ANALYSIS OF THE CRIMINAL JUSTICE SYSTEM'S DATA ARCHITECTURE

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Abstract

The criminal justice system in the United States is a complex national enterprise consisting of a multitude of independent units of government (jurisdictions and agencies) that must coordinate their activities in order to achieve a common goal: an efficient and effective justice system. To effectively coordinate these activities, system stakeholders must effectively share information. However, due to its diversity and decentralization, the justice system lacks a common framework for sharing data — in other words, it lacks a common data architecture. The primary hypothesis of this project was that while the justice community has invested significantly in developing information sharing standards, which are critical components of a data architecture, it has not developed a complete "enterprise" view of the justice process that properly identifies all of the components required to understand the entire enterprise, nor has it properly scaled these exchanges to maximize their utility across organizational boundaries.

The results of this research affirm this hypothesis — there is little demonstration that the justice system has developed a comprehensive enterprise model of a criminal justice data architecture. However, this research has also moved the discussion forward by developing a framework for assessing the state of the justice data architecture. Justice stakeholders can use this framework to capture, document, and measure the components that exist, and they can add to it to develop a robust criminal justice data architecture.

The goals of this project were to—

1) document the current as-is state of the criminal justice system's data architecture compared to its ideal future to-be state, and identify gaps between the two, and
2) develop a common framework or structure for defining the information sharing requirements and capabilities of the criminal justice process — a data architecture metamodel and framework.

To accomplish these goals, researchers defined the structure of the framework following principles of Enterprise Architecture, Service Oriented Architecture, and Business Process Modeling. Following this framework, researchers used the framework to document the as-is and to-be states of the criminal justice data architecture.

Summary of Gaps*:* The law enforcement community is well-represented by GRA/NIEM standards, particularly in CAD/RMS, and incident and criminal history reporting and querying. Judicial and corrections communities are somewhat less well-represented, but they have a body of state-level IEPDs that could be transformed into national standards. Emerging lines of business, such as forensics and statistical data analytics, are lightly represented in the data architecture, as is guidance and data elements for exchanging unstructured data, such as video, images, and voice. Cross-domain exchanges between the justice and nonjustice domains (e.g., health, emergency response) are limited to those areas of commonality that are largely represented by the common person identifiers contained in the Admissions/Discharge/Transfer (ADT) HL7 exchange and the Emergency Incident Description Document (currently under APCO review). Researchers are evaluating other research and national initiatives to understand, expand, and document the current state of the architecture.

The results of this research illustrate significant gaps between the as-is and to-be states. The as-is state identifies those exchanges that practitioners can model in the framework using published national reference models and other authoritative resources. The to-be state identifies potential exchanges used by the justice community and their nonjustice partners. These potential exchanges numbered 680, whereas research identified fewer than 50 published specifications exchanges within the as-is state. The incomplete nature of the as-is state illustrates the need for broader participation and active outreach to close the gap.

Conclusions with respect to the Data Architecture Framework and tool include:

1) Analysis of the to-be state illustrates that practitioners can model most information exchanges using one of three basic exchange archetypes: Event, Query-Response, and Request-Response;
2) The framework is robust and practitioners can use it to develop their own information architectures for their local justice enterprise;
3) Practitioners can use the framework as a model for broader adoption and use by other domains;
4) Existing resources and standards establish a foundation to share information that needs to be expanded; and
5) Matriculation to the ideal, to-be state will require further investment to promote the adoption, use, and management of the justice data architecture.

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Executive Summary

Problem

The criminal justice system in the United States is a complex national enterprise consisting of a multitude of independent units of government (jurisdictions and agencies) that must coordinate their activities in order to achieve a common goal: an efficient and effective justice system. Coordinating activities among these different entities has long been a challenge due to the "stove-piped" nature of each key component — each entity performs separate core business functions that address its specific mission. Law enforcement focuses on crime prevention and public safety, courts focus on delivering just outcomes in criminal and civil disputes, while corrections and jails are responsible for safely and effectively managing incarcerated or detained individuals.

The justice community has long recognized the benefits of using technology to improve their business processes and perform their core missions. In the 1990s, the justice community recognized the need to further improve system performance and capabilities by augmenting their core business systems to include electronic information sharing. This effort began at the state and local level; federal authorities then acknowledged and embraced it by forming the Global Justice Information Sharing Advisory Committee (known as "Global"), a Federal Advisory Committee to the U.S. Attorney General. Global has since fostered the development of a set of national standards — the Global Information Sharing Toolkit (GIST) — that promotes information sharing by federal, state, local, and tribal justice entities. The entire justice community has benefitted from the standards, guidelines, and frameworks the Toolkit provides, which help improve interoperability and information sharing capabilities at lower costs.

However, for all of the progress made in this area, the nation still lacks a comprehensive national data architecture for the criminal justice system as a whole. The work of Global and justice community members at all levels of government has evolved without an explicit, well-defined architecture. Through a sense of goodwill and common purpose — rather than by design — a great deal of effective information sharing occurs among the various stakeholders in the justice system. These capabilities fit remarkably well together; as a result, the nation has taken great strides forward in sharing justice information. But we still lack a single, comprehensive picture of this complex enterprise, which limits our ability to make further progress and make the wisest use of our investments.

Purpose

The purpose of the Criminal Justice System Data Architecture project is to assess the state of the national data architecture framework for criminal justice and public safety information sharing in the United States, and to model this assessment based upon Enterprise Architecture principles for information architecture. By developing this architecture, practitioners and technologists will share an integrated view of the business problems to be solved within the greater justice enterprise. SEARCH, The National Consortium for Justice Information and Statistics, conducted this research project with two primary objectives:

1) **Produce a report that documents**:
   - The current as-is national data architecture for information sharing among criminal justice agencies at all levels of government, and between criminal justice agencies and their partners in related domains such as first responders, health, and social services agencies;
   - Any gaps or misalignments in the architecture, as measured against a conceptual to-be target architecture.

2) **Define and develop an information sharing framework and associated tools to capture and document the current as-is and future to-be state of a National Justice Data Architecture (NJDA)**. This framework includes three perspectives or "views," which address the needs of specific stakeholders based upon their role and primary responsibilities and assist in decision-making:

Planning View	Operational View	Design View
Senior executives, division managers, and strategic planners to identify goals and policy initiatives and to allocate resources at the strategic level.	Architects and business managers responsible for designing integrated justice systems and information flows at the business level.	Technology architects and developers to make decisions about service oriented technologies and technical designs at the implementation level.

Research Design/Methods

The primary hypothesis for this work is that while the justice community has invested significantly in developing information sharing standards, which are critical components of a data architecture, it has not developed a complete "enterprise" view of the justice process that properly identifies all of the components required to understand the entire enterprise, nor has it properly scaled these exchanges to maximize their utility across organizational boundaries.

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In conducting research and analysis for the first objective, SEARCH determined that synthesizing the disciplines of Enterprise Architecture (EA), Business Process Modeling (BPM), and Service Oriented Architectures (SOA) would provide the best approach to represent the as-is and to-be states. EA and BPM are naturally synergistic; BPM provides the business context, understanding and metrics, while EA provides the disciplines for translating vision and strategy into architectural change. Simply put, EA helps organizations to do the right things and BPM helps to do things in the right way. The key added-value for BPM is its focus on flexible process design, as well as process orchestration and information technology (IT) enablement. Service Oriented Architecture

provides a technical framework for implementation, and many mature organizations have adopted a service oriented approach to business process design as the preferred approach to software development. Using a combined EA/BPM/SOA approach helps agencies address data, privacy, and security compliance and risks, and document the data requirements. The broad end-to-end view of an information sharing environment from these perspectives of both exchange partners ensures that regulatory compliance is met.

Applying EA principles was foundational to developing the data architecture framework. SEARCH followed current best practices of EA, a discipline developed by John Zachman in 1987.[1] SEARCH also researched these related frameworks: The Open Group Architecture Framework (TOGAF),[2] the Federal Enterprise Architecture Framework (FEAF),[3] and the NASCIO Enterprise Framework.[4] These partition the analysis of an enterprise into architectural areas. Exhibit 1 depicts a typical set of architectures:

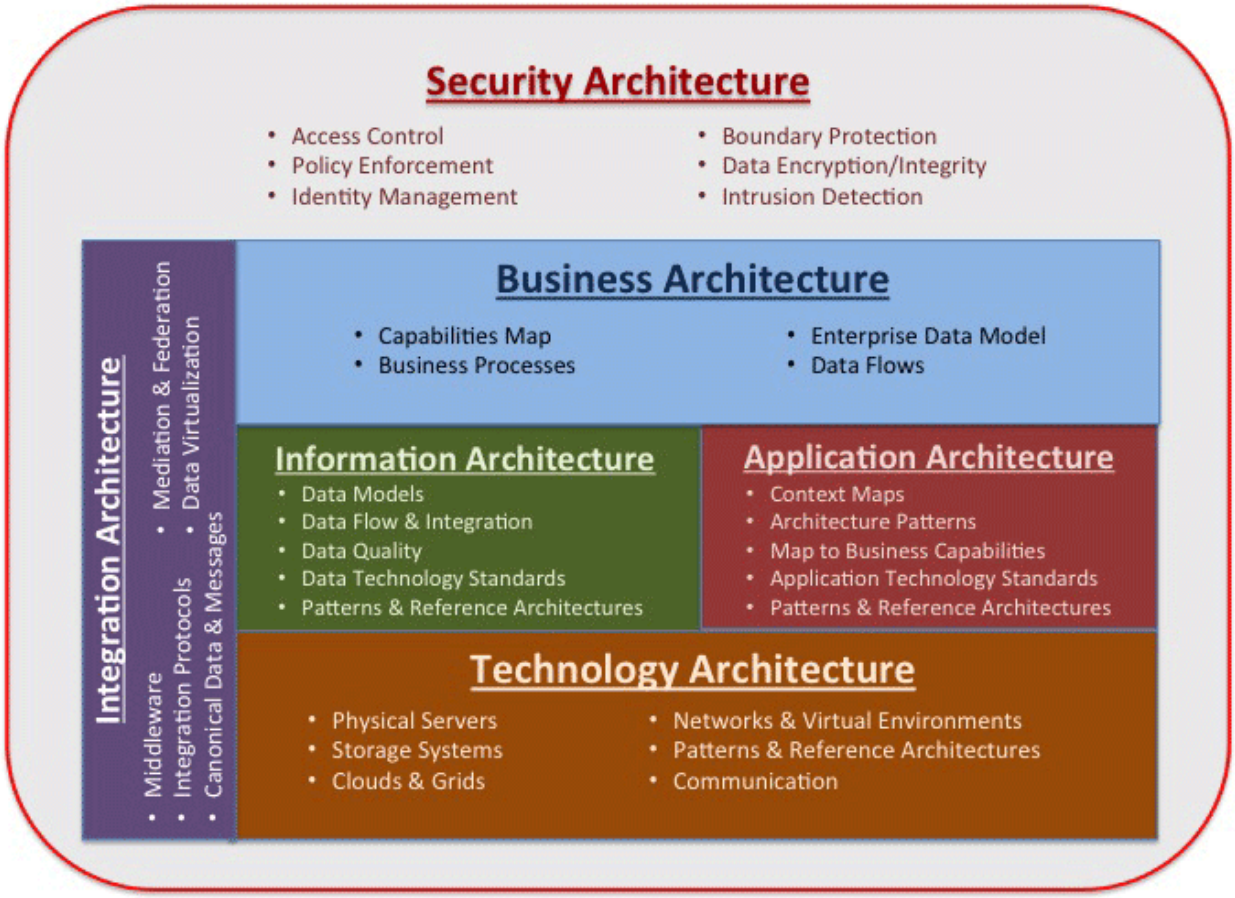

Exhibit 1. Enterprise Architecture Layers

[1] http://www.zachmaninternational.com/images/stories/ibmsj2603e.pdf
[2] http://pubs.opengroup.org/architecture/togaf8-doc/arch/
[3] http://www.whitehouse.gov/ombv/e-gov/fea/
[4] http://www.nascio.org/committees/EA/

In conducting research in support of the second objective (develop a tool or framework to document the architecture), SEARCH evaluated existing resources available to the justice community that promote and/or support information sharing as the basis for the architecture. These include the work of the Global initiative, published Global Reference Architecture (GRA) Service Specification Packages (SSPs), the National Information Exchange Model (NIEM) Program Management Office (PMO), the Information Exchange Package Documentation (IEPD) Clearinghouse, and the Justice Information Exchange Model (JIEM) Adult Felony Reference Model (AFRM). The project also explored two related disciplines to assess their alignment with the Criminal Justice Data Architecture:

- The **first responder community**, represented by the Emergency Incident Data Document (EIDD) initiative. EIDD clearly aligns with the justice domain because of commonalities between the two communities. While aligning with NIEM, the EIDD initiative has taken a different approach in some respects to the established NIEM methodology and model.
- The **health domain**, represented by the Health Level 7 (HL7) standard. This standard predates the justice information sharing initiatives that led to the current GIST. It follows a message-driven approach rather than the all-inclusive data model approach followed in NIEM. Alignment of HL7 to NIEM is limited to those areas of commonality, which are largely represented by the common person identifiers contained in the Admissions/Discharge/Transfer (ADT) HL7 exchange and similar elements found mostly in the NIEM core.

SEARCH is evaluating other research and national initiatives to understand, expand, and document the current state of the architecture.

In developing the framework and tool under the second objective, SEARCH adopted the concept of "views," as commonly found in each of the EA methodologies reviewed. Views tailor the presentation of the architecture to the needs or interests of particular stakeholders in the enterprise. This provides a body of knowledge that decision-makers, at different levels, can consult when facing decisions about the stewardship and sharing of justice information. SEARCH conceptualized the NJDA views to address three different audiences: executive-level, operations-level, and implementer-level. Based on this framework, this project produced a view-oriented architecture that presents three different views, with each view addressing the needs of a specific stakeholder audience:

Planning View	identifies the organizational structures, policies, "line-of-business" (LoB) capabilities, and interoperable high-level processes that allow the organization to identify and prioritize needed information sharing capabilities.
Operational View	identifies the core information (or data) assets of the enterprise, and generally consists of static and dynamic views that describe information semantics, structure, storage, and ownership, as well as its flow throughout the organization.
Design View	documents standards for technology infrastructure components and implementation approaches that support the Planning and Operational Views.

Stakeholders can use these views to help analyze an enterprise's current information exchanges and to identify the need for new information exchanges. Using these views, partnering agencies will be able to design a sharing architecture as a foundation to continually develop, deploy, and expand their information sharing capabilities.

Results

Objective 1 – Analysis of Data Architecture Report

Adoption and Use of Enterprise Architecture and Service Oriented Architecture. Researchers determined that a significant body of knowledge exists that describes the data architecture as a component of Enterprise Architecture, and that many industries have embraced the broader use of EA. Service oriented architecture is now the de facto standard for information sharing. However, while the justice community has adopted many of the standards of EA and data architecture, a complete, enterprise view of the criminal justice data architecture has yet to emerge. This lag in adoption is influenced by the nature of the criminal justice system and the mission diversity of its various entities and components, the lack of uniform governance represented by the diversity in levels of government (local, state, federal) and separation of powers (legislative, executive, judiciary), resource contention, and changing public priorities. While limited in number, the justice community has successfully adopted a broader EA approach to technology planning. Examples include the Regional Information Sharing Systems (RISSNET), the San Diego area's Automated Regional Justice Information System (ARJIS), and numerous portal implementations. EA's limited adoption and implementation means there is a limited number of metrics and evidence-based data upon which to make an informed assessment of EA's utility and value.

Information Sharing Standards for Business Architectures. Using NIEM to design and build messages and the GRA to design and build services is the accepted direction for justice information sharing. NIEM contains a large body of content that represents multiple communities of interest; it is over-inclusive by design. However, because of the complexity inherent in the model, it is not easy for the novice to use effectively. One approach to consider is to develop common, reusable subcomponents such as conceptualized by Business Information Exchange Components (BIECs).

NIEM was designed to be extensible to other domains, as evidenced by the number of domains beyond justice and public safety that adopted and participate in NIEM — a total of 13 to date. However, many other standards have been developed and the justice data architecture needs to interoperate with those that have a nexus with justice. Emergency management and health are two such domains. The emergency management domain has adopted NIEM but recognizes the need to interoperate with other standards. They are pursuing the concept of a "super standard" that accommodates NIEM and other standards, such as the NENA Registry Systems Standard[5] and the NENA/APCO Next

[5] NENA-STA-004.1-2014. NENA is the National Emergency Management Association.

Generation 9-1-1 Public Safety Answering Point (NG9-1-1 PSAP) Requirements.[6] The health domain uses multiple standards for data exchange, with HL7 being predominant. There is limited overlap with NIEM to date, and interoperability may be constrained to person-based data elements and demographic information.

The lack of strong governance over the NIEM Clearinghouse and the justice domain impedes the effectiveness of the standard to some extent. NIEM is very inclusive and this results both in benefits, such as higher levels of participation, and in weaknesses, such as duplicated examples and a lack of clearly identified authoritative examples. While several reference specifications exist, they cover only a limited number of exchanges. Stronger governance exists for the GIST, where reference specifications are vetted independently and represent a more authoritative resource.

Summary of Gaps. The law enforcement community is well-represented with GRA/NIEM standards, particularly in records management and computer-aided dispatch systems (RMS/CAD), and incident and criminal history reporting and querying. The judicial and corrections communities are less well-represented, but they have a body of state-level IEPDs that could be transformed into national standards. Emerging lines of business, such as forensics and statistical data analytics, are lightly represented in the data architecture, as is guidance and data elements for exchanging unstructured data such as video, images, and voice. Cross-domain exchanges between the justice and nonjustice domains (e.g., health, emergency response) are limited to those areas of commonality that are largely represented by the common person identifiers contained in the ADT HL7 exchange and the EIDD currently under APCO review. SEARCH is evaluating other research and national initiatives to understand, expand, and document the current state of the architecture.

Objective 2 – NJDA Framework

The National Justice Data Architecture is a tool developed to document the as-is and to-be states of the criminal justice data architecture. This tool is based on principles of Enterprise Architecture and employs three views to provide appropriate information to three distinct audiences (Exhibit 2).

[6] NENA/APCO-REQ-001.1.1. APCO is the Association of Public-Safety Communications Officials–International.

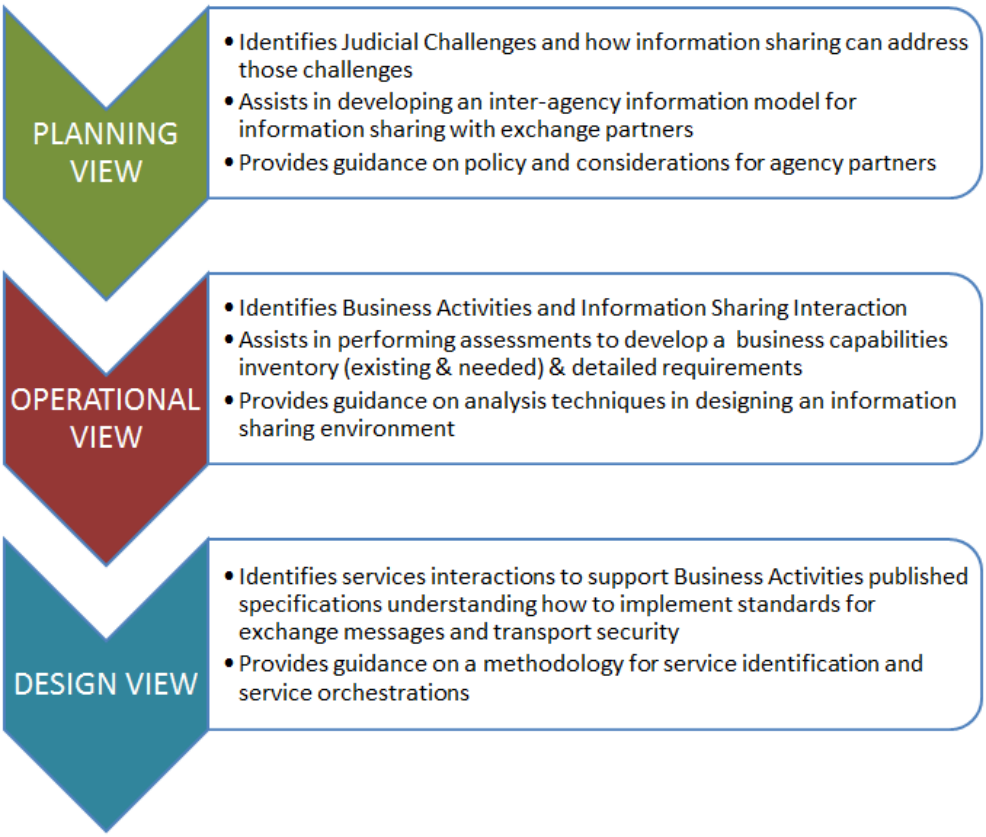

Exhibit 2. NJDA Framework Views

- The **Planning View** will demonstrate for public safety and criminal justice executives, legislators, and policy-maker bodies how the information sharing environment will look nationally and assist in strategic planning.
- The **Operational View** will demonstrate for operational managers and information architects how the pieces fit together so they can make decisions about how and where information exchanges should occur.
- The **Design View** will assist technology architects and developers to make decisions about systems and technologies that adopt and contribute to a standards-based national architecture.

The tool is based on the open source Mediawiki platform with support for page management, contribution control, presentation, user management, and administrative tools. This platform is well known through Wikipedia, so it provides familiar presentation and navigation via its links, page content, and site search capabilities. Categories and properties are the basic organization method for a Mediawiki site, with form and templates providing capabilities for users to enter and edit information. The NJDA employs visual modeling as much as possible to produce business and service models using standards-based tools, such as the Business Process Modeling Notation (BPMN) language and Unified Modeling Language (UML). This aligns with SOA and Model-Driven Architecture (MDA) and the recommendations of NIEM and the GRA.

As of July 2016, the following NIEM IEPDs or GRA Service Specifications are published as national standards and contributed to the NJDA Framework:

- Law Enforcement Information Technology Standards Committee (LEITSC):[7]
  - 7 CAD/CAD Service Call Information IEPDs
  - 1 CAD/RMS Service Call Information IEPD
  - 2 RMS/RMS Incident Query/Response IEPDs
- Global Standards Council:[8]
  - 2 Federal Data Repository SSPs: Suspicious Activity Report, Terrorist Screening Encounter
  - 6 Federated Query/Search/Response SSPs
  - 4 Court SSPs: Charging, Supervision Conditions, Disposition Reporting, Victim Notification
  - 7 Law Enforcement SSPs: Arrest Reporting, Warrant Activities, Fingerprinting
  - 5 Supervision/Corrections SSPs: Inmate Release/Transfer, Sex Offender Location
- Federal Bureau of Investigation:
  - National Data Exchange (N-DEx) Incident/Arrest
  - N-DEx Incarceration, Booking, Parole, Probation
- IJIS Institute: 12 CAD/Intelligent Transportation Public Safety IEPDs
- NENA/APCO sponsored a "super-standard" EIDD,[9] to include NIEM, GRA, NENA, APCO, and other national standards.
- Reference specifications and national standards are largely in law enforcement activities with limited representations for other justice activities, particularly supervision (Detention, Corrections, Community Supervision) and nonjustice domains.
- Model-Driven Architectural practices and graphical artifacts are recommended but largely absent in the GRA SSPs and NIEM IEPDs specifications. This contributes to difficulties in understanding the underlying schema of published IEPDS and facilitating reuse.

[7] LEITSC-sponsored IEPDs are available from the International Association of Chiefs of Police (IACP) website (2013): http://www.theiacp.org/About-IACP/Governance/-CAD-RMS

[8] Global-sponsored SSPs are available from their website (2015): https://it.ojp.gov/gist/

[9] (APCO International and IJIS Institute, 2013). The IJIS/APCO *Emergency Communications Task Force* (ECTF) report calls for a "universal standard/super standard" that provides additional requirements on the creation of future data exchange requirements.

Conclusions

The primary hypothesis for this work is that while the justice community has invested significantly in developing information sharing standards, which are critical components of a data architecture, it has not developed a complete "enterprise" view of the justice process that properly identifies all of the components required to understand the entire enterprise, nor has it properly scaled these exchanges to maximize their utility across organizational boundaries.

The results of this research affirm this hypothesis — there is little evidence that the justice system has developed a comprehensive enterprise model of a criminal justice data architecture (Exhibit 3). However, this research has also moved the discussion forward by developing a framework for assessing the state of the justice data architecture. Justice stakeholders can use this framework to capture, document, and measure the components that exist, and they can add to it to develop a robust criminal justice data architecture.

SUMMARY OF GAPS	
• The corrections, detention, and supervision business areas are not well-represented in the published standards (IEPD and SSPs) and the data architecture. • New and emerging lines of business, such as forensics and data analytics, are not represented in the data architecture. • Information exchange points between the justice and nonjustice communities, such as health and first responders, are not documented in the data architecture. • The data architecture lacks guidance on the NIEM for capabilities and techniques, to include external standards (e.g., HL7, NENA) and unstructured data (images, voice, and video) to support the "super-standard" concept proposed by APCO/NENA.	• Non-technical persons could more readily understand data architecture specifications if IEPDs and SSPs always included graphical representations. • The NIEM can be difficult to understand and navigate for nontechnical persons; visual representations would assist both in understanding the model and to ensure the integrity and coherency of the model. • Lack of metrics and measured results makes it difficult to make evidence-based investment decisions on the impact of sharing information. • Justice strategies and practices are shifting to reforms in corrections, behavioral health programs, and community services to decrease recidivism and reduce costs. These areas are not strongly represented in the body of standards and specifications.

Exhibit 3. Summary of Gaps Identified Between "As-Is" and "To-Be" State

The researchers initially posited a variety of questions that should be of interest to practitioners and that a comprehensive data architecture could address. The framework and tool demonstrate that they can address most of these questions, making the tool an effective source of enterprise information to planners, policymakers, and developers.

Conclusions regarding the Data Architecture Framework and tool include:

1. While there are hundreds of potential exchanges within the justice enterprise, most, if not all, can be modeled using one of three basic exchange archetypes: Event, Query-Response, and Request-Response.
2. The framework is robust and practitioners can use it to develop their own data architectures for their local justice enterprise.
3. Practitioners can use the framework as a model for broader adoption and use by other domains.

4. Existing resources and standards establish a foundation to share information that needs to be expanded; and
5. Matriculation to the ideal, to-be, state will require further investment to promote the adoption, use, and management of the justice data architecture (see summary of recommendations in exhibit 4).

	SUMMARY OF RECOMMENDATIONS
PLANNING VIEW	1. Collect content and document the justice and public safety lines of business (LoBs) and key information exchange points to create an accurate model of justice information life-cycle. Essentially this would be a revised Criminal Justice Case Flow Life-cycle diagram. 2. Confirm and apply an expandable NJDA meta-model (taxonomy) — e.g., domain, LoB, activity, capabilities, information, and services — to support a discoverable categorization of GRA, GIST, and NIEM assets, specifications, and resources. 3. Decompose the updated Criminal Justice Case Flow Life-cycle into complete business process models and activities. Explore emerging LoBs, such as forensics and data analytics, and changing LoBs, such as corrections and community supervision. 4. Identify points of information exchange between the justice, public safety, and health and human services domain models, and unify into the NJDA. 5. Expand the scope of the NJDA to identify alignment and gaps with other domains and their associated LoBs.
OPERATIONAL VIEW	1. Develop a logical enterprise-level graphical representation of the NIEM model to establish a visual representation and ensure the integrity and coherency of the model, with the "Type" elements in the justice domain being the likely input. 2. Create guidelines on how to develop Business Information Exchange Components, including samples that align with the NJDA Business Reference Models. These would be the initial high-level data models of a national Information Reference Architecture. 3. NIEM: Assess and update the model definitions to eliminate tautological definitions and create more accurate business definitions. 4. NIEM: Assess the model for new capabilities or techniques to include external standards (e.g., HL7, NENA) and nonstructured data (images, voice, and video) to support the "super-standard" concept as proposed by APCO/NENA. 5. NIEM IEPDs: Perform a quality assessment and report of the NIEM Clearinghouse IEPDs to confirm currency, accuracy, and compliance. 6. NIEM IEPDs: Expand the meta-model to include the NJDA and add to the search capabilities of the clearinghouse. 7. GRA SSPs: Evaluate the published GRA service specifications and determine if refactoring is needed.
DESIGN VIEW	1. Perform a gap analysis on an LoB-by-LoB basis to determine the services needed to support the Business and Information Reference Models. 2. Create profile specifications that incorporate Security Assertion Markup Language (SAML), GFIPM, and eXtensible Access Control Markup Language (XACML) elements in tiered levels of security, identity, and information assurance. 3. Develop a multi-layer framework that includes NIEM and GFIPM elements and possible security aspects such as SAML or Trustmark that equals and satisfies FBI Criminal Justice Information Services (CJIS) Security requirements for Internet and public message transport. These could be the foundation for a NJDA Security Reference Model. 4. Establish an ongoing committee to evaluate open source solutions, SOA deployment practices, model-driven tools, cloud services, and emerging technologies, and make recommendations on inclusion or relationships with the NJDA Technology Reference Model. The intent is to strengthen enabling assets and resources to increase the ease of information sharing deployment. 5. Develop a Security Reference Model, possibly using the National Institute of Standards and Technology's (NIST) *A Framework for Improving Critical Infrastructure Cybersecurity* (February 2014).

Exhibit 4. Summary of Recommendations by View

I. Introduction

Statement of the Problem

The criminal justice system in the United States is a complex national enterprise consisting of a multitude of independent units of government (jurisdictions and agencies) that must coordinate their activities in order to achieve a common goal: an efficient and effective justice system. Coordinating activities between these different entities has long been a challenge due to the "stove-piped" nature of each key component — each entity has its own mission and performs separate core business functions to support that mission. Law enforcement is focused on crime prevention and public safety, courts are focused on delivering just outcomes in criminal and civil disputes, and corrections and jails are responsible for safely and effectively managing sentenced or detained individuals. The justice system as a whole is like a conveyor belt where each station in the process aligns with each of these entities — and each entity is responsible for performing specific, specialized activities as individuals enter, move through, or exit the justice process. Because of the specialized, entity-centric nature of the justice process, few, if any, of the entities involved see or work with the system as a whole — no one really sees the "big picture." Consequently, the criminal justice system is often characterized as a "nonsystem."[10]

The justice community long ago recognized the benefits of using technology to improve their business processes and perform their core missions. Ironically, as relatively early adopters of technology, much of this "adoption" led to the current stove-piped nature of the justice process. Each entity built data systems to address their core functions and relied on paper to exchange information with the next entity in the process. In the 1990s, the justice community recognized the need to improve system performance and capabilities by augmenting their core business systems to include electronic information sharing. While initially seen as largely a technology challenge, stakeholders in the justice process came to recognize the need for effective governance and accountability across organizational boundaries as well. Because of the independent nature of agencies and jurisdictions involved in the justice process, the justice community recognized the importance of fostering agreement about how information sharing should occur. By establishing broadly accepted standards and guidelines, justice organizations could make their own policy and technology choices, while still enabling information flow and business process integration with their partners.

Efforts to address both technology and policy issues related to justice information sharing began in the late 1990s with the formation of the Global Justice Information Sharing

[10] Criminal Justice Nonsystem, A. W. Cohn (from Crime and the Criminal Justice Process, by James A. Inciardi and Kenneth C. Haas, 1978 – See NCJ-53277), www.ncjrs.gov/App/publications/abstract.aspx?ID=53283; To What Extent Should the Criminal Justice System be a "System"?, Martin L. Forst, Center for the Study of Law and Society, University of California at Berkeley, http://cad.sagepub.com/content/23/4/403.abstract; Criminal Justice in the U.S.: Restructuring a 'Non-system,' National Civic Review, Volume 62, Issue 5, pages 240–247, May 1973, published online January 31, 2007, http://onlinelibrary.wiley.com/doi/10.1002/ncr.4100620504/abstract.

Initiative ("Global"), a Federal Advisory Committee to the U.S. Attorney General. One of the early achievements of Global was to support and direct development of the Global Justice XML Data Model (GJXDM), which for the first time established a key component of a national data architecture for justice information sharing. The success of GJXDM led the Department of Homeland Security (DHS) to join with Global and the Department of Justice (DOJ) to form the National Information Exchange Model (NIEM) initiative in 2006. With NIEM, the data architecture established by GJXDM expanded both in scope and adoption with the majority of states in the U.S. adopting NIEM at some level, and with NIEM at the core of many nationwide initiatives as well. As GJXDM and NIEM became established standards for the structure and semantics of shared information, Global turned its attention to developing other important components of the data architecture. In 2004, Global published a paper identifying service oriented architecture (SOA) as the strategic approach for state, local, and tribal justice information sharing nationwide, and tasked its Infrastructure/Standards Working Group (GISWG) with developing a service oriented reference architecture that practitioners could use as the basis for implementing SOA in their own jurisdictions. Since 2007, GISWG has produced several documents establishing this reference architecture, which it published as the Global Justice Reference Architecture (GRA). In addition, the Global Security Working Group (GSWG) published a set of guidelines for federated identity management, called Global Federated Identity and Privilege Management (GFIPM), and the Privacy/Information Quality Working Group published a framework for implementing machine-enforceable privacy policies based on open industry standards. Most recently, Global has aggregated all standards, policies, and guidelines into the Global Information Sharing Toolkit (GIST).[11]

Global has led the effort to establish and promote information sharing within the justice and public safety community. The entire community has benefitted from these standards, guidelines, and frameworks through greater interoperability and better information availability at lower costs. These improvements would not have been possible without the development and adoption of standards and the leadership of groups like Global. However, for all of the progress made in this area, the nation still lacks comprehensive national data architecture for the criminal justice system as a whole.

All of the work of Global, NIEM, and community members at all levels of government has evolved without an explicit, well-defined architecture. Through a sense of goodwill and common purpose — rather than by design — a great deal of effective information sharing occurs between the various stakeholders in the justice system. The various components that have been put in place fit remarkably well together; as a result, the nation has taken great strides forward in sharing information. But we still lack a single, comprehensive picture of this complex enterprise, which limits our ability to make further progress and make the wisest use of our investments.

[11] https://www.it.ojp.gov/gist

Fortunately, enterprise architectures (and the standards, guidelines, and technologies they contain) are quite flexible, so it is never too late to step back and consider formalizing the relationships and linkages between components through the creation of an architecture.

Literature Citations and Review

Literature citations for the analysis are organized by their contribution to:

A. Authoritative references for the Enterprise Architecture (EA), SOA, and Business Process Modeling (BPM) disciplines and development of the National Justice Data Architecture (NJDA) framework;

B. Analysis of the current state of justice information sharing;

C. Content for the NJDA Framework.

A. Authoritative references for EA, SOA, and BPM include electronically published materials from the:

- NASCIO Enterprise Architecture Toolkit 3.0
- Federal Enterprise Architecture Framework 2.0 (FEAF)
- IBM Center of Excellence (COE)
- Carnegie-Mellon, Software Engineering Institute (SEI)
- IBM SOA Foundation Group
- Open Group Organization

The NASCIO EA Toolkit 3.0, Information Architecture volume contributed to the assessment and discussion of how "data architectures" matured into "information architectures." Information architectures are still evolving with the dramatic proliferation of nonstructured data and questions of how to manage the transient nature of mobile data.

The FEAF 2.0 DOJ Reference Models contributed to the high-level definition of the taxonomy of the NJDA Framework. It also contributed to the content of the justice "lines of business" category and the advocacy of a "common approach" with the facets of primary outcomes, levels of scope, basic elements, sub-architecture domains, reference models, current and future views, transition plans, and roadmaps.

The IBM COE and the Carnegie-Mellon SEI contributed significantly to the value of the combined approach of EA, BPM, and SOA with several white papers, IBM "Redbooks," research studies, and case studies. Significantly, these studies have shown that the combined value of these disciplines far outweighs the value of practicing any one of them individually. Successful SOA is realized by effective BPM; effective BPM is realized by strategic enterprise architecture.

The IBM SOA Foundation Group and the Open Group Organization materials confirmed the value of using SOA not just in the sense of designing software (service) development, but also in describing the business. Their materials also contributed to the value of using visual modeling tools such as UML and BPMN to create robust, integrated, and complete models of process, information, and services.

B. Analysis of the current state of justice information sharing includes published material from:

- The IJIS Institute and APCO International
- The RAND Corporation
- The Urban Institute
- SEARCH
- The National Strategy for Information Sharing and Safeguarding
- Reports from *Governing the States and Localities, Government Technology*, and other periodicals focused on the public sector
- State-level Enterprise Architecture websites (see Appendix B)
- *NIEM Core Evaluation* report

The IJIS Institute and APCO International contributed information on state and industry information sharing initiatives and programs, such as the Prescription Monitoring Drug Program, the Emergency Incident Description Document IEPD, and the Justice Reinvestment Initiative. The EIDD IEPD (still in review at this writing) is an example of a "super-standard" information sharing specification that combines industry standards.

The RAND report, *Improving Information-Sharing Across Law Enforcement: Why Can't We Know?*, contributed an assessment specific to the computer-aided dispatch/record management system (CAD/RMS) industry and associated IEPDs identifying progress and remaining barriers. The report focuses on the systems that are relatively mature, governed and standardized, but the issues and challenges it addresses are equally germane to other criminal justice entities.

Several Urban Institute publications provided context on criminal justice issues, particularly evidence-based research. The NJDA Framework is capable of capturing metrics and performance results from evidence-based research in a "data-driven" visualization manner to aid in valuating information exchanges.

SEARCH published a comparative analysis of NIEM to Health Level 7 (HL7) with the intent of identifying opportunities to bridge the two standards.[12] The findings of this research suggest that there are important but limited opportunities for the two standards to interoperate, which focus on the person-based demographic and other descriptive data contained in the HL7 Admission/Discharge/Transfer (ADT) exchange.

The National Strategy for Information Sharing and Safeguarding contributed to the understanding of the federal vision and strategies for information sharing. It provided some NJDA content on where future funding sources might arise and policy implications that might "trickle-down" to state and local jurisdictions.

Reports from *Government Technology* and other periodicals provided context and specific examples of information sharing experiences, which confirm that jurisdictions

[12] http://www.search.org/files/pdf/TechBrief_HL7-NIEM_Comparative_Analysis.pdf

encounter the same problems and issues in cross-agency information sharing. They also confirm that the difficulty of information sharing rests not in technology, but rather in policy, integration with disparate systems, budget constraints, and conflicting priorities.

SEARCH used David Hay's *NIEM Core Evaluation* report to understand the implementation challenges that development staff and subject matter experts encounter when using NIEM IEPDs and associated schemas.

C. Content for the NJDA Framework:

The NJDA Framework is a tool to help plan, design, develop, and deploy an information sharing environment between a set of collaborating exchange partners. The framework strives to address concerns and interests of decision-makers, business managers, and technologists through Planning, Operational, and Design views (Exhibit 5). Each view provides guidance through recommendations, standards, frameworks, and other disciplines such as the EA frameworks, GRA, and SOA design. These are extensively noted in **Section II: Methods**.

Each view also provides navigable artifacts, such as business process models, service interaction models, and service inputs and outputs. These artifacts are intended to be adapted to the particular goals and priorities of users.

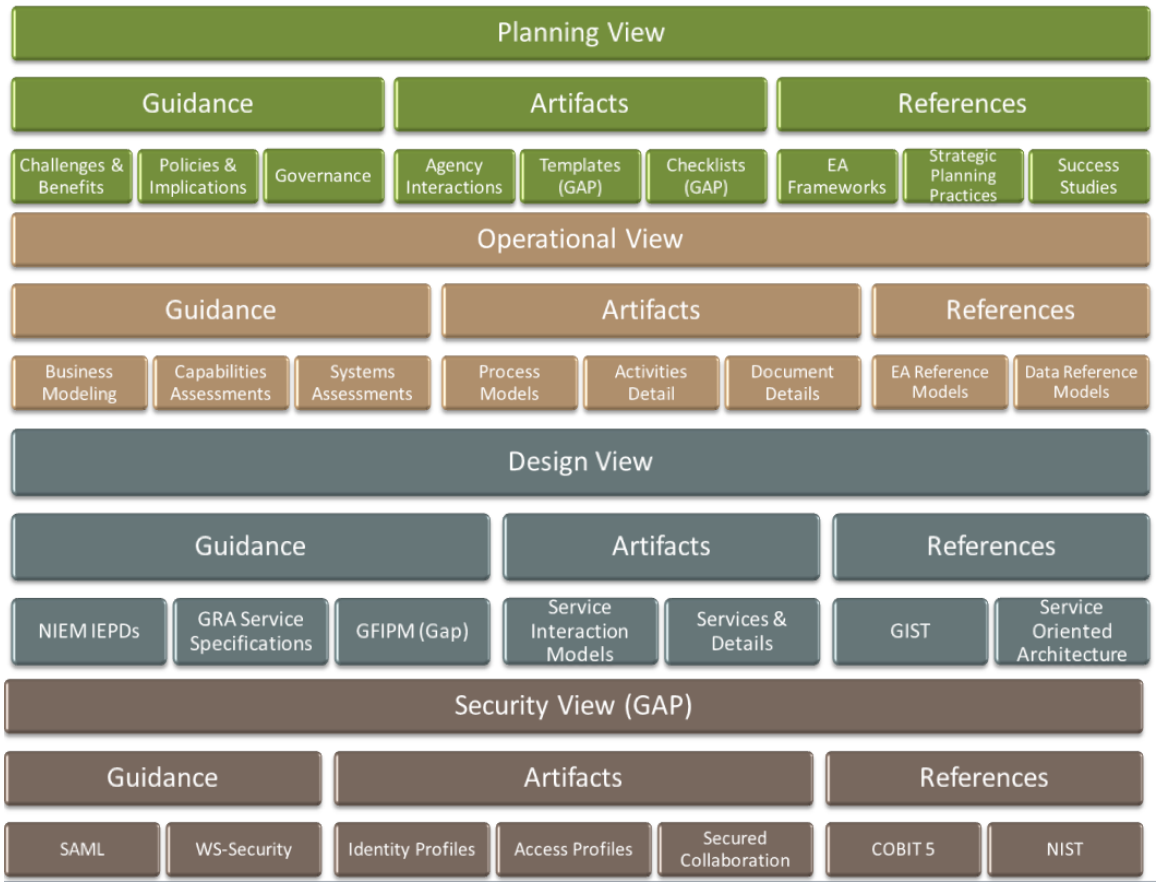

Exhibit 5. Diagram of NJDA Framework

The NJDA Framework, based upon the Mediawiki platform, is intended to be used as a tactical decision-making tool rather than a prescriptive representation of the data architecture. SEARCH limited the scope of this initial effort to the business aspects and functional information sharing exchanges within Business and Data Reference Models (BRM and DRM). SEARCH recommends also providing guidance and artifacts for a Security Reference Model (SRM) on identity and privilege management, secure collaboration, transport protocols, and safeguarding of shared information. Users can do this by adding a security reference model to the framework (see our recommendations, embodied in **Section IV. Conclusions**).

The framework collects and organizes the available information sharing functional and technical artifacts into BRMs and DRMs guided by the planning, operational, and design views, each of which has its own taxonomy. In this manner, SEARCH was able to identify gaps in the architecture.

SEARCH derived significant content for the NJDA Framework from:

- The National Information Exchange Model (NIEM) Information Exchange Package Document (IEPD) Clearinghouse
- Global Reference Architecture (GRA) Service Specification Packages (SSPs)
- Global Information Sharing Toolkit (GIST)
- The SEARCH Adult Felony Reference Model (AFRM)

NIEM	This model provides an extensive vocabulary and a common language to enable information sharing between diverse organizations. It is organized into domains, of which the justice domain is the arguably the richest and most complete. NIEM also provides a standard process and tools to assemble selected subsets of the model into an IEPD that enables partners to define their specific XML exchange messages. As IEPDs are developed, they are published into the NIEM IEPD Clearinghouse for others to review, reuse, and adapt for their information sharing needs.
GRA	The Global Justice Information Sharing Initiative (Global), funded by the Departments of Justice and Homeland Security, supports information sharing through the development of the GRA framework. The framework provides guidance and technical specifications on how to secure and transport NIEM messages. These specifications are packaged into SSPs that conform to both the GRA and NIEM standards.
GIST	Global also developed a toolkit, known as GIST, to help exchange partners design their exchange to meet their security, privacy and reliability requirements. GIST is a broad collection of policy guides, governance framework specifications, and assessments to assist in the composition of designing an information sharing environment. The searchable materials are presented in videos, podcasts, presentations and traditional publications, organized by topics and tagged with keywords. The GIST was used extensively to document essential enabling assets and resources to support an information sharing environment.

AFRM The ARFM is designed to facilitate planning and deployment of integrated justice information sharing initiatives.[13] The conceptual model identifies interagency business processes, key agency decision points, and the information flow between agencies when these decisions or events occur. The model provides state and local practitioners with a tool to develop an enterprisewide view of their information sharing requirements. The ARFM was used extensively to document the business capabilities in the justice domain. The AFRM defines and documents the information exchange requirements for 654 information exchanges between justice partners along five dimensions — agencies, events, processes, conditions, and information.[14] These dimensions contributed to the design of the NJDA Framework, and the provided the majority of the content for the NJDA Operational View.

SEARCH developed this diagram (Exhibit 6) as a high-level operating model of an integrated justice domain environment.[15] The NIEM and the AFRM contributed to the capabilities and information components, while the GIST contributed to the enabling assets and resources components.

The NIEM IEPD Clearinghouse and the GRA Service Specifications provided content to the NJDA Framework. Key content for the NJDA includes business process models, service interaction models, and information models and metadata information. Researchers focused on assessing national reference models, such as the N-DEx Incident/Arrest IEPD or the GRA Charge Filing SSP.

[13] SEARCH produced the AFRM in 2004 using the Justice Information Exchange Model (JIEM) tool.

[14] Note: The JIEM tool models point-to-point exchanges, whereas the NJDA models service oriented exchanges with web services that support multiple message actions.

[15] (Robertson, Ross, & Weill, 2006), pages 28–34.

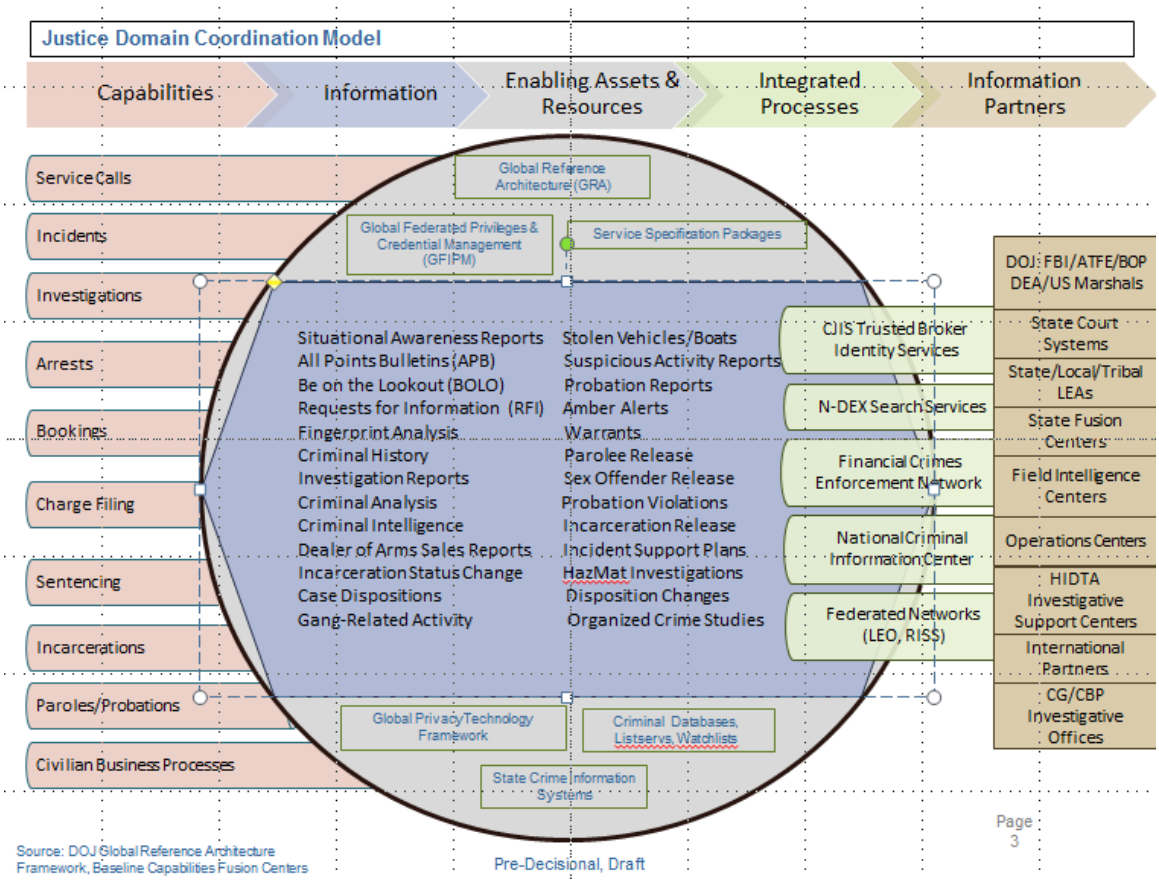

Exhibit 6. Justice Domain Coordination Model

Statement of Hypothesis or Rationale for the Research

SEARCH's primary hypothesis for this work is that while the justice community has invested significantly in developing information sharing standards, which are critical components of a data architecture, it has not developed a complete "enterprise" view of the justice process that properly identifies all of the components required to understand the entire enterprise, nor has it properly scaled these exchanges to maximize their utility across organizational boundaries.

The complete lifecycle of the criminal justice business process depends upon activities and processes that cross many agencies and jurisdictional boundaries. A case may begin in law enforcement, then is evaluated by a prosecutor, who in turn will prosecute the case in court, which may result in sentencing to either a state department of corrections, jail, or probation department — each of which could be a separate independent unit of government. Each of these entities has its own mission, which may contend or even conflict with another within the same system. It is no wonder that the justice system epitomizes the concept of stove-pipe systems and would significantly benefit from taking an enterprise approach to information architecture.

This decentralization of the justice process necessitates a high level of collaboration and coordination between agencies to be successful. While NIEM and the GRA provide

specific data message and service design standards, cross-jurisdictional collaboration initiatives need a higher-level view to develop a comprehensive set of capabilities. The literature review confirmed that the disciplines of Enterprise Architecture, Business Process Modeling, and Service Oriented Architectures are the best approach for the analysis.

EA and BPM are also naturally synergistic; BPM provides the business context, understanding and metrics, and EA provides the disciplines for translating vision and strategy into architectural change. Simply put, EA helps organizations to do the right things and BPM helps to do things in the right way. The key added-value for BPM is its focus on flexible process design, as well as process orchestration and IT enablement. Mature organizations have adopted a service oriented approach to business process design, which then naturally combines with an SOA approach for software development.

Using a combined EA, BPM, and SOA approach helps agencies to address data, privacy, and security compliance and risks — as well as to document the data requirements. The broad end-to-end view of an information sharing environment from these perspectives of both exchange partners ensures that regulatory compliance is met. For example, compliance requirements in the sharing of prescription drug history records from the perspective of a law enforcement agency may be quite different than the perspective of a treatment program provider. As the demand for information continues to grow across the sharing environment, common information services will be exposed to larger user communities. Consequently, it often falls upon managers and architects to identify new requirements and potential security exposures. But without a well-documented architecture that is based on a firm foundation, it can become nearly impossible to track data throughout the infrastructure and effectively establish the necessary means of authentication, authorization, and transport protection.

SEARCH followed current best practices of EA, a discipline developed by John Zachman in 1987.[16] SEARCH also researched related frameworks, including: The Open Group Architecture Framework (TOGAF),[17] the Federal Enterprise Architecture Framework (FEAF),[18] and the NASCIO Enterprise Framework.[19] These frameworks partition the analysis of an enterprise into layered architectural areas, which are also referred to as "domains" or "models" within the overall architecture. These are further decomposed into sub-domains (sub-models) to the detail and extent needed by the enterprise. This high-level model (Exhibit 7) depicts the typical starting point of an EA framework:

[16] http://www.zachmaninternational.com/images/stories/ibmsj2603e.pdf
[17] http://pubs.opengroup.org/architecture/togaf8-doc/arch/
[18] http://www.whitehouse.gov/ombv/e-gov/fea/
[19] http://www.nascio.org/committees/EA/

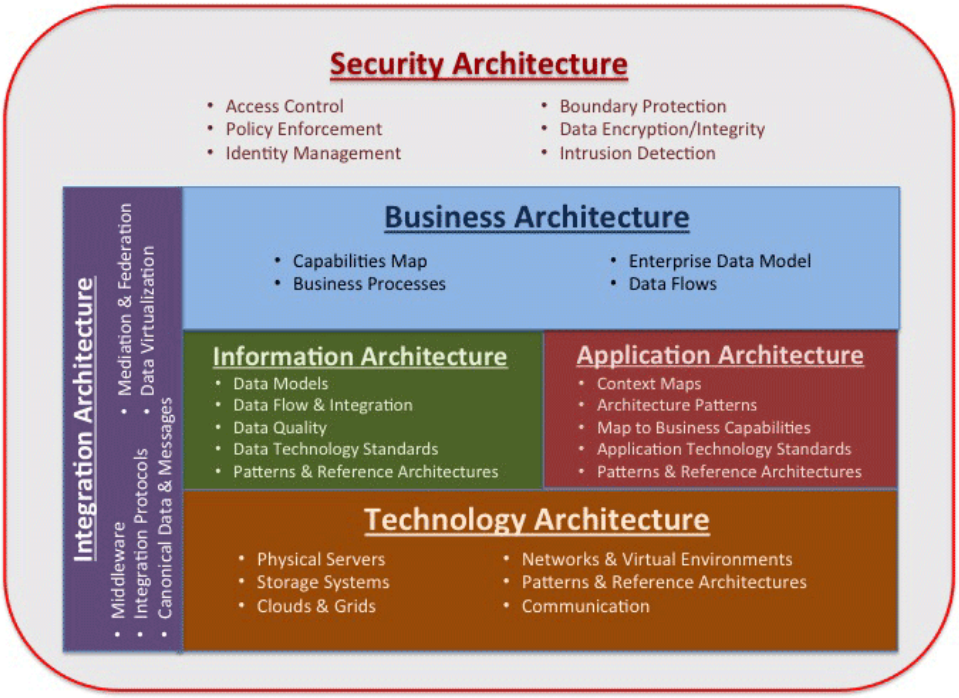

Exhibit 7. Enterprise Architecture Layers

An EA framework combines structure, processes, and templates to document the desired architecture in a systematic and disciplined manner. It can be described as a technique for developing the necessary repository for the Enterprise Architecture. Stakeholders must construct the framework before they can document the detail regarding the organization's business, information, and technology functions.

Specific elements of the EA that contributed to the development of the NJDA Framework are Business and Information Architectures, which informed development of the NJDA's Planning and Operational Views, and the Application and Technology Architectures, which informed development of the Design View.

Business Architecture documents items such as exchange partners, capabilities, events, and information with their existing and future significance. The business capabilities statements in the business model are more completely documented in refined and exchange partner-specific BPMs, preferably in standardized languages such as Business Process Notation Language. The NJDA helps develop these visual models by providing decomposed BPMs, information models, and agency data flows. Business process models are decomposed into service interaction models, which provide input into the web service design and orchestration. The business models depict the information to be shared or exchange, which is the input to Information Architecture.

Information Architecture is the compilation of the business requirements of the enterprise: the information, process entities, and integration that drive the business and rules for selecting, building, and maintaining that information. Information Architecture addresses the informational needs of the enterprise. Reference models are the core of an

information exchange environment: they contain source data models, information exchange models, target data models, information orchestration, data quality, and applicable data technology standards. In this scenario, charge filing and prosecution case information is to be shared. The NJDA uses both description information and class diagrams from published specifications from NIEM IEPDs or GRA Service Specifications.

Application Architecture defines the major kinds of application systems necessary to manage the data and support the business. Applications are mapped back to capabilities in the Business Architecture and data assets in the Information Architecture. Application architecture identifies the applicable standards for security and privacy, which the Technology Architecture then details. The NJDA uses a general level to describe the applications that support law enforcement records management systems (RMS), prosecution, court and prosecution case management systems (CMS), jail management systems (JMS), and offender management systems (OMS).

Technology Architecture is a disciplined approach to describing the current and future structure and inter-relationships of the enterprise's technologies in order to maximize value in those technologies. The Technology Architecture framework provides a sound set of structured processes and templates to support implementation and communication of the architecture. The mapping of the technology products and standards to the Business Drivers is vital to align the overall enterprise direction. Vendors, employees, and business users can benefit from an understanding what technology standards exist and where these standards can be found.

Aligning Enterprise, Information, and Service Oriented Architectures

Both the GRA and NIEM proscribe using SOA for compliant exchanges. A service oriented style is applied to an enterprise by being adopted as the overarching style for any architecture within that enterprise — business architectures, information systems architectures, and infrastructure architectures. While SOA is typically associated with web services, the concept is now applied to business-oriented services that enable flexibility and improved delivery speed. Exhibit 8 illustrates a basic interaction view of EA and the SOA and BPM disciplines.

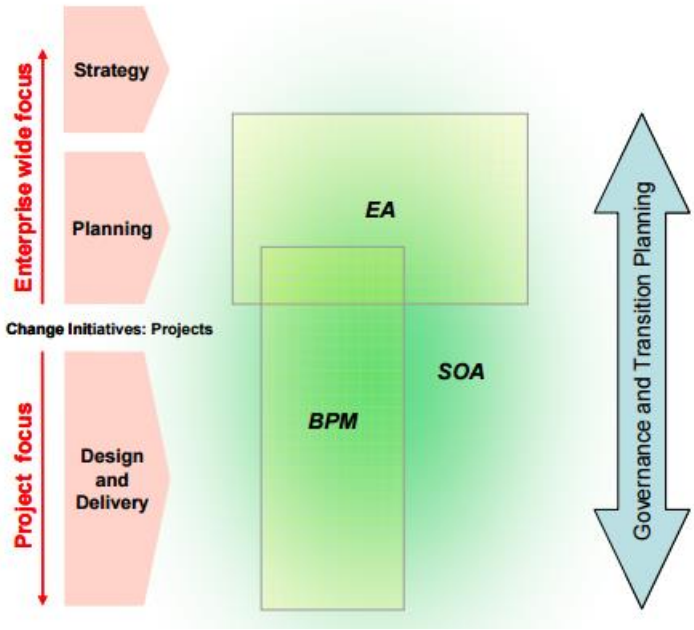

Exhibit 8. Interaction View of EA, SOA, and BPM in Enterprise Architecture

This analysis synthesizes these three disciplines into one perspective or framework in order to effectively address the decentralized nature of the criminal justice system. A private sector EA plan is centrally managed, aligned, and traceable to the top strategic goals. The plan can reflect and integrate all aspects of the business — customer service, human resource, financial, marketing, logistics, and chain supply business processes — into one centrally managed effort that allows all stakeholders in the business to "pull the cart together." While private sector environments might be complex, information integration initiatives have been successful and have standardized much of the information sharing solutions with an extensive set of internal partners. Information sharing with external partners is mutually beneficial based on decreased costs and incentives for return on investment. However, the full-cycle completion of law enforcement and judicial case business processes depend upon activities and processes that cross many agencies and jurisdictional boundaries. A case will start locally; may flow horizontally or vertically through local, county, or state jurisdictions; and may cross into nonjustice communities, such as private or public health and human services.

While each agency or organization may have its own EA, including IT capabilities and systems, their strategic drivers, goals, and aligned capabilities are unlikely to be compatible due to their often-nonaligned missions. This leads to contention about priorities and competition for funding, resources, and assets. It is necessary for partner agencies to collaborate and develop a shared information sharing architecture that mutually aligns their capabilities, meets their business requirements, protects their data assets, and complies with internal policies.

II. Methods

Rationale for Approach

SEARCH researchers based this analysis of the criminal justice system data architecture on the disciplines of Enterprise Architecture, Business Process Modeling, and Service Oriented Architecture. The analysis integrated these disciplines into a common framework to define and describe the justice data architecture. Following the principles of EA (as previously discussed), the justice data architecture focused on defining the current (as-is) state of information using the published standards, best practices, and guidelines developed and governed by the domain stewards—Global for the GIST and the DHS Program Management Office o for NIEM. Researchers assessed the current state of information sharing by evaluating the set of published GRA Service Specifications and NIEM Information Exchange Package Documents in conjunction with other authoritative resources. To define the future (to-be) state, researchers used a broad scan of the literature, input from subject matter experts, and a review of the Adult Felony Reference Model of the JIEM tool. Then, following EA principles, researchers conducted a gap analysis between the current (as-is) state and the future (to-be) state. Developing the as-is and to-be states involved creating detailed business process models, identifying document sharing points, and determining whether information standards existed for those documents.

EA frameworks include the notion of *views*, and the use of views was seen as integral to the presentation of data included in the NJDA. Views are intended to enable different constituencies to use the architecture to address their individual needs or areas of concern. For example, an application designer or chief information officer (CIO) will ask different questions of an architecture than a policymaker (police chief or judge). Some users will look for guidance on how to build things — such as what constraints should be in place to ensure that a particular application or resource fits with everything else. Other users will look to the architecture to understand how investments and information flows support key business objectives, such as reducing offender recidivism or reporting suspicious activity. Following this strategy, researchers identified a variety of questions that could reflect the different requirements and needs of three constituencies — Planners, Operational Managers, and Designers — and that potentially could be addressed through a better understanding of the criminal justice data architecture.

The project team posited that the following questions may be of value to these three user types, and each of these questions is evaluated in **Section IV. Conclusions**.

Planning View Questions:

- What policy objectives can information sharing help achieve?
- What current business challenges is the justice community facing, and how can we address those problems with information sharing?
- What risks are inherent in information sharing, and how do we mitigate those risks? For example, developing and enforcing proper privacy policies mitigate the

risks associated with the maintenance and exchange of personally identifiable information (PII).

- What governance models are in place to establish ownership and control over information and information exchanges?
- What principles determine who should provision and control information and exchanges?
- What strategic plans exist currently, and what is the progress toward those plans? How do jurisdictions and agencies align with those plans?
- What are the measures of success?

Operational View Questions:

- Who is, or should be, exchanging information?
- What is the content (structure and meaning) of exchanged information?
- What systems (or "capabilities," in GRA) typically capture or record information about the occurrence of those events?
- What is the business process or policy response to each event?
- What "nonfunctional" requirements ("service interaction requirements," in GRA terminology) apply to each exchange? That is, what are the access control, confidentiality, availability, reliability, logging, accountability, and similar requirements that apply?
- How do existing information exchanges (e.g., service specifications, IEPDs) map into the reference exchanges (events, process responses)? Are any existing exchanges misaligned?
- What partner organizations' capabilities/systems/processes typically participate in the policy response?
- What events trigger information exchange in the justice system (and related domains)?
- What are the priorities for building exchanges?

Designer View Questions:

- What is the typical state of implementation of supporting technology at the state and local levels of government?
- What networks and other national technology infrastructure elements are in place to support information sharing?
- What technical principles can inform choices of technology provisioning strategy (e.g., cloud or shared services)?
- Where are there gaps in what the Operational and Planning Views require?

Assessment of the Current, As-Is State

SEARCH based its current (as-is) state assessment on the Case Flow Sequence Diagram originally developed by the President's Commission on Law Enforcement and Administration of Justice in 1967 (Exhibit 9).[20] Although the DOJ updated the diagram in 1997, it has remained substantially unchanged for 50 years.

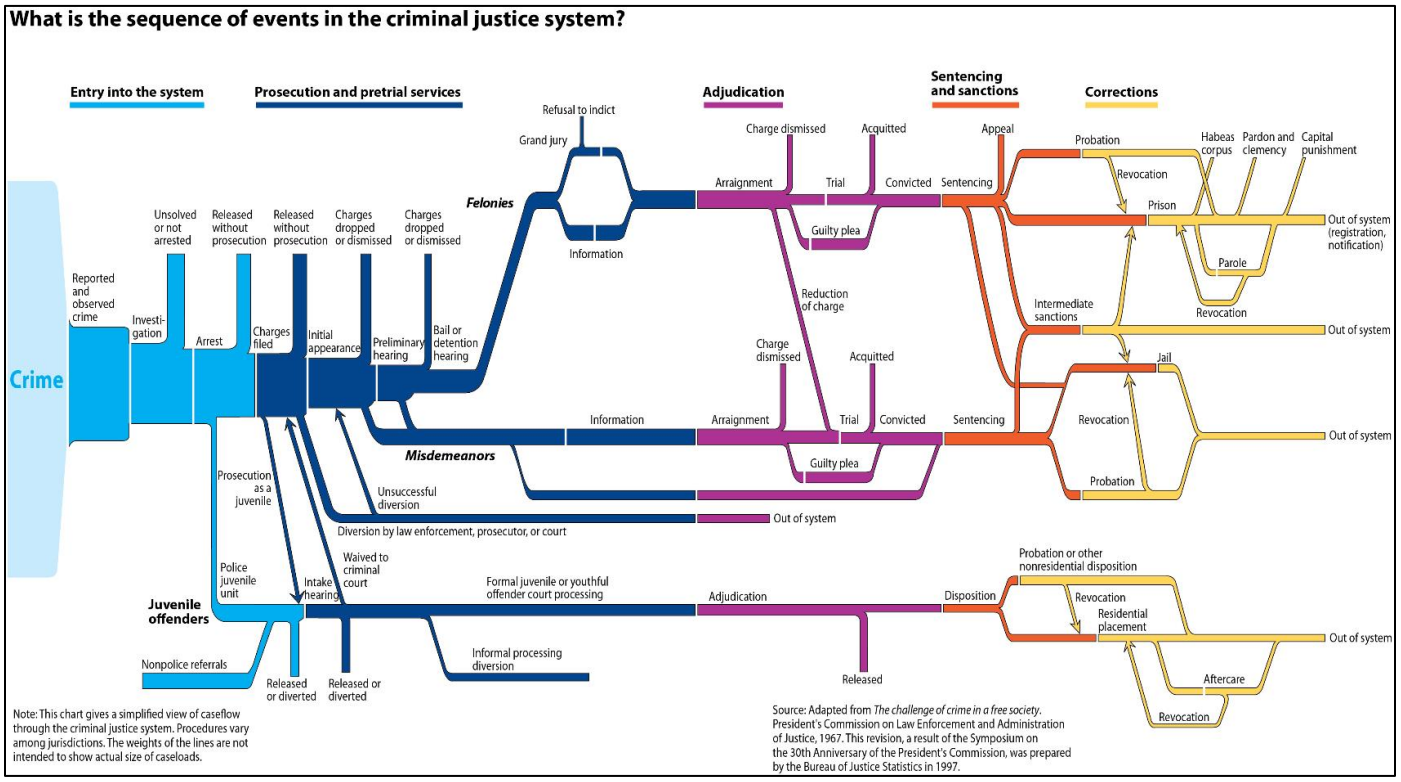

Exhibit 9. Case Flow Sequence Diagram

The diagram provides a high-level overview of the criminal justice process, breaking the process into five major components: Entry (arrest), Prosecution and Pretrial Services, Adjudication, Sentencing and Sanctions, and Corrections. More specific activities or actions are broken down within each component. Where there is some crossover or "bleeding" across the components, colors are used to clarify how each task or activity aligns with the model.

A second key authoritative resource was the Justice Information Exchange Model (JIEM) developed by SEARCH, The National Consortium for Justice Information and Statistics, in 2003. JIEM was an early effort to map and model the key exchanges between justice partners, and decomposed information sharing into five key dimensions: Processes, Agencies, Events, Conditions, and Information. The model provided further detail about

[20] Adapted from *The Challenge of Crime in a Free Society*, President's Commission on Law Enforcement and Administration of Justice, 1967. This revision, a result of the Symposium on the 30th Anniversary of the President's Commission, was prepared by the U.S. DOJ Bureau of Justice Statistics in 1997.

the justice process, focusing on data exchange requirements. A key product in the development of JIEM was the production of the Adult Felony Reference Model (AFRM), which identified and documented 654 information exchanges among justice partners.

Researchers used information from both of these authoritative resources to more precisely define the justice process using Business Process Modeling Notation (BPMN). Researchers identified and defined high-level "lines of business" and developed detailed business process models to graphically illustrate how data moves between justice partners. The business process models identified triggering activities, subsequent activities, and associated documents. Document descriptions identified sending agencies, receiving agencies, and national reference service specifications associated with document exchanges.

While the AFRM captures a vast array of exchange requirements, it does not document the data that must be exchanged. The NJDA Framework allows data to be documented at a more detailed level and relies on various authoritative national resources to identify the content of each exchange.[21] As an example, the AFRM identifies that an incident report is the exchanged document. The NJDA captures more detail about the content of the incident report. Researchers used the Service Specification Packages available on the Global website to capture this added detail. The SSPs also included design details such as transport and security requirements. Together, researchers used these resources to identify and document the components of the framework/architecture.

Assessment of the Conceptual, To-Be State

The future (to-be) state of information sharing relies on these same authoritative resources but also adopts and applies the principles of the GIST, use of SOA-based design, use of web services, standards for security and transport, and NIEM for XML data format. Following the GIST, development teams can use standards and design elements to develop solutions that follow a broader, more consistent and holistic approach. This produces information sharing in agreement on a set of business-aligned SOA services that collectively and mutually supports the business processes and goals of the exchange partners. By collaborating on a joint EA Information Sharing Reference Model, partners can realize a flexible technology environment, improve the quality of service delivery, and prevent security breaches and business interruptions.

The objectives of successful SOA are embedded in the EA concepts of "sharing" and "reuse." SOA supports the overall enterprise architecture by enabling agility so the enterprise can respond to new business needs, respond quickly to trends, and handle disruptions such as legal and regulatory changes. SOA influences the business architecture with well-defined, reusable business processes; influences the application architecture to use components and service interfaces; influences the information architecture to use standards; and influences the technical architecture with standards for

[21] The N-DEx Incident/Arrest IEPD and the N-DEx Incarceration/Booking/Probation/Parole IEPD.

infrastructure to support the following: services, service consumers, and messaging infrastructure.

Both the GRA and NIEM leverage SOA concepts for technical implementations. To assist in reference model planning, the GRA addresses the full range of information sharing use cases by providing a flexible blueprint to implement interoperable data sharing services across organizations — whether they are technologically advanced or those with limited technology resources.

The to-be assessment included the SOA discipline because SOA provides flexibility through autonomous web services and cost-effective message movement by using Internet transport. SOA provides solutions to the challenges of information sharing in criminal justice as it decouples technology from the exchange. (Such challenges occur due to the lack of a common mission; the existence of multiple independent exchange partners; and diversity of systems, data assets, and security requirements.)

Using SOA design and construction principles ensures that the sets of web services are well-defined, appropriately interact, and — when in context with EA — are fully traceable to real-world functions, capabilities, activities, and business objectives. As stakeholders identify and model new business objectives throughout the enterprise, they can quickly assemble available information assets and services to meet the new objective. If there are gaps, stakeholders can quickly identify new solutions. An example of this speed of service delivery is illustrated by the continually expanding mobile applications for cell phones and tablets.

The National Justice Data Architecture Tool

During the course of the project, the project team determined that a tool to capture and organize the project artifacts would be useful for justice agencies and their partners to create a joint enterprise information sharing plan. The tool is intended to assist partner agencies to develop a joint Information Reference Model (IRM) that meets their information exchange needs, leverages their data assets resources and security policies, and uses existing GRA and NIEM exchange standards.

When developing complex information exchanges, it is often difficult to bridge the gaps between business and service requirements. Designing and implementing a business-aligned set of services that works for all exchange partners presents a fundamental problem: Business requirements are difficult to translate into deployable specifications. The NJDA addresses these challenges by providing a systematic, modular approach to identify and associate business processes and information with service interactions through model-driven architecture practices and recommended standards. Using the NJDA, partners can design a comprehensive information sharing plan that they can develop and implement in increments as partners have available assets and resources.

Documenting the Data Architecture

The NJDA tool is based on the open source Mediawiki platform with support for page management, contribution control, presentation, user management, and administrative tools. This platform is well known through Wikipedia, so it provides familiar presentation and navigation via its links, page content, and site search capabilities. Categories and properties are the basic organization method for a Mediawiki site, with form and templates providing capabilities for users to enter and edit information. The NJDA employs visual modeling as much as possible to produce business and service models using standards-based tools such as the BPMN language and Unified Modeling Language (UML). This aligns with SOA and Model-Driven Architecture (MDA) and the recommendations of NIEM and the GRA.

The Mediawiki platform is augmented with additional semantic extensions to increase the capabilities for category drill-downs, additional property support, custom queries, and inline views. The category tree extension allows a dynamic, direct navigation through the category structure. The semantic drilldown extension provides a page for drilling down through the site, using categories and filters on semantic properties. Semantic capabilities are added to templates and forms to ensure that entered information conforms to a defined data structure that supports the metadata model and enables semantic queries.

Distinguishing a Data Architecture from an Information Architecture

While this report refers to the Criminal Justice System Data Architecture, in practice, the analysis performed and the framework and tool developed for documenting the state of the criminal justice *data architecture* align with the more mature definition of an *information architecture*.

An "architecture" is primarily a decision-making framework, whether building a house, organizing an enterprise, or designing a system. Like any architecture, the goal for the NJDA is to serve as a decision-making framework. It should be a body of guidance that decision-makers, at all levels, can consult when facing decisions about the stewardship and sharing of justice information. An architecture documents the intended environment with the components, specifications, and relationships to other components.

While frequently used interchangeably, in the context of EA, the terms "information architecture" and "data architecture" are distinctly different.[22]

Data architecture addresses the available data assets that systems produce and store. It establishes the enterprise data assets and defines how those assets are created, stored, protected, and managed.[23] It is typically documented through data models such as entity-relationship diagrams, UML class diagrams, data dictionaries, or in spreadsheets.

[22] Early EA models have Data Architecture as one of four reference models: Business, Data, Applications, and Technical.

[23] (Lewis, Comella-Dorda, Place, Plakosh, & Seacord, 2001).

Information architecture addresses the informational needs of the business. It is frequently defined as the organization of data into usable formats that are accurately transformed into the desired format that end users can understand. Information architecture describes how these assets flow through business processes, levels of quality standards, data aggregation rules, required security during transport, and how information is treated by non-owning systems, generally policy-directed. It is focused on information integration and interoperability, typically documented in data flow diagrams, message formats, and transport protocols.

Information architecture differs from data architecture in that it encompasses both *structured* (data marts, databases, database tables, and data exchanges) and *unstructured* information (web content, jpeg or video files, and documents). Information architecture also defines business functional processes and delineates the relationship of the data element concepts to the processes. Information architecture documents the relationships between business domains and business processes, as well as the information, business rules, and organizational roles/responsibilities that are part of each process. In other words, data architecture is focused on "data-at-rest" and information architecture is focused on "data-in-motion." (NASCIO, 2008)

Data and information architectures can be documented in combined or separate EA Reference Models. The Federal Enterprise Architecture Framework describes them in the Data Reference Model (DRM). In the NASCIO EA Framework, they are governed in the Information Architecture Reference Model. Exhibit 10 from the NASCIO EA Toolkit[24] represents where data/information architecture fits into an EA Program:

Regardless of name, this architecture is a key bridge, driven by the Business Model and a driver to the Technology Reference Model. Using the detail documented in the information architecture provides the basis to share information throughout the enterprise, as well as across organizational boundaries. The NJDA uses both concepts and contains models that represent both data-at-rest and data-in-motion.

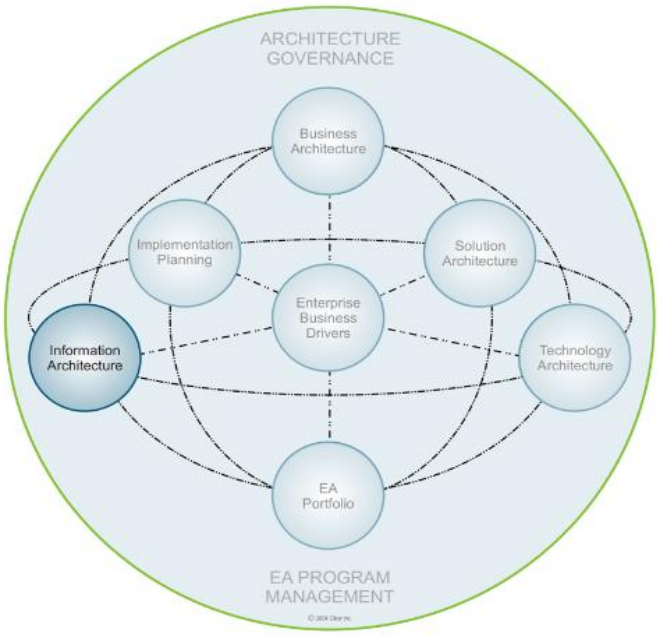

Exhibit 10. Where Data Architecture Fits in Enterprise Architecture

[24] http://www.nascio.org/EA

III. Results

Objective 1 – Analysis of Data Architecture Report

Over the past two decades, corporations and private businesses successfully implemented and realized the benefits of maturing business management practices and technology advancements. These practices are ingrained in planning activities and successfully used to align business objectives with technology adoption and investment. (IBM, 2008) The disciplines that are germane to enterprise data architecture include:

- **Enterprise Architecture** (EA) creates a framework that places integrated strategic goals, business operations, and technologies into a set of unified models to support an enterprise vision.
- **Business Process Management** (BPM) practices identify, optimize, consolidate, and integrate core business operations and processes to achieve improvements in productivity, cycle times, and quality.
- **Service Oriented Architecture** (SOA) and supporting standards and technologies improve business agility, lower development costs, reduce risks, and decrease ongoing maintenance.

Adoption and Use of EA and SOA

The current state of information sharing in the justice community reflects an understanding of GRA and NIEM principles — that SOA and web services are best suited for the underlying application architecture for information sharing. SOA is a broadly adopted and proven discipline that aligns business strategy and IT solutions with results that increase productivity, reduce costs, and speed system deliveries. (Jenson, Charters, Amsdens, Darlington, Owen, & Eric, 2008) Since the early 2000s, SOA implementations have successfully transformed businesses with integrated systems, reduced redundancies through consolidation, and increased information access using a host of new technologies and delivery capabilities.[25] Due to its features of loose coupling and platform independence, SOA is becoming the preferred and more suitable architectural style for ubiquitous or pervasive computing and information interoperability. (Zanuz, Barcelos, Filippetto, & Pinto, 2008)

Concurrent with the rising use of SOA, and driven by the economic downturn, organizations introduced EA programs to support multiyear consolidation projects and increase shared services. (Patton, 2010) They merged data centers, selected single-source email and Internet providers, and centralized procurement and provisioning. Subsequent projects merged or replaced functional systems (e.g., finance, HR); e-government initiatives were mandated; and Internet self-service capabilities replaced administrative services. All of these gave rise to the importance of understanding the data assets and how the information was used and presented to the business entities.

[25] (Patton, 2010), http://www.governing.com/blogs/view/The-Push-to-Consolidate.html

However, law enforcement and other justice agencies have been slower to adopt EA and SOA and/or to join state-level EA programs because they face challenges unique to the justice domain. These, in turn, adversely impact cross-agency information sharing progress. (Newcombe, Merging IT Systems Causes Problems for States and Localities, 2010)

Mission Diversity: The criminal justice system consists of multiple agencies or actors with different and often conflicting missions. Law enforcement is responsible for ensuring public safety, while prosecutors, defense, and courts are responsible for ensuring a fair judicial process. Corrections and supervisions agencies are responsible for managing offender consequences and the reintegration of offenders into the community. Conversely, many other public sector systems, such as education or health agencies, generally have similar missions.

Alignment of Cross-Agency Enterprise Architectures: Even if partnering justice agencies have an EA program with developed enterprise plans and deployment standards that include IT capabilities and systems, it is likely that their funding, priorities, and resources will not align. This makes it difficult for a given project to be smoothly coordinated and successful. Project delays occur because needed resources (staff or funding) are not available at the needed time.

Organizational Disparity and Legislative Constraints: The justice system is directly affected by the diversity of legal and organizational authorities within which it must operate. Cities, counties, special districts, nonjustice agencies, states, the separate branches of government, and the federal government often produce conflicting requirements that make information sharing difficult because of the lack of a single, centralized authority.[26] For example, oversight of state Prescription Drug Monitoring programs may be provided by health departments, pharmacy boards, or law enforcement agencies — each of which has different policies and legislative constraints on sharing of patient drug prescription and dispensed history. Similarly, sharing juvenile criminal history or mental health records is highly constrained by privacy legislation and respect for citizen concerns.

Justice Reforms: Another factor is change. Priorities within the justice domain are shifting to reforms in policing, corrections, behavioral health programs, and community services to reduce crime, decrease recidivism, and reduce costs. These are introducing new or changing business processes — and practitioners are still studying and exploring effective programs, treatments, and metrics. (Kim, Becker-Cohen, & Serakos, 2015) A key premise of EA is that evidence-based metrics are used as input to investment decisions, but measurement metrics and program performance results are being reevaluated as reforms and changing policies are evaluated.

[26] Of note, the Texas State Code, Title 1, Part 8, Chapter 177 Rule 2 mandates the justice information exchanges between courts and law enforcement conform to NIEM IEPDs developed under the "Texas Path to NIEM" project.

There are also many new SOA-based information sharing capabilities provided through regional federated networks, such as RISSNET and ARJIS, and through open portals, such as the Police Foundation's Public Safety Open Data Portal, the Kentucky State Police Open Data Portal, and others.

EA and SOA As-Is Findings:

- Statewide Enterprise Architecture practices are gaining ground and producing successes in modeling business strategies, predominantly to support consolidation and to streamline procurement and provisioning, which is typically the first maturity level of EA.
- Due to its features of loose coupling and platform independence, SOA is becoming the preferred and more suitable architectural style for information interoperability. (Zanuz, Barcelos, Filippetto, & Pinto, 2008) (Ziemann, 2010)
- Lack of metrics and measured results makes it difficult to make evidence-based investment decisions on the impact of sharing information.
- Portals with single sign-on and federated capabilities are frequently the earlier solutions to information sharing, preceding more complex information integration and interoperability projects.

Information Sharing Standards for Business Architectures

Using NIEM to design and build messages and the GRA to design and build services is the accepted direction for justice information sharing. Vendor products are increasingly including NIEM-compliant information, and government funding includes NIEM and GRA language in their Requests for Proposals. (Hollywood & Winkelman, 2015)

NIEM Model: NIEM has a great deal of content that represents multiple communities of interest. Most organizations using NIEM to share information will only use a small fraction of the model to meet their specific information sharing requirements. Because NIEM is so large and overly inclusive, it is often difficult for IEPD developers to find the appropriate NIEM content because there is so much to sift through. (NIEM Technical Advisory Committee, 2011) Since NIEM was developed without the semantics of data structure[27] and no graphical components, it requires subject matter expertise, data design skills, and specific NIEM model navigation skills to find appropriate NIEM elements and

[27] Since XML is a linguistic model, semantics would describe the logical relationships of types, properties, aspects of reference, and implication and logical forms.

then manually define and map the business semantics.[28] The NIEM model would benefit from the addition of graphic models to assist IEPD developers.[29]

NIEM BIEC/EIEM Concept: A Business Information Exchange Component (BIEC) is a collection of closely related business data organized at an object level and defined as extension data components in an IEPD. Often they are business data components developed and used by multiple organizations within the same community of interest (COI). Once an organization defines a number of BIECs, it can use the collection of BIECs as a library of business components or as the basis of an Enterprise Information Exchange Model (EIEM). Instead of developing each IEPD by mapping business data to NIEM and extension components, sub-setting NIEM, and defining extensions, organizations can perform much of the IEPD development by mapping high-level business content to existing BIECs in their own EIEM.

The Maritime Information Exchange Model (MIEM) is an example of the BIEC/EIEM concept. BIECs were modeled for the high-level maritime objects such as Vessels, Cargo, Passengers, Crew, Ports of Call, etc., and collated into the MIEM. The MIEM is now being used as the basis for information sharing between the U.S. Coast Guard, Department of the Navy, the National Center for Vessel Movement, and other maritime entities to develop IEPDs specific to their business needs.

The use of BIECs has the potential to simplify IEPD development and increase consistency of the business object definitions at all steps in the process, including exchange content modeling, mapping to NIEM, creating NIEM extension components, and generating XML schemas.

Integration of industry standards: All data standards need to recognize and address how to exchange data with other standards. NIEM is no exception and has limited capabilities to integrate with other models and industry standards, such as HL7, NG9-1-1, and NIST. As an example, the APCO/NENA Emergency Incident Data Document (EIDD) IEPD Workgroup has been developing a national super-standard for public safety answering point (PSAP) incident reporting for more than three years, and the work is still in progress. An ongoing difficulty is including external standards into the IEPD, which has complicated completion of this effort. The IEPD is currently in APCO review.

The health community is another domain with potential interactions and a need to exchange data with the justice community. There are several health data exchange standards. The one with broadest adoption is Health Level 7.[30] HL7 predates the

[28] A particular design aspect is that the model requires the use of references between data elements in combination to communicate one piece of business information. For example, there are data structures for an offense and for locations, and the offense location is determined by creating a reference link between those structures, tying a specific location to an offense. This is not intuitive to many developers, and makes eyeballing the XML by nondevelopers difficult and even harder for subject matter experts. (Hay, 2014)

[29] The Bureau of Justice Statistics sponsored a NIEM UML project. The tool specification was based on NIEM 2.1, which has since been superseded by NIEM 3.1.

[30] www.hl7.org

development of justice data exchange standards and varies significantly both in the content and transport methods used in justice. There are multiple versions of HL7 in use, and although the most recent version (Version 3, implemented in 2005) uses XML, it has not been broadly adopted. By far, the largest number of implementations — more than three quarters of all exchanges[31] — use some variant of Version 2.3 or older and rely on an older Electronic Data Interchange transport standard and character delimited data structures. Despite this variability, there is semantic equivalence between some of the data and messages of HL7 and NIEM. Commonality can be found between the person descriptive data contained in the HL7 Admissions/Discharge/Transfer (ADT) message and person-related elements found in NIEM Core.

IEPD Governance: Reflecting both a strength and weakness, any entity that seeks to specify a document or collection of data elements in a manner compliant with the top-level NIEM specifications can prepare and submit IEPDs. There is no authoritative oversight to the content, design quality, appropriate contextual modeling, and implementation documentation within the NIEM IEPD review process.

NIEM Clearinghouse Organization: Finding relevant IEPDs in the clearinghouse could be improved. There is a limited amount of metadata that users can employ to find and determine the suitability of a given specification. Given that graphical documentation (e.g., class diagrams, business flows) is recommended but not required, it is time-consuming to drill-down into schemas and XML. Thus, it is easier and more effective to create another IEPD — which has rendered significant duplication and overlap of IEPDs in the clearinghouse. It is also difficult to determine the level of development and implementation of IEPDs.

GRA Information Sharing Toolkit: The GRA and the GIST significantly enhance information sharing with the continuing publication of reference Service Specification Packages. The GRA/GIST provides extensive technical guidance for service identification and design and a standardized framework that can reduce development costs. The toolkit offers a good governance process, policy guidance, and links to resources.

NIEM and GRA As-Is Findings:

- Reference specifications and national standards are largely in law enforcement activities with limited representations for other justice activities, particularly supervision (Detention, Corrections, and Community Supervision) and nonjustice domains.
- Model-Driven Architectural practices and graphical artifacts are recommended but largely absent in the GRA SSPs and NIEM IEPDs specifications. This contributes to difficulties in understanding the underlying schema of published IEPDs and facilitating reuse.

[31] Technical Brief, *A Comparative Analysis of HL7 and NIEM: Enabling Justice-Health Data Exchange*, Mo West, SEARCH (2015), page 5.

- There is a limited amount of data that can be exchanged with other domains, such as health, yet interoperability is practical and achievable.
- The concept of a super-standard[32] as proposed by APCO/NENA is viewed as providing high value to the industry. As interactions between health and human services and the justice domains increase, stakeholders will need to develop techniques to integrate multiple standards.
- The use of BIECs has the potential to simplify IEPD development and increase consistency of the business object definitions at all steps in the process, including exchange content modeling, mapping to NIEM, creating NIEM extension components, and generating XML schemas.
- The XML-based NIEM is difficult to understand and foster discussion with nontechnical persons who communicate the information requirements. The addition of graphical or visual models would assist in understanding the NIEM information structure and relationships for both nontechnical and technical persons.

Summary of Gaps

- The corrections, detention, and supervision business areas are not well-represented in the published standards (IEPD and SSPs) and the data architecture.
- New and emerging lines of business, such as forensics and data analytics, are not represented in the data architecture.
- Information exchange points between the justice and nonjustice communities, such as health and first responders, are not documented in the data architecture.
- The data architecture lacks guidance on the NIEM for capabilities and techniques, to include external standards (e.g., HL7, NENA) and unstructured data (images, voice, and video) to support the "super-standard" concept proposed by APCO/NENA.
- Nontechnical persons could more readily understand data architecture specifications if IEPDs and SSPs always included graphical representations.
- The NIEM can be difficult to understand and navigate for nontechnical persons; visual representations would assist both in understanding the model and to ensure the integrity and coherency of the model.
- Lack of metrics and measured results makes it difficult to make evidence-based investment decisions on the impact of sharing information.
- Justice strategies and practices are shifting to reforms in corrections, behavioral health programs, and community services to decrease recidivism and reduce costs.

[32] The APCO ECTF report calls for a "universal standard/super standard" that provides additional requirements for creating future data exchange requirements. The super standard was specified to incorporate NIEM, GRA, specifications from the forthcoming NENA EIDD standard (NENA and APCO, 2013), and information assurance measures. (Wisely, Wormeli, and Gabbin, 2013)

These areas are not strongly represented in the body of standards and specifications.

Objective 2 – NJDA Framework

The NJDA Framework is a tool to assist in planning, designing, developing and deploying an information sharing environment between a set of collaborating exchange partners. The framework strives to address concerns and interests of decision-makers, business managers, and technologists through Planning, Operational, and Design views.

Each view provides guidance through recommendations, standards, frameworks, and other disciplines, such as EA frameworks, GRA, and SOA design. These are extensively noted in **Section II: Methods**.

Each view also provides navigable artifacts, such as business process models, service interaction models, and service inputs and outputs. These artifacts are intended to be adapted to the particular goals and priorities of users.

The high-level diagram (Exhibit 11) summarizes main references used to create the guidance and artifacts provided by the NJDA tool. The diagram also identifies gaps within the tool, which are further described in **Section IV: Conclusions**.

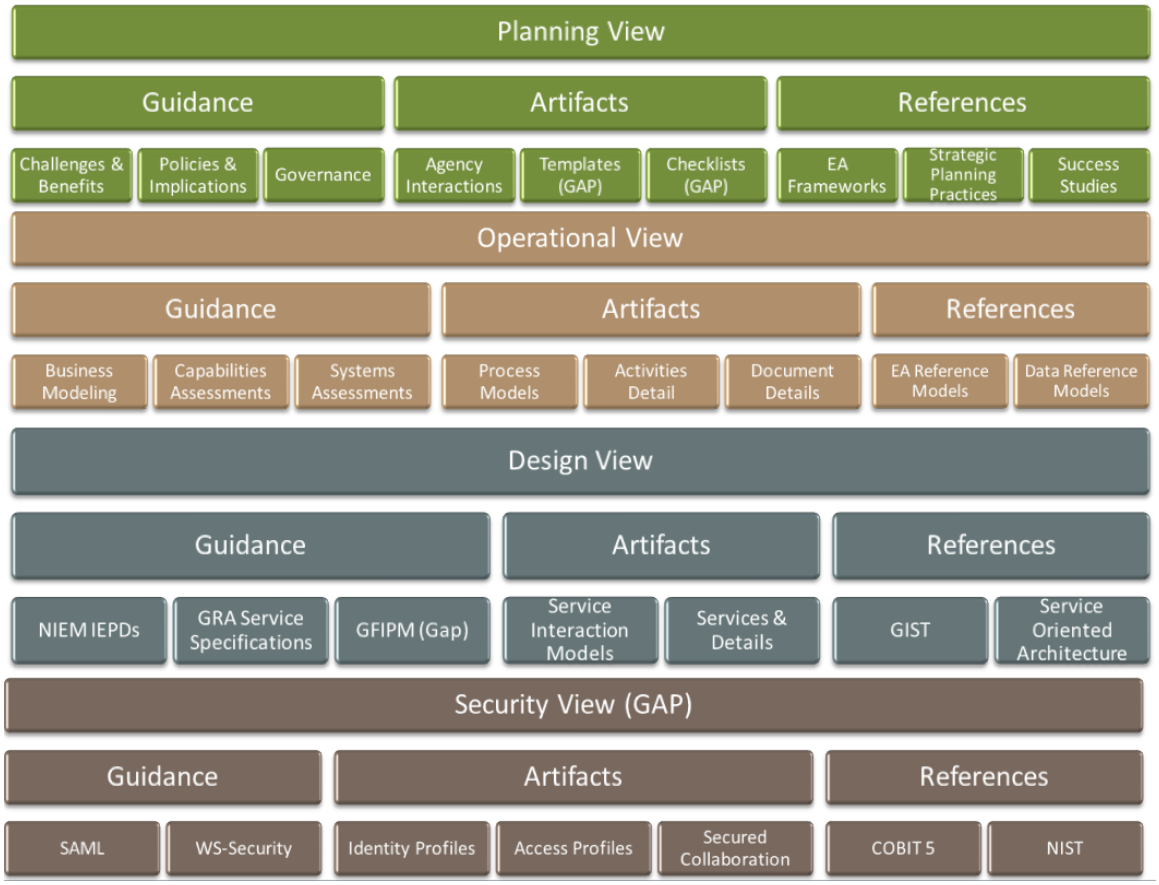

Exhibit 11. NJDA Framework Overview

The NJDA Planning View guides a process through which partnering agencies can develop a strategic interagency interaction model and create a roadmap of prioritized information exchanges to mutually meet their agencies' goals. Business and IT managers can use this roadmap to assess the needed service capabilities and document detailed requirements of the exchanges through process models, and reference and information models. Then, architects and technologists can use these requirements to design the services using NIEM IEPDs and GRA SSPs where possible. If IEPDs are not available, the NJDA tool provides guidance on how to develop information exchange packages and service specifications. The diagram in Exhibit 12 summarizes this process flow:

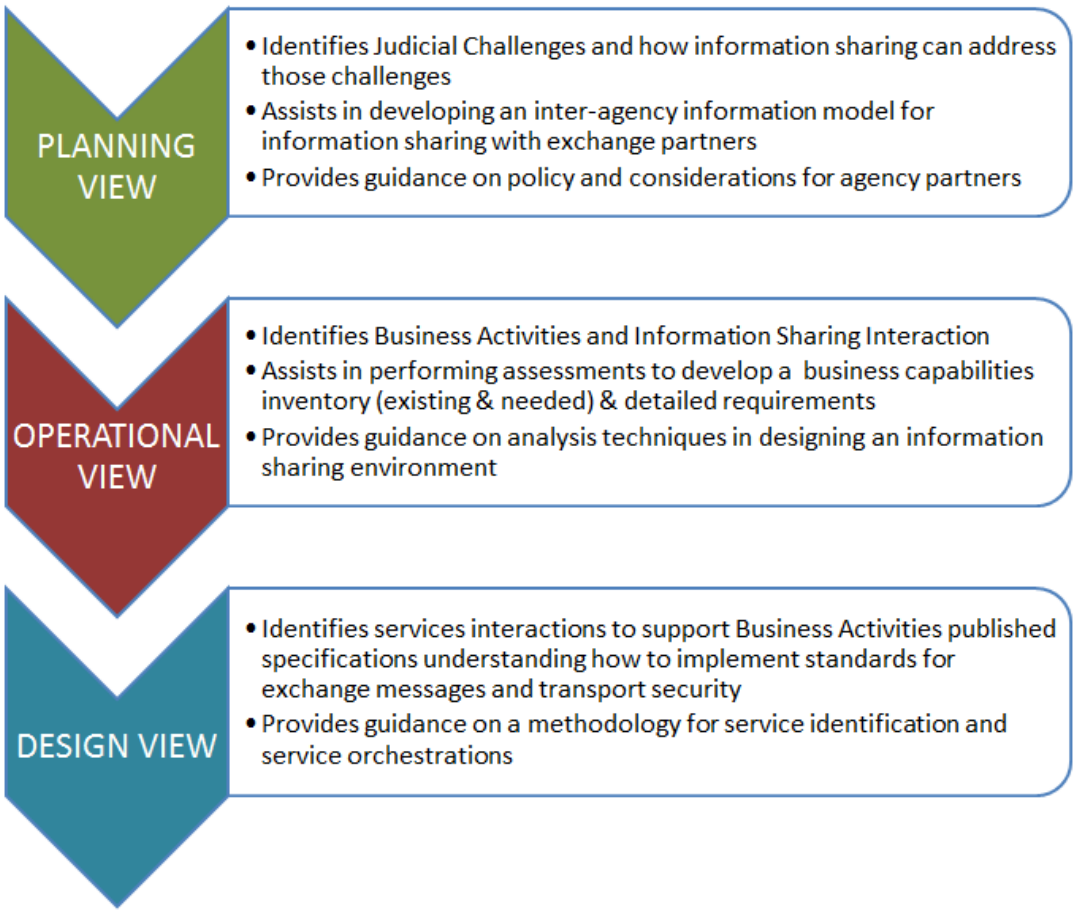

Exhibit 12. Process Flow for Using the NJDA Tool

The NJDA starts with the main page, which presents the three top-level views that address the needs of specific stakeholder audiences. Each view has associated metadata to provide semantic context and queries, and each assists in analyzing current information exchanges and the need to engineer new information exchanges:

Planning	demonstrates for public safety and criminal justice executives, policymakers, and national bodies how a to-be information sharing environment might look and assists in assessing their as-is environment and planning their to-be environment. This view provides navigation to page content to help assess the criminal justice information sharing

	environment in terms of policies, initiatives, and technology standards or trends. It provides information that addresses criminal justice challenges, reviews evidence-based research, and evaluates what information sharing capabilities need to be strengthened or developed. Responsible information sharing requires policy mechanisms and legal authorities that encourage sharing, with appropriate safeguards, as well as a proven way to resolve legal and policy issues that may impede such sharing.
Operational	demonstrates for operational managers how the pieces fit together so they can make decisions about how and where information exchanges should occur. This view presents business processes and models that are decomposed and bi-directionally linked with activities. The activities provide links to triggering activities, subsequent activities, and associated documents. CIOs and managers will want to develop and review the business process models and clarify where to best invest resources, identify architecture platforms, and evaluate and recommend standards.
Design	assists technology architects in making decisions about systems and technologies that adopt and contribute to a standards-based national architecture. Architects will want to review services and service interaction models, as well as published GRA SSPs, to determine their applicability to meet operational and strategic goals. Documents and Services are bi-directionally linked, with both linking back to activities.

Exhibit 13 depicts the category structure of each view:[33]

Exhibit 13. Category Structure of Planning, Operational, and Design Views

[33] Note: By default, the category tree extension shown here orders categories alphabetically, although the hierarchical structure typically followed when using the tool is Planning, Operational, and Design.

Planning View

The NJDA **Planning View** presents topics, questions, and information to guide partner planning discussions to consider how policies, processes, systems, and information are currently organized and what a to-be environment might look like for their agency interactions. The view starts by presenting a well-established, conceptual information sharing diagram of the justice process first developed in 1967 (see Exhibit 9). This diagram depicts the overall domain and assists in identifying and selecting which processes are most critical to improve business efficiencies, increase public safety, or address emerging challenges. The diagram identifies only the steps in the process and the high-level business relationships between the major entities that are engaged in the criminal justice process.

The goal of the Planning View is to help inform an EA approach to designing business processes that decreases information silos, increases the use of standardized technologies, and optimizes core capabilities. This produces a foundation for execution that guides the operational decisions with implementation actions that produce results.

The Planning View includes content on topics that are intended to be for continual user contributions, such as:

Policy Implications of Information Sharing. This topic identifies the emerging policy considerations in order to identify information sharing assets that are of value to inter-agency sharing, what external access is appropriate, and what security protection measures need to be in place. This topic is initially guided by the policy products developed by the Global Justice Information Sharing Initiative and the DOJ IT policies, along with various federal- and state-level IT strategic plans. The policy implications of legislation such as the Adam Walsh Act and emerging legislation on physical and behavioral health records are examples of group areas of discussion.

Governance Models. This topic identifies various governance models that detail the candidate measures to be taken to achieve the policy objectives. These measures include data asset risk assessments, performance indicator values for exchanged information, and the roles and responsibilities of each exchange partner. This component is initially guided by frameworks such as Control Objectives for Information and Related Technology 5 (COBIT 5) and governance models in place for federated networks, such as RISSNET and JNET.

Principles of Identity Management and Information Access Security. This topic identifies existing and emerging standards and architectures to ensure that users are appropriately identified and provisioned for access to data assets; that user credentials are secured; and that appropriate audits and oversight are in place. This component is largely guided by the Global Federated Identity and Privilege Management (GFIPM) standard.

The Planning View is intended to help identify what information exchanges would be of most value to the enterprise and what set of capabilities are needed for those exchanges. The output of planning is intended to answer the questions about what needs to be done, along with a business model of the intended operating environment and a prioritized set

of enterprise goals for sharing information to exchange partners. For example, it may be a goal to automate all information sharing between a prosecution system and a court system using standards to increase accuracy and productivity. This would require that both systems provide and use capabilities that exchange information on cases, charges, sentencing, and disposition. Or it may be that all warrant information is desired to be shared between law enforcement, courts, and state repositories to eliminate manual processes. This would entail fewer reusable services that exchange information between many agencies. This is the beginning of developing a portfolio of sharing capabilities.

High-level business relationship models, as illustrated in Exhibit 14, provide the next level of detail for the planning process. This diagram depicts the interagency interactions to aid in the discussion on what business areas could most benefit from, and are prepared for, electronic information sharing. These are not detailed business process models; however, they illustrate the progression of events between law enforcement and other justice agencies. These diagrams are the bridge from the Planning View to the Operational View; as an example, the diagram depicts the interaction between agencies from a Call for Service to an Open Court Case.

The NJDA Operational and Design Views then provide more detailed models and underlying components that produce information, such as Call for Service data, that is shared with partners and determine how that sharing is enabled through security, identity, transport, and federated assets. The role of these diagrams is discussed more thoroughly in the following **Operational View** subsection.

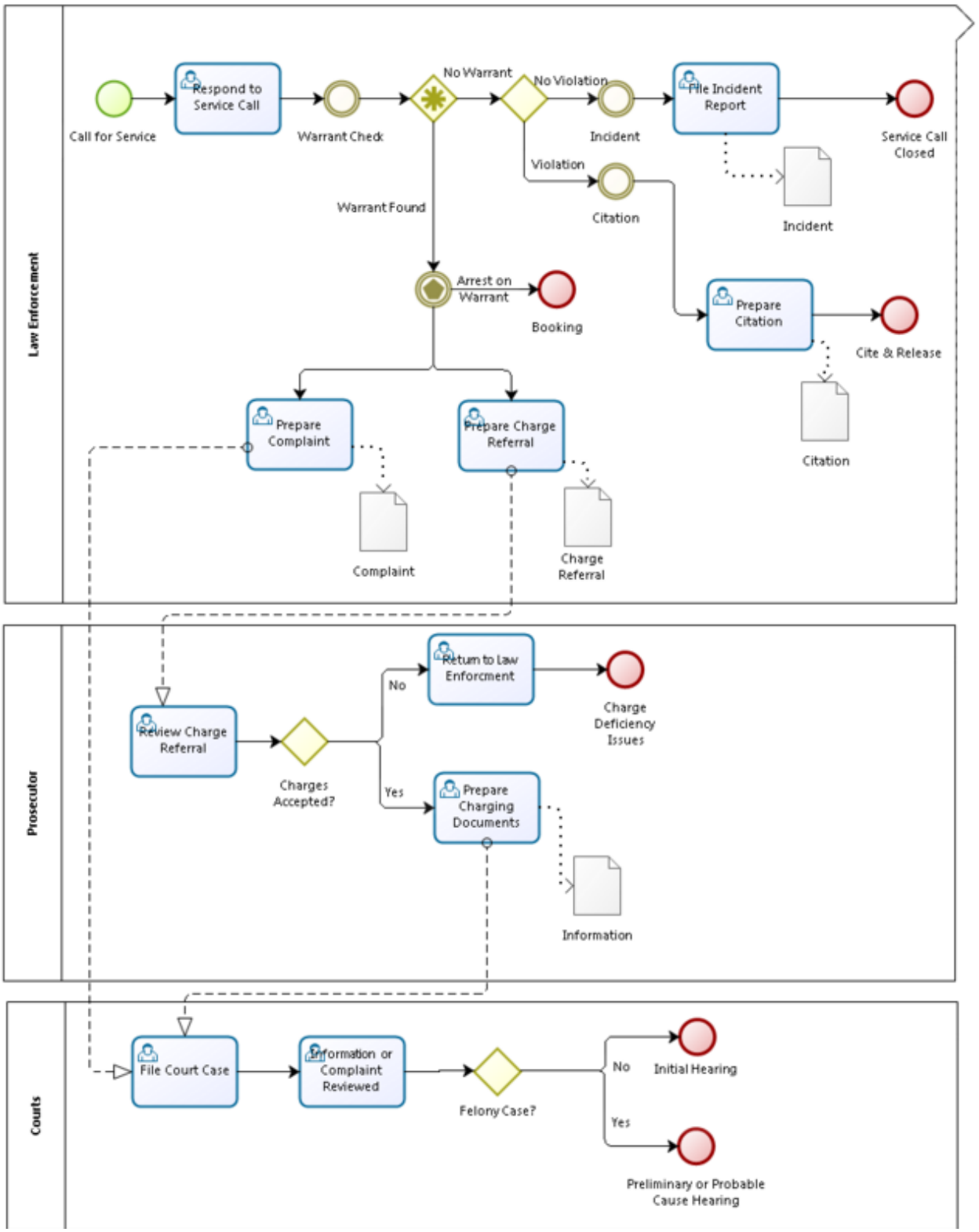

Exhibit 14. Call for Service to Open Court Case

Operational View

The NJDA **Operational View** depicts related or coordinated business processes, activities, and key partners and documents these using Business Process Modeling Notation, a broadly used technique to model business processes and interactions. Collectively using the models, CIOs and architects can adapt the models to create their own portfolio of business capabilities, based upon the strategic planning goals. The models define roles, responsibilities, and ownership, and are loosely coupled with each other. Ideally, they are easy-to-manage models with a level of decomposition that allow operational managers to reuse them in larger process compositions or orchestrations. These business models and documents can be a starting point for exchange partners to identify and customize the exchanges needed for their own processes that are relevant to information sharing priorities established during planning.

The Operational View is built around the following components:

Business Reference Models (BRMs). This component documents justice lines of business into formal Business Process Models diagrams assembled into a Justice BRM. This component is guided by various criminal justice publications and academic studies.

Business Activities. This component documents the details of individual business activities within a justice line of business. This component is largely guided by the JIEM.

Exchange Documents. This component documents the information that is exchanged between agencies within a business activity. The component is largely guided by published NIEM IEPDs in the NIEM Clearinghouse or IEPDs within a GRA Service Specification Package.

The Operational View is modeled on three sets of well-established information sharing resources: the JIEM Adult Felony Reference Model; documentation artifacts within NIEM IEPDs in the Office of Justice Programs' IEPD Clearinghouse; and GRA SSPs, as published by the Global Advisory Committee. As of July 2016, the following NIEM IEPDs or GRA Service Specifications are published as national standards and contributed to the NJDA Framework (Exhibit 15):

Sponsor	IEPD or Service Specification
Law Enforcement Information Technology Standards Committee (LEITSC) [34]	• 7 CAD/CAD Service Call Information IEPDs • 1 CAD/RMS Service Call Information IEPDs • 2 RMS/RMS Incident Query/Response IEPDs
Global Standards Council[35]	• 2 Federal Data Repository SSPs (Suspicious Activity Report, Terrorist Screening Encounter) • 6 Federated Query/Search/Response SSPs • 4 Court SSPs (Charging, Supervision Conditions, Disposition Reporting, Victim Notification) • 7 Law Enforcement SSPs (Arrest Reporting, Warrant Activities, Fingerprinting) • 5 Supervision/Corrections SSPs (Inmate Release/Transfer, Sex Offender Location)
FBI	• N-DEx Incident/Arrest • N-DEx Incarceration, Booking, Parole, Probation
IJIS Institute	• 12 CAD/Intelligent Transportation Public Safety IEPDs
NENA/APCO	• A "super-standard" [36] Emergency Incident Data Document (EIDD), to include NIEM, GRA, NENA, APCO, and other national standards

Exhibit 15. NIEM IEPDs and GRA Service Specifications Contributing to the NJDA Framework

SEARCH used the AFRM as reference material to decompose the processes into "Lines of Business" (LoBs) business process models within justice and public safety agencies. These models identify activities, documents, capabilities, and services for storing, managing, and sharing information with key partners. SEARCH used the IEPD and GRA artifacts to identify content and structure of exchanged information (e.g., booking reports, charge filings, and warrants).

Business process *models, activities,* and *documents* are the core category of the Operational View. The metamodel of this view includes triggering and subsequent activities, sending and receiving agencies, associated documents with a given activity, and associated data elements with a given document. The Operational View assists in a business capabilities analysis approach with a view of the justice enterprise LoBs, and business activities shown through business process models. During the subsequent decomposition, the analysis of selected business functions is refined and specified in greater detail until the entire analysis is reduced to those low-level core business capabilities. The high-level Business Relationship Models (Planning View) are decomposed into related activities. These are grouped and organized within LoB business process models, such as Investigation and Prosecution, depicted in Exhibits 16 and 17.

[34] LEITSC-sponsored IEPDs are available from the International Association of Chiefs of Police (IACP) website (2013): http://www.theiacp.org/About-IACP/Governance/-CAD-RMS

[35] Global-sponsored SSPs are available from Global's website (2015): https://it.ojp.gov/gist/

[36] (APCO International and IJIS Institute, 2013). The IJIS/APCO *Emergency Communications Task Force* (ECTF) report calls for a "universal standard/super standard" that provides additional requirements on creation of future data exchange requirements.

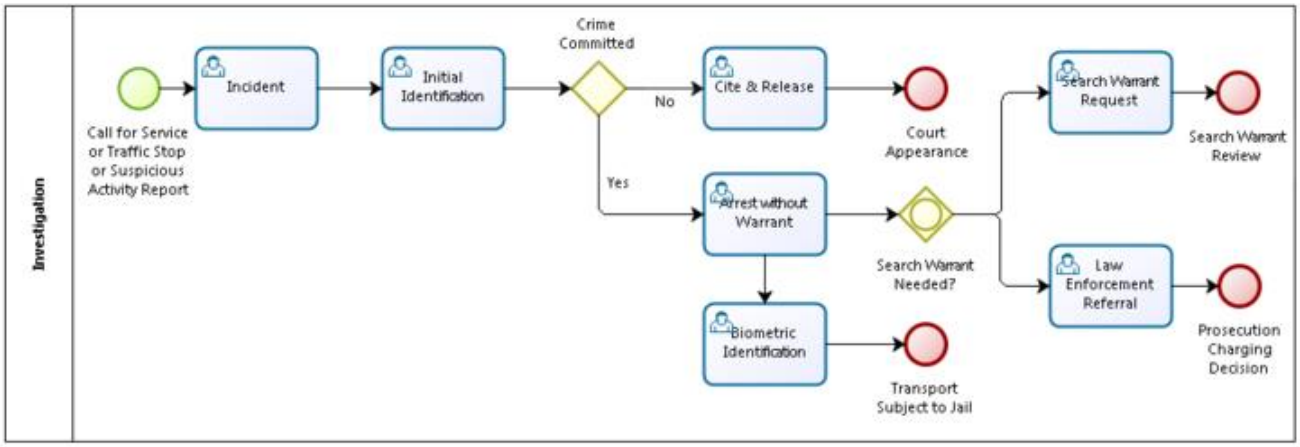

Exhibit 16. LoB Business Process Model – Investigation Activities

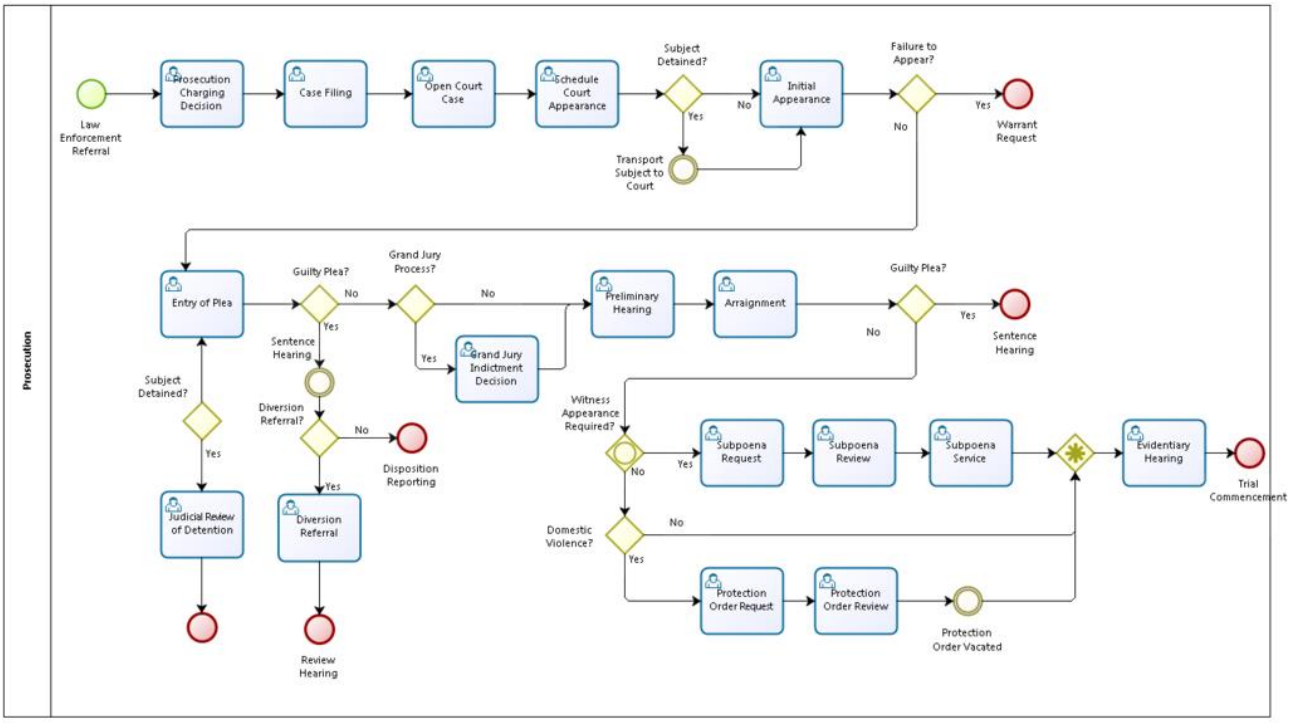

Exhibit 17. LoB Business Process Model – Prosecution Activities

The result of the business capabilities analysis is a set of information sharing capabilities that will be used during the next step of the services identification methodology. For the purpose of simplicity at this step of the process, it is assumed that each business capability is provided by a single service or service candidate.

Design View

The NJDA **Design View** is intended to help technical managers, architects, and their development teams identify more technical components of the architecture — what web service capabilities are needed, the concepts and best practices of SOA, and available references and resources. This view contains the services and service interaction process models, content on designing exchanges, information on published SSPs, and technology standards. The Design View will describe the implementation initiatives at state and local agencies, what national networks and infrastructure elements are in place to support information sharing, and what technical principles can assist in provisioning strategy decisions.

The Design View is built around the following components:

Services. This component describes specific web services that are used to request and receive information during the course of a business activity. This component is guided by published GRA Service Specifications and conceptual models.

Service Interactions Models. This component documents conceptual service orchestrations to accomplish a collection of business activities. This component is largely conceptual; there is no extensive library of published service specifications and the interaction between agencies can widely vary from one jurisdiction to another.

Technologists must become more outward-facing and knowledgeable about the business side of the broader justice enterprise. While they do not need to become experts in the business, they need an understanding of the language that allows them to talk with business analysts about the business. Architects, in particular, provide the communications channel and the link between the justice business requirements (Operational View) and the resulting technology solution (Design View). They need to ensure that business requirements and solutions are traceable and interdependent. They can achieve this interdependence by working very closely with business analysts to ensure that the solutions proposed fully align with the justice business requirements. In common SOA vernacular, it is called "exposing the business architecture."

The NJDA Design View provides this perspective by decomposing the Business Process Models (Operational View) into services. ("Services" in the context of this view of the tool are a technical means to exchange data between systems.) This aids architects and designers in arriving at the right service granularity for their capabilities and identified business services, and building an enterprise service catalog. By using a standard process to identify an organization's capabilities, even nonexperts in a given business domain (e.g., the justice enterprise) can facilitate a useful discussion about business requirements and can surface important information on function, metrics, performance, maturity, interconnectedness, governance, and compliance. Because business process practitioners are answering questions from a technical architect, the architect helps to expose a view that the practitioners may not yet have. The introduction of a service model between the business model and the technology model is a key factor that can help achieve this goal, which leads into Model-Driven Architecture as another premise of the NJDA.

Services are the core organizational category of the Design View and are based upon the standards for NIEM IEPDs and GRA Service Specifications. The metamodel includes scope, real-world effect, associated documents, exchange archetype, and service actions, as depicted in Exhibit 18. If a national reference IEPD or GRA Service Specification is published, these are noted.

Arrest on Warrant Service

Scope	The service receives information regarding the arrest on warrant event.
Real-world Effect	Agencies receive notice of the arrest on warrant.
Associated Documents	Arrest Report, Arrest Warrant, Return of Service
Archetype	Event
Service Actions	Notify
GRA or NIEM Specifications	https://niem.gtri.gatech.edu/niemtools/iepdt/display/container.iepd?ref=RISYulcKmFw%3D

Exhibit 18. Service Metamodel Example

Service Interaction Process models depict possible service orchestrations. In the example in Exhibit 19, an arrest event is reported and routed, in turn, to jail, prosecution, and community service systems. While similar to business process models in appearance, service interaction models focus on the inter-relation between service providers and service consumers. Using the vernacular of the GRA, these are called "adapters" and "connectors." The diagram can also identify service actions and message content.

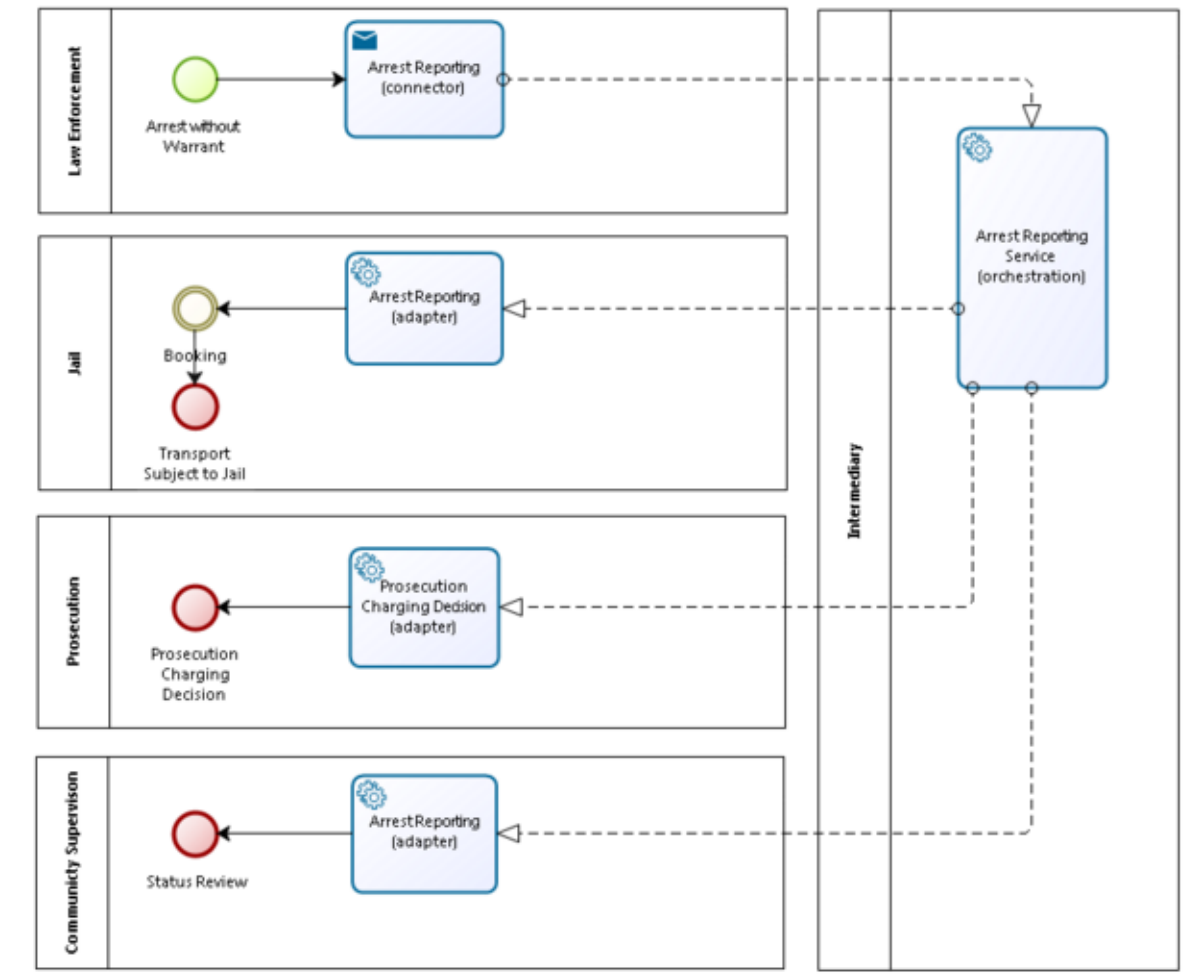

Exhibit 19. Service Interaction Process Model Example

Semantic queries can produce customized listings, such as those shown on a list of Real World Effects of Services in Exhibit 20.

Real World Effect of Services

The following is a listing of the real world effects of services.

Service Name	Real World Effect
Arrest Reporting Service	Case Management Systems are updated and notifications are sent to prosecution, jail, and community services.
Arrest on Warrant Service	Agencies receive notice of the arrest on warrant.
Case Filing Service	Case information is received for the court to determine whether sufficient cause and evidence is present to open a court case.
Charge Referral Service	Prosecutor is requested to review the charges submitted by Law Enforcement and make a decision on whether to file a court case.
Court Case Decision Service	Prosecution and law enforcement receive the decision on whether to request to open a court case was approved or denied.
Criminal History Query Service	Requester receives information on person regarding criminal history.
Incident Reporting Service	The consumer will have submitted an incident report and initiated the policy response for incident reporting.
Prosecution Charging Decision Service	Law enforcement is informed on whether or not a court case will be filed based on the charges, evidence, and probable cause.
Protection Order Request Service	The court reviews the application and either issues or denies a protection order.
Protection Order Review Decision Service	A requesting agency receives the court's decision on whether a protection order has been issued or not. If the protection order is issued, the prosecution and state repositories are notified.

Exhibit 20. Semantic Query Example

IV. Conclusions

Discussion of Findings

The primary hypothesis for this work is that while the justice community has invested significantly in developing information sharing standards, which are critical components of a data architecture, it has not developed a complete "enterprise" view of the justice process that properly identifies all of the components required to understand the entire enterprise, nor has it properly scaled these exchanges to maximize their utility across organizational boundaries.

The results of this research affirm this hypothesis — there is little evidence that the justice system has developed a comprehensive enterprise model of a criminal justice data architecture. However, this research has also moved the discussion forward by developing a framework for assessing the state of the justice data architecture. Justice stakeholders can use this framework to capture, document, and measure the components that exist, and they can add to it to develop a robust criminal justice data architecture.

Using the NJDA as a sustainable and extendable framework, stakeholders can readily add and categorize additional content and structure within the views of the framework. The framework is extendable into other domains, such as health or emergency management. It could also be packaged into a product that can be customized by agency exchange partners to document their joint sharing environment.

The premise of this research was that an enterprise framework has value in that multiple audiences can use it to better understand and take advantage of the data architecture of the justice domain, thereby resulting in a more efficient and effective justice system. The framework is arranged around three "views" of the architecture to be used by key audiences to address their areas of concern:

- The **Planning View** will demonstrate for public safety and criminal justice executives, legislators, and policy-maker bodies how the information sharing environment will look nationally and assist in strategic planning.
- The **Operational View** will demonstrate for operational managers and information architects how the pieces fit together so they can make decisions about how and where information exchanges should occur.
- The **Design View** will assist technology architects and developers to make decisions about systems and technologies that adopt and contribute to a standards-based national architecture.

Researchers developed practical questions to be answered by the framework views. These sets of questions are presented (Exhibits 21, 22, 26) with a description on where and how it is addressed in the framework in the second column. If a question is partially or not addressed, additional capabilities to close the gap are noted in the third column.

Planning View

The Planning View questions (Exhibit 21) address policy, information sharing strategies, and how information sharing can address challenges within the justice community. They are of concern to investment decision-makers, strategic planners, and policy analysts.

Planning View Questions	NJDA Implementation	NJDA Additional Recommended Capabilities/Comments
What policy objectives can information sharing help achieve?	Privacy and security policies are described at the document and service category levels.	Add Identity Management category and taxonomy metadata.
What current business challenges is the justice community facing, and how can we address those problems with information sharing?	Business challenges are described through page content.	Evidence-based research is needed to understand what information sharing effectively addresses what problems, and what metadata to add to the NJDA taxonomy.
What risks are inherent in information sharing, and how do we mitigate those risks? For example, developing and enforcing proper privacy policies mitigate the risks associated with the maintenance and exchange of personally identifiable information (PII).	***Risk Management is not addressed.***	Users can readily add a Risk Management topic, but it needs subject matter expertise.
What governance models are in place to establish ownership and control over information and information exchanges?	The NIEM and GRA governance models are described. Guidance on agency governance is provided.	The GIST provides governance templates and examples.
What principles determine who should provision and control information and exchanges?	***This topic is not addressed in the NJDA.***	Needs further discussion with subject matter experts.
What strategic plans exist currently, and what is the progress toward those plans? How do jurisdictions and agencies align with those plans?	Many state-level EA strategic plans are described in the NJDA, focused on those that include comprehensive justice information sharing projects.	Research these projects in further detail within an evidence-based perspective. Determine what business challenges these projects intend to address, what metrics are designed, and the resulting performance. A good example is the Colorado Offender Management System, which started in 2016 (Colorado Office of Information Technology).
What are the measures of success?	Related to previous questions.	Topic needs evidence-based input. Pretrial services that use risk-based evaluations of offenders might be an area to evaluate.

Exhibit 21. Planning View Questions

The NJDA can answer most of these Planning View questions by page content and external links to federal, state, and local references. The very nature of planning activities is that decision-makers and strategic planners need to assess their own environment,

challenges, constraints, and capabilities in order to plan their future environment. The NJDA can serve as a model and identifies a broad spectrum of material relevant to planners, which they can use to identify the plan scope. Ultimately, each set of constituents will need to define their own planning view unique to their specific environment and requirements.

Performance measures, key indicators, and risk factors are typical measures found in broader EA planning activities, which are backed by evidence and are typically included in a planning metamodel. However, SEARCH discovered only a limited amount of authoritative evidence-based research pertaining to the justice domain to confirm the metamodel and associated values as originally envisioned. This is reflected in Exhibit 21, where certain questions could not be addressed, such as "What are the measures of success?" and "What risks are inherent in information sharing?" Further collaboration with subject matter experts is needed to confirm and possibly redefine the metamodel and metadata in order to answer questions applicable to this view. Adding this is necessary in order to guide selection and prioritize decisions for information sharing exchange capabilities.

The Planning View also contains information about business challenges and other areas of concern (e.g., drug-related crime, firearms registration and control, mental health problems of offenders, and juvenile justice) and includes external links to reference materials and government sites.

In addition to planning the information sharing capabilities portfolio, the Planning View enables users to determine what security standards and data asset policies are needed (e.g., how data are protected, nonfunctional requirements). Once users establish the portfolio priorities and policies, use of the NDJA transitions from the Planning View to the Operational View.

Planning View Findings:

- Many national organizations have worked and continue to work to evolve the national justice data architecture, including Global, the NIEM Project Management Office, the FBI Criminal Justice Information Services Advisory Policy Board (CJIS APB) and its working groups, and the Program Manager for the Information Sharing Environment's (PM-ISE) Standards Coordinating Council (under which industry standards development organizations operate).
- State and local jurisdictions have undertaken similar efforts to define a standard architecture for their jurisdictions — examples include the Colorado Offender Management System, and the California Health and Human Services Systems Integration and Interoperability Project.
- Within the justice business processes, standards and specifications exist and are broadly adopted for investigative activities, such as incident and arrest reporting, wanted/missing persons, stolen property, and CAD/RMS communications. These are reflected in the NJDA.

- The Planning View can help identify agencies and exchanges to support justice lines of business (such as investigative or prosecution), but there are gaps in associating business problems with evidence-based research to assist in setting priorities.
- Justice strategies are shifting to reforms in corrections, behavioral health programs, victim services, and community services to decrease recidivism and reduce costs. These areas are not strongly represented in the body of standards and specifications.
- Performance measures, key indicators, and risk factors are typical measures found in broader EA planning activities, which are backed by evidence and are typically included in a planning metamodel. However, SEARCH discovered only a limited amount of authoritative evidence-based research pertaining to the justice information sharing to assist in prioritization and investment decisions.
- The concept of a fused "super-standard,"[37] as proposed by the Association of Public-Safety Communications Officials–International and the National Emergency Number Association (APCO/NENA), is viewed as providing high value to this domain. A successful example of this is the Maritime Information Exchange Model (MIEM) led by the U.S. Coast Guard in collaboration with federal and international partners.
- As the health and human services communities develop stronger relationships and interactions with the justice community, the governing entities will need to consider how to integrate the health business processes and domain standards into the data architecture.

Planning View Recommendations:

1. Collect content and document the justice and public safety lines of business (LoBs) and key information exchange points to create an accurate model of justice information life-cycle. Essentially this would be a revised Criminal Justice Case Flow Life-cycle diagram.
2. Confirm and apply an expandable NJDA meta-model (taxonomy) — e.g., domain, LoB, activity, capabilities, information, and services — to support a discoverable categorization of GRA, GIST, and NIEM assets, specifications, and resources.
3. Decompose the updated Criminal Justice Case Flow Life-cycle into complete business process models and activities. Explore emerging LoBs, such as forensics and data analytics, and changing LoBs, such as corrections and community supervision.

[37] The APCO ECTF report calls for a "universal standard/super-standard" that provides additional requirements on creating future data exchange requirements. The super-standard was specified to incorporate NIEM and GRA specifications from the forthcoming NENA EIDD standard. (NENA and APCO, 2013), (Wisely, Wormeli, and Gabbin, 2013)

4. Identify points of information exchange between the justice, public safety, and health and human services domain models, and unify into the NJDA.
5. Expand the scope of the NJDA to identify alignment and gaps with other domains and their associated LoBs.

Operational View

The Operational View questions (Exhibit 22) address the operational design and business process flow of information exchanges between agencies. These questions are of concern to functional division managers, IT operational managers, and design architects.

Operational View Questions	NJDA Implementation Status	NJDA Additional Recommended Capabilities/Comments
Who is, or should be, exchanging information?	This is captured in the "Sending" and "Receiving Agency" metadata.	The supervision area needs more subject matter expertise to define activities and documents.
What is the content (structure and meaning) of exchanged information?	This is captured in the metadata of the document category.	Affirm and adapt document metadata and semantic queries with subject matter experts.
What systems (or "capabilities," in GRA terminology) typically capture or record information about the occurrence of those events?	This is captured in the activity and service.	Affirm and adapt activity and service metadata and semantic queries with subject matter experts.
What is the business process or policy response to each event?	This is captured in the business models.	Affirm and adapt business models, particularly in supervision and corrections.
What "nonfunctional" requirements ("service interaction requirements," in GRA terminology) apply to each exchange? That is, what are the access control, confidentiality, availability, reliability, logging, accountability, and similar requirements that apply?	***No***	Metadata is designed but not implemented. Agency policies and standards determine these nonfunctional requirements. The NJDA can recommend, but there are no standards for nonfunctional requirements.
How do existing information exchanges (e.g., service specifications, IEPDs) map into the reference exchanges (events, process responses)? Are any existing exchanges misaligned?	This is captured in the metadata of the service category, described in content, and depicted in diagrams.	Affirm and adapt for misalignments.
What partner organizations' capabilities/systems/ processes typically participate in the policy response?	This is captured in the business process models.	Affirm and adapt activity and agency categories' metadata and semantic queries.
What events trigger information exchange in the justice system (and related domains)?	This is captured in the activity category.	Affirm and adapt activity category metadata and semantic queries.
What are the priorities for building exchanges?	***Not applicable***	The situation of the enterprise should determine priorities.

Exhibit 22. Operational View Questions

The activities of the justice domain are well-documented through legislation, public records, and academic and scholarly publications. These resources served as input to the Operational View, resulting in a more robust metamodel, so users can answer the majority of these questions either directly through the NJDA Framework or through semantic queries. Stakeholders can answer the first question — "Who is, or should be, exchanging information?" — by using the tool to view activities and documents. For example, a court may want to provide capabilities that allow systems to electronically send court-related documents. The tool presents this information by answering the question, "What documents are sent to courts by what agencies?" This produces the following results (Exhibit 23):

What documents are sent to courts by what agencies?

	Sending Agencies
Affidavit for Arrest Warrant	Law Enforcement Prosecutor Courts
Affidavit for Summons	Law Enforcement Prosecutor
Appearance Bond	Law Enforcement
Arrest Report	Law Enforcement Diversion Providers
Bench Warrant	Law Enforcement Courts
Bill of Information	Prosecutor
Charge Complaint	Law Enforcement Prosecutor
Citation	Law Enforcement
Criminal History Report	State Repository
Order of Discharge	Corrections
Parole Agreement	Corrections Parole Board Treatment Provider
Return of Service	Law Enforcement Service Agency

Exhibit 23. Results for Question,
"What documents are sent to courts by what agencies?"

While the question addresses what documents are received by the courts, the tool also reveals additional information that may not otherwise be apparent based on the perspective of any one stakeholder. The query results identify that the court is also a sending entity for some of these documents. This correctly occurs when the exchanged information is part of a "request-response" archetype pattern, in that the information is expecting a policy response to the request. Looking at the "Affidavit for Arrest Warrant," this would be a request to the courts to review and approve or deny the Arrest Warrant and return the affidavit with their decision.

Further analysis of this inquiry allows the user to limit this scope to only law enforcement documents. The question "What documents are sent by law enforcement to courts and what triggers the exchange?" produces the following results (Exhibit 24):

What documents are sent by law enforcement to courts?

	Triggering Activities
Affidavit for Arrest Warrant	Incident Arrest Warrant Request Arrest Warrant Review Summons Service Sex Offender Registration
Affidavit for Summons	Incident Summons Request Prosecution Charging Decision Probation Violation Charging Decision
Appearance Bond	Release
Arrest Report	Arrest without Warrant Charge Referral Arrest on Warrant
Bench Warrant	Review Hearing Arrest on Warrant Court Appearance
Charge Complaint	Arrest on Warrant Arrest without Warrant Case Filing
Citation	Cite and Release Open Court Case Case Filing Traffic Stop
Return of Service	Summons Service Subpoena Service Arrest on Warrant

Exhibit 24. Results for Question, "What documents are sent by law enforcement to courts?"

The question "What events trigger information exchange in the justice system (and related domains)?" is answered within the Subsequent Activities and Triggering Activities properties in the activity category. For example, "Arrest without Warrant" is triggered by an incident and itself can be the trigger to multiple activities, as illustrated in the output (Exhibit 25).

Arrest without Warrant

Business Process	**Investigation**
Subsequent Activities	**Prosecution Charging Decision, Booking, Open Court Case, Transport Subject to Court, Status Review, Capture**
Associated Services	**Arrest Reporting Service**
Triggering Activities: • **Incident**	

Exhibit 25. Example Output

Operational View Findings

- Due to its features of loose coupling and platform independence, SOA is becoming the preferred and more suitable architectural style for information interoperability. (Zanuz, Barcelos, Filippetto, & Pinto, 2008) (Ziemann, 2010) (Ziemann, 2010)
- The three archetypal patterns of Events, Requests, and Query produce a consistent structure to describe a jurisdiction's set of justice information exchanges or national reference exchanges.
- The exchanges in the architecture fit very well into the NJDA's graphical depictions, archetypal patterns, and metamodel. Exchanges are expressed within a taxonomy that includes agencies, lines of business, activities, documents, and services. While these are all within the justice domain, stakeholders can readily expand the framework to additional domains.
- Each level of the taxonomy has associated metadata to produce a consistent, understandable description of the business, document, and service components.
- As much as possible, components in the architecture are described and united by graphical models using tools based on standards such as Business Process Modeling Notation language and Unified Modeling Language.
- Operational metrics, performance measures, and key indicators are needed in the architecture metamodel to assist jurisdictions in determining the relative value of exchanges and how information sharing addresses business challenges.
- Gaps exist in the corrections, supervision, and community services areas that need more subject matter expertise and research to resolve and close.

Operational View Recommendations

1. Develop a logical enterprise-level graphical representation of the NIEM model to establish a visual representation and ensure the integrity and coherency of the model, with the "Type" elements in the justice domain being the likely input.
2. Create guidelines on how to develop Business Information Exchange Components, including samples that align with the NJDA Business Reference Models. These would be the initial high-level data models of a national Information Reference Architecture.

3. NIEM: Assess and update the model definitions to eliminate tautological definitions and create more accurate business definitions.
4. NIEM: Assess the model for new capabilities or techniques to include external standards (e.g., HL7, NENA) and nonstructured data (images, voice, and video) to support the "super-standard" concept as proposed by APCO/NENA.
5. NIEM IEPDs: Perform a quality assessment and report of the NIEM Clearinghouse IEPDs to confirm currency, accuracy, and compliance.
6. NIEM IEPDs: Expand the meta-model to include the NJDA and add to the search capabilities of the clearinghouse.
7. GRA SSPs: Evaluate the published GRA service specifications and determine if refactoring is needed.

Design View

The Design View questions (Exhibit 26) address the technological infrastructure needed to support information sharing and are of interest to Technical Managers. Exhibit 26 provides a set of questions intended to be addressed by the Design View.

Design View Questions	NJDA Implementation Status	NJDA Additional Recommended Capabilities/Comments
What is the typical state of implementation of supporting technology at the state and local levels of government?	***The framework does not include a comprehensive state and local level perspective.***	Add a state and local perspective to the tool.
What networks and other national technology infrastructure elements are in place to support information sharing?	These are described in the tool.	These would be an ongoing task as networks and technologies mature.
What technical principles can inform choices of technology provisioning strategy (e.g., cloud or shared services)?	***The framework does not address provisioning strategies and principles.***	Add provisioning strategies to the framework. Would need to adapt it.
Where are the gaps in what the Operational and Planning Views require?	These would be identified through subject matter expert review.	Affirm and adapt the framework.

Exhibit 26. Design View Questions

Stakeholders can answer the Design View questions with content to be provided through user contributions and ongoing collection of information as technologies emerge and mature and as principles change and evolve. With respect to gaps in the Operational and Planning views (Question 4), researchers identified high-level gaps in the corrections, community supervision, and health services areas.

These questions are not completely answered by the Design View, as the view was addressing the interests of web service designers and software developers rather than the supporting technologies. Examples of questions that the Design View can answer are:

- "What set of services are needed to support the Issuance and Serving of a Warrant?"

- "What are the methodologies and guidelines to identify and decompose services?"
- "What service specifications exist for services to support Court Case Filing?"

Design View Findings

- The GRA provides valuable guidance that aligns with the archetypes and provides sufficient detail to develop consistent, interoperable service designs.
- The data architecture tool is robust and communicates "traceability" from business problems and evidence to data. This approach was used to develop the research tool used by the project.
- Identifying archetypes for data exchanges leads to a simplified data architecture that can focus on key justice information objects like arrests, incidents, and dispositions. Stakeholders can use three basic information flow archetypes to describe nearly all information flows in the justice system. These archetypes recast prior concepts like "push," "pull," "publish," "subscribe," etc. to a more service oriented model. These archetypes are:

  Events: In the event-driven service interaction flow archetype, the information exchange begins with the occurrence of a real-world business event that is either citizen-initiated (e.g., an arrest) or procedural (e.g., sentencing). The composite (intermediary) response under this archetype represents the enterprise response or "handling" of this event, which generally involves orchestrating individual component (responding entity) responses. Note that the component response can also trigger a subsequent event that would follow the same flow.

  Requests: In the request-driven service interaction flow archetype, the information exchange begins with a practitioner's request for procedural action (e.g., requesting a warrant) or for some change in the state of the world (e.g., updating status of compliance with an offender's terms of sentence). The composite (intermediary) response under this archetype, much like the composite response in the event-driven archetype, represents the enterprise response or handling of the request. Note that the component response can also trigger a subsequent event. Resources like the GRA and NIEM provide useful guidance that aligns with the archetypes, but there are insufficient guidelines and specifications to develop orchestrated service design.

  Queries: In the query-driven service interaction flow archetype, the information exchange begins with a practitioner's or citizen's desire to know information about the state or history of the justice system (including events that occurred and any responses to those events). The composite response under this archetype represents the enterprise effort to gather the

requested information from one or more component data sources and assemble the component responses into a single, enterprise response to the requester.

- Portals with single sign-on and federated capabilities — such as RISSNET,[38] Pennsylvania's JNET,[39] and Vermont's Justice Information Sharing System (VJISS) Portal[40] — are increasingly being used to simplify user authentication and management.
- The PSAP/CAD/RMS industry is rapidly adopting unstructured, nontext technologies into their solutions, thereby rendering a data-rich source of incident information (voice, images, and video).
- REST/JSON[41] is increasingly being adopted as a technology to represent and exchange information; it is not yet fully supported in the justice data architecture. However, Global is working to include these in the standards.

Design View Recommendations

1. Perform a gap analysis on an LoB-by-LoB basis to determine the services needed to support the Business and Information Reference Models.
2. Create profile specifications that incorporate Security Assertion Markup Language (SAML), GFIPM, and eXtensible Access Control Markup Language (XACML) elements in tiered levels of security, identity, and information assurance.
3. Develop a multi-layer framework that includes NIEM and GFIPM elements and possible security aspects such as SAML or Trustmark that equals and satisfies FBI Criminal Justice Information Services (CJIS) Security requirements for Internet and public message transport. These could be the foundation for a NJDA Security Reference Model.
4. Establish an ongoing committee to evaluate open source solutions, SOA deployment practices, model-driven tools, cloud services, and emerging technologies, and make recommendations on inclusion or relationships with the NJDA Technology Reference Model. The intent is to strengthen enabling assets and resources to increase the ease of information sharing deployment.
5. Develop a Security Reference Model, possibly using the National Institute of Standards and Technology's (NIST) *A Framework for Improving Critical Infrastructure Cybersecurity* (February 2014).

[38] https://www.riss.net/
[39] http://www.portal.state.pa.us/portal/server.pt/community/jnet_internet
[40] http://www.ojbc.org/files/VermontOJBCspotlight.pdf
[41] Representational State Transfer/JavaScript Object Notation.

Summary of Views Analysis

A key premise of the data architecture is that it useful and valuable to practitioners concerned with developing an enterprise view of the justice system. Researchers divided practitioners into three groups and developed separate views of the architecture to address the needs and requirements of these groups. To assess the benefits of the architecture to these groups, researchers posed and evaluated questions germane to each group at the outset of the project: seven questions under the Planning View, nine questions under the Operational View, and four questions under the Design View. Exhibit 27 summarizes the ability of the framework to address these questions.

View	Number of Questions	Number of Questions the Framework Addresses	Percentage Addressed
Planning	7	5	71.5%
Operational	9	7	77.7%
Design	4	2	50.0%
Total	20	14	70.0%

Exhibit 27. Summary of Research Questions

The framework was able to collect information that pertains to and provides a means to evaluate 14 of the 20 reference questions posed — or 70%. This represents a reasonable degree of utility of the framework to meet real-world needs. This research identified other questions that stakeholders can address using the tool's query capabilities. For example:

- "What are the agencies that receive or send Arrest Reports?"
- "What documents are involved in moving subjects between jails and courts?"
- "What service capabilities should a Court provide to be fully web-enabled for electronic receipt of any court document?"

The framework consists of:

- 449 Content Pages
- 78 Semantic Properties for Query
- 24 Agencies
- 73 Activities
- 152 Documents

The Adult Felony Reference Model provided baseline data on exchanges that were incorporated into the NJDA. The NJDA documents a total of 680 exchanges, yet less than 10% are represented by existing national standards, although several states have published suites of IEPDs that could be adapted into national standards [42]

[42] The California DOJ published 44 IEPDs in 2008–09 under their Data Exchange Project. The Texas Department of Public Safety published 28 IEPDs in 2007–08 under their "Path to NIEM" project.

Implications for Further Research

The implications discussion is organized by NJDA Views within the tool, and expanded upon in the following recommendations. The associated recommendations represent proposed activities for the upcoming year in collaboration with the National Institute of Justice (NIJ). SEARCH previously reported the following preliminary findings, which continue to be valid based on continued research:

The following represents proposed activities to be undertaken with appropriate collaboration partners to extend the NJDA Framework and expand the content.

Extending the NJDA Framework Taxonomy

The framework consists of a taxonomy structure with each level having a set of metadata, except for the first level:

- Domain/Line of Business/Activity/Document/Service

In this manner, a service, e.g., Arrest Reporting Service, is categorized thusly:

- *Criminal Justice/Investigation/Arrest without Warrant/Arrest Report/Arrest Reporting Service*

This taxonomy serves the Operational and Design Views but lacks support for the Planning View. The framework could be extended with an additional taxonomy, such as the "Line of Business" level connecting the two taxonomies (conceptual):

- Domain/Line of Business/Challenges/Programs/Evidence-Based Research

In this manner, research could be categorized with metadata about metrics and performance results.

Adding a state and local perspective would likely require a change to the framework by adding a level between "Domain" and "Line of Business" to (conceptual):

- Domain/Jurisdiction/Line of Business/Activity/Document/Service

Users could extend the framework to support Security, Identity, and Policy, either through a separate taxonomy and/or metadata. For example, they could extend the document category metadata with security considerations, or the service category metadata with policy considerations.

Based on metadata, query development is preliminary and basic. If the metadata is considered adequate, users can quickly develop extensive queries, but requirements for "What questions are to be answered?" is needed. If the metadata does not support those questions, users can extend the metadata by adding metadata elements or adding values to existing elements.

Developing Business Information Exchange Components into the framework would introduce another level of semantic capabilities to the information model.

Expanding the NJDA Content

***Corrections**:* The corrections and supervision activities need additional subject matter expertise to affirm and adapt the business process models, activities, documents, and services. This represents a discovery gap in the research materials for authoritative information. California and Colorado are implementing comprehensive offender management systems that might provide input to creating reference SSPs and IEPDs that align with emerging reforms in corrections. Emerging corrections reforms are making distinctions between jail and prisons (Hall, 2006) (Schlanger, 2003) that could argue for a separate line of business between detention and incarceration.

***Health/Mental Health**:* The recommendations that came out of *Aligning Justice to Health Priority Exchanges Task Team Final Report, 2014* could begin the expansion by adding a health and human services domain:

- Health and Health Services/Line of Business/Activity/Document/Service

Semantically connecting a Health and Human Services domain to the Criminal Justice domain would likely come through the "Triggering" and "Subsequent" activities property of "Activity" and the "Sending" and "Receiving" agency property of a "Document." This may also encompass expanding into health interoperability standards, such as the Electronic Health Record (EHR), Emergency Responder Electronic Health Record (ER-EHR), and the Medication Management Interoperability Specification (MISP).

***Incident/Emergency Management**:* The National Incident Management System extensively documents organizations, processes, and information to plan, prepare, respond, recover, and mitigate all-hazard incidents and disasters. The associated five plans would easily translate to the framework and taxonomy, as they are similarly structured with organizations, activities, processes, and information. The metadata of the taxonomy would likely need to reflect the emergency management/first responder community rather than law enforcement.

***Governance**:* For the data architecture tool to become sustainable for extension and expansion, stakeholders would need to develop a governance plan for technical support, framework design, user administration, and content contribution and review. They would also need to develop policies regarding privacy, security, and copyrights. A working group might be considered with credentialed members from justice, health, and incident management domains.

Summary

This analysis of the Criminal Justice System's Data Architecture had two objectives:

1. A report that documents:
    - The current as-is national data architecture for information sharing among criminal justice agencies at all levels of government, and between criminal justice agencies and their partners in related domains such as first responders, health, and social services agencies;

- Any gaps or misalignments in the architecture as measured against a conceptual target; and
- Recommendations for strategy, standards, information, and technology changes necessary to close the identified gaps.

2. An information sharing framework and associated tools to capture and document the current and to-be state of a National Justice Data Architecture. This framework includes three perspectives, or "views," that address the needs of specific stakeholders based upon their role and primary responsibilities and assist in decision-making:
   - **Planning View**: Senior executives, division managers, and strategic planners to identify goals and policy initiatives and to allocate resources at the strategic level;
   - **Operational View**: Architects and business managers responsible for designing integrated justice systems and information flows at the business level;
   - **Design View**: Technology architects and developers to make decisions about service oriented technologies and technical designs at the implementation level.

In conducting research and analysis for the first objective, SEARCH determined that synthesizing aspects or elements of Enterprise Architecture (EA), Business Process Modeling (BPM), and Service Oriented Architecture (SOA) provided the best approach to represent the data architecture framework. This objective was achieved for information sharing within the justice domain, but there was a gap in sharing with nonjustice domains.

In order to complete the gap analysis, SEARCH developed a framework and tool that combined elements of EA, BPM, and SOA. SEARCH developed the tool using open source products, and it can be used to capture and document the data architectures of other domains. For the second objective, applying principles of EA was foundational to developing the data architecture framework. The objective was achieved using the available research materials and published specifications, and the framework is readily able to represent the justice data architecture.

The analysis and framework confirms that through a model-driven approach, a National Data Architecture can provide a systematic methodology to identify and create cross-agency information sharing plans that can be incrementally implemented through expanding services capabilities. Employing the principles of EA, BPM, and SOA provides justice stakeholders the agility to respond to new business needs, introduce new technologies, and more readily comply with legal and regulatory changes. The result is a well-defined, reusable set of components and services based on standards that work for all exchange partners with respect to business, information, and security requirements.

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VI. Appendices

Appendix A. Solving Problems Using the NJDA – Practical Application of the Architecture

The following discussion presents use cases to demonstrate how the NJDA assists in defining an information exchange and enabling services, and then orchestrating a set of services into a series of exchanges that support a full, interagency business process.

These are not intended to be normative but illustrative and a starting point for exchange partners to examine and adapt to their particular information assets. Also, note that this is an abbreviated set of artifacts that would be associated with each use case.

Use Case 1: Court Case Filing

District courts would like to electronically receive prosecution case and charge information in order to reduce data entry, decrease data errors, and reduce the overall time for a judge to review a case filing.

Starting with the NJDA document category, a user can find applicable documents and supporting information artifacts for the use case, such as the Bill of Information and a Charge Complaint, information models, and related service specification.

Bill of Information

Charging document that is generally used in felony proceedings

Associated Services:

- **Case Filing Service**
- **Prosecution Charging Decision Service**

Triggering Activities	Amendment of Charges, Open Court Case, Prosecution Charging Decision, Case Filing
Sending Agencies	Prosecutor
Receiving Agencies	Defense, Jail, Law Enforcement, Victim Services, Courts
Person Roles	Defendant, Prosecutor, Enforcement Official
Person Information	Name, Address, Title
Person Identifiers	AFIS, FBI, State ID (SID)
Agency Information	Name, Agency ID
Activity Information	Activity Type, Activity Date, Activity Location
Activity Identifiers	Arrest Tracking Number, Case Tracking Number, Charge Tracking Number
Case Information	
Case Identifiers	Case Tracking Number, LE RMS Case Number
Item Information	
Item Identifiers	

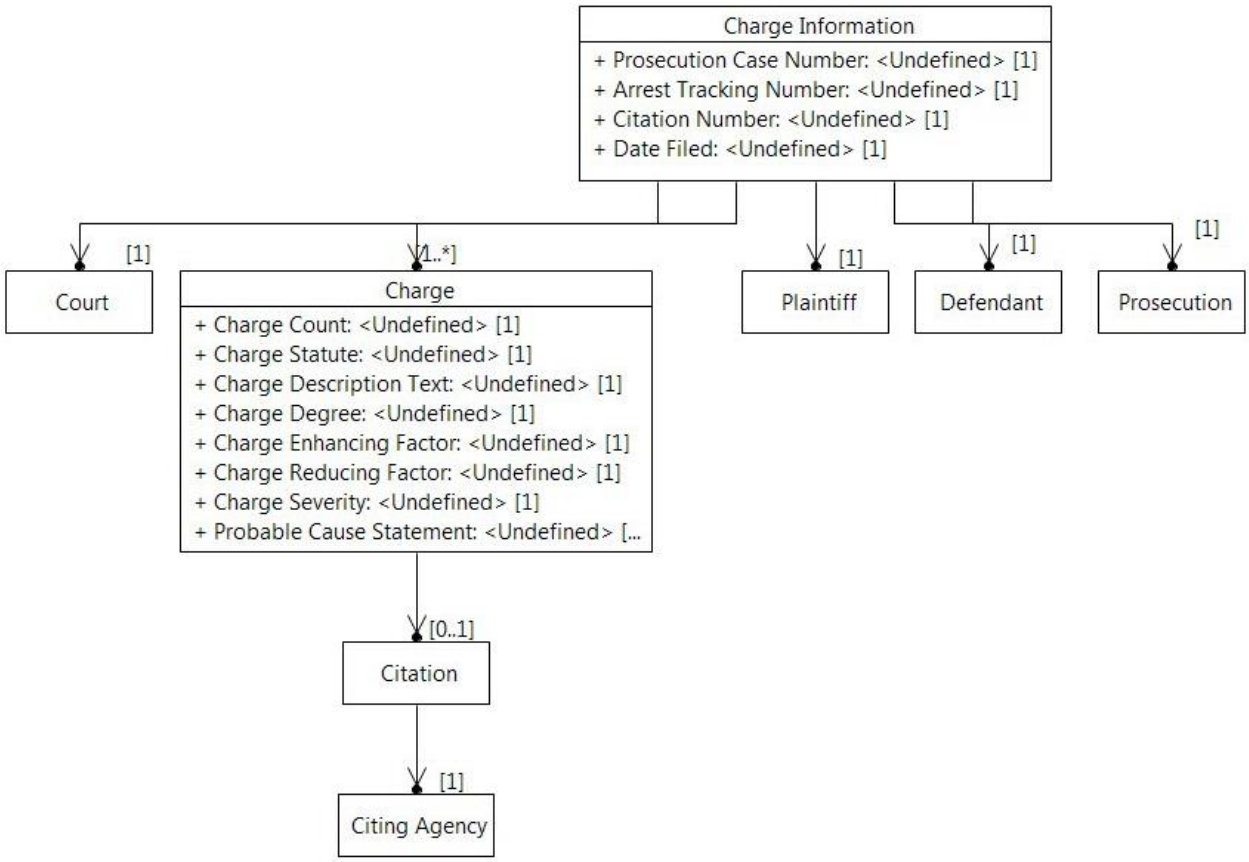
Charge Complaint

The Complaint is the formal written document identifying the criminal charge, the date and place of the incident or crime, and the circumstances of the arrest. The complaint is typically used for misdemeanors. The Complaint is sworn to and signed under oath by the complainant, usually a police officer. The complaint requests that the defendant be present at an initial hearing to be held soon after the arrest is made. The initial hearing may also be referred to as an arraignment.

Associated Services:

- **Case Filing Service**
- **Charge Referral Service**

Triggering Activities	Arrest on Warrant, Arrest without Warrant, Case Filing
Sending Agencies	Law Enforcement, Prosecutor
Receiving Agencies	Prosecutor, Courts
Person Roles	Defendant, Law Enforcement Official
Person Information	Name, Address
Person Identifiers	Drivers License, Badge Number, State ID (SID)
Agency Information	Name, Agency ID
Activity Information	Activity Type, Activity Date, Activity Location
Activity Identifiers	Citation Number, Arrest Tracking Number, Incident Number, Warrant Number
Case Information	Citation Information, Incident Information, Jurisdiction, Charge, Enforcement Official
Case Identifiers	LE RMS Case Number
Item Information	
Item Identifiers	License Plate, VIN



Case Filing Service

Scope	Service provides the capability to submit case and charge information.
Real-World Effect	Case information is received for the court to determine whether sufficient cause and evidence is present to open a court case.
Associated Documents	Citation, Bill of Information, Criminal Complaint, Charge Complaint
Archetype	Request Response
Service Actions	Request
GRA or NIEM Specifications	https://it.ojp.gov/GIST/148/Charging-Service-Specification--Version-1-0

Use Case 2: Open Court Case

Prosecutors' offices would like to electronically receive the court clerk's review of the case filing documents and an indication of whether the case will proceed to a judge's case review. This will reduce data entry and increase timeliness of case processing.

Using the NJDA document category, a user can find applicable documents and supporting artifacts for the use case, such as the Court Case or Court Case Deficiency Notification, information model, and the Court Case Decision Service.

Court Case

When a court clerk reviews a prosecutor's referred case, the clerk will review the submittal and determine whether the filing is sufficient in terms of complete documentation, legibility, etc. If the filing passes the clerk's review, a case is opened and a document ID assigned.

Associated Services:

- **Court Case Decision Service**

Triggering Activities	Open Court Case, Court Case Review
Sending Agencies	Courts
Receiving Agencies	Prosecutor
Person Roles	Defendant, Prosecutor, Enforcement Official, Judicial Official, Court Clerk
Person Information	Name, Address, Title
Person Identifiers	Drivers License, SSN, Bar Number, Badge Number
Agency Information	Name, Address, Agency ID
Activity Information	
Activity Identifiers	
Case Information	Case Type, Case Status, Citation Information, Jurisdiction, Court Information, Filing Attorney, Judicial Official, Case Filing Date, Case Opened Date, Court Appearance Date
Case Identifiers	Case Document ID, Case Tracking Number
Item Information	
Item Identifiers	

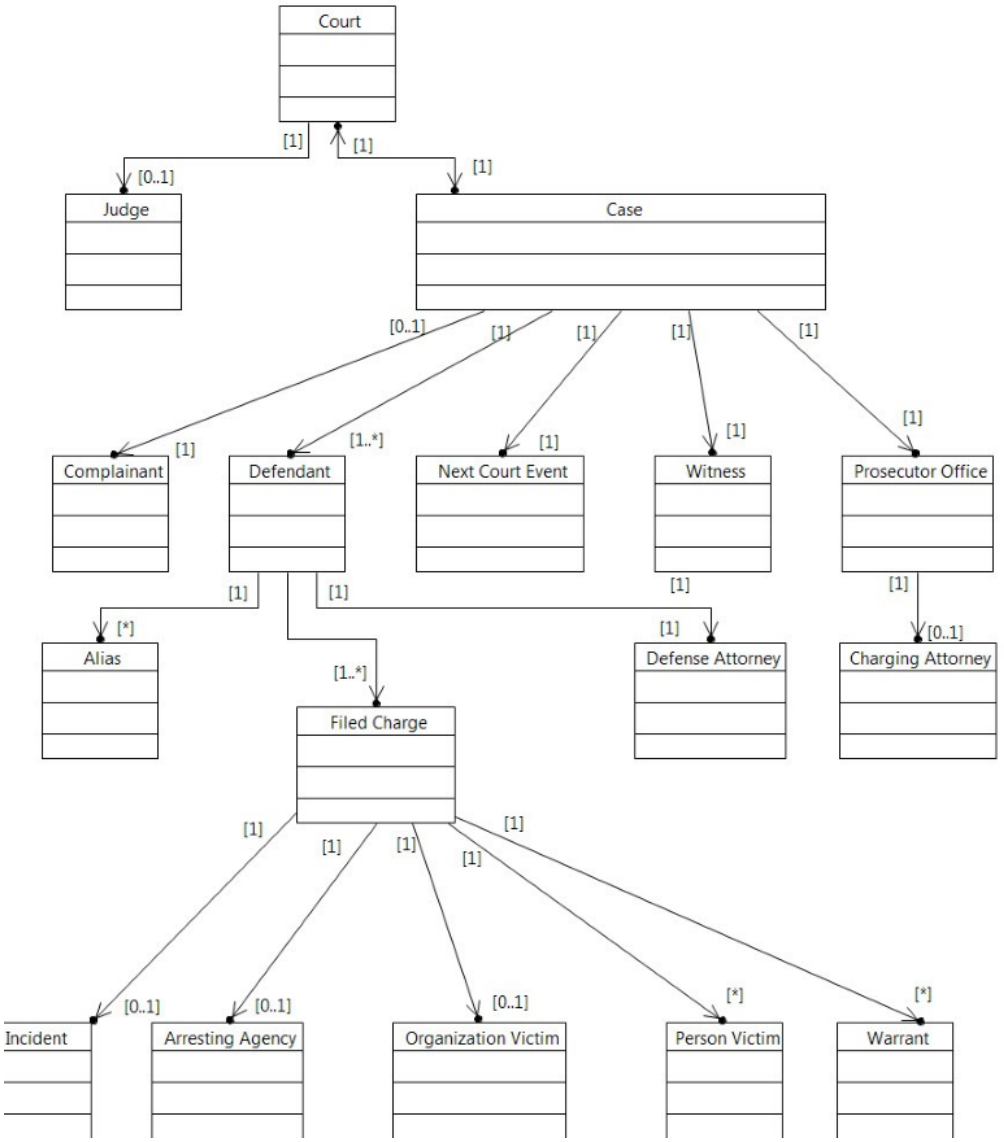
Court Case Deficiency Notification

Deficiency orders are assigned to a docket entry during quality control review by a docket clerk. The docket clerk typically issues a deficiency notification or memo as a subsequent docket entry. The entry specifies a code that corresponds to a corrective action that an attorney needs to address

Associated Services:

- **Court Case Decision Service**

Triggering Activities	Open Court Case
Sending Agencies	Courts
Receiving Agencies	Prosecutor
Person Roles	Court Clerk
Person Information	Name, Title, Contact Information
Person Identifiers	
Agency Information	Name, Agency ID, Point of Contact
Activity Information	
Activity Identifiers	
Case Information	Case Type, Case Status, Jurisdiction, Filing Attorney, Case Filing Date
Case Identifiers	Case Docket ID, Case Tracking Number, LE RMS Case Number
Item Information	
Item Identifiers	



Court Case Decision Service

Scope	Service provides the decision of the court on whether or not to open a court case in response to either a prosecutor or a Law Enforcement agency.
Real-World Effect	Prosecution and law enforcement receive the decision on whether to request to open a court case was approved or denied.
Associated Documents	Court Case Deficiency Notification, Court Case
Archetype	Request Response
Service Actions	Notify, Request
GRA or NIEM Specifications	https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=legalxml-courtfiling

Use Case 3: Charge Referral

The County law enforcement agencies and prosecutor's office would like to electronically share charge referral documents to reduce data entry for both agencies, eliminate time-consuming hand-delivery of documents by law enforcement, and speed the overall time to court case filing. The partners agree that only misdemeanor charges are within the scope of this use case.

Using the NJDA activity category, the partners use the NJDA Charge Referral activity (within the investigation process) to find applicable documents and supporting artifacts for the use case. Working together, the exchange partners agree on the following business rules for the Charge Referral information package:

- For a Cite and Release misdemeanor, only the citation is needed
- For an Arrest without Warrant misdemeanor, incident and arrest reports are needed.

The partners review the NJDA charge referral and incident service interaction models. They decide to adapt the service interaction model that accomplishes the full request-response process of submitting a charge referral and receiving the prosecutor's decision.

Charge Referral

Law enforcement receives the incident report, arrest report, and evidence, and determines what charges to submit to the prosecution.

Business Process	Investigation
Subsequent Activities	Prosecution Charging Decision
Associated Services	Incident Reporting Service

Triggering Activities:

- Incident
- Initial Identification
- Release Data Review
- Status Review

Associated Documents	Sending Agencies	Receiving Agencies
Arrest Report	Law Enforcement Diversion Providers	Defense Jail Parole Board Prosecutor State Repository Victim Services Community Supervision Courts
Criminal History Report	State Repository	Jail Law Enforcement Parole Board Prosecutor Fusion Center Courts
Disposition Reporting Form	Jail Law Enforcement Prosecutor State Administrative Office of the Courts	Law Enforcement Prosecutor State Administrative Office of the Courts State Repository Victim Services
Incident Report	Law Enforcement	Parole Board Prosecutor State Repository

Incident Report

Associated Services:

- Charge Referral Service
- Incident Reporting Service

Triggering Activities	Incident, Charge Referral
Sending Agencies	Law Enforcement
Receiving Agencies	Jail, Law Enforcement, Parole Board, Prosecutor
Person Roles	Citizen, Subject, Enforcement Official, Victim, Witness
Person Information	Name, Address, Title, Contact Information
Person Identifiers	Drivers License, Badge Number
Agency Information	Name, Address
Activity Information	Activity Type, Activity Date, Activity Location
Activity Identifiers	Citation Number, Incident Number
Case Information	Incident Information, Charge, Enforcement Official
Case Identifiers	LE RMS Case Number
Item Information	
Item Identifiers	License Plate

Arrest Report

Report produced by law enforcement that provides relevant details regarding arrest.

Associated Services:

- Arrest Reporting Service
- Charge Referral Service
- Incident Reporting Service

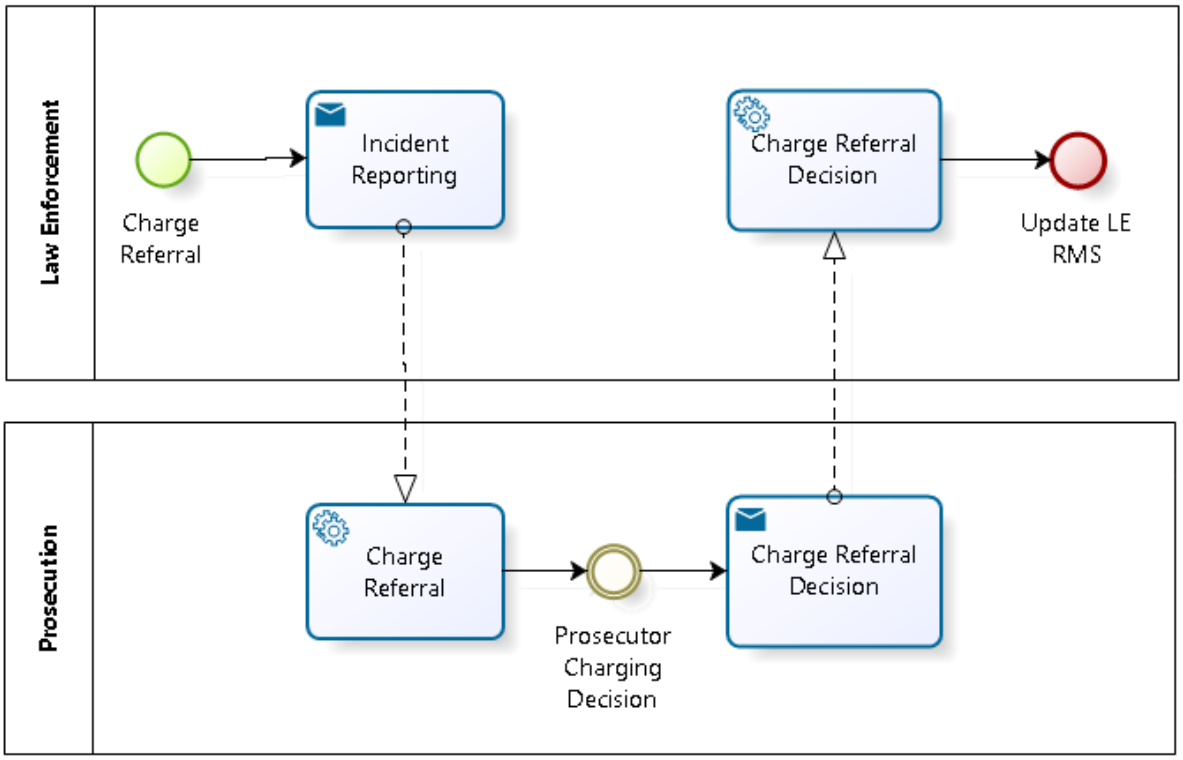
Triggering Activities	Arrest without Warrant, Charge Referral, Arrest on Warrant
Sending Agencies	Law Enforcement, Diversion Providers
Receiving Agencies	Defense, Jail, Parole Board, Prosecutor, State Repository, Victim Services, Community Supervision, Courts
Person Roles	Subject, Enforcement Official
Person Information	Name, Address
Person Identifiers	Drivers License, Badge Number
Agency Information	Agency ID
Activity Information	Activity Type, Activity Date, Activity Location
Activity Identifiers	Arrest Tracking Number
Case Information	Case Type, Citation Number, Jurisdiction, Court Information, Enforcement Official, Offense, Court Appearance Date
Case Identifiers	LE RMS Number
Item Information	
Item Identifiers	

Charge Referral Service

Scope	Service provides Law Enforcement the capability to submit incident information to prosecutor.
Real-World Effect	Prosecutor is requested to review the charges submitted by Law Enforcement and make a decision on whether to file a court case.
Associated Documents	Incident Report, Arrest Report, Citation, Charge Complaint
Archetype	Request-Response
Service Actions	Request, Notify
GRA or NIEM Specifications	

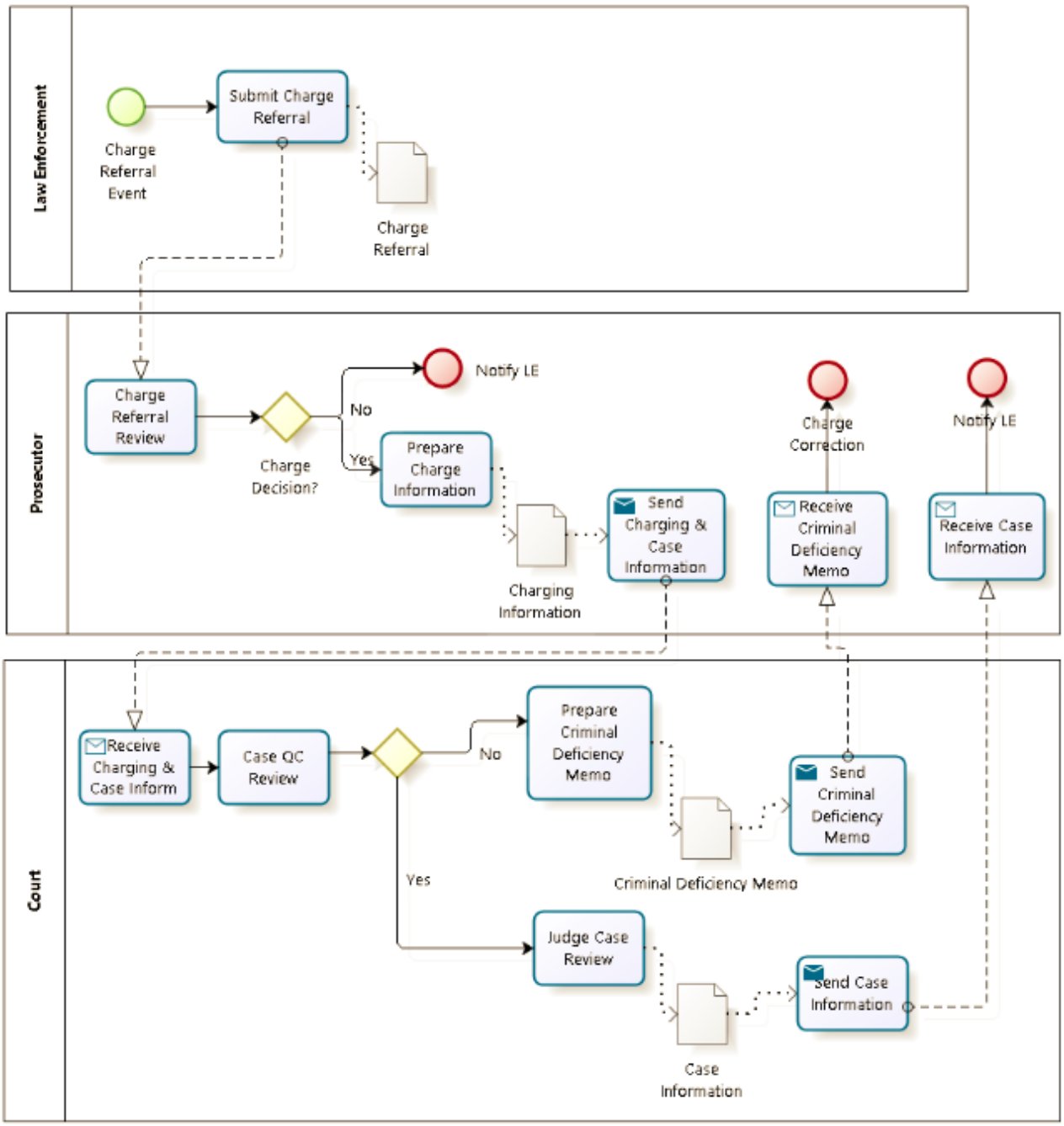
Incident Reporting Service

Scope	This service is intended to assist with automating policy response to recording of incident information. A likely consumer of this service is any agency able to issue incident reports, most likely law enforcement agencies. The Incident Reporting Service is limited to reporting details of new and updated incidents.
Real-World Effect	The consumer will have submitted an incident report and initiated the policy response for incident reporting.
Associated Documents	Incident Report, Missing Person
Archetype	Event
Service Actions	Modify, Submit
GRA or NIEM Specifications	https://www.fbi.gov/about-us/cjis/n-dex



Use Case 4: Business Scenario – Electronic Court Case Filing (e-Filing)

A decentralized county court system currently receives more than 30,000 court case charge filings a week. Court caseloads have been increasing annually by 3–10% in their nine court divisions (e.g., civil, criminal, family law). Court and prosecution data entry costs are increasing, data accuracy is decreasing, case filing time is lengthening, and there is frequent data loss. Additionally, the court is out of full legislative compliance with providing public access to court cases and case information within 30 days of filing.



Use Case 5: Planning

The senior stakeholders who have an interest in the outcomes hold initial discussions to establish the project. The stakeholders agree to initiate an Electronic Court Case Filing information sharing project between the superior court case management system (CMS), the district court's CMS, and the prosecuting office's CMS. The NJDA presents the following questions for senior leadership to consider, answer, and document:

- What policy objectives do we seek to achieve with information sharing?
- What current business challenges does the justice community face, and how can we address those problems with information sharing?
- What risks are inherent in information sharing, and how do we mitigate those risks?
- What governance models are in place to establish ownership and control over information and information exchanges?
- Are there principles to determine who should provision and control information and exchanges?
- What strategic plans exist currently, and what is the progress toward those plans? How do jurisdictions and agencies align with those plans?
- Who is — or should be — exchanging information?
- What are the measures of success?
- What mechanisms are available to fund justice information exchange development and maintenance?

The NJDA Planning view helps document the outcome of planning activities by providing planners reference material to develop the Performance Measures (PRM) and to contribute to areas of the Business Reference Model (BRM) and the Security Reference Model (SRM).

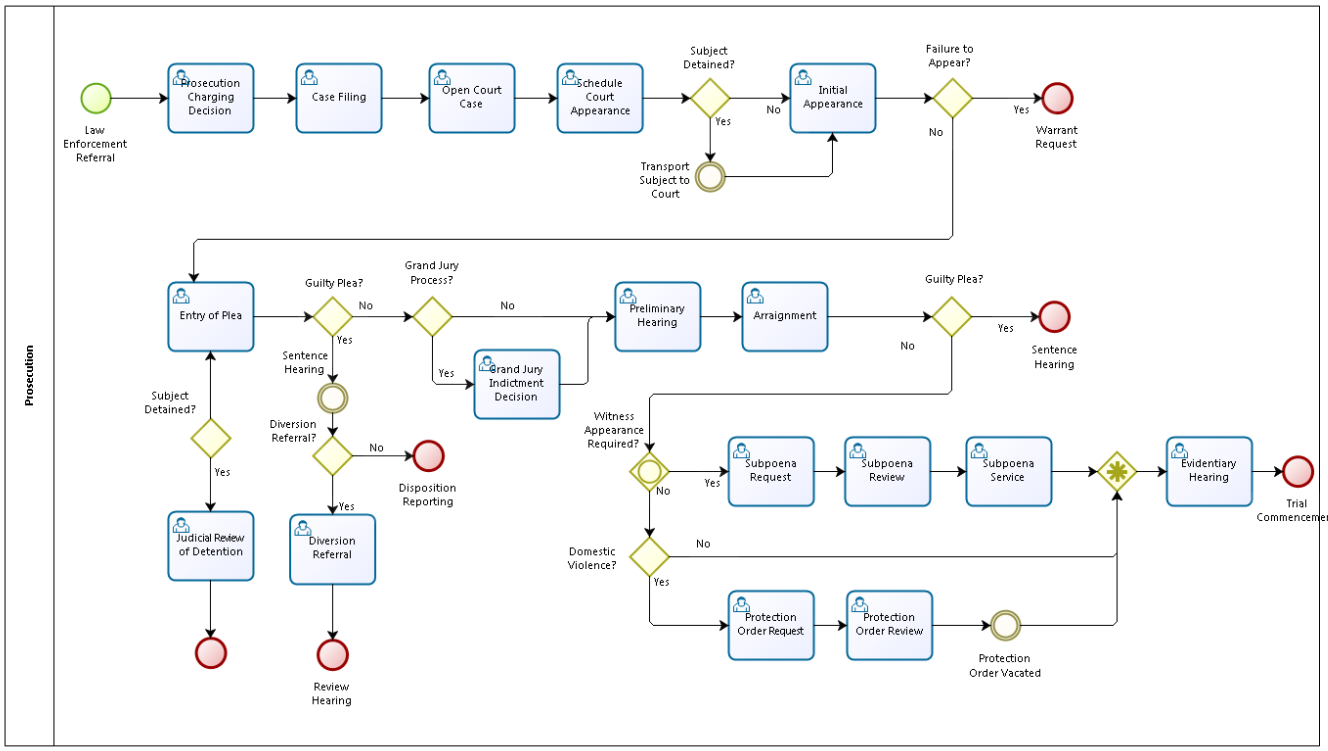
PRM: Performance measures are statements of objectives that have accompanying measurements and timelines, and are associated with a line of business. Within an information sharing initiative, all exchange partners should jointly develop these. Agency strategic plans are good sources to identify goals and objectives that exchange partners share; they can use these as input for performance measures. For this business scenario, a partial list could take the form of:

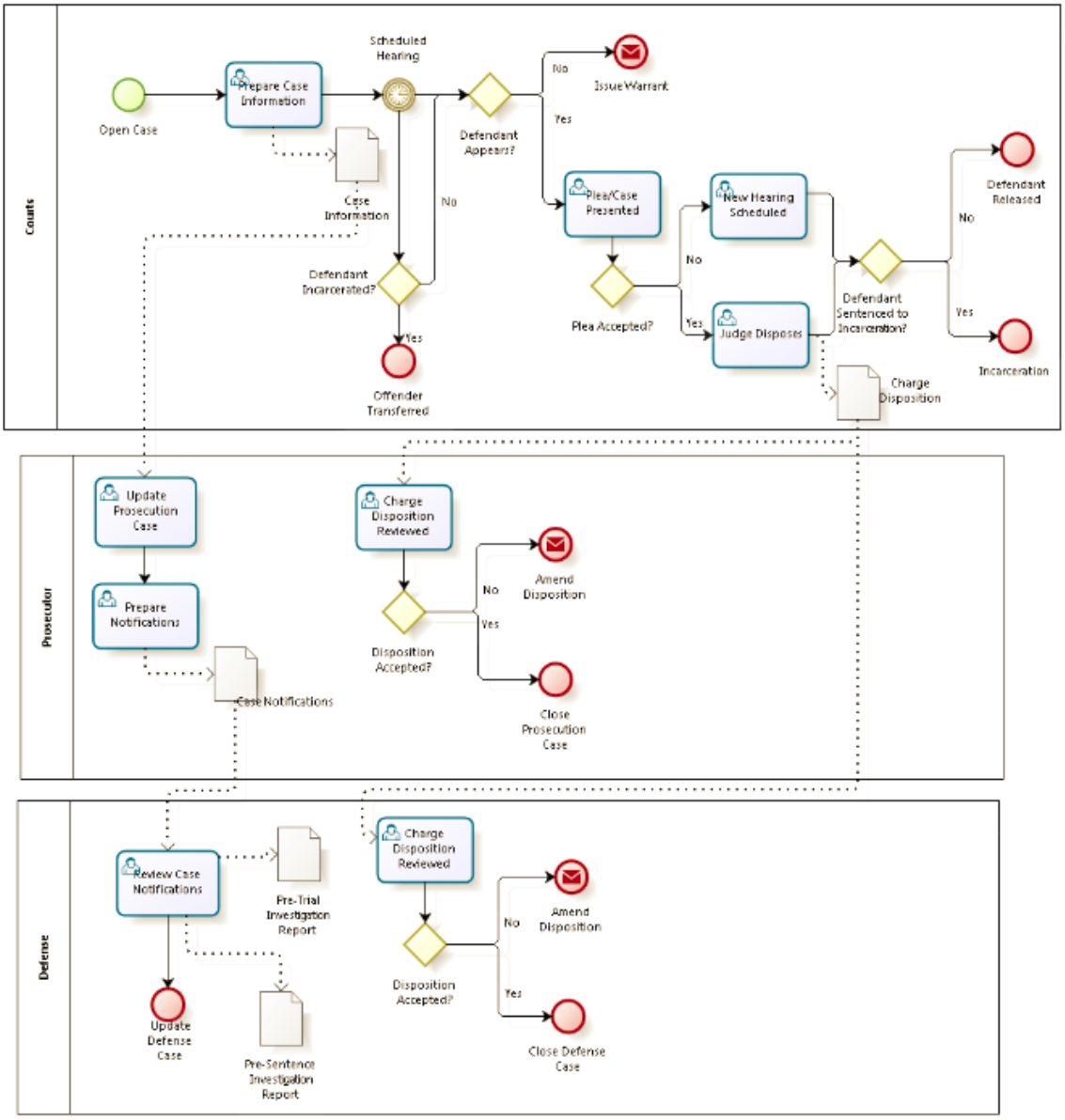
- "By 2Q16, district courts will be able to complete civil, traffic, family, and probate case filing reviews and notifications within 5 business days of prosecution case referral submission.
- By 3Q16, district courts will be able to complete criminal and appellate case filing reviews and notifications within 10 business days of prosecution case referral submission.
- By 4Q16, all appropriate cases, case information, and case updates will be available for public access within 48 hours of being updated in the court systems.
- By 1Q17, electronic information and data audits will be in place to eliminate data loss and ensure data consistency."

These are the incentives that subsequently determine what business capabilities that stakeholders need to develop or improve to meet the performance objectives. The NJDA

is developing evidence-based research content to help identify proven performance measurements.

BRM: The NJDA provides line of business (LoB) functional models from various views and levels. For example, the "Prosecution Line of Business" is a single agency view, while the Court Case Interaction Process is a cross-agency view of the performed functions.





For this business scenario, a partial list of business capabilities may specify that:

- "A district court CMS can accept a complaint for a civil case from a prosecution CMS.
- A district court CMS can accept a bill of information for a criminal case from a prosecution CMS.
- A superior court CMS can accept a civil case from a district court CMS.
- A superior court CMS can accept a criminal case from a district court CMS.
- A district court can accept a 'case accepted' notification from a superior court.
- A prosecution CMS can receive a notice of the outcome from a court case filing."

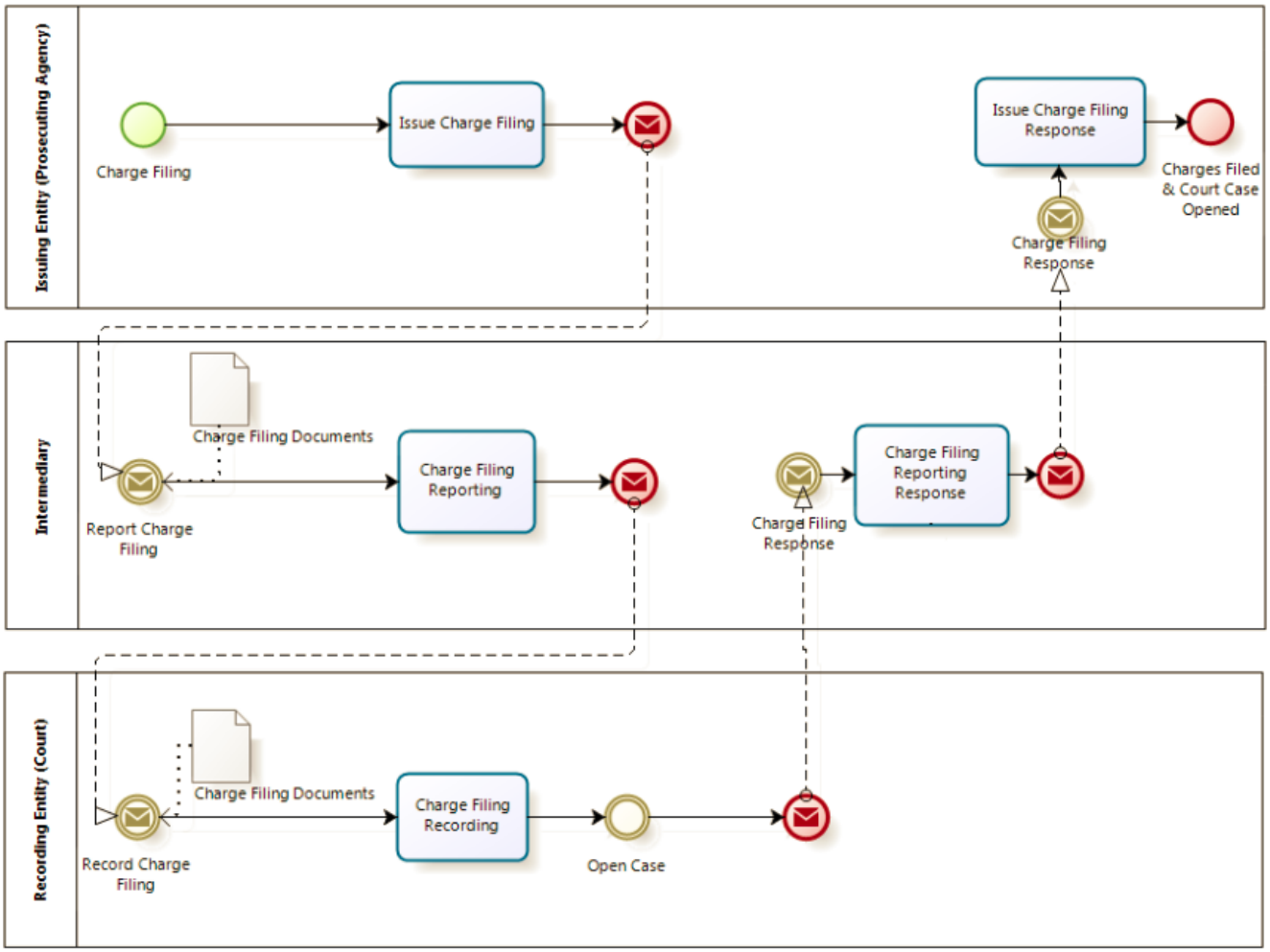
SRM: Within an information sharing initiative, the security reference model is concerned with protecting data assets from perspectives of access, usage, confidentiality, and accountability at every layer of the exchange.

Use Case 6: Operational Assessment and Requirements

Operational business managers, IT development managers, and architects complete the Business Reference Models and the Information Reference Model. The NJDA presents the following questions, which these managers and architectures should consider, answer, and document:

- What systems typically capture or record information about the business functions?
- What are the detailed business processes of the business functions?
- What is the content (structure and meaning) of the exchanged information?
- What is the quality level of the available data assets?
- What "nonfunctional" requirements apply to each exchange?
- Do any existing specifications map into the requirements, or are there any applicable reference specifications?
- Is there a rational sequence of deploying the exchanges that provide incremental benefit?

BRM: The business capability statements in the BRM are more completely documented in refined and exchange partner-specific business process models, preferably in standardized languages such as Business Process Notation Language. The NJDA helps develop these models by providing decomposed business process models, information models, and agency data flows. The following charge filing process diagram is an example of the decomposition of the case charge filing interaction, which provides input into the web service design and orchestration. Stakeholders should prepare as many models as needed to document all the business exchange capabilities. It is not necessarily needed to document the agency's internal business activities, but reviewing those processes could expose opportunities for different or more effective information exchange points. The business models depict the information to be shared or exchanged, which is the input to the Information Reference Model.



IRM: The information reference models are the core of an information exchange environment. They contain source data models, information exchange models, target data models, information orchestration, data quality, and applicable data technology standards. The starting point for the IRM is: What documents or messages are to be shared or exchanged? In this scenario, charge filing and prosecution case information is to be shared. The NJDA uses both description information and class diagrams from published specifications from NIEM or the GRA, depicted in the following illustration for a Bill of Information. Stakeholders can assemble and refine these to assist in developing the IRM.

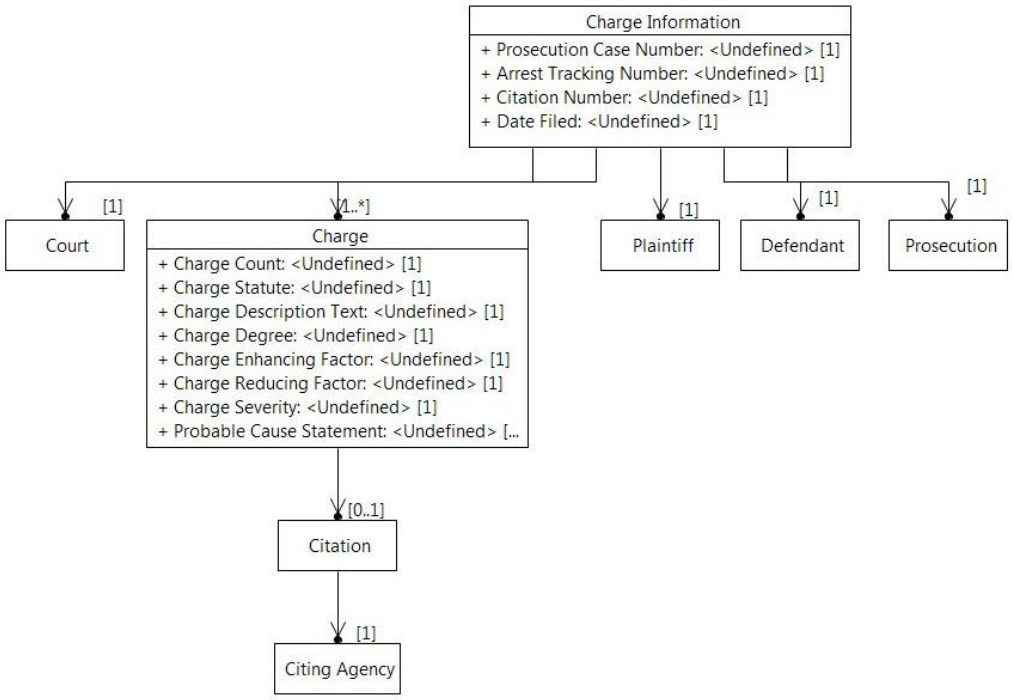
Bill of Information

Charging document that is generally used in felony proceedings

Associated Services:

- Case Filing Service
- Prosecution Charging Decision Service

Triggering Activities	Amendment of Charges, Open Court Case, Prosecution Charging Decision, Case Filing
Sending Agencies	Prosecutor
Receiving Agencies	Defense, Jail, Law Enforcement, Victim Services, Courts
Person Roles	Defendant, Prosecutor, Enforcement Official
Person Information	Name, Address, Title
Person Identifiers	AFIS, FBI, State ID (SID)
Agency Information	Name, Agency ID
Activity Information	Activity Type, Activity Date, Activity Location
Activity Identifiers	Arrest Tracking Number, Case Tracking Number, Charge Tracking Number
Case Information	
Case Identifiers	Case Tracking Number, LE RMS Case Number
Item Information	
Item Identifiers	



Use Case 7: Service Assessment and Design

IT development managers, SOA architects, and SOA teams complete the Application Reference Models and the Information Reference Model. The NJDA presents the following questions, which these managers and architects should consider, answer, and document:

- What is the typical state of implementation of supporting technology within the information sharing partners?
- What networks and other technology infrastructure elements are in place to support information sharing?
- Where are there gaps in what the operational and planning views require?

The NJDA provides summary reference information on published service specifications; in this scenario, these are the Case Filing Service and the Court Case Decision Service. These two services achieve and are traceable back to the business requirements of:

- A district court CMS can accept a complaint for a civil case from a prosecution CMS.
- A district court CMS can accept a bill of information for a criminal case from a prosecution CMS.
- A prosecution CMS can receive a notice of the outcome from a court case filing.

Case Filing Service

Scope	Service provides the capability to submit case and charge information.
Real-World Effect	Case information is received for the court to determine whether sufficient cause and evidence is present to open a court case.
Associated Documents	Citation, Bill of Information, Criminal Complaint
Archetype	Request-Response
Service Actions	Request
GRA or NIEM Specifications	https://it.ojp.gov/GIST/148/Charging-Service-Specification--Version-1-0

Court Case Decision Service

Scope	Service provides the decision of the court on whether or not to open a court case in response to either a prosecutor or a Law Enforcement agency.
Real-World Effect	Prosecution and law enforcement receive the decision on whether to request to open a court case was approved or denied.
Associated Documents	Court Case Deficiency Notification
Archetype	Request-Response
Service Actions	Notify, Request
GRA or NIEM Specifications	https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=legalxml-courtfiling

Appendix B. Links to Federal and State Enterprise Architecture Sites

Federal Government:	https://www.whitehouse.gov/omb/e-gov/FEA
Arizona:	https://aset.az.gov/strategy/enterprise-architecture http://www.azcourts.gov/
California:	http://www.cio.ca.gov/ea/
Colorado:	http://www.oit.state.co.us/cto/ea
Kentucky:	http://technology.ky.gov/Governance/Pages/KITS.aspx
Michigan:	http://www.michigan.gov/dtmb/0,5552,7-150-56355_56580---,00.html
North Dakota:	http://www.nd.gov/itd/services/enterprise-architecture
Oregon:	http://www.oregon.gov/DAS/CIO/ITIP/pages/pol_arch_overview.aspx
Virginia:	http://www.vita.virginia.gov/oversight/default.aspx?id=349