

- Absent investments in standardization, systems and programs are siloed, non-comparable, and the content not effectively sharable. The result is a boundary-filled system and adverse impacts on veteran experiences.
- Injecting interoperability design into project planning, better cross-agency information flow among VA projects, improved engagement and sharing with external partners, broader alignment with industry, and more adaptable and durable solutions.
- This i-VA document serves as a launch-point to discover relevant content intended to lessen the learning-curve and facilitate decision-making.

- Interoperability is **often not considered until after funding commitments and timelines** have been set
- Interoperability cannot be considered “in micro”. It is essential that we look not just at one process or system at a time, but how that system connects with others.
- Discrete efforts to include interoperability requirements must be considered in the product/services acquisition
- **Focal theme of the Page** Standard is that interoperability is not typically considered in project design, development, and implementation timelines and should be

Change	Impact
Perform standards due-diligence on cross-system dependencies	Assess interactions with interfacing systems with an eye toward use of standards.
Take a pro-active posture based upon estimated system longevity	Often system interfaces are based upon current "as is" state without regard for total lifecycle. Design can support API evolution over time if done thoughtfully
Anticipate changes to data, data format, and interface protocol over time	When these elements are considered inviolate, systems and interfaces are brittle. Designing for adaptation is more flexible and

Click or Tap this icon in the title bar of any page to see a brief explanatory video for that page.

Anchor Graphic Elaboration

Myth	Reality
FHIR is solving our interoperability needs.	FHIR brings a modern web stack to healthcare and is a powerful tool, but does not “solve” interoperability by itself.
Using standards is difficult and adversely impacts project timelines	While true in the short term, benefits from available reference implementations, broad industry adoption, and reduced sustainment costs outweigh project time constraints.

Term	Definition
API	Application Programming Interface
CIDMO	Clinical Informatics and Data Management Office
FHIR®	Fast Healthcare Interoperability Resources
i-VA Blueprints	Interoperable-VA Blueprints
KBS	Knowledge Based Systems, CIDMO, OHI
OHI	Office of Health Informatic
VAIL	VA Interoperability Leadership

VA INTERNAL REFERENCE
KBS Intranet site
VAIL Intranet Site
Further Reading
VA PUBLIC REFERENCE
INDUSTRY REFERENCE

Applicable Audiences for this Page

[illegible]

At a Glance:

- The framework of the i-VA Blueprints
- Each page is specific to a theme or purpose
 - The “Anchor Graphic” depicts the **key point**
 - The **Left Panel** provides relevant context
 - The **Bottom** provides explanatory detail, exceptions, or supplemental information
 - The **Right Panel** provides reference information
 - The **Bottom Right** icons help navigate

Why Produce the i-VA?

- **Discovery** of relevant materials and guidance is difficult given VA’s size and complexity
- Even when aware of an artifact, it can be difficult to **locate** it
- It is not always clear how different references are meant to **fit together**
- Projects need **specificity** at lower levels than the VAEA and Segment Architectures sometimes provide
- It provides a **targeted focus** on just what needs to be done, as well as where to learn more.

How to Use the i-VA Blueprints

The i-VA Blueprints were created to bring together VA guidance impacting VA programs and projects.

- Use navigation tools (Table of Contents, Page “Navigator”) to find content relevant to a need
- Each section is focused on a “theme”, with successive pages delving deeper into that theme
- The artifact is intended as a reference document, and not generally read cover-to-cover
- The i-VA helps users to make informed decisions, but does not necessarily provide **the** answer
- **Set 18 months in the future, the i-VA helps you make project and acquisition decisions for activities planned or underway**

i-VA Blueprints Intended Use

Project Teams • Provides guidance on how to select standards for use • Provides a consolidated point-of-reference for technical assets • Defines metadata to assist in interop tradeoff decisions • Identifies proven practice patterns	VA Leadership • Improves delivery confidence on interop concerns • Provides consistent guidance to project teams • Enhances technical transition management / versioning • Aligns with existing governance
Governance • Elaborates specificity for current technical ambiguities • Designed to extend existing assets (VA EA) • VAIL provides accountability and executive visibility • Stewarded by neutral body to harmonize agency needs	Strategy • Guidance is aligned with industry strategic roadmaps • Provides convergence across VHA, VBA, NCA • Differentiates between current, transition, future state

i-VA Blueprints

Navigating the Blueprints



What the i-VA Blueprints are

- A guide and a technical reference to support VA project teams in implementing information systems and processes that are highly interoperable:
- Identifies relevant HIT standards
 - Catalogs and classifies APIs
 - Defines key terms, practice patterns, tradeoffs
 - Convergence point of program and project guidance, with reference links to further reading (FHIR, HL7, terminology; VA guidance such as VA EA, VHA Business Architecture etc.)
 - Based on Enterprise Architecture approach and industry best-practices

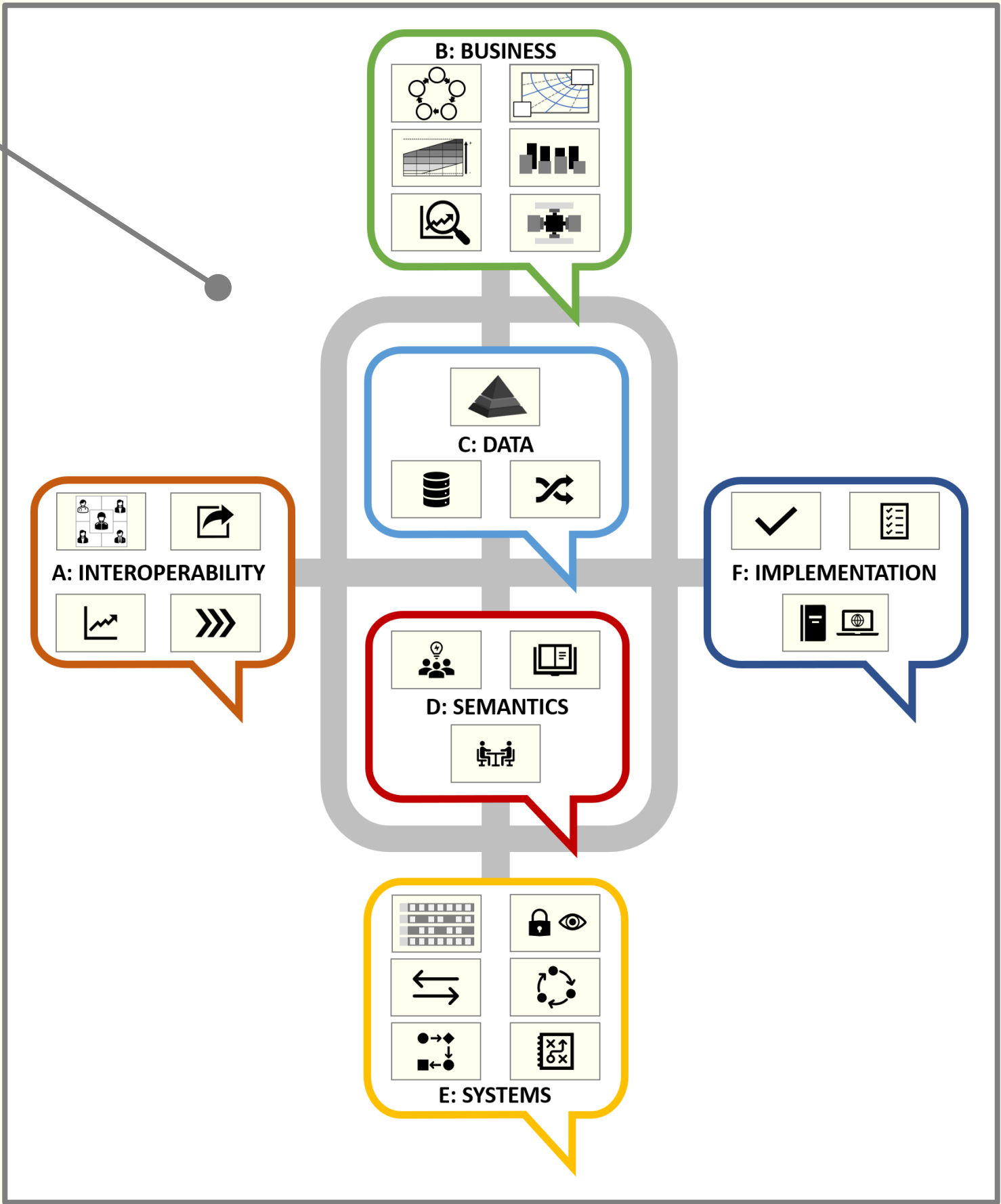
Why It Matters

- Pragmatic guidance targeted to support project teams
- Intended to underpin VA EA and VHA Business Architecture
- Facilitates discovery and appropriate use of existing agency and industry assets
- Helps project teams make informed decisions
- Contextualizes guidance for assets/ standards in the TRM
- Tools to advance interoperability across and beyond VA
- Supportive of existing governance processes

i-VA “Navigator” by Intended Use

References listed in order of decreasing relevancy. Key citations are in BOLD.

- **PRIMER / Overview** [A-2, A-4, A-5]
- **Acquisition Planning** [A-2, A-5, A-3, A-4]
- **Architecture**
 - Requirements Traceability [B-1]
 - Design Patterns [E-1]
 - System Architecture [B-6, E-1, A-4, C-1]
- **Data Design** [C-2, D-3]
- **Governance and Compliance** [E-6, B-4, B-5]
- **Learning Health System** [C-3, A-5, C-1]
- **Maturity** [B-3, B-4, B-5]
- **Policy** [B-1, A-4, A-3, C-1]
- **Program Management** [A-5, E-3, B-1, B-5]
- **Quality Management** [A-4, A-5, B-3, B-1]
- **System Design**
 - Data Design [C-2, D-3]
 - Interface/API Design [E-5, B-6, C-1, D-3]
 - Integration Design [F-1, E-4]
 - Requirements Traceability [B-1, A-4, B-6]
- **Standards**
 - Information Standards [D-3, C-1, D-2, D-1]
 - Knowledge Representation Standards [C-3, C-1]
 - Process Engineering Standards [C-3, B-6, E-6]
 - APIs [E-6, E-5, E-4, C-1]



A: Introduction & Overview

- A-1 Navigating the Blueprints
- A-2. Interoperability and Its Benefits
- A-3. Current State Interoperability
- A-4. Interoperability Challenges
- A-5. Seamless Beneficiary Experience

B: Business & Policy Considerations

- B-1. Interoperability Goals and Business Drivers
- B-2. VA Health Informatics Transition Roadmap
- B-3. Interoperability Maturity Model
- B-4. Improving Organizational Maturity
- B-5. Assessing and Maturing Interop Capability
- B-6. Transitioning to Service-Oriented Delivery

C. Interoperable Data Assets

- C-1. Introduction to Interoperable Assets
- C-2. Data Access and Sharing
- C-3. Sharing Knowledge and Non-Data Assets

D. Information Semantics

- D-1. Informational Semantic Interoperability
- D-2. Maturing Information Semantics
- D-3. Standardizing on Concept Representation

E: Systems Design and Implementation

- E-1 Platforms, Components, and Patterns
- E-2 Security & Privacy Considerations
- E-3 Systems Interfaces (API) Overview
- E-4 Interface Consumers’ Viewpoint
- E-5 Interface Creators’ Overview
- E-6 Selecting Interfaces, Endpoints, and Protocols

F. References and Case Studies

- F-1. Case Study: Interface Selection Process
- F-2. Case Study: Applied i-VA Use/PsychTools
- F-3. References and Glossary

Myth Busting

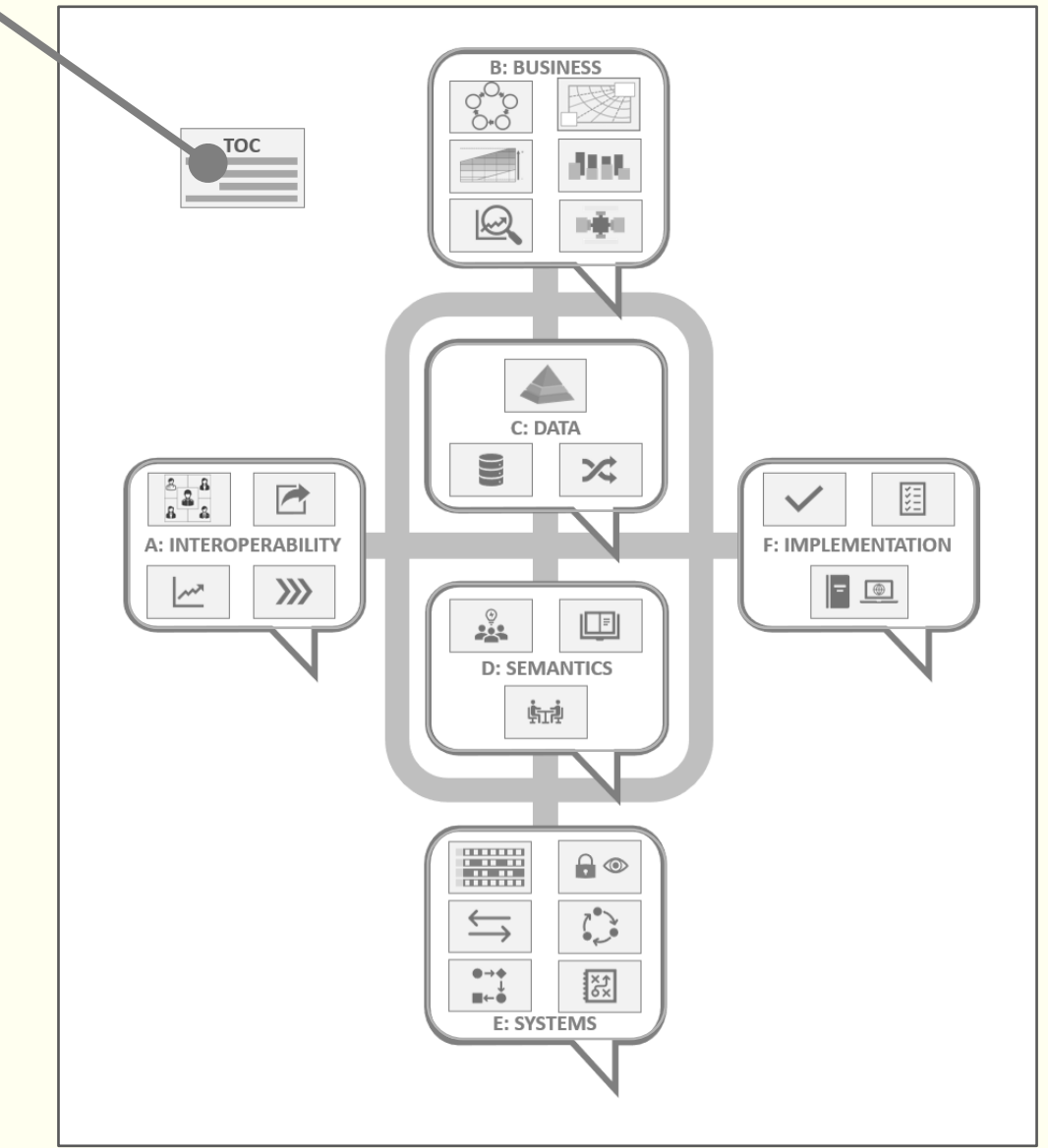
Myth	Reality
A common misconception or myth on the topic of the page	Correction, context clarification, guidance and key take-away message
Another common myth	Correction, clarificaion

Glossary of Terms

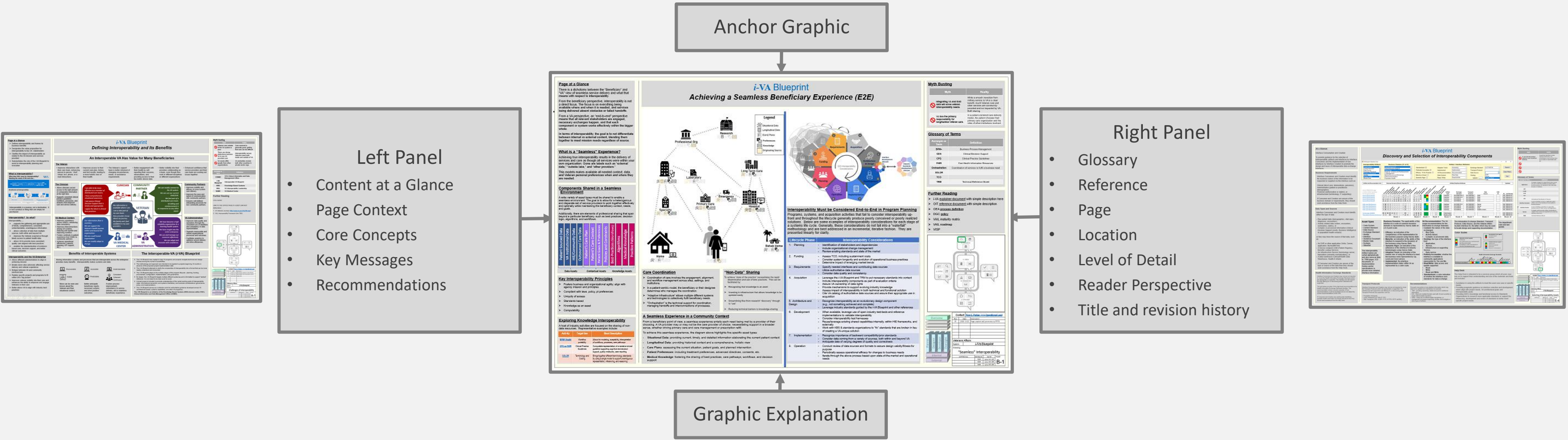
Term	Definition
API	Application Programming Interface
EA	Enterprise Architecture
FHIR™	Fast Healthcare Interoperability Resources
HIT	Health Information Technology
HL7	Health Level Seven – an interoperability standards development organization
ICT	Information and Communication Technology
i-VA	Interoperable VA Blueprints
NCA	National Cemeteries Administration
TRM	VA Technical Reference Model
VAEA	VA Enterprise Architecture
VAIL	VA Interoperability Leadership
VBA	Veterans Benefits Administration
VHA	Veterans Health Administration

Further Reading

VA INTERNAL REFERENCE
Reference Link
VA PUBLIC REFERENCE
Reference Link
INDUSTRY REFERENCE
Reference Link



i-VA Blueprints Page Layout



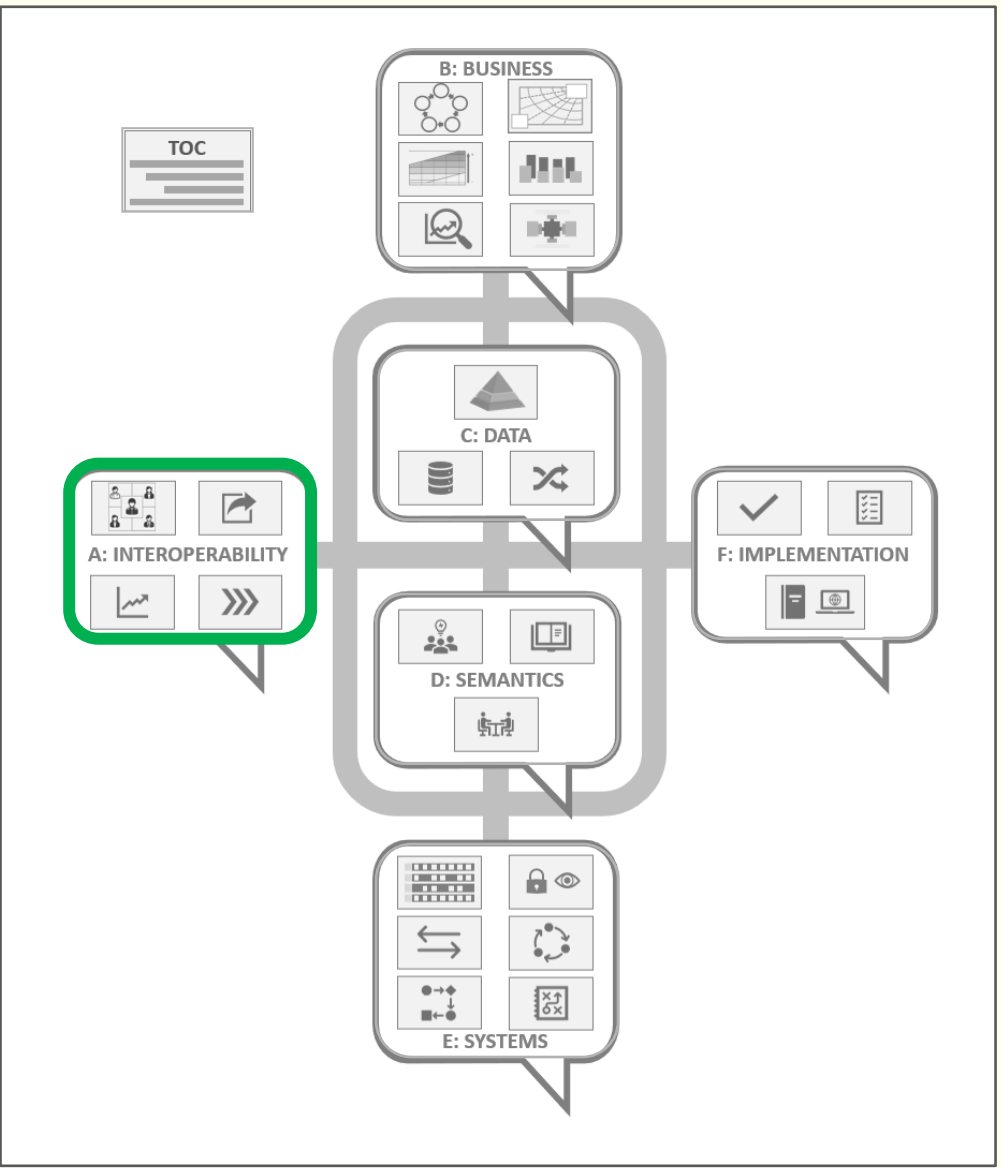
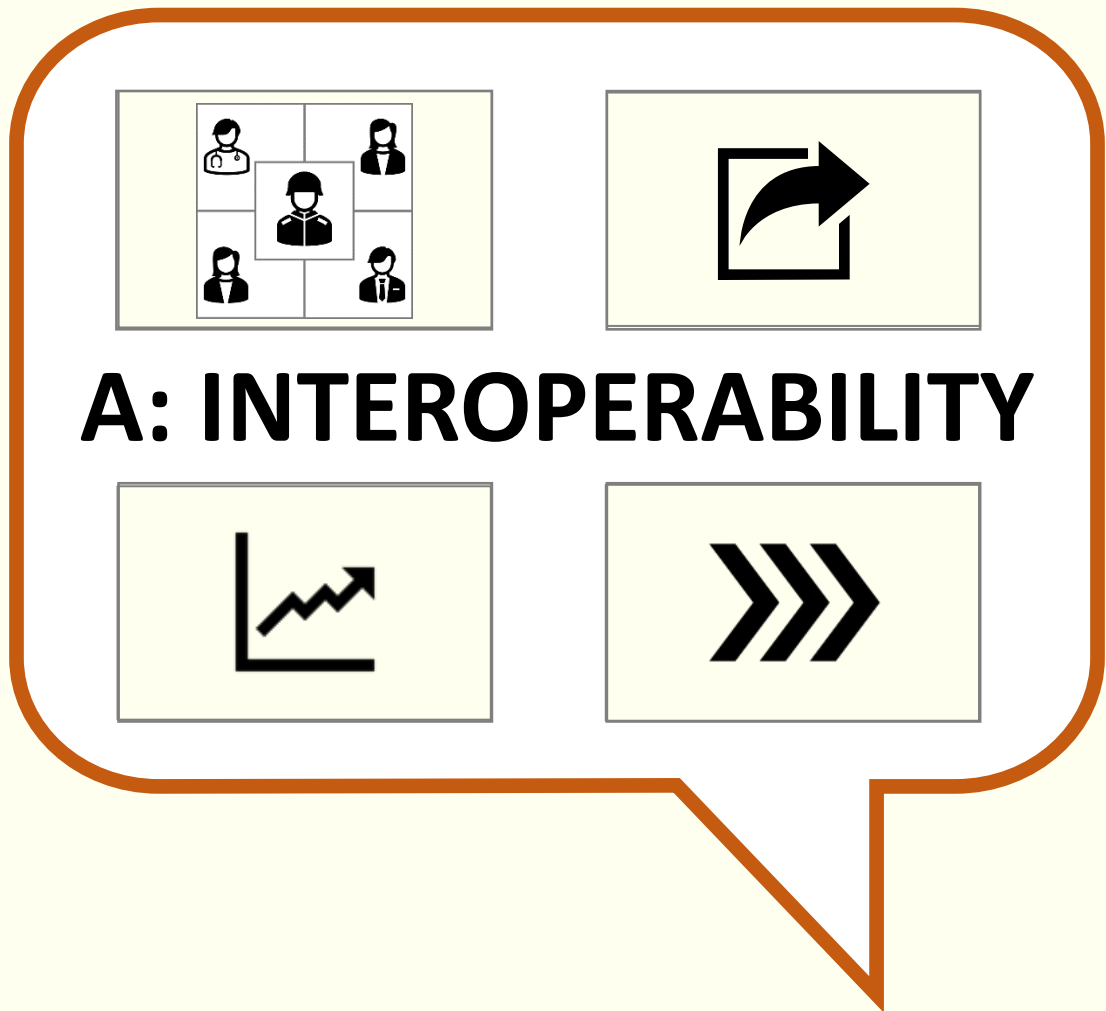
Overview



Contact: VHA Knowledge-based Systems		
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:		PAGE
Navigating the Blueprints		A-



i-VA Blueprints Version 1.5
Section A – Benefits of Interoperability



Page at a Glance

- Defines interoperability and frames its business benefits
- Designates the value proposition for interoperability to key VA stakeholders
- Clarifies the impact of interoperability as related to the VA mission and services provided
- Substantiates the role of the i-VA Blueprints to assist in interoperability planning and execution

What does VAIL mean by *interoperability*? Meeting the needs of the end-user...



Interoperability is a combination of conditions that enable the **right information** to **securely** reach the **right person** at the **right time** in the **best manner** to make an informed decision and **take an action**.

Beneficiaries of Interoperability:



Interoperability is a journey, not a destination. It is not a product or thing that can simply be acquired.

Interoperability? So what?

Interoperability....

- ...supports the gathering and appropriate use of timely, comprehensive, consistent, understandable, unambiguous information.
- ...allows collection of data from multiple sources, both within and beyond VA.
- ...improves Veteran experiences through timely access to patient data, context, preferences.
- ...allows VA to provide more consistent, quality care aligned with best practices.
- ...enables the standardization of evidence-based care, decision support, and better clinical outcomes.

Interoperability and Appropriate Use

- Standards-based interoperability provides consistent information representation and unambiguous semantics that set the context for:
 - what information is needed, how it is reliability understood, and how it is appropriately and ethically actioned as outlined in “Ethics Principles for Access to and use of Veteran Data”. (see Further Reading)

Interoperability and the VA Enterprise

- Allows different administrations to align in achieving mission
- Breaks down silos adversely affecting service delivery and veteran experience
- Bridges between VA and community services/care
- Relates specific projects and programs to fit within VA’s “big picture”
- Improves veteran visibility into their care and enhances the ability to empower and engage Veterans in their care
- Better allows VA to align with industry best practices

i-VA Blueprints

Serving Our Veterans: Why Interoperability Matters



The Veteran

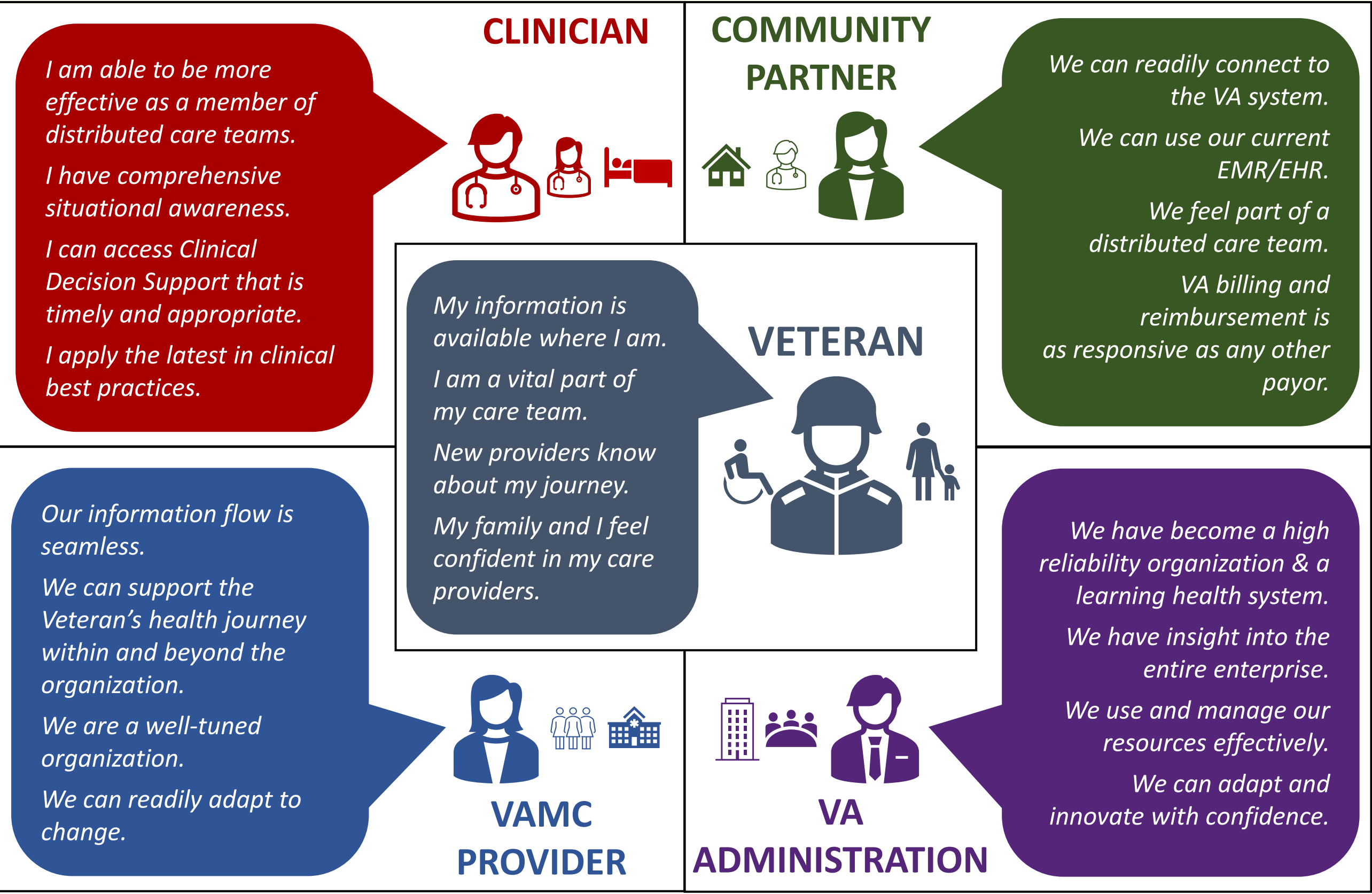
- Improves interactions with their care team, enhancing person to person, “chat”, virtual, text, phone, or e-mail interactions.
- Improves access to their current care plan, history, and test results, leading to a more holistic view of their health.
- The Veteran’s support team is better informed of changing circumstances, needs, or assistance requirements.
- Better engagement with their health by self-reporting their concerns, observations, and providing access to their bio-metric device data.
- Better visibility into their providers collaborating as a team, even though they work in different disciplines or different organizations
- Enhanced confidence that service providers and their care team are working out issues together.

The Clinician

- Allows clinicians secure access to the right amount of comparable information at the right time.
- Supports consistent clinical practice guidelines, workflows, processes, and analytics that empower care and service delivery.

VAMC Providers

- Improves consistency across VAMCs, enhancing data consistency.
- Improves interconnections among VA systems, reducing user burden and improving workflow.
- Fosters continuity in patient experience from VAMC to community partners.
- Achieves operational efficiencies (capacity planning, KPI support, etc.).



Community Partners

- Improves visibility and efficacy of cross-system care delivery.
- Improves the ease and speed of communication with community partners.
- Ensures well-defined onboarding processes for new community partners.

VA Administration

- Improves data quality and operations through the consistent use of identifiers and consistency in data representation.
- Supports measurable and valued organizational processes and outcomes.
- Facilitates analytics to optimize service delivery and drive efficiencies.

Characteristics of Interoperable Systems

Having information systems and processes that are interoperable across the enterprise provides many benefits. Interoperability makes systems and data:



Discoverable



Accessible



Understandable



Visible



Predictable



Consistent
Coherent
Continuous

More can be seen and known about the Veteran and their situational context.

Better anticipate beneficiary needs, necessary actions, and drive positive outcomes.

Fosters process improvement, consistency in service delivery, and a seamless beneficiary experience.

Introducing the “Interoperable VA” (i-VA) Blueprints

- The i-VA Blueprints have been created to help VA programs and projects navigate technical and design choices
- The methodology and approach are intended to be applied to projects beginning 18 months in advance of the proposed project implementation date.
- The i-VA Blueprints attempt to clarify the complexities of interoperability into a format that can be more readily understood and consumed.
- The i-VA Blueprints align to the multiple stages of the program lifecycle: planning, funding, requirements, acquisition, etc..
- By design, the i-VA Blueprints target multiple different audiences and is formatted to support “tactical” reference. It is not meant to be read cover-to-cover.
- A broad scope is included to promote understanding of the varied working parts of interoperability (data, informational semantics, and systems interfaces), and business considerations (governance, policy, and implementation).
- The i-VA Blueprints serve as a collection point for authoritative guidance developed across VA (architectural assets, systems capabilities, and other VA programs).

The *i-VA Blueprints* are an initiative of the Knowledge Based Systems (KBS) division within VHA’s Clinical Informatics and Data Management Office (CIDMO).

Myth Busting

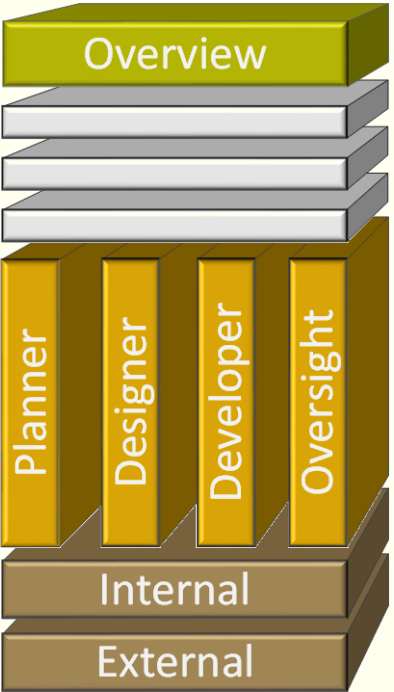
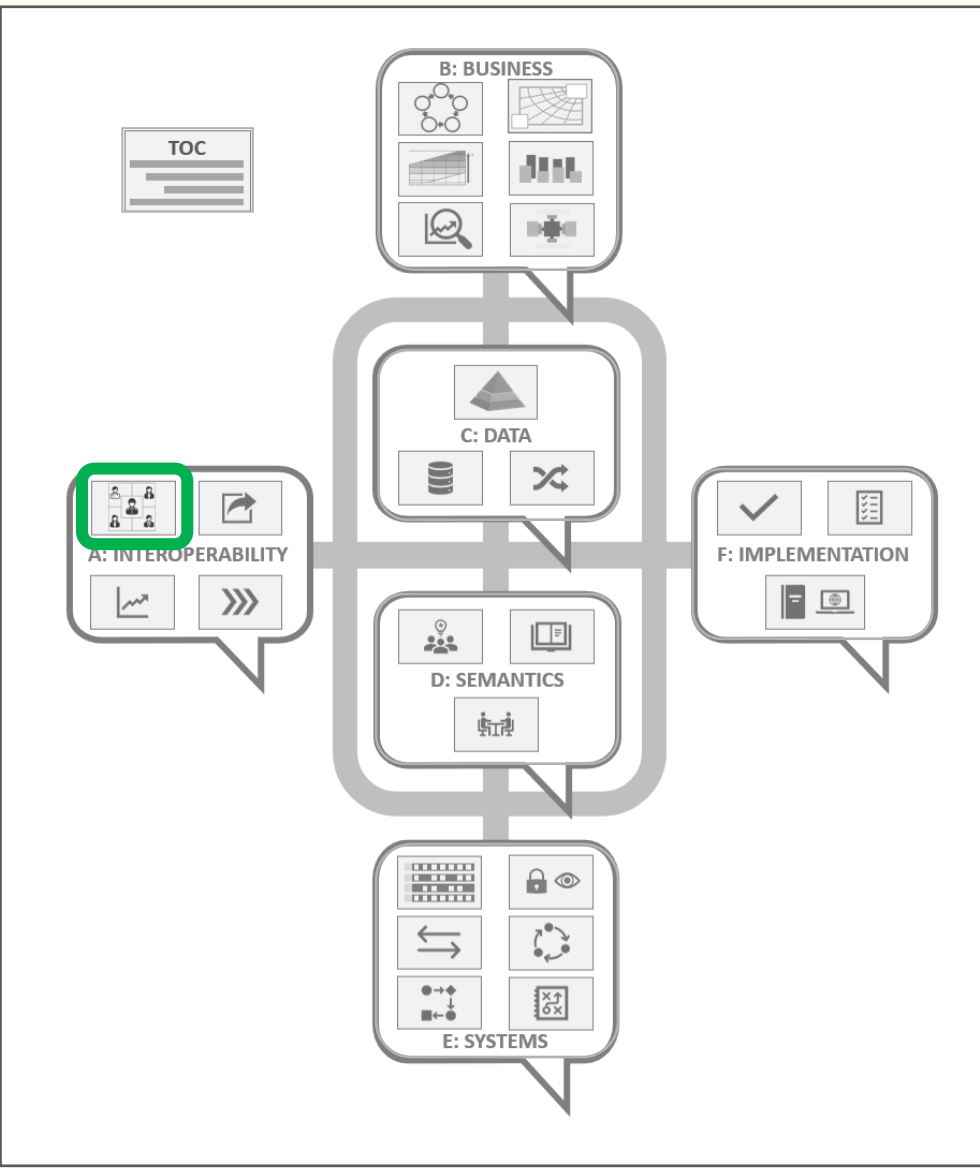
Myth	Reality
Veteran care outside of the VA system is poor.	Care received is generally good; getting that care can be difficult.
There are strong distinctions between VA & non-VA provided care.	Interoperability serves Veterans seen both inside and outside of VA.
VA is organizational-ly unique and differs greatly from other institutions.	VA has many similarities both with other countries’ healthcare systems & with private sector orgs.

Glossary of Terms

Term	Definition
CIDMO	VHA Clinical Informatics and Data Management Office
KBS	Knowledge Based Systems
VAIL	VA Interoperability Leadership
VAMC	VA Medical Center

Further Reading

VA INTERNAL REFERENCE
VAIL Interoperability Framework
VA PUBLIC REFERENCE
Veterans Journey Maps
Ethics Principles for Access to and Use of Veteran Data
INDUSTRY REFERENCE



Contact:	VHA Knowledge-based Systems	
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Executive Summary	PAGE A-2

Page at a Glance

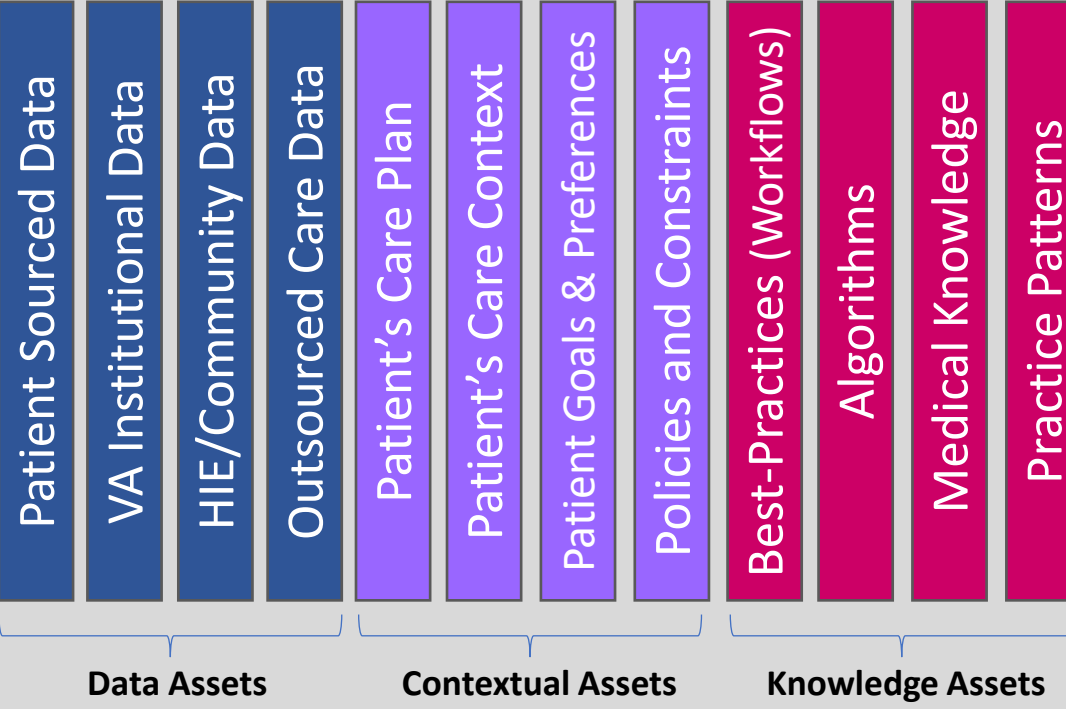
- There is a dichotomy between the “Beneficiary” and “VA” views of seamless service delivery and what that means with respect to interoperability.
- From the beneficiary perspective, interoperability is not a direct focus. The focus is on everything being available where and when it is needed, and services being delivered absent obstacles or failed handoffs.
- From a VA perspective, an “end-to-end” perspective means that all relevant stakeholders are engaged, necessary exchanges happen, and that each component or system works effectively within the bigger whole.
- In terms of interoperability, the goal is to not differentiate between internal vs external content, blending them together to meet mission needs regardless of source.

What is a “Seamless” Experience?

- Achieving true interoperability results in the delivery of services and care as though all services were within your own organization. Gone are labels such as “external data,” “outside labs,” and “other providers.”
- This models makes available all needed context, data, and Veteran personal preferences when and where they are needed.

Components Shared in a Seamless Environment

- A wide variety of asset types must be shared to enable a seamless environment. The goal is to allow for a heterogenous and disparate set of service providers to work together effectively and optimally while maintaining the beneficiary context, needs, and goals.
- Additionally, there are elements of professional sharing that span beyond a particular beneficiary, such as best practices, decision logic, algorithms, and workflows.



Patient-oriented Sharing

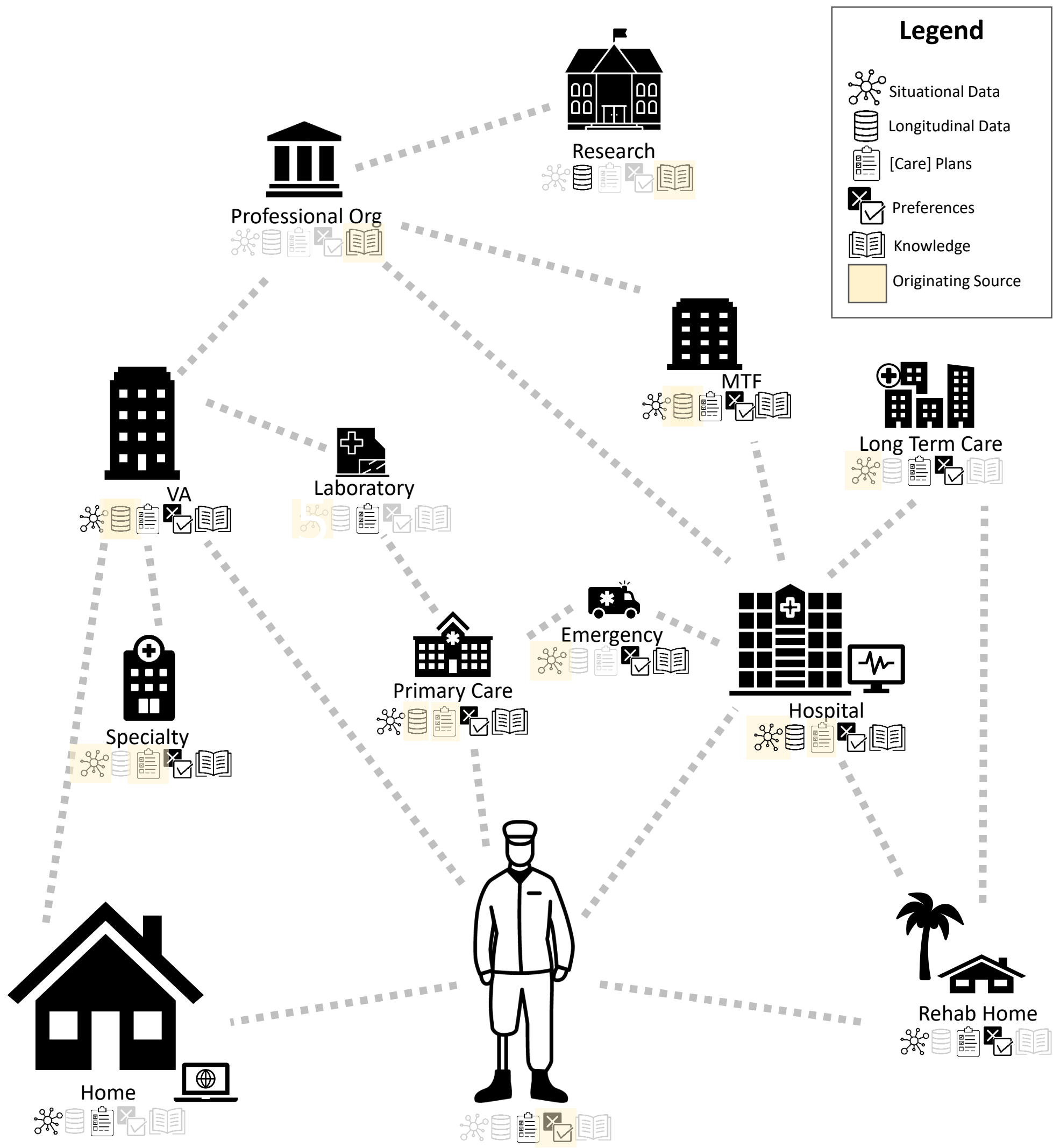
- Beneficiary wellness and health maintenance happens substantially beyond one institution
- The preferences, goals, and needs of the patient must span their encounters and interactions across locations and institutions of care
- The datagraph below depicts the mean number of health system visits by patients during one year. This illustrates the importance of engaging individuals in their wellness



● Health System Encounter

i-VA Blueprints

Achieving the Seamless End-to-End (E2E) Beneficiary Experience



Care Coordination

- Coordination of care involves the engagement, alignment, and workflow management across sites, settings, and institutions.
- In a patient-centric model, the beneficiary or their designee determines who manages the coordination.
- “Adaptive Infrastructure” allows multiple different systems and technologies to collectively fulfil beneficiary needs.
- “Orchestration” is the technical support for coordination, managing handoffs and interconnections of processes.

“Non-Data” Sharing

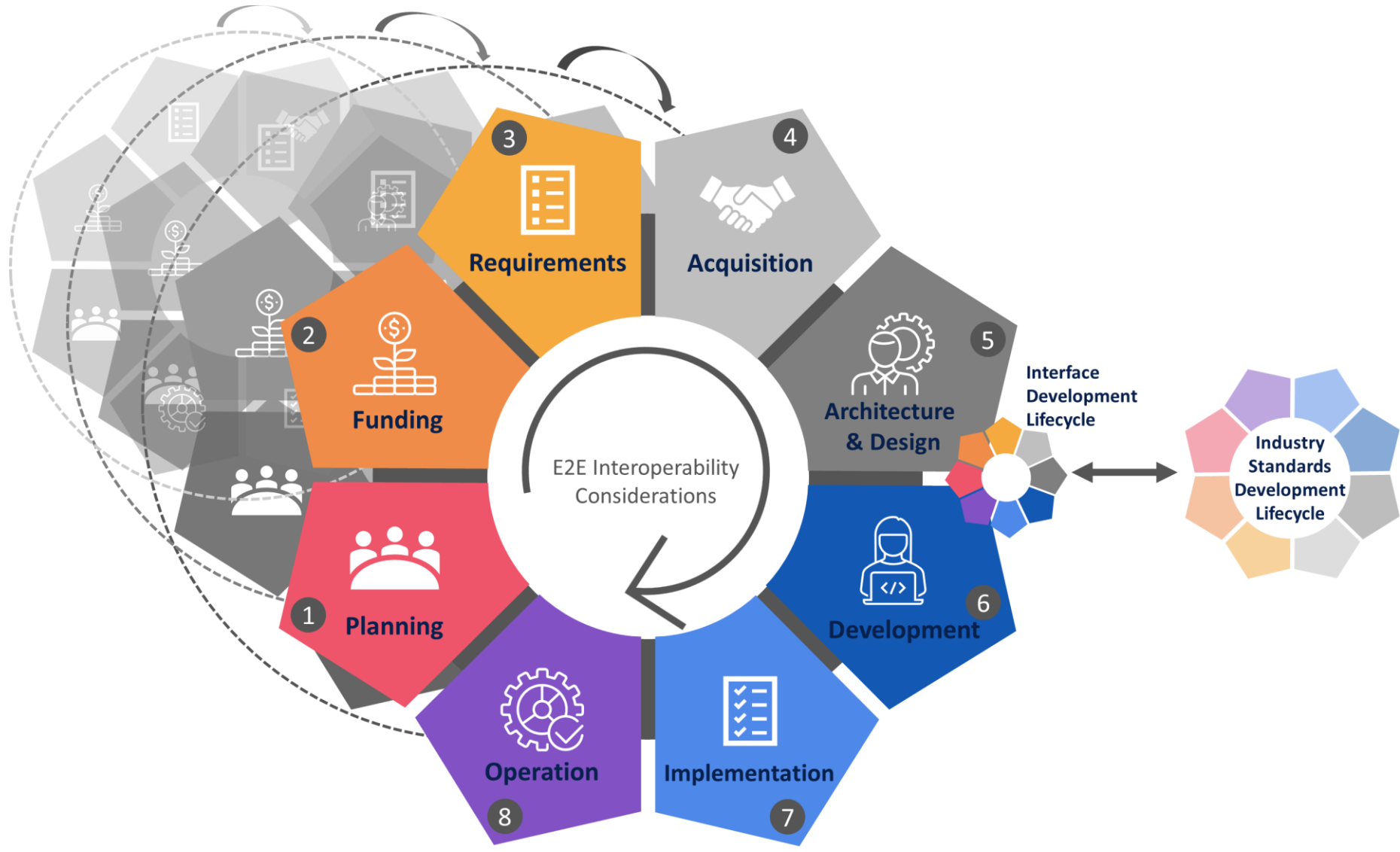
- To achieve “state of the practice” necessitates the rapid dissemination and use of best practices, facilitated by:
- Recognizing that knowledge is an asset
 - Investing in infrastructure that allows knowledge to be updated easily
 - Streamlining flow from research “discovery” through to “use”
 - Reducing technical barriers to knowledge-sharing

A Seamless Experience in a Community Context

From a beneficiary point of view, a seamless experience entails each need being met by a provider of their choosing. A VA provider may or may not be the care provider of choice, necessitating support in a broader sense, whether driving primary care and care management or prescription refill.

To achieve this seamless experience, the diagram above highlights five specific asset types:

- **Situational Data:** providing current, timely, and detailed information elaborating the current patient context
- **Longitudinal Data:** providing historical context and a comprehensive, holistic view
- **Care Plans:** assessing the current situation, patient goals, and planned intervention
- **Patient Preferences:** including treatment preferences, advanced directives, consents, etc.
- **Medical Knowledge:** fostering the sharing of best practices, care pathways, workflows, and decision support



Interoperability Must be Considered End-to-End in Program Planning

Programs, systems, and acquisition activities that fail to consider interoperability up-front and throughout the lifecycle generally produce poorly conceived or poorly realized solutions. Below are some examples of interoperability considerations for each stage of a systems life cycle. Generally, these considerations do not fall into a “waterfall” methodology and are best addressed in an incremental, iterative fashion. They are presented linearly for clarity.

Lifecycle Phase	Interoperability Considerations
1. Planning	- Identification of stakeholders and dependencies - Include organizational change management - Review existing standards and state of the market
2. Funding	- Assess TCO, including sustainment costs - Consider system longevity and evolution of operational business practices - Determine impact of emerging market trends
3. Requirements	- Specify needed interfaces and contributing data sources - Utilize authoritative data sources - Consider data quality and consistency
4. Acquisition	- Leverage the i-VA Blueprints and TRM to put necessary standards into context - Include interoperability components as part of evaluation criteria - Assure VA ownership of data rights - Provide mechanisms to support evolving industry knowledge - Assess impact of interoperability in both technical and functional solution - Cite VA catalog of authoritative data sources and assure their appropriate use in acquisition
5. Arch. and Design	- Recognize interoperability as an evolutionary design component (e.g., not something achieved and complete) - Leverage industry standards guided by the i-VA Blueprints and other references
6. Development	- When available, leverage use of open industry test-beds and reference implementations to validate interoperability - Consider interoperability test harnesses - Reuse/leverage existing shared capabilities internally, within HIE frameworks, and externally - Work with KBS & standards organizations to “fix” standards that are broken in lieu of creating a VA-unique solution
7. Implementation	- Recognize importance of backward compatibility/prior standards - Consider data coming from a variety of sources, both within and beyond VA - Anticipate data of varying degrees of quality and correctness
8. Operation	- Conduct review of data sources and formats to assure design validity/fitness for purpose - Periodically assess operational efficacy for changes to business needs - Iterate through the above process based upon state-of-the-market and operational needs

Myth Busting

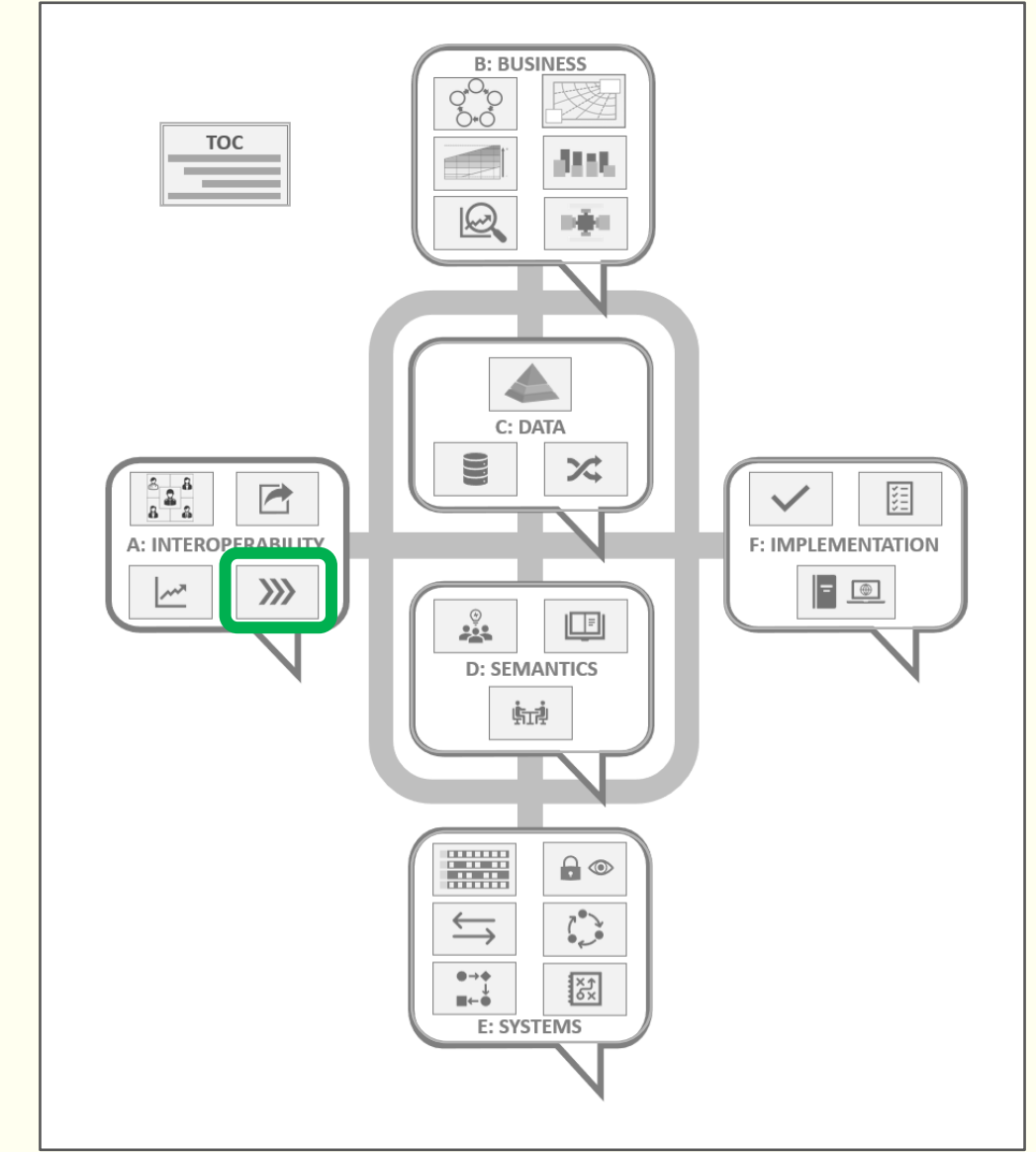
Myth	Reality
Integrating VA and DoD data will solve veteran interoperability needs.	While a smooth transition from military service to VA is a clear benefit, much Veteran care and other services are community-provided and not impacted by VA-DoD sharing.
VA has the primary responsibility for longitudinal Veteran care.	In a patient-centered care delivery model, the patient chooses their primary care organization and the roles of other institutions involved.

Glossary of Terms

Term	Definition
E2E	End-to-End Process
KBS	Knowledge Based Systems
Longitudinal	Across all sources and over time
Orchestration	Coordination of services to fulfil a business need
Situational	Additional data providing context for decision making
TCO	Total Cost of Ownership
TRM	Technical Reference Model

Further Reading

VA INTERNAL REFERENCE
Possible refs: Entities in the Lifecycle phase block (1 through 8). Weaker: EA, OIT, generic link to EA
VA PUBLIC REFERENCE
INDUSTRY REFERENCE



Concept	Contact: VHA Knowledge-based Systems
Planner	Rev: Date: Description:
Designer	
Developer	
Oversight	
Internal	
External	
Veterans Affairs	
System: i-VA Blueprints	
Drawing: “Seamless” Interoperability	
PAGE A-3	

Page at a Glance

- Absent investments in standardization, systems and programs are siloed, non-comparable, and the content not effectively sharable. The result is a boundary-filled system and adverse impacts on veteran experiences.
- Injecting interoperability design into project planning and execution results in better flow among VA projects, improved engagement and sharing with external partners, broader alignment with industry, and more adaptable and durable solutions.
- This i-VA document serves as a launch-point to discover relevant content intended to lessen the learning-curve and facilitate decision-making.

The Need for End to End (E2E) Interoperability

- Interoperability is **often not considered until after funding commitments and timelines** have been set
- Interoperability cannot be considered “in micro”. It is essential that we look not just at one process or system at a time, but how that system connects with others.
- Discrete efforts to include interoperability requirements must be considered in the product/services acquisition
- Standards and interface development lifecycles are not typically considered in project design, development, and implementation timelines and should be
- Best practices in interoperability related project management needed to ensure thorough and consistent interoperability interfaces development across the organization.
- System testing often fails to account for interoperability testing. Moreover, testing plans often don’t consider the impact of bad data across the wire

Incorporating Interoperability Thinking: Exemplar Changes to a Program Lifecycle

Change	Impact
Perform standards due-diligence on cross-system dependencies	Assess interactions with interfacing systems with an eye toward use of standards.
Take a pro-active posture based upon estimated system longevity	Often system interfaces are based upon current “as is” state without regard for total lifecycle. Design can support API evolution over time if done thoughtfully
Anticipate changes to data, data format, and interface protocol over time	When these elements are considered inviolate, systems and interfaces are brittle. Designing for adaptation is more flexible and interoperable.

Primary audience:

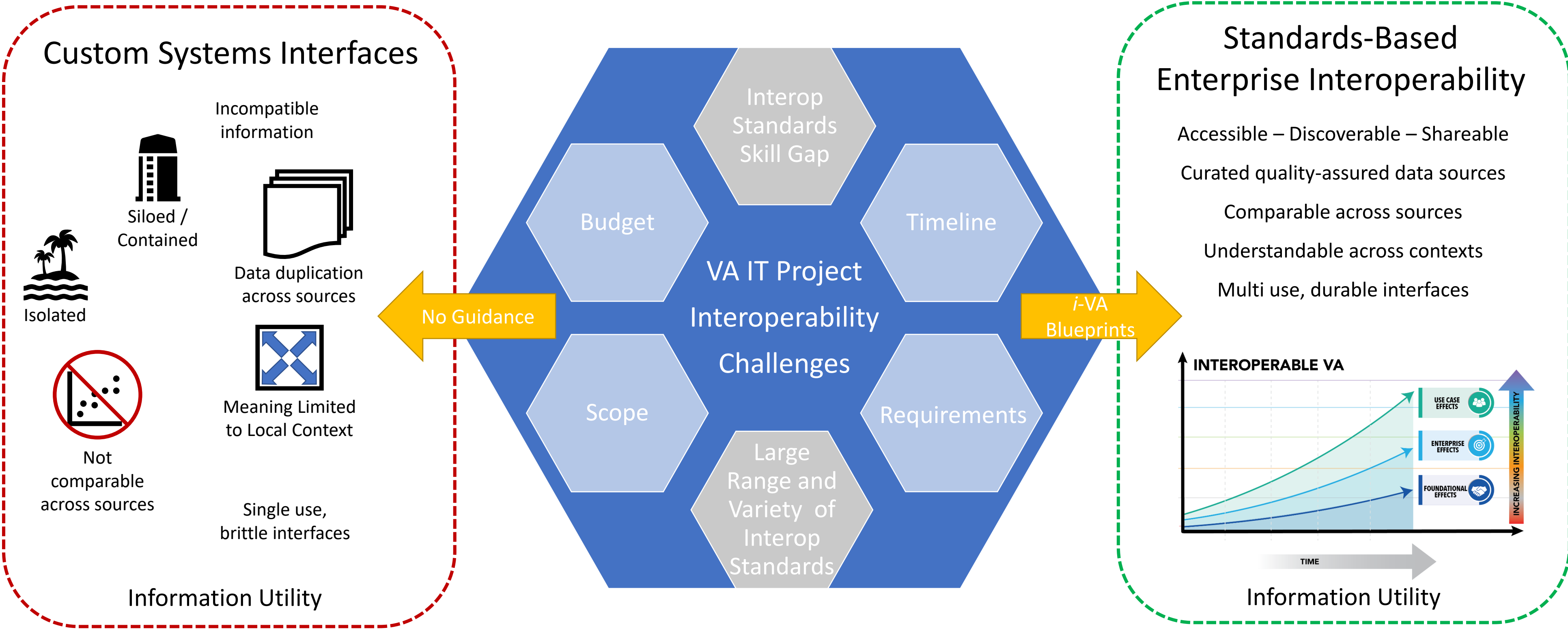
- Project teams implementing interoperable information systems
- Both VA internal teams and teams of external partners connecting their systems with VA

Secondary audiences:

- VA
 - Service Providers
 - Strategists and planners
 - Architects and Designers
 - Organizational oversight and governance
- Standards Development Organizations (SDOs)
- Community Partner organizations

i-VA Blueprints

Interoperability Challenges for Projects and Program Delivery



Challenges With Project-Based Interoperability

- Recognize that there the apparent tension between mission requirements and interoperability requirements is a false flag
 - This can be a misconception. Many interoperability requirements directly tie to Veteran needs that are not well represented or explored.
 - Note impacts on total costs of ownership vs. short-term time-to-market pressure.
 - Interoperability requirements are often viewed as a project “tax”
- Interoperability skills can be niche and are nuanced
 - There are stark differences in capability between standards implementation experience vs. standards engagement experience.
 - Leverage available VA expertise around standards, including VHA CIDMO Knowledge-based Systems (KBS), VAIL, and other offices.
- Good reference examples can be difficult to find
 - Note that many industry efforts have open-source reference implementations that can be leveraged at no-cost, illustrating best-practices and helping educate
 - VA is a member of several leading standards bodies and industry consortia, from which we can draw best-practices and tap industry expertise.

The Risks of Not Doing

- Projects not following standards custom-create interfaces that result in added integration burden and sustainment cost
 - Interfaces between systems are “brittle”, easily broken, and costly to maintain.
- Failure to leverage authoritative sources results in data representation, currency, or semantic concerns, specifically:
 - Information is duplicated
 - Information is siloed or inaccessible when and where it is needed
 - Informational semantics is incompatible for other purposes

Benefits of Standards-Based Interoperability

- The utility of information gathered across many VA systems is greatly enhanced when
- Consistent standards are applied to the identification, representation, semantic content, and the transmission of data across and outside of VA.
 - Information about the Veteran or the services they receive is discoverable, accessible, comparable and shareable for many other forms of services the Veteran is entitled to
 - Authoritative data sources are known and accessible through the application programming interfaces their custodians provide
 - APIs are durable, adaptable, and reusable for many purposes.

Impacts to the Enterprise

- Improved consistency, data, and process flow within the organization, and across Administration
- Alignment with industry providers, fostering a more consistent beneficiary experience with VA as a part of their broader support ecosystem
- Enhanced agility and ability to adapt to ever-present change

Myth Busting

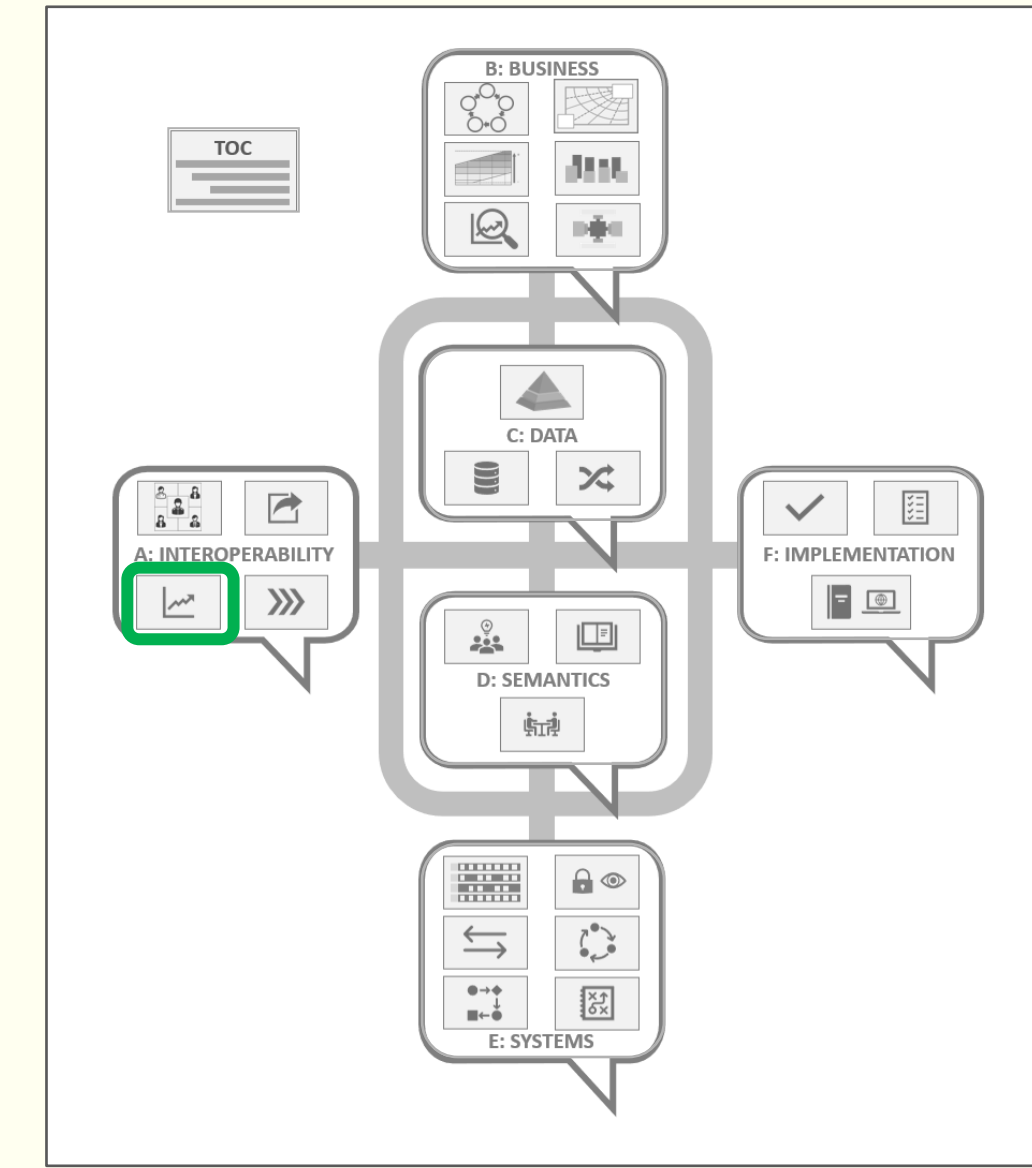
Myth	Reality
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Term	Definition
API	Application Programming Interface
CIDMO	Clinical Informatics and Data Management Office
FHIR®	HL7® Fast Health Interoperability Resources
i-VA Blueprints	Interoperable-VA Blueprints
KBS	Knowledge Based Systems, CIDMO, OHI
VAIL	VA Interoperability Leadership

Further Reading

VA INTERNAL REFERENCE
VA PUBLIC REFERENCE
INDUSTRY REFERENCE



Contact:	VHA Knowledge-based Systems	
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Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Interoperability Challenges	PAGE A-5

The Need for End to End (E2E) Interoperability



Incorporating Interoperability Thinking:
Exemplar Changes to a Program Lifecycle

Change	Impact
Perform standards due-diligence on cross-system dependencies	Assess interactions with interfacing systems with an eye toward use of standards.
Take a pro-active posture based upon estimated system longevity	Often system interfaces are based upon current “as is” state without regard for total lifecycle. Design can support API evolution over time if done thoughtfully
Anticipate changes to data, data format, and interface protocol over time	When these elements are considered inviolate, systems and interfaces are brittle. Designing for adaptation is more flexible and interoperable.

Primary audience:

- Project teams implementing interoperable information systems
- Both VA internal teams and teams of external partners connecting their systems with VA

Secondary audiences:

- VA
 - Service Providers
 - Strategists and planners
 - Architects and Designers
 - Organizational oversight and governance
- Standards Development Organizations (SDOs)
- Community Partner organizations

i-VA Blueprints

Agile Delivery



Challenges With Project-Based Interoperability

- Recognize that there the apparent tension between mission requirements and interoperability requirements is a false flag
 - This can be a misconception. Many interoperability requirements directly tie to Veteran needs that are not well represented or explored.
 - Note impacts on total costs of ownership vs. short-term time-to-market pressure.
 - Interoperability requirements are often viewed as a project “tax”
- Interoperability skills can be niche and are nuanced
 - There are stark differences in capability between standards implementation experience vs. standards engagement experience.
 - Leverage available VA expertise around standards, including VHA CIDMO Knowledge-based Systems (KBS), VAIL, and other offices.
- Good reference examples can be difficult to find
 - Note that many industry efforts have open-source reference implementations that can be leveraged at no-cost, illustrating best-practices and helping educate
 - VA is a member of several leading standards bodies and industry consortia, from which we can draw best-practices and tap industry expertise.

The Risks of Not Doing

- Projects not following standards custom-create interfaces that result in added integration burden and sustainment cost
 - Interfaces between systems are “brittle”, easily broken, and costly to maintain.
- Failure to leverage authoritative sources results in data representation, currency, or semantic concerns, specifically:
 - Information is duplicated
 - Information is siloed or inaccessible when and where it is needed
 - Informational semantics is incompatible for other purposes

Benefits of Standards-Based Interoperability

- The utility of information gathered across many VA systems is greatly enhanced when
- Consistent standards are applied to the identification, representation, semantic content, and the transmission of data across and outside of VA.
 - Information about the Veteran or the services they receive is discoverable, accessible, comparable and shareable for many other forms of services the Veteran is entitled to
 - Authoritative data sources are known and accessible through the application programming interfaces their custodians provide
 - APIs are durable, adaptable, and reusable for many purposes.

Impacts to the Enterprise

- Improved consistency, data, and process flow within the organization, and across Administration
- Alignment with industry providers, fostering a more consistent beneficiary experience with VA as a part of their broader support ecosystem
- Enhanced agility and ability to adapt to ever-present change

Myth Busting

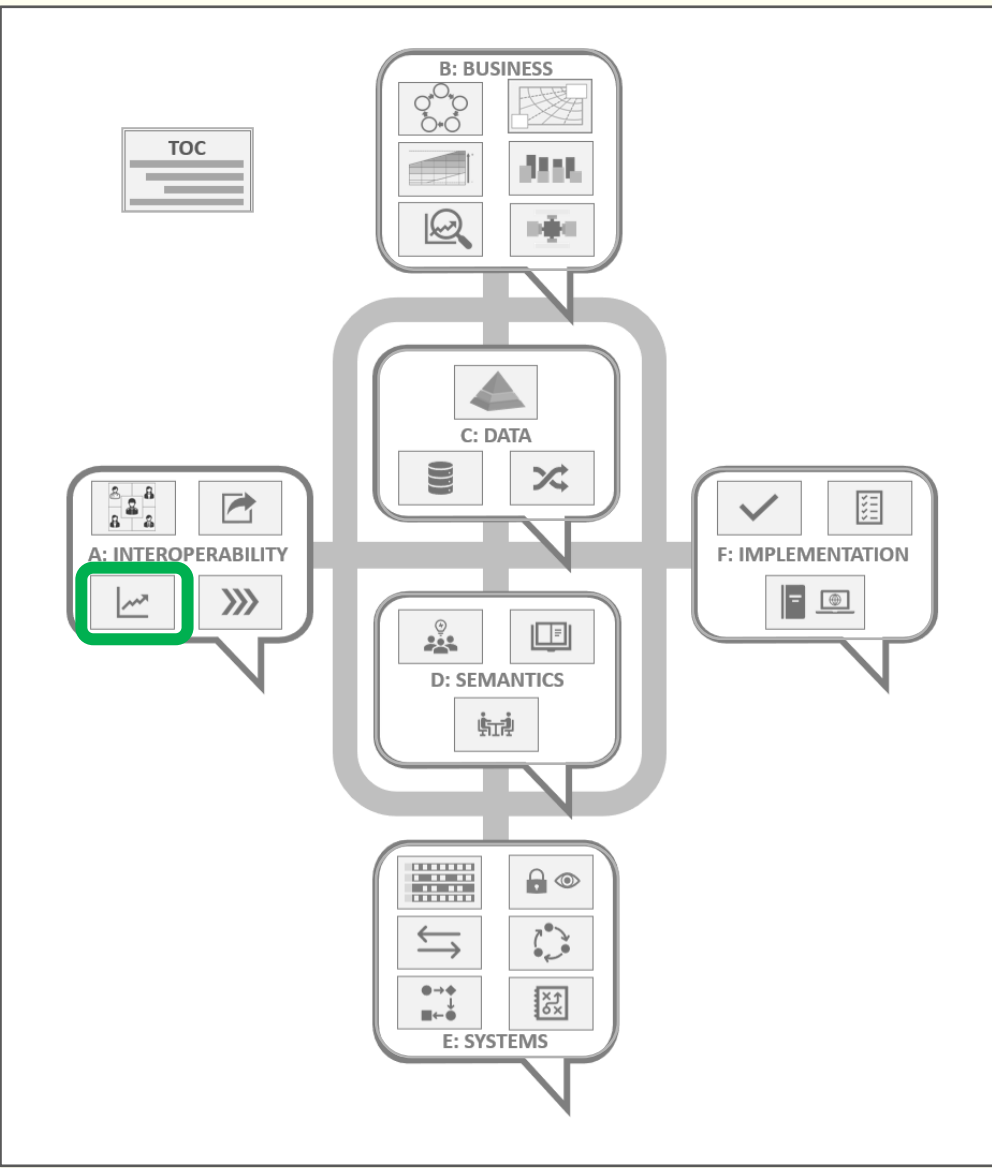
Myth	Reality
 Myth 1	
 Myth 2	

Glossary of Terms

Term	Definition

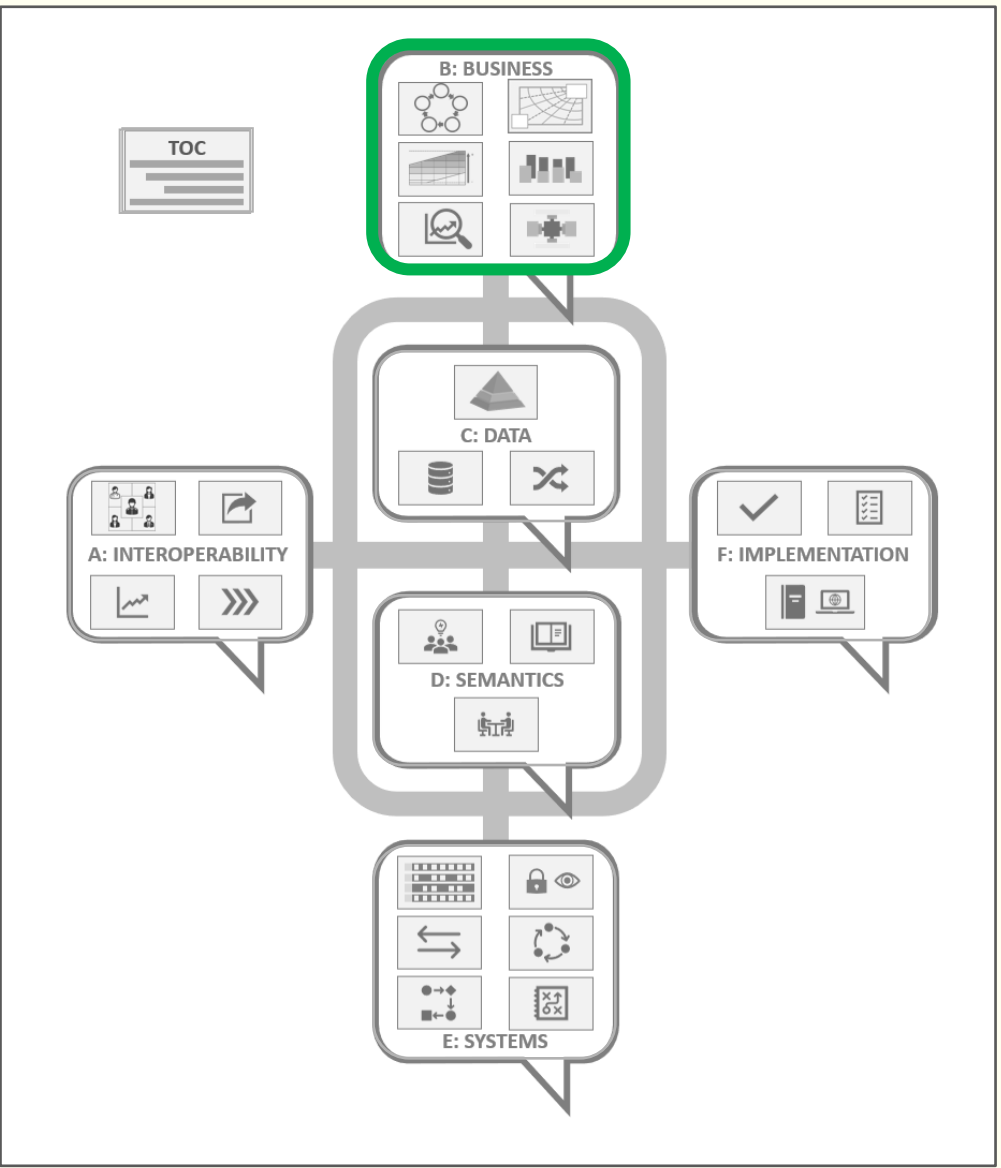
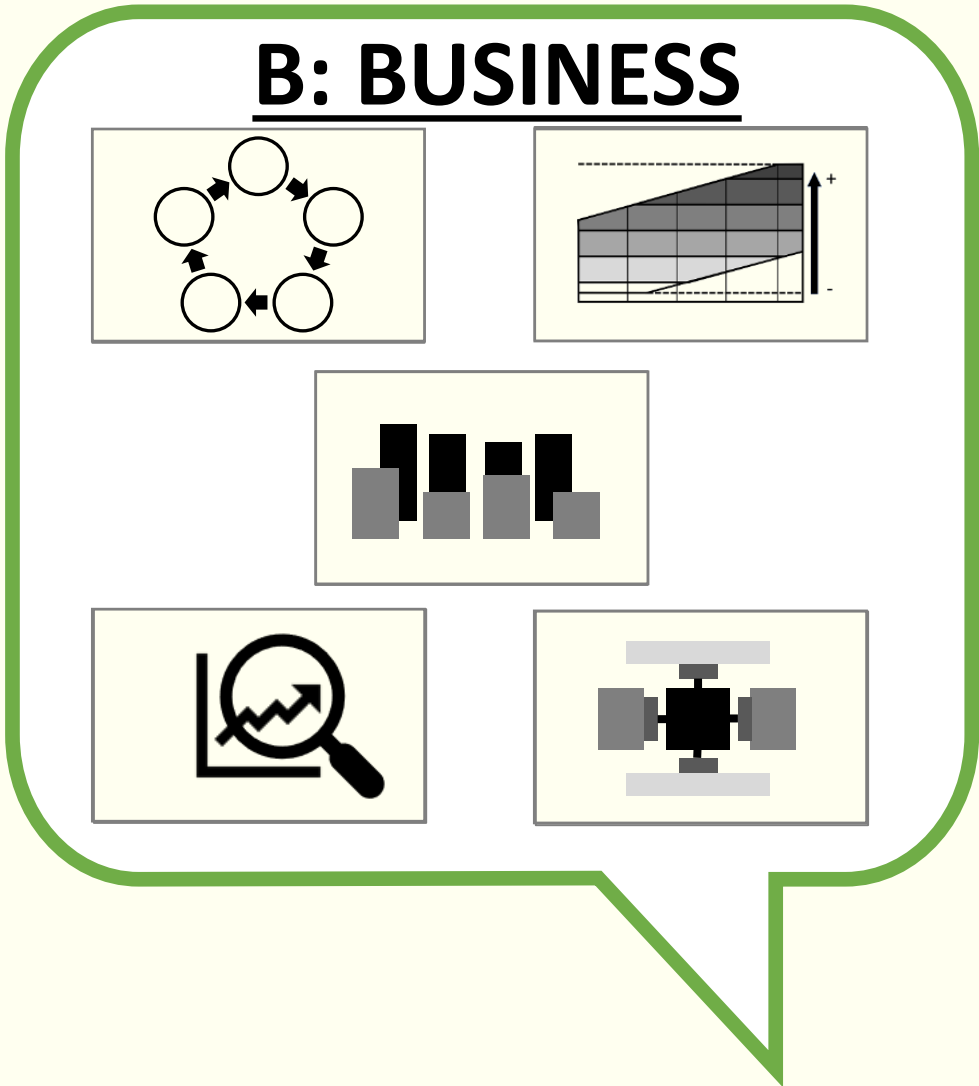
Further Reading

VA INTERNAL REFERENCE
VA PUBLIC REFERENCE
INDUSTRY REFERENCE



Contact: VHA Knowledge-based Systems		
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Interoperability Challenges	
	PAGE	A-6

i-VA Blueprints Version 1.5
Section B – Business and Policy Considerations
for Interoperability



Page at a Glance

- Interoperability cannot be accomplished with technology alone. It must be integrated as seamlessly as possible into workflow, it requires organizational change at many levels, and the informatics and IT tooling necessary to enable that change over time.
- This page illustrates a roadmap approach to planning and achieving organizational transition to a desired future state for VA. This includes a transition map that depicts the interlinked dimensions of people, processes, and tooling that need to co-evolve in a phased manner to achieve VA’s organizational goals.

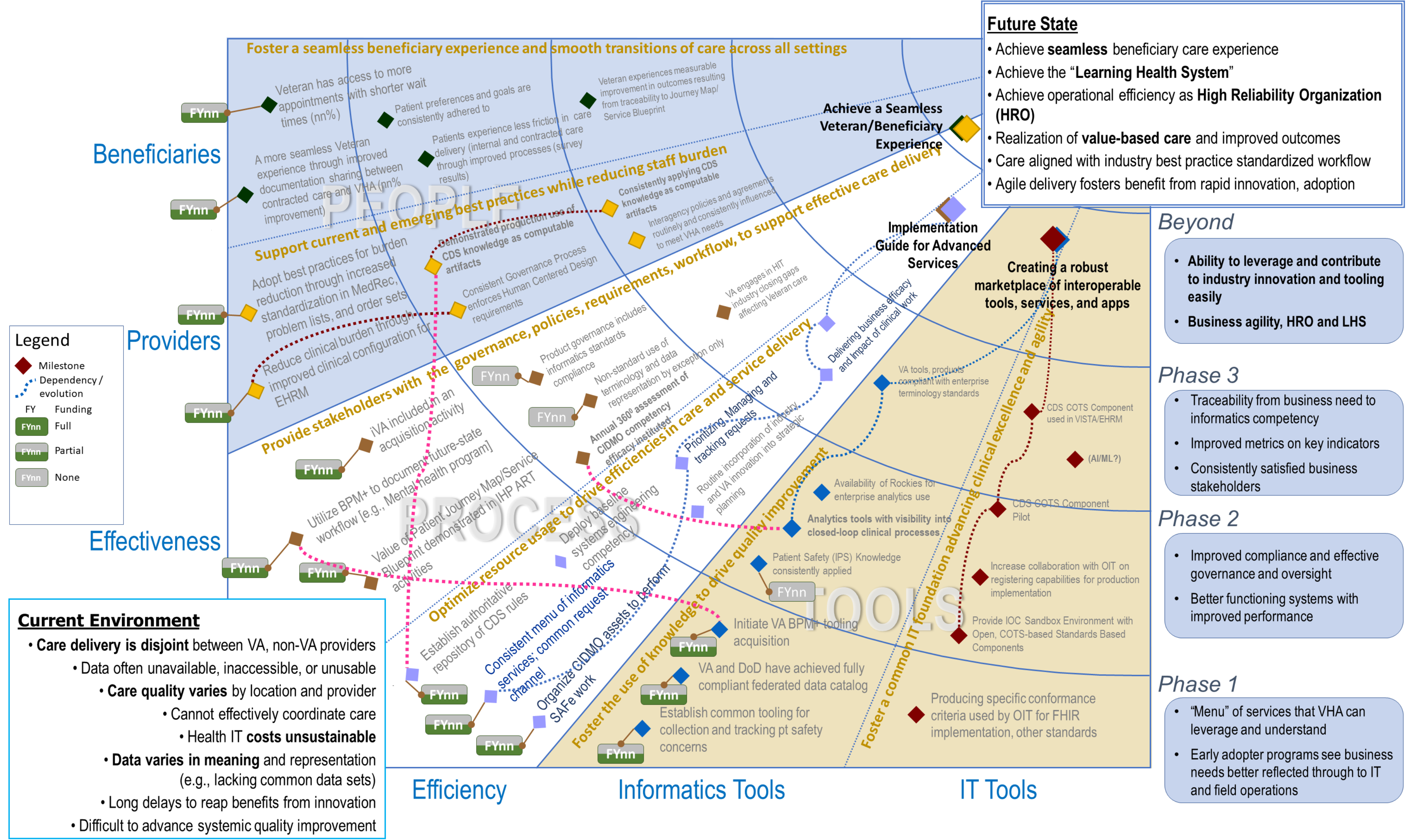
Purpose of the Roadmap

- The Veterans Health Administration is responsible for providing care whenever and wherever a beneficiary needs it. The goal is to improve care delivery for those beneficiaries who can access the VHA system, and for those who receive care outside of the system.
- This requires more than standards-based system-to-system interoperability. It requires:
 - Engaging people in many roles that leverage their skills and insight.
 - Integrated processes and policy to achieve consistency, quality of service, and high performance across the organization.
 - Informatics and system tools to enable delivery of advanced service capabilities.
- The roadmap helps enable the VHA to deliver “The Best Care Anywhere” in a consistent and comprehensive manner.
- It is a reference for stakeholders to have a shared understanding of their respective roles in near-, medium-, and long-term organizational goals and activities.
- It illustrates the necessity for functional areas of VA (CIDMO divisions, OIT, BA, etc.) to collaborate to achieve outcomes-based projects, rather than projects specific to a particular functional area.
- The Roadmap evolves over time, responsive to changing internal and external context.

The Transition Map Diagram

- The Transition Map (T-Map) illustrates an evolution of people, process, and tooling from the Current Environment to Future State.
- It is representative of only key activities and milestones, relying upon the companion roadmap document providing a more comprehensive and complete narrative of all objectives and activities.
- This evolution is accomplished over time in a deliberate, measured, and phased manner with activities and milestones coordinated within and across, the people, process, and tooling dimensions.
- Each phase advances the maturity and capabilities of the organization towards a Learning Health System, recognizing that aspects of some phases will span fiscal years.

i-VA Blueprints
VA Health Capabilities Transition Roadmap



Current Environment

- Healthcare delivery in the VA, and the US in general, suffers from significant loss of coherence, quality, and consistency in health service as silos of excellence are separately attacking their own challenges. In many cases this leads to redundancy of effort, divergent approaches, or results in significant gaps in system performance.
- Given the large, distributed nature of VHA and its beneficiaries, staff in a broad range of clinical, administrative, and support roles are utilizing many different systems with varying levels of capability maturity.
- Clinical Practice standards are designed from the clinical domain perspective, and no one is accountable for designing practice standards from the Veterans perspective
- The Current Environment text box of the Transition Map highlights some of the challenges that limit VA’s ability to support a “Learning Health System”.

Future State

- It is VA’s intent to focus is on ensuring our health information systems (people, process, and technology) support the delivery of safe patient care and positive health and experience outcomes for our Veterans / beneficiaries.
- This will be achieved by collaboratively leveraging the many skillsets and competencies across offices and divisions to solve the current limitations of the system through improved performance by health service delivery teams.
- The Future State Text Box elaborates on the achievements, competencies, and capabilities necessary for EA to evolve to be a highly reliable Learning Health System

Objectives of each phase

Phase 1 The baseline for the Transition Map, this phase is centered around assessing service competencies, determining potential gaps in the portfolio, and establishing the reusable artifacts in VA’s inventory. Existing assets be coordinated to deliver solutions for pilot initiatives. Priorities for this phase are the consistent, repeatable processes such as triage activities, identification of required competencies, request tracking, traceability, measurement, and execution supporting business needs and objectives.

Phase 2 The next phase activities build upon the success, adjust to address challenges, and recognize opportunities as they arise. The principal objective is to evolve from a CMMI Level 3 operating capability (consistent and repeatable) to begin to incorporate monitoring and quality improvement activities, enhancing efficacy, efficiencies, and impact. This results in increased quality of work products, reduced duplication of effort, and increased quality of performance by people, processes, and tools.

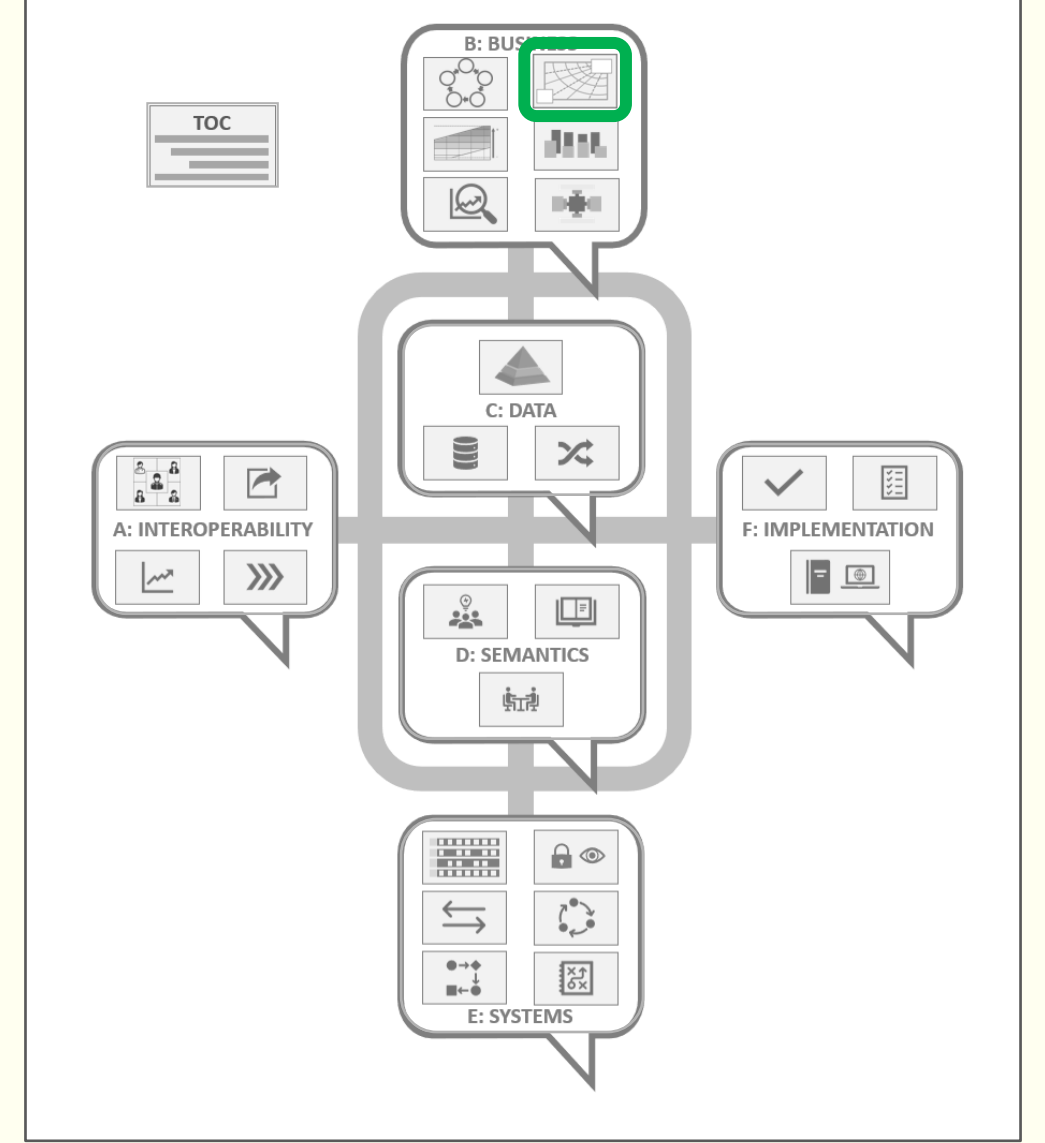
Phase 3 This phase marks the transition from operational efficiencies and consistency toward a pro-active and anticipatory stance. Having achieved Consistent, Repeatable, Measurable, and Continuous Improvement in the applied leverage of Clinical Informatics in VHA and VA with demonstrated Veteran impact. This phase elevates the discipline of informatics, demonstrating its value to the VA as a vital contributor to holistic solutions.

Beyond Leveraging earlier successes and learnings, subsequent phases are focused on optimization of Service Delivery through use of effective Health Informatics will see the VA realizing its aspiration to be a High Reliable Organization and Learning Health System

Myth	Reality
 VA goals are accomplished by each division focusing on their functional role and core competency	VA can only realize it’s vision and goals if the competencies collaborate holistically and interactively.
 Success is achieved through ensuring projects are executed within a fiscal year budget and timeline.	While good project management is always necessary, success is accomplished as the result of a number of coordinated projects.

Glossary of Terms	
Term	Definition
CDS	Clinical Decision Support
COTS	Commercial Off-The-Shelf
FHIR*	HL7 Fast Healthcare Interoperability Resources
LHS	Learning Health System
MedRec	Medication Reconciliation
HRO	Highly Reliable Organization
T-Map	Transition Map
EHRM	Electronic Health Record Modernization
BPM+	Business Process Modeling + Health
CIDMO	Clinical Informatic and Data Management Office
OIT	Office of Information Technology

Further Reading	
VA INTERNAL REFERENCE	
VA Health Capabilities Transition Roadmap	
CIDMO Divisions intranet sites	
VA PUBLIC REFERENCE	
VA Health Information Strategic Plan 2022-2026	



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System:	i-VA Blueprints	
Drawing:	Transition Roadmap	PAGE B-2

Page at a Glance

The VAIL Interoperability Framework and Maturity Model explores multiple key dimensions of team and institutional capabilities expected at stratified levels of maturity.

By enumerating expectations and representative skills and behavior, it allows projects and offices to determine their current state and to improve their overall efficacy and impact, by:

- Assessing current support for interoperability across the VA offices and departments that have an enabling role.
- Guiding strategic planning, the definition of goals, and the realization of intended outcomes.

Interoperability Framework

Interoperability is an overarching discipline that manifests in several different areas.

- **Data and Information:** Considers the meaningful exchange of information across systems and organizations. When speaking of interoperability, this is generally the implied area of focus.
- **Business Interoperability:** Considers operational needs, policies, culture, and other capabilities that must interoperate to fulfill mission objectives.
- **Systems and Technology:** Considers the IT and other technical elements of interoperability, such as transport protocols and infrastructure.
- **Shared Tenets:** Considers a foundation of principles, standards, and governance. These are represented by the foundation in the Interoperability Framework diagram.

Interoperability Maturity Model (IMM)

The Interoperability Maturity Model was developed by the VAIL team to serve both as a reference and tool for the assessment and advancement of institutional, program, and project capabilities. It is loosely based on the CMMI Institute’s Capability Maturity Model (ISACA CMMI), which defines the layers of the model.

There are several items of note in the IMM diagram:

- Phases (along the bottom) are not strictly bound to time but reflect an overall progression as capabilities mature.
- There is an expectation that as capabilities grow, the minimum viability within the organization advances. The result is that the “floor” of capability continues to elevate.
- There is no expectation that reaching the Optimized maturity level (Level 5) is necessary for all functions.
- Although considered independently, there are cross-topic dependencies among each of the dimensions of the IMM.
- The IMM pairs with a detailed assessment checklist that elaborates on each of the topics and can be used to evaluate program maturity.

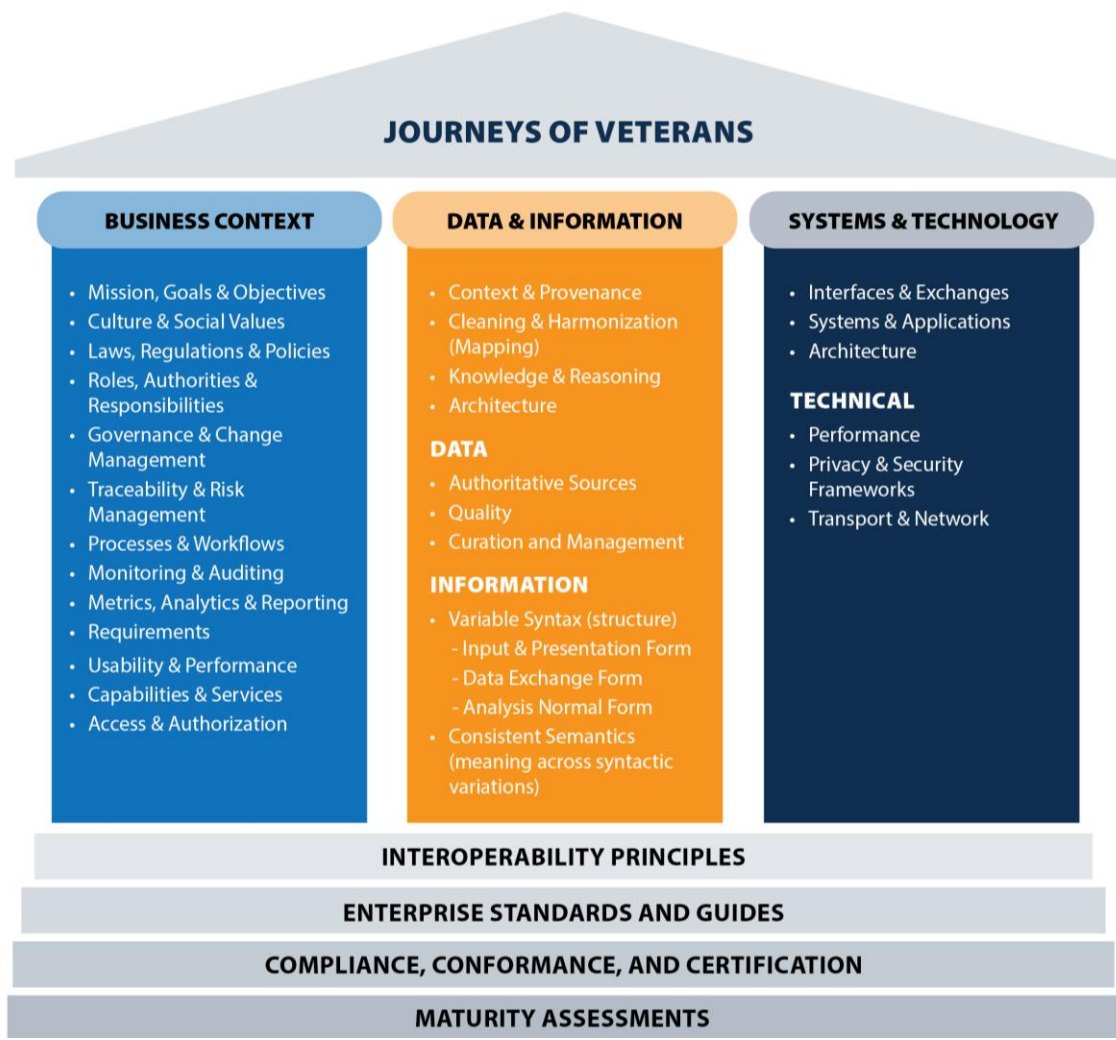
i-VA Blueprints

Interoperability “Maturity”

Introducing the Interoperability Framework and Maturity Model



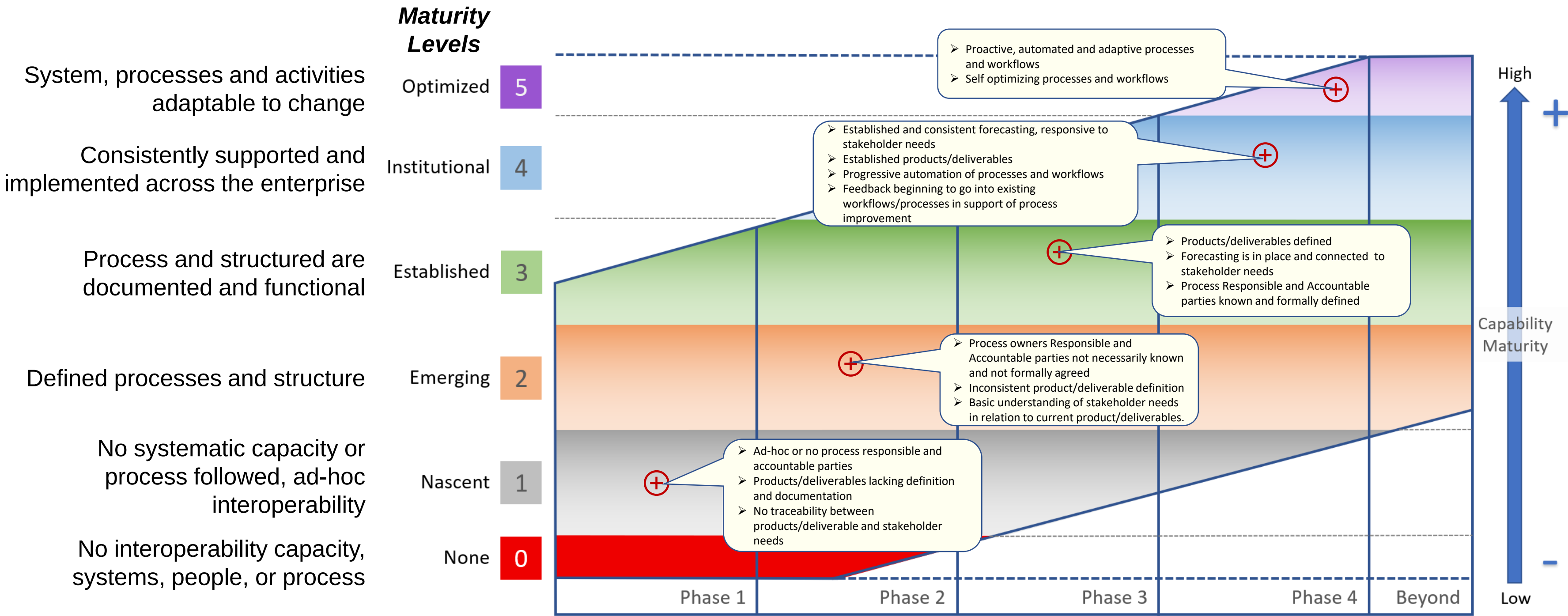
VAIL Interoperability Framework



Explaining the Framework

- The framework identifies three core areas that serve as “pillars” of interoperability
 - Business Context
 - Data and Information
 - Systems and Technology
- Each pillar has identified capabilities enumerated into sub-areas and supported by a maturity model
- The pillars are “supported” by crosscutting concerns, such as interoperability principles, standards, and compliance programs
- While pillars address specific elements of interoperability, there are cross-dependencies among the topics, driven by business and operational needs

Interoperability Maturity Model (IMM)



Example: Business Pillar > Processes and Workflow Maturity Criteria

What is within the Interoperability Maturity Model Diagram?

- Stratification of interoperability maturity, designated as levels of increasing capability
- Characteristics indicative of interoperability capability for each maturity level
- Progression over time showing impact on an organizational journey
- Specific indicator points within the graphic with exemplar behaviors or indicators
- Elevating “floor” over time indicating advancement of the market and increasing expectations

Rationale for considering Interoperability Maturity

- Veterans expect seamless experiences across VA programs, and VA- and non-VA services, something achievable only through effective interoperability
- What is expected of an “interoperable” system changes over time
- Skillsets and processes need to mature to keep pace with emerging best-practice
- Objective understanding of our capabilities allows for thoughtful investment in skills, tools, and technologies to meet business challenges
- Programs have interdependencies necessitating interoperability and sharing

Myth Busting

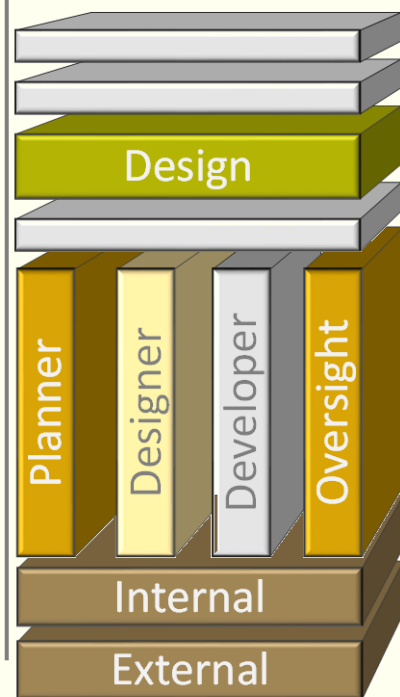
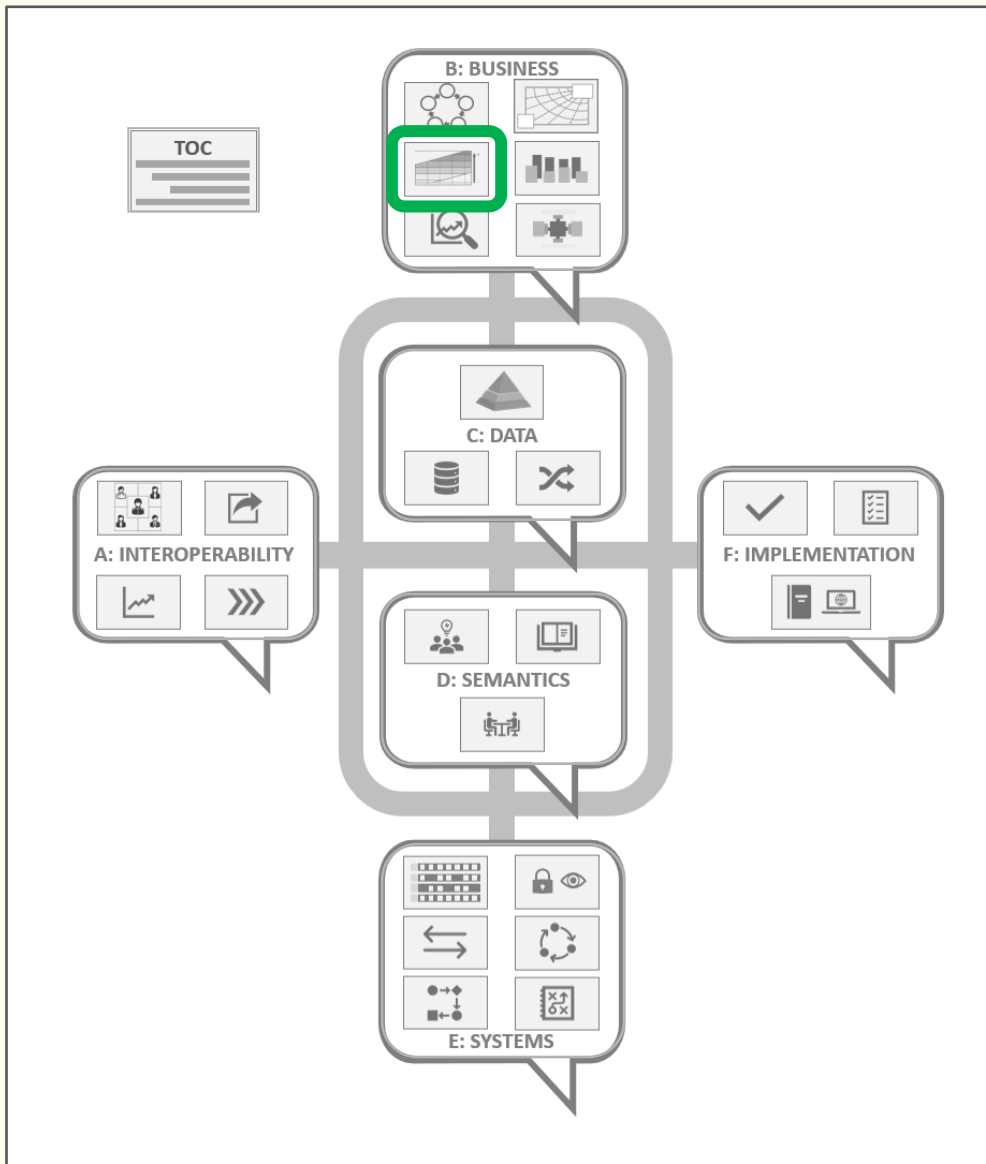
Myth	Reality
Maturity models are largely academic exercises.	A maturity model is intended to accurately assess your project and better understand what is necessary to mature it.
A project timeline is too tight to waste time on something that doesn’t directly benefit the work.	Use of a maturity model may appear counterintuitive, but identification of a key skillset gap or shortfall may substantially benefit project delivery and avert project risk.

Glossary of Terms

Term	Definition
CMMI	Capability Maturity Model Integration
E2E	End-to-End, from start to completion of a process
IMM	Interoperability Maturity Model
VAIL	VA Interoperability Leadership

Further Reading

VA INTERNAL REFERENCE
VAIL Interoperability Framework
VAIL Maturity Model
VAIL Assessment Methodology
VA Interoperability Leadership
VA PUBLIC REFERENCE
INDUSTRY REFERENCE
Capability Maturity Model Institute



Contact:	VHA Knowledge-based Systems	
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Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Interoperability Maturity	PAGE B-3

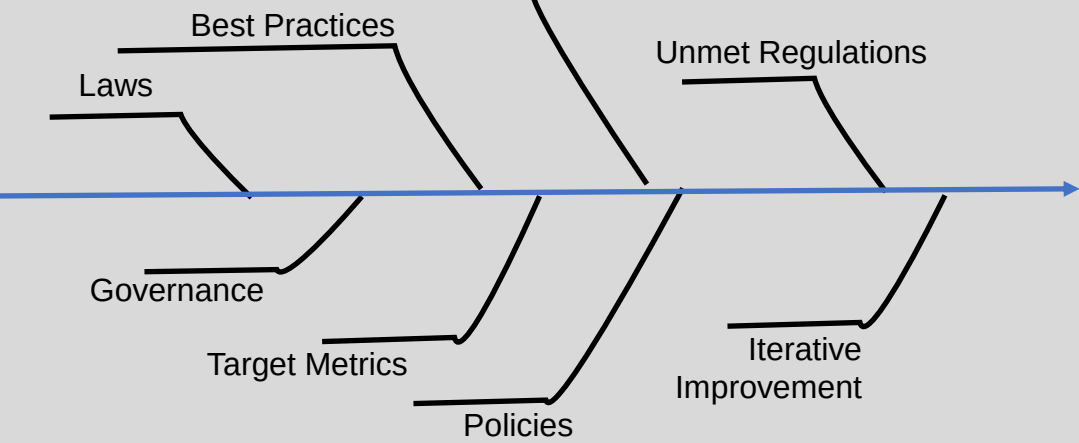
Page at a Glance

- The Interoperability Maturity Model provides a roadmap for improving the Business, Data, and Systems/Technical capabilities to interoperate.
- Each strata presents illustrative examples of the challenges, activities, and capabilities realized at each level of maturity.
- Effective use of these approaches will materially improve capability and capacity incrementally, while striving for an ideal Optimized target state.

Important Concepts

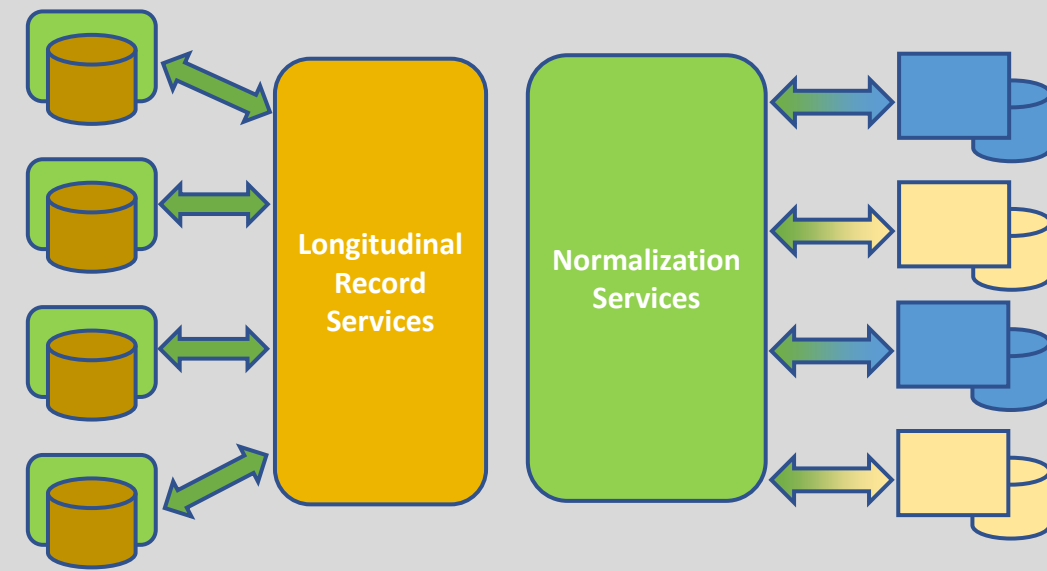
- Interoperability Maturity is a subset within organizational change management.
- The purpose of a maturity model is to advance capabilities and identify improvement opportunities.
- There is no expectation that an organization should fall within “Optimized - Level 5” for everything. Assess cost vs. benefit.

Business Interoperability Transition Spotlight

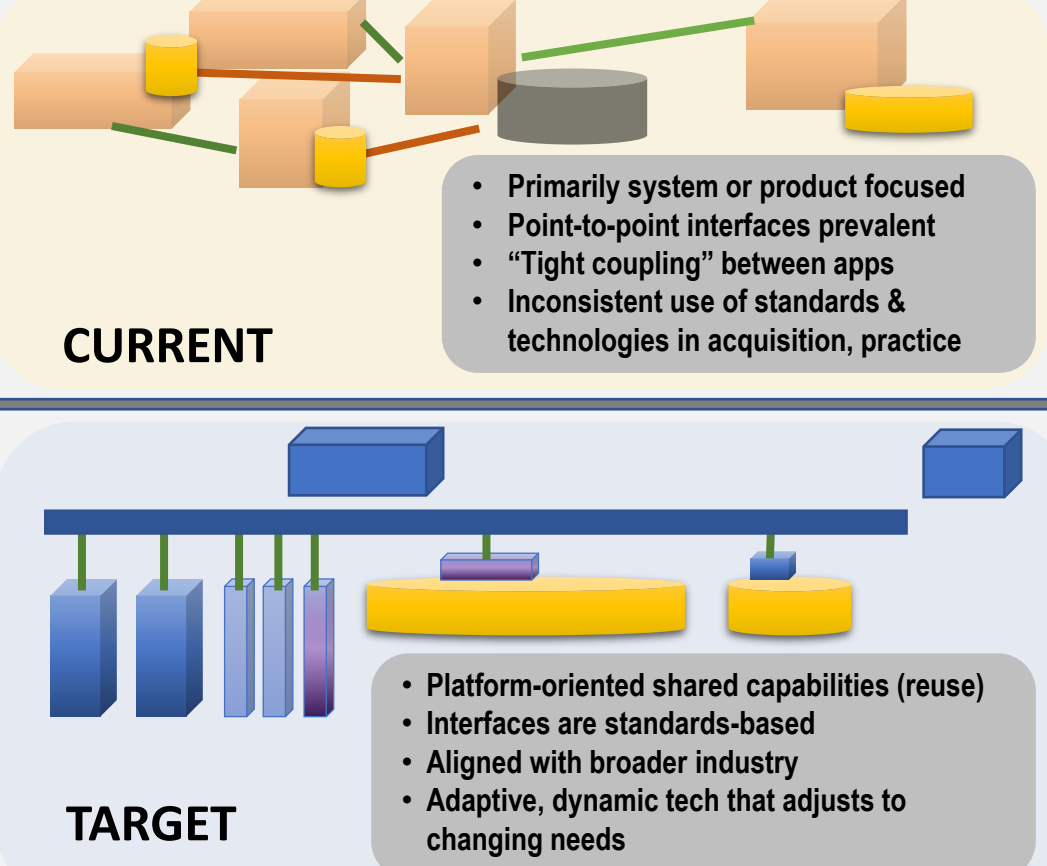


Data Interoperability Transition Spotlight

Data evolves from independent sources and disparate representations toward a canonical set of types, terminologies, and support services leveraged across Enterprise systems.



Technical Interoperability Transition Spotlight



i-VA Blueprints

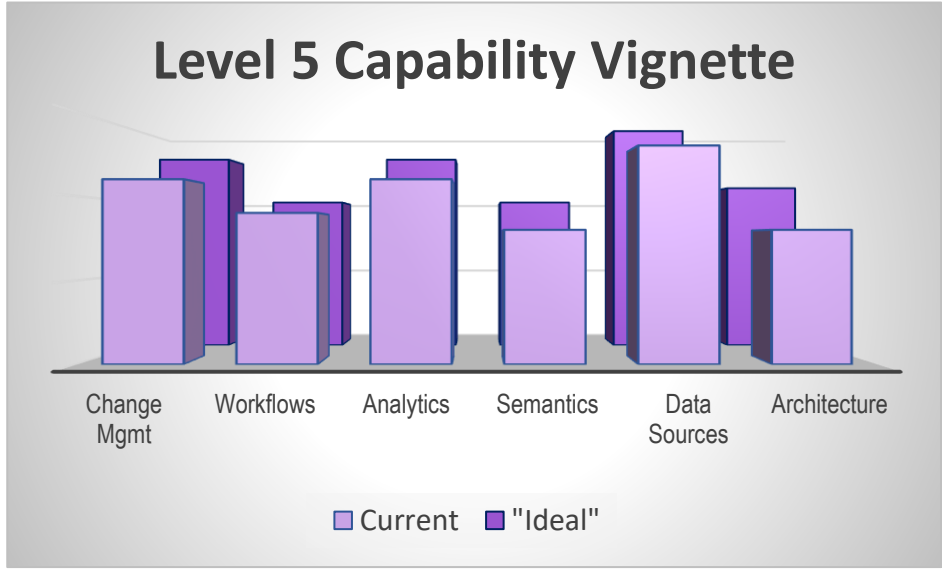
Improving Organizational Interoperability Maturity



Organizational Challenges/Level 5

- Seamless availability and use of both internal and community-sourced data.
- Continuous agility and effective adoption of emerging best practices.
- Seamless “swappability” of technology solutions and components.
- Reducing time from research to practice.
- Ability to apply and positively impact population-based wellness and outcomes.

Optimized 5



Activity Highlights

- Culture and emphasis on incremental service delivery and quality improvement
- Seamless experience driven by beneficiary preferences and engagement
- Analytics-driven quality improvement based upon longitudinal and contextual data
- Business needs supported via dynamic chaining of technology platform components, including AI/ML
- Infrastructure to support HRO

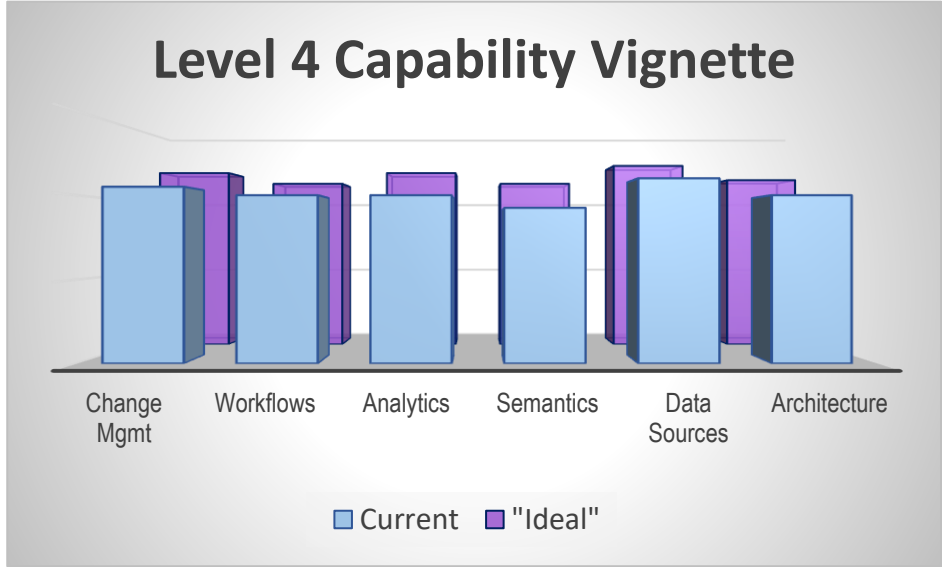
Capabilities Realized

- Capacity exists to adopt improvement initiatives rapidly and effectively.
- Conformance to interoperability standards at a sector level; “inter-organizational interoperability”.
- Shared data assets loosely coupled to applications, available at point-of-need.
- Substantial organizational agility in adopting new business practices and workflow models.
- Dynamic use and orchestration of IT based on situation and context.
- Seamless beneficiary experience across systems, sources, technologies.

Organizational Challenges/ Level 4

- Assuring consistency in adoption of policies, processes, and IT across an enterprise.
- Advancing ‘late-adopters’ to reach capacity of organizational baseline.
- Elevating and sufficiently staffing governance and compliance activities.
- Pivoting emphasis from capability development toward capability improvement.
- Strengthening operational efficacy with external/collaborating organizations.

Institutional 4



Activity Highlights

- Systematic measurement in place to identify and remediate interop problems
- Established, consistent approaches for org change management and adoption
- Consistently incorporate data best-practices into acquisition activities
- Adjust data use and policy based upon deployment experiences
- IT governance assures authoritative APIs and system source utilization
- Use of and planned roadmap maintaining currency with industry standards

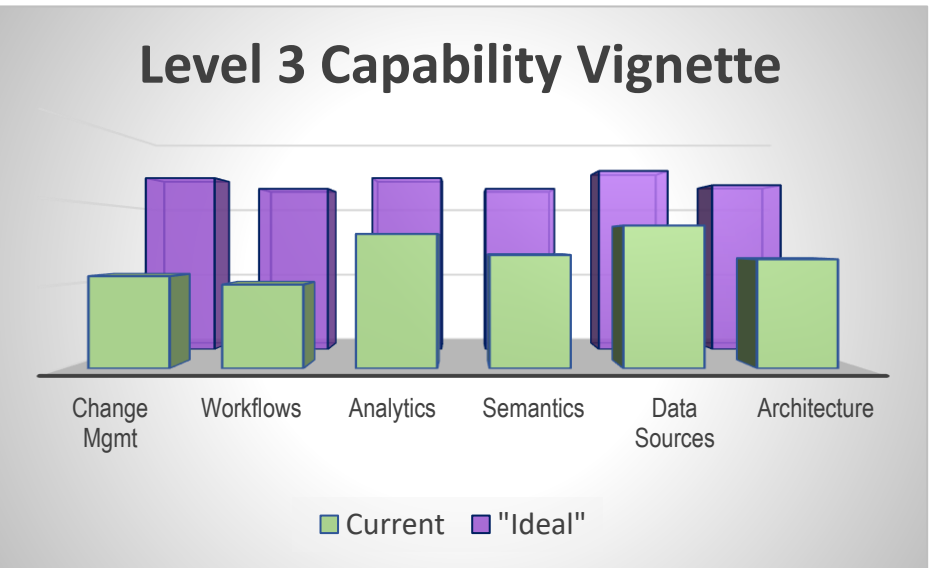
Capabilities Realized

- Uniform methodologies for E2E interop planning, execution, and implementation.
- Architecture patterns with interoperability addressed explicitly.
- Conformance to sector standards within the enterprise, with consistency in structured concept representation.
- Ubiquitous use of consistent data representations and shared semantics.
- IT portfolio aligned with business needs and without sharing barriers across systems.

Organizational Challenges/Level 3

- Transforming data into targeted set of representations and semantics.
- Providing infrastructure to support consistency and quality in care across sites.
- Aligning IT to better support business workflows and process improvement.
- Atrophy use of non-authoritative data sources; eliminate unplanned redundancy.

Established 3



Activity Highlights

- Instituting policy to promote and advance interoperability consistently across Enterprise
- Promote culture of sharing and reuse
- Data mapping, ETL, and scrubbing activities underway
- Metadata mgmt improving to include provenance for internal and external data
- Transition out of direct data access and point-to-point interface to APIs underway
- Select project use of industry software constructs (ref. implementations, profiles)

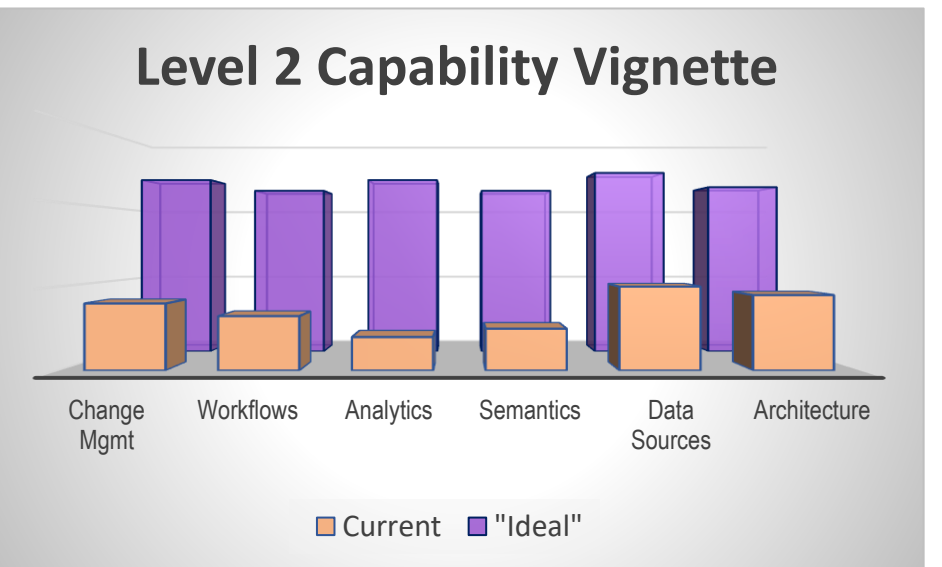
Capabilities Realized

- Selective, growing use of standards-based interfaces and representations.
- Info services provide read access to external systems and mobile apps.
- Institutional culture recognizes need to use authoritative sources
- Conformance assurance largely rests on project team; growing governance
- Progressive project-based conformance to sector standards for interfaces and terminology.
- Limited consistency in data semantics.

Organizational Challenges/Level 2

- Reliance on legacy point-to-point interfaces.
- Inconsistent data representation and meanings.
- Duplicative data sources contain inconsistent data.
- Workflow and processes not well supported by IT; focus on work-arounds.
- Organizational change management is arduous and labor intensive; non-agile.

Emerging 2



Activity Highlights

- Identify key stakeholders, their needs, and policy implications or barriers
- Identify and address resource and skillset gaps
- Identify authoritative data sources, owners
- Determine preferred coding systems, terminologies, data types
- Determine data quality gaps, concerns
- Define preferred interface protocols
- Leverage use of industry standard APIs
- Establish governance program, oversight

Capabilities Realized

- Growing availability of interoperability guidance influencing implementation and acquisition activities.
- Information being exchanged in select circumstances, generally via paired systems exchanging information.
- Use of proprietary interfaces or interfaces based on locally modified standards.
- Awareness of data consistency and duplication efforts; formative work to establish authoritative sources and representations.

Myth Busting

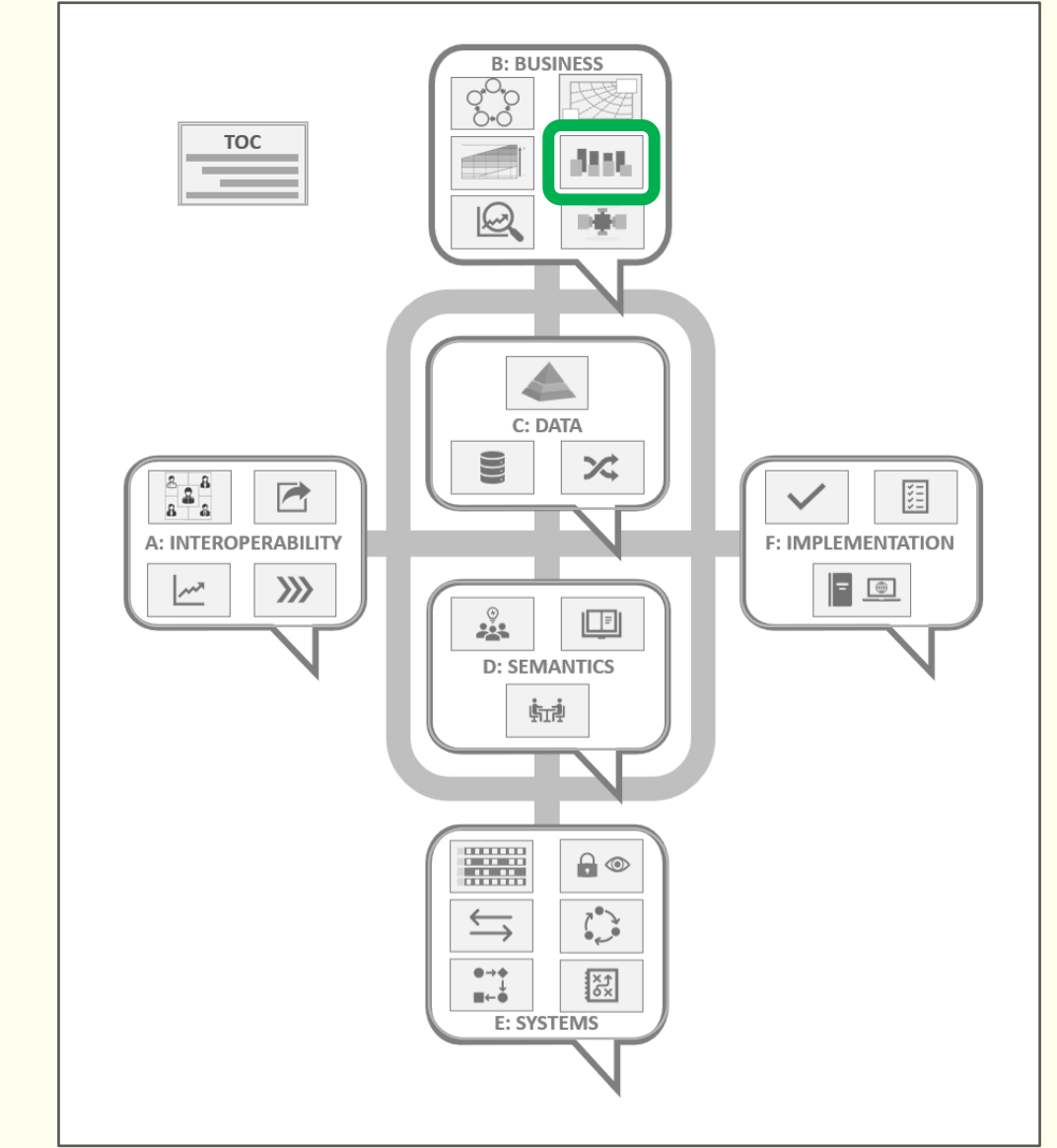
Myth	Reality
The challenge in organizational transformation is getting to an ideal state.	Each capability needs to be determined separately, and “ideal” is not always the right target.
The principal focus in achieving interoperability is the exchange of data.	While data has been an early, dominant focus, the need for business and technical interoperability is just as prevalent.

Glossary of Terms

Term	Definition
AI	Artificial Intelligence
API	Application Programming Interface
ETL	Extract, Transform, and Load
E2E	End-to-End, from start to completion of a process
ML	Machine Learning
RPC	Remote Procedure Call
HRO	High Reliability Organization

Further Reading

VA INTERNAL REFERENCE
VAIL Maturity Model
VA Health Capabilities Transition Roadmap
VA PUBLIC REFERENCE
VA Data Strategy
VA Strategic Plan FY 2022-28
VA Enterprise Roadmap 2020-2026
VA Health Information Strategic Plan 2020-2026
INDUSTRY REFERENCE

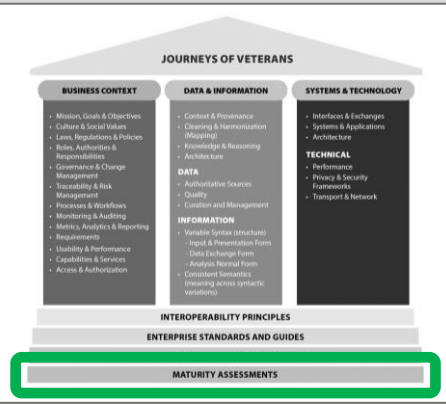


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Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Improving Organizational Interoperability Maturity	
		PAGE B-4

At a Glance

- This page describes:
- The VAIL approach to describing the various stages of the Interoperability Maturity Model
 - How the maturity model is used to assess current support for interoperability across the VA offices and departments that have an enabling role
 - How the maturity assessment guides strategic planning and the definition of goals, and the realization of outcomes.

VAIL Maturity Assessment Concept



To enable the right information and services to securely and reliably reach the right person at the right time in the best manner...

- Interoperability ties IT capabilities together across the VA enterprise to serve the Veteran most effectively
- Measuring maturity helps gauge how well VA is accomplishing the objective of more effective service
- Maturity assessment considers the business and organizational environments, data and systems
- Assessment process identifies areas for action
- Periodic reassessment confirms what areas have been improved and what gaps remain

Interoperability Maturity Assessment Criteria

- Based on a modified CMMI approach
- Each pillar of the interoperability framework has many elements that need to be assessed
- Assessment is a facilitated Q&A process to determine current state of support for interoperability
- Criteria for each level of maturity (1 through 5) for each interoperability element is applied.

Maturity Evaluation - Launch Point for Planning

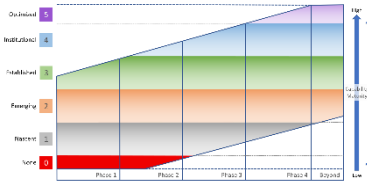
- Maturity levels and recommendations are the basis of the assessor’s report
- Recommendations are made to help the program advance interoperability for each framework element
- Findings and recommendations are shared with the OTI team and the business owner
- If a roadmap is to be built, it will be based on recommendations
- Interoperability SMEs work with business owner to determine what will be put onto the roadmap and in what fiscal year each milestone will be met

i-VA Blueprints

Assessing and Maturing Enterprise Interoperability



Assessment Approach

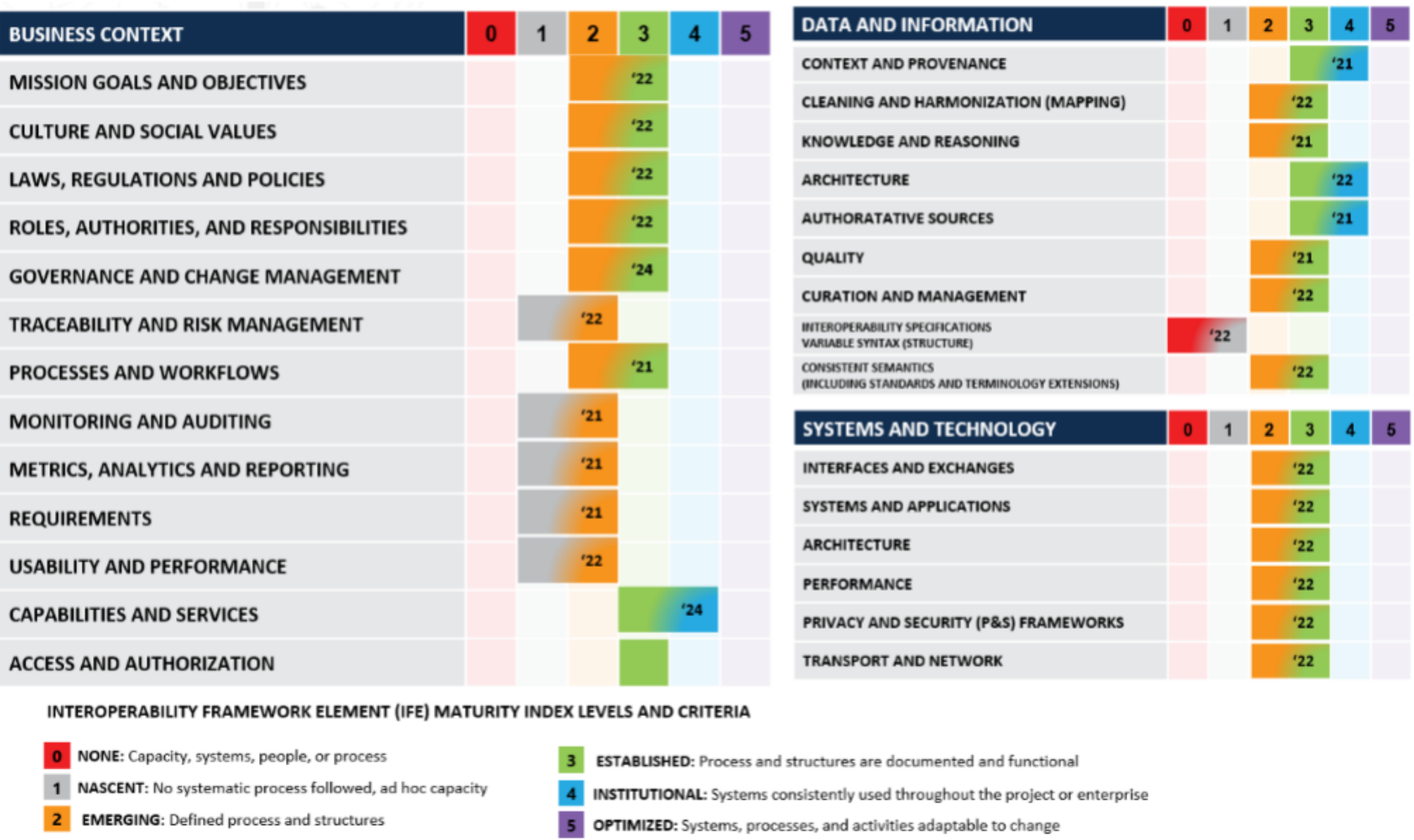


- 1 • Use Case Assessment Intake
- 2 •Use Case Engagement and Information Gathering
- 3 • Interviews and Data Collection
- 4 • Analysis and Maturity Level Scoring
- 5 • Sustainment & Closing
- 6 • Reassessment

- Outlined is a stepwise process for assessing program interoperability maturity
- Objective is to determine current, state, identify improvement opportunities
- While illustrated linearly, the re-assessment step results in an iterative refinement approach
- Goal is to enhance interoperability across programs

Interoperability Maturity Questions - Samples

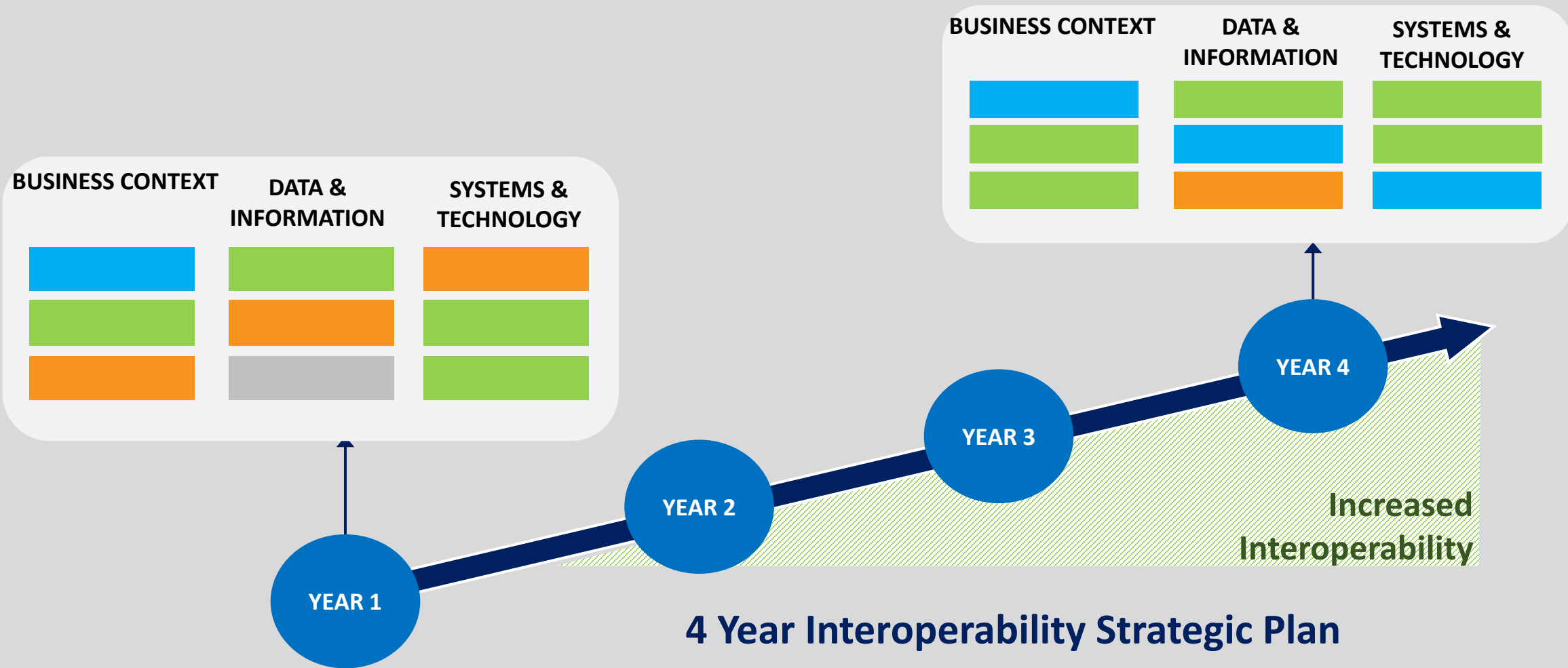
- **Business processes and foundation:** What *supporting elements* for interoperability are in place? (documents, processes, and culture)
- **Process Depth:** How *thoroughly* do the supporting elements reinforce the development of interoperable workflows and products?
- **Process Uniformity:** How *consistently* are these supporting elements used? Are they applied at the outset of projects or attempt to be retrofitted later?
- **Success Gauges:** How *satisfactory* are the outcomes? Can they be measured? Do they meet the need?
- **Continuous Improvement:** How well do the program’s interoperability processes meet current and adapt to meet evolving needs? Does an improvement process exist? Does the organization adopt and contribute best practices to the enterprise?



Assessment Findings Explained

- Major categories of consideration align to the VAIL Maturity Framework
- Each topic/theme elaborates the corresponding Framework pillar and is scored
- The scoring bar indicates the starting “position”, intended target state, and anticipated date
- Note that target transition state varies in time & maturity

Maturity Assessment Guides Strategic Planning



- The strategic plan illustrates the evolution from current state (Year 1) to target state (Year 4)
- Color indications depict advancement progress toward intended interoperability maturity
- This depiction can be annotated to include key enabling activities or milestones

Myth Busting

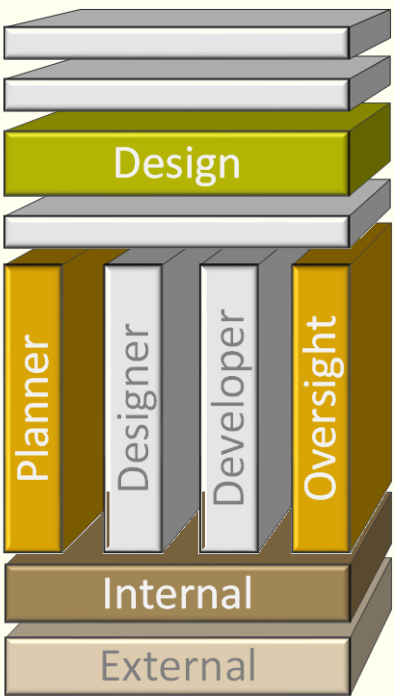
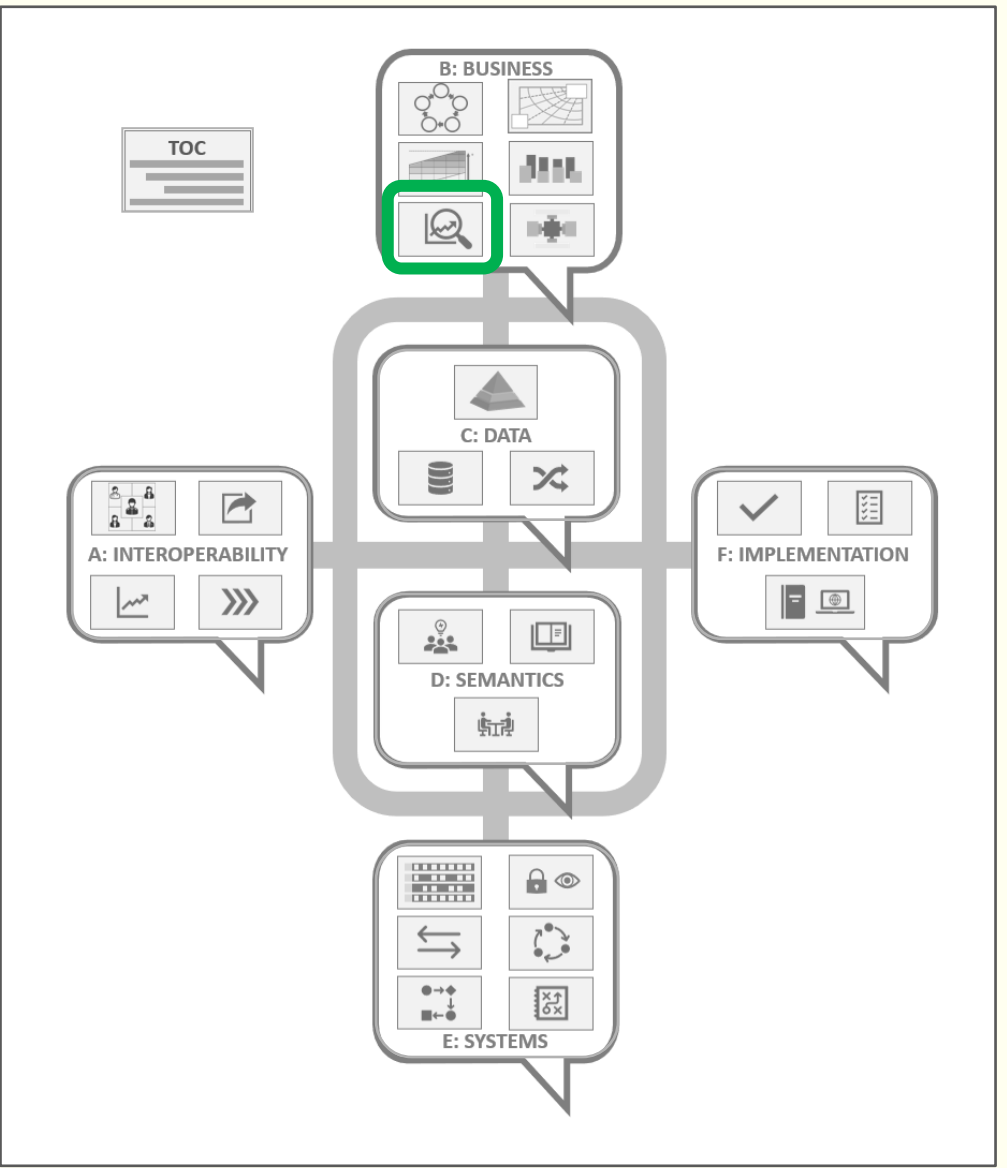
Myth	Reality
The principal value of interoperability assessments is as part of an enterprise Governance activity	While governance and advancing consistent delivery is important, these assessments help identify risk areas impacting product efficacy & program delivery.
The ideal target state for maturity activities should be “Level 5” so as to optimize VA delivery.	Not all capabilities require Level 5 maturity, or may not be cost-effective, or bring substantive incremental value.

Glossary of Terms

Term	Definition
VAIL	VA Interoperability Leadership
CMMI	Capability Maturity Model Integration

Further Reading

VA INTERNAL REFERENCE
VAIL Assessment Methodology
VAIL Maturity Assessment Change Control
VAIL Interoperability Strategic Plan
VA Interoperability Leadership
VA PUBLIC REFERENCE
INDUSTRY REFERENCE
Capability Maturity Model Institute



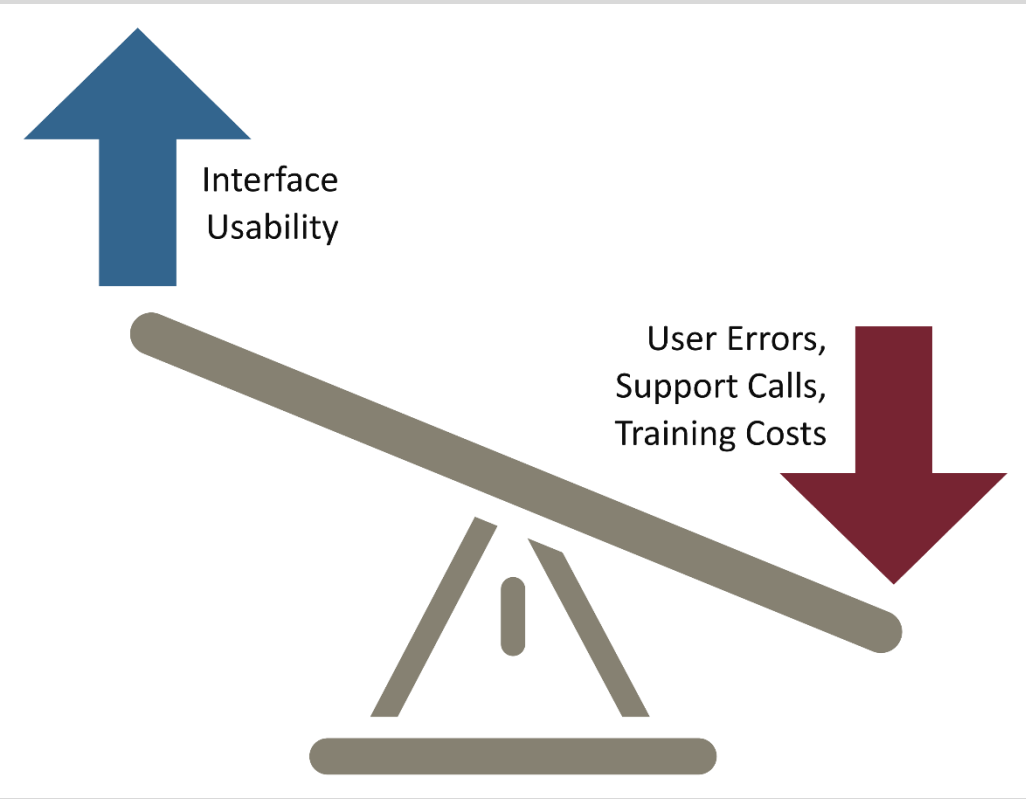
Contact:	VHA Knowledge-based Systems	
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Assessing Maturity	PAGE B-5

At a Glance

- Early engagement provides
 - Minimal cost with high impacts
 - Low risk with high rewards
 - Low burden with high business value
- Optimizes the effectiveness, efficiency and satisfaction for systems
- Well-suited to Agile, iterative systems development
- A human-centered mindset; a way of design thinking applied throughout the system life cycle
- A systematic approach for identifying and resolving usability deficiencies early in project development cycles of goals, and the realization of outcomes.

The Value of Human Systems Integration

- Improves efficacy and efficiency by supporting needs of the user
- Reduces errors by integrating human performance into the design of a system.
- Reduces support calls by making systems more understandable
- Reduces training costs by making systems easier to learn and operate

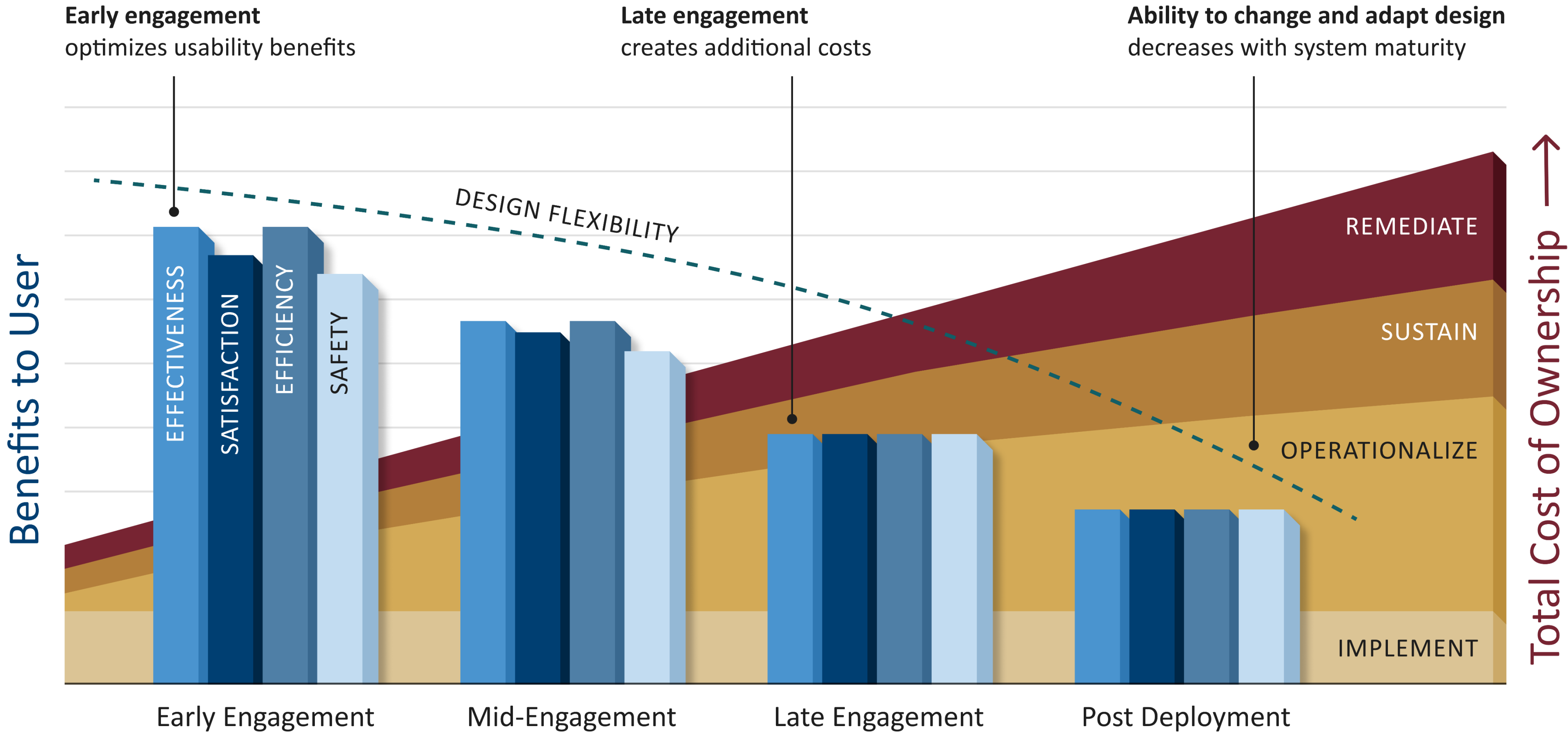


Context

- HSI is the science of designing systems that:
 - Are easy to use
 - Allow users to accomplish their goals effectively
 - Ultimately meet business goals
- HSI is focused on maximizing impact and value of systems that cross the human-computer divide, amplifying capabilities of both.
- Software engineers spend nearly 50% of their time on rework that is avoidable. Early implementation of HSI reduces the need for this rework (IEEE).
- Systems that are easy to use are not easy to design
- Designing systems that are easy to use requires specialized skills, methodologies, and approaches

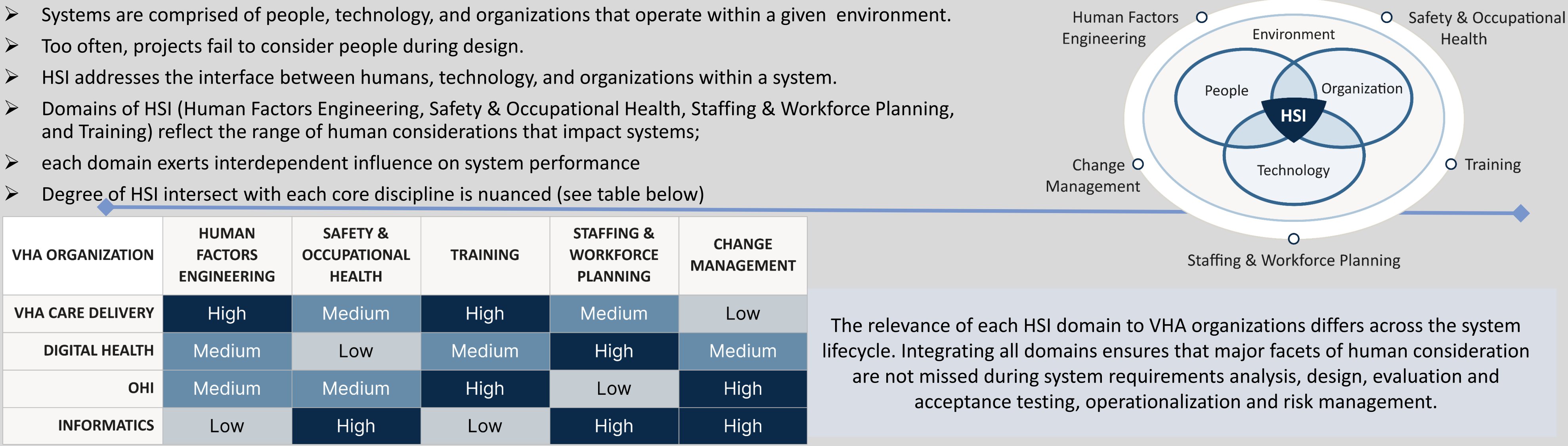
i-VA Blueprints

Human Systems Integration (HSI)



Early HSI Engagement Maximizes Efficacy at Lowest Cost ^{1, 2}

- **Engaging with HSI early allows maximum flexibility** to address usability deficiencies. Enhancements to system effectiveness, efficiency, and safety can be incorporated into the design before the system is fielded, lowering total cost of ownership for the system.
- **As development of the system progresses, design flexibility decreases.** Opportunities to incorporate HSI are diminished, allowing usability flaws to reach users, and increasing the need for design re-work, training, and maintenance



Myth Busting

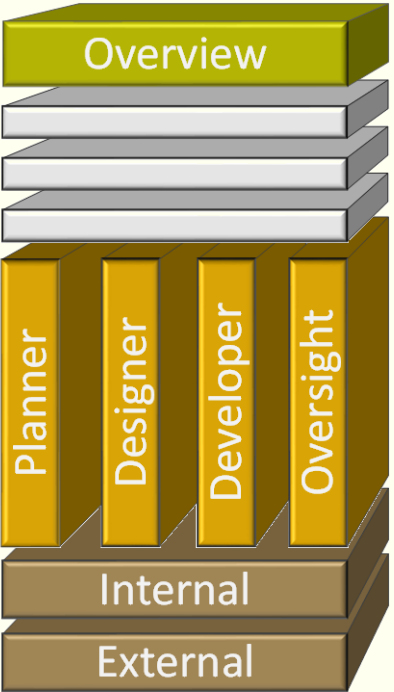
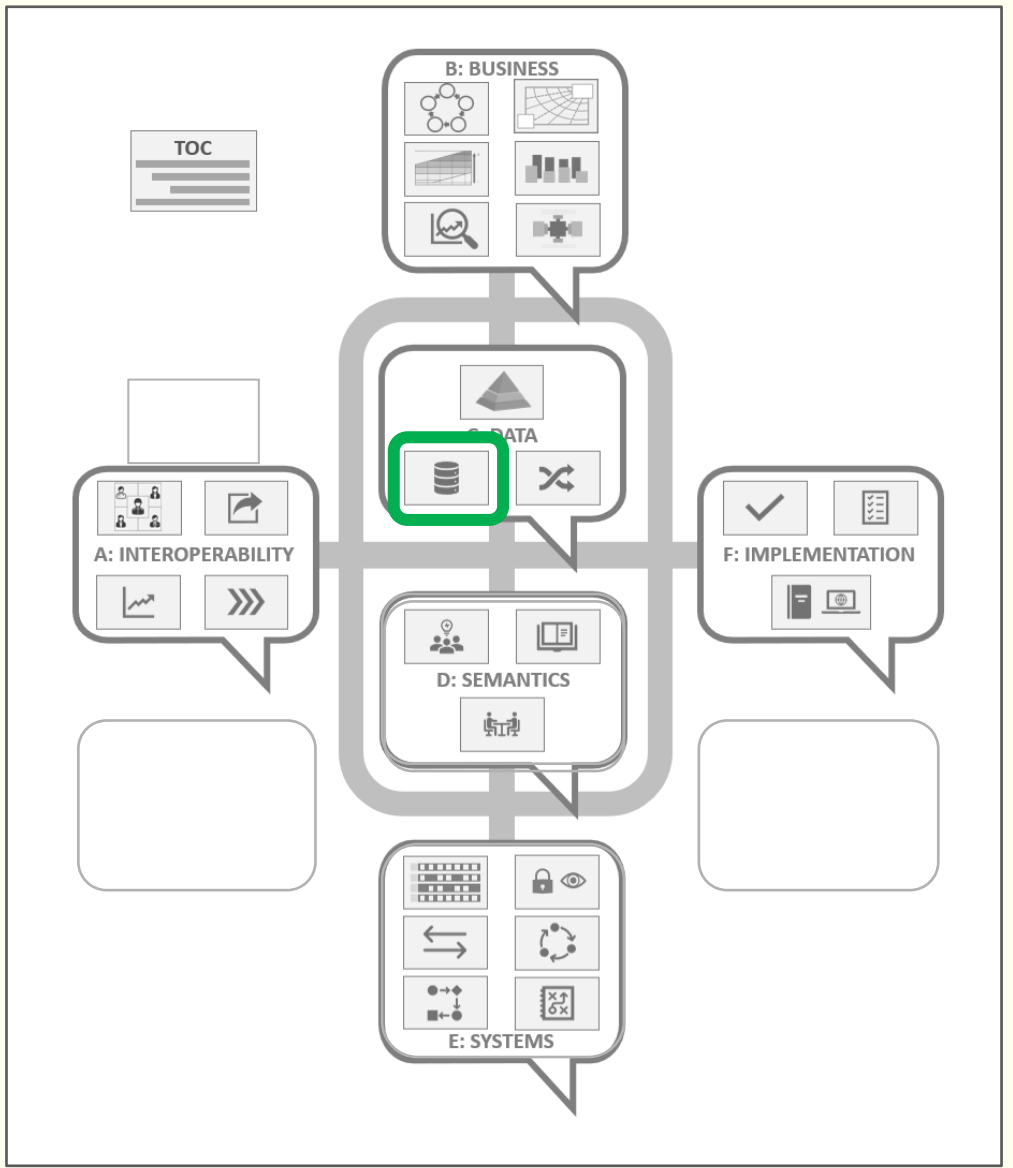
Myth	Reality
 HSI is equally impactful at any time in the system development process	Research shows that the impacts of HSI decreases substantially over the system lifecycle
 Deficiencies in the usability of VA systems can be remedied with training	Research shows that training alone is not sufficient to remedy many safety issues that result from deficiencies in system interfaces
 HSI is common sense	Designers must identify and incorporate different users' mental models and expectations into the system, which may not align with common sense

Glossary of Terms

Term	Definition
HSI	Human Systems Integration (incose.org)
CMMI	Capability Maturity Model Integration
Situational Awareness	Perception of the elements in the environment, comprehension of what they mean and how they relate to one another, and projection of their future states (reference link)
Usability	Ease of access and/or use of a product or website. (reference link)

Further Reading

VA INTERNAL REFERENCE
HFE Effort Tracker Home Page
VA PUBLIC REFERENCE
INDUSTRY REFERENCE
1. Haskins, C., Forsberg, K., Krueger, M., Walden, D., & Hamelin, D. (2006). Systems Engineering Handbook. INCOSE (Vol. 9, pp. 13-16)
2. Nielsen, J. (1994). Usability Engineering. Morgan Kaufmann. 7, 10-13, 24-26.



Contact: Human Systems Interaction (HSI)		
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Human Systems Integration	PAGE B-5

Page at a Glance

- Using VHA as an example, this page illustrates the concepts of business capability decomposition and traceability to shared services.
- Based upon key interoperability concepts such as *separation of concerns*, *service orientation*, and *orchestration*, this page depicts how Veteran services relate to IT and support services, and how APIs and delegation allow for services to work together to fulfill business needs.
- Existing capabilities can be exposed via APIs serving as a façade. One capability can support multiple APIs, thus multiple formats or versions

Important Interoperability Concepts

- **Cohesion** brings like functions together into one service.
- **Interoperability-oriented design** encourages the use of standards any time systems “talk” or “touch”.
- **Separation of Concerns** is an approach to modularizing a system or problem into pieces, each of which has shared interests, objectives, and purpose.
- **Orchestration** is the process of chaining together services or functions together to deliver business value. This can be done the same way each time (static) or adapted based on need (dynamic).

What are shared services?

- Shared services are common functions that can be leveraged across business units and programs.
- They reduce costs by fostering reusability of investments, also improving delivery consistency
- They are accessed via an interface (or API) which binds the services to a service contract.
- Services that use standards-based APIs enhance interoperability by making it easier to invoke by service consumers, and can be readily replaced with better performing alternatives.

Service Structure and Composition

- Typically, several variants of a service are implemented, classified both by the nature of their work and the way they fulfill it.
- Implementing services behind an API allows the underlying system to be adapted or changed without adversely impacting business consumers of that service
- Services are accessed via an API which may be publicly accessible or have a restriction on who may call it.
- The API receives incoming requests and delegates responsibility to parts within the service or to other support services.
- Composite services break requests into smaller pieces and leverage smaller support services to fulfil needs.
- The process of chaining together and managing multiple services working together is *orchestration*.

Service Design Best Practices

- Typically, services are most effective when they do one thing (or a very small number of related things).
- This singular focus allows services to be fine-tuned, optimized, and composable into an integrated set of platform capabilities
- Data is the “cargo” of a service. The service should be the Authoritative Source of the data in its control, and all updates should be managed by the service. This promotes data integrity and consistency.
- Services should be designed to work together.
- Micro-services follow this same approach but are very limited in scope and generally highly scalable.
- Legacy applications can be “wrapped” to appear as services (i.e., one system can be “hidden” behind multiple service interfaces). This is particularly useful for legacy modernization approaches.

i-VA Blueprints

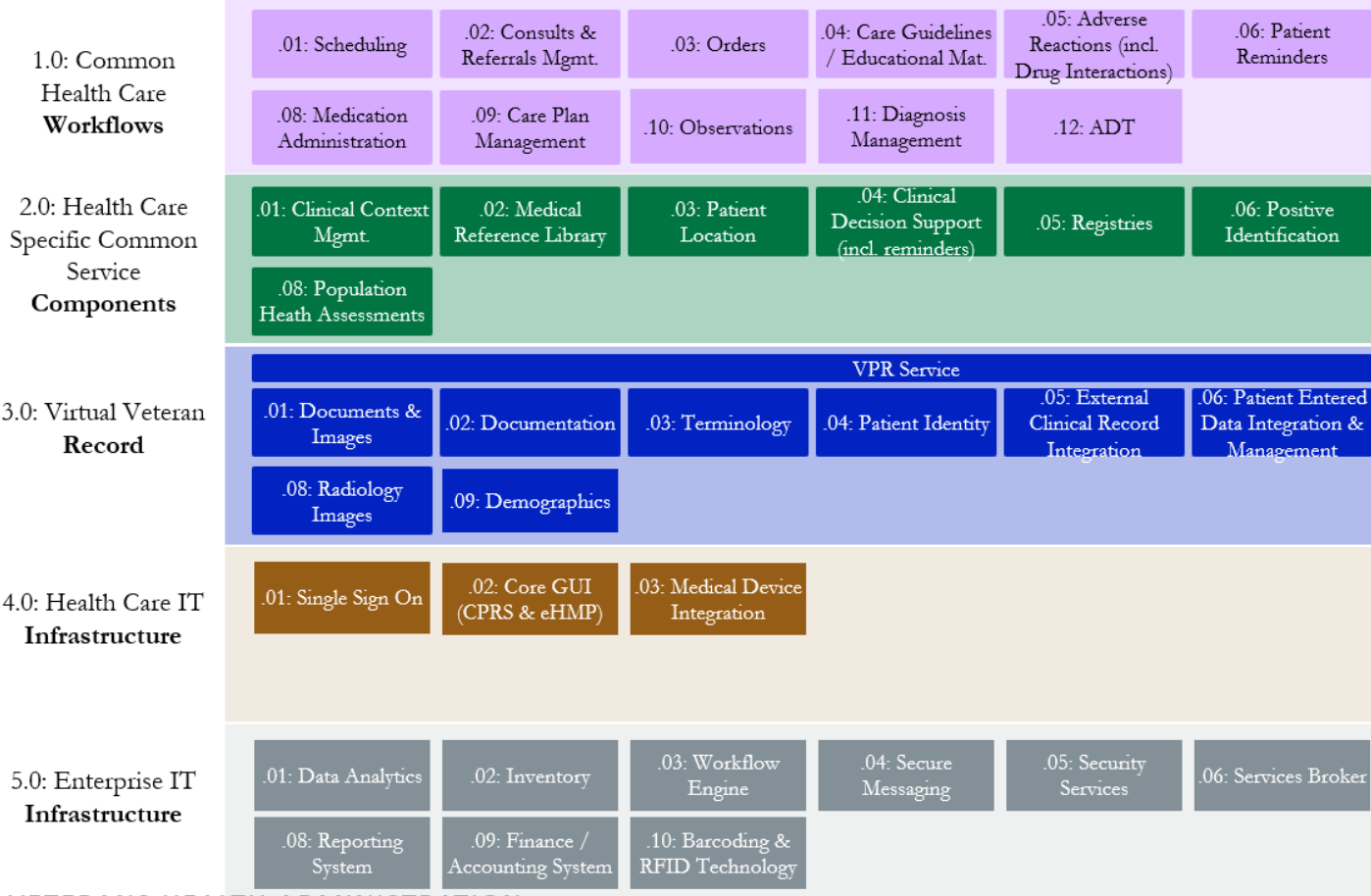
Capabilities, Services, and Components

Functional Interoperability, Service Design, and APIs



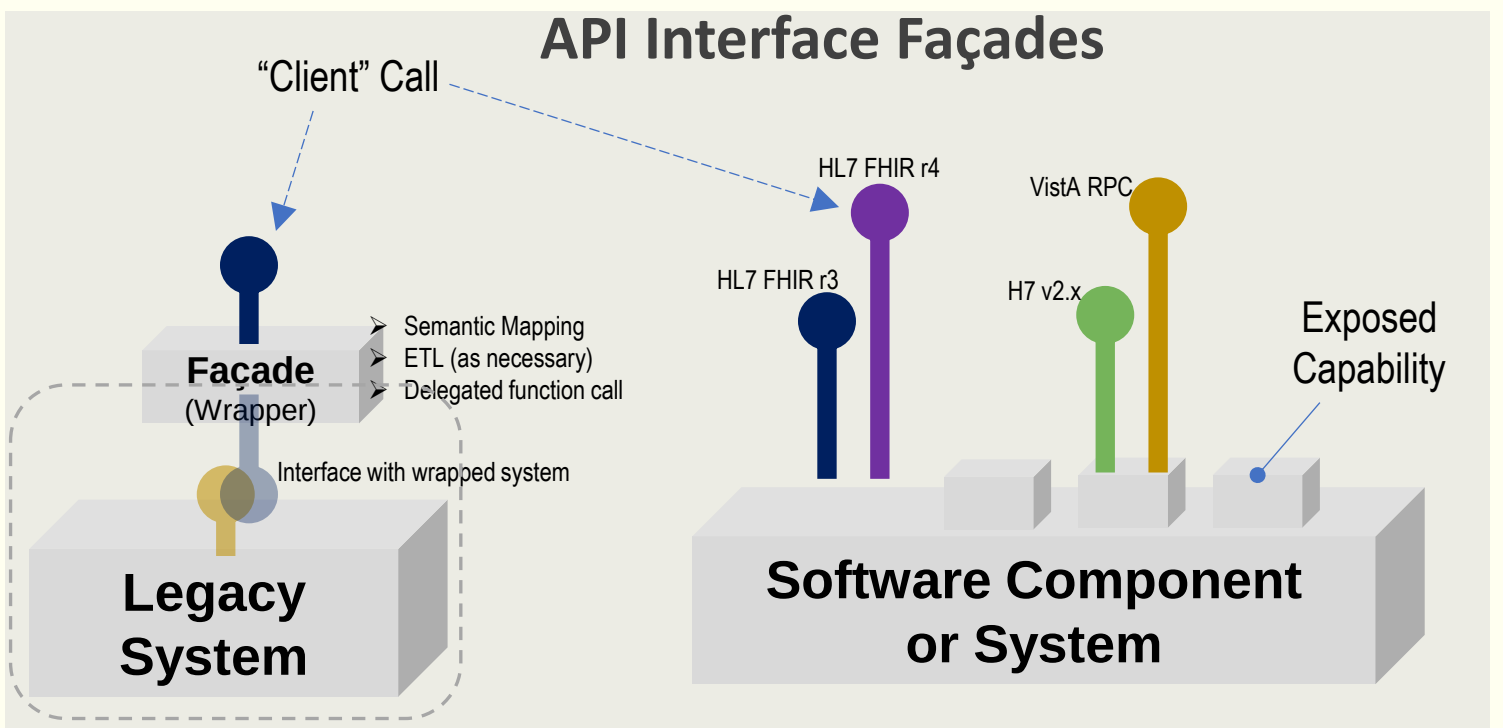
VHA Service Perspective

These Services are the mechanisms by which VHA achieves its Capabilities and form a Perspective into the Business Architecture.



Items to Note

- VA Services often relate to multiple distinct capabilities
- The way VA systems interact with services is via a [systems] interface, which exposes the capabilities and what is being shared
- Services and capabilities can be chained together to solve complex needs
- “Orchestrating” services can dynamically adjust complex chains based upon situational need
- Service can be composed into “bigger” functions, or broken apart into smaller component parts as needed
- Legacy applications can be “exposed” as services (e.g., an approach that can be leveraged for EHRM)



The above illustrates a pattern for exposing specific functional capabilities, making them accessible to Enterprise consumers is a façade. A few items of note:

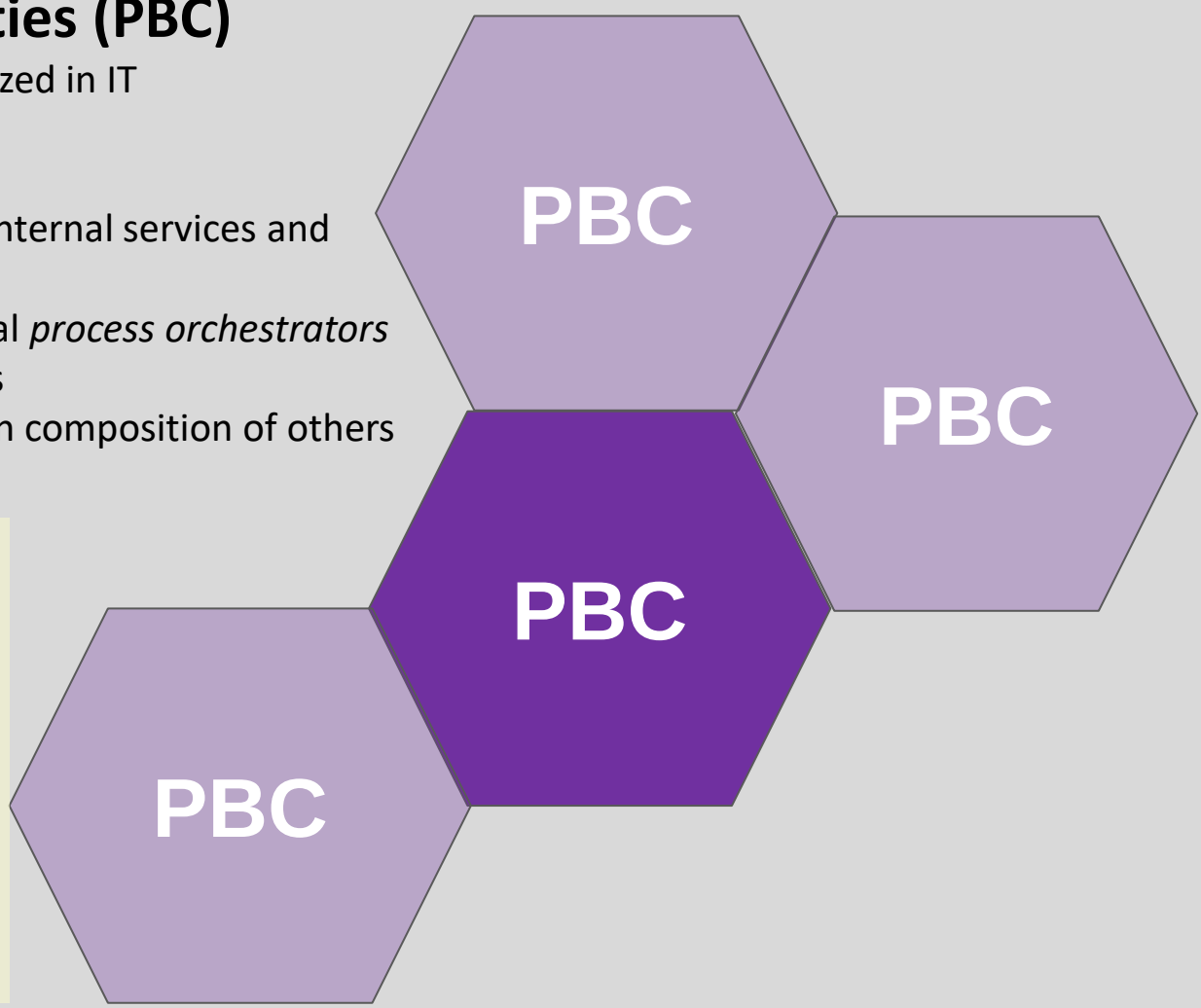
- One component can provide multiple capabilities/functions
- There can be more than one interface into a capability
- Interfaces may be proprietary or standards-based (e.g., FHIR)
- Multiple versions of an API can be supported concurrently
- APIs can be native to a component, or disintermediated via a “wrapper” layer

Packaged Business Capabilities (PBC)

- Allows for business functions to be realized in IT
- Each function is “cohesive” in nature
- Capabilities are Composable
- Capabilities are autonomous and have internal services and requisite data
- Functionality exposed allows for external *process orchestrators*
- APIs exposing the functional capabilities
- New services can be created based upon composition of others

Implications

- Business capabilities can be dynamically restructured to adapt to changing needs
- Can use 3rd party orchestration
- Enhances maintenance possibilities due to encapsulated functionality
- Dynamic scalability based upon each capability
- Clearer line-of-sight between business and technology

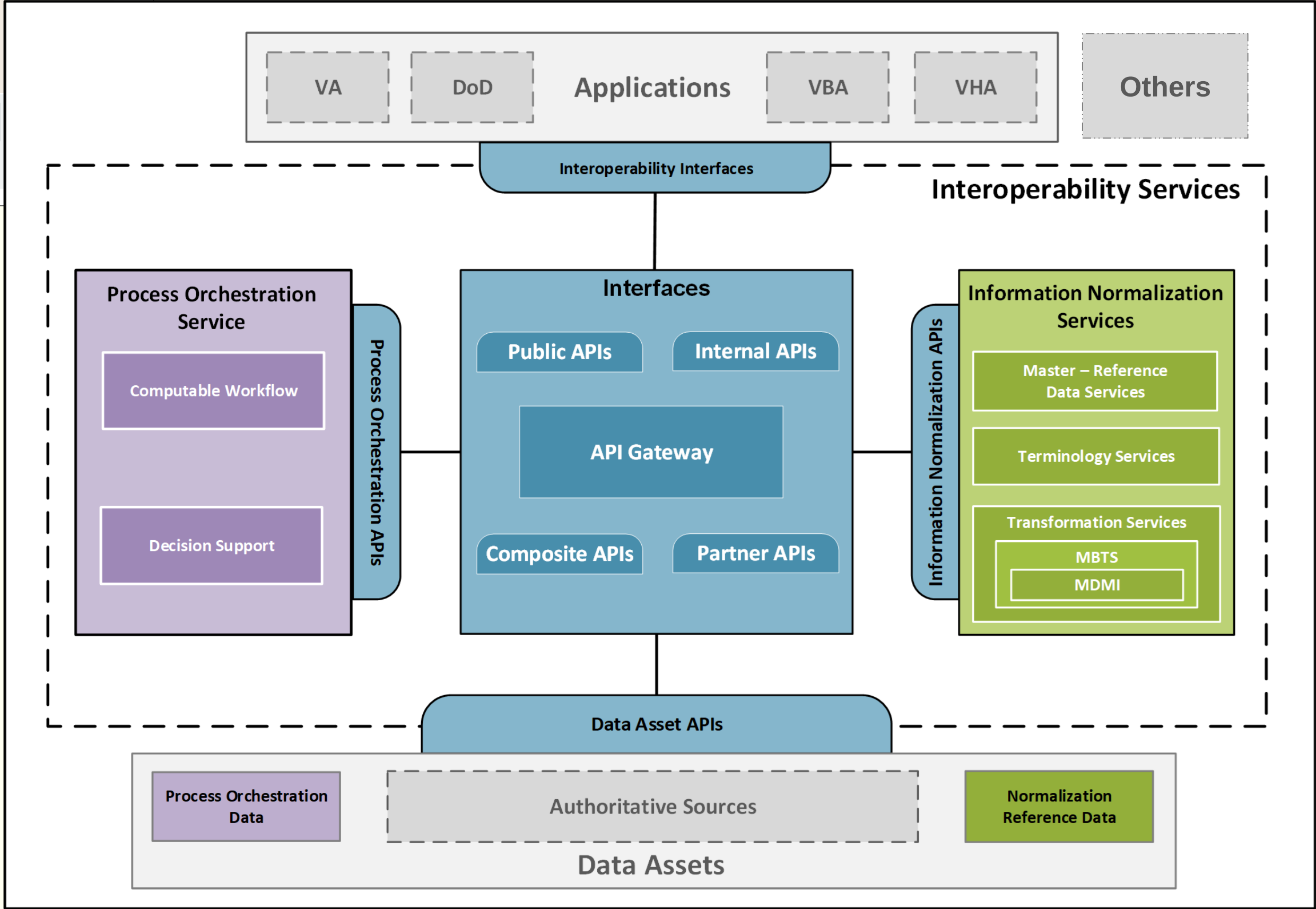


How are PBC’s used?

- Business capabilities provide fulfillment services of the functions they support
- In most cases a business need or use-case is satisfied by chaining together PBCs into a value-chain, calling them in some sequence realize a set of capabilities
- In some cases, a specific PBC is used to meet a direct business need (e.g., 1:1)
- The “chaining” of these calls in a sequence is a *choreography*, and that choreography is managed by an *orchestrator*.
- Choreographies can be reusable to fulfil like needs, documented as *patterns*.

How are PBC’s created?

- PBCs may be realized as new components or by exposing collections of existing functions “wrapped” into a capability
- PBCs are accessed via API’s that shield external “callers” from the internals of service delivery (e.g., “black-box”)
- PBCs themselves may be composites, with several internal services, data, and functions used in concert to fulfil their packaged capability
- Legacy systems can be packaged, with internal capabilities exposed via an API to form a packaged capability



Myth Busting

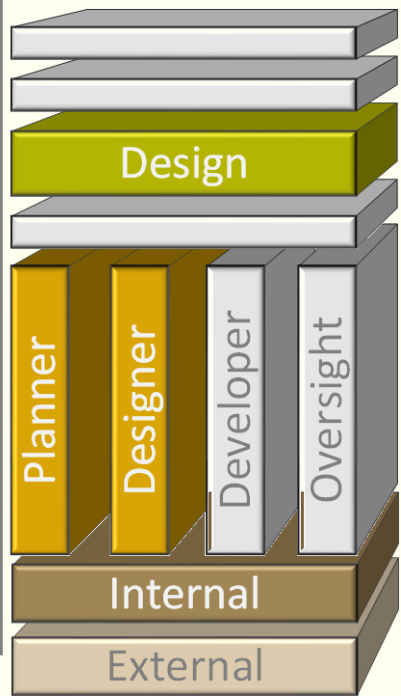
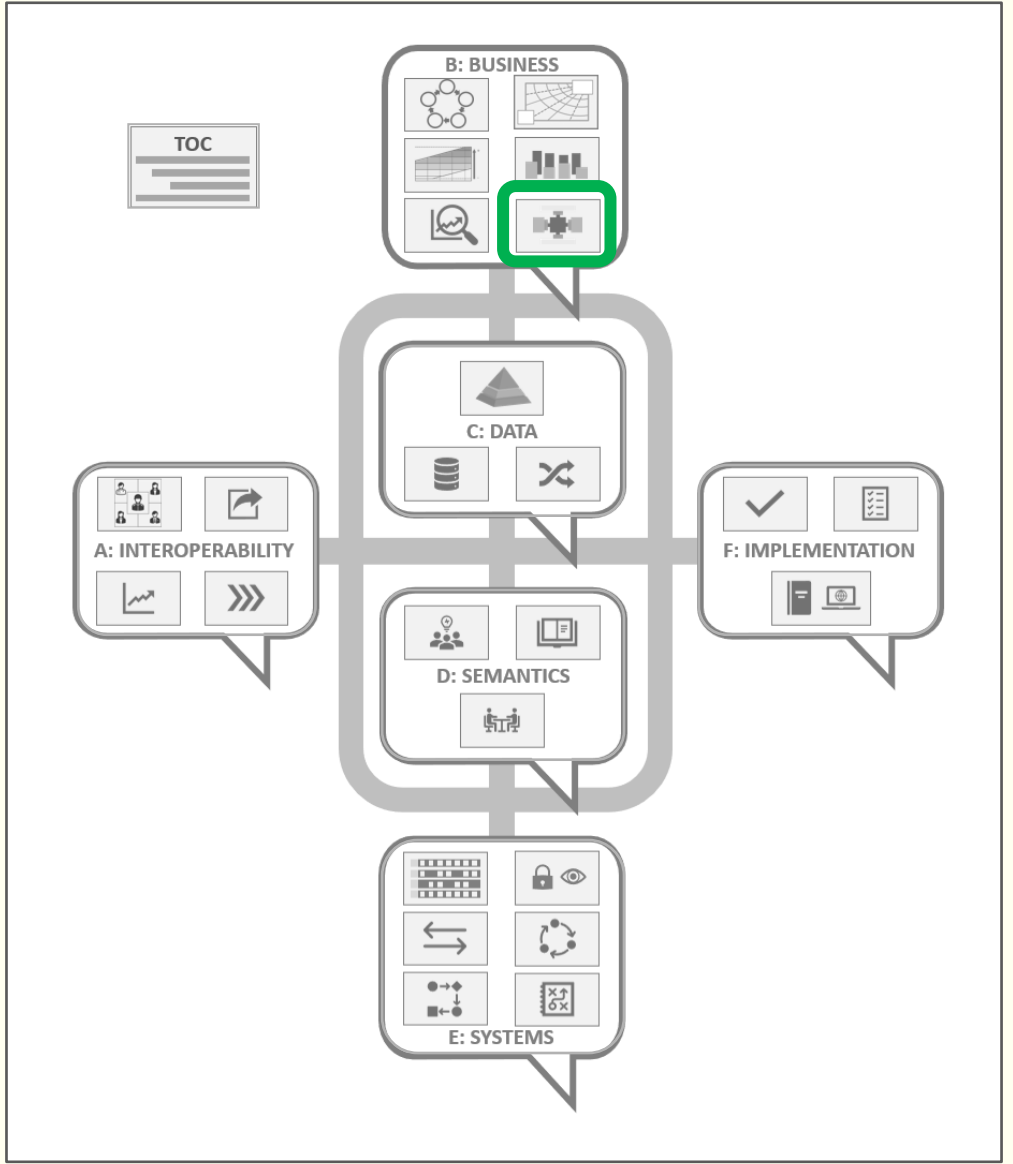
Myth	Reality
Business capabilities are best supported by one system or IT service component.	Traceability between business capabilities and shared services is advantageous. There should be no expectation that this is a 1:1 relationship. Use of multiple support services to support business capabilities is appropriate and should be expected.
With a drive toward COTS acquisition, the role of IT services is no longer necessary.	The use of COTS is not inconsistent with services. In fact, cloud services are service-based and many integrated suites are exposing shared services via APIs.

Glossary of Terms

Term	Definition
ADT	Admission, Discharge, Transfer
API	Application Programming Interface
COTS	Commercial off-the-shelf
CPRS	Computerized Patient Record System
eHMP	eHealth Management Platform
GUI	Graphical User Interface
MBTS	Model-Based Transformation Services
MDMI	Model-Driven Message Interoperability
RFID	Radio-frequency identification

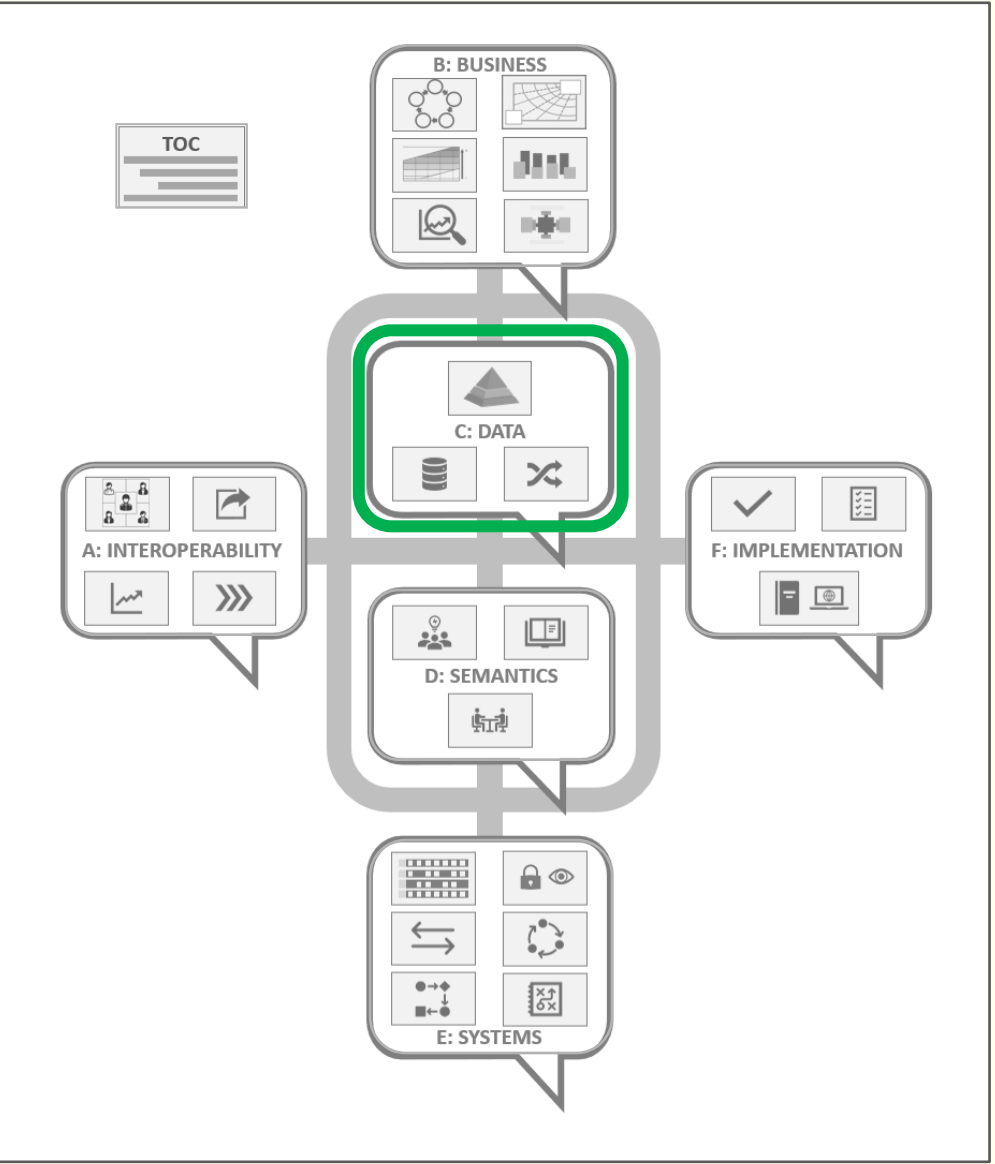
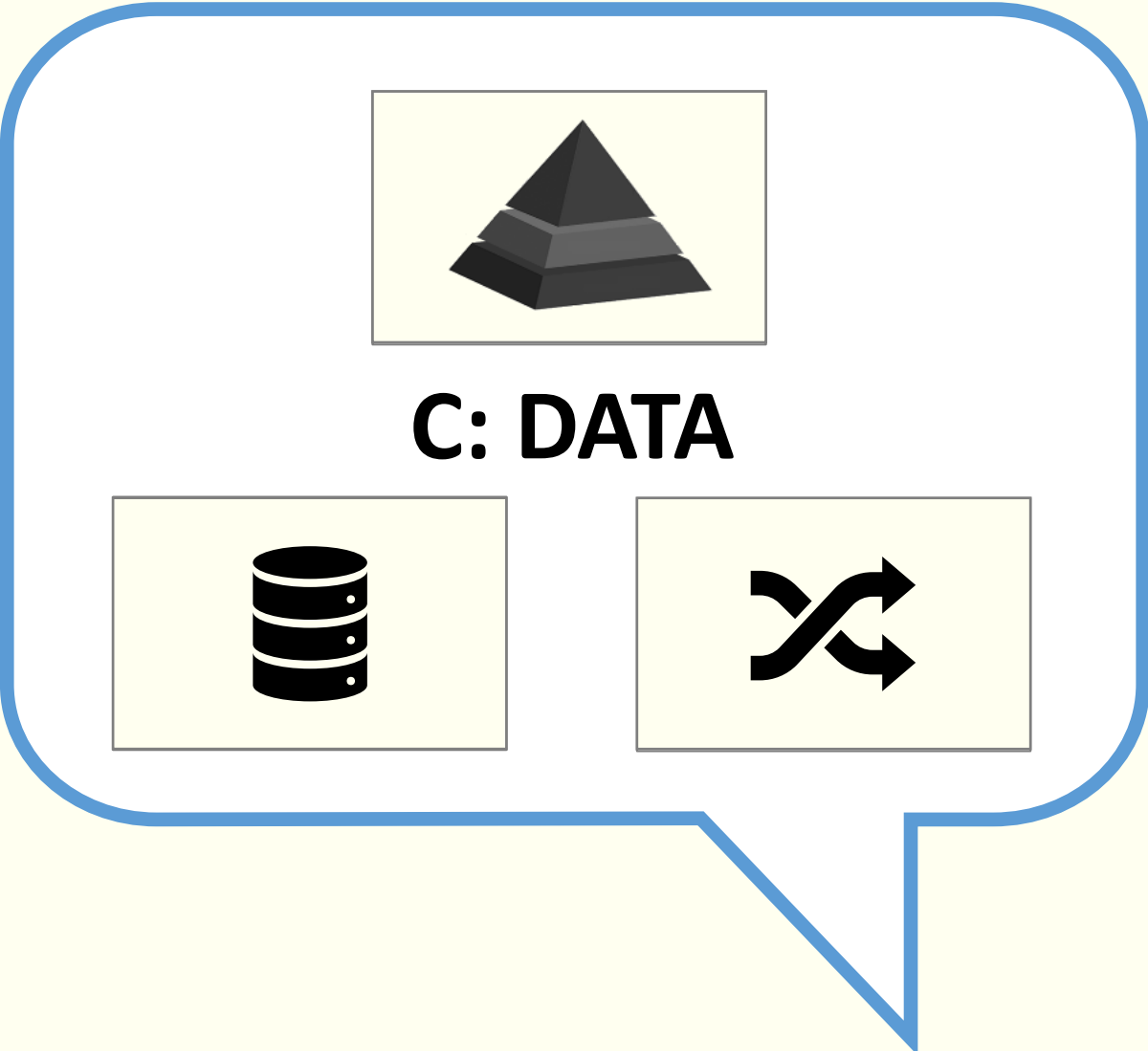
Further Reading

VA PUBLIC REFERENCE
VA EA OIT Business Reference Model
VA EA Enterprise Design Patterns
VA OIT Product Line Architecture
VHA Business Function Framework [validate]
INDUSTRY REFERENCE
Gartner Composable Enterprise Architecture



Contact:	VHA Knowledge-based Systems	
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i-VA Blueprints Version 1.5
Section C – Interoperable Information Assets

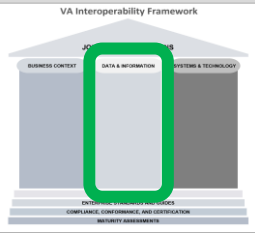


At a Glance

- Information and knowledge are assets that must be leveraged, just like systems and technologies
- Managing these distinctly from IT allows the organization the change and adapt as needed
- It is important to draw on **authoritative sources** to maintain data integrity and consistency in use
- Use of industry representations allows unfettered sharing, fosters reuse, and promotes quality

Data as an Enterprise Asset

- Data about a patient belongs to the patient, not the VA. We are trusted stewards.
- Increasingly patient data comes from outside the VA, or from the patient themselves. Data sourced from within VA is often “siloeed” in one program or system.
- Unplanned data duplication fosters data quality issues, data inconsistency, and redundant work
- Context is frequently essential for data to be consumable and useful. Understand when data is “composite” (City & State; systolic AND diastolic)
- **Information Semantics** define how data is represented so maintain consistency and durability of meaning
- Use of established data standards (e.g., terminologies, value sets, etc.) help maintain consistent meaning and data use across VA and with community providers of services to veterans.



Authoritative VA Data Assets



Taken from the [Data Steward Authoritative Data Source Guide](#)

- **Authoritative sources** of data should be used to assure current, timely, and accurate information
 - Sourced from responsible program office or designated system
 - Recognized “System of Record”
 - Applied use of established data standards, formats
 - Leverages Enterprise Master Identity Data, Reference Data
- Planned duplication of data (e.g., caching) is okay, so long as data integrity is maintained
- Data “due diligence” includes:
 - Identifying what data assets are required
 - What presently exists
 - Efficacy analysis of the extent it meets needs
 - Implications of reuse
 - What new data is needed, and the breadth of its potential use
- The VA Systems Inventory system (VASI) contains a comprehensive listing of existing systems and associated data assets. [Access it here >](#)
- The Business Reference Model (BRM) provides a comprehensive model and listing of existing information systems capabilities and services VA Systems Inventory (VASI). [Access it here >](#)
- The VA Business Information Model (BIM) defines core business concepts and helps identify ownership and reuse potential. [Access it here >](#)
- The Interface Control Document Catalog also provides a listing of the available interfaces for existing assets. [Access it here >](#)

i-VA Blueprints

Introduction to Interoperable Assets



Data Assets [Instance Data]			Non-Data Assets [Knowledge and Process Data]			Industry Formalism	Data – Direct Use	Reference Knowledge	Process Enablement
Data Role	Type of Data	System Source	Knowledge / Process Role	Type of Asset (Format)	Source(s)				
Direct Care	Ref. Data	Reference Data / Lookup Tables	Coding	Reference Data / Lookups	File 200				
		Medical Images, DICOM		Medical Vocabulary, Terminology	SNOMED, RxNORM, others				
		Patient self-entered data		Knowledge Assertions [Medical]	SNOMED, Clinical Professional Orgs, Licensed Knowledge				
		Patient Instance Data		Clinical Decision Support Rules	FEHRM, Clinical Organizations, Licensed content				
		Patient Instance Data		Business Rules	HL7, Prof. Societies, Licensed Content				
		Allergies & Medications		Care Pathways, Workflows, Practice Guidelines	Clinical Societies, COTS, Licensed Content				
		Patient Instance Data – Joint DoD Medical Record (JLV)		Clinical Evidence	CDW, NIH, ORD, Research Institutions				
		Longitudinal Records; Data Lake							
		Population							

- Types of Data Assets**
- Transactional data – process oriented
 - Category data, resource data, event data
 - Master Identity Data
 - Master Reference Data
 - Metadata

The way data is represented has profound implications on its usability for decision support, inferencing, and automation.

For more detail, please visit the i-VA section on [Information Semantics](#).

- Types of Knowledge Assets**
- Decision Logic, such as Logic Tables
 - Concept interrelationships, e.g. ontologies
 - Patient Evaluation Rules
 - “Computable” expressions of medical evidence

Knowledge assets express our understanding of medicine and other content in a way that can be consumed by people and machines. Treatment of knowledge as distinct assets supports its independent evolution, and better allows IT to support constant changes.

For more detail see the [Seamless Experience journey](#), and the [i-VA References](#)

- Types of Process Assets**
- End-to-End Business Processes
 - Clinical Practice Guidelines
 - Coordination of Care / Care Plans
 - Orchestration of Care Activities

Process assets represent workflows, practice guidelines, care pathways, and best practices. These assets consider human activities, automatable processes, and the interaction between human and machine.

These can be represented in a host of formalisms, from natural language through to computable graphic languages such as BPMN, BPM+ , and CPG on FHIR.

- Accessing Assets**
- Best practice is to isolate access via a formally defined interface
 - Standards-compliant interfaces/APIs reduce vendor lock-in risk
 - Interfaces define both **what** content is available/provided, as well as **how** that content can be accessed

By isolating asset access behind and interface, this becomes a control point preventing “brittle” systems from failing when something changes. Data specifications define the type, format, and representation of the data/knowledge payload. Behavioral specifications define how the interface works.

Please visit [Section E](#) for more detail.

Myth Busting

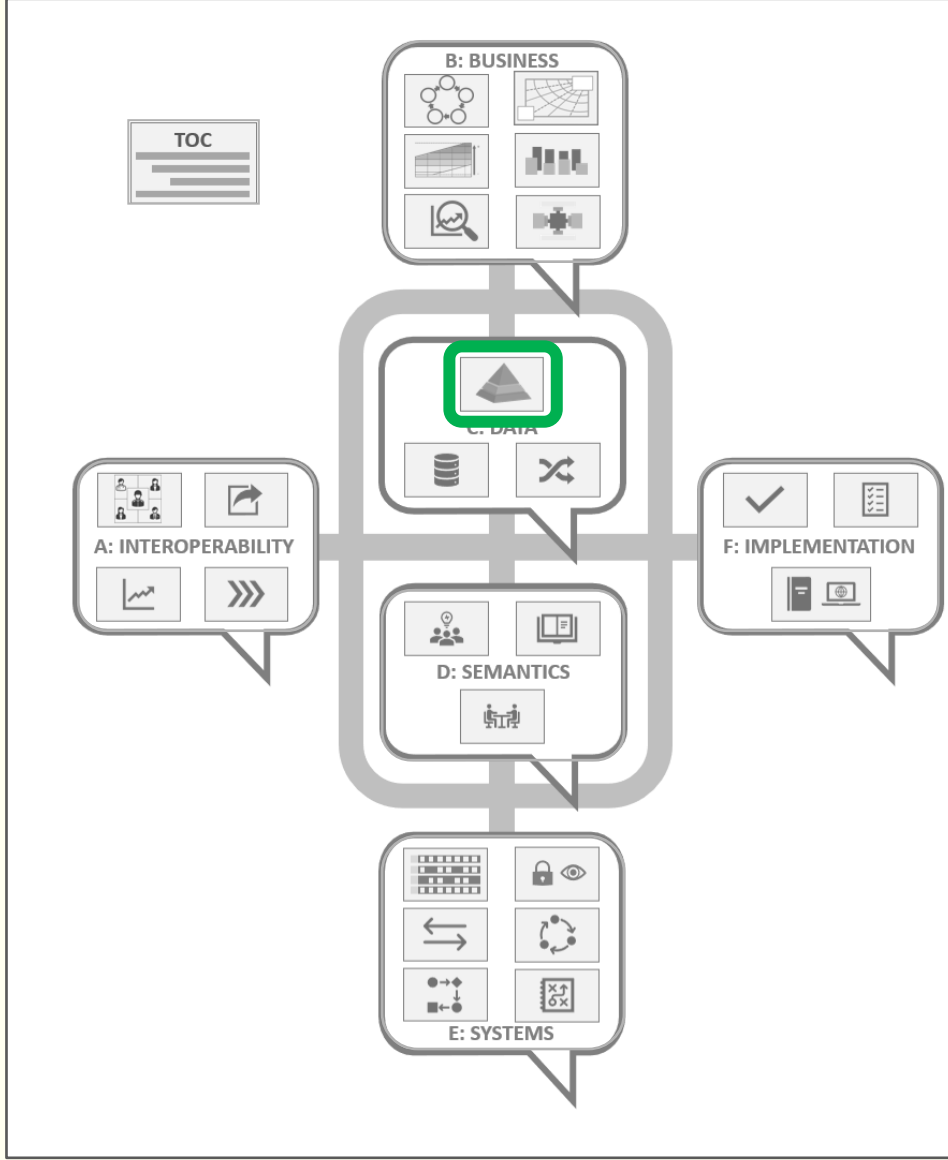
Myth	Reality
Interoperability is focused on data sharing.	While historically the predominance of interop work has been data-oriented, there are business reasons to also share knowledge and processes needed to deliver appropriate and effective care
Best-practice is to pull data directly from a data source.	Direct access to databases by other systems is to be avoided, preferring instead the use of API's published by the custodian of authoritative data sources

Glossary of Terms

Term	Definition
VASI	VA Systems Inventory
BRM	VA Business Reference Model
BIM	VA Business Information Model
OEI	VA Office of Enterprise Integration
DGC	VA Data Governance Council
LHS	Learning Health system
API	Application Programming Interface

Further Reading

VA INTERNAL REFERENCE	
Data Steward Authoritative Data Source Guide	
VA Systems Inventory system (VASI)	
VA Business Information Model (BIM)	
VA PUBLIC REFERENCE	
VA Office of Data Governance and Analytics	
VA EA OIT Business Reference Model	
INDUSTRY REFERENCE	
DAMA Data Management Body of Knowledge 2	



Interop Design or Implementation Characteristic	Interop IMPACT	Risk	Neutral	Benefit
Leveraged use of enterprise authoritative data sources				X
Use of formal data representations consistent with enterprise semantics (see Info Semantics section)				X
Duplication of reference data for performance enhancement			X	
Native use of COTS knowledge and decision logic		X	X	
Use of formally expressed business knowledge / business rules (e.g., computable)				X
Ingest of 3 rd party data in native formats		X	X	
Ingest of 3 rd party data adapted to standardized format				X
Leveraged use of prior-version of VA-accepted terminology		X	X	
Direct access to database from existing VA system		X		
Access to VA authoritative system via published authoritative API				X

Planner

Designer

Developer

Oversight

Design

Internal

External

Contact: [VHA Knowledge-based Systems](#)

Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Intro to Interoperable Assets	
		PAGE
		C-1

At a Glance

- This page defines the characteristics of data that is authoritative, suitable, and necessary for sharing across the VA enterprise and with VA’s community-based service providers
- Provides insight into what the implications are for the use of different data sources
- Cites the types of Reference data and identifies authoritative sources
- Provides examples from VHA of different data standards appropriate for sharing and accessing Veteran’s health data for a range of purposes and contexts

Key Concepts

- While data about Veterans may be distributed across the VA enterprise, as well as with community service providers, not all data sources can be considered equally authoritative
- What makes data authoritative depends upon:
 - The nature of the source
 - The closer the data capture is in time and the location of an encounter with the Veteran the more accurate it should be
 - The purpose for which the data was gathered in that encounter
 - How the data was gathered
 - How consistently structured the data is across sources
 - How consistently enterprise master identity and reference data is used across the VA
 - How reliably and readily data can be accessed
- To simplify access while ensuring the integrity and appropriate use of authoritative data sources, data custodians should define and make available the APIs necessary to share or receive information in their data source

Value of Reference Data to the Enterprise

- Managing Master Data and facilitating its accessibility and reuse across the enterprise:
 - reduces risks of data redundancy
 - allows correlation of data across sources, creating a consistent coherent picture of past and present
- Ensures higher data quality data across the enterprise
 - Essential in providing a seamless experience to the veteran
 - Helps ensure a current and coherent picture of the Veteran’s circumstances and services
 - Essential for the effective and efficient operation of the organization and evaluation of outcomes and progress toward operational goals

Identity, Reference, and Knowledge Assets as a Service

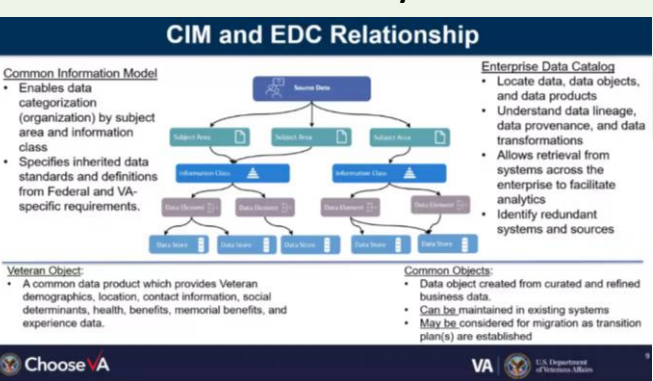
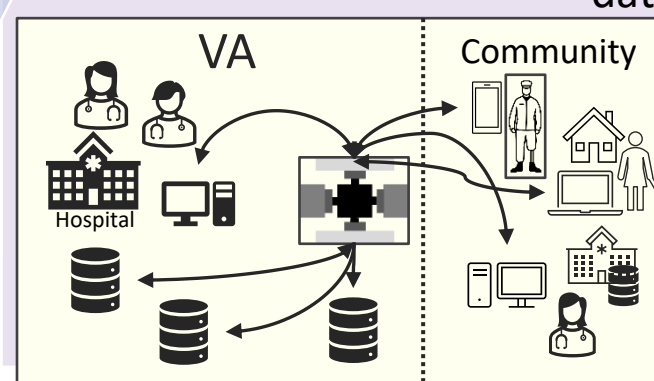
- Just as with instance data, enterprise identity, reference, knowledge, and process-related information should be provided as a data service using published APIs

i-VA Blueprints

Data Access and Sharing



Interoperable “Instance” Data

Use and Representation	Semantics	Access
• Instance data is transactional • Qualities of authoritative data are also needed for interoperability • Consistent use of identifiers across the enterprise • Standardization of key data content and representation ensuring consistency, understandability • Planned intention to share relevant data with other systems, programs • Redundancy is deliberate, thoughtful, drawn from authoritative sources • Information models assure consistency and context 	• Semantically-consistent data is suited for analytics, inferencing, decision-making • Information systems can ingest information without altering meaning or losing accuracy • Automated processes can reliably act on it • Data is accessible to other information systems without negatively impacting the function, performance or integrity of the source information system(s) • Use Standard coding systems and terminologies to maintain meaning 	• Data can be drawn from variety of internal or external sources • It is critical to leverage authoritative sources • Access to data should be through published APIs • Data should only be provided when compliant with data use policy (e.g., policy enforcement points) • Planned Duplication is okay considering currency and quality implications • Note that preferred data sources are not always internal – Context matters (e.g., community care, referrals, patient-sourced data) 

Choosing a Data Source

Nature of Source	Authoritative	Enterprise Defn	Code set(s) Used	Data Sharable	API Access Path	Context Provided	Posture	Implications
Transactional System (System of Record, <u>normalized</u> data)	✓	✓	✓	✓	✓		✓	• Preferred Source; secondary only to shared services
Transactional System (System of Record, <u>unnormalized</u>)	✓	✗	✗	✓	✓		✓	• Use with <u>caution</u> • Need ETL to use
<i>Transactional System</i> (System of Record, <i>direct access</i>)	✓	✗			✗		✓	• Establish proxy interface • Limit direct access • Monitor for volatility
Transactional System (System of Record, <i>Policy constraints on Sharing</i>)	✓						✓	• Assess policy, ethics impacts; • Utilize policy enforcement point to limit sharing
Transactional System (<u>NOT</u> System of Record)	✗						✗	• Do not use as a primary data source
Enterprise Shared Service (<i>Authoritative</i>)	✓	✓		✓	✓		✓	• Ideal, Preferred Source
Analytics Platform	✗	✓	✓	✓		✓	✓	• Use as secondary source • Not intended for transactional use
Corporate Data Warehouse	✗	✓	✓	✓	✓		✓	• Not authoritative • Comprehensive view
VHIE/VDIF	✓	✓		✓	✓	✓	✓	• Limited control of externally sourced data

Bold indicates high-impact consideration factor.

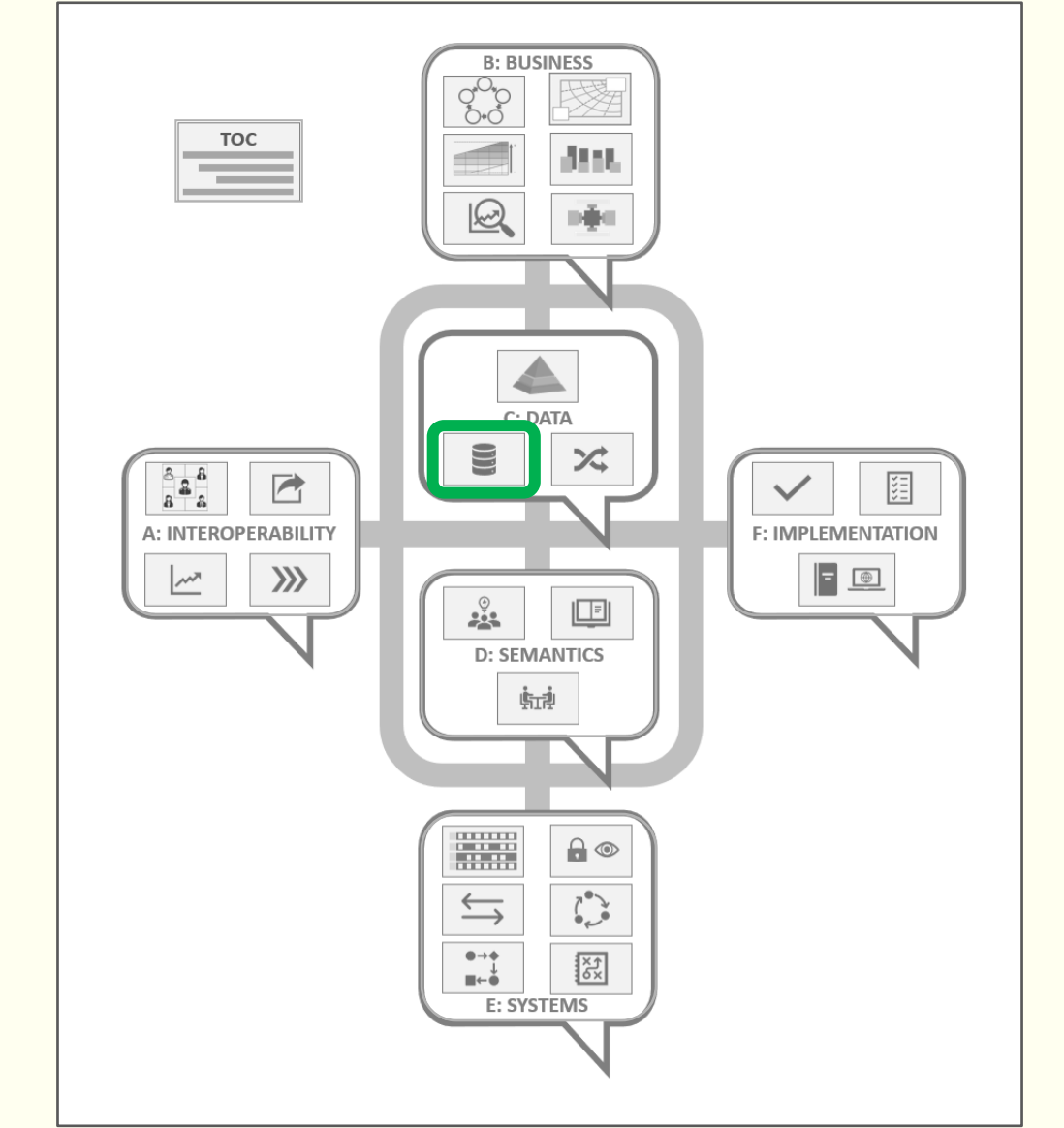
“Reference” Data

Reference Topic	Reference Impact/Implication	Auth. References
➤ Veteran Identity	➤ Assures accurate identity management, consistency across systems	➤ Master Veteran Index
➤ Facility/Location Lookup	➤ Allows for performance analytics and performance management; administrative oversight, business operations	➤ <to be added>
➤ Medical References / Clinical Coding	➤ Common terms allows for health analytics, clinical decision support, quality management; In some cases provides support for billing reimbursement	➤ Terminology Svcs APIs
➤ Reference Values/ Codes	➤ Provides information form which to populate pop-up lists and selection tables	➤ Master reference data APIs

Myth	Reality
Community-sourced or externally provided data is of suspect quality and utility.	The standards-based API’s VA publishes for requesting data from external sources, along with provenance, helps ensure data is consistent in format and meaning and reliably actionable.
I don’t need to share my data.	The custodian of data about a veteran’s health the services they receive cannot anticipate why or when that data is needed. Where that data is that is relevant-for-sharing, they cannot withhold it.
Exposing an API to access my data is all that is needed for effective sharing.	APIs provide by VA for data access must be conformant with industry standards in format and meaning and use shared identifiers in order to be useful and effective.
VA Internal Data is higher quality than external sources.	Lack of internal data standardization within VA risks data being considered unreliable by external users.

Glossary of Terms	
Term	Definition
API	Application Programming Interface
Normalized	Data that follows a consistent format, structure, and use of unique identifiers for entities and concepts
FHIR®	Fast Healthcare Interoperability Resources
VHIE	Veterans Health Information Exchange

Further Reading	
VA INTERNAL REFERENCE	
Data Governance Council	
VA PUBLIC REFERENCE	
i-VA Blueprints Section D – Informational Semantics	
VA Data Governance and Analytics	
INDUSTRY REFERENCE	
DAMA Data Management Body of Knowledge 2	



Different Data Standards for Different VHA Purposes

Codified		Decision Support & Analytics	
Atomic	• DEERS MPI	• Disease / Condition Registries	• VA FHIR Profile
	• USCDI	• FHIR Data Element	• CCD
	• VistA RPC	• Demographics	• Military Service History
Composite	• Terminologies	• CCR	
	• CDA r1	• CDA International Patient Summary	
	• Problem list	• VBA Benefits Registry	
Narrative		• Social Determinants of Health	Patient Context

Contact: VHA Knowledge-based Systems		
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
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Page at a Glance

- Business operations necessitate the ability to receive, adopt, and apply organizational and industry knowledge in a timely and accurate fashion
- Accurate interpretation of business knowledge depends upon its precise expression, furthered by the use of formalisms and industry standards
- There are emerging tools that can directly consume and apply knowledge
- Separating knowledge from the systems that execute that knowledge allows for improved business agility; opportunity to apply best-practices
- Several standards and industry initiatives are in place and underway working in this space. The challenge is using each piece appropriately in a cohesive strategy
- AHRQ has published a roadmap illustrating how pieces fit

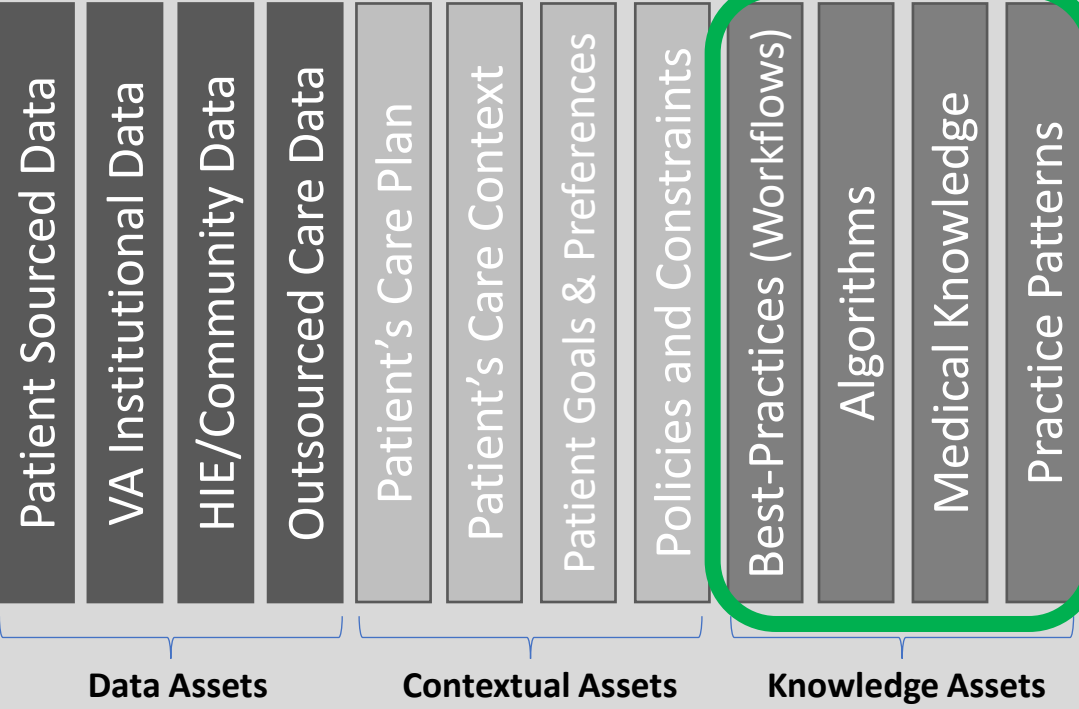
Why focus on Knowledge and Process Interoperability?

- So much of industry attention goes to data sharing, but critical to healthcare delivery is the intersection of data, process, and knowledge. As business and clinical operations perform their workflows, they apply processes that often need to be shared within and outside of the institution, and are reliant upon timely data, business rules, and [where appropriate] industry knowledge and best practices being applied.
- The ability to share those non-data assets is essential to providing a beneficiary experience allowing for each beneficiary interaction to meeting their needs, and to allowing for optimal delivery and VA's keeping pace.

Implications of Knowledge-as-an-Asset

- Elevating knowledge to being managed as assets allows it to be discoverable, portable, and sharable
- This separation allows knowledge to evolve independently from underlying technologies
- Like any digital asset, this approach allows for versioning, update, and asset management
- Knowledge assets are intellectual property, and as such can be licensed
- Emerging are industry repositories for knowledge discovery, dissemination, and distribution

Orientation around knowledge sharing



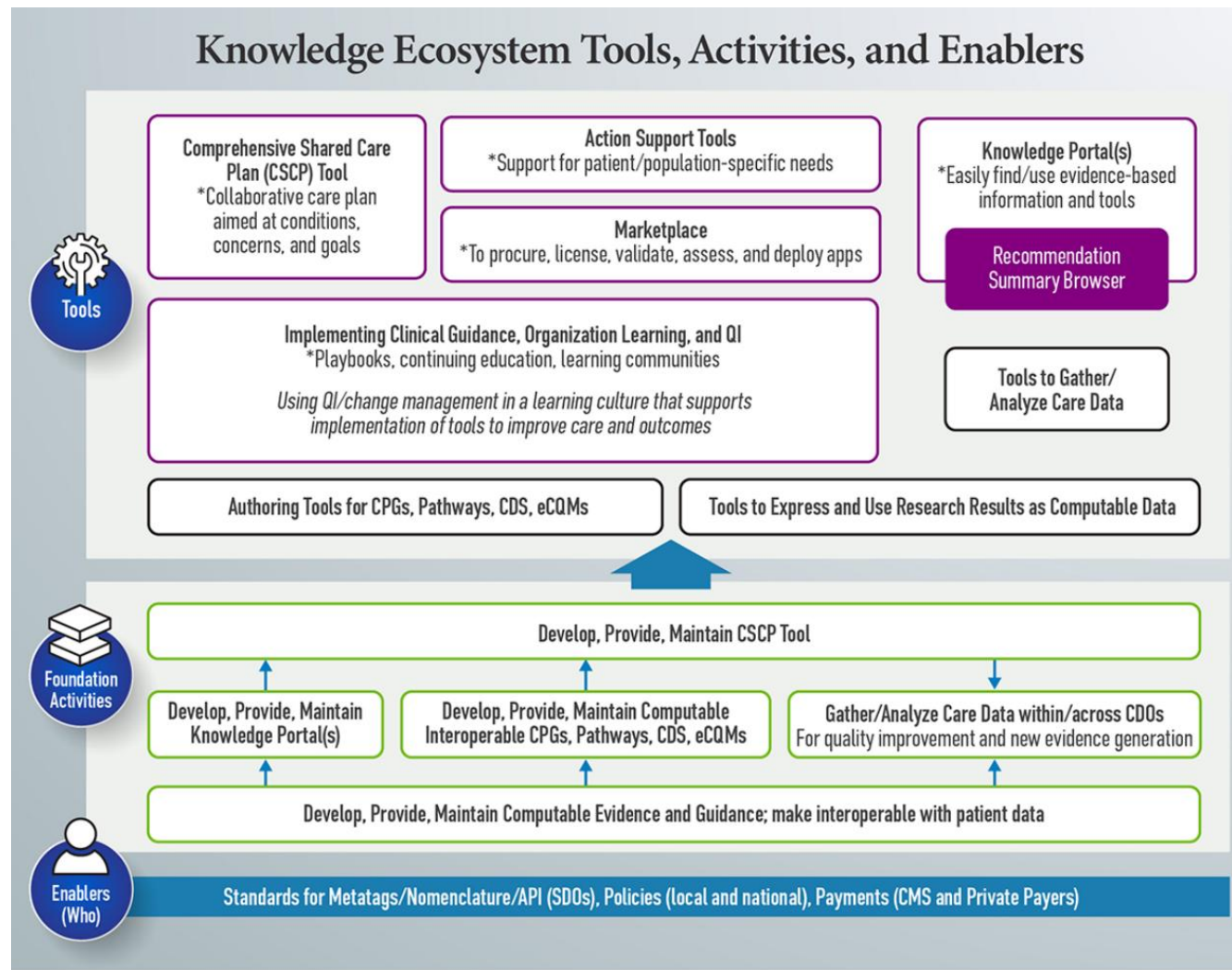
Exploring Knowledge Interoperability

A host of industry activities are focused on the sharing of non-data resources. Representative examples include:

Activity	Target Use	Short Description
BPM+ Health	Workflow portability	Allows for modeling, swapability, interoperation of workflows, processes, care pathways
CPG on FHIR	Clinical Practice Guidelines	Computable representation of a narrative clinical guideline supporting cognitive and decision support, quality measures, case reporting
SOLOR	Terminology and Coding	Brings together different terminology standards by using a single model to support unambiguous representation, inferencing, and reasoning.

i-VA Blueprints

Sharing Knowledge and Process Assets



Concept Expression

Terminologies ♦ Ontology ♦ Coding Systems ♦ Vocabulary

- Structured reference data used for lookup, consistency of meaning, discovery of related concepts
- Formal representations enable decision support, inferencing, and analytics

Rules and Algorithms

Business Rules ♦ Business Logic ♦ Decision Support

- Allows for systems to adapt and evolve based on emerging practices
- De-couples medical knowledge from the platforms that support it
- Enhances potential to apply insights from AI and Machine-Learning (ML)

Processes and Workflows

End to End Process ♦ Business Process ♦ Practice Guideline

- These expressions capture business requirements, assure traceability through the technology stack, and document best-practices
- When expressed via graphical languages, these are human- and machine-readable

About the “Learning Health System”

- Within health care, there is strong interest in achieving the “[Learning Health System](#)” [LHS]. While oversimplified, the LHS embodies:
 - A culture of continuous improvement
 - The ability to rapidly and effectively adapt to emerging best practices
 - Achievement of High Reliability (e.g., consistent, quality delivery)
 - Science, informatics, incentives, and culture are aligned
- Key to enabling the LHS is the availability, dissemination, and use of knowledge
- The landscape to express “knowledge” is complex and diverse, from evidence to discovery to rules/algorithms to processes to performance measures

Stratified Logic Model

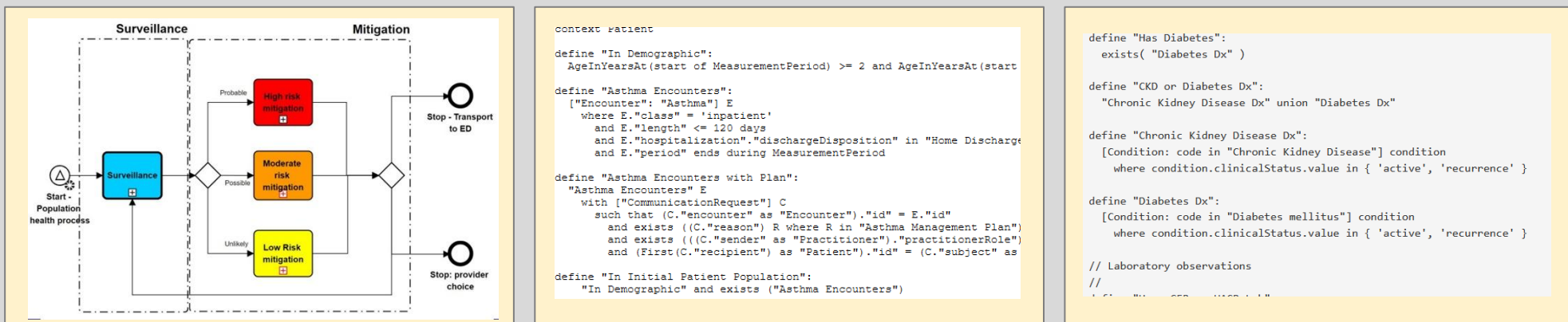
HL7 has embraced a layered conceptual model to describe strata of decision logic. Details available [here](#)

Knowledge Level	Description	Example
L1	Narrative	Guideline for a specific disease that may be written in the format of a peer-reviewed journal article
L2	Semi-structured	Flow diagram, decision tree, or other similar format that EXPLICITLY describes or expresses logic constructs that are interpretable by non-SMB 'computable logic developer' for constructing L3, BUT are also expressed in a manner sufficient for domain SMB to review and validate
L3	Structured	Standards-compliant Specification for CDS that explicitly encodes computer interpretable logic including data model(s), terminologies (concepts, value sets), logic expressions in a computable language sufficient for implementation- often across a broader set of local implementations
L4	Executable	Manifestation of the logic (typically in a user interface) that is used in a local execution environment (e.g. CDS interventions running live in a local production EHR environment) or available via web services

Knowledge Levels with Examples (Michaels, U.S. Centers for Disease Control and Prevention, 2019; Adapted from: Boxwala, AA, et al. A multi-layered framework for disseminating knowledge for computer-based decision support. J Am Med Inform Assoc 2011(18):132-139)

Spotlight on Process Modeling and Care Pathways

Multiple industry standards initiatives are focused on the authoring and sharing of clinical guidance and process models. The purpose of these is to allow for knowledge “portability” – enabling it to be managed as an asset. Common among the approaches are use of formal languages, computer-interpretability, and tooling support. Exemplars follow.



BPM+ Health Benefits:

- Based on broadly used BPMN std
- Off-the-shelf tools available
- Suitable for multiple styles of workflow (directed, event driven)

Implications

- Suited to functional and technical audiences
- Precise semantics allows models to be simulated and executed
- Complementary to FHIR

CQL Benefits

- Broad adoption, particularly by payer community
- Used in CQI initiatives to express quality indicators
- Closely integrates with FHIR

Implications

- Assertive language well suited to technical implementation
- No visual element makes it poor for functional reviewers

CPG on FHIR Benefits

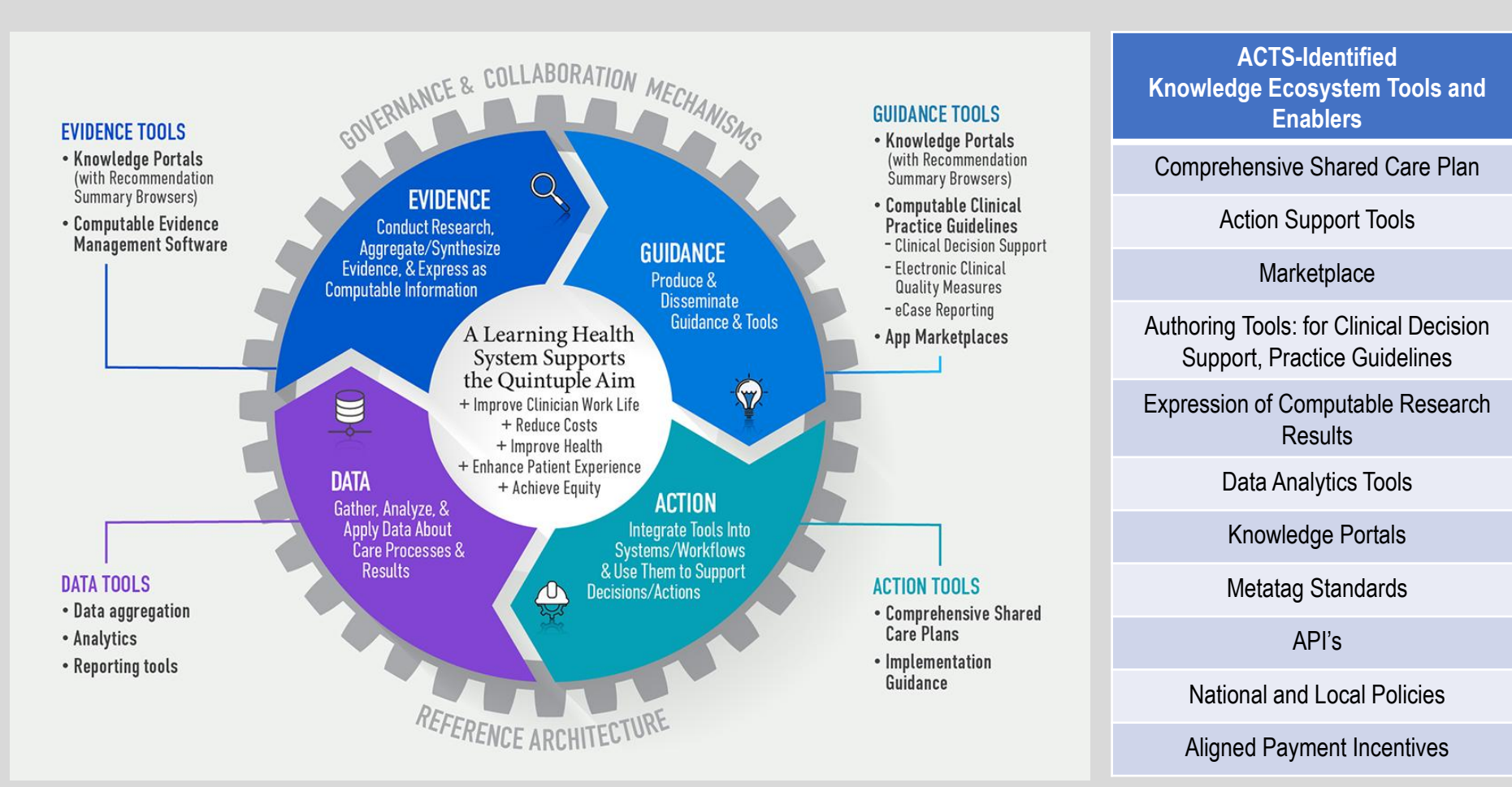
- Strong alignment with FHIR
- Narrative is precise, computable but suitable for human review

Implications

- Assertive language well suited to technical implementation
- Well suited for use in clinical decision support

AHRQ Evidence-based Care Transformation Support (ACTS) Initiative

AHRQ has been instrumental in developing a “Learning Health System Concept Demonstration” to illustrate how an integrated knowledge ecosystem can serve as a key enabler in realizing a Learning Health System. The objective is to bring together multiple different initiatives, approaches, and technologies that complement one another and are part of mobilizing knowledge to be more accessible, consumable, and available when and where it is needed as part of care delivery, population health, and other health related efforts. Visit their [website](#).



Myth Busting

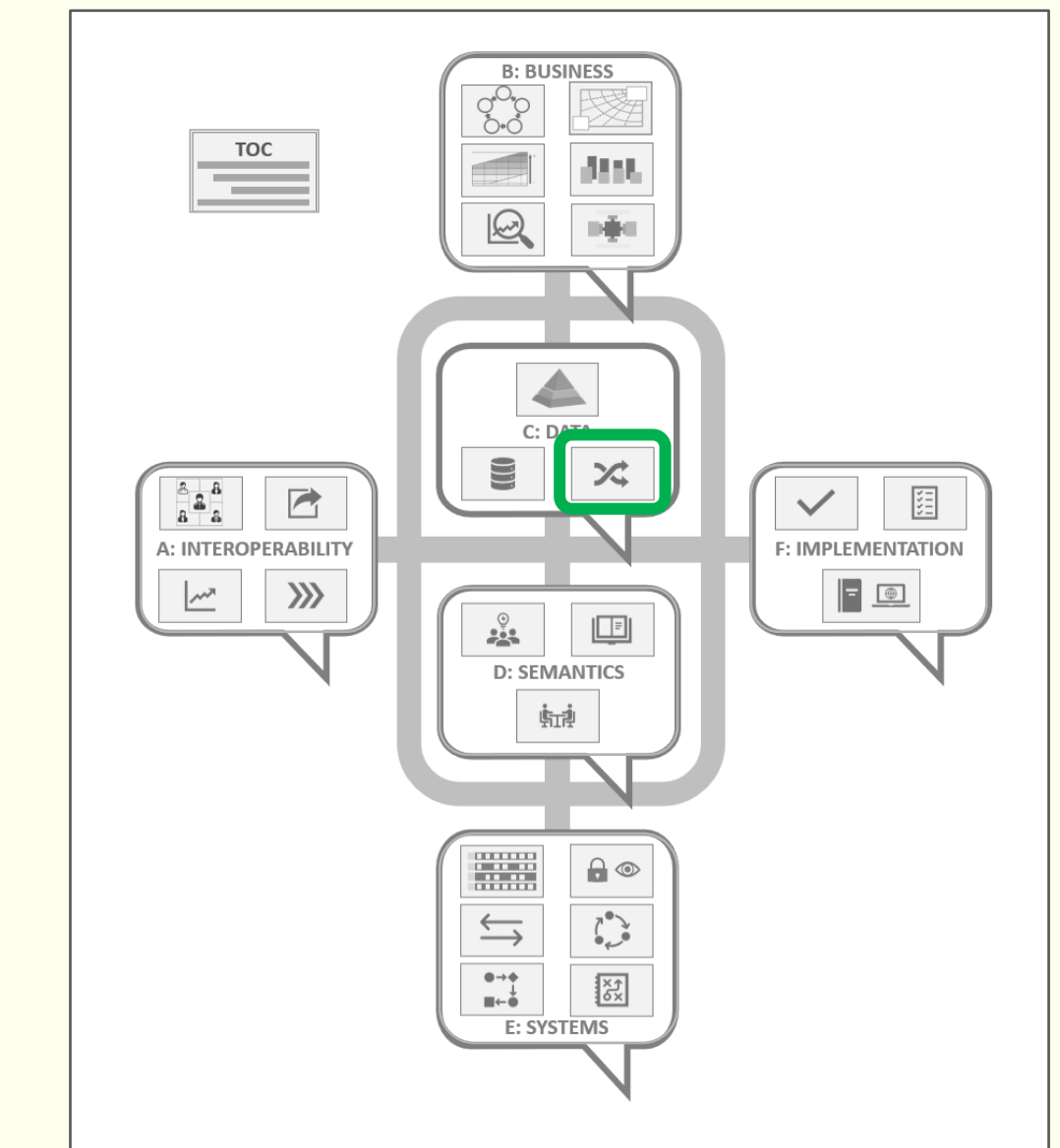
Myth	Reality
Achieving interoperability is predicated on the effective sharing of patient data.	Patient data sharing is a pillar of interoperability, but it is not sufficient. Keeping pace with changing medical practice requires rapid adoption & exchange of emerging knowledge.
By using modern systems and software, we are keeping up with the “state of the practice” of medicine.	While vendors and products invest in care pathways and workflows, innovation happens from multiple sources. When that knowledge is expressed interoperability, it can be updated more readily

Glossary of Terms

Term	Definition
AHRQ	Agency for Health Research and Quality
BPM+	Business Process Management + Health
CDS	Clinical Decision Support
CPG	Clinical Practice Guidelines
FHIR®	HL7 Fast Health Information Resources
Orchestration	Coordination of services to fulfil a business need
SOLOR	Integrated, normalized SNOMED, RxNORM
TCO	Total Cost of Ownership
TRM	Technical Reference Model

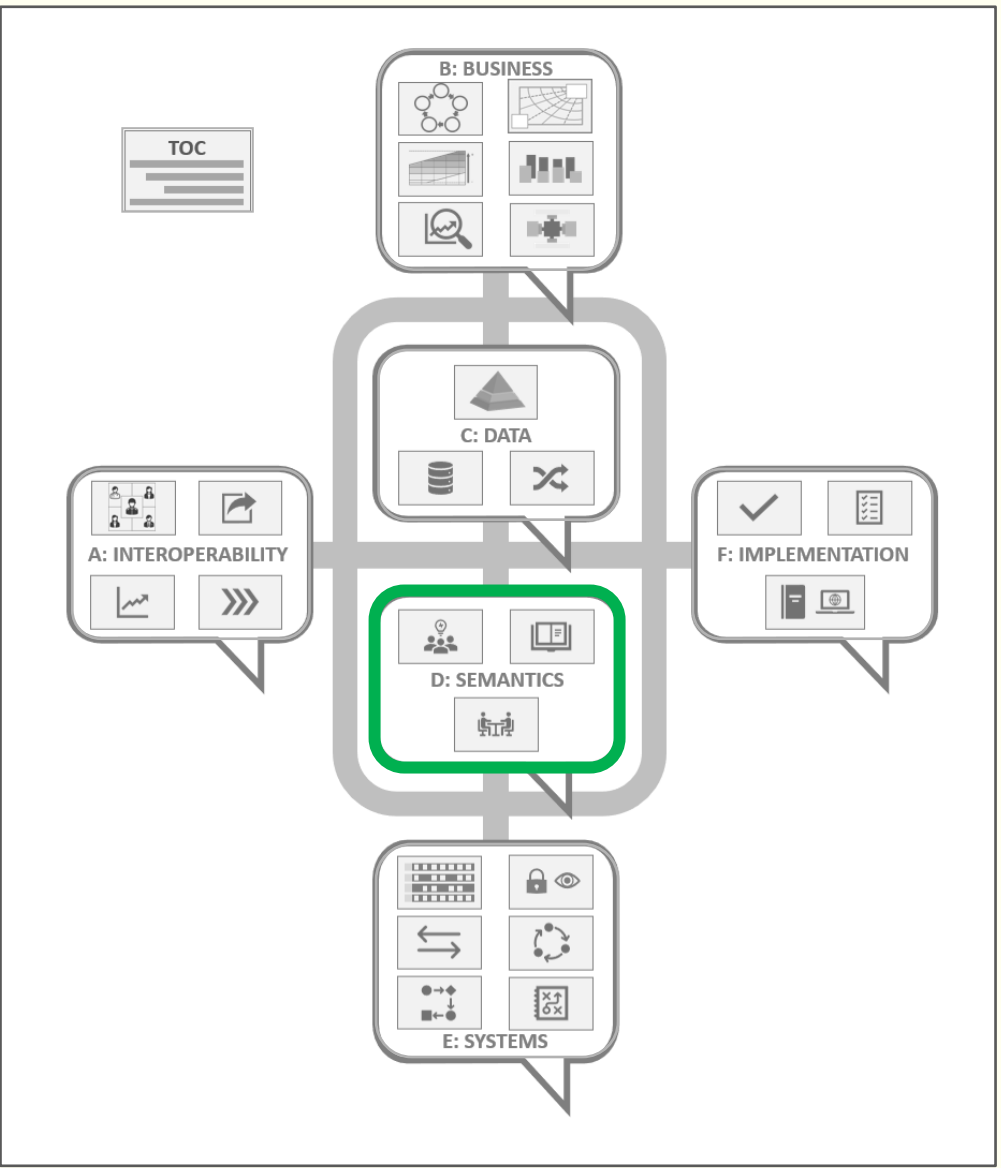
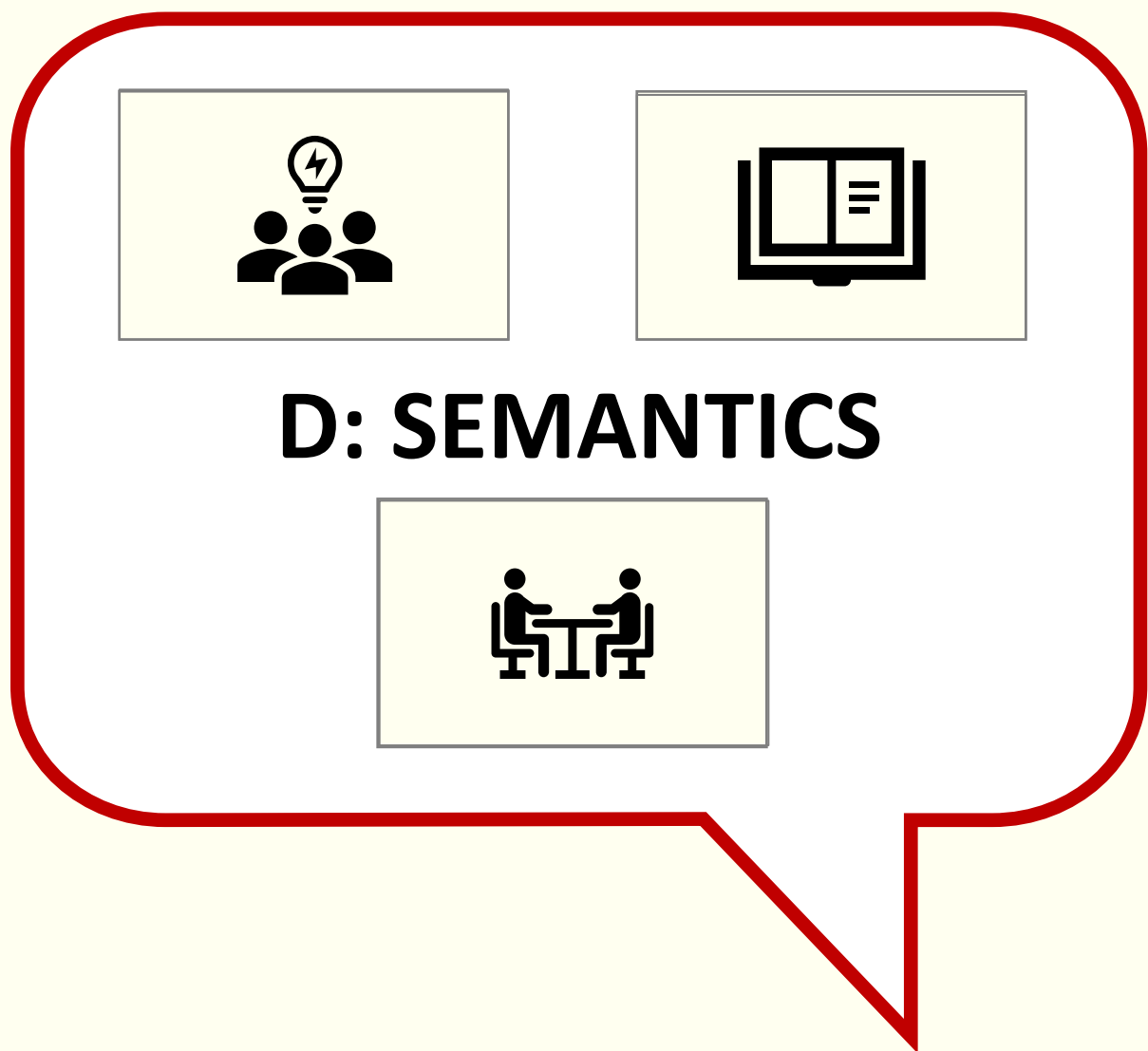
Further Reading

INDUSTRY REFERENCE
AHRQ ACTS
BPM+ Health
Clinical Quality Language (CQL)
CPG on FHIR
Learning Health System



Concept		
Planner	Designer	Developer
Internal	External	
Contact: VHA Knowledge-based Systems		
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Section D – Informational Semantics



- What is meant by Informational Semantics.
- Why it is important to the veteran and their service providers.
- What role it plays in achieving interoperability.
- What project teams need to know.

- In order to effectively and safely support care of Veterans and improve service outcomes. It is necessary for humans and information systems to work effectively together (interoperate).
- Safety and efficacy require consistent and unambiguous meaning of concepts and observations (informational semantics) - Especially when exchanging information between people or between systems across VA and with external service providers
- Exchange of semantically clear and consistent information is required across the enterprise for
 - Analysis and insight
 - Innovative research
 - Effective decision support

Define “semantic boundary” and the importance or recognizing when information is crossing those boundaries:

- context for understand may be lost
- words used in different operational contexts may have different meaning
- information may be represented at different levels of detail and precision in different operational contexts

- **Concepts Based on Standard Terminologies:**
The enterprise manages concepts and value sets as “VA standardized domains” from a number of terminologies e.g. in healthcare: SNOMED CT, LOINC, RxNorm, etc.)
- **Context:** Necessary for safe and appropriate interpretation and processing of the information
- **Computable Provenance:** Knowing origin and authorship provides authority to information used for treatment

The foundational data elements that are shared across systems are specified by the Office of National Coordinator (ONC) for Health IT:

USCDI v1			
Assessment and Plan of Treatment	 Laboratory  Test  Values/Results	 Prevalence "NEW"  Author  Author Time Stamp  Author Organization	
Care Team Members	 Medications  Medications  Medication Allergies	 Smoking Status	
Clinical Notes "NEW" Consultation Note Discharge Summary Note History & Physical Imaging Narrative Laboratory Report Narrative Pathology Report Narrative Progress Note Progress Note (inpatient)	Patient Demographics First Name Date of Birth Last Name Race Ethnicity Middle Name Preferred Language Address "NEW" Address "NEW" Phone Number Birth Sex	Unique Device Identifier(s) for a Patient's Implantable Device(s) Vital Signs Diastolic Blood Pressure Systolic Blood Pressure Body Weight Heart Rate Height Respiratory rate Body Temperature Pulse oximetry Inhaled oxygen concentration Portable "Vital Signs" "NEW" 90% oxygen on nasal cannula and on flow 20% 2-30 Weight for age Length for age Occipital frontal circumference for children > 18 mos old	
Patient Goals Health Concerns	Problems Procedures		
Immunizations			

Informational Semantic Interoperability

The diagram illustrates the integration of various healthcare systems around a central EHR (Electronic Health Record) hub. The central EHR is represented by a large orange block with icons for a stethoscope, syringe, ECG, and a human skeleton. It is connected to several other systems via double-headed arrows:

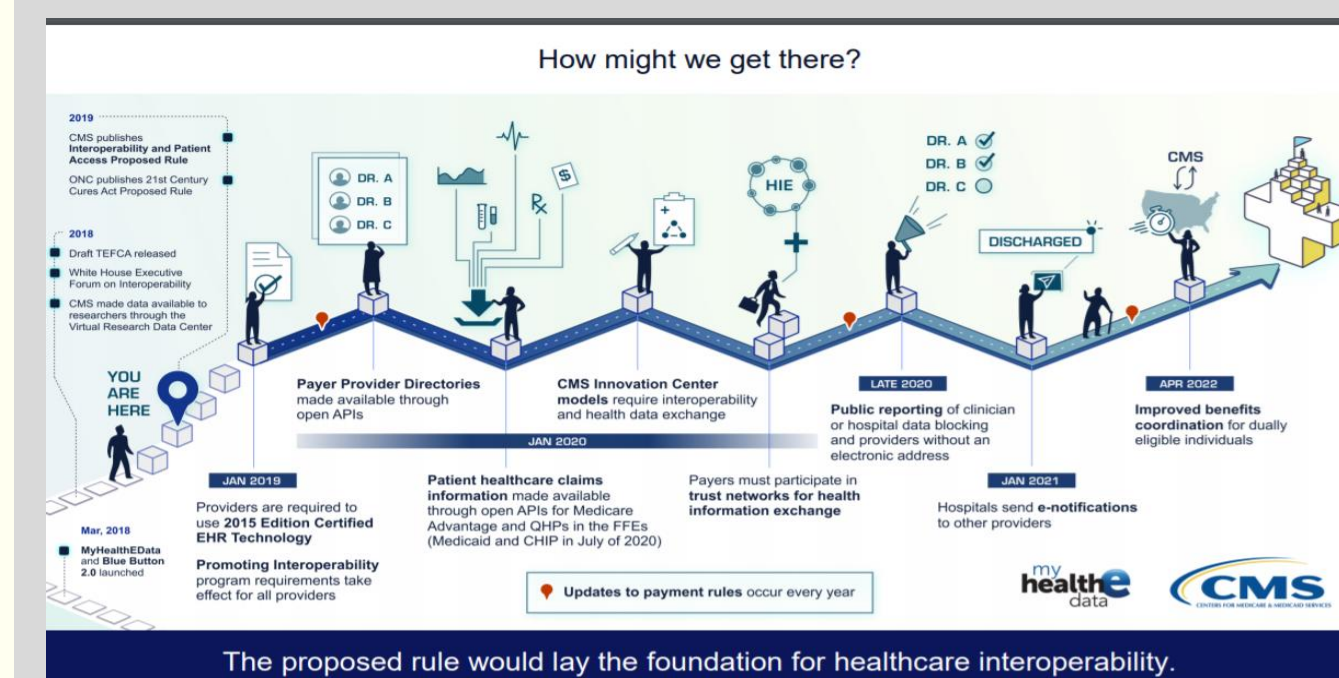
- Patient Identity References** (top left): Common patient identifier links information managed by different systems, departments, organizations. Icon: Two people silhouettes.
- Billing** (top right): Clinical events and master list items are used to create billing items and insurance claims for services (e.g. radiology procedures). Icon: Money bag with dollar sign.
- Scheduling** (middle right): Scheduling encounters, diagnostic procedures, other services. Icon: Clock.
- Patient Identity** (bottom right): Identity management, cross-referencing, managing identifiers (i.e. master patient index). Icon: Two people silhouettes.
- Diagnostic Imaging** (bottom center): Ordering and reporting findings. Icon: Human skeleton.
- Information Exchange** (bottom left): Consistent, computable semantics, context, and provenance across semantic boundaries including complex flow sheet information. Icon: Double-headed arrow.
- ICU** (left): Intensive Care Unit. Icon: ECG and two people silhouettes.
- Radiology** (bottom left): Ordering and reporting findings. Icon: Human skeleton and clock.
- Echo Lab** (middle right): Echocardiography laboratory. Icon: Clock and two people silhouettes.
- MPI** (bottom right): Master Patient Index. Icon: Two people silhouettes.

- In healthcare, LOINC, SNOMED CT, RxNorm are the primary clinical terminologies to support treatment, payment, research, clinical decision
- Terminologies are readily useable
- Provided to applications via drop-down lists, allowable value sets, and look-up functions
- By using established terminologies, the meanings of data are retained over time, making them durable

- **Is necessary** for interoperability
- **Within the enterprise and with external partners:** A system's semantics need to be consistent with other systems in the enterprise and beyond
 - A pre-requisite to seamless care, good clinical outcomes, and quality care for Veterans
 - Ensures information can be shared across systems and with community care
- **Is Processable by Systems**
 - without human intervention
 - Information flows across system boundaries to support treatment, payment, operations, and research

Context

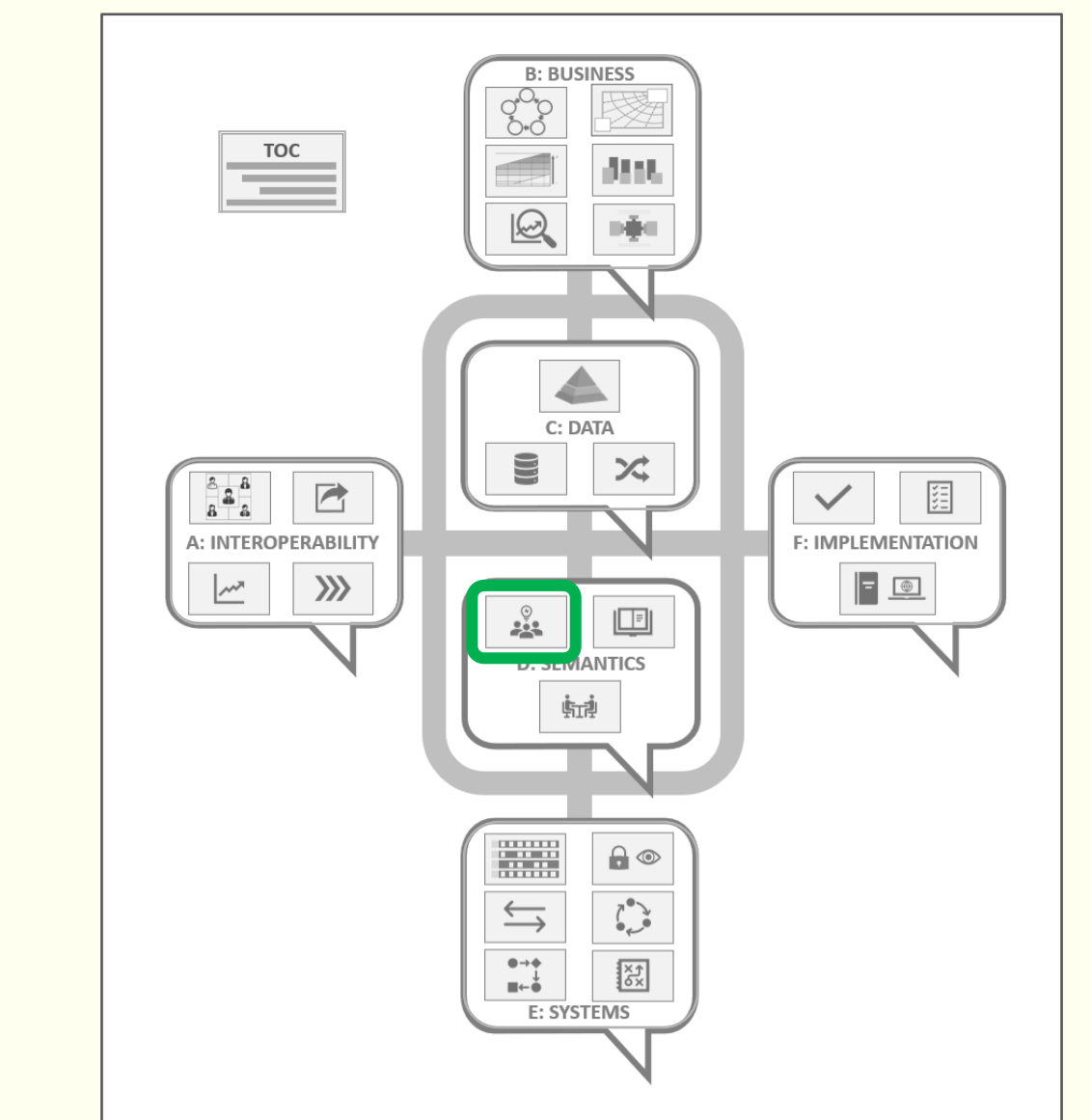
- Circumstance (timing, purpose) for performance or request
- Data necessary to interpret the concepts in order to safely and effectively support decisions and computable processes



	Myth	Reality
	“The latest standard-based protocol will automatically lead to semantic interoperability”	Standard-based exchanges are preferable to proprietary solutions or vendor lock-in but the semantics of the data are more important to successful interoperability than the choice of standard or protocol
	“C-CDA will solve all our transition-of-care problems”	Without high-quality implementation guidance technology and standards don't lead to interoperability
	“FHIR will definitely solve all our problems because it's better than...”	Without consistent information semantics, the sender and receiver will misinterpret information regardless of standard / format / protocol
	“FHIR APIs will solve all our interoperability problems because anyone can implement it without any health IT experience”	Exchanging inconsistent information more easily will lead to the wrong invalid medical decisions as providers rely on information systems rather than provider-to-provider communication

Term	Definition
C-CDA	Consolidated Clinical Document Architecture
Cures Act	21st Century Cures Act
FHIR®	HL7 Fast Healthcare Interoperability Resources
LOINC	Logical Observation Identifiers Names and Codes
MPI	Master Patient Index
RxNorm	Normalized names for clinical drugs linked to pharmacy and drug interaction systems
SNOMED CT	Systematized Nomenclature of Medicine Clinical Terms
USCDI	US Core Data for Interoperability

VA PUBLIC REFERENCE
Ethics Principles for Access to and Use of Veteran Data
INDUSTRY REFERENCE
CMS Provider Burden, Patient Access, and Interoperability Roadmap

[illegible]

At a Glance:

Information semantics has reached a level of maturity that allows the enterprise to record and reuse consistent, interoperable information....

That preserves its meaning and context across semantic boundaries and can be used for research, analysis, billing, and outcome analysis.

A semantically interoperable system-of-systems must meet enterprise requirements and also meet national regulatory requirements and certification criteria applicable to health IT software (e.g. EHR systems)

Aligned with VAIL Interop Maturity Model

Information semantics maturity in i-VA follows a CMMI approach and recognizes the importance of accurate and complete information

- Precise coded concepts using reference terminology defined by national regulation and best-practices
- Contextual information that provides the details necessary to process and interpret information across semantic or system boundaries
- Improving the quality of information by introducing enterprise governance processes for improvements of semantics, context, and provenance at the right level of granularity

Key Concepts

Information semantics applies to any type of information exchange regardless of format, protocol, or approach (APIs, transaction documents).

- Terminology: in the context of interoperability, terminology represents the set of code systems, value sets, and other constructs that govern the meaning of information in such a way
- National regulatory requirements are driving the standardization

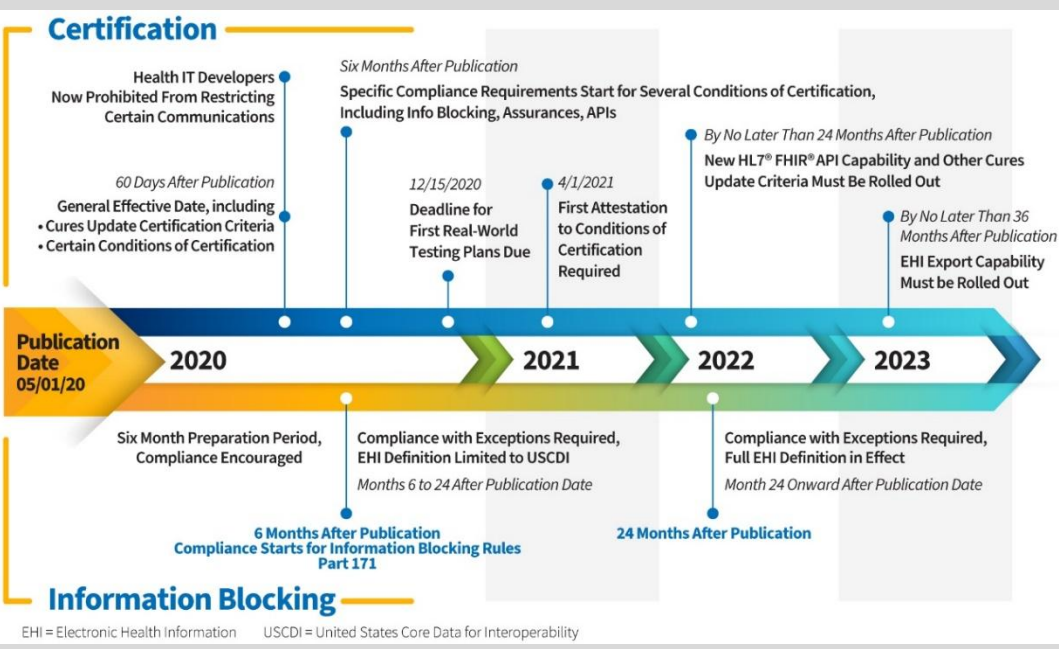
Drivers for Semantic Maturity

VA information maturity must respond to the regulatory requirements included in ONC Interoperability Rule that mandates the use

Health IT products including EHR systems will be certified according to criteria published by the ONC in conjunction with CMS updates to payment and reimbursement rules.

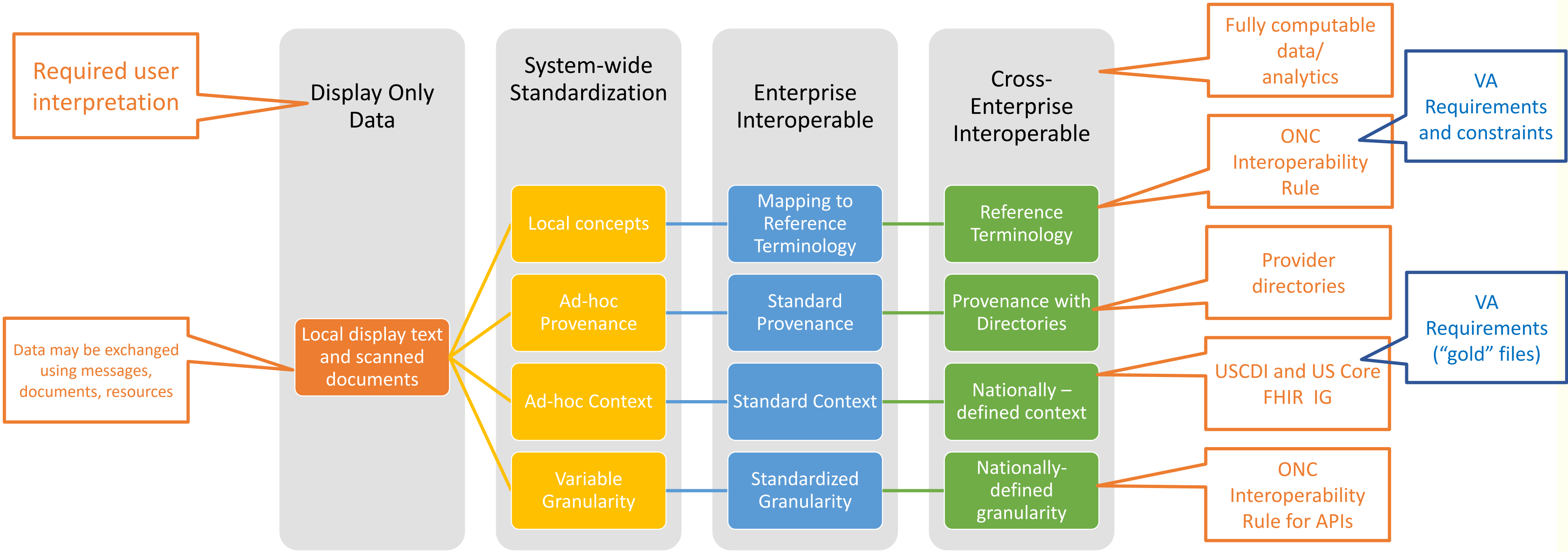
Therefore the health IT, including VA, DoD, and its industry partners must align with overarching interoperability drivers mandated by CMS in collaboration with ONC. This includes the EHR modernization efforts underway within VA.

Certification and Regulatory Milestones



i-VA Blueprints

Maturing Informational Semantics Across VA and Beyond



Maturing Use of Coded Data and Terminology

Limited use of codes and coded data

- Reliance on locally-defined terms, text labels, abbreviations
- Terminology maps used to send/receive/interpret data
- Human/expert interpretation needed for safe data
- Standards-based concepts used for key data elements
- Terminology maps optional for nationally-required terminology use (ONC)

Local codes used to address identified gaps in mandated standards (e.g. SNOMED CT, LOINC)

- Standard-based terminology based on latest ONC Interoperability Standards Advisory (ISA) vocabulary, code sets, terminology standards.

Local codes apply national code systems and value sets, current with ONC ISA (no gaps).

- Only standards-based codes used for information exchange
- Consistent use of national standards re: terminology
- Reuse and contribute to VA standardized terminology
- Able to support and adopt new concepts (e.g. COVID-19, CMS Rules Changes)

Agile processes to adopt and create new terminology extensions based on research, outcomes, clinical practice, and evolving workflows

Maturing Information Granularity

Information provided in format selected by sender, one-size-fits-all.

- No adjustments for intended use (e.g., summary health records).
- Granularity is either too coarse (excessive aggregation) or too fine-grained
- Contextual elements missing, stripped, or necessitating human interpretation.

Standards-based data granularity to ensure that system users have access to the most accurate view of Veteran's data using industry best-practices and reference terminology.

Information can be processed correctly (transactions, documents, distinct resources, APIs).

- Meets national guidance and interoperability rules
- Interfaces determined in advance at "design time"; Consumers can choose relevant granularity by interface

Data can be provided in form and format needed by requester;

Data conduits capable to adapt to changing needs (dynamic representation)

Maturing Information Provenance

Text-based provenance information

- Based on local provider and organization identity
- Provenance requires human interpretation

Structured provenance

- Based on enterprise identifiers
- Using national guidance for
- Partial computability of provenance information

Standards-based, computable provenance

- Follows national guidance on patient-generated, locally, and externally authored information
- Provider and organization identify validated by using enterprise registries

Seamless processing of provenance across enterprise

- Seamless support for patient and provider generated information
- Provider and organization identify validated by using national registries

Maturing Information Context

Text descriptions convey relevant context about the data

(e.g. related info, reason, frequency, occurrence)

Contextual requires human interpretation.

- Hybrid use of free-text and structure to represent information context; both standardized and local representations used.

Unstructured/text-based context requires human interpretation.

- Context conveyed using structured representation and standard concepts.

Context can be processed automatically; suitable for clinical decision support and automation

Agile process to enhance contextual information and improve outcomes based on industry drivers

Context enriched from sources outside the system or enterprises.

Myth Busting

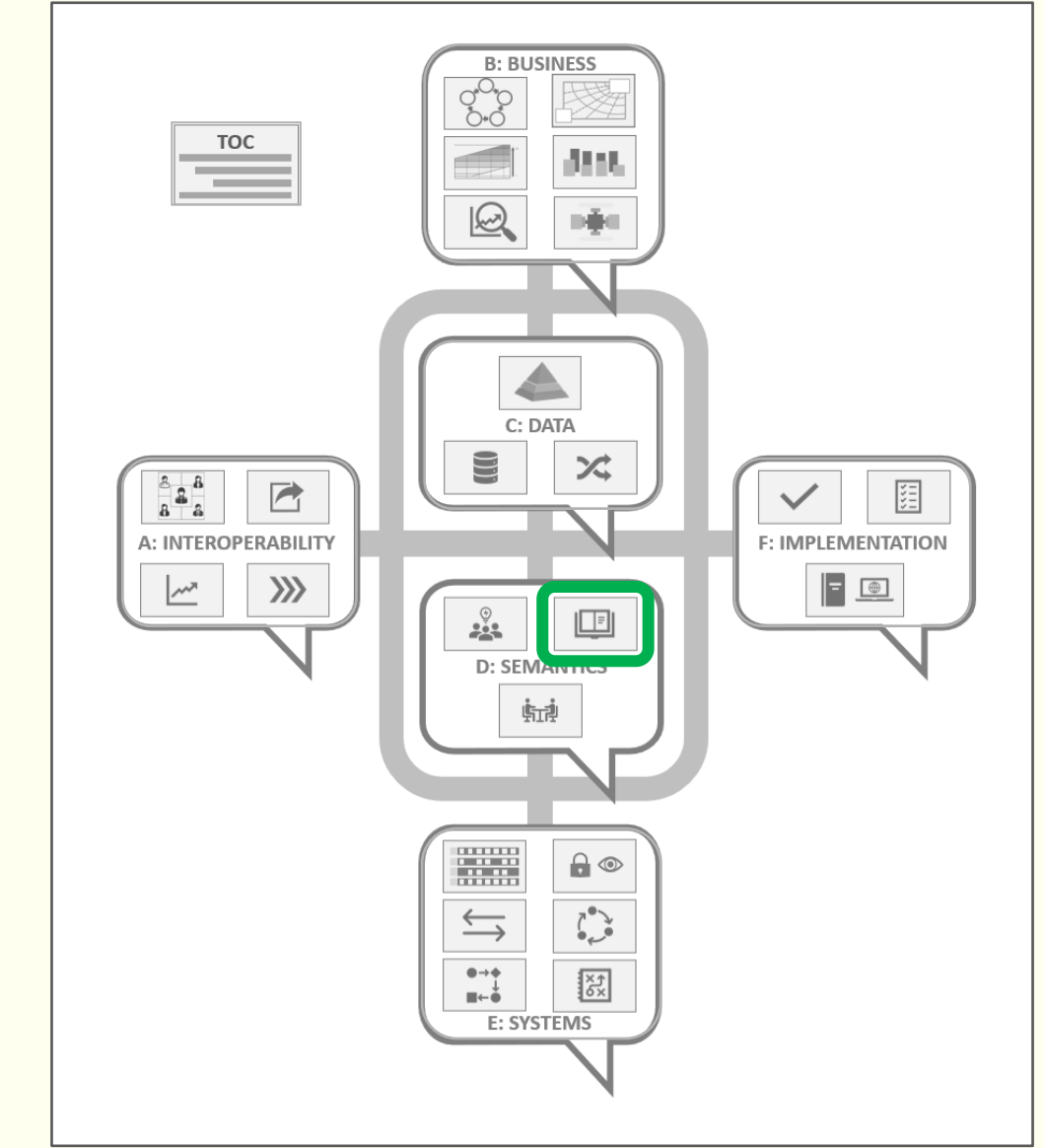
Myth	Reality
"With the right software tools, middleware, and technology we will have semantic interoperability across our organization"	Software tools allow an enterprise to accelerate the design and deployment of interoperability solutions, but they don't guarantee data quality and semantic consistency without explicit governance
"Our enterprise service bus is so great it will solve all our interoperability needs"	Transforming and cleansing of data is limited by quality and completeness of source systems ("garbage in, garbage out")
"We can integrate any system even if it doesn't use standard semantics or protocols and even if don't know that they support all the data needed because we have the greatest interface tools"	The quality and semantic information exchange by systems cannot be improved by software tools, standards, or technology alone. Be aware that there are open-source APIs and reference implementations of FHIR that provide guidance in exchanging information of high semantic quality.

Glossary of Terms

Acronym	Definition
CMMI	Capability Maturity Model Integration
FHIR US Core IG	FHIR US Core Implementation Guide that meets USCDI data requirements
ISA	Interoperability Standards Advisory
LOINC	Logical Observation Identifiers Names and Codes
RxNorm	Normalized names for clinical drugs linked to pharmacy and drug interaction systems
SNOMED CT	Systematized Nomenclature of Medicine Clinical Terms

Further Reading

VA INTERNAL REFERENCE
VAIL Interoperability Maturity Model
INDUSTRY REFERENCE
FHIR Registry of US-realm Implementation Guides
ONC Interoperability Rule: Health IT Certification Process
HL7 FHIR US Core



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At a Glance:

- Projects and systems across VA must ensure they exchange standards-based, semantically interoperable data sets must reuse and leverage national best-practices and guidance
- The needs of the VA enterprise to remain consistent with industry best-practices, national regulations (e.g. ONC Interoperability Rule), 21st Cures Act, and US Core Data for Interoperability (USCDI)

Relevant Audiences

Project teams:

- Implementers
- Project and product managers
- Business analysts

Information semantics and consistency has an outside effect on the ability of system users to their work effectively, to be efficient and to deliver outstanding outcomes to Veterans.

Key Concepts

- Interoperability rules influence how terminology standards
- ONC Interoperability Standards Advisory (ISA)
 - National guidance for terminology identifies code systems and value sets applicable across domains.
 - VA Enterprise standardized clinical domains identify those semantic domains that have been optimized for Veteran care and are necessary to facilitate cross-enterprise semantic interoperability.

Approach

Projects are expected to proceed in a systematic workflow:

- 1 Information semantics including coded data elements are identified and analyzed in the context of the project's overall requirement to ensure they serve Veterans needs
- 2 Project teams can seek guidance from the KBS team and reuse existing vocabulary guidance from VA and from the Office of National Coordinator for Health IT and CMS via Interoperability Standards Advisory
- 3 It is preferred that project teams reuse National and VA standardized terminology, if available but it's possible that Veteran care may require additional terminology guidance.
- 4 If the terms and concepts required to meet the projects are included in standards and already subject of VA standardization, the KBS Terminology team will use methodology, architecture, and SOPs to fill the remaining gaps

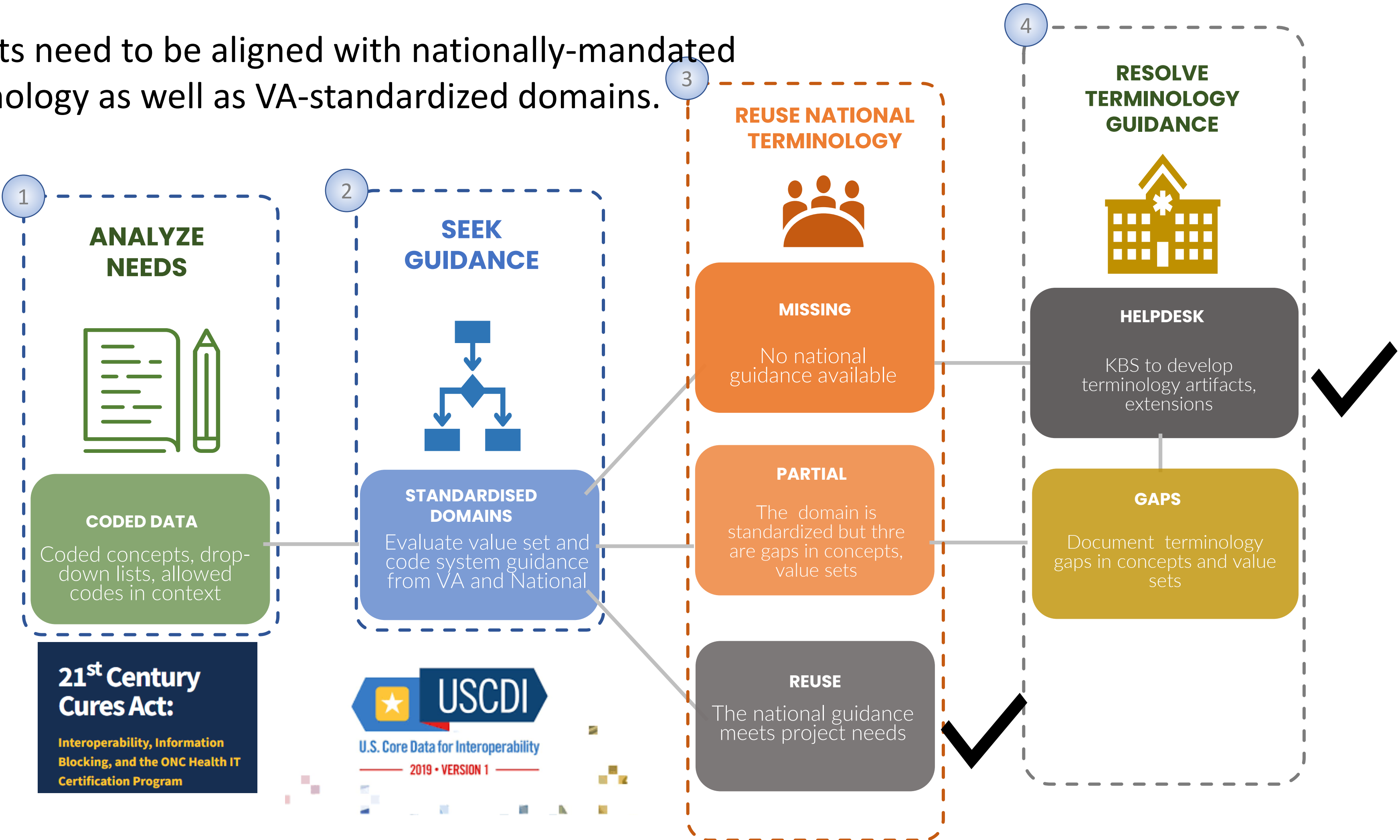
Engagement with ONC re: USCDI to address missing standards

Interoperability is determined by internal and external drivers. If a project identifies that If VA projects discover additional data elements necessary for Veterans health, social history, etc., ONC provides ONDEC (ONC New Data Element and Classes) submission process.

i-VA Blueprints

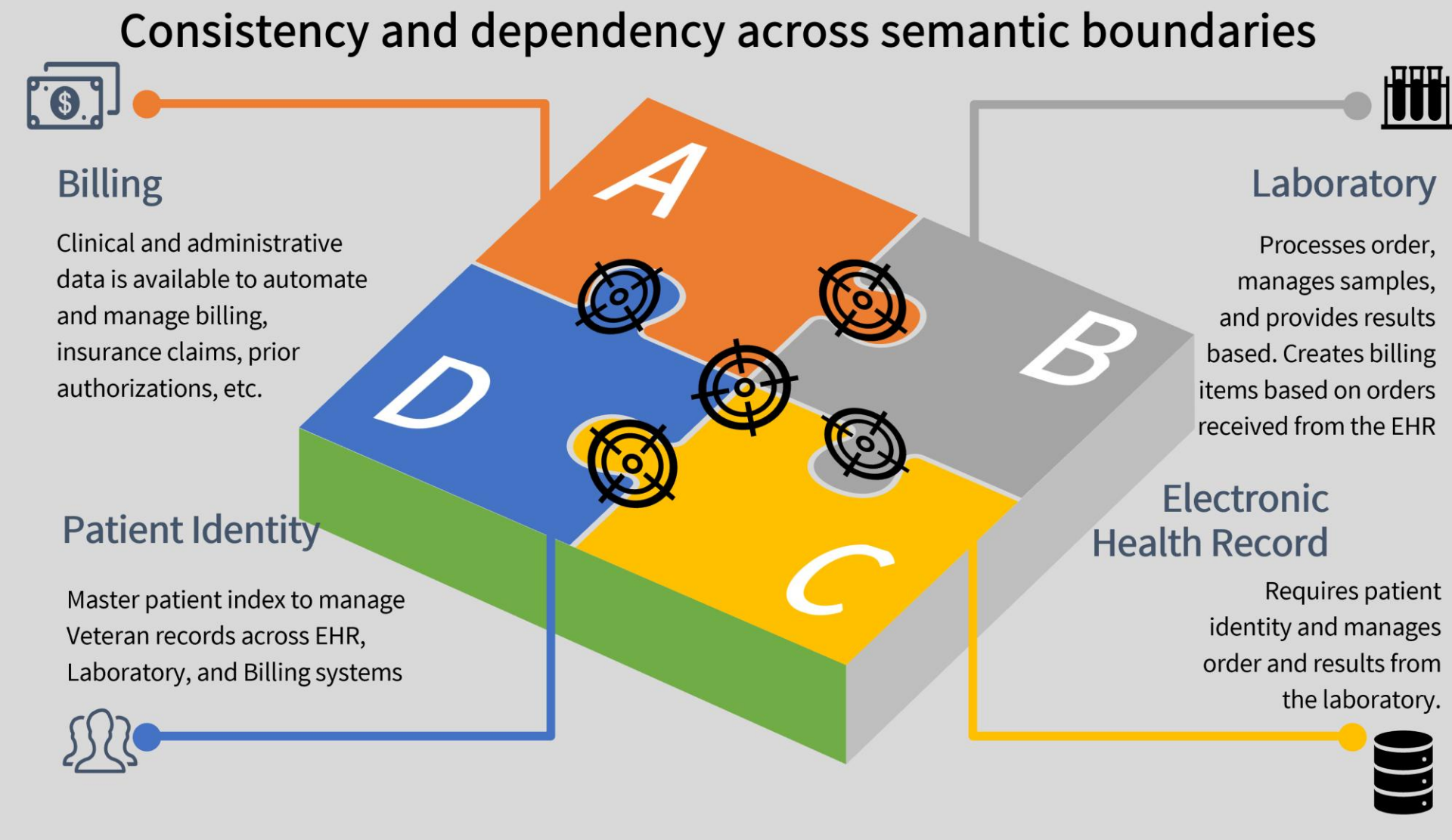
Standardizing on Concept Representation

Projects need to be aligned with nationally-mandated terminology as well as VA-standardized domains.



Interoperability Requires Standardized Terminology Domains

- Each project is expected to use information from existing systems to reuse information:
- For example, identify information must be standardized across semantic boundaries
 - Point-of-care information must be used for financial and other management functions.



Reuse National and VA-wide guidance

Types of guidance available:

- VA guidance on standard domains: Terminology, and Master data sets “gold files”
- US guidance: ISA is updated on a yearly basis and the specification versions are advanced using SDVAP
- KBS assistance/guidance: Terminology, Standards, and Engagement

Resolve gaps in terminology, guidance, and data elements

If a project identifies new data elements that are necessary for VA/Veterans, they have two choices:

- Maintain the data elements in “gold” data sets
- Submit new data elements to ONC using ONDEC process

Veteran safety issues take priority over other concerns/reasons to submit new content to ONC due to the complexity of submission justification and documentation requirements.



Myth Busting

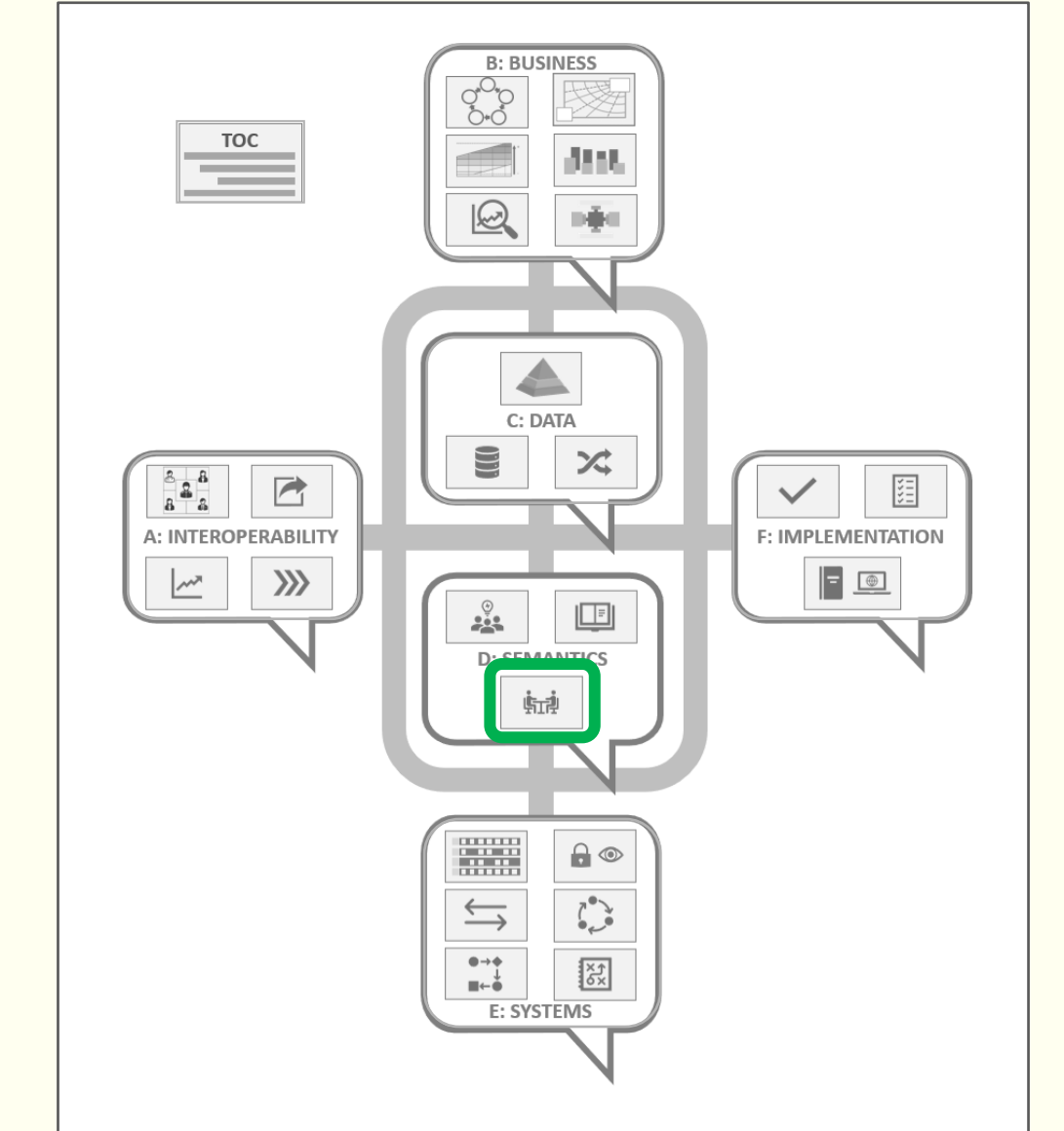
Myth	Reality
"There is no standard terminology for my project; therefore, I need to use locally-defined concepts."	Standards can be extended and enhanced to meet patient needs. Projects must be aligned with nationally-mandated terminology as well as VA-standardized domains.
"The problem with standards is that there are so many to choose from."	Meaningful Use and the ONC Interoperability rule provide guidance on the use of specific value sets and code systems. Choice of terminology is not helpful for interoperability across the VA (or any other provider organization). Therefore, regulations are working to be more specific and prescriptive for coded data.
"If a concept doesn't exist in a standard code system, it must not be relevant."	Standard terminology is intended to evolve to meet the needs of clinicians and administrators. Therefore, they intended to grow over time as medical and regulatory requirements change. The requirements dictate terminology not the other way around.

Glossary of Terms

Term	Definition
CMS	Center for Medicare and Medicaid Services
Cures Act	21st Century Cures Act
ISA	Annual Interoperability Standards Advisory
KBS	VHA Office of Knowledge-based Systems
ONC	Office of National Coordinator for Health IT
ONDEC	ONC New Data Element and Classes
USCDI	US Core Data for Interoperability
SDVAP	Standards Version Advancement Process

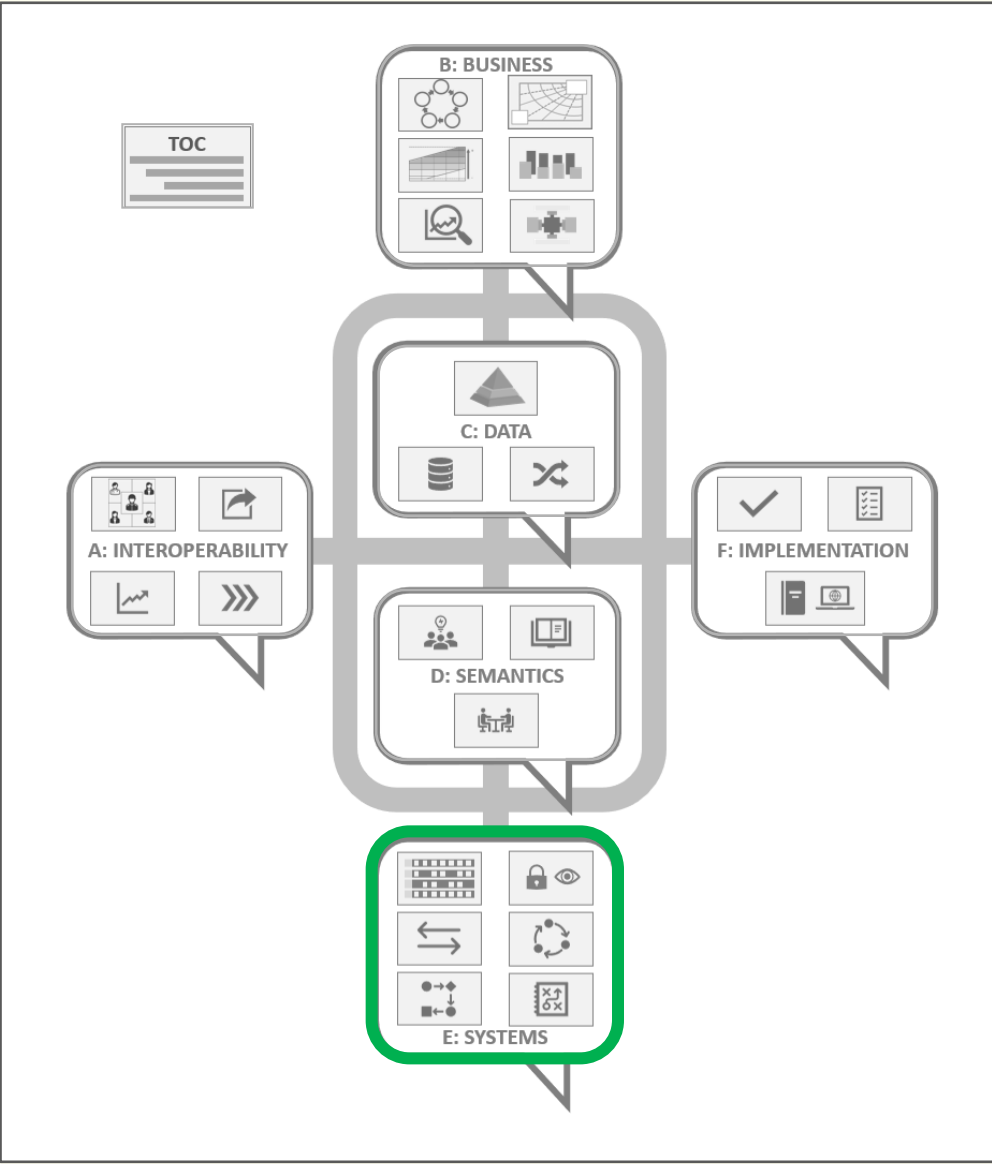
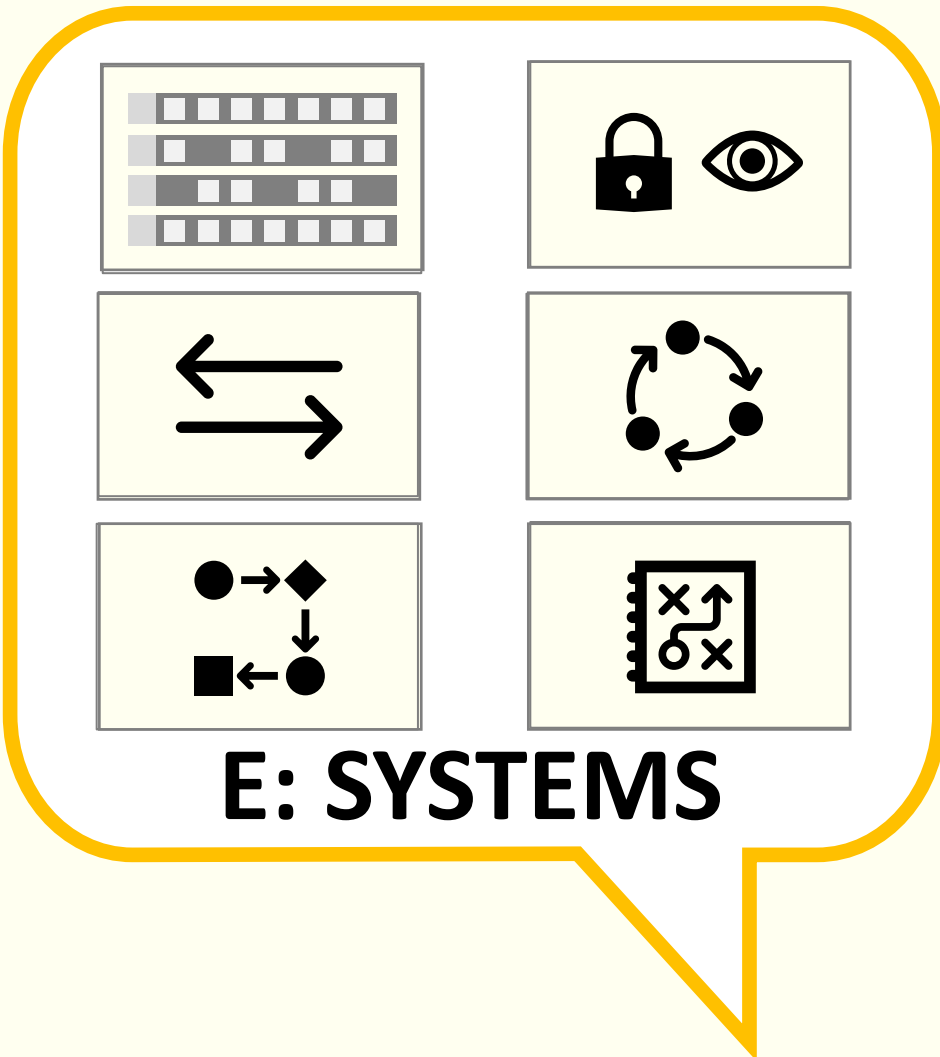
Further Reading

VA INTERNAL REFERENCE
CIDMO Clinical Practice Guidelines
VA PUBLIC REFERENCE
VA Standardized Data Domains
INDUSTRY REFERENCE
ONC Vocabulary Guidance



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Section E – Systems Design and Implementation



- The ability to leverage common components and packaged capabilities across use cases fosters business and IT agility
- Platforms are technical infrastructure pieces designed to fit together and which can be used in concert
- Patterns are reusable, proven designs to address specific problems or challenges.

- Platforms are a set of underlying infrastructure capabilities that can be leveraged across systems and programs
- Key to platforms is their integrative nature; components complement one another
- Platform components serve as “building blocks” to compose more complex capability offerings
- Platform capabilities are exposed via [APIs](#)
- Coordination among discrete capabilities to fulfil workflow is called [orchestration](#)

- Name:** Short Name makes for easy referencing of a pattern and facilitates communication/understanding
- Intent:** Characterizes the goal or design purpose of the pattern; the gestalt of the approach.
- Problem:** Illustrates the principal purpose of the pattern; the nature of problem it solves
- Solution:** Explains what the pattern is, how it is constructed, where it was discovered, how it is used
- Consequences:** Considerations to keep in mind when using a pattern: known issues, tradeoffs, etc.

Pattern Name	Pattern Type	Pattern Name	Pattern Type
API Documentation Standard	? Integration Pattern	Cloud Migration Framework	? Integration Pattern
API Management	? Design Pattern	Enterprise Secrets Management	? Design Pattern
API Release Standard	? Business Pattern	Single Sign On	? Business Pattern
Cloud-based 3D Printing Services		User Account Restoration	...
Image and 3D Model Data Security			
Documenting API Security			
User ID Federated Authentication			
GovCloud Deployment Model			
		More...	

The diagram illustrates the relationship between four domains: Business Process Domain, Line of Business Domain, Product Management Domain, and Information Technology Domain. It uses various patterns to represent different types of relationships and components.

- Business Process Domain:** Includes components like Portfolio, Value Stream, Business Process, and Process Step. It features swimlane patterns for Design, Integration, and Data.
- Line of Business Domain:** Includes components like Portfolio, Line of Business, and Business Function. It features swimlane patterns for Design, Integration, and Data.
- Product Management Domain:** Includes components like Product Line, Business Product, and Business Capability. It features swimlane patterns for Design, Integration, and Data.
- Information Technology Domain:** Includes components like IT Services Portfolio, Consumer IT Service, Internal IT Service, and IT Platform. It features swimlane patterns for Design, Integration, and Data.

The diagram is annotated with various elements, including swimlane patterns, swimlane notes, and swimlane comments. It also includes a legend for the swimlane patterns and a legend for the swimlane notes and comments.

Swimlane Patterns Legend:

- Design Pattern
- Integration Pattern
- Data Pattern

Swimlane Notes and Comments Legend:

- Swimlane Note: What is the relationship?
- Swimlane Comment: What are the relationships between the pattern types?

- Assess business requirements to understand needs and context
- Business patterns identify thematic problems and high-level solution factors to consider (known issues, approach styles, implantation considerations)
- Identify relevant enabling capabilities (e.g., [Packaged Business Capabilities](#)) involved in service fulfillment/delivery
- Review technical patterns to select and determine coordination requirements
- Apply orchestration techniques to coordinate among components as part of delivery/fulfillment
- Assess implications and mitigate against identified delivery risks
- Review the VA Pattern Catalog for potential candidates; survey existing implementations for examples and lessons-learned

Platforms and Patterns	E-1
------------------------	-----

At a Glance

- Engage in standards development efforts and advocate for VA's privacy and security requirements
- Monitor emerging and nascent healthcare IT technologies with emphasis on security and privacy aspects.
- Monitor emerging and nascent security and privacy technologies with the emphasis on the application in healthcare IT.
- Interoperability as a cross-cutting concern across all the efforts.
- Focus on formulating requirements and implementation guidance.

Target Audience

- Executives looking for high-level briefing on privacy and security technologies and requirements.
- Technical staff drafting requirements for acquisition.
- Internal developers and implementers.
- External Implementers and vendors.

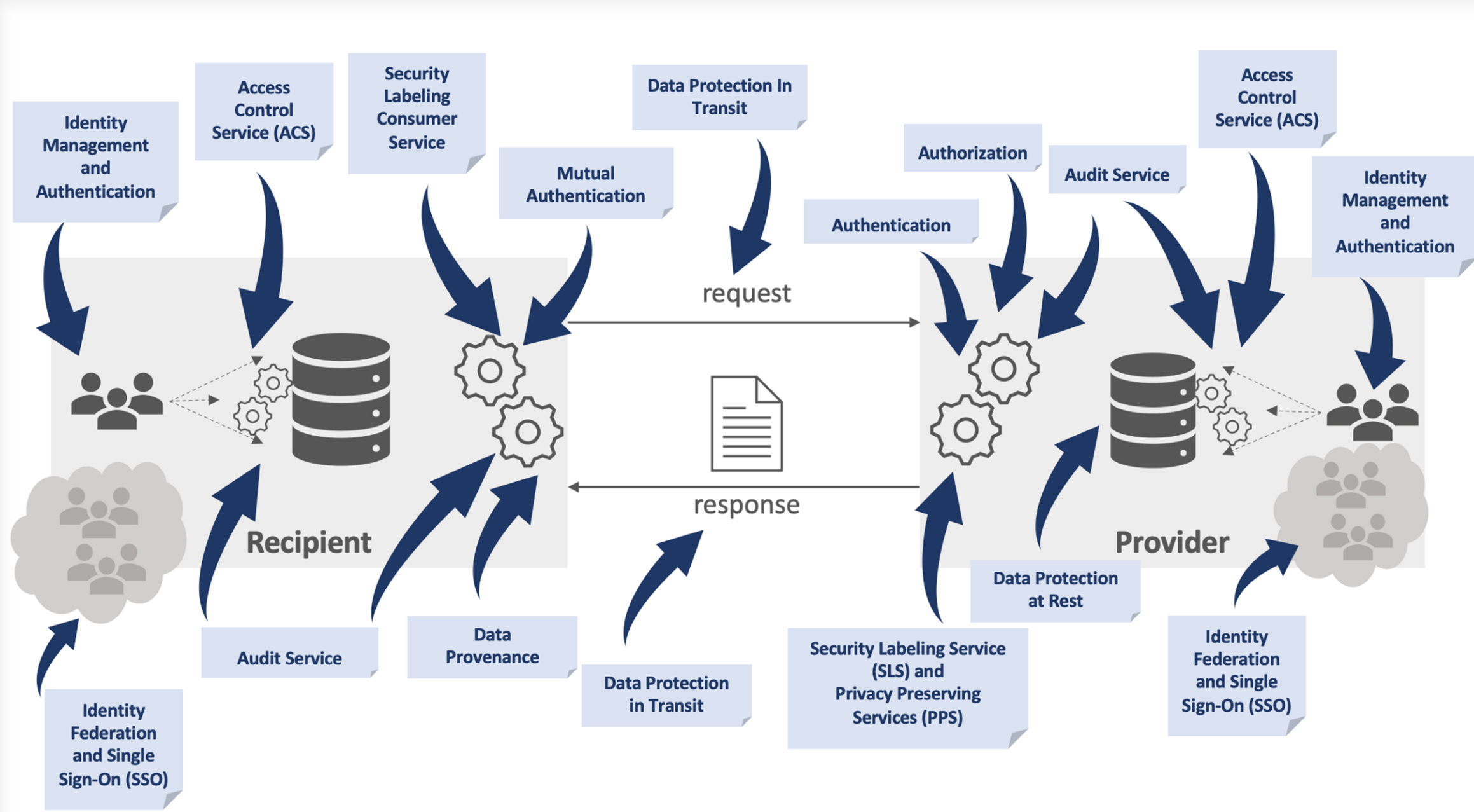
Key Concepts

- **Security:** Protection against unauthorized access and disruption. Confidentiality, integrity, and availability of data and services.
- **Access Control:** Protective service ensuring data and services are only accessible to authorized entities.
- **Privacy:** Individual right to protection and exercise control control over how it is processed and used. While security and access control technologies are often used to protect privacy, privacy requirements are much broader and include requirements to record and provide access to information; for example, patient's right to access their health record and record of release.
- **Security Label:** Metadata tags used to associate security attributes with a specific information object as part of the data structure for that object. For example, a confidentiality mark indicating a data object contains *restricted* information.
- **Data Segmentation for Privacy (DS4P):** marking information using security labels based on the level of privacy protections required according to overarching policies and regulations. Processing information by enforcing the appropriate privacy protections (based on policies) for each segment of the data.
- **Security Labeling Service (SLS):** A service that determines and assigns security labels to data objects based on applicable rules such as security and privacy policies, patient consent, and business workflow requirements.
- **Identity Management and Authentication:** a set of technologies and processes to onboard users, issue credentials for them, maintain their identity and attributes, and ensure that they can be identified suing their credentials.
- **Audit Service:** a set of processes and services that define what events in the system should be tracked and recorded in order to ensure accountability and tracking.
- **Provenance:** The record and timeline of the processing and changes to a data object; for example, the detailed metadata about the creation, transformation, and updates of a data object.

i-VA Blueprints

Security and Privacy Considerations

The Big Picture



Data Segmentation for Privacy Example: FHIR

- Security labels on individual resources and resource collections.
- **Inline security labels** enable recording a security label on a portion of a FHIR resource via an extension. This extension provides a powerful mechanism to assign security labels at the sub-resources level and at various levels of granularity.
- **Data Segmentation Metadata** defined by FHIR DS4P IG provides the tools to record additional metadata about security labels.
 - The **display extension** enables a provider to record the requirement for the consumer to display specific privacy or security marks on any rendering of the resource in print or in electronic user interfaces.
 - The **Security Label Basis extension** enables a provider to record the policy or regulation based on security label assigned.
 - The **Related Artifacts** extension enables a provider to record related artifacts (e.g., a patient consent or a provenance) that provide additional justification or explanation for the assignment of the security label.
 - The **Classifier extension** enables a provider to record the identity of the entity (e.g., person, organization, software service) who has determined and assigned the security label.

Security Labels

Confidentiality	Classifying a resource according to its level of sensitivity	Unrestricted, Normal, Very Restricted
Policy	Conveying a mandate, obligation, requirement, rule, or expectation relating to its privacy.	HIPAA Right of Access Directive, GDPR consent
Sensitivity	Categorizing the value, importance, and vulnerability of a resource.	STD, HIV
Compartment	Indicating that access and use is restricted to members of a defined community or project.	Care Team, Research Project
Integrity	Conveying the completeness, veracity, reliability, trustworthiness, and provenance of a resource.	Anonymized, Digitally Signed
Provenance	Conveying the provenance of the resource as asserted or reported.	Patient Reported, Clinician Asserted
Trust	Conveying the basis for trusting the source.	Trust Accreditation, Trust Agreement
Purpose of Use	Conveying the reason for performing one or more ops on information.	Treatment, Pymt, Operation, Research
Purpose of Use	Conveying the reason for performing one or more operations on information of purpose of use at a general level.	Coverage, Patient Requested, Emergency Treatment
Obligation	Conveying the mandated workflow action that an information custodian, receiver, or user must perform.	Encrypt, mask, comply with policy
Refrain	Conveying prohibited actions that the receiver is not permitted to perform.	No disclosure, reuse without consent,
CUI Privacy Mark	Conveying a displayed mark, required to be rendered to indicate that the electronic or hardcopy information is protected as CUI.	CUI, SP-CUI
Sec. Label Mark	Conveying a displayed mark rendered as specified.	Draft, Confidential
Sec. Authz Policy	Conveying specific permissions used for access control.	Authorization policy, Delegation policy

Privacy and Security for Emerging Technologies

FHIR Bulk Data Access

- Authorization requirements to control whether a client's request for bulk import or export should be permitted.
- Filtering requirements to control, at a more fine-grained level, what will appear in the results of an export, or accepted in an import operation, based on the details of the permissions granted to a client.
- Transformation requirements to apply functions on imported or exported resources to modify and transform their content such as de-identification.
- Provenance requirements for recording and consumption of provenance information in an export or import operation.

FHIR Subscription

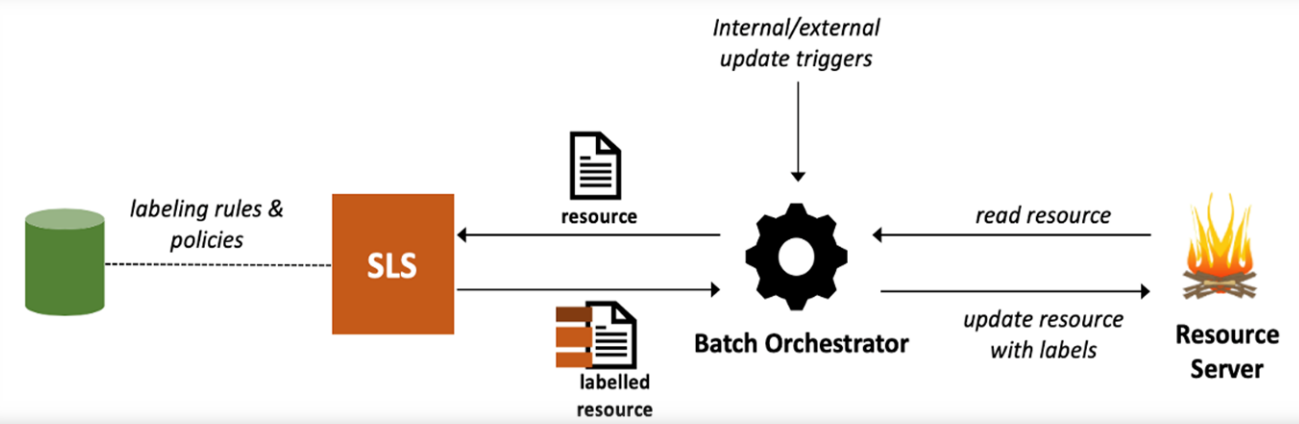
- Requirements for access control over subscription management functions.
- Requirements to ensure Recipient's Consent
- Requirements to ensure sustained and authorization throughout the lifetime of the subscription
- Requirements for managing revocation of authorization
- Requirements to invoke Security Labeling and Privacy Preserving Services
- Requirements to ensure the authenticity of notifications

FHIR Sub-Resource Access (e.g., GraphQL, FHIRPath)

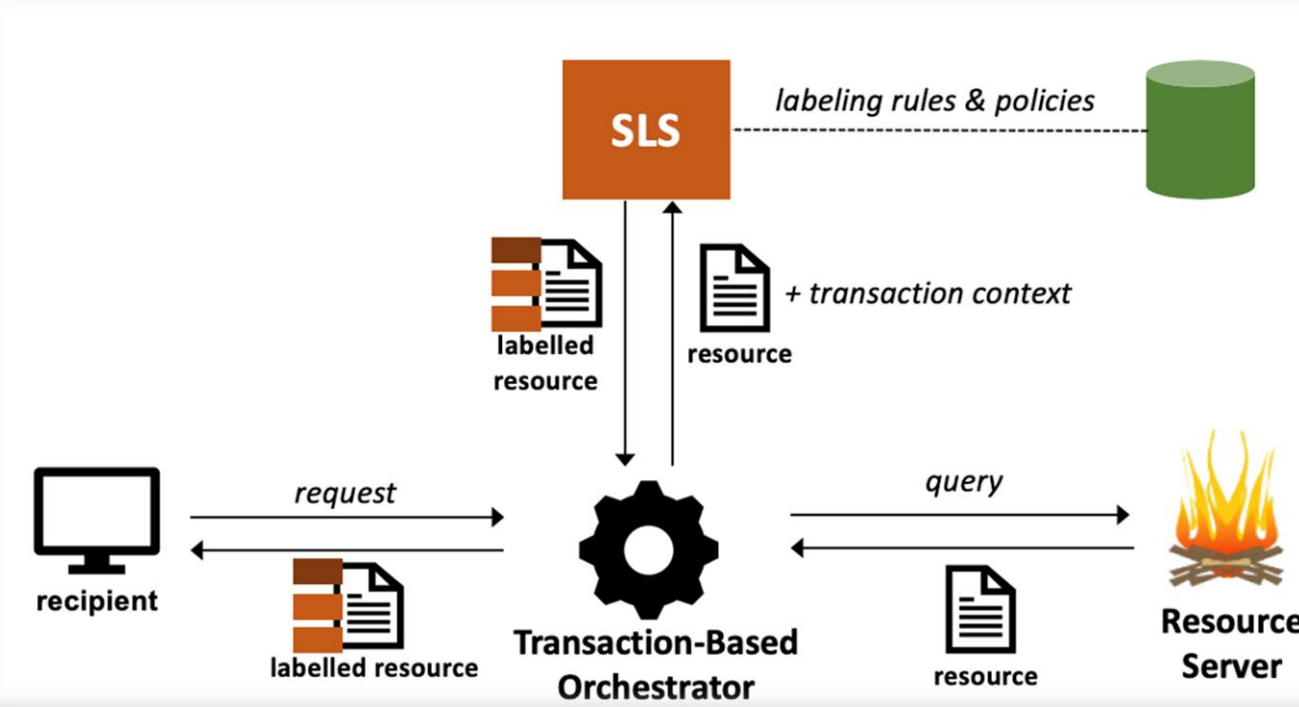
- Authorization requirements to control whether sub-resource access should be permitted at all, based on policies, request context, and the client's credentials and granted clearances.
- Requirements for assigning security labels to outgoing data objects resulting from fulfilling a sub-resource access,
- Requirements for filtering and redaction requirements to optionally remove certain values from collections based on the client's clearances and policies.
- Provenance requirements to ensure the capabilities for tracking and recording the provenance for the data objects created by sub-resource access.

Security Labeling Service Implementation Models

Batch labeling for data at rest or bulk-imported data



Transaction-Based on-the-fly labeling



Myth Busting

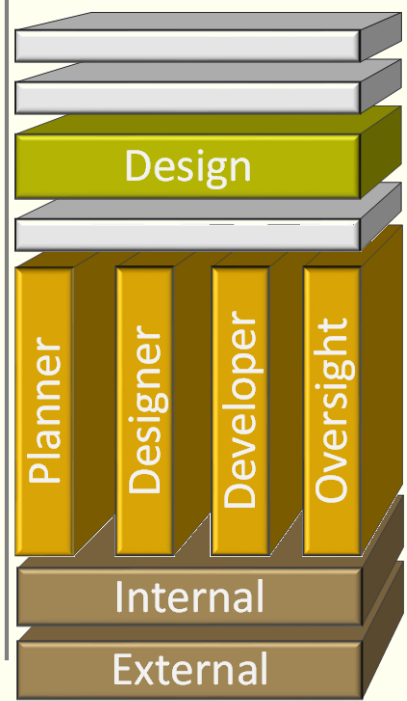
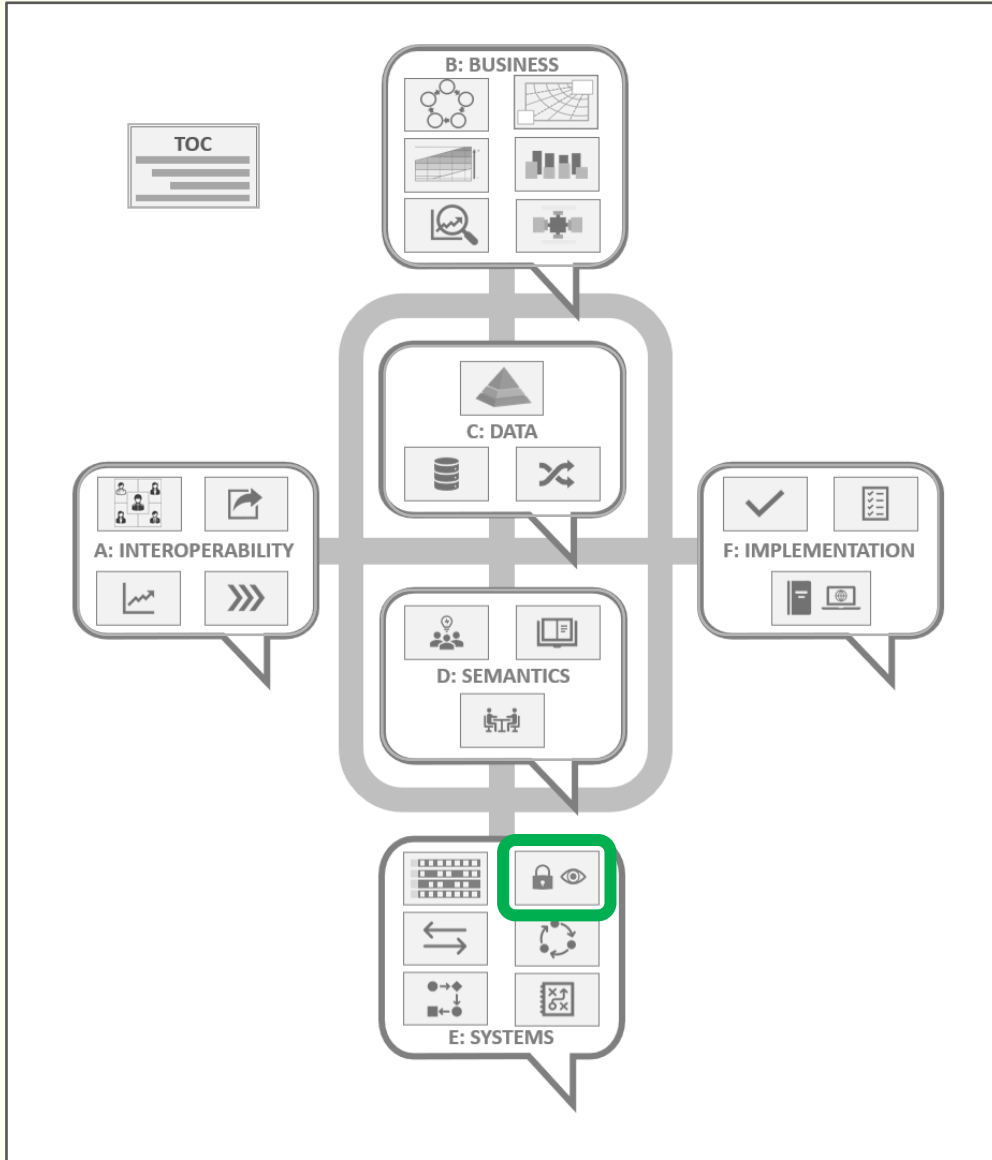
Myth	Reality
 OAuth and FHIR will bring security/vulnerability.	OAuth and FHIR are simply specifications. The devil is in the details of how they are implemented, configured, and deployed. FHIR and OAuth per se will not necessary introduce security or vulnerability.
 Security Labeling leads to information blocking	Information blocking is a result of policy decisions; security labeling is a policy-neutral technology. For example, security labels can be as informative for a consumer without withholding any information.
 Data Segmentation can jeopardize patient safety by enabling patients to hide information from a clinicians	The extent of a patient's control is still subject to policies. Clinical Decision Support systems can alert clinicians to break the glass when patient safety concerns arise. Lack of control over sharing can also jeopardize patient safety by diminishing patient's trust and willingness to confide sensitive information.

Glossary of Terms

Acronym	Definition
DS4P	Data Segmentation for Privacy
FHIR®	HL7 Fast Healthcare Interoperability Resources
SLS	Security Labeling Service

Further Reading

VA PUBLIC REFERENCE
VHA-Sponsored Security and Privacy Papers
Ethics Principles for Access to and Use of Veteran Data
INDUSTRY REFERENCE
HL7 FHIR Security & Privacy Module



Contact:	VHA Knowledge-based Systems	
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Security and Privacy Considerations	PAGE
		E-2

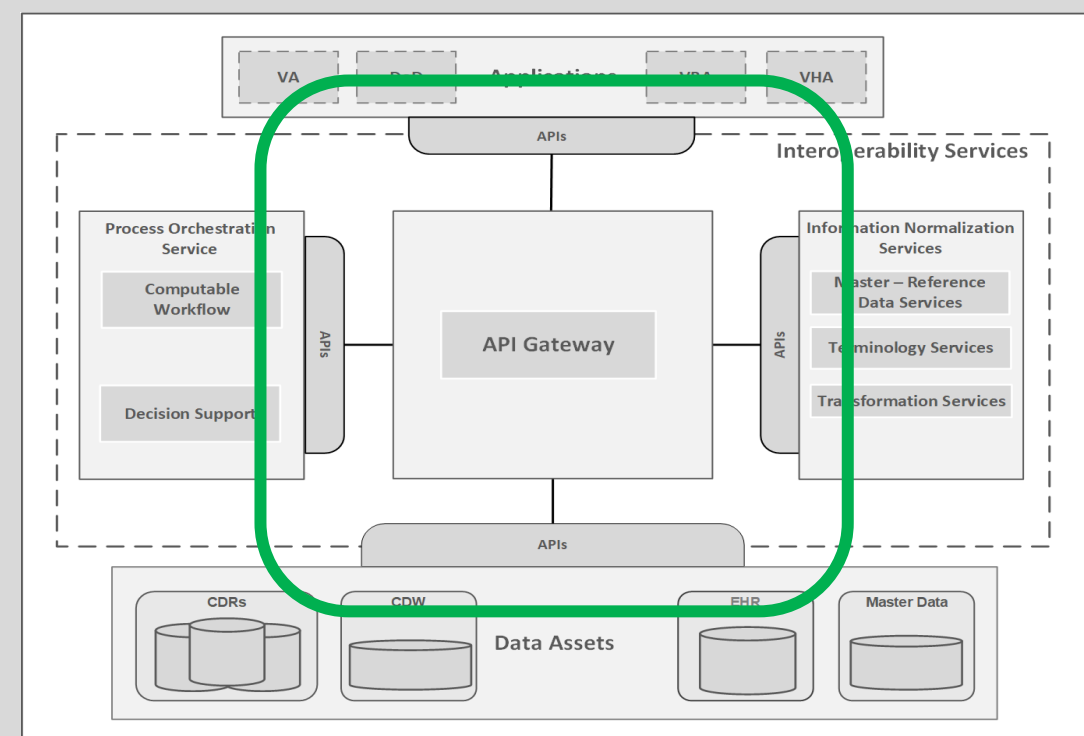
The selection and development of systems interfaces, though seemingly straightforward, actually depends upon a number of complex interdependencies. This page explores those relationships, and helps inform decision-making resulting in highly-interoperable APIs.

- Projects, programs, interfaces, and standards each have systems lifecycles affecting the work

- ## Interlinked Development Lifecycles

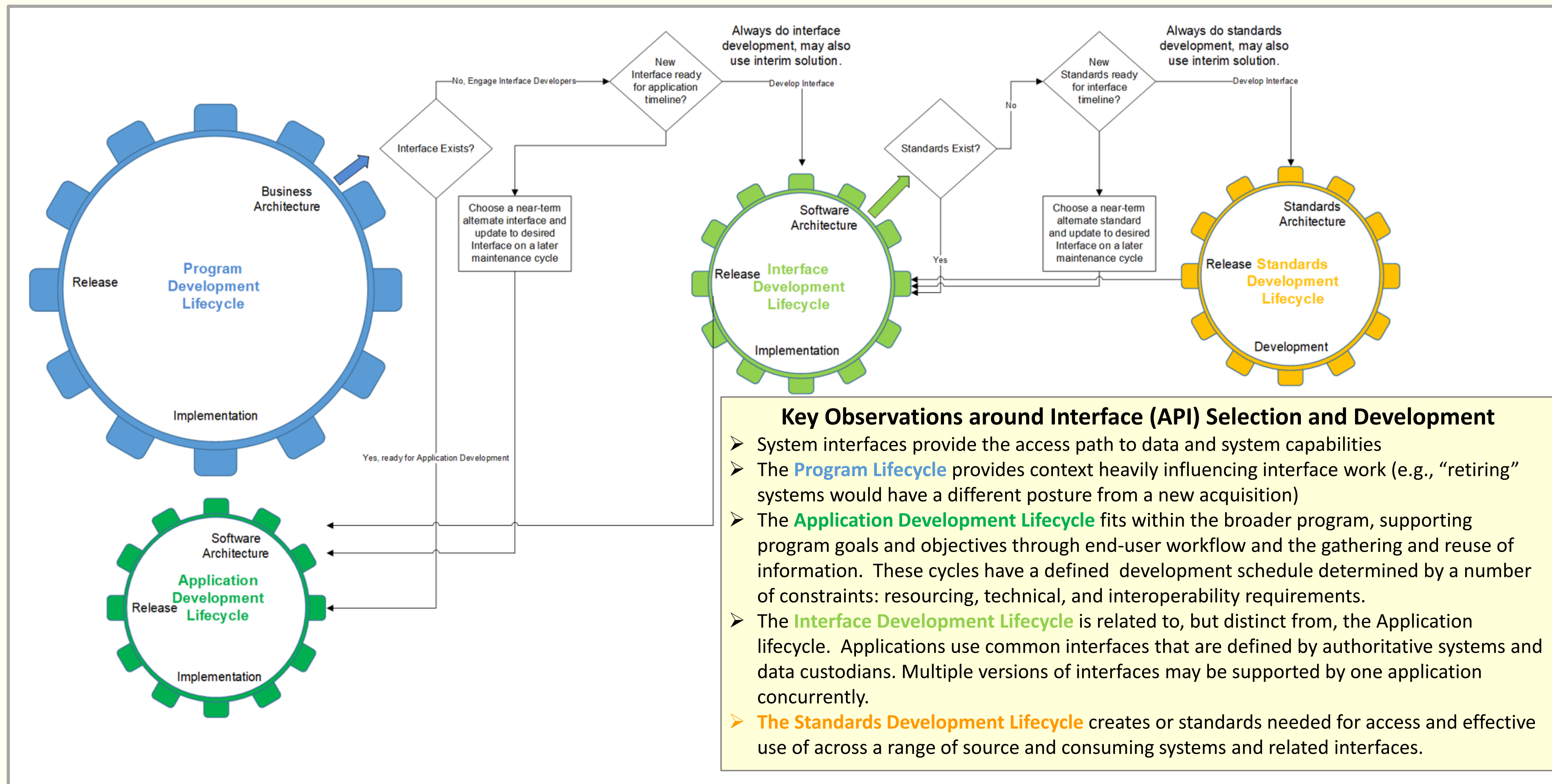
- Identifying requirements for systems interfaces should occur early in the program / product planning and development lifecycle.

- ## Conceptual API Gateway Architecture



- Applications (Presentation Layer) set the context for what data API services are required (lines down and up)
- With a potentially a broad range of standardized interfaces in place over time, consideration must be given to supporting legacy APIs while new or updated APIs are added
- Application agnostic work-flow orchestration and common, reusable decision support logic are also types of interoperability service

Systems Interfaces (API) Overview



- Behaviour which the endpoint is expected to conduct including expectation of the input, output, and error content models.

- Clinical versus payor versus back-office interfaces

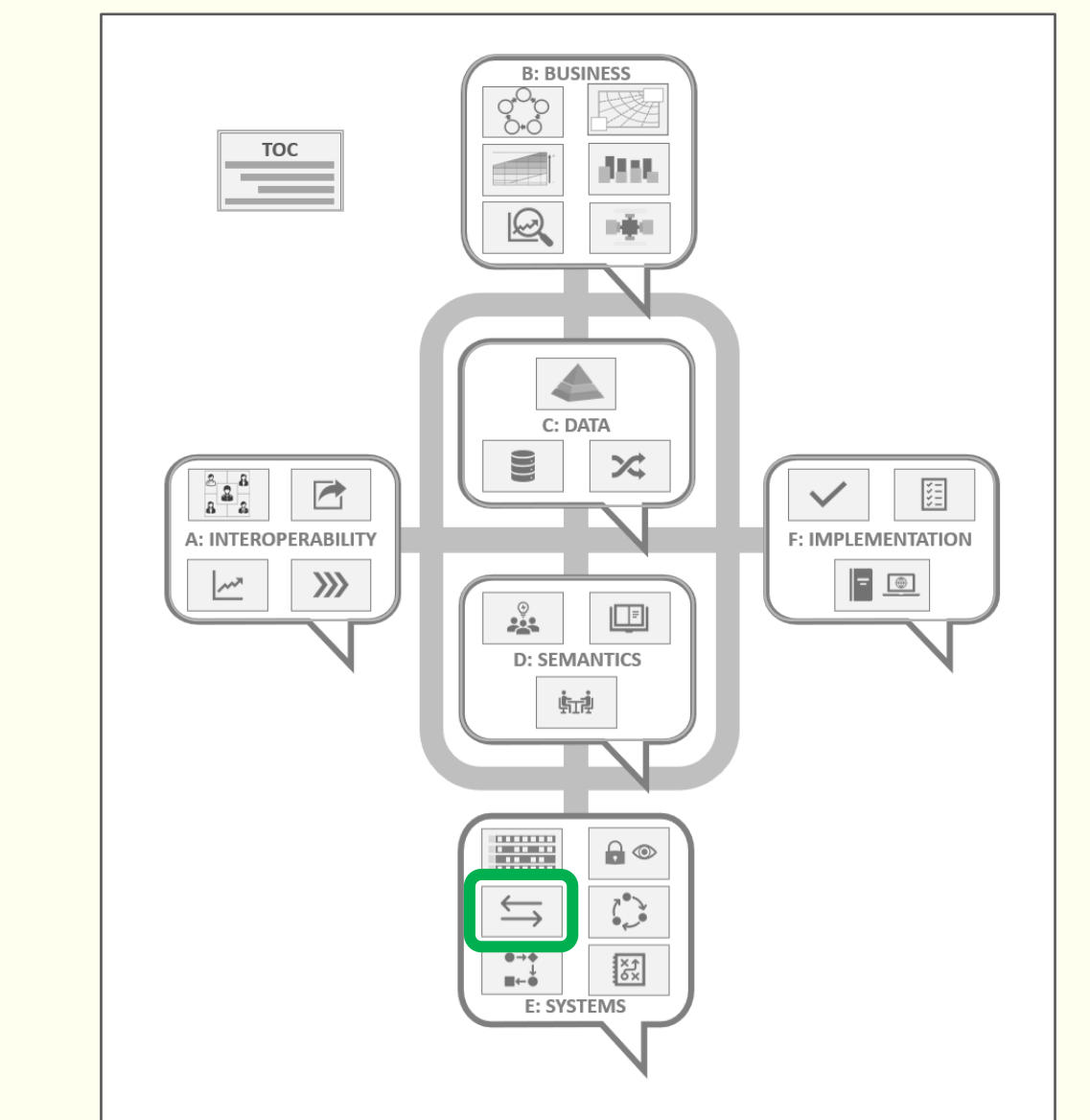
The table following relates different topics/domains of interest to standards types suited to those domains. This is elaborated in more detail on E-6.

Schedule of CHI Standards	
Domain	CHI Adopted Standard
Messaging Standards	Health Level 7 (HL7) Version 2.3
Retail pharmacy transactions	NCPDP SCRIPT
Instrument Data Exchange	IEEE 1073
Imaging (intra-agency)	DICOM
Laboratory Results Names	LOINCLab
Test Order Names	LOINCLab
Result Contents	SNOMED CT
Medications	
Federal Drug Terminologies	(FDA, NLM, VA)
Demographics	Health Level 7 (HL7) Version 2.4 and higher
Immunizations	CVX and MVX codes from HL7 Version 2.3.1
Units	HL7 Version 2.4+
	CHI Recommended Standard
Interventions/ Procedures	SNOMED CT
Clinical Encounters	Health Level 7 (HL7) Version 2.4 and higher
Diagnostics/ Problem List	SNOMED CT
Medical Devices/Supplies	No recommendation.
Anatomy/Physiology	SNOMED CT
Population Health	No recommendation
History and Physical	Defeer
Nursing	SNOMED CT
Genes and Proteins	Human Gene Nomenclature (HUGN) for genes. No recommendation for Proteins
Text-Based Reports	HL7 CDA Release 1.0- and higher
Disability	Future Work
Financial/ Payment	(Billing HIPAA) HIPAA approved code sets
Chemical (UMLS)	Conditional: EPA Substance Registry System

Myth	Reality
VA-specific or native APIs are faster to implement and give us more control.	While historically this has been true, increasingly third party applications, websites, and systems interact with VA. Creating custom interfaces increases integration burden and reduces interoperability
The requirements tell me all I need to know.	Requirements are frequently imprecise or incomplete, necessitating the need for additional domain expertise either within or available to the team.
We can figure this out during development.	Standards and terminology changes take time. Mitigate risks by addressing standards readiness early to meet project timelines.

Term	Definition
System (API) Interfaces	Callable endpoints or APIs (Application Programming Interfaces) which exchange information between systems and data assets
Application Layer	User-facing and software applications that provide a defined functionality to record, support or monitor healthcare delivery
Business Interoperability Layer	Application-agnostic services which support common and reusable business functions
Semantic Normalization Layer	Services which transform codified data from varied sources into a consistently defined, understandable, and usable form
Master Data Management Layer	Services to retrieve or persist reference data for reuse by enterprise systems

VA PUBLIC REFERENCE
INDUSTRY REFERENCE
Standards Development Lifecycle
Application (Software) Development Lifecycle

[illegible]

At a Glance

- This page provides guidance and considerations for application and service developers who are consumers of VA public and private interfaces.
- It illustrates the relationship between the software development cycle and the selection and implementation of existing APIs

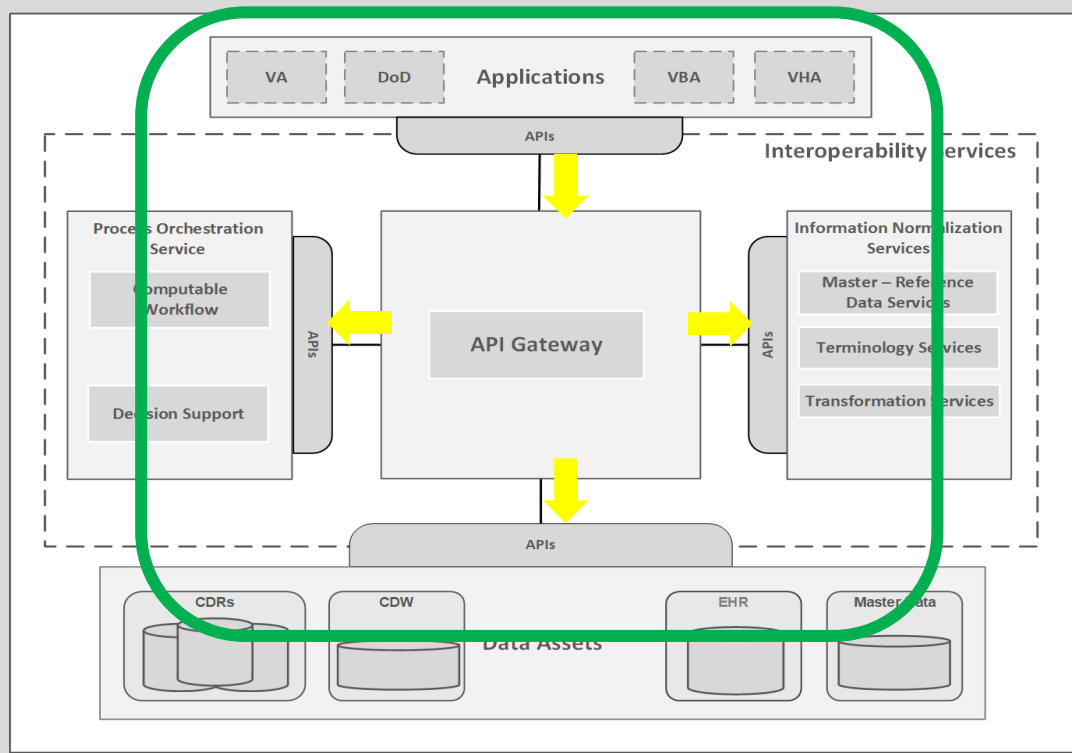
Audience

Project teams looking for interfaces and artifacts which they can consume to make their applications/systems interoperable and reusable

Builders of:

- business services
- infrastructure services supporting business services; and
- backend data services (persistence layer)

Application Access Services



Localization

Profiling – guidance for localizing information exchange specifications

Valuesets – localizing terminology – fit-for purpose

Codesets - and creation/management of local codes and concepts

Extensions – additional data for use case

Needs

Owners of an application service domain to provide their APIs and supply/review guidance.(Perhaps also their API dependencies)

Infrastructure owners to supply lists of approved transports and Further Reading.

Business/infrastructure owner to provide guidance on existing initiatives to determine what is possible at print +18-24 months.

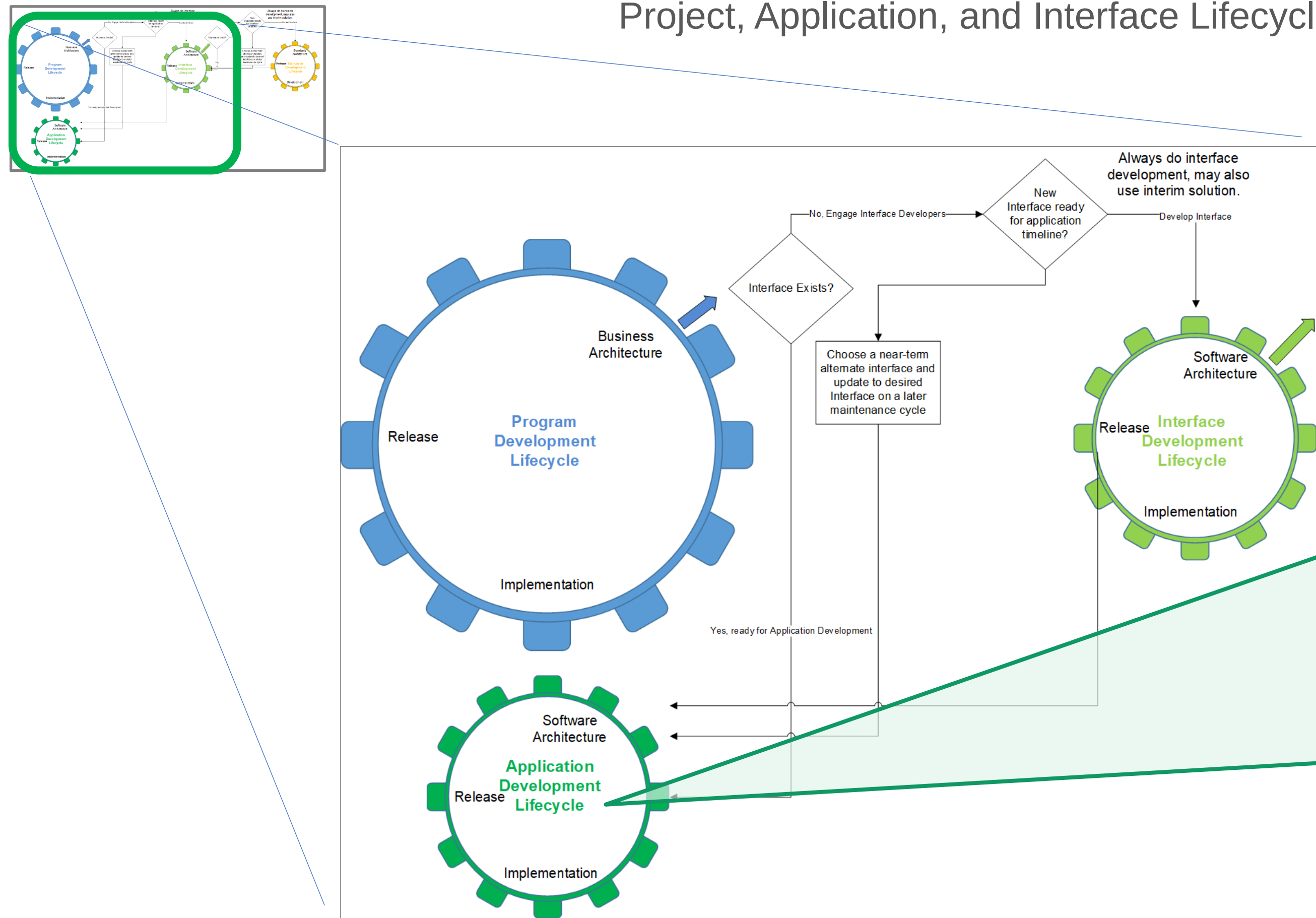
TRM support to provide Further Reading. Reference API ‘product pages’ for D4 details.

Need to consider application lifecycle diagram requirements and linkage to guidance.

i-VA Blueprints

API Consumers’ Viewpoint

Project, Application, and Interface Lifecycles



Selecting and Consuming APIs

- API protocols have different qualities, strengths, and weaknesses. Be mindful of intended use and fitness for purpose as you assess alternatives.
- Note that some systems and services expose multiple APIs. When possible, use the newest version
- Consider the long-term (sustainability). Prefer APIs based on open standards to proprietary alternatives
- Several factors go into selecting the API of choice for content retrieval and/or capability invocation
 - Determining the authoritative source(s)
 - Considering the comprehensiveness and completeness of the data
 - Addressing usability of the format

Authentication

(API gateway, service, external application)

All application/service etc. authentication and authorization should be managed by the API gateway which may rely on communication with other services or applications to complete (e.g. OAUTH).

Time of Implementation Considerations

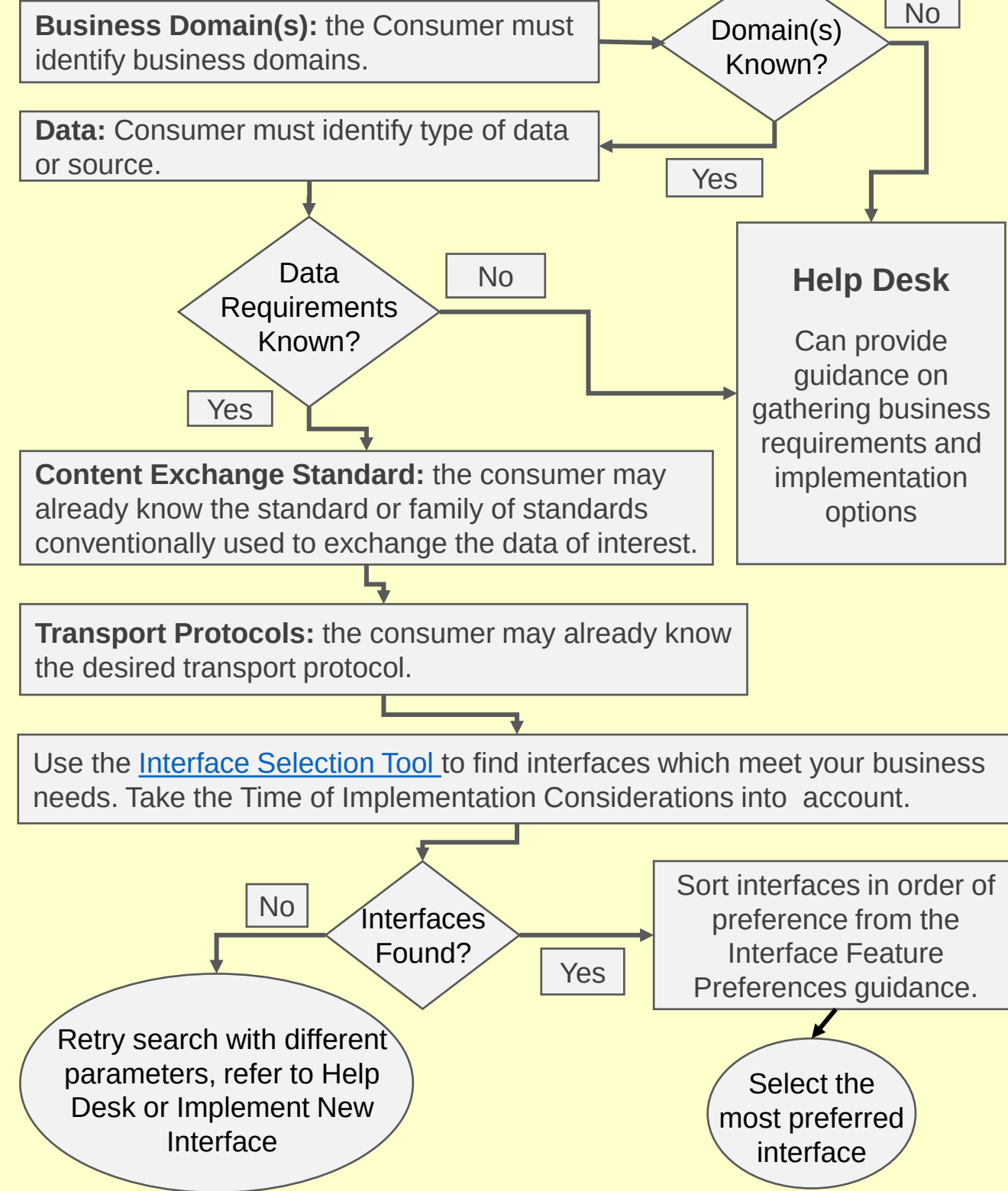
The guidance provided here is intended to reflect a lead-time of 12-24 months from the initial publishing of the i-VA Blueprints. Should the Interface Consumer or Creator be implementing significantly in advance of that time frame then the following applies:

If the interface is planned for deprecation, then consider the deprecation date relative to your implementation and planned refresh cycles.

For interfaces that are planned/in development consider the project timeline relative to your implementation. Assume the maturity of interfaces which are not yet in production to be one level less mature than indicated in the VA Posture and selection tools.

The user may always refer to the Help Desk personnel who may be able to provide further insights and point-in-time guidance.

Decision Path for Interface Consumers



Interface Feature Preferences

When multiple interfaces are available to support a business need the following guidance dimensions may assist the user in selecting the most appropriate interface:

- Interfaces which support standardized terminologies are Preferred;
- The interface which provides the minimum of information which meets the business need is Preferred;
- The Interface which is implemented and not set for removal or is planned to be available within the user’s implementation timetable is Preferred;
- The most preferred existing specification according to the VA Posture is Preferred;
- The interfaces for which authorization can be obtained are Preferred;
- Standardized interfaces are Preferred;
- Interfaces using Data sources which are not slated for removal are Preferred; and
- Interfaces sources which can support the appropriate breadth of the current and anticipated future needs are Preferred.
- Interfaces which have been designed to be reusable enterprise-wide are Preferred;

The user may always refer to the Help Desk personnel who may be able to provide further insights and fresher guidance.

Myth Busting

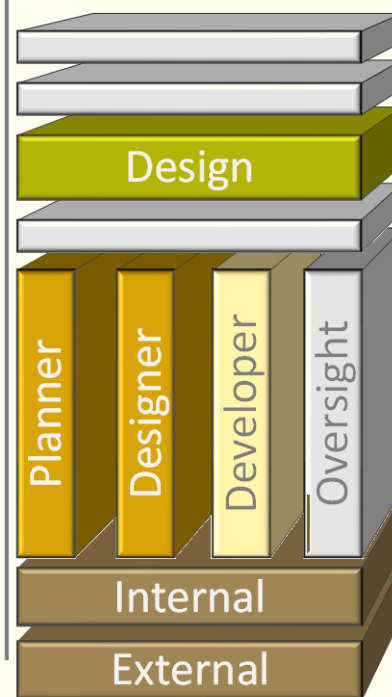
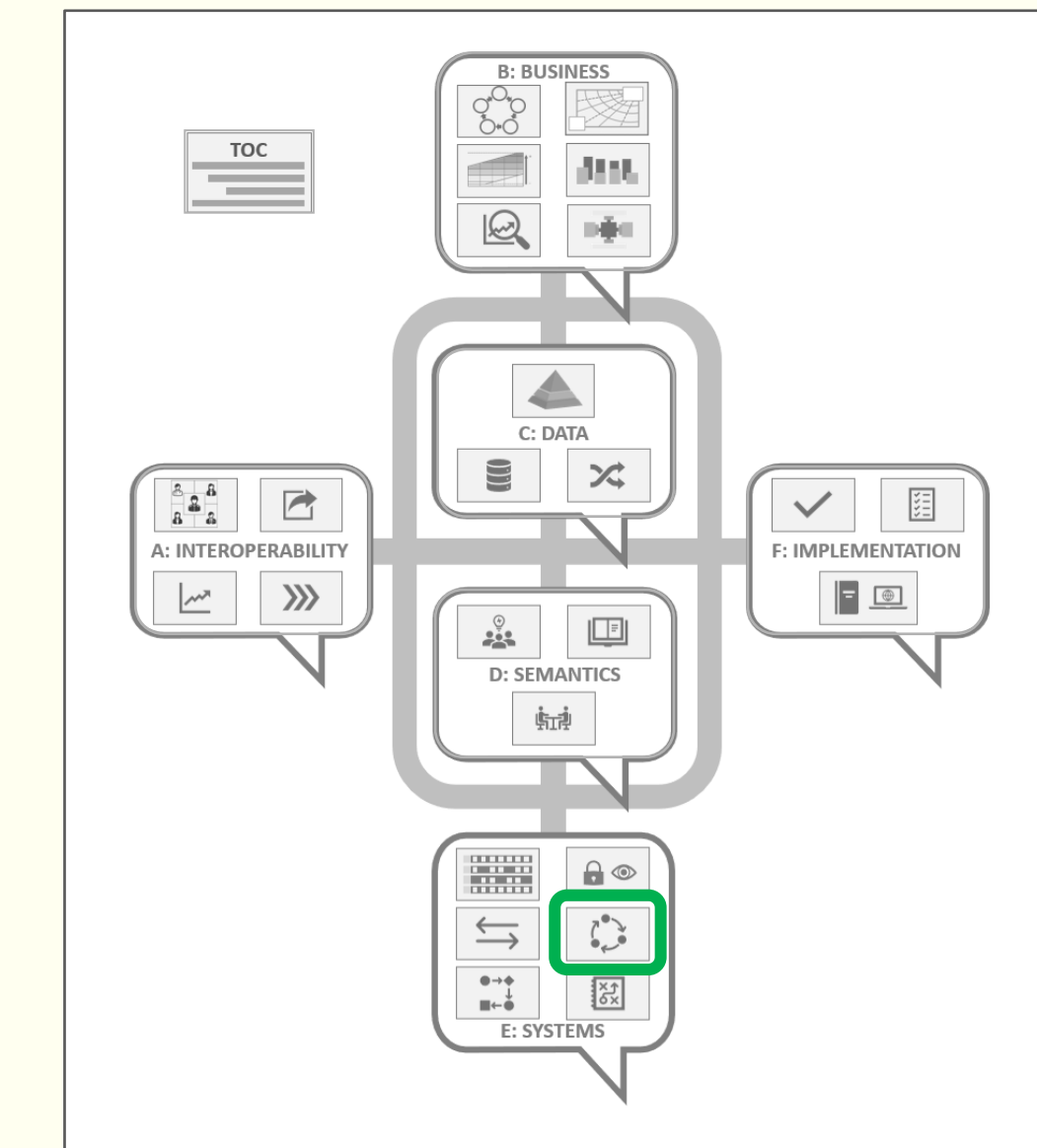
Myth	Reality
If I can't find the interface we need we should just create one for our needs.	The project may need to create a new interface, but interoperability requires that usage considerations go beyond the project.
The standards most projects are using should work for my project too.	Meeting the business requirements should come first. Sometimes to meet new requirements newer standards are required and someone must be first to adopt.
Getting changes into existing standards is too hard, better to develop our own.	This should not be a barrier if interoperability is a goal. Standards experts in VA can assist in liaison with standards development organizations.

Glossary of Terms

Term	Definition
API	Application Programming Interface
System Interfaces	Callable endpoints or APIs (Application Programming Interfaces) which provide services or system functionality.
Application Layer	User-facing and system-embedded applications which provide a defined functionality to record, support or monitor healthcare delivery.
Business Interoperability Layer	Application agnostic service applications which provide defined business functions
Semantic Normalization Layer	Services which transform data from a domain specific form to a domain agnostic form
Master Data Management Layer	Services to retrieve or persist data.

Further Reading

VA INTERNAL REFERENCE
VA PUBLIC REFERENCE
INDUSTRY REFERENCE



Contact:	VHA Knowledge-based Systems	
Rev:	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Interface Consumers Viewpoint	PAGE E-4

At a Glance:

This page proposes a cataloging and discovery tool for IT project teams to use when determining if their interoperability requirements are met by existing interface components, or if they need to be built.

The tool allows the team to search the catalog using a number of criteria, including: the component type, business domain, potential data source and interface characteristics. This returns a list of potential artifacts with hyperlinks to where they can be found.

Business Requirements

Interface Consumers and Creators must identify the business nature of the information to be requested or supplied via the interface such as:

- Clinical (direct care, telemedicine, genomics),
- Administrative (patient or practitioner demographics,
- Financial (authorization or claims), or
- infrastructural (terminology, IT supporting).

If Consumer and Creators are unsure of the business domain or requirements, they should seek assistance from KBS.

Data Types and Sources

Effective use of interfaces is predicated on identifying the type of data being both provided and consumed:

- Raw patient data (demographics, vital signs, diagnoses, encounters),
- Activity related data (orders, encounters, summaries, claims), or
- Complex or processed information (Clinical Decision Support results, Business Intelligence or population health extracts)

or they may know the source of that data, such as:

- An EHR or other application (Vista, Cerner, application, MyHealthEVet)
- A Service endpoint (IAM (Patient Registry), Benefits Lookup Service),
- An Infrastructure Service (terminology server, translation (semantic normalization)), or
- A data warehouse (Clinical/Health Data Warehouse, Health-E-Intent)

If Consumer and Creators are unsure of the type or source of the data, then they should seek assistance from the Help Desk.

Health Information Exchanges

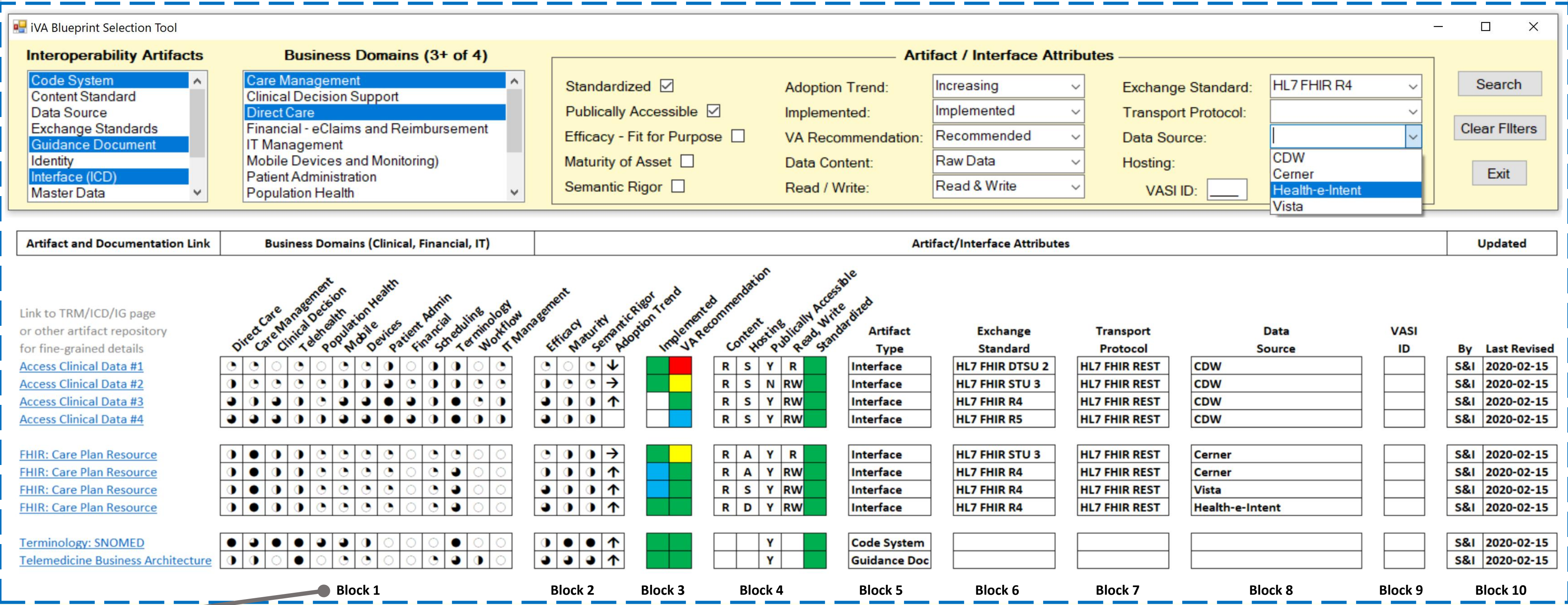
Health Information Exchanges (HIEs) are regional and national infrastructure to allow for data sharing across organizations.

Whether emerging capabilities, such as Qualified Health Information Networks (QHINs) or HIE’s, these frameworks are based upon industry HIT standards.

The building-block standards and specific standards profiles (e.g., tailored versions of standards to specific use cases) are included in the selection tools provided here. See [TEFCA](#), [VHIE](#), [HIE](#), [Sequoia Project](#), etc..

i-VA Blueprints

Concept for Discovery and Selection of Interoperability Components



Block 1: Business Domains

Indicates qualitative applicability of the interface for identified business domains depicted by “Harvey Balls”.

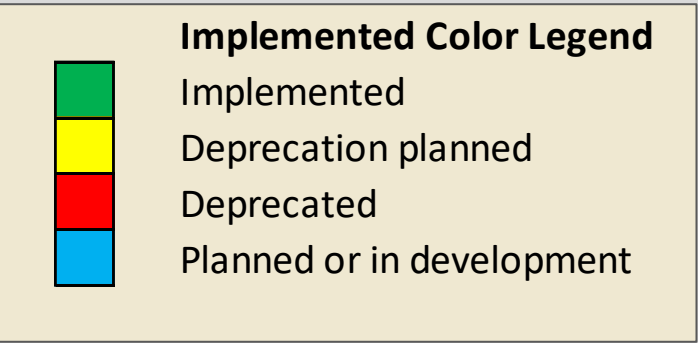
Block 2: Interface “Qualities”

Efficacy: an indication of the completeness of the implementation for the business purpose using Harvey Balls.

- **Maturity:** an indication of the ability of the interface to respond to the dynamics of the business.
- **Semantic Rigor:** an indication of the adherence of the interface to industry terminologies.
- **Adoption Trend:** indication of the market acceptance of the interface based upon implementation trend, indicated as stable, increasing, or decreasing

Block 3: Implementation Status

- **Implemented:** the interface implementation status within VA (e.g., internal “uptake”)
- **VA Recommendation:** The VA usage recommendation for the Information Exchange Standard.



Block 4:

Content: nature of data exchanged:

- Raw Data,
- Activity-based,
- Complex or processed data.

Hosting: the type of the interface host:

- Application,
- Service,
- Infrastructure/supporting Service,
- Data service

Publicly Accessible: Indicator as to whether the interface is available to non-VA entities [Yes / No]

Read/Write: flag indicating each data access permission availability [Read/Write/Read+Write: RW]

Standardized: a color indication of whether the interface uses standards for data exchange.

Block 5: Artifact Types

Identifies the nature and format of the artifacts described. Values include:

- Code System
- Content Std
- Data Source
- Exchange Std
- Identity
- Interface
- Guidance Document
- Master Data
- Systems
- ValueSet

Block 6: Standards

Identifies the relevant interface standard

Standardized Color Legend

- Standards-based
- Proprietary

Block 7: Protocol

Identifies the transport protocol supported as technical binding, and which are supported, such as:

- Proprietary transport
- Local (LLP, MLLP, TCP)
- Web Transports (WSI, SOAP, HTTP, HTTPS, SFTP, ebXML)

Block 8: Data Source

Indicates the system or repository hosting the data content being exposed via the interface being described.

This allows consumers to determine appropriate authoritative sources and which ones to use based upon need/circumstance.

Block 9: VASI ID

The VASI system maintains an inventory of enterprise interfaces with extensive detail around their technical specifications.

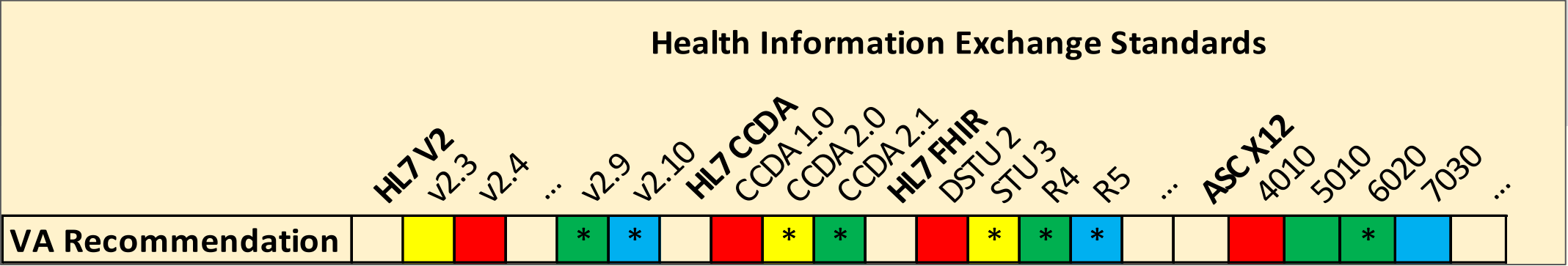
When designated this allows for consumer lookup of the interface requested.

Block 10: Metadata

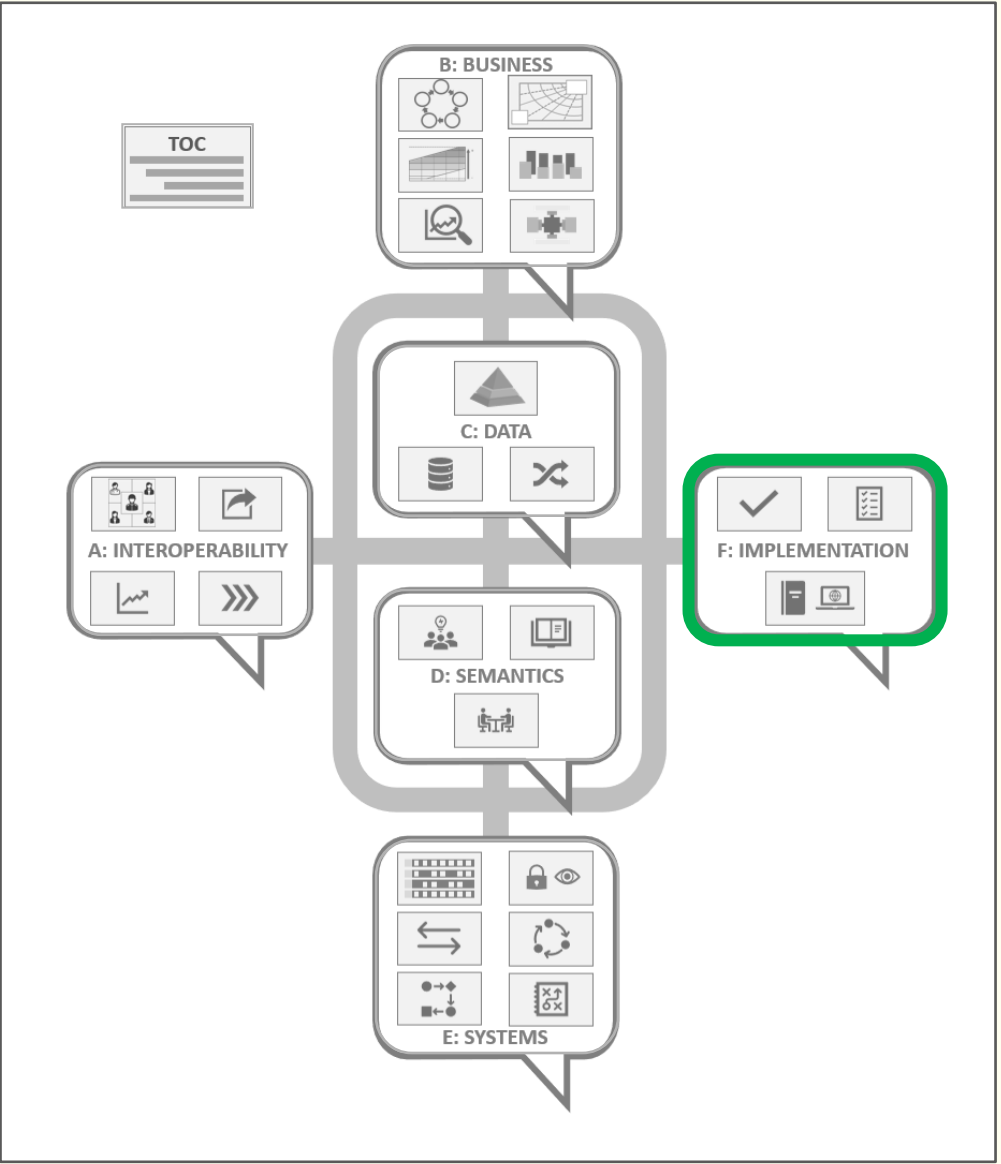
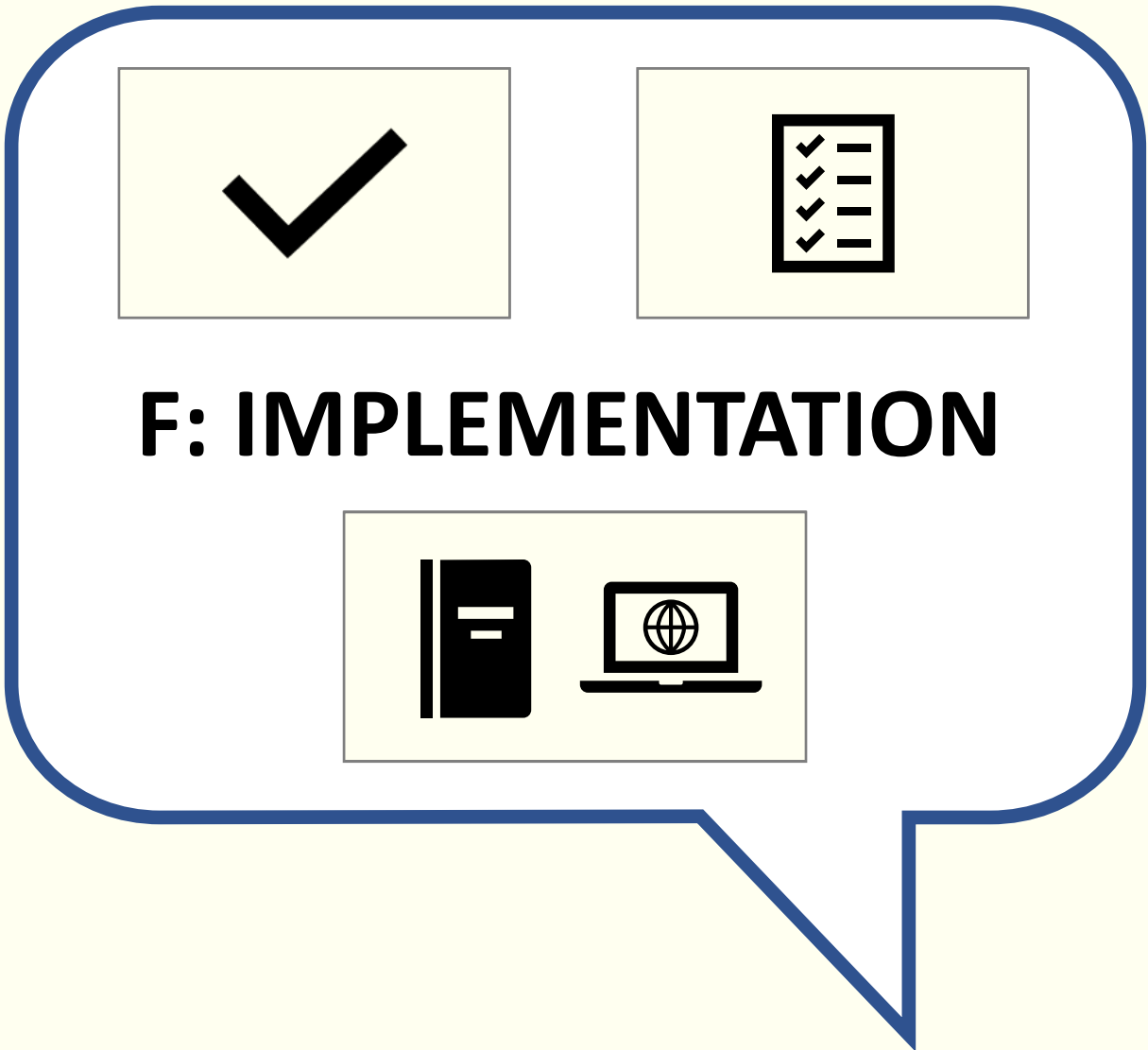
Designates the organizational entity and last revision dates for each asset included.

Summary Recommendations

- Selecting an appropriate interface is predicated on intended use, longevity, product lifecycle state, and consuming applications
- Standards cited as “preferred” indicate desirable selections for new, emerging, or long-lived capabilities
- This guidance is intended to complement existing VA authoritative sources, such as the [TRM](#) and Interface Control Document library
- Concurrent support for multiple APIs using different standards and/or version is particularly effective for transition
- Contact VA KBS for assistance



i-VA Blueprints Version 1.5
Section F –References and Case Studies



At a Glance

Example of timing and types of project decisions made by application builders in their use of interoperable interfaces, the Interface Selection Tool, and Help Desk to support these projects.

Key takeaways

- Consider whole project needs early, including interdependencies
- Seek guidance from existing VA expertise
- Reuse, and encourage reuse and interoperability

Reference Use Cases

Evolution of the i-VA Blueprints’ Implementation section will include numerous examples of the kinds of interoperability decisions made during application development.

These examples highlight the interdependency of the project development lifecycle with other interface and standards development lifecycles.

These dependencies and the lead time for these activities should be considered in:

- Project team planning and resourcing
- Setting realistic timelines for incorporating standards-based interoperability
- Determining what interoperability subject matter experts need to be engaged or consulted

Example Problem

Who: The Hematology Team

What: Develop mobile application to provide support and case management information for Veterans with End Stage Renal Disease.

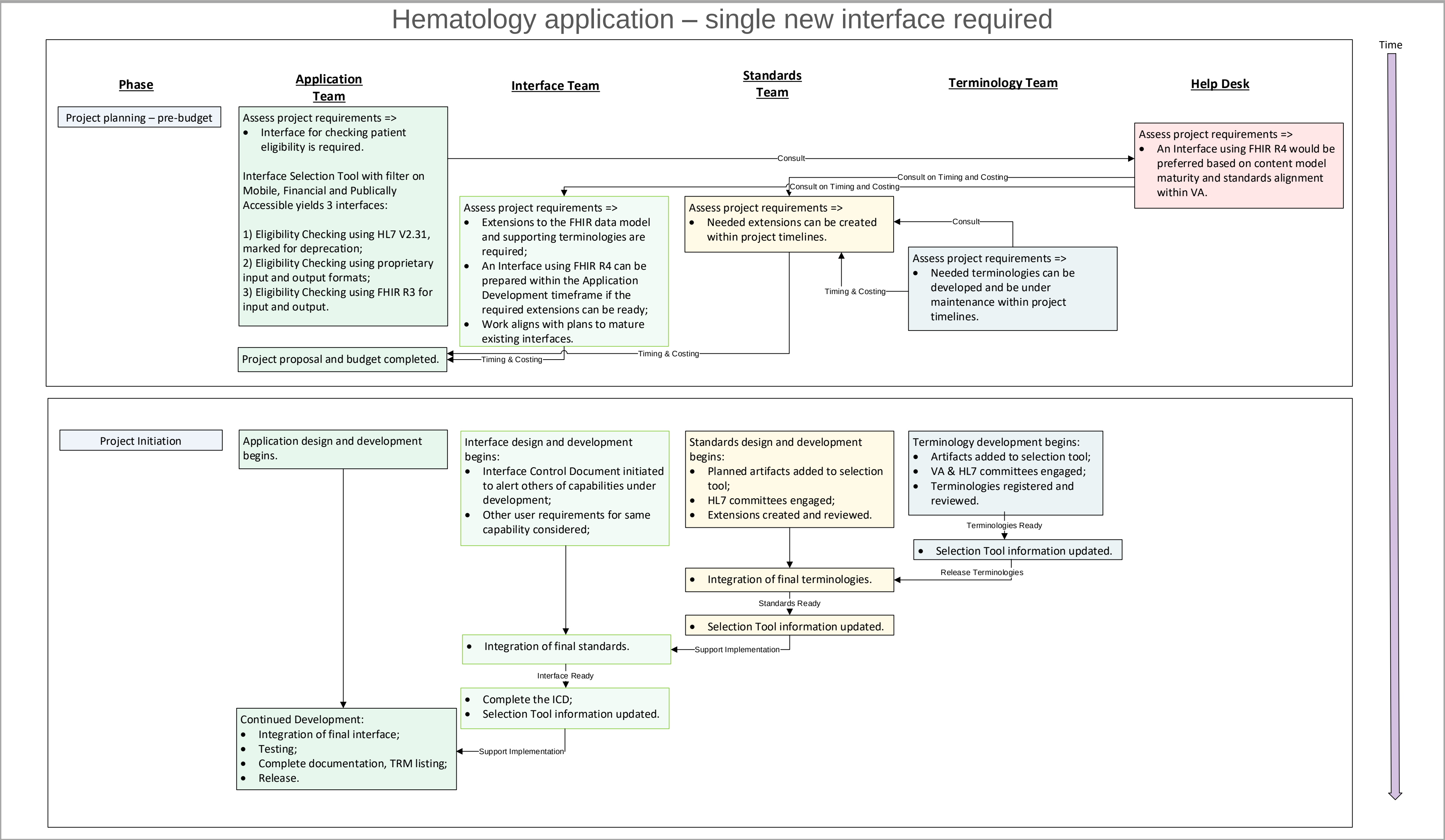
Challenge: During program planning it was determined an Interface is missing to support the app, which could provide patient demographics to check on program eligibility.

Solution: The chart illustrates the use of the Interface Selection Tool, Help Desk, and coordination among VA teams to select, develop and mature systems within VA.

Sections UNDER REVISION

i-VA Blueprints

Example Application of Interface Selection Process



Myth Busting

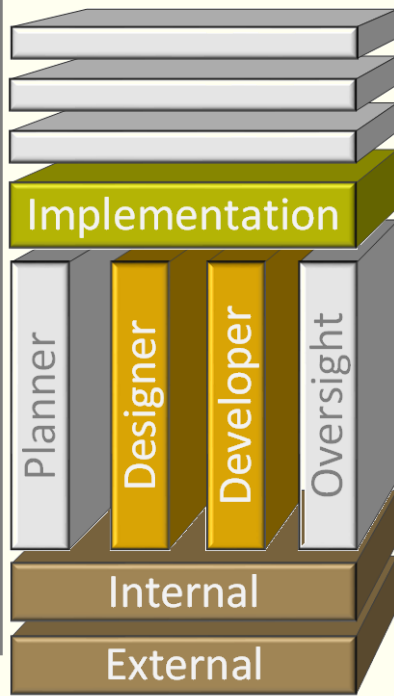
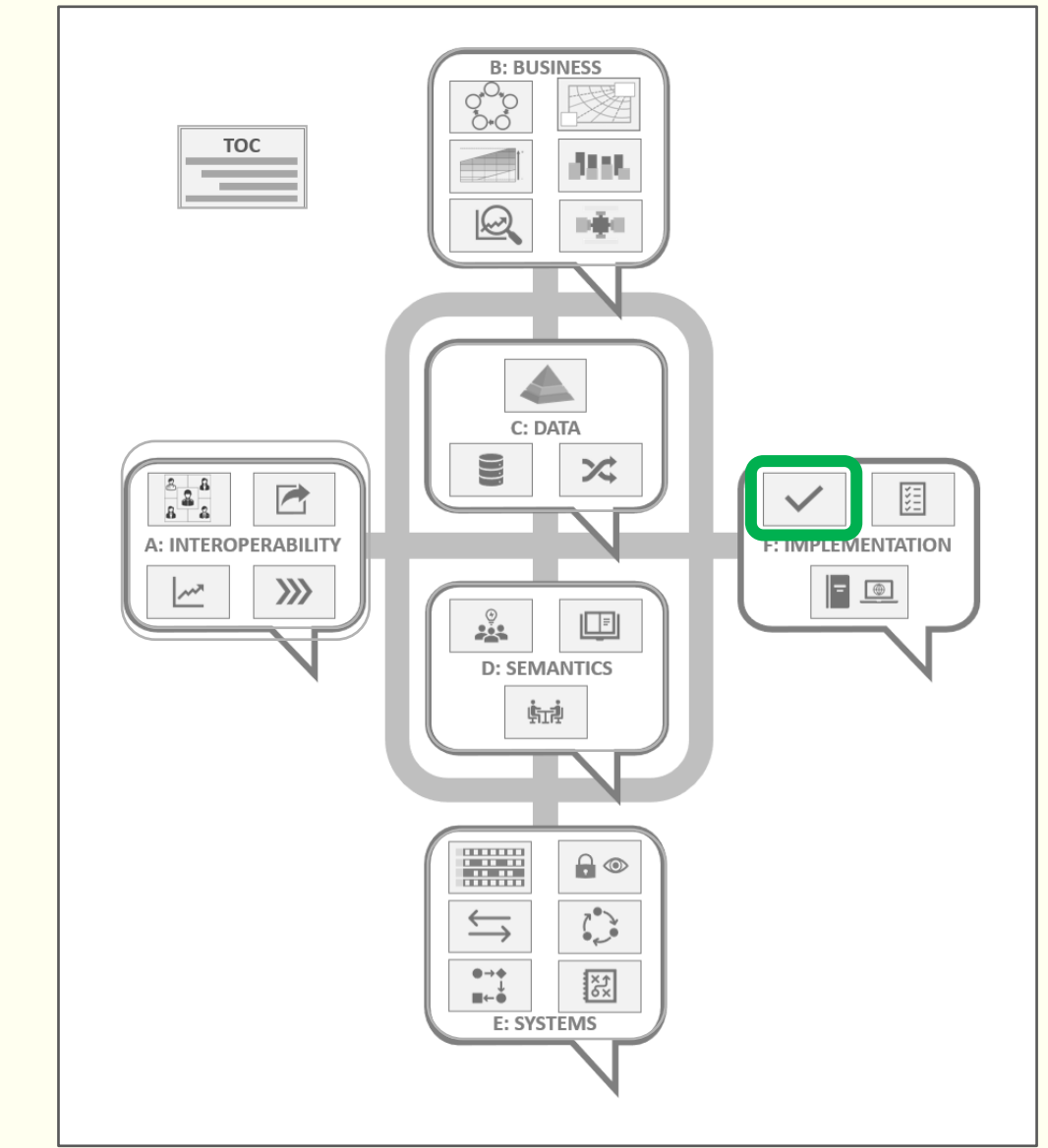
Myth	Reality
❌	
❌	
❌	
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Glossary of Terms

Term	Definition

Further Reading

VA INTERNAL REFERENCE
VA PUBLIC REFERENCE
INDUSTRY REFERENCE



Contact: VHA Knowledge-based Systems		
Rev.	Date:	Description:
Veterans Affairs		
System:	i-VA Blueprints	
Drawing:	Interface Selection Example	PAGE F-1

At a Glance

This exemplar project illustrates how i-VA Blueprints interoperability perspectives are applied in a real-world context.

Key Takeaways

- This model project represents business and interoperability capabilities at an optimized level of maturity, part of a Learning Health System.
- Interoperable data assets, precise semantics, and standardized APIs are foundational to achieving the business and clinical goals and KPIs for the project.

Use Case Outline

The model use case is a digital decision support system for psychotherapy care delivery teams.

Focused on addressing:

- Data availability
- Maximizing Veteran benefit
- Driving continuous improvement in treatment
- Giving safe performance feedback to psychotherapist
- Supporting critical resource allocation decisions

About the Project

OVERVIEW: Web application to help clinicians deliver mental health care to support improved veteran outcomes.

➤ GOALS:

- Streamline and simplify the psychotherapy session and documentation.
- Use AI to discover patterns and possible suicidal warnings, increasing the chance to save lives.
- Ensure patient information and status moves with the patient wherever they go.
- Ensure new providers have context and Clinical Decision support tools needed for the psychotherapist to use current best-practices and achieve optimal outcomes for the Veteran.

Note: Application design is being iterated with users and collaboration with Human Factors Engineering.

Application of i-VA Principles, Process and Methodology

With this exemplar, the KBS S&I and i-VA teams provide skill and expertise to illustrate the application of i-VA Blueprints insights and processes

➤ This includes:

- Setting up of the project information technology in a sandbox environment
- Identification of the appropriate structured and standardized data needed, in format, content, and semantic expression
- Design requirements for the standards-based APIs needed to access data assets from a range of authoritative sources
- Architecture of the transformation services and APIs required to map individual systems to a common information exchange format

i-VA Blueprints

i-VA Model Use Case

Mental Health Care Quality Learning System

Data Access

- Veteran data may be distributed across a number of authoritative sources
- A standards-based API* is developed and, along with an API implementation guide, provided to custodians of authoritative sources to provide data needed by the software application.
- This API can also be reused by and other applications at the point-of –service delivery.

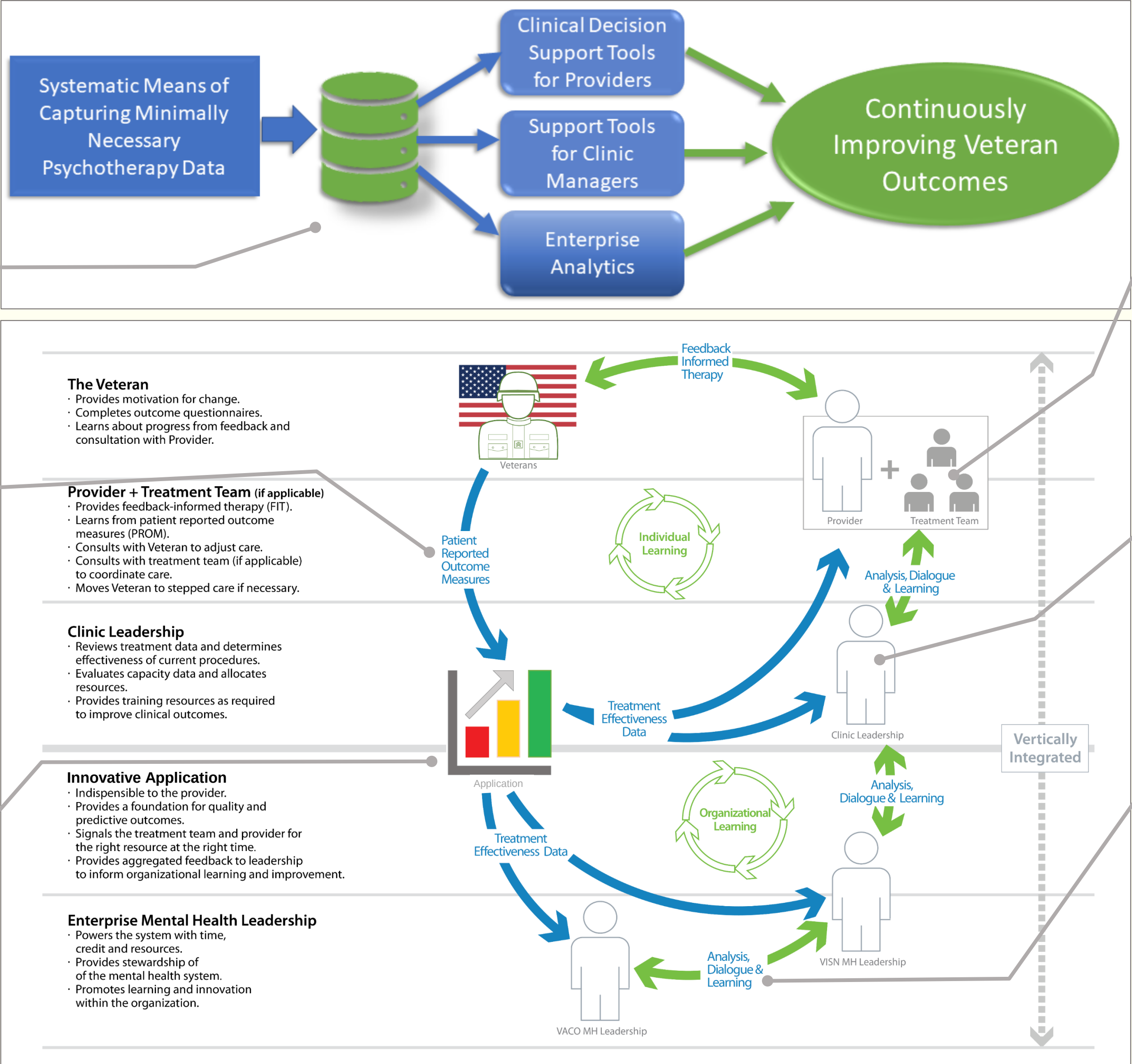
* See the interoperability services inset below.

Patient Reported Outcomes

- Use of a mobile device app for gathering Veteran provided data requires:
 - A mobile API using FHIR Structured Data Capture standard for gathering data
 - This API enables access to cumulative Veteran data by the Provider and Treatment team.

Support Tools for Clinic Managers

- Interoperability promotes consistent use of standardized, structured, and semantically precise data that enable:
 - Analysis of progress against KPIs
 - Analytics for predictive outcomes
 - Optimized resource utilization



Adaptive Treatment

- Providers and Treatments Teams recognize changes in outcomes earlier.
- Using BPM+ tools to enable adaptive workflow and decision support, individual patient’s conditions and circumstances result in tailored treatment.

Clinical Learning

- Changes in outcomes.
- Decision support and workflow models are created, maintained, and versioned based upon evidence reviewed by clinical leadership.
- Clinical providers can be confident that evidence-based best practices are discovered sooner and rapidly made available in the field.

Organizational Learning

- Consistent use of standardized clinical terminology...
- Combined with standards-based interoperability across the enterprise...
- Enables analytics that inform the maturation of processes and best practices, an essential part of a Learning Health System.

Myth Busting

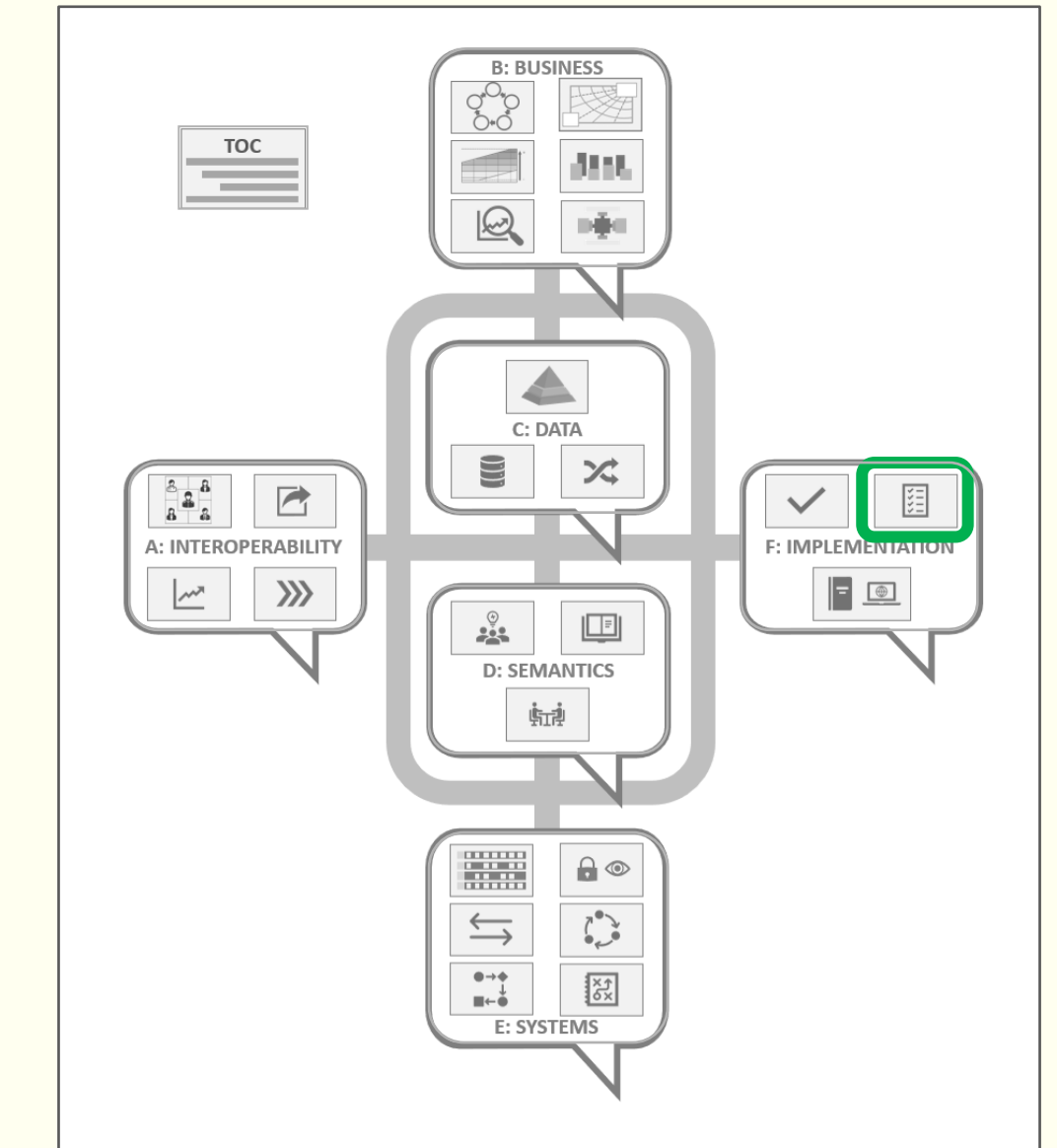
Myth	Reality
 Optimization of interoperability capabilities can only be done across the entire enterprise at the same time.	New or upgraded E2E business and capabilities can be implemented at an optimized maturity level at any time, provided enabling interop services are in place.

Glossary of Terms

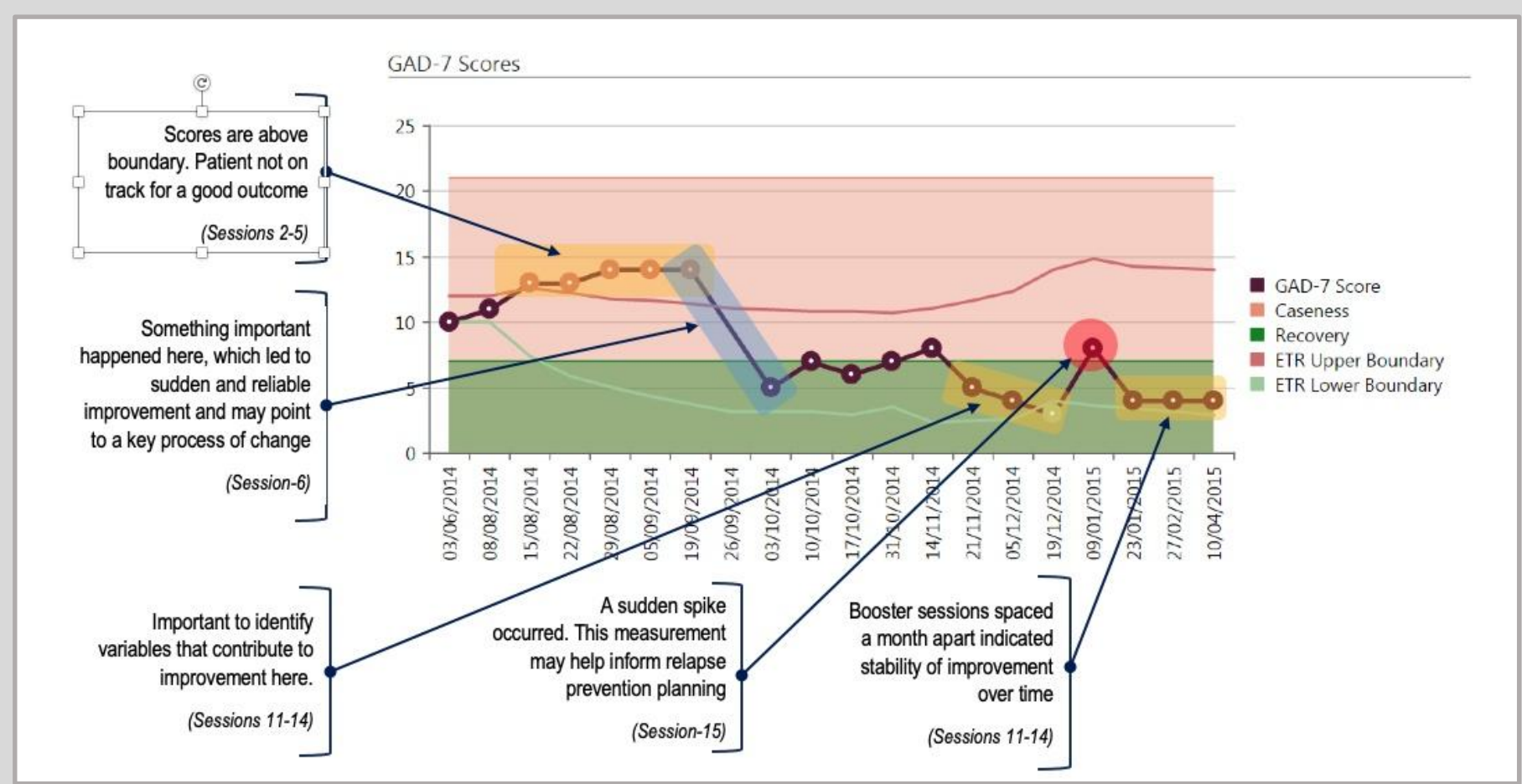
Term	Definition
API	Application Programming Interface
BPM+	Business Process Modeling + Health
CQL	Clinical Quality Language
EBP	Evidence Based Practice
FHIR®	HL7 Fast Healthcare Interoperability Resources
FIT	Feedback Informed Therapy
KBS i-VA	Knowledge-Based Systems - VA Interoperability Blueprint
KBS S&I	Knowledge Based Systems – Standards and Interoperability
LHS	Learning Health System
PLDR	Participatory Learning, Design and Research
PROM	Patient Reported Outcome Measures

Further Reading

VA INTERNAL REFERENCE
Knowledge Based Systems (KBS)
VHA Business Information Models
VA PUBLIC REFERENCE
Ethics Principles for Access to and Use of Veteran Data
VA Data Strategy
INDUSTRY REFERENCE

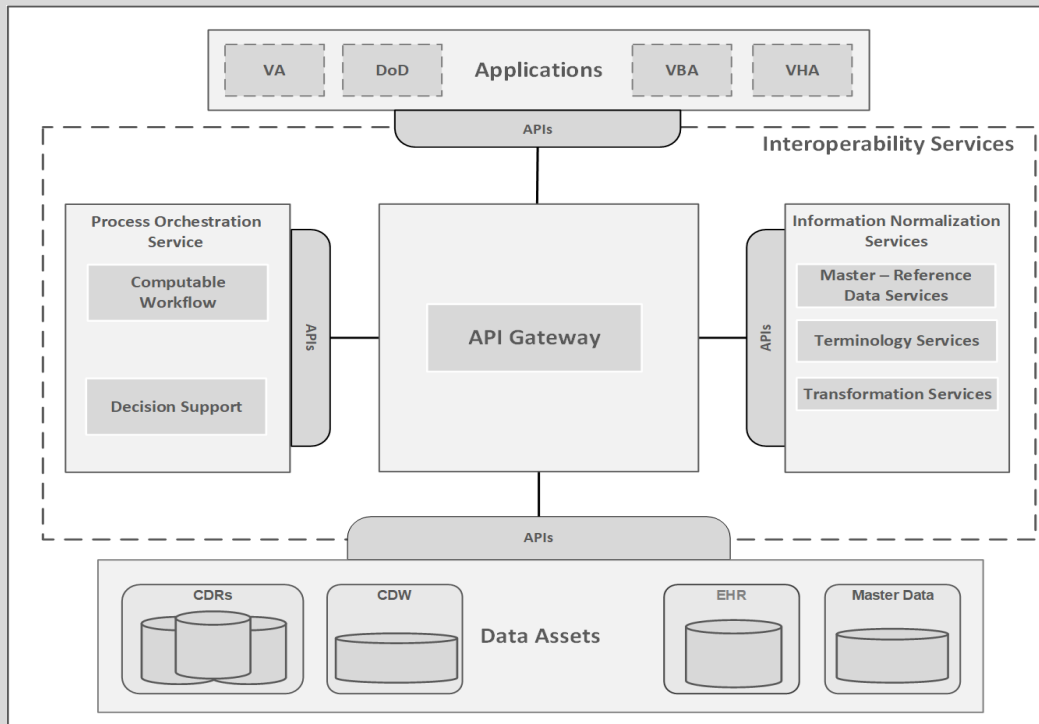


Identify Data Events that Affect Outcomes



Interoperability Services

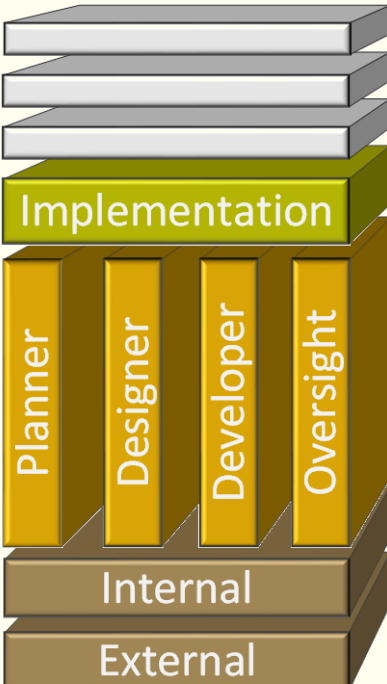
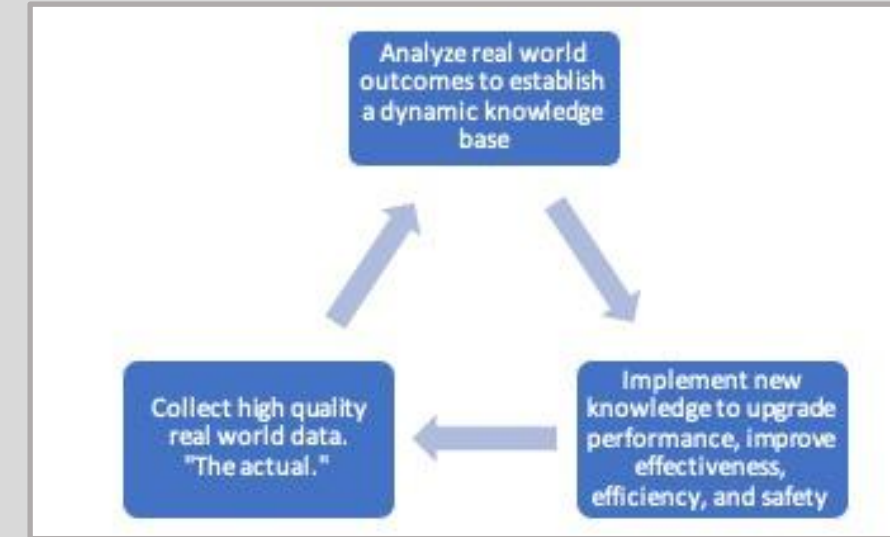
Use of interoperability services gives access to authoritative data sources, normalized and consistent reference data, and access to application independent enterprise workflow and decision support.



Compare Outcomes to Benchmarks to support Learning Cycle

Use of standardized reference data and concepts in the patient health record enable benchmarking of patient cohorts and subsequent evaluation of treatment and service efficacy.

This provides insight that shapes adaptive workflow and decisions support.



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About

The interoperable VA (*i*-VA) Blueprints are an initiative of the Knowledge Based Systems (KBS) division within the VHA Clinical Informatics and Data Management Office (CIDMO).

The Goal

The *i*-VA Blueprints’ goal is to promote a consistent enterprise-level approach to interoperability for the U.S. Department of Veterans Affairs (VA) that is proactively aligned with industry interoperability trends and best practices. A specific objective is to allow IT projects that are implementing information systems to have ready access to organizational interoperability resources and the insight needed to effectively use them.

The Approach

Led by the KBS team, the Blueprint references existing operational, definitional, architectural assets, and existing systems capabilities from across VA. This material is integrated with current and emerging terminology and systems interface standards as the Blueprints to guide health information technology teams in implementing information systems that are interoperable at an enterprise level.

Bringing much needed clarity on how to achieve working interoperability in VA, this “first-stop source” provides guidance that will enhance and streamline the technical and semantic interoperability of information flow across and between VA, its partners, and community-based service providers.

A Living Document

The i-VA Blueprints are not a static document. The field of standards-based interoperability is continually changing and advancing, and the VA's interoperability capabilities and enablers are maturing as well.

After its initial release, the Blueprints will be updated on a recurring basis, reflecting new knowledge and practical feedback from the teams implementing interoperable systems.

The KBS team will be acting as the steward for the maintenance of the document, working with other VA organization teams to ensure their authoritative content on interoperability assets and enablers is appropriately contextualized, featured, and refreshed in the document.

Support, Suggestions, and Improvements

The KBS Standards and Interoperability team is available to support project teams in the application of this work. Should you have need for assistance, have suggestions for improving this work, please contact them at: i-VA_Blints_Support@va.gov

Dedication

In the early 2000’s, VHA undertook a program to internally modernize its VistA EHR system into a platform-oriented solution, based upon “modern” standards at that time, and component-based architecture. The program was known as HealtheVet.

The VHA Chief Architect conceived of an alternative to what historically had been tomes of architectural guidance, supplementing those artifacts with a set of “Blueprints” modeled after Construction Documents as would be found on a job-site for building construction – “classic” architecture.

*The “Blueprints for HealtheVet” formed the inspiration for the i-VA Blueprints. This work is dedicated to **Jim Demetriades**, the father of the original set of VA Blueprints.*

i-VA Blueprints

References

Consolidated Glossary of Terms

Acronym	Definition
ADLC	Application (Software) Development Lifecycle
ADS	Authoritative Data Source
ADT	Admission, Discharge, Transfer
AHRQ	Agency for Healthcare Research and Quality
AI	Artificial Intelligence
API	Application Programming Interface
Application	A program designed to support the business needs of a user or all of the activities associated with a business purpose, for example an EHR, EMR, Web Browser, or Database.
Application Layer	User-facing and software applications that provide a defined functionality to record, support or monitor healthcare delivery
ASC X12	Accredited Standards Committee X12
BIM	VA Business Information Model
BPM+	Business Process Modeling + Health
BRM	VA Business Reference Model
Business Interoperability Layer	Application-agnostic services which support common and reusable business functions
C-CDA	Consolidated Clinical Document Architecture
CDA	Clinical Document Architecture
CDS	Clinical Decision Support
CIDMO	VHA Clinical Informatics and Data Management Office
CMMI	Capability Maturity Model Integration
CMS	Center for Medicare and Medicaid Services
COTS	Commercial Off-The-Shelf
CPG	Clinical Practice Guidelines
CPRS	Computerized Patient Record System
CQL	HL7 Clinical Quality Language
Cures Act	21st Century Cures Act
DGC	VA Data Governance Council
DoD	Department of Defense
DS4P	Data Segmentation for Privacy
E2E	End-to-End, from start to completion of a process
ECA	Event/Condition/Action architectural pattern
eHMP	eHealth Management Platform
EHRM	Electronic Health Record Modernization
EPB	Evidence Based Practice
ETL	Extract Transform and Load
FHIR US Core IG	FHIR US Core Implementation Guide that meets USCDI data requirements
FHIR®	HL7 Fast Healthcare Interoperability Resources
FIT	Feedback Informed Therapy
GUI	Graphical User Interface
HL7®	Health Level Seven
IMM	Interoperability Maturity Model
Interface Consumer	A person building a service or application which utilizes one or more interfaces to accomplish its business purpose.
Interface Creator	A person building an interface to support the business needs of other services and applications.

Acronym	Definition
ISA	Annual Interoperability Standards Advisory
KBS	Knowledge Based Systems
LHS	Learning Health system
LOINC	Logical Observation Identifiers Names and Codes
Longitudinal	Across all sources and over time
Master Data Management Layer	Services to retrieve or persist reference data for reuse by enterprise systems
MBTS	Model-Based Transformation Services
MDMI	Model-Driven Message Interoperability
MedRec	Medication Reconciliation
ML	Machine Language
MPI	Master Patient Index
Normalized	Data that follows a consistent format, structure, and use of unique identifiers for entities and concepts
OEI	VA Office of Enterprise Integration
OHI	Office of Health Informatics
OIT	Office of Information Technology
ONC	Office of National Coordinator for Health IT
Orchestration	Coordination of services to fulfil a business need
PLDR	Participatory Learning, Design and Research
PROM	Patient Reported Outcome Measures
PsychTools	A suite of vertically integrated tools that help Veterans and clinicians achieve desired clinical outcomes.
RFID	Radio-frequency identification
RxNorm	Normalized names for clinical drugs linked to pharmacy and drug interaction systems
SDLC	Standards Development Lifecycle
Semantic Normalization Layer	Services which transform codified data from varied sources into a consistently defined, understandable, and usable form
Situational	Additional data providing context for decision making
SLS	Security Labeling Service
SNOMED CT	Systematized Nomenclature of Medicine Clinical Terms
SOLOR	Integrated normalized and consolidated terminology systems
TCO	Total Cost of Ownership
T-Map	Transition Map
TRM	Technical Reference Model
USCDI	US Core Data for Interoperability
VAIL	VA Interoperability Leadership
VAMC	VA Medical Center
VASI	VA Systems Inventory
VISTA CPRS	Veterans Health Information Systems and Technology Architecture Computerized Patient Record System

Consolidated Further Reading

References
VA Internal Reference
Clinical Informatics and Data Management Office (CIDMO)
Data Steward Authoritative Data Source Guide
Knowledge Based Systems (KBS)
Office of Health Informatics (OHI)
Process and Information Architecture - IMSR
VA EA Product Line Architecture (PLA)
VA Systems Inventory system (VASI)
VAIL Assessment Methodology
VAIL Interoperability Framework
VAIL Interoperability Maturity Model
VAIL Interoperability Strategic Plan
VAIL Intranet Site
VAIL Maturity Assessment Change Control
VHA Business Architecture (BA)
VHA Business Information Models
Veterans Health Information Systems and Technology Architecture (VISTA), Computerized Patient Record System (CPRS)

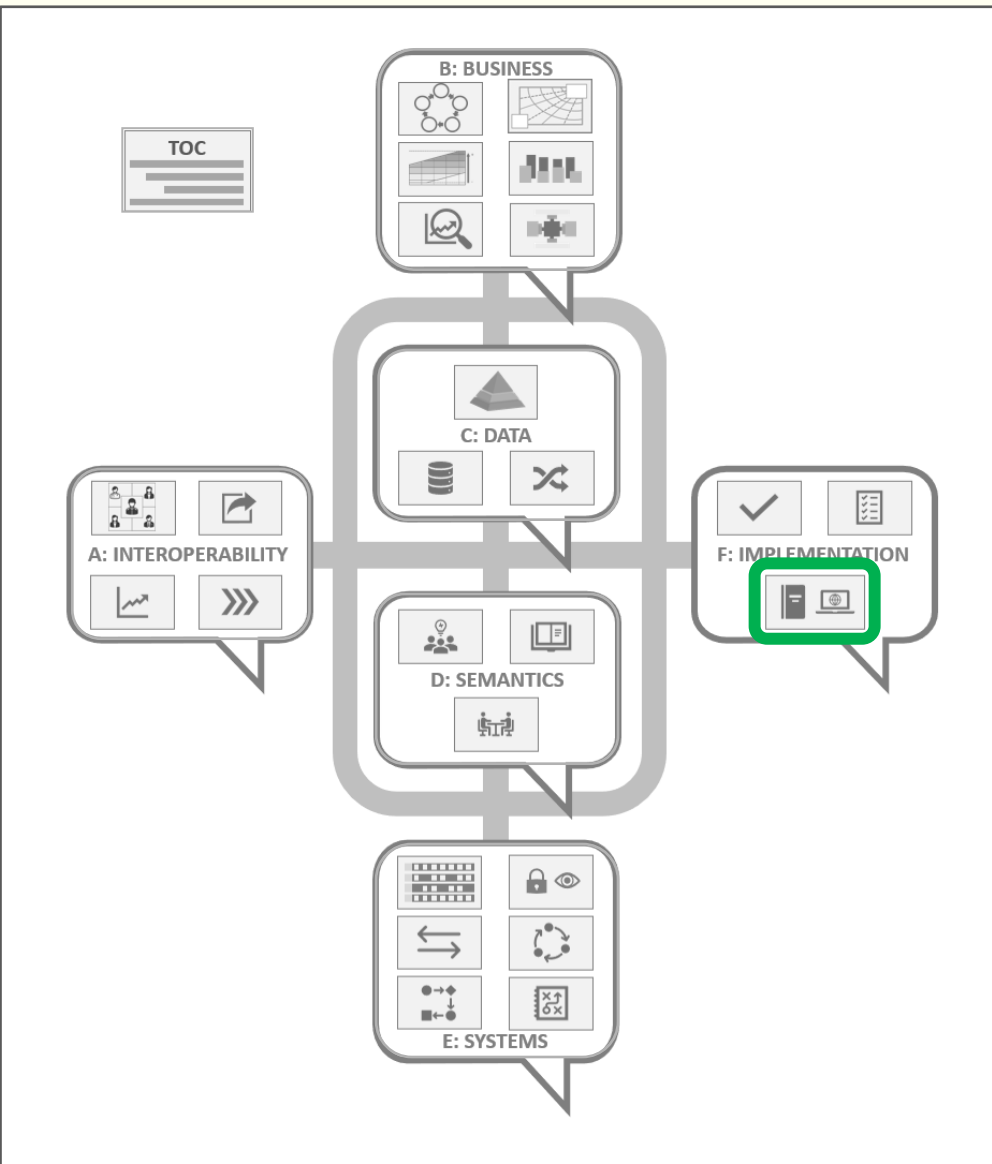
VA Public Reference
Ethics Principles for Access to and Use of Veteran Data
Information Resource Management Strategic Plan 2018-2024
VA Data Governance Council Charter & Definitions
VA Data Management Glossary
VA Data Maturity Model Selection
VA Data Strategy
VA EA Enterprise Design Patterns
VA EA OIT Business Reference Model
VA Health Information Strategic Plan 2022-2026
VA Office of Data Governance and Analytics
VA Office of Enterprise Policy and Governance
VA Office of Planning and Performance Management
VA OIT Product Line Architecture
VA Strategic Plan FY 2022-28
Veterans Health Information Exchange
Veterans Journey Maps
VHA-Sponsored Security and Privacy Papers

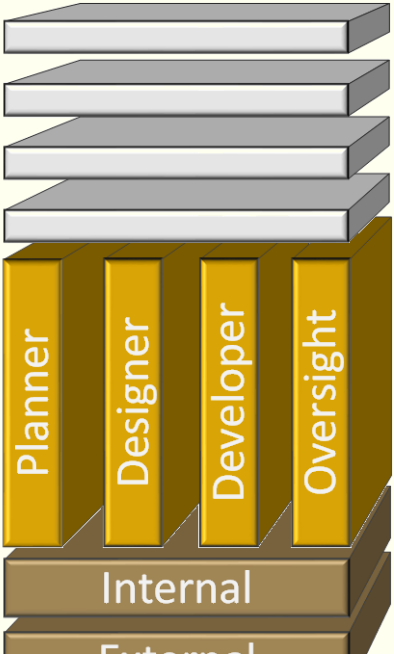
Industry Reference
21st Century Cures Act
AHRQ ACTS
Business Process Modeling + Health (BPM+)
Capability Maturity Model Institute
Clinical Practice Guidelines (CPG) on FHIR
CMS Interoperability and Patient Access Final Rule
CMS Provider Burden, Patient Access, and Interoperability Roadmap
DAMA Data Management Body of Knowledge 2
FHIR Registry of US-realm Implementation Guides
FHIR Security & Privacy Module
Gartner Composable Enterprise Architecture
HL7 FHIR US Core
Office of the National Coordinator for Health Information Technology
ONC Final Rule
ONC Interoperability Rule: Health IT Certification Process
ONC Vocabulary Guidance
United States Core Data for Interoperability (USCDI)

Acknowledgements

While not an exhaustive list, the producers of this document would like to thank the following individuals and organizations for their substantial and material contributions to the work. Contributors appear in random order.

Organizations	Individuals
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