Interoperability Framework For Application-Oriented Ontological Models

by

Mohamed Ishan Sabar

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The work described in this thesis was carried out by me under the supervision of Dr. Prasad M. Jayaweera and Dr. E.A.T.A Edirisuriya and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree/Diploma.

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Abbreviations

1. **AOM** : Application-Oriented Ontology Model
2. **BF** : Behavioural Framework
3. **BIO** : Baseline Interoperability Ontology
4. **CDA** : Clinical Document Architecture
5. **DAM** : Domain Analysis Model
6. **DM** : Data Modelling
7. **EA** : Enterprise Architecture
8. **ECCF** : Enterprise Conformance and Compliance Framework
9. **EEAF** : Enhanced Enterprise Architecture Framework
10. **EHR** : Electronic Health Record
11. **GF** : Governance Framework
12. **GPRS** : General Packet Radio Service
13. **GPS** : Global Positioning System
14. **HL7** : Health Level 7
15. **HL7-SAIF** : Health Level 7 – Service-Aware Interoperability Framework
16. **IF** : Information Framework
17. **II** : International Interoperability
18. **MDA** : Model-Driven Architecture

19. **MOH** : Ministry of Health

20. **OMG** : Object Management Group

21. **OWL** : Web Ontology Language

22. **RIM** : Reference Information Model

23. **RM-ODP** : Reference Model for Open Distributed Processing

24. **SA** : Self-Actualization

25. **SA-AOM** : Self-Actualized Application-Oriented Ontology Model

26. **SAIF** : Service-Aware Interoperability Framework

27. **SI** : Semantic Interoperability

28. **SOA** : Service-Oriented Architecture

29. **WI** : Working Interoperability

30. **XML** : Extended Markup Language

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ABSTRACT

Ontological models define the foundational structure upon which ubiquitous domain applications are built. Whether it be the precision crafting of efficient static systems and immutable information models, or the design of fluid, formal workflows in diverse industrial and professional environments, ontologies and their associated modelling have always entailed the identification of components, their structure, and the associated inter-relationships. A temporal dimension has been identified with regard to dynamic, mutative environments, their *period* being perhaps just a *sliver* of a time measured in sub-second intervals, yet, their components operating with in-step synchronicity, ensuring efficient macro-system operation.

This research focused on the deeper study of ontology-driven domain applications. In comprehending and acknowledging the prime importance of ontologies, and their abundant, ubiquitous presence and use, the principle research problem was how to enact a *unified*, *secure*, versatile, *Self-Actualizing*, *Application-Oriented Ontology Model* (SA-AOM) *Framework* in order to overarchingly derive and generate *Self-Actualized* (SA), *interoperable*, *inclusively-efficient* target ontologies, with guaranteed precision and minimal iterations in construction and operation. This entailed the analysis of the spectrum of application-oriented ontology models, paying due attention to structure, definition, complexity, spread, depth, and usage.

The first phase of the research therefore focused on the chosen *healthcare* domain, and a study of prevalent healthcare standards and associated ontologies. It is fact that globally-instituted healthcare standards are few in number, and an appropriate base standard had to be chosen based upon the fulfillment of certain stringent criteria. Amongst them were that the

chosen standard should be *ontology-driven*, have potentially universal applicability and usage, afford effective and efficient means for interoperability and exchange of valued, accurate, and timely healthcare information, and be cost-effective and implementable even in the Sri Lankan context. The finest choice in this case was *Health Level 7* (known as *HL7*) for its widespread use in the world's most developed countries where it has been instituted as the healthcare standard of choice in their respective *National Health Services.* Efficacious solution *threads* were devised for pressing issues. This *spawned* twelve scientific publications which were presented at eminent international scientific research fora. The next phase extended these findings and solutions to encompass *ubiquitous*, *Application-Oriented Ontological Models* (AOMs), with the principle aim of developing a *unified*, *interoperable*, *Self-Actualizing Framework* for any *AOM*. This solution framework should afford the fleetest, most efficient convergence to the final solution, irrespective of domain. An indepth, comparative study of the gamut of *AOMs* were performed, and novel artifacts and solutions were enacted and *incrementally-integrated* to formulate the unified *SA-AOM* framework. This framework generates *optimally-efficient* and *interoperable* target *AOMs* with *minimal solution-convergence steps* and *iterations* (termed *Self-Actualized AOM* or *SA-AOM* herein). Comprehensive correctness, validation, and rigor testing of the unified solution was also performed.

Summing up, this research efficiently-infused superlative *international interoperability* and *inclusive efficiency* in all *HL7-based* final specifications and allied systems construction. In addition, these solutions and artifacts were refactored, reengineered, and prudently extended to the realize the target *SA-AOM* framework, the definitive, unified, final research solution. The comprehensive findings and solutions are completely presented herein.