. OPSCON

- CONOPs can be called/confused with many terms – most common is OpsCon
- CONOPs – Concept of Operation:
  - **Focuses on the product you are developing with the purpose of** driving out stakeholder expectations prior to requirements development.
  - **A CONOPs is the bridge between Needs, Goals, and Objectives (NGOs) and the requirements**.
  - ConOps covers all operational phases of the lifecycle
- OpsCon – Operational (Sometime Operations) Concept:
  - Focuses on **the infrastructure** in which our system will operate – the Mission Architecture.
  - **OpsCon is a precursor to development of operational procedures**.
  - The perspective is on the users'roles and functions – what the users do and how they interact with the system once it is operational.

Pelo INCOSE

- *Concept of operations (ConOps)—Describes* ***the way the organization will operate to achieve its missions, goals, and objectives****. The ConOps captures* ***how the system will potentially impact*** *the acquiring and other organizations. "The ConOps describes the organization's assumptions or intent in regard to an overall operation or series of operations of the business with using the system to be developed, existing systems and possible future systems. The ConOps serves as a basis for the organization to direct the overall characteristics of the future business and systems, for the project to understand its background, and for [its] users ... to implement the stakeholder requirements elicitation" (ISO/IEC/IEEE 29148, 2018) Ideally, the enterprise level ConOps should be an input to the Business or Mission Analysis process, but if it does not exist, it may need to be jointly developed and maintained. The ConOps also describes the higher-level system in which the SoI must operate.*

Pelo INCOSE

- *Operational concept (OpsCon)—Describes the **way the system will be used during operations**, for what purpose, in its operational environment by its intended users and does not enable unintended users to negatively impact the intended use of the system nor allow unintended users from using the system in unintended ways. Also addressed are the needed capabilities, functionality, performance, quality, safety, security, compliance with standards and regulations, interactions with external systems, and operational risks. An OpsCon provides a **user-oriented perspective** that describes system characteristics of the to-be-delivered system. The OpsCon is used to communicate overall quantitative and qualitative system characteristics to the acquirer, user, supplier and other organizational elements.*

CONOPs Document

IEEE Std 1362™-1998 (R2007)
(Incorporates
IEEE Std 1362a-1998)

IEEE Guide for Information Technology—System Definition—Concept of Operations (ConOps) Document

Sponsor
Software Engineering Standards Committee of the IEEE Computer Society

Approved 19 March 1998
Reaffirmed 5 December 2007

IEEE-SA Standards Board

Abstract: The format and contents of a concept of operations (ConOps) document are described. A ConOps is a user-oriented document that describes system characteristics for a proposed system from the users' viewpoint. The ConOps document is used to communicate overall quantitative and qualitative system characteristics to the user, buyer, developer, and other organizational elements (for example, training, facilities, staffing, and maintenance). It is used to describe the user organization(s), mission(s), and organizational objectives from an integrated systems point of view.
Keywords: buyer, characteristics, concept of operation, concepts of operations document, ConOps,

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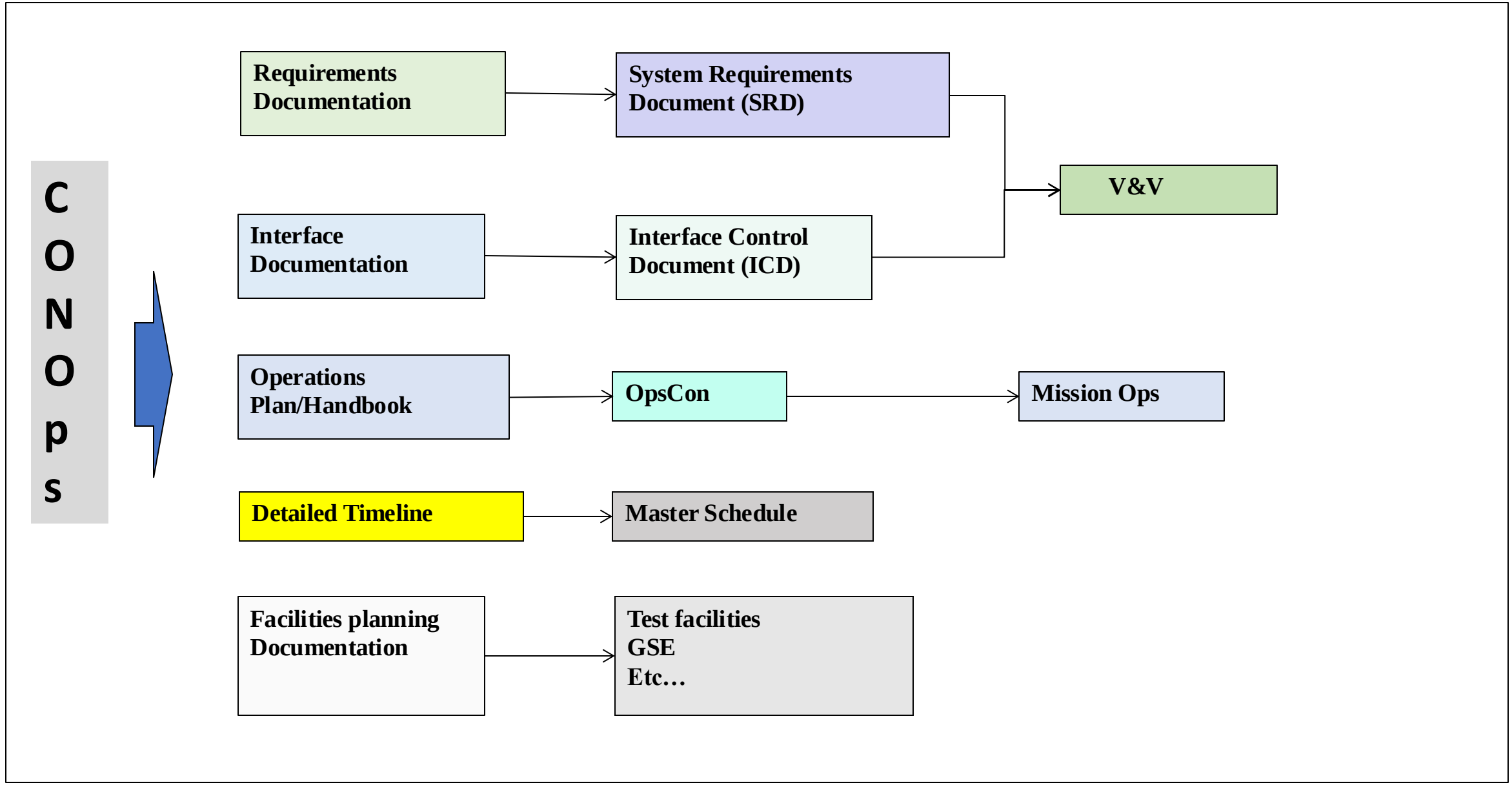
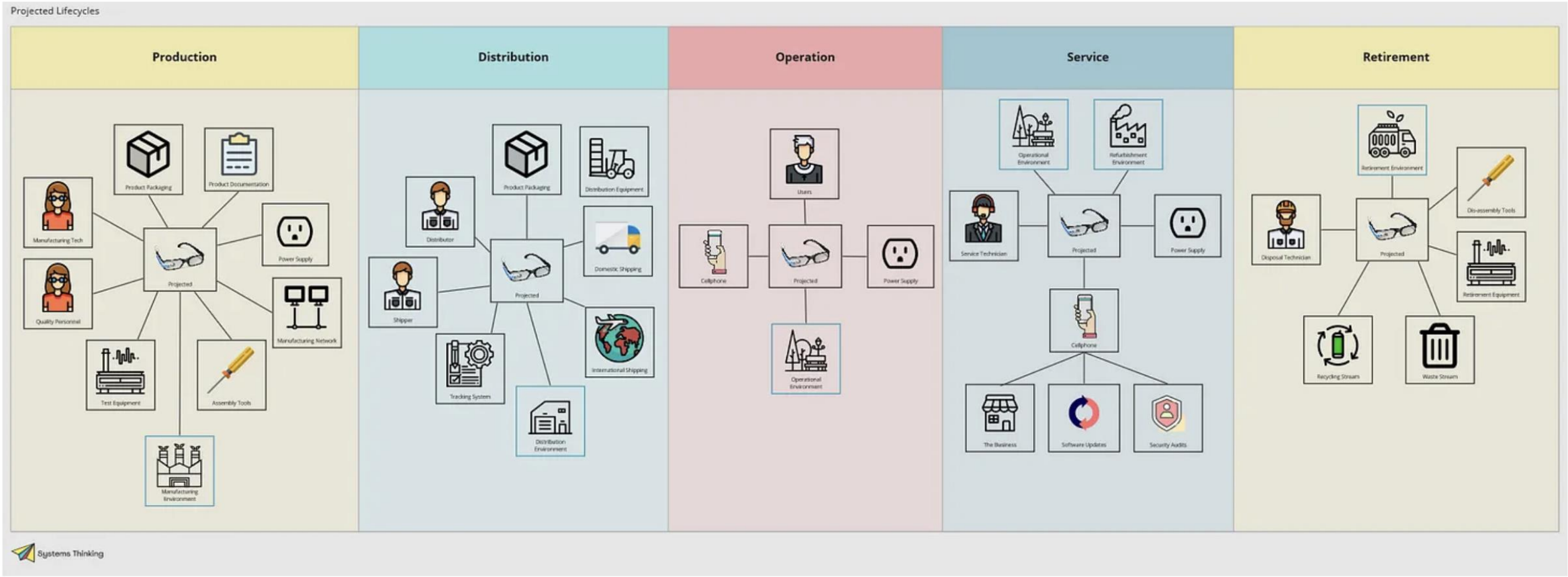
Products that will flow from the CONOPs



Examples



https://systemthink.substack.com/p/how-to-make-a-conops

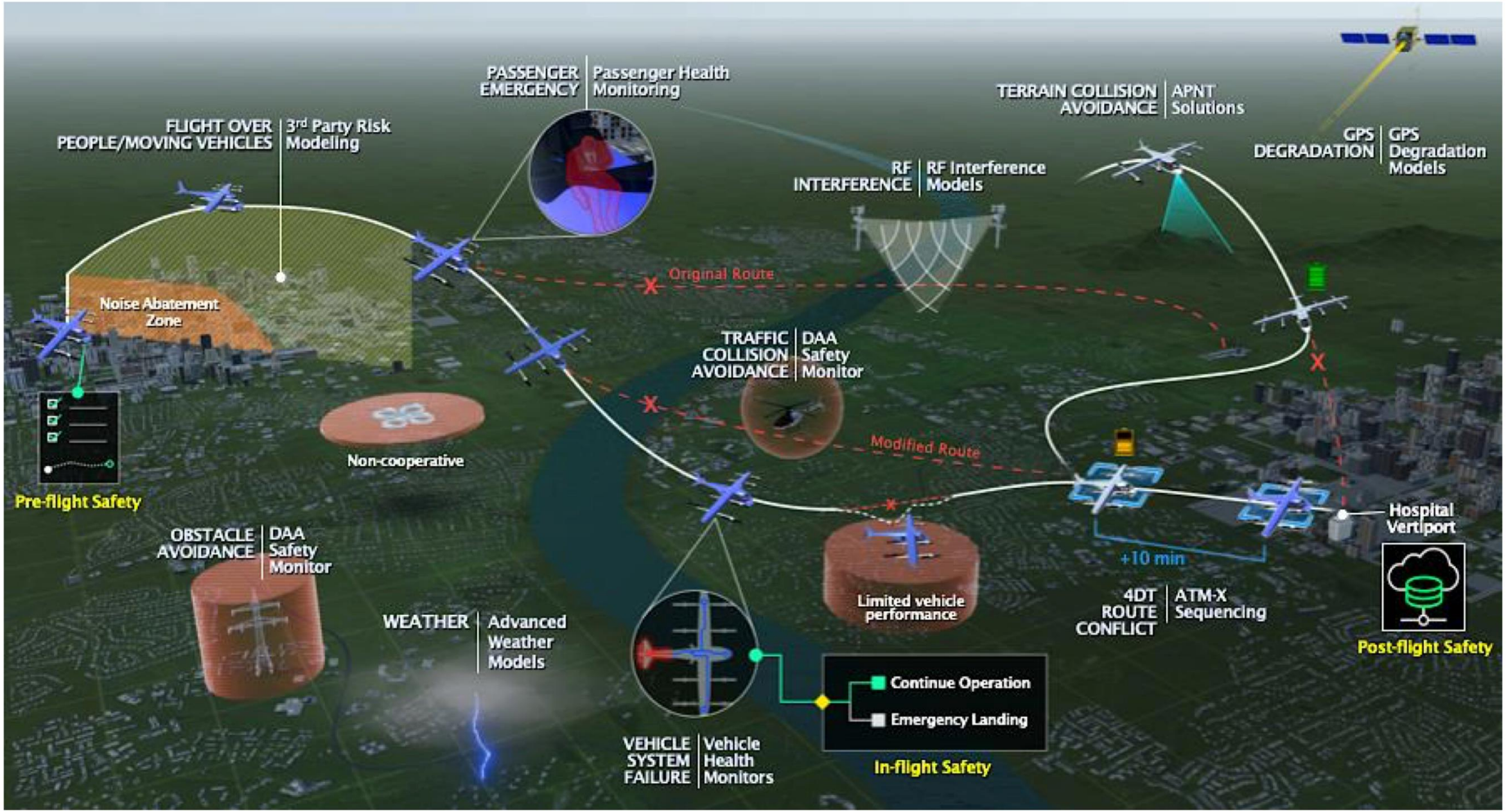


Fig. 1 IASMS Operational View.

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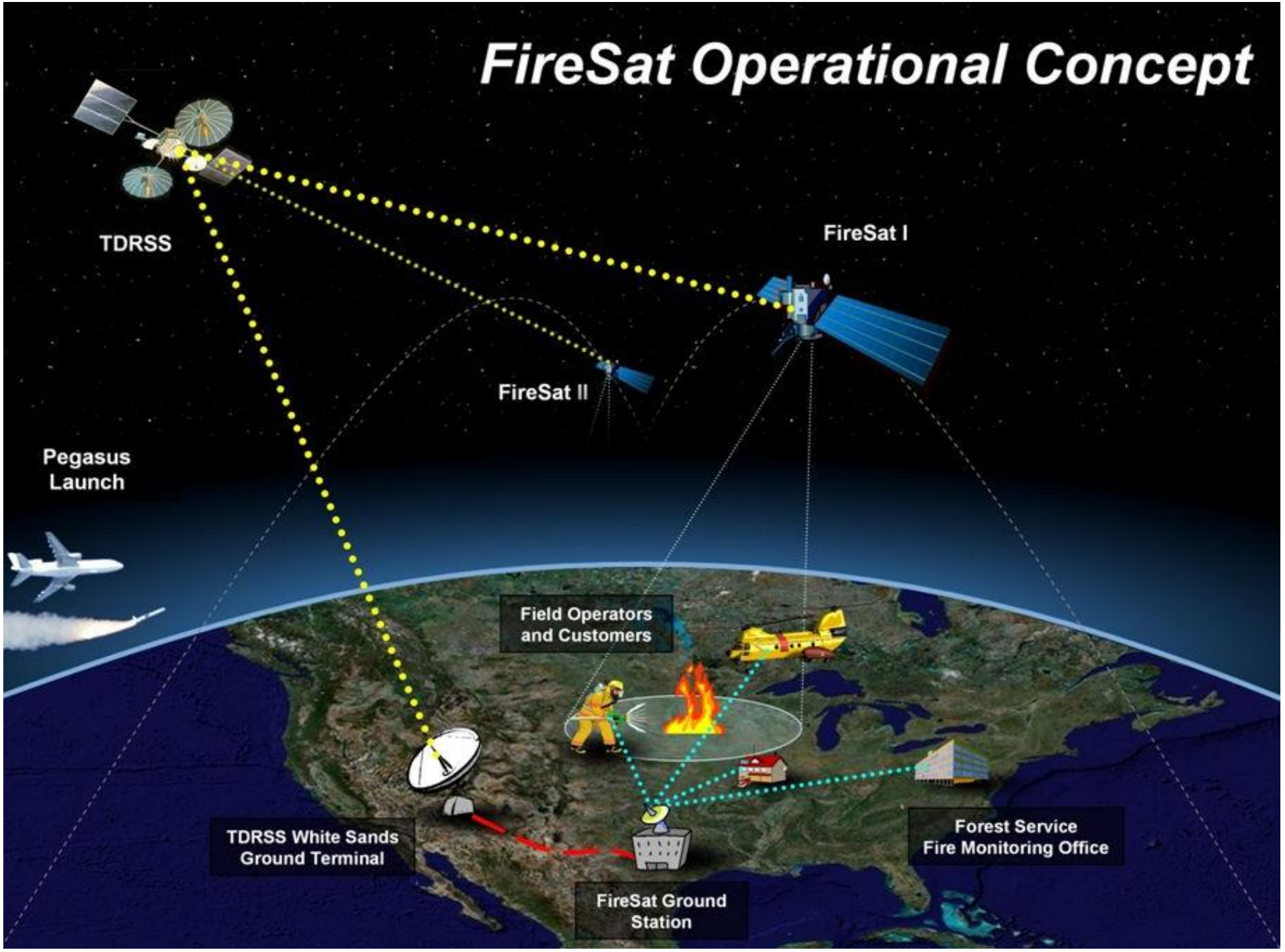

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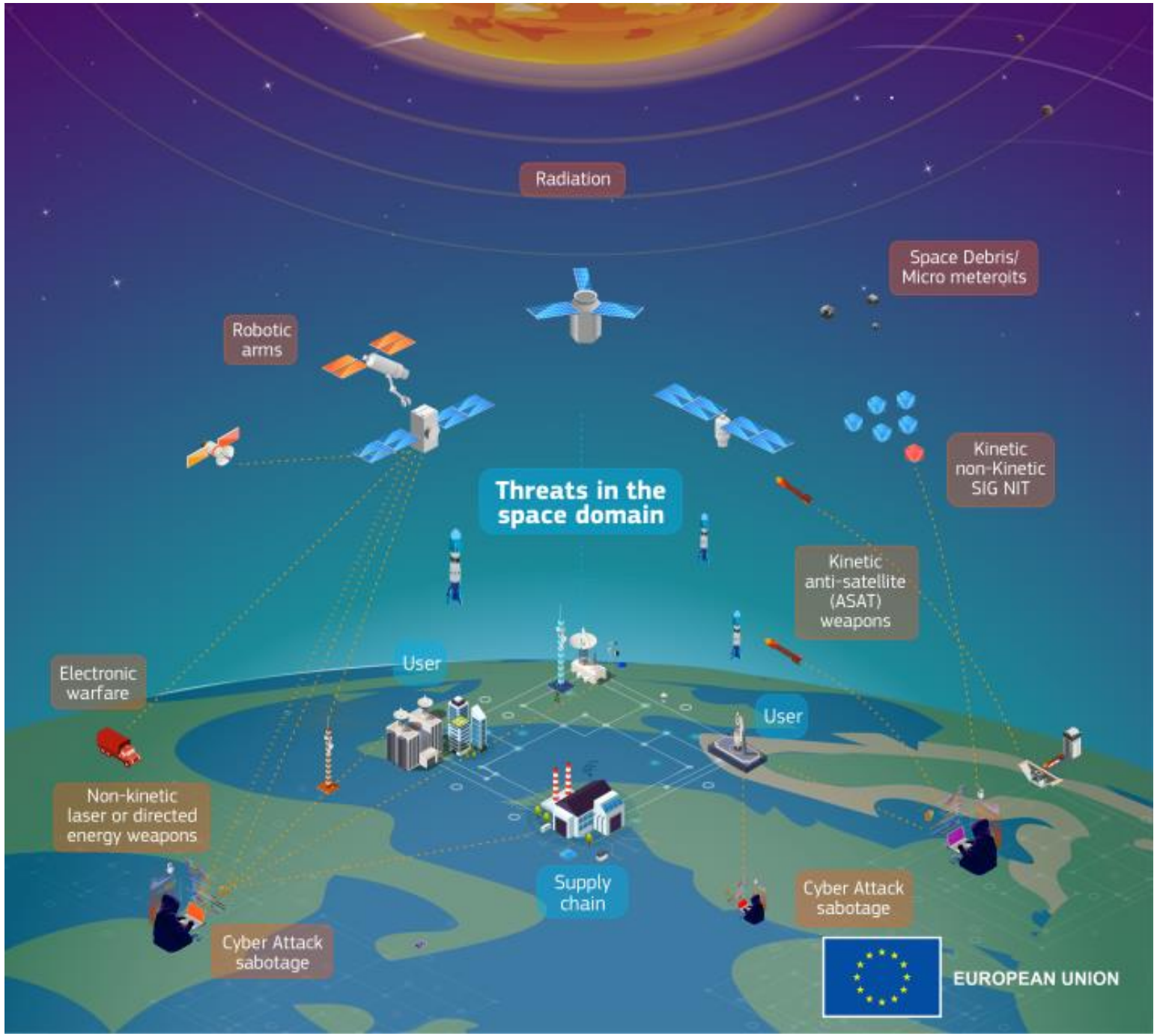
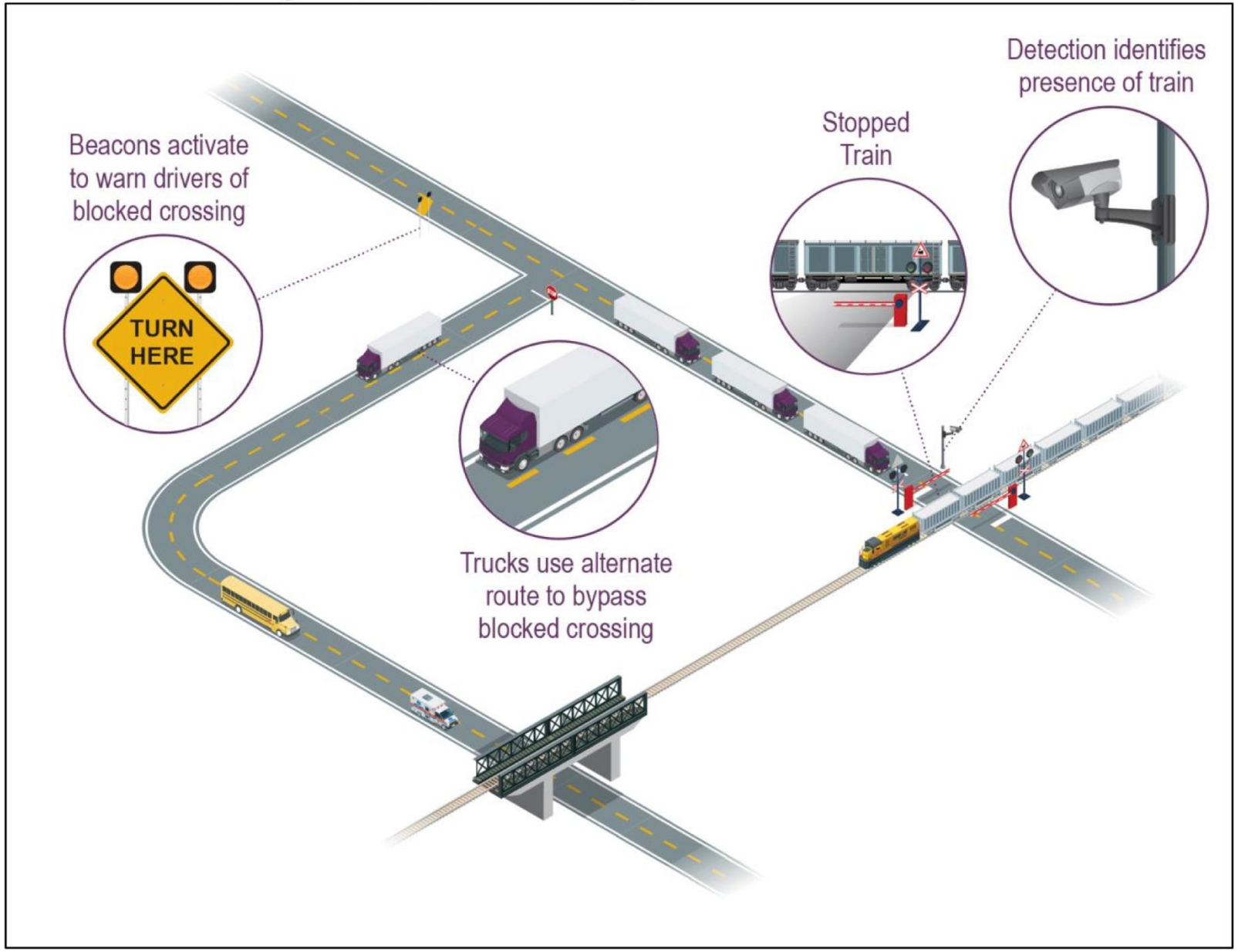


https://spacewatch.global/2023/03/eu-space-strategy-for-security-and-defense-announced-by-the-european-commission/

Exhibit 27: Illustrative Example of Blocked Rail Crossing Traffic Management System Strategy



https://ftp.txdot.gov/pub/txdot/tpp/freight-planning/fntop/concepts/blocked-rail-crossing-traffic-management-system.pdf

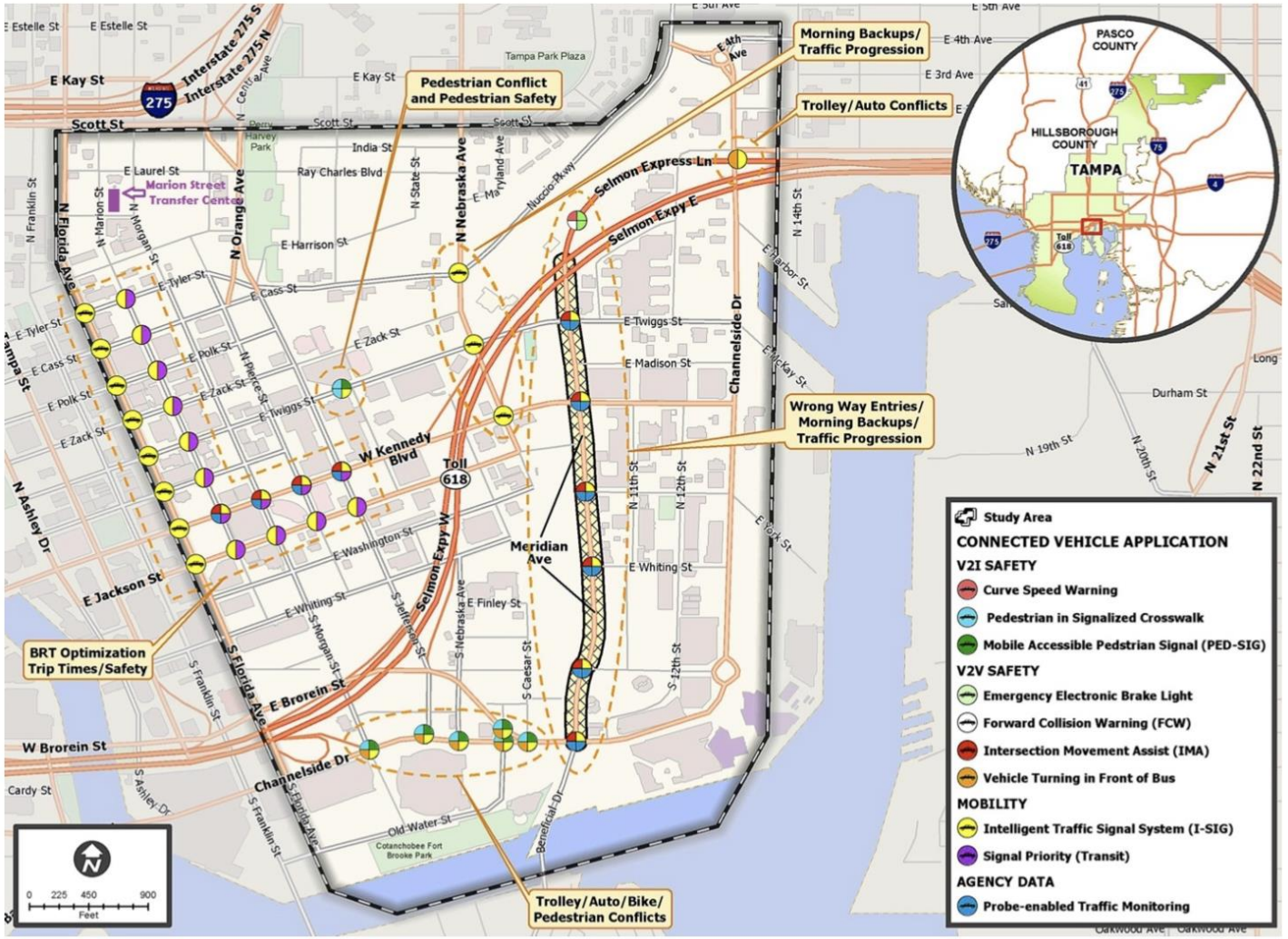
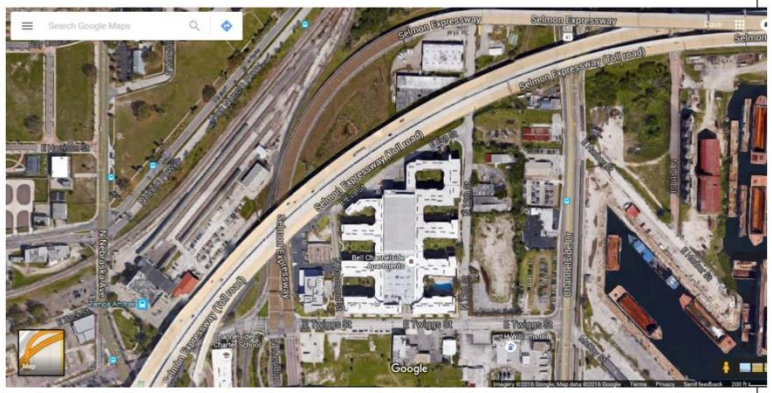


Figure 4: THEA CV Pilot Deployment Locations **Source: Googlemaps.com, HNTB**

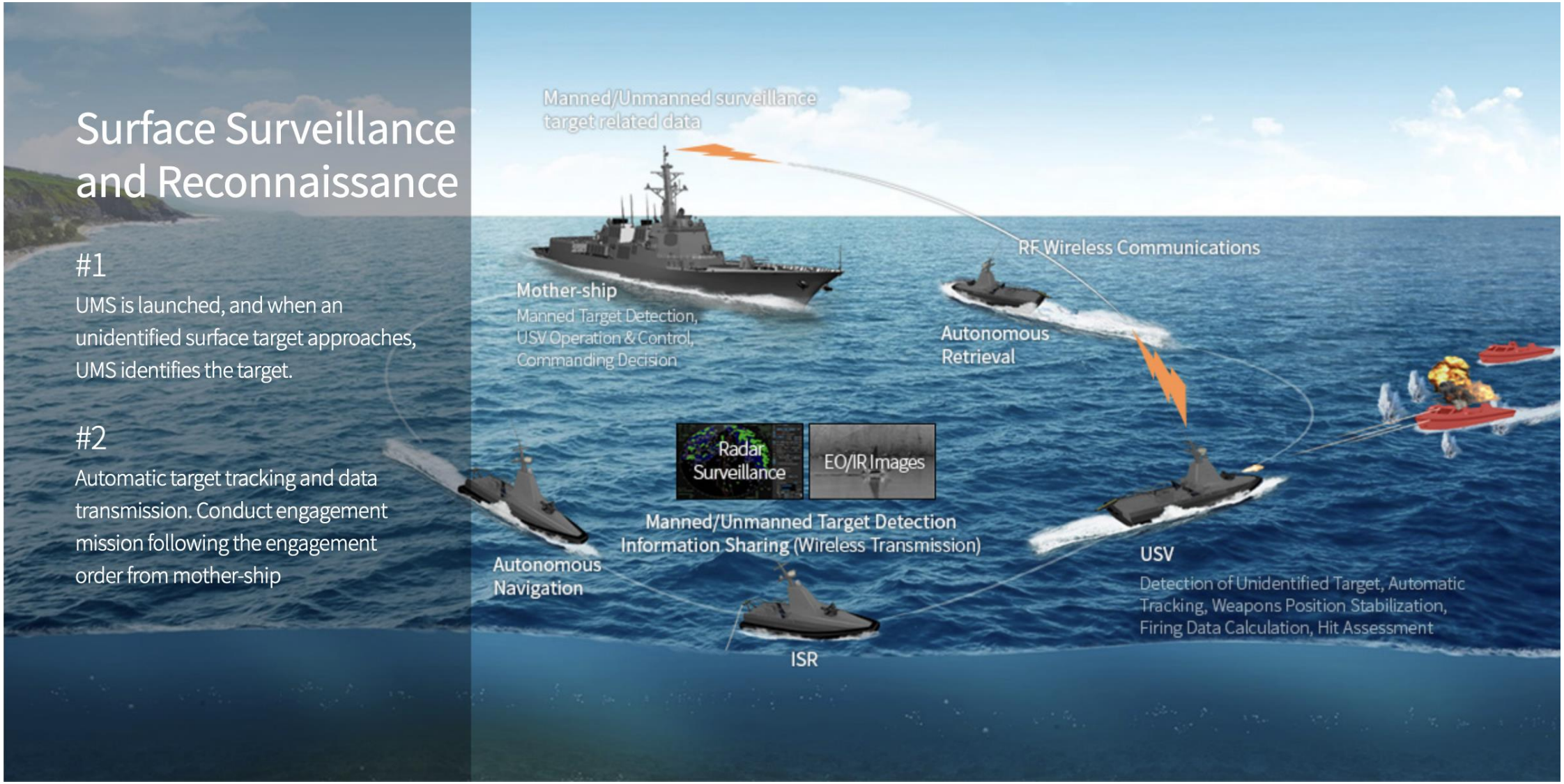
10.1 Use Case 1: Morning Backups

Table 11: Morning Backup Use Case Scenario 1: Normal Conditions

Use Case	*Morning Backups*
&	*UC1-S1: CV Normal Conditions*
	This scenario describes the normal conditions where there is a “no problem” or “no issue” with the Drivers exiting the Selmon Expressway REL at the intersection of Meridian Avenue and Twiggs Street in the morning peak period. Traffic exits the Selmon Expressway REL Monday to Friday 6 – 10 AM plus split operation from 10 AM – 1 PM. Although the site is equipped with the proposed CSW, EEBL and FCW technologies, normal events do not initiate the use of the proposed CV technology in the vehicle. Current Situation: At this site, a driver is proceeding west on the REL exit to a signalized intersection at Meridian Avenue and may turn right or left onto east-west Twiggs Street, or may proceed south through on Meridian without incident.  Source: Google Maps Proceeding west at mile marker 6.2, the REL begins a sweeping left curve while descending to ground level with limited forward visibility towards the queue at the Twiggs Street traffic signal.

https://www.its.dot.gov/pilots/events.htm

UMS Operation Concept



https://www.hanwhasystems.com/en/business/defense/naval/marine_index.do

https://wwwcdn.imo.org/localresources/en/MediaCentre/IMOMediaAccreditation/Documents/MSC%20100%20special%20session%20presentations/20181203_Technology_Progression_In_MASS_IMO_Final_For_PDF.pdf

Dual channel approach

Unmanned Aircraft Systems (UAS) Traffic Management (UTM)

UTM Pilot Program (UPP)

UPP Summary Report

Context

- The primary goal for the UPP was to enable the development, testing, and demonstration of a set of UTM capabilities. These capabilities support the sharing of information that promotes situational awareness and deconfliction (i.e., cooperative separation) Some of the UTM capabilities successfully demonstrated in the UPP included (a) sharing of operational intent between operators, (b) the ability for a UAS Service Supplier (USS) to generate a UAS Volume Reservation (UVR), and (c) providing access to FAA Enterprise Services to support shared information.

Demonstrated capabilities

1. **Operation Planning for Participating UAS Operators** Capability demonstrations include Visual Line of Sight (VLOS) (14 CFR Part 101(e) & Part 107) and Beyond Visual Line of Sight (BVLOS) operations in uncontrolled airspace under 400 feet Above Ground Level (AGL) in remotely-populated areas away from airports, with minimal manned/UAS traffic, and low risk to people and property on the ground. VLOS Part 101(e)/107 operators are not required to share their intent but may voluntarily do so in promotion of shared situational awareness.
2. **Shared Situational Awareness between Participating UAS Operators** This included sharing intent and state information among UAS Operators and between UAS Operators and Remote Pilots in Command (RPICs). The capability demonstrations include the same environmental conditions as Capability #1 above.
3. **Automated Airspace Authorization for 14 CFR Part 107 Operations** Capability demonstrations include 14 CFR Part 107 operations occurring within controlled airspace at low altitude (under 400 feet AGL).
4. **UVRs and their effect on UAS Operations** Capability demonstrations include VLOS (14 CFR Part 101(e) & Part 107) and BVLOS operations in uncontrolled airspace, as well as Part 107 VLOS operations in controlled airspace, with other environmental conditions similar to those above

EXAMPLE OF CONOPS NARRATIVES X CAPABILITIES EXPLORED

Description		Use Case 1	Use Case 2	Use Case 3
Participation	UTM-Participating Operators	✓	✓	✓
	Non-Participating Operators		✓	
Airspace Characteristics	Uncontrolled	✓	✓	
	Controlled			✓
Operation Plan/Intent Development & Sharing		✓	✓	✓
UVR Creation/Dissemination			✓	✓
FIMS query of USS Network for UTM information			✓	

MAAP (Multi-Atlantic Aviation Partnership) developed three use cases to test the desired UTM interactions:

1. VLOS (Visual Line of Sight) & BVLOS (Behind VLOS) Operations in Uncontrolled Airspace
2. UVR (Unmanned Aircraft Systems Volume Reservation) in Uncontrolled Airspace
3. UVR in Controlled Airspace

Use Case 2: UVR in Uncontrolled Airspace

- This use case demonstrated a USS processing a UVR, FIMS processing a UVR (including the display of the UVR to the Public Portal), and the FAA's capability to query participating USSs.
- For this use case, the UVR was filed using the ANRA USS by MAAP test personnel. The timing of the UVR was based on the events in the use case outline and was determined by the Test Director for each iteration of the use case.
- After the test was completed, the Test Director requested that the FAA initiate a historical query. Figure 9 presents an overview of the operational scenario of this use case.

Figure 9: MAAP Use Case 2 Operational Overview

MAAP Use Case 2 Narrative

- Wing conducts routine BVLOS package delivery operations to rural areas around the Kentland Farm area using the Wing USS. Wing also shares the operation intent, as appropriate, with the LUN (Local USS Network). Meanwhile, a real estate agent wants to obtain aerial imagery of a house and surrounding property. The real estate agent uses the ANRA USS to check for nearby UAS operations and to share their operation intent. It is determined that these two operations do not conflict with each other, and they start their operations accordingly. Nearby, a recreational user wants to fly near the New River to take video of the local trains and his friends kayaking on the river. The recreational user does not use a USS but instead uses the FAA Public Portal to monitor for any UVRs that may occur during his flight and does not actively monitor the operations of other airspace users.

- During the UAS flights, a report of a capsized boat on the river with missing persons comes into the local sheriff's office. To expedite the response, a Search and Rescue (SAR) helicopter (simulated) is called in to help facilitate the location of the missing persons and the boat. The SAR helicopter operator files a UVR through the ANRA USS and takes off shortly thereafter from the Blacksburg airport. Wing receives notification of the UVR and determines there is no conflict for some delivery locations while others are within the SAR reservation. The real estate agent receives the same notification and determines that he must change course and decides to cease operations for the day. The recreational user also receives a notification and checks the FAA Public Portal, determining that no conflict exists and therefore continues operating.

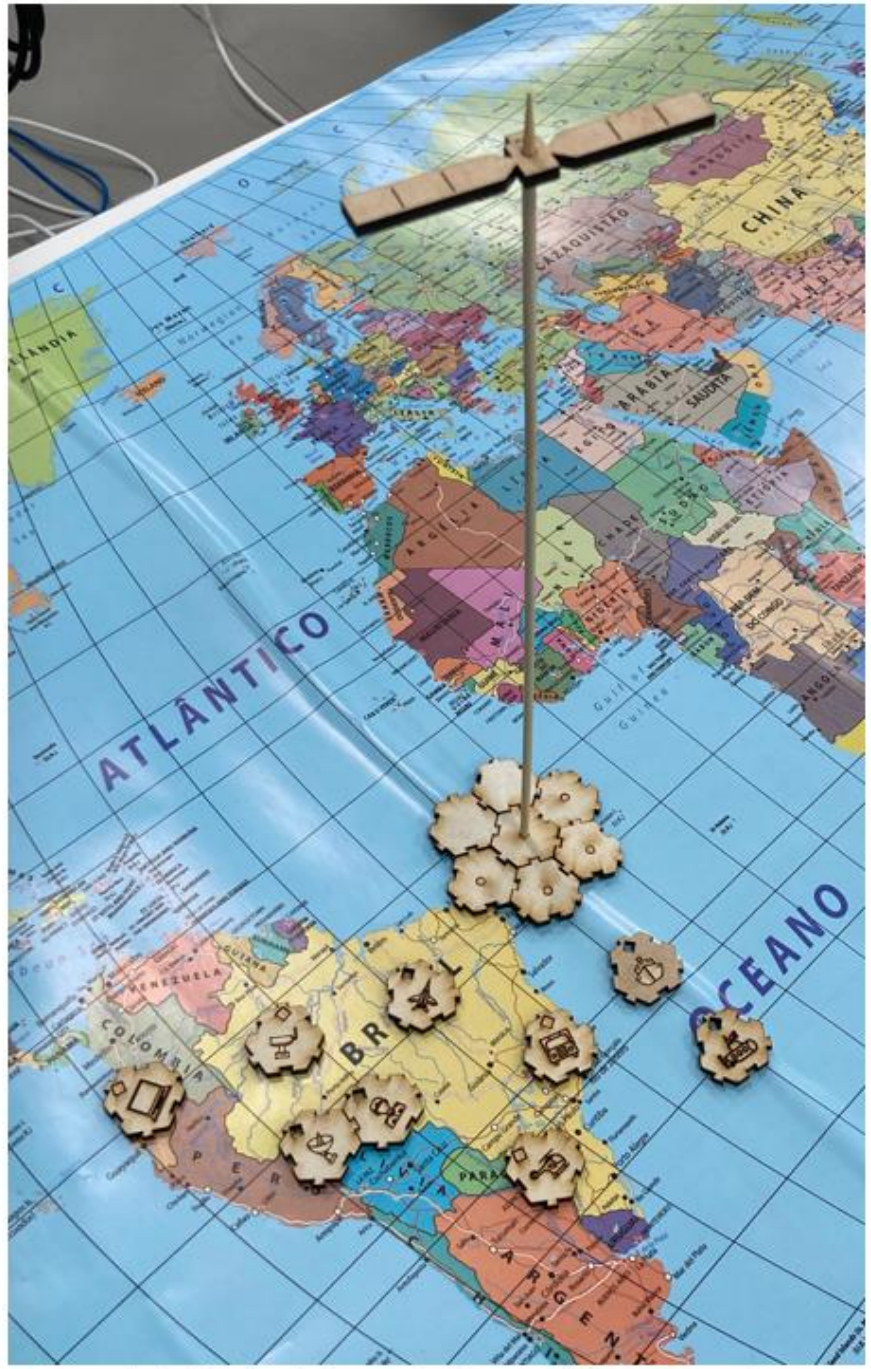
- During the SAR mission, the simulated helicopter has a ‘near-miss’ with a sUAS flying near the border of Kentland Farm. The pilot makes a report about the near miss to the FAA upon returning to the Blacksburg airport, and the FAA subsequently queries the UTM system for details. The UTM system provides data from the operators that are using a USS, who are both in compliance, but no data is available for the non-compliant operator.

Our very-recent use to validate / refine needs

We will return in this example, to build the MBSE CE Based Approach

Initialization

- One month before we requested a 5W2H of each need to each stakeholder.
- Created the game vocabulary and mechanics.
- From the use description we planned the situations.
- During the application
  - One day reviewing the needs and harmonizations proposal
  - One day and a half running the situations
  - One day reviewing the “finalized” needs wording.



(a) Global Level Scene Placement

(b) Country Level Scene Placement

(c) Local Level Scene Placement

(a) Game Controller

(b) Game Facilitator

Results

- Similarities and differences enabled harmonization of needs
- Over 30 validated needs confirmed/refined by the proposed situations
- ~10 needs were created within the perception of the situation

Extra.: ANSI/AIAA G-043B-2018

Concept of Operations definition

- The ConOps is the user definition of **how the overall organization will be operated to satisfy its mission**. It is a verbal and graphic statement, in broad outline, of an organization's (enterprise's) **assumptions or intent in regard to an operation or series of operations** of new, modified or existing organizational (enterprise) systems.

- NOTE The concept of operations frequently is embodied in long-range strategic plans and annual operational plans. In the latter case, the concept of operations in the plan covers a series of connected operations to be carried out simultaneously or in succession to achieve an organizational (enterprise) performance objective. The concept is designed to give an overall picture of the organization's (enterprise's) operations. It is also called the CONOPS.

Operational Concept definition

- The user definition of **how a specific system will be utilized within the organization**. It may include a flow down of the concept of operations activities to be performed using the specific system and/or a verbal and graphic statement of an organization's (enterprise's) **assumptions or intent in regard to an operation or series of operations of a specific system** or a related set of specific new, existing or modified systems.

- NOTE The operational concept is frequently developed as part of a system development or acquisition program. The operational concept is designed to give an overall picture of the operations using one or more specific systems, or set of related systems, in the organization's (enterprise's) operational environment from the users' and operators' perspective. It is also called the OpsCon.

Operational Concept Documents

- A document for **recording an Operational Concept**. It is prepared at the acquisition organization and developer level to **describe how a particular system (new, modified or existing) will be operated to satisfy its user and operator needs**.
- The description is **independent of specific design solutions**, although it will **make reference to a possible design solution at the highest level of abstraction**.
- The Operational Concept Document is not a requirements document. It describes the system operational intent and context, and is **used to derive needs and requirements**.

Operational Scenarios

- The key to a successful OCD is the development of Operational Scenarios. These scenarios **describe the dynamic views of the system's operation**, primarily from the users' points of view.
- It is this articulation of **how the system is perceived to operate through various modes and mode transitions**, including its expected interactions with the external environment, outlining all important anticipated user, operator, tester, and maintainer interactions that provide the basis and framework for the system analysis and evaluation.

Scenarios Validation

- Scenario validation involves several activities aimed at **providing assurance that the scenarios** provided are adequate for the purposes of the OCD.
  - Correct, Executable, Understandable, clear, accurate, Feasible and Complete

- Validation of the scenarios is accomplished by **performing walk-throughs** on the defined scenarios in accordance with any governing policies and procedures.
- In performing scenario validation, the stakeholders should use historical data (where available) and experience and comparable reference systems. Lastly, scenario **validation should be performed using simulation or modeling**, where feasible, to assess the dynamic characteristics of the system.

About the team to create conops-ocdS

- The **interdisciplinary OCD team** is led by a **senior systems/requirements engineer** and is comprised of **personnel competent in the operational domain** and in all of the **disciplines relevant to the system context**.
- The OCD development team should also include **participants familiar with the regulatory environment** affecting the system development and deployment, and participants knowledgeable of the natural and induced operational environments.

Outline for an operations concept document