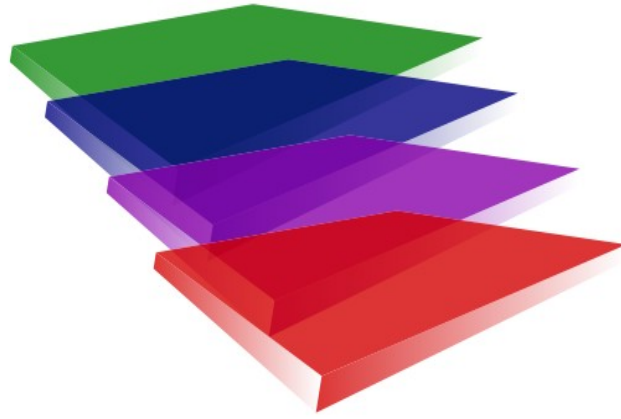


Multi-Level Health Information Modelling



MLHIM

Technology Specifications Evaluation Report

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The goal of MLHIM is to be Minimalistic, Sustainable, Implementable AND Interoperable.

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Purpose

Make everything as simple as possible; but no simpler – Albert Einstein

This evaluation is designed to provide decision makers with a basis for selecting healthcare IT infrastructure implementation specifications.

Background

*Don't be afraid to take a big step when one is indicated. You can't cross a chasm in two small steps.
– David Lloyd George*

The process to evaluate specifications and standards has been a try and see if it works in our situation. Undoubtedly this has contributed to many undesired outcomes for IT projects. This approach does however lead to many lessons learned and opportunities to correct them and to mitigate the negative effects of similar errors in the future.

A founding goal of the MLHIM specifications and reference implementation is correct past mistake in healthcare IT interoperability and to mitigate the negative effects of possible errors that may be made currently.

Until the release of the evaluation framework described in “*Evaluating and classifying the readiness of technology specifications for national standardization*”¹ there has not been a clear methodology to making these decisions prior to implementation. The *best guess* was to use what was popular.

Though the evaluation process is necessarily a subjective one. This framework defines clear guidelines for side-by-side assessment of similar specifications.

Methods

Each of the attributes in Appendix A of the reference publication was carefully considered in the context of the MLHIM specifications and reference implementation. The most appropriate criteria definitions were chosen and a Rank for that attribute was assigned.

The Evaluation section below provides the reader with; the selected ranking, criteria and a discussion, to assist in establishing context, follows each attribute.

1 Baker DB, Perlin JB, Halamka J. J Am Med Inform Assoc Published Online First: May 30, 2014 doi:10.1136/amiajnl-2014-002802 <http://jamia.bmj.com/content/early/2014/05/28/amiajnl-2014-002802.abstract>

Evaluation

Maturity Metrics

Maturity of Specification

Breadth of Support

Rank: Moderate

The criteria met for this attribute is:

1. Existing community with notable activity
2. 2-5 organizations supporting authorship and/or review
3. Single organization provides support service
4. Single organization provides implementation/training services

Discussion:

The MLHIM developers shows consistent, public activity via various social media channels. Input is constantly solicited in order to improve the specifications and promote implementation. Authorship and review are performed under the guidance of *Instituto Nacional de Ciência e Tecnologia Medicina Assistida por Computação Científica* (INCT-MACC) and the *MLHIM Technological Development Unit* (MLHIM TDU). The MLHIM TDU is an Innovation Laboratory certified and partially funded by the Rio de Janeiro State University

Stability

Rank: High

The criteria met for this attribute is:

1. Stabilized releases providing minor corrections to core Standard. New core functionality changes in response to industry required changes
2. No known history of major problems or crises

Discussion:

Changes to the MLHIM specification and reference implementation are based on implementation feedback. Any change other than documentation updates and corrections generates a new release. Data from each release can co-exist with all previous data and knowledge models and does not require (in fact specifically avoids) any data migration. This provides for full semantic fidelity of all existing data and future proofing the implementation and specifications.

Adoption of Specification

Rank: Moderate

The criteria met for this attribute is:

1. Few references of specification's use on non-critical programs (i.e. in pilot)
2. Current adopters of specification represent the intended adopter organizations in terms of size and organization type.

Discussion:

MLHIM is at this point, an emerging technology. Though the concepts of multi-level modelling are more than two decades old. MLHIM has improved on the implementability of those concepts.

Maturity of Underlying Technology Components

Breadth of Support

Rank: High

The criteria met for this attribute is:

All core technology components have:

1. Strong community with numerous contributors and advocates throughout industry
2. >5 individuals leading development
3. >7 developers with low turnover
4. Multiple organizations provide support services
5. Multiple organizations provide implementation/training services

Discussion:

The multi-level modelling concepts of MLHIM have been implemented in accordance with the tools and experience of the international XML community. XML technologies are the most ubiquitous tools in computing.

Stability

Rank: High

The criteria met for this attribute is:

All core technology components have:

1. A stabilized release process and a development process that implements new core functionality changes in response to industry requirements.
2. No known history of major problems or crises

3. Multiple known implementations in operation for over 3 years

Discussion:

XML technologies are well known and have a stable release process governed by the W3C².

Adoption of Technology

Rank: High

The criteria met for this attribute is:

All core technology components have:

1. Numerous references of use in production for critical programs
2. Been implemented for use cases similar to those addressed by the specification

Discussion:

XML technologies have been used to implement other standards and specifications such as NEIM, ebXML and HL7v3. However, MLHIM does use a unique approach to enable semantic interoperability while maintaining pure XML technology implementation.

Technical Readiness Level

TRL 9: Actual system proven through successful mission operations. Actual application of technology in its final form and under mission conditions.

Discussion:

XML technologies are proven globally, on a daily basis, in mission-critical environments.

Platform Support

Rank: High

The criteria met for this attribute is:

All core technology components have:

1. Support multiple platforms with no or minimal effort

Discussion:

XML technologies are available on all platforms.

² <http://www.w3.org/>

Maturity of the Technology within its Life Cycle

Rank: High

The criteria met for this attribute is:

The maturity of all core technology components is characterized as:

TRL 9: Actual system proven through successful mission operations. Actual application of technology in its final form and under mission conditions.

Market Adoption

Installed Health Care User Base

Rank: Moderate

The criteria met for this attribute is:

1. Detectable references of use outside of developers of pilots within health care market

Discussion:

The are completed and in progress MLHIM pilot implementations at multiple institutions.

Installed User Base Outside Health Care

Rank: Low

The criteria met for this attribute is:

1. Few users other than the developers of the standard or pilots

Discussion:

There are no known implementations of MLHIM outside of healthcare. However, a generalization of the XML based multi-level modelling approach is being developed based on the MLHIM experience.

Interoperable Implementations

Rank: Moderate

The criteria met for this attribute is:

1. 2 - 4 non-coordinated implementations
2. Some indications of interoperability between at least 2 implementations

Discussion:

All data instances based on MLHIM are 'by definition' syntactically and semantically interoperable. The ranking of High was not achieved because of the requirement for five or more implementations. Therefore further uptake of MLHIM will automatically improve this ranking.

Future Projections and Anticipated Support

Rank: High

The criteria met for this attribute is:

1. Roadmap and future announcements of releases are tightly coupled and are provided to a broad audience (members and public) on regular basis.

Discussion:

The current status and future roadmap of MLHIM is discussed, on a daily basis, via several social media services and most specifically the [MLHIM Community](#) (primary support) on Google Plus.

Investments in User Training

Rank: Moderate

The criteria met for this attribute is:

1. Limited user investment in learning, primarily through indirect means such as discussion boards

Discussion:

Currently there is little understanding in broader health informatics community regarding the power of multi-level modelling in general and in MLHIM specifically. We expect the training business to grow significantly over the next two years.

Adoptability Metrics

Ease of Implementation/Deployment

Availability of Off-the-Shelf Infrastructure to Support Implementation

Rank: High

The criteria met for this attribute is:

1. Most of supporting infrastructure components can be purchased off-the-self

Discussion:

All of the supporting infrastructure is open source and/or available off-the-shelf.

Standard as Success Factor

Rank: Moderate

The criteria met for this attribute is:

1. No consensus view among deployed implementations on whether standard is a success factor or challenge to deployment

Discussion:

In relative terms to other multi-level modelling approaches. MLHIM is much easier to implement. In relation to conventional software development approaches, new comers perceive complexity due to the requirement to *think differently*.

Conformance Criteria and Tests

Rank: High

The criteria met for this attribute is:

1. Complete conformance criteria
2. Conformance tools and/or methodology applied to at least one operational implementation.
3. Significant automated test support

Discussion:

All conformant MLHIM data must be valid according to a Concept Constraint Definition (CCD) which in turn must be valid according to one specific release of the MLHIM reference implementation. All MLHIM reference implementation releases are valid according to the W3C XML Schema specifications. The W3C XML Schema test suite³ contains nearly 40,000 test files and associated metadata. This approach provides a complete *validation chain* from MLHIM data back to the W3C specifications. This validation chain can be exercised using commonly available, off-the-shelf, open source and/or proprietary tools.

Availability of Reference Implementations

Rank: Moderate

The criteria met for this attribute is:

1. Well-established reference implementations on a limited set of platforms

Discussion:

The High ranking here requires, according to the framework, *multiple reference implementations*. With MLHIM there is no need for multiple reference implementations due to the ubiquity of XML. So, MLHIM cannot attain a High ranking for this attribute.

Specification Modularity

Rank: High

The criteria met for this attribute is:

1. Specification is composed of one or more modules
2. If large, specification can easily be decomposed to simpler smaller parts
3. Modularity aligns well with the business problem, and parts are unambiguously identified

Discussion:

The multi-level modelling approach specifically defines modularity in order to provide for semantic interoperability.

Quality and Clarity of Specifications

Rank: High

The criteria met for this attribute is:

1. Precisely defined semantics and providing evidence of interoperability with other systems or networks
2. Consistent, unambiguous terminology within standard

³ <http://www.w3.org/XML/2004/xml-schema-test-suite/>

3. Explicit terminology alignment with any referenced or dependent standards

Discussion:

The documentation is written in plain language to improve readability. Uncommon terminology is referenced and/or included in a glossary. The reference implementation uses commonly used XML technology definitions.

Separation of Concerns

Rank: High

The criteria met for this attribute is:

1. Clean separation. Referenced standards do not solve the same business problem as the standard under evaluation.

Discussion:

MLHIM a layer of abstraction as well as the constraint layer providing domain experts with concept definition tools that require computer scientists to build in lower level technologies. Current experience shows that when these lower level technologies are used they are not implemented in a way that provides semantic interoperability across healthcare IT systems. MLHIM is specifically defined to fill that gap between the layers of implementation and low level programming.

Ease of Use of Specification

Rank: High

The criteria met for this attribute is:

1. Easily read and understood by domain experts
2. Easily used as a starting point for maintenance activities
3. Navigation links provided or indexed

Discussion:

The MLHIM specifications are designed to fill that gap and be the communications channel between systems developers and healthcare domain experts.

Degree to which Specification Uses Familiar Terms to Describe “Real-World” Concepts

Rank: High

The criteria met for this attribute is:

1. Most concepts in standard are based on terminology well established in the industry
2. Concepts in specification expressively described in business language

Discussion:

The documentation is written in plain language to improve readability. Uncommon terminology is referenced and/or included in a glossary. The reference implementation uses commonly used XML technology definitions.

Runtime Decoupling

Rank: High

The criteria met for this attribute is:

1. Loosely coupled to externally defined interfaces. Message and Data coupling only.

Discussion:

This is the primary purpose of MLHIM; to capture the syntactic and semantic definitions of concepts in a way they can be exchanged across disparate systems.

Appropriate Optionality

Rank: High

The criteria met for this attribute is:

1. Interoperability use cases met by implementations that ignore (at runtime) or do not implement (at design time) optional elements.

Discussion:

Optional elements are; optional.

Ease of Operations

Comparison of Targeted Scale of Deployment to Actual Scale Deployed

Rank: High

The criteria met for this attribute is:

1. Scale is documented in standard and evidence that scale has been achieved or exceeded in operations

Discussion:

The scaling of MLHIM based systems is fully dependent upon the ability to scale any XML system. MLHIM does not place any additional restrictions on the system.

Number of Operational Issues Identified in Deployment

Rank: High

The criteria met for this attribute is:

1. Few issues identified during deployment

Discussion:

The major issue is a conceptual one that requires the ability to think in a manner where health-care domain experts are tasked with defining the concept data models.

Degree of Peer-Coordination of Technical Experts Needed

Rank: High

The criteria met for this attribute is:

Minimal peer-coordination of technical experts required on as-needed basis

Discussion:

The multi-level modelling approach, by definition decouples the implementation development from knowledge model development.

Operational Scalability (i.e. operational impact of adding a single node)

Rank: High

The criteria met for this attribute is:

1. Addition of nodes has little to no additional impacts to operational effort or complexity for either implementers or users

Discussion:

MLHIM places no additional restrictions on scalability. Any scalability issues are purely based upon platform implementation choices.

Fit to Purpose

Rank: High

The criteria met for this attribute is:

1. All or nearly all target use cases are met by use of the standard and specifications

Discussion:

Healthcare domain experts are free to define any concept in the manner that fits their need. While the ultimate goal is to have a sharable pool of well defined knowledge models (CCDs) varying preferences of domain experts as well as the constantly evolving body of medical knowledge is fully supported by MLHIM. All the while, maintaining full interoperability.

Intellectual Property

Openness

Rank: High

The criteria met for this attribute is:

1. Open to public

Discussion:

All specifications, reference implementations and many tools and demos are available for free via <http://www.mlhim.org>

Affordability

Rank: High

The criteria met for this attribute is:

1. No fees for accessing standard or referenced specifications
2. No costs to use standard and standard documentation

Discussion:

There are no purchase fees or usage fees; ever.

Licensing Permissiveness

Rank: High

The criteria met for this attribute is:

1. Unrestricted for any use (commercial, academic, governmental)
2. Perpetual use rights
3. Derivative work allowed
4. Unlimited number of users or instances

Discussion:

All MLHIM artifacts are fully licensed under published well known open source licenses that are business friendly.

Copyright Centralization

Rank: Moderate

The criteria met for this attribute is:

1. Rights held by a few individuals or entities

Discussion:

The copyright is currently held by the original developers. It can be transferred to an appropriate organization in the future if the terms meet the spirit of the founding agreement for MLHIM to remain open and freely available.

Freedom from Patent Impediments

Rank: High

The criteria met for this attribute is:

1. No known or anticipated patents required to implement any portion of the specification

Summary

This is not a quantitative framework and every decision maker will need to weight the categories and attributes within the context of their own needs.

Considering the ranking results of MLHIM in this framework the technological approach as well as the robustness of the foundation makes it a serious contender for implementation across all levels of healthcare IT projects.

You can find out more about MLHIM and participate in development by joining the [MLHIM Community](#) on Google Plus and by [Following MLHIM](#) on Facebook.

The specifications as well as tools and demos are available on [GitHub](#).