



HL7 Informative Document: Health Services
Orchestration Blueprint,
Edition 1
May 2025

HL7 Informative Ballot

Sponsored by:
Orchestration Services and Architecture

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Introduction and Scope

A substantial amount of FHIR invocations typically involve a request-response pattern, where information is sought and returned via invocation of an API call. This artifact is a blueprint - a set of large high-level diagrams, providing design alternative tradeoffs, implications, and solution approaches, intended for multiple professional roles. It is a visual roadmap serving as a desk reference to assist the reader in making informed choices.

A challenge often faced when making significant design decision stems from the large diversity of content sources, and the cognitive burden of differentiating among approaches absent a consistent depiction and understanding of the problem space.

The Orchestration Blueprints are intended to address this concern, drawing upon the motif of "classic" building architecture, using virtual "paper" simulated as large blueprint pages, leveraging a visual storytelling approach to introduce key concepts and considerations affecting the choice of design approaches.

In particular, these blueprints are focused on service orchestration, navigating the reader from a primer introducing the concept through a representative instance design.

The blueprints themselves have a rich template, containing a core theme for each page instance ("focal graphic", depicted on the top center of the page), with contextual information (page left), reference materials (page right), and elaborative details (lower center).

The audience for the work is expected to be widely varied, though a general understanding of health and health IT is presumed.

The blueprints comprise three core pages:

- An Orchestration Primer, introducing the concept of service orchestration and the relative benefits and tradeoffs of this design approach
- An orchestration design overview, introducing a spectrum of design approaches and relating each to core tenets allowing readers to select preferred options based upon business and technical need, and
- A Reference Design Page, illustrating how one select pattern from the above could manifest in a technology solution.

Artifact

The blueprint itself is found in pdf file bundled with this document.

Acknowledgements

The Orchestration Services and Architecture Work Group would like to acknowledge the efforts of the following contributors in making this artifact a reality.

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Health Services Orchestration Blueprint

Edition 1

HIT and Services Orchestration

v1.00

A challenge often faced when making significant design decision stems from the large diversity of content sources, and the cognitive burden of differentiating among approaches absent a consistent depiction and understanding of the problem space. These Orchestration Blueprints are intended to address this concern, drawing upon the motif of "classic" building architecture, using virtual "paper" simulated as large blueprint pages, leveraging a visual storytelling approach to introduce key concepts and considerations affecting the choice of design approaches.

In particular, these blueprints are focused on service orchestration, navigating the reader from a primer (*Blueprint Page 1*) introducing the concept through a representative instance design (*Blueprint Page 3*). The blueprints themselves have a rich template, containing a core theme for each page instance ("focal graphic", depicted on the top center of the page), with contextual information (page left), reference materials (page right), and elaborative details (lower center). The audience for the work is expected to be widely varied, though a general understanding of health and health IT is presumed.

Note that this artifact has been rendered at extreme resolution, so you are able to “zoom in” to see substantial embedded detail. This practice is recommended when reviewing the artifact

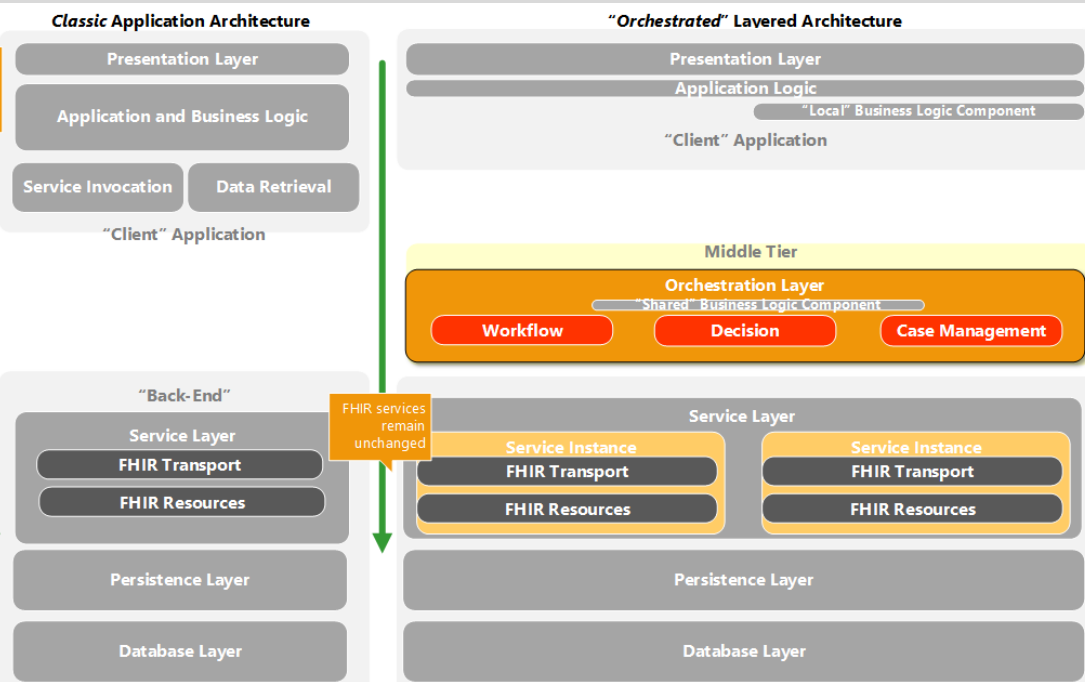
Page at a Glance

- *Orchestration* is a term used to coordinate, manage flow-of-control, and bring together “actors” to fulfil a process flow, and can relate to real-world tasks or IT processes
- Typical FHIR implementations use simple, intuitive “request/ response” patterns
- High-complexity or high-volatility workflows are not well suited to “request/response” implementation approaches
- Introduction of an orchestration layer mitigates complexity in application logic and fosters higher resilience and flexibility in system design.

Why consider orchestration?

- **Defers and shields complexity**, as multiple steps and interactions can be aggregated and managed as units
- **Reuse** enabled through ability to execute holistic workflows that can be used by multiple apps and processes
- **Resilience to change** by intermediating access with “lower level” access, retrieval, and logic tasks from the applications using them
- **Aligns with business need** representing business processes in a transparent way understandable by people and machines and fostering rapid cycle change
- **Enhances existing infrastructure**, still leveraging FHIR Servers as well as other exchange protocols

Why consider an Orchestration Layer?



- **“Layered” architectures** are the industry standard, fostering resilience to change
- An **Orchestration Layer allows for complex business logic** and processes to be grouped, managed, exposed as holistic units
- Orchestration helps **realize the full potential of FHIR’s service layer** in part thru migrating complexity from application logic to a middle tier
- Leveraging orchestration services **can be done piecemeal**
- Orchestration **empowers business stakeholders**, giving them ability to define workflow and needs separate from technical details and data access
- FHIR Resources with orchestration facilitate a flexible clinical or administrative path, **making state management explicit** by considering it distinct from data

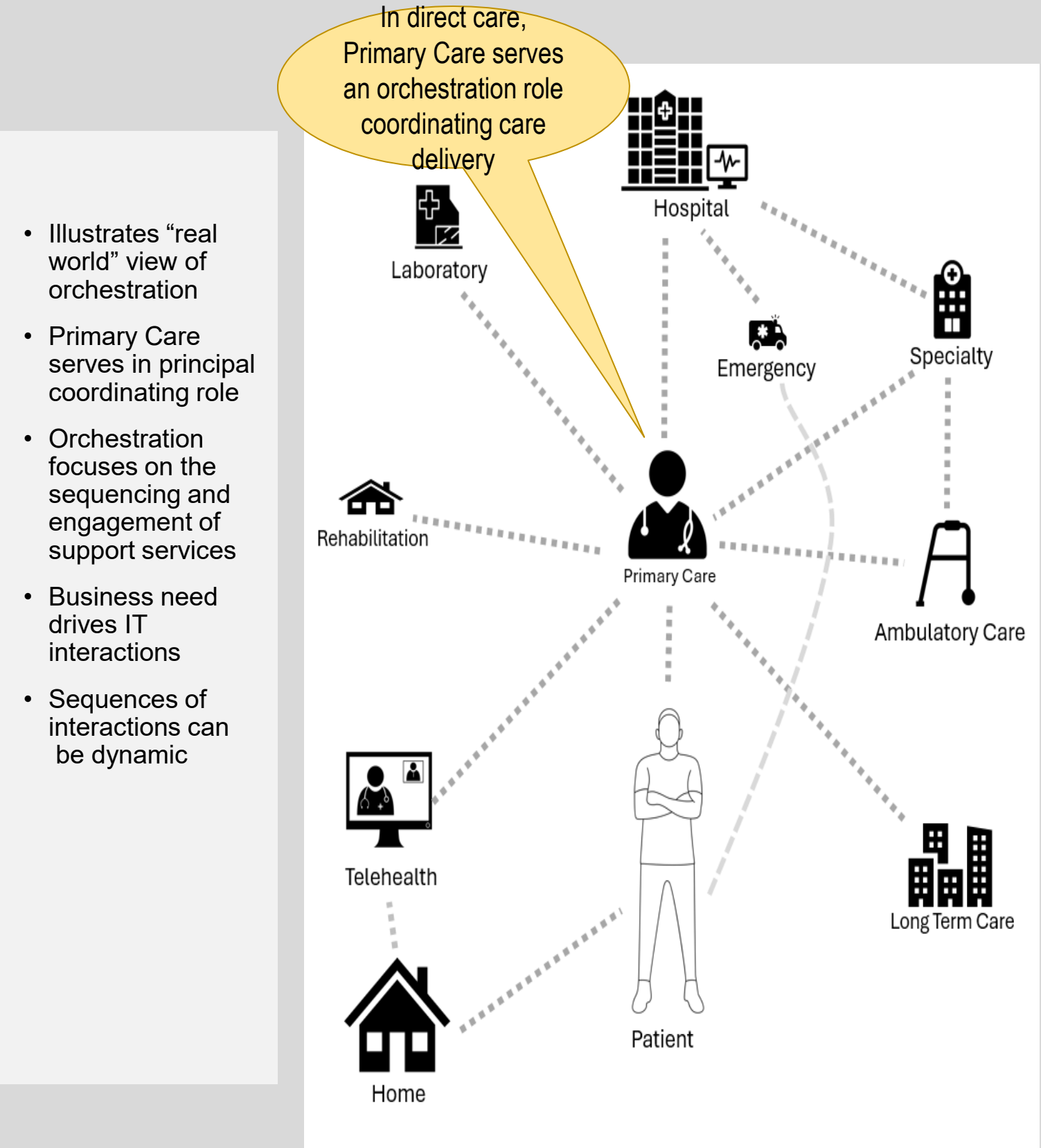
Introduce Patterns

- Patterns provide proven, reusable guidance leveraging best-practices to solve specific problems or problem types
- Patterns are not “authored”, they are “discovered” based upon implementation experience
- In this context, patterns serve as building-blocks in two levels: **architectural** and **business-process**

Health Services Orchestration Blueprint

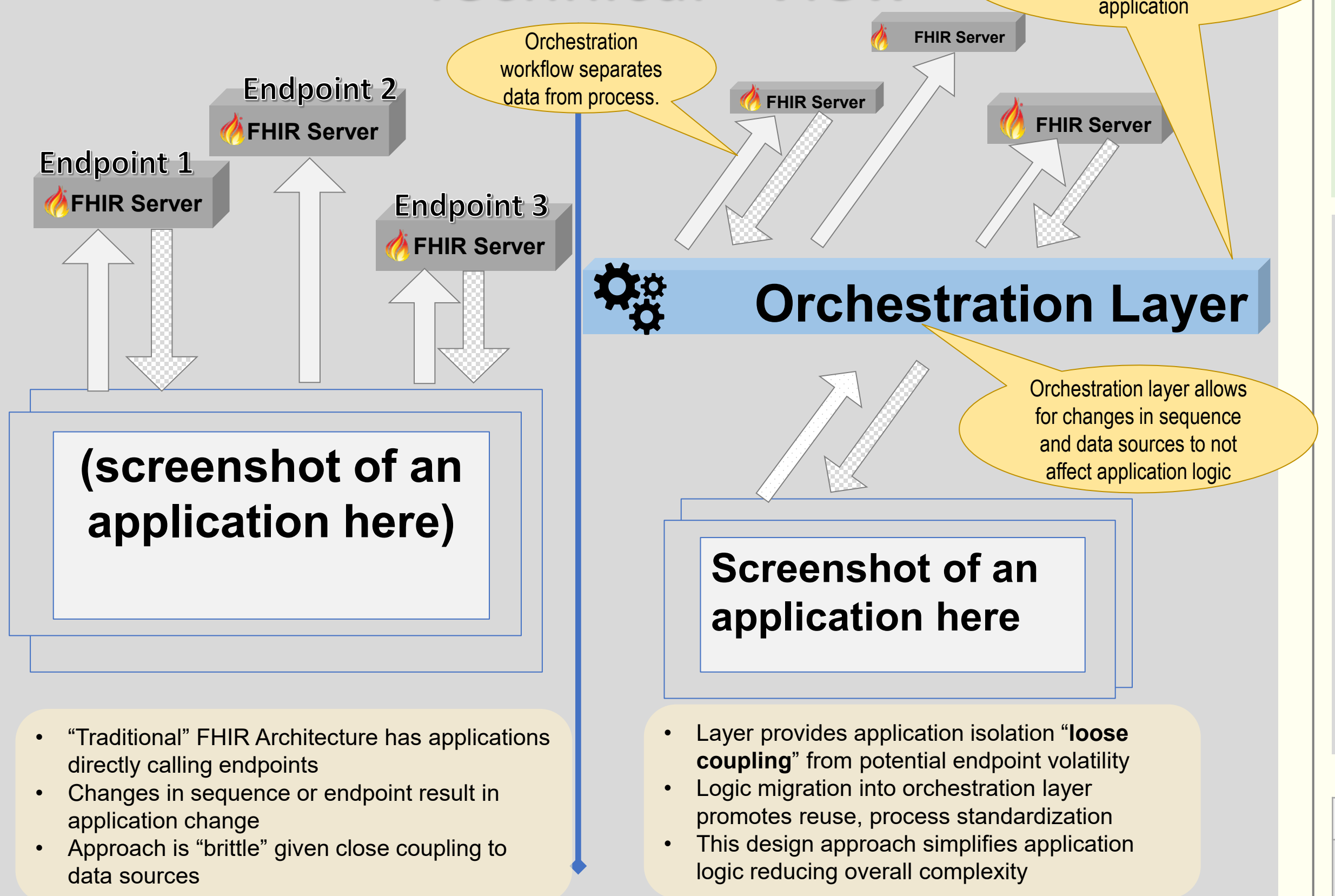
Introducing Orchestration: Overview and Primer

Business view



- Illustrates “real world” view of orchestration
- Primary Care serves in principal coordinating role
- Orchestration focuses on the sequencing and engagement of support services
- Business need drives IT interactions
- Sequences of interactions can be dynamic

“Technical” View



- “Traditional” FHIR Architecture has applications directly calling endpoints
- Changes in sequence or endpoint result in application change
- Approach is “brittle” given close coupling to data sources

- Layer provides application isolation “**loose coupling**” from potential endpoint volatility
- Logic migration into orchestration layer promotes reuse, process standardization
- This design approach simplifies application logic reducing overall complexity

Implications and Considerations

“Classic” Approach

Strengths:

- Integrating system components via a “request-response” is proven, simple, and effective implementation pattern
- Broadly understood, widely implemented
- Easy architecture to understand
- Well suited to low-volatility static use cases

Weaknesses:

- Not well resistant to change – can be fragile
- State management burden is responsibility of the invoking application
- Multi-component integration is cumbersome (e.g., multiple servers, systems, locations as part of one interaction)
- Not well suited to high-complexity, multi-endpoint, and adaptability needs, particularly when human interaction is involved. People become the default orchestrator

Opportunities:

- Enhance ability to see within processes underway to improve visibility (process metrics, status, etc.)
- Identifying patterns that leverage strengths and ease implementation/adoption

Threats:

- Pace of change and volatility makes keeping pace in this approach difficult
- Request/response not well suited to address innate variabilities within the vertical
- Implementations that introduce human burden will be rejected by workforce

Orchestration-Based Approach

Strengths:

- Ability to express complexity in formal models results in adaptive systems that extensively support robust, complex state management
- Dynamic workflow – orchestration layer allows for real-time adaptation of workflow and sequencing based upon data inputs and influencing context.
- Ideally suited to adapt in support of high-complexity, multi-endpoint scenarios with skilled staff
- Orchestration change process and decision points without changing the service layer
- Simplifies testability of systems via expression/ validation of process models & simulation tools
- Ability of real-world workflows to minimize change and/or burden to clinical staff

Weaknesses:

- Additional execution components are necessary to support the architecture in implementation
- More advanced implementation technique requires additional experience/skills
- Less widely implemented in health vertical than request/response




Opportunities:

- Introduce orchestration use case to address high complexity scenarios in concert with request/response implementations
- Leverage this infrastructure to enhance capture of metrics and improve transparency into processes
- Provides the ability to introduce escalation paths in situations needing intervention
- Introduce and more consistently apply common patterns as solutions to known challenges

Threats:

- Absent deliberate design consideration decisions, higher potential for “lock-in”
- Higher bar to initial implementation - experience, skills, and technical

Myth Busting

Myth	Reality
 Request response is the ideal FHIR implementation pattern	<ul style="list-style-type: none">• Healthcare Interactions are often complex , stateful, and highly adaptive to situational context
 Machine learning/ AI can solve workflow efficiency and efficacy issues.	<ul style="list-style-type: none">• AI learnings need to be intermixed with human processes and integrated into care processes.
 FHIR is an ideal tool for expressing and implementing workflow	<ul style="list-style-type: none">• FHIR is not a visual language and has limitations in its ability to precisely express workflow, orchestration, and state management

Glossary of Terms

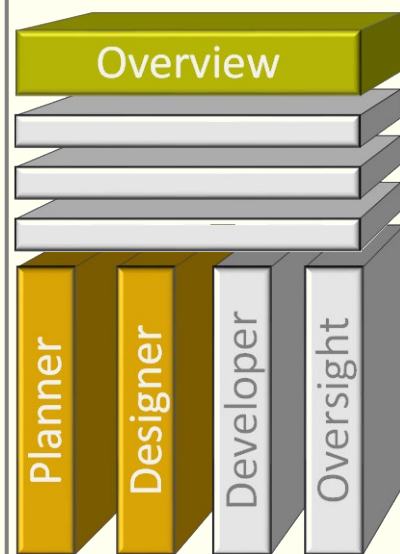
Term	Definition
Care Coordination	“Real-world” instance example of orchestration, where multiple different entities of care delivery are brought together in concert to meet a clinical need.
Choreography	Approach where interaction among system components are self-managed based upon the situational context and the roles/responsibilities each actor has.
Orchestration	<i>Orchestration</i> is a term used to coordinate, manage flow-of-control, and bring together “actors” to fulfil a process flow, and can relate to real-world tasks or IT processes
Pattern	Industry best-practice for collecting, documenting, and reusing approaches mindful of solution context and implementation considerations.
Request/Response	Pattern where a “client” makes an API call to a server that responds with corresponding results; Typically a synchronous interaction.

Further Reading

CPG on FHIR
URL goes here

Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions; Hohpe et. al., 2003

CPG Implementation Guide



Contact:		
Rev.	Date:	Description:
HL7 Orchestration, Services, & Architecture		
System:		
Page Name		PAGE ID
Introducing Orchestration		A-1

Page at a Glance

- *Orchestration* processes are implemented with a varying degree of automation.
- By underpinning system requirements with orchestration constructs, we can manage complexity and select the appropriate automation approach
- Orchestration *patterns* are proven, repeatable approaches to solving well understood situations
- Data and process are closely related but distinct entities
- Effective use of the above introduces and reinforces system flexibility and resiliency
- Product of this analysis is a design construct ready for implementation and technology decisions

Use Cases and Context

Use Case/ Example	Context	Opt. 1	Opt. 2	Opt. 3	Opt. 4
Emergency Departments	Suitability for high volatility environment.	Poor	Poor	Fair	Fair
Retrieve demographic information.	Narrow-use, point retrieval of data from identified source(s).	Good	Good	Fair	Good
Trauma care center has 3 primary levels, and each has different resources available.	Extent to which the implementation would need to be adapted based on rules, care setting, etc.	Poor	Fair	Good	Good
Pull sequence of labs for last 5 years from across the geographic regions where the patient lived to determine patient history and trend related to cancer diagnosis.	Effective for working with multiple systems, data sources, data types, and representations to support the needs of a specific use case (encounter, etc.).	Poor	Poor	Fair	Fair
Searching and pulling ER or testing information prior to a patient visit.	Broad data pull from one or more HIEs to collect data relevant to an episode and intervention.	Poor	Poor	Good	Good
Use and assessment of an eCQM for a specific CMS and/or State program to assess efficacy.	Leveraging the value of data from HIEs to monitor clinical quality/ performance.	Poor	Poor	Fair	Fair
Prior authorization	Access to claims data for provider or payor for reimbursement, medical necessity, and eligibility.	Fair	Good	Good	Fair

Process emerging from transactions vs. process driving transaction

How do we decide when to enforce a top-down, process-driven approach versus allowing a process to emerge naturally from transactional data?

This requires weighing the benefits of standardization against the potential for adaptability.

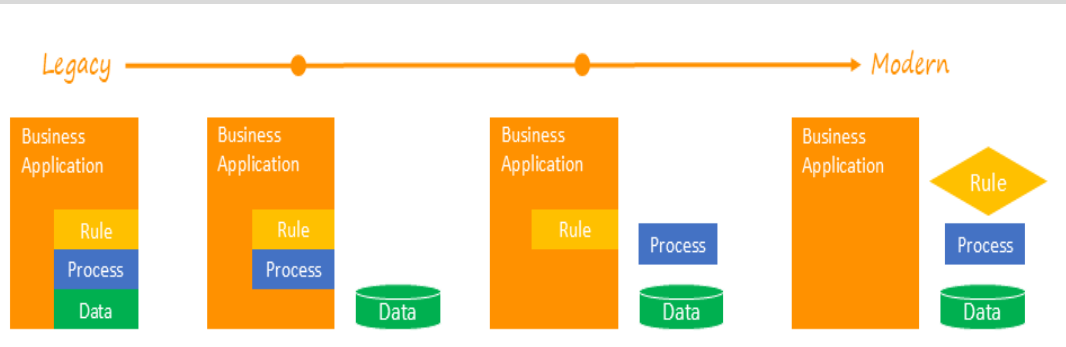
What governance models are best suited for each scenario?

Evaluate whether centralized control (for uniformity) or distributed control (for flexibility) better supports the organizational context and desired outcomes.

How can macro-level strategies be reconciled with micro-level realities?

Integrating top-down standardized processes with bottom-up, data-driven transaction insights allows organizations to align macro-level strategies with everyday operational realities.

Interaction between Data and Process



- Over time, the IT industry has evolved to extracting rules, processes, and data as external components consumed by applications
- Note that data and processes are distinct but co-dependent. Processes consume data. Processes may produce data.
- This separation allows for composability, coordination, and orchestration

Health Services Orchestration Blueprint

Choosing the Best Design Option

Implementation Options

Note that there is a continuum of representations and approaches for expressing processes (depicted in left diagram, above). The Options presented here reflect discrete “points” along the continuum.

Option 1: Process Implicit. Represents implementations which do not formally express process steps or sequence, rather it includes interfaces or function calls where their invocation sequence is assumed or implied. Example includes RESTful FHIR calls/APIs.

Option 2: Process is Hard Coded. Represents a sequence of activity steps that are pre-coordinated and directive within an implementation, driven by a pre-determined sequence that are innate within the implementation. For example, a series of FHIR invocations sequenced and embedded within an application or service.

Option 3: Process is Dynamic. Represents a process expressed using a representative formalism, such as a process model, which describes the sequence of events and decisional triggers affecting process execution. This option is situationally aware, using input “variables” to inform process steps, branching, etc. Example includes BPM+ models.

Option 4: Process is Adaptive. Represents a self-adjusting process, such as a machine-learned model, where the paths through the process adjust based upon inputs and evidence, resulting in adaptations to context, inputs, and over time. Examples: LLMs, AI, etc., coupled with formal modeling such as BPM+.

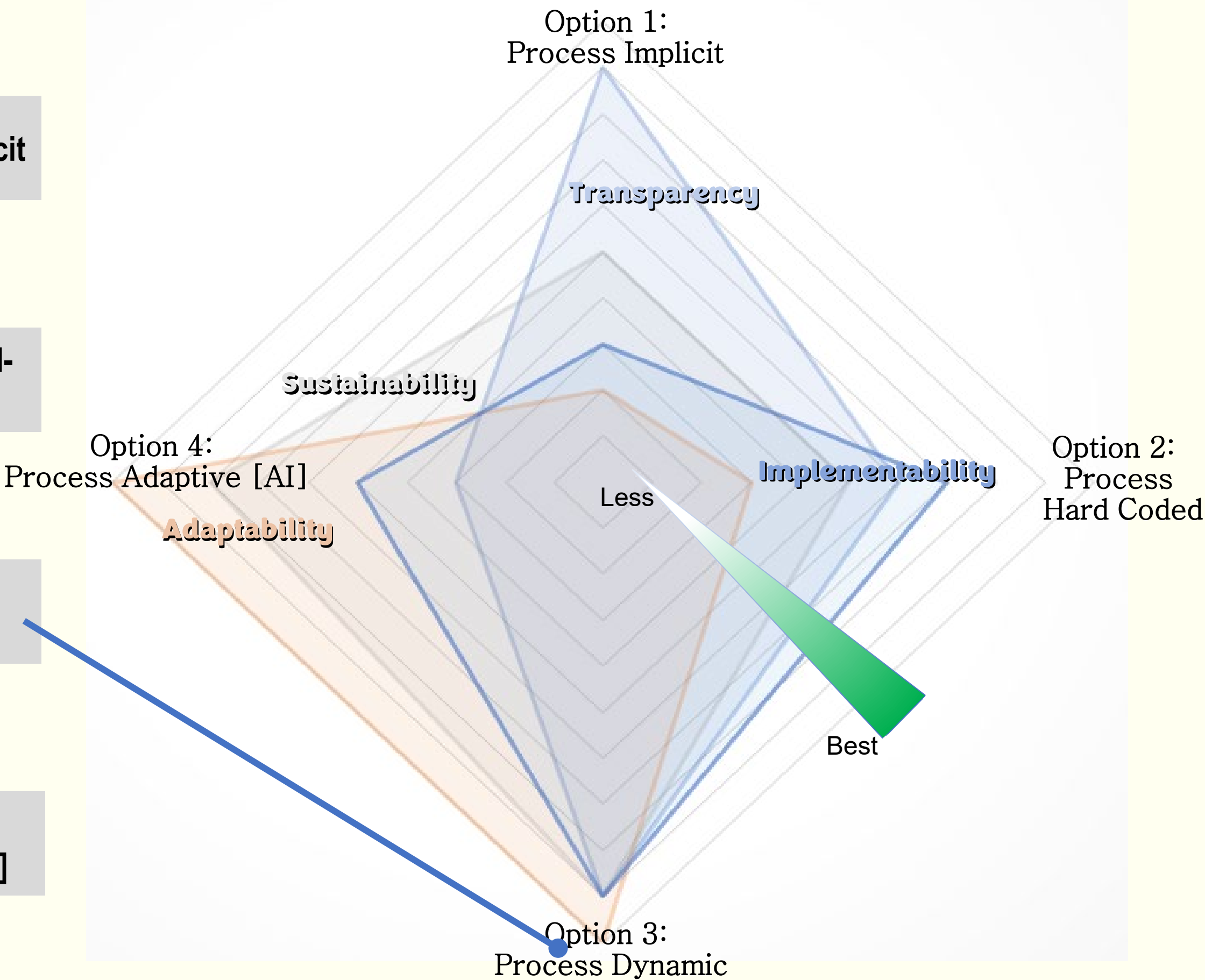
Spectrum of Alternatives

Process Implicit

Process Hard-Coded

Process Dynamic

Process Adaptive [AI]



Assessment Criteria: Definitions and Scoring Basis

Each option was scored against the criteria below, applying a 1-5 scale, (5 is most desirable). The depiction is qualitative to show relative strengths and weaknesses of the options.

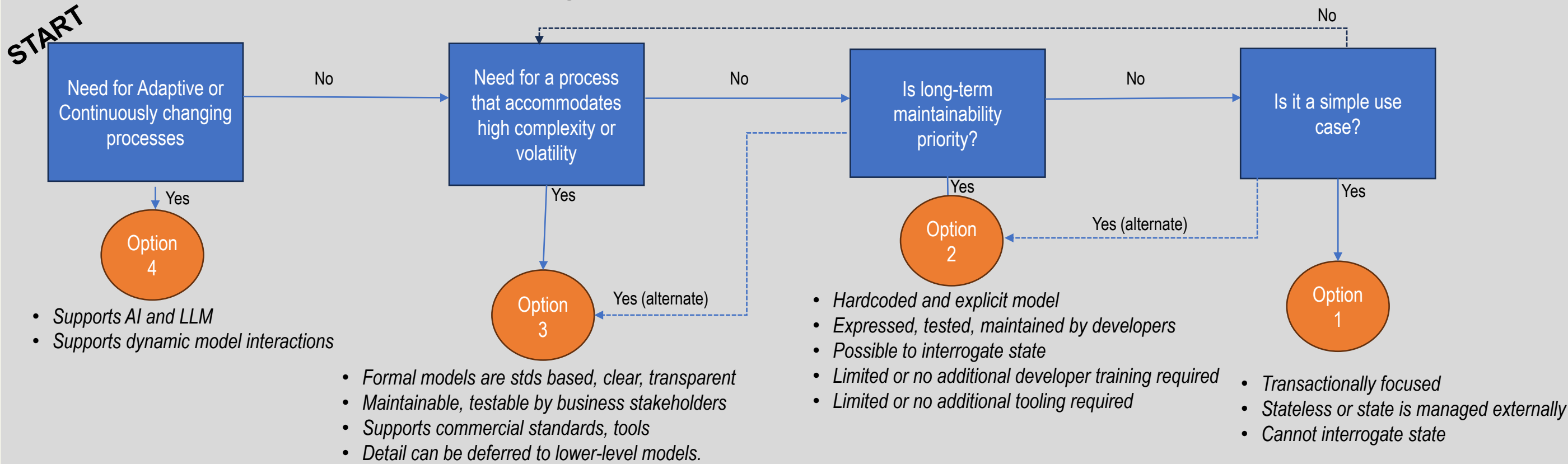
Implementability: Assessment of the ease of implementation of the option, based upon niche skill requirements, complexity to undertake, specialized tools needed. Higher score indicates easier to implement. [Dark Blue]

Adaptability: Indication of the readiness and ease to adjust the option to accommodate changes in business requirements. Higher score indicates enhanced ease and ability to accommodate change. [Orange]

Maintenance/Sustainability: Reflects the abilities, skill requirements, difficulty, and level of effort required to maintain the option. Higher score indicates enhanced ability to maintain. [Grey]

Transparency/Visibility: Indication of the extent and ease to inspect, review, and assess processes represented by the implementation option. Higher score indicates better visibility. [Light blue]





Design Option Selection Workflow



We have identified a set of representative design alternative options, differentiating solution approaches based upon key salient characteristics. The flow diagram (left) leverages these to inform the reader as to best suited options based upon key criteria described below:

- Adaptive solutions leverage AI and Machine Learned models, and are unique among the solution sets. [Option 4]
- Complexity and volatility are differentiators as corresponding solutions provide for transparency, versioning, and rapid adaptation not available in other alternatives. [Option 3]
- Hard-coded or simple service calls are well suited to narrow use cases or “point” needs. [Options 2 and 1]

Myth Busting

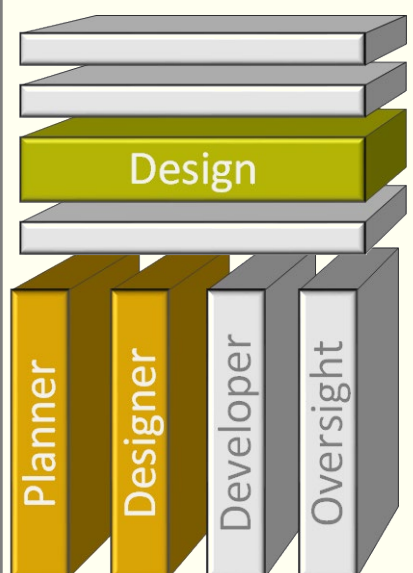
Myth	Reality
 Healthcare data availability is sufficient to provide and coordinate care.	<ul style="list-style-type: none">• Understanding data requires understanding of the context, processes, patterns, and intent that shapes that data
 The goal of orchestration is automation.	<ul style="list-style-type: none">• Orchestration plays a key role as an enabler of process improvement. Processes may be human, computer, or involve both.
 Process models and patterns are becoming obsolete due to AI	<ul style="list-style-type: none">• AI is effective and valuable at detecting patterns and optimizing workflow• Clinical processes must integrate human and machine-based processes• Current best-practice is to leverage process models to integrate AI capabilities into workflow
 Solving data interoperability solves business needs	<ul style="list-style-type: none">• Data without context has no value• Processes are a function of business intent, reliant upon but distinct from the data supporting it• Business value is achieved by coordinating processes and corresponding data to drive outcomes and efficiencies

Further Reading

HL7 RESOURCES
Title and / or Hyperlink
OTHER RESOURCES

Definitions

Term	Definition
BPM Process Models	Representations used to define, visualize, and standardize process. In the HL7 context, it also aligns these representations to other HL7 standards.
Formalism	Expression of precise techniques that can be used to define, specify, model, and verify software to ensure its unambiguous interpretation.
Realm of Control	scope within a system to make decisions and enforce rules without external intervention.
Large Language Model (LLM)	a machine learning model trained on vast amounts of data, capable of understanding and generating human-like text to perform a wide range of tasks, including answering questions, summarizing information, and generating content.



Contact:		
Rev.	Date:	Description:
HL7 Orchestration Service Architecture WG		
System:		
Page Name		PAGE ID
Choose Design Options		A-4

Page at a Glance

- This page illustrates **Option 3** (prior page) showing how a process model drives IT flow-of-control among systems and FHIR data sources
- The focal graphic is a “generic” **care journey** involving screening and a specialty referral
- The orchestration engine executes the process model, managing detailed FHIR calls and sources
- With this approach, changing system behavior is done by changing the process model without need change underlying IT

Deep Dive on Data/Process Interaction

- Consider the depicted BPM Process Model, reflected in the Focal Graphic as the large horizontal process bar. There are several items to note.
- Process steps consume or produce data drawing upon multiple potential sources
 - The process diagram depicts which data inform which activities, and indicate when a process step or activity produces data objects
 - FHIR is the preferred data representation construct. **BPM processes are synergistic with FHIR.**
 - Orchestration services call upon FHIR endpoints [IT stack] to gather and package data. Data transformation or enrichment is done at an originating source or via a bus service.

Managing the human-computer divide

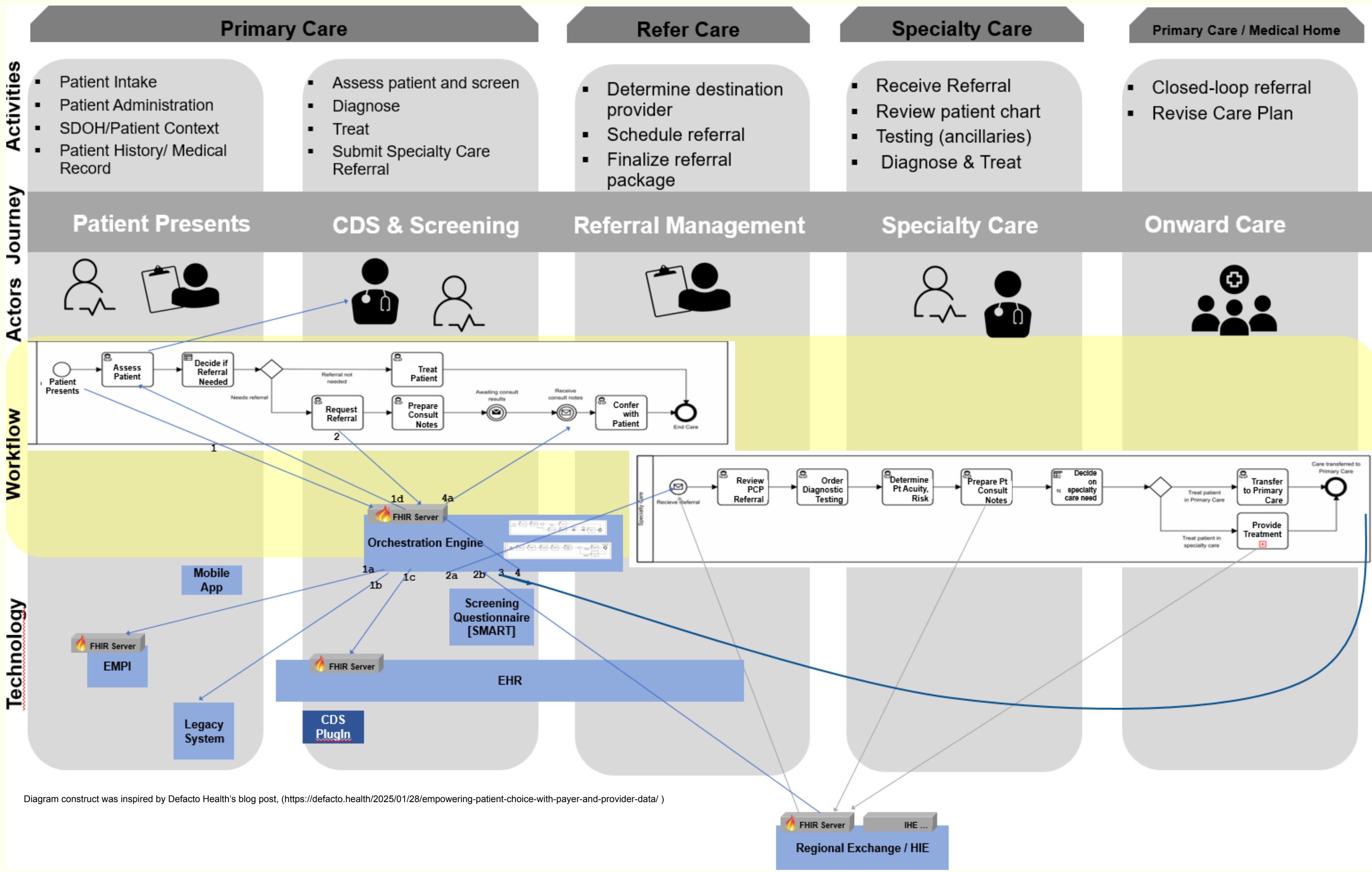
- There are several benefits to this approach as related to human-computer interaction:
- Use of formal process models are **human readable** and can be validated by functional experts
 - Formal **process models are “computable”** machine-assessed for syntactic accuracy, use in low-code, no-code execution environments as in this example
 - Integrated workflow models **bring together human and computer tasks**. There are constructs to call out process steps requiring human input or affirmation.
 - Use of **environmental triggers** allows for richer expression and execution flexibility. For example “timing events” can automatically trigger based upon exceeding duration thresholds
 - **Integration of AI into process flow** is not technical limitation. Process automation allows for seamless integration of AI. A process step can be an AI bot. The end-to-end process can be adapted by AI.

Orchestration and Patterns

- Patterns are a discipline using generalized solution approaches that have been proven to address pre-determined situations or business needs
- Patterns typically are represented with a name, a logical construct, known implications, and implementation considerations.
- Delegating specific activity steps to an orchestration component aligns well with Pattern-based approaches
- Publications of Integration Patterns, Analysis Patterns, and implementation patterns can be applied to extend this basic architecture.

Health Services Orchestration Blueprint

Reference Implementation Design: FHIR w BPM-based Orchestration



Design Highlights and Commentary

- The clinical example above is intended to be reflective but not exhaustive. It was selected for clarity and is NOT fully clinically accurate.
- Workflows expressed above in white are formal models depicting flow-of-control and interaction among human and technology components
- This design approach (“Option 3”) utilizes formally expressed workflows as executable elements within the orchestration engine
- While there is implicit data flowing, the arrows in the above indicate flow-of-control among system components and actors
- Data needs (e.g., process steps that consume or produce data) would typically be reflected as FHIR resources

Implications of this Orchestration Architecture

- The orchestration is driven by a formal model, allowing for rapid adaptation by business stakeholders via **low-code/ no-code**
- Technical details around FHIR server selection, flow-of-control, and sequence management are handled by the orchestrator
- Process state can be interrogated, providing enhanced statusing, visibility, and transparency (where we are in the process)
- IT infrastructure is “separated” from business workflow need, allowing for more agile business adaptation without retooling
- Underlying data access mechanisms leverage open standards, such as FHIR – this solution approach is not “rip and replace”
- Allows for patient-level audit based upon process path executed
- Readily adapts to workflow versioning, including parallel deployment of differing models for quality assessment, workflow transition, etc.

Myth Busting

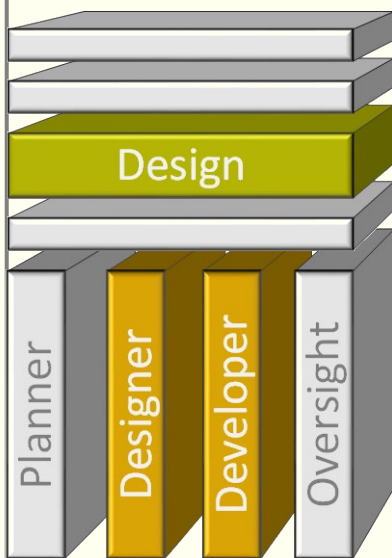
Myth	Reality
Healthcare processes can be managed statelessly, leveraging APIs to provide intended functions	Using a formal, precise process model improves process transparency, ability to version manage, and ability to support change management in both the institution and software.
FHIR allows for robust expression of processes and process interaction. No additional representations are necessary.	While this might be true for deep technical audiences, clinical and business stakeholders will not have the skills or interest in consuming FHIR.
FHIR implementations can be readily extended to address increasing complexity or change in scope.	While extensions in scope are possible in FHIR, best-practice indicates that encapsulating complexity via a lower-level model (e.g., federation) better supports scale and is easier to maintain and consume.

Glossary of Terms

Term	Definition
EMPI	Enterprise Master [Patient] Index
BPM	Business Process Management; The discipline of workflow expression represented by process models, such as BPMN
Computable	Reference to artifacts that can be ingested into a computer-based process and machine executed.
Low-Code/ No-Code	Representations of logic that are human-understandable and reduce/avoid need for direct computer programming
“Lifting Layer”	A layer of software that adapts the representation and format of data into another, fit-for-purpose representation
“Closed Loop” Referral	A healthcare workflow where care is fulfilled via some third party provider (often community-based), and following the completion of that interaction the results are returned to the originator.

Further Reading

CATEGORY
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Health Services Orchestration Blueprint

SUPPLEMENTAL CONTENT