



**IJIS Institute**

**NATIONAL INFORMATION EXCHANGE MODEL  
UNIFIED MODELING LANGUAGE  
(NIEM-UML) RECOMMENDATION**



*IJIS Institute*

**IJIS Technical Advisory  
Committee (I-TAC)**

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## OVERVIEW

This white paper is a recommendation of the IJIS Technical Advisory Committee (I-TAC)<sup>1</sup> on the policies, implementation, and use of the NIEM-UML<sup>2</sup> specification recently adopted by the [Object Management Group \(OMG\)](#)<sup>3</sup>.

As will be discussed in more detail below, NIEM-UML leverages both NIEM and UML to provide high-level and business-focused models of information exchange information that is then used to generate NIEM technical specifications based on the OMG's Model Driven Architecture (MDA) standards.

*I-TAC recommends that organizations consider using NIEM-UML for current and future information exchange projects. It is our consensus opinion that NIEM-UML and other MDA standards have the potential to enhance information sharing and exchange.*

### **About NIEM**

The National Information Exchange Model (NIEM)<sup>4</sup> is a well-established U.S. sponsored program and community for standardized information exchange. The NIEM Program is sponsored by the Department of Homeland Security (DHS), Department of Health and Human Services (HHS), and the Department of Justice (DOJ).

### **About MDA and the UML**

The OMG's MDA vision and standards provide an approach for deriving value from models and architecture in support of the full life cycle of physical, organizational, and IT systems. The MDA approach represents and supports everything from requirements to business modeling to technology implementations. By using MDA models, practitioners are able to better deal with the complexity of large systems and the interaction and collaboration between organizations, people, and computer software.

The primary feature of MDA that enables stakeholders to deal with complexity and derive value from models and modeling is defining the structure, semantics, and diagrammatic notations of models using industry standards. These well-defined models can then be used for the production of documentation, acquisition specifications, system specifications, technology artifacts (*e.g.* "source code"), and executable systems.

The use of MDA can improve planning and design processes, as well as make the results of planning and design more agile, actionable, and maintainable. These features are due, in part, to the ability to employ automation to help relate plans and designs, represented as models, to the capabilities and technologies that help implement those plans and designs in system solutions.

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<sup>1</sup> A fully defined list of acronyms and abbreviations are included in the [Reference Material](#) section of this document.

<sup>2</sup> For more information about the NIEM-UML specification, visit: [http://www.omg.org/spec/NIEM\\_UML/](http://www.omg.org/spec/NIEM_UML/); or, the industry-supported website: <http://www.niem-uml.org>

<sup>3</sup> For more information about OMB, visit: <http://www.omg.org>

<sup>4</sup> For more information about NIEM, visit: <http://www.niem.gov>

UML is a key component the OMG MDA modeling standards. UML is most widely known for object-oriented class modeling but also includes other capabilities such as business process modeling using activity diagrams, systems modeling, information modeling, and services modeling. As a very general modeling language, UML often needs to be tailored for a specific purpose. The ability to “profile” UML is a built-in capability. Multiple UML profiles exist for many purposes, including the modeling of NIEM information exchanges.

### ***About NIEM-UML***

The NIEM-UML standard leverages UML and the MDA standards of the OMG to define a model-based representation for NIEM with a mapping to and from the technology-focused NIEM XML schema and packaging representations. The intent of NIEM-UML is to simplify NIEM, reduce the barrier to entry, utilize industry best practices and tools, allow for other technologies to be used with NIEM, and reduce the time and cost of defining and implementing information sharing solutions. NIEM-UML is defined as a “profile” of the UML with the capability of generating and reverse-engineering the XML specific representations of NIEM based on the normative NIEM specifications [*e.g.* Naming and Design Rules (NDR) / Model Package Description (MPD) Specification]. As a design requirement of the NIEM-UML profile, no changes were made to the existing NIEM or UML specifications.

NIEM-UML was adopted as a beta specification<sup>5</sup> by OMG in 2012. Publication of the final NIEM-UML specification is expected in fall 2013.

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<sup>5</sup> A beta specification allows for minor changes based on implementation experience.

## ANALYSIS

I-TAC members have evaluated NIEM-UML with respect to the needs of the NIEM community, including government organizations, non-governmental organizations, practitioners, tool vendors and service providers. This analysis included:

- A detailed review of the NIEM-UML specification
- Evaluation of available tools, resources and industry support
- Usage of tools implementing the NIEM-UML specification
- Implementation of the specification in UML tools
- Pilot projects

### Findings

The following represent the consensus position of I-TAC.

#### **NIEM-UML accurately represents NIEM.**

A requirement of NIEM-UML was that it be able to completely and accurately represent NIEM – both the data model and XML representation. The NIEM-XML representation and information exchange packaging guidelines are documented in the NDR Specification<sup>6</sup>, MPD Specification<sup>7</sup>, and the NIEM Conformance guide<sup>8</sup>. These pre-existing specifications define NIEM in terms of XML technology standards—in particular, XML schema—as defined by the World Wide Web Consortium (W3C)<sup>9</sup>.

Using a variety of test cases, it was verified that NIEM-UML tools were able to both read existing NIEM-XML based models into UML and to produce conformant NIEM-XML artifacts from NIEM-UML models. Producing conformant NIEM-XML artifacts requires that the model be correctly constructed in NIEM-UML.

*The importance of a tool’s ability to produce conformant NIEM XML artifacts should not be overlooked. Producing conformant NIEM XML specifications can be a difficult and time-consuming process requiring detailed and specific NIEM and XML Schema Definition (XSD) experience. Being able to automatically produce conformant specifications from models using tools with built-in validation rules provides a substantial benefit.*

In this evaluation, there were some exceptions noted. Some issues in the tooling were identified, most of which have been fixed; and, some capabilities used by some NIEM practitioners were not covered by the specification or tools. This is primarily the use of “constraint schema,” a NIEM-specific construct used by some, but not all, practitioners. Issues have been raised in the OMG process to request that these capabilities be addressed in the next maintenance release. The capabilities covered by the NIEM-UML specification functioned well when importing and generating NIEM Information Exchange Package Documentation (IEPD).

<sup>6</sup> <https://www.niem.gov/documentsdb/Documents/Technical/NIEM-NDR-1-3.pdf>

<sup>7</sup> <http://reference.niem.gov/niem/specification/model-package-description/1.0/model-package-description-1.0.pdf>

<sup>8</sup> <reference.niem.gov/niem/specification/conformance/1.0/conformance-1.0.pdf>

<sup>9</sup> For more information about W3C, visit: <http://www.w3.org/>

### **High-quality UML tooling and expertise is widely available.**

UML is a well-known and well-established standard. There is a large selection of quality commercial and open source UML tools that implement this standard. Complementing the tools is a wide assortment of training, books, certifications, and technical support. Many practitioners and business stakeholders have experience with UML. UML can be considered industry common practice.

NIEM-UML is a specific way to leverage UML through use of a *profile*<sup>10</sup> and automation to generate and reverse-engineer NIEM-conformant MPD (*i.e.* IEPD) artifacts. While UML is widely available there is, as of this writing, a very limited number of UML tools that have implemented NIEM-UML. It should not be assumed that any UML tool will implement NIEM-UML “out of the box.” The capability to model NIEM in UML (*i.e.* the profile) can be easily implemented in most tools; however, the MDA capabilities to produce and reverse engineer IEPDs require specific implementations, probably with the support of the tool vendor.

Using NIEM-UML requires some knowledge of NIEM and of UML. NIEM-UML models have to be very complete and precise to correctly generate NIEM-conformant MPD artifacts. This precision is more than some practitioners are used to putting into UML models and also requires some specific NIEM knowledge. An understanding of XML is, of course, still required to implement a NIEM IEPD.

### **Initial NIEM-UML tools are usable and stable but more are needed.**

While the selection of NIEM-UML specific tools is currently limited, the current tools<sup>11</sup> were found to be high-quality tools that are professionally implemented and supported. Considering the “1.0” state of these tools, there were few bugs or usability issues.

NOTE: The IJIS Institute does not recommend any, one specific tool.

While there are existing options available, the NIEM community should be offered more choices – including some that are free to use or open source. Given the size and growth of the NIEM community, we recommend that tool vendors consider support for NIEM-UML. Additionally, just as important as the tools, is a vibrant user community with adequate training and support. Based on conversations with tool vendors, some of which cannot be publicly disclosed, it is our expectation that more tools, training, and support will be available within a short timeframe.

It should also be noted that supporting NIEM-UML does not necessarily require a complete UML tool. A more NIEM-specific tool could be produced that supports the NIEM-UML model exchange format [XML Model Interchange (XMI)] but does not use UML diagrams. While UML diagrams are one notation for documenting NIEM-UML models, others may be used as well. In addition, the NIEM-UML specification has a variety of compliance points so different tools may choose to implement different parts of the NIEM-UML life-cycle.

### **NIEM-UML reduces the complexity of and barrier to entry for using NIEM but education is still required.**

A stated goal of NIEM-UML is that it reduces the complexity of and barrier to entry for using NIEM. These goals have been successfully met: using NIEM-UML is substantially easier than using the legacy

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<sup>10</sup> A *profile* tailors UML for a particular need.

<sup>11</sup> For more information about tools, visit: <http://www.niem-uml.org>

XML-focused tools and process. The time for a new user to come up to speed and productive with NIEM should be sharply reduced.

Although the complexity of and barriers to entry are reduced, they are not eliminated. NIEM introduces new concepts such as augmentations and subsets, which need to be understood. The NIEM reference data models are large and complex—and reusing components of the reference data models is essential to NIEM—so developers are still required to learn and understand these reference models to build new exchanges. NIEM-UML tools may make this somewhat easier by providing good diagrams, search tools, and subsetting wizards; however, the essential reuse process does, and may always, require an understanding of these reference models. What NIEM-UML does is simplify the representation of the reference models, their technical details, and the way in which they are subsetted and reused. It also ensures reuse and subsetting are valid and NIEM-conformant.

Besides the ability to define new domains and exchanges, business stakeholders need to understand their information sharing needs and to engage in the process of defining and leveraging standards. Models and diagrammatic notations provide a more intuitive and business-focused way for stakeholders to engage in the process. The learning curve for stakeholders to read and understand a NIEM-UML model is minimal provided that an effort has been made to produce high quality UML diagrams of the models. A purely logical model may still provide benefit for stakeholder understanding. Such a logical model would serve as the basis for producing a NIEM-UML model.

Beyond the NIEM reference models, there is still a learning curve for architects to define NIEM-UML models. Current UML tools are substantial and deep, with many features that are not needed just for NIEM. Study, books, and/or training will be required to come up to speed on NIEM-UML. Those familiar with NIEM and UML will have a much easier time. The learning curve for practitioners already familiar with both NIEM and UML would be less than a week for the production of IEPDs of average complexity.

Experienced NIEM practitioners also found that generating NIEM-UML from pre-existing constraint schemas was not as well supported by the tooling, which is to be expected because constraint schemas are not part of the normative NIEM specifications. This is expected to improve as the standard and tooling mature and has the benefit of promoting greater consistency of NIEM XML artifacts. In addition, by default, the tooling may structure XML schemas differently than the manual methods used by advanced users so advanced users may need to merge their methodology with the UML approach.

### **More MDA standards and capabilities would complement NIEM-UML.**

NIEM is very specifically scoped to the structure and semantics of “data in motion” between exchange partners. While data in motion is essential to the exchange, it is not the only requirement. There is, of course, the need for services, choreography, queries, security, and privacy to specify exchanges. These are outside the scope of NIEM; and, consequently, NIEM-UML is able to work in conjunction with service-oriented architecture (SOA)-related standards. There is also the need for adapters, application servers, databases, and other technologies to implement NIEM in information technology (IT) systems.

UML and the MDA approach can and are used for the “full life cycle” of information exchange solutions. Additional information sharing focused standards should be endorsed or developed that include service specifications, query, and security. These new specifications should work with NIEM-UML for a more complete solution. In addition to the standards, there are opportunities for vendors to support the mapping of NIEM exchanges to back-end systems implementations using the MDA approach. We encourage standards and technology support for a full life-cycle approach to information sharing.

**Model Driven Architecture (MDA) could positively impact the evolution of NIEM.**

The use of NIEM-UML has the potential to change the guidelines published on NIEM-GOV for IEPD and service specification packages (SSP) since the artifacts have evolved from the original NIEM schema-based process. A notable example is the reduced reliance on the presence of an optional component mapping spreadsheet in an IEPD. Another example is the increased importance of inclusion of machine-readable UML files in service specifications. In addition, there will be significant implications for the NIEM training program as UML modeling is included.

**NIEM-UML is recommended for use in creating, evolving, and implementing NIEM information exchanges and domains.**

*Based on the above factors, it is the I-TAC position that NIEM-UML and other MDA standards have the potential to enhance information sharing and exchange.*

*We endorse the use of NIEM-UML for current and future information exchange projects and encourage vendors and practitioners to embrace and support this specification. The most benefit will come from projects that are earlier in their life-cycle or are undergoing a substantial revision. NIEM-UML can be used for the development and/or maintenance of IEPDs, domains, Enterprise Information Exchange Model (EIEM), and other NIEM artifacts. Utilizing NIEM-UML at the domain and reference model level would substantially enhance the development of IEPDs within that domain.*

*Further, we recommend that NIEM-UML models be considered as a required artifact in future acquisitions and specifications for information sharing.*

## ABOUT THE IJIS INSTITUTE

The IJIS Institute<sup>12</sup> unites the private and public sectors to improve mission-critical information sharing for those who protect and serve our communities. The IJIS Institute provides training, technical assistance, national scope issue management, and program management services to help government fully realize the power of information sharing.

Founded in 2001 as a 501(c)(3) nonprofit corporation with national headquarters on The George Washington University Virginia Science and Technology Campus in Ashburn, Virginia, the IJIS Institute has grown to nearly 200 member and affiliate companies across the United States.

The IJIS Institute thanks the I-TAC for their work on this document. The IJIS Institute also thanks the many companies who have joined as members that contribute to the work of the Institute and share in the commitment to improving justice, public safety, and homeland security information sharing.

### ***About the I-TAC***

The I-TAC develops policies, programs, and training or educational materials in support of the Office of Justice Programs (OJP) information sharing initiative that can be adopted or disseminated by industry as a whole.

The I-TAC reviews significant issues under consideration to develop and document industry recommendations and positions by the various national committees including: XML Structure Task Force (XSTF), NIEM Business Architecture Committee (NBAC), NIEM Technical Architecture Committee (NTAC), and Justice Training and Technical Assistance Committee (JTTAC). The I-TAC also assists in facilitating industry participation in NIEM IEPD development activities and encourages content contribution and reuse by IJIS Institute members and other organizations.

As the Steering Committee for the IJIS Institute National Information Sharing Standards (NISS) Help Desk project, the I-TAC provides guidance, review, and issue resolution to the IJIS Institute staff. The I-TAC also liaises with the Information Sharing Architecture Committee in the support of Global Reference Architecture (GRA) efforts, supports the coordination of testing and reporting of test results for evolving XML-based initiatives (e.g. NIEM), and explores and recommends new and emerging information sharing technologies.

## About the OMG

The OMG is a leading industry consensus standards development organization with a track record of over 20 years of developing modeling and middleware related standards that have achieved wide scale and mainstream use. OMG's mission is to develop, with their worldwide membership, enterprise integration standards that provide real-world value. OMG is also dedicated to bringing together end-users, government agencies, universities, and research institutions in communities of practice to share experiences in transitioning to new management and technology approaches, like cloud computing.

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<sup>12</sup> For more information about the IJIS Institute, visit the website at: <http://www.ijis.org/>; follow on Twitter: [@ijisinstitute](https://twitter.com/ijisinstitute); read the [IJIS Factor Blog](#); or, join LinkedIn at: [Justice and Public Safety Information Sharing](#).

The OMG adopts industry specifications through a well-defined and open process that ensures that all OMG specifications will be supported by commercial and/or open source implementations.

## REFERENCE MATERIAL

The IJIS Institute  
<http://www.ijis.org>

Best Practices for XML Internationalization  
<http://www.w3.org/TR/xml-i18n-bp/>

Official NIEM Website  
<http://www.niem.gov/>

RFC 1766 Language/Locale Codes  
<http://www.ietf.org/rfc/rfc1766.txt>

ISO-4217 Currency Codes  
[http://www.iso.org/iso/currency\\_codes\\_list-1](http://www.iso.org/iso/currency_codes_list-1)

### *Acronyms and Abbreviations*

ACRONYM OR ABBREVIATION	DEFINITION
<b>EIEM</b>	Enterprise Information Exchange Model
<b>GRA</b>	Global Reference Architecture
<b>IEPD</b>	Information Exchange Package Documentation
<b>IJIS</b>	IJIS Institute
<b>IT</b>	information technology
<b>I-TAC</b>	IJIS (Institute) Technical Advisory Committee
<b>JTTAC</b>	Justice Training and Technical Assistance Committee
<b>MDA</b>	Model Driven Architecture (OMG)
<b>MPD</b>	Model Package Description
<b>NBAC</b>	NIEM Business Architecture Committee
<b>NDR</b>	Naming and Design Rules
<b>NIEM</b>	National Information Exchange Model
<b>NISS</b>	National Information Sharing Standards (Help Desk)
<b>NTAC</b>	NIEM Technical Architecture Committee
<b>OJP</b>	Office of Justice Programs
<b>OMG</b>	Object Management Group
<b>SOA</b>	Service-Oriented Architecture
<b>SSP</b>	service specification package
<b>UML</b>	Unified Modeling Language
<b>W3C</b>	World Wide Web Consortium
<b>XMI</b>	XML Model Interchange
<b>XML</b>	eXtensible Markup Language
<b>XSD</b>	XML Schema Definition
<b>XSTF</b>	XML Structure Task Force