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If one can measure interoperability as this approach allows, then one can define a methodology that integrates several techniques and tools for analysis and evaluation, drawn from the business-process engineering or enterprise-engineering domains. For example, business-activity monitoring and business-process simulation will be used to measure improvements in interoperability.

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Enterprise collaboration is becoming more and more important because of the globalized economic context. The competitiveness of enterprises depends not only on their internal productivity and performance, but also on their ability to collaborate with others. This necessity leads to the development of interoperability, which makes it possible to improve collaborations between enterprises. Therefore, more and more networked enterprises are being developed. Further, enterprise interoperability is one of the most suitable solutions to total enterprise integration.

In the last decades, a great deal of research has focused on this problem, including the use of high-level architecture (HLA) to solve some interoperability problems. HLA is a software-architecture specification that defines how to create a global software execution composed of distributed simulations and software applications (IEEE 2000). It has succeeded in many aspects, especially in the areas of reuse and interoperability. However, with the rapid pace of technical change and further development of the IEEE standard, HLA faces many new challenges.

Our research focuses on reducing the time and cost of development, making federation more flexible and open while retaining adequate security and synchronization. Our work aims to contribute to the rapid and intelligent development of distributed enterprise information systems by proposing a harmonized and reversible development framework for HLA-based interoperable application, as figure 1 shows.

High-level architecture has many advantages, such as its generalized development process, distributed simulation engineering and execution process (DSEEP), synchronization standard, runtime infrastructure specification, and data standards. In order to keep these advantages,

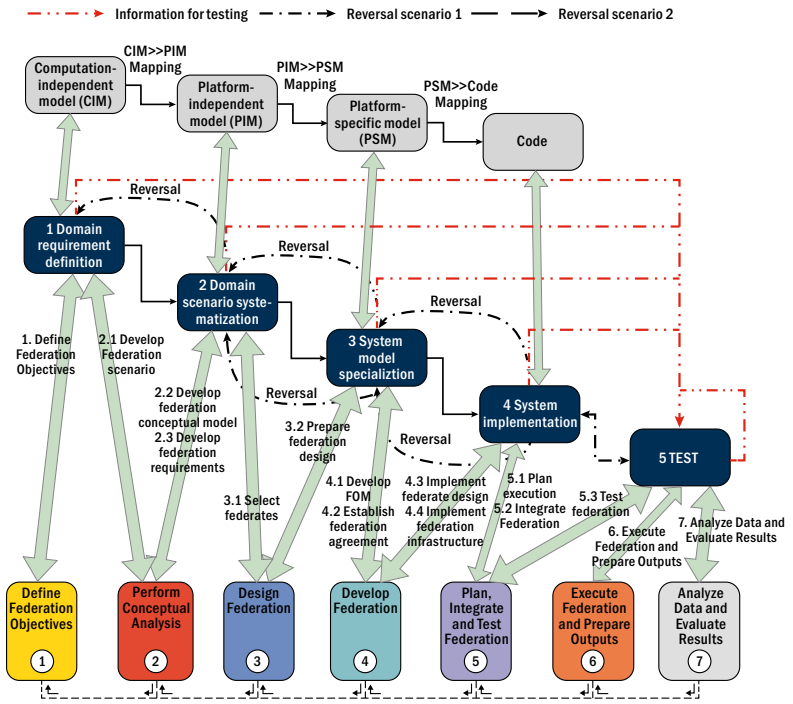

Figure 1. Harmonized and reversible development framework

HLA needs to benefit from developments in the commercial domain (Tolk 2002). Model-driven architecture (MDA) has the most to offer HLA, since MDA is popular, since it is a compatible development lifecycle with HLADSEEP, and since MDA can facilitate the construction of simulators and provide the standardized meta models to this integration. Elvesaeter and others proposed a model-driven interoperability framework in 2007 to provide a foundation (consisting of a set of reference models) for applying model-driven development in software-engineering disciplines that support the business-interoperability needs of an enterprise.

Basically, the harmonization of MDA and HLA is intended to simulate MDA-based systems using modeling and simulation. Therefore we need to consider the existing MDA-based systems.

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As a result, finding a way to rapidly acquire the knowledge from legacy systems becomes the key point of reducing the time and cost of development. Fortunately, after MDA became well known as an important change in software-development practice, the Object Management Group launched another project called architecture-driven modernization. This approach, the opposite of model-driven architecture, aims to "rewind" the models from legacy systems. However, sometimes one would like to discover more specific models from a legacy system. This is why the architecture-driven-modernization group has defined several metamodels to this purpose, the best known being the Knowledge Discovery Metamodel and Abstract Syntax Tree Metamodel (Jouaultet al. 2009).

In order to adapt to the "Web 2.0" context, IEEE was published 1516TM-2010 in August 2010 (IEEE 2010), which benefits from web services such as support for numerous newer and older languages and operating systems as well as the ease of deployment across wide area networks. Because we are dedicated to developing an open framework, we have chosen an open-source RTI (run time infrastructure), poRTIco (Portico Project 2009), which does not provide web-RTI functionality. Thus, we implement a special federate, WebservicesFederate, as a bridge, which takes in charge of providing web services, connecting and synchronizing federates outside traditional federation with federates inside.

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