The True Value of the Unified Modeling Language (UML)
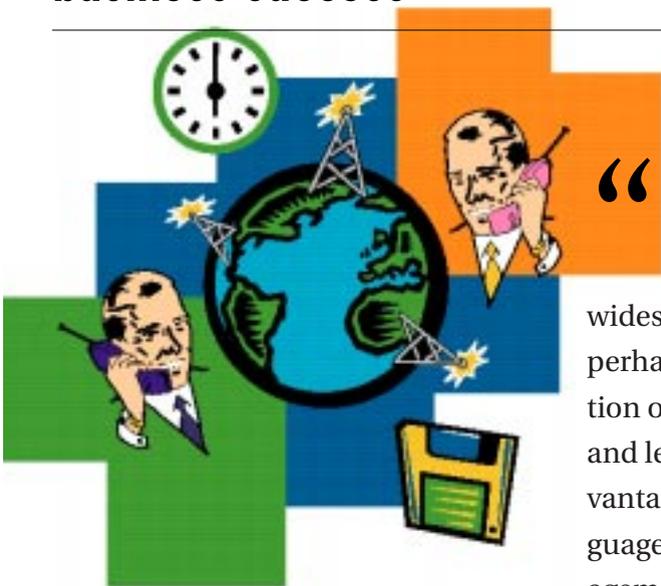
Knowledge: The dictating factor of business success

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"KNOWLEDGE AND HUMAN POWER are synonymous," once said the great philosopher, Francis Bacon. In today's global market, where competition is widespread, knowledge and the ability to apply it provide perhaps the most important advantage. This raises the question of how an organization can best capture, communicate, and leverage knowledge in order to gain that competitive advantage. Perhaps the answer is the Unified Modeling Language (UML)[1] from Rational Software and the Object Management Group (OMG).

Today's businesses compete vigorously in a global market filled with opportunities and risks. They are bombarded with ongoing business and technological change as well as ever-increasing complexity that is partially due to their evolutionary response to change.

Businesses are charted to solve complex and ever-changing problems for themselves and their clients by applying their knowledge within this environment. The problem-solving process involves understanding a problem and evolving a solution from it through the application of knowledge. Therefore, the knowledge that a business is able to capture, communicate, and leverage to solve problems becomes the dictating factor of its success or failure.

While business focus on solving problems and realizing their visions by applying business and technological knowledge, they often overlook the value of the artifacts generated by these problem-solving processes. It is these artifacts that best capture an organization's lessons learned, best practices, and knowledge. If such knowledge is captured and reapplied, the organization can become even more competitive and proactive, rather than reactive, to change and complexity, thus increasing its probability of success.

Knowledge Lost

However, even with today's most advanced technology and understanding of human problem-solving methods, much strategic, tactical, and operational knowledge is lost or never

captured, and organizations often spend much time and money rediscovering what they already knew but never took the time to capture.

It would be highly advantageous for organizations to establish some formalized mechanism for capturing, communicating, and leveraging knowledge—and in doing so, to increase value by increasing quality, reducing costs, and reducing time-to-market while managing risks and being proactive to ever-increasing change and complexity.

The Unified Modeling Language

The UML is a modeling language for specifying, visualizing, constructing, and documenting the artifacts of a system-intensive process. The UML has gained significant industry support through the UML Partners Consortium and was submitted to the OMG for adoption as a standard. In November 1997, the OMG adopted the UML. Let's begin by defining the UML:

Unified. The UML was originally conceived by Rational Software and three of the most prominent methodologists in the information systems/technology industry: Grady Booch, James Rumbaugh, and Ivar Jacobson. It represents the evolutionary unification of their experience with other industry engineering best practices.

Modeling. With an emphasis on modeling, it focuses on how we understand the world around us. For example, how do we determine the weight a bridge will support before we build it? Fundamentally, we model the real thing in such a way that we can understand its characteristics and manipulate its parameters to attain the desired results.

A model is an abstract representation of some other thing (which may be real). It is more easily manipulated than, and facilitates our understanding of, the thing it represents. This is critical where constructing the real thing would be very costly.

Language. The UML functions as the means for expressing and communicating knowledge. The UML brings together the industry's best practices regarding how we understand the world around us and how we represent and communicate that understanding; it provides a best-of-breed mechanism for capturing, communicating, and leveraging problem-solving artifacts. It has four distinguishing characteristics in comparison to other modeling languages: It is general-purpose, broadly applicable, tool-supported, and industry standardized.

Among its other benefits, the market share held by industry and tool vendors supporting it, widespread use of the methods founded by its creators, and its adoption by the OMG will make the UML a pivotal force in today's businesses. However, it not only offers true opportunities, but also various challenges.

Capitalizing on the UML

Similar to the emergence of object-orientation, the patterns movement, and various knowledge management initiatives, the UML can be used to solve problems. In order to solve a problem, organizations bring together various stakeholders who apply their knowledge cooperatively to derive a solution. The UML can be used to function as the communication language within such a process.

General Purpose

First, the UML is holistic and integrated. It provides mechanisms for organizing and classifying knowledge regarding a given context or situation in which the problem resides and in which the solution must be implemented. Such knowledge is captured in a model consisting of various modeling elements, and it is represented through distinct but interconnected views (or sets of diagrams). The model itself captures the knowledge, and the views represent the knowledge in a communicable form.

Furthermore, each view captures a different set of concerns and aspects

regarding the subject, and each modeling element represents some concept, construct, or element of knowledge regarding the subject. These views, with the modeling elements they use, describe the content of the communication among the individuals involved in the problem-solving process. Together, all of the views holistically form an integrated window to the body of knowledge that is applied and gained through the process. It is the sharing and reapplying of this knowledge (and artifacts representing its fragments) that enables an organization to capitalize on and realize the benefits of applying the UML.

The UML offers five distinct, but interconnected, views through which to present a given body of knowledge: use-case, structural, behavioral, implementation, and environment.

Use-Case View. The use-case view describes knowledge regarding the needs and requirements of the various stakeholders. This view is depicted by use-case diagrams. A *use-case diagram* captures relationships among various entities and their roles, responsibilities, and objectives within the environment. This view functions as the primary motivating force for the whole problem-solving process and provides validation criteria for the resulting solution.

Structural (Logical or Static) View. This view describes knowledge regarding the structural characteristics of the elements involved; it is depicted by *class diagrams,* which capture declarative (static) information; and *object diagrams,* which capture a snapshot of this information at a point in time. This view facilitates understanding the structural characteristics of the problem and solution entities involved.

Behavioral (Process, Concurrent, Collaborative, or Dynamic) View. This view describes knowledge regarding the behavioral characteristics of the involved elements and the dynamic interactions

or collaborations among them. It is depicted by

- *sequence diagrams,* which capture interactions arranged in time sequence.
- *collaboration diagrams,* which capture interactions organized around elements and their relationships.
- *state diagrams,* which capture the life cycle or sequence of status conditions an element sustains throughout its existence.
- *activity diagrams,* special cases of state diagrams that capture activities or actions of elements.

This view helps us understand how different entities behave and interact in order to realize their objectives.

Implementation (Component or Development) View. This view describes knowledge regarding the realization of the solution and is depicted by *component diagrams,* which capture the organization of those elements that constitute the solution. This view facilitates understanding the packaging of the solution.

Environment (Deployment or Physical) View. This view describes knowledge regarding the context in which the solution must be actualized and is depicted by *deployment diagrams,* which capture the configuration of resources or business constructs as required to support the solution. This view facilitates understanding of how the solution is realized within a business environment. Together, these views establish a coherent body of knowledge regarding the business, the problem/solution, and the problem-solving process by addressing and reconciling the concerns of the various stakeholders.

Broadly Applicable
Second, the UML is broadly applicable to different types of domains or subject areas, including those involving software and hardware components or those involving more autonomous entities. It can also be applied through different methods and processes.

The UML is explicitly method independent in that a method may apply it to the extent required to achieve its objectives within a given domain. Furthermore, it enables and promotes (but does not require or mandate) a user-case driven, architecture-centric, iterative, and incremental process. Because the UML is broadly applicable, various mechanisms are critical to its successful application, including: perspectives, dichotomies, levels of abstraction, and extension mechanisms.

This broad applicability across system types, domains, and methods allows the same language to be applied within the same organization to solve different and unique problems. Each set of artifacts resulting from a given problem-solving process captures a subset of the whole body of knowledge within the organization.

Tool Supported
Third, the UML is widely supported by a broad set of tools. Various tool vendors, some of which are part of the UML Partners Consortium, intend to support the UML in order to facilitate its application throughout an organization. By having a set of tools that support the UML, knowledge may be more readily captured and manipulated to meet an organization's objectives.

Industry Standardized
Fourth, the UML is not a proprietary and closed language but an open and fully extensible language. The extensibility mechanisms of the UML allows it to be customized and tailored to particular system types, domains, and methods/processes. It can be extended to include constructs for working within a particular context where even very specialized knowledge can be captured. Furthermore, it enables each organization to adapt and tailor the UML to its particular needs and requirements.

These four distinguishing characteristics of the UML including its holistic and integrated nature, broad ap-

plicability, tool-support, and industry standardization, make it a very viable mechanism for capturing, communicating, and leveraging knowledge.

Conclusion
Conclusively, the Unified Modeling Language is an evolutionary general-purpose, broadly applicable, tool-supported, and industry standardized language for specifying, visualizing, constructing, and documenting the artifacts of a system-intensive process. It is a fundamental communication mechanism that empowers organizations to capture, communicate, and leverage strategic, tactical, and operational business and technological knowledge on an enterprise-wide scale. Such knowledge can be applied to improve value by increasing quality, reducing costs, and reducing time-to-market while managing risks and being proactive to ever-increasing change and complexity.

Furthermore, caution should be emphasized. Simply because the UML evolved primarily from various second-generation object-oriented methods, the UML is not simply a third-generation object-oriented modeling language. Its scope extends its usability far beyond its predecessors. And it is experience, experimentation, and gradual adoption of the standard that will reveal its true potential and enable organizations to realize its benefits. 🐾

References
1. Rational Software Corporation, Unified Modeling Language, Version 1.1. September 1997.

Sinan Si Alhir is a consultant and author of "UML in a Nutshell" (O'Reilly & Associates, Inc., September 1998).

> Before you judge someone, walk a mile in his shoes. Then, when you do judge him, you'll be a mile away and you'll have an extra pair of shoes.
> —Anonymous