APPLICATION INTEGRATION FRAMEWORK FOR A LARGE BUSINESS PROCESS REDESIGN PROJECT

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ABSTRACT
Boeing has nearly completed a major program for business process redesign. Given the scale of this project and the large number of existing, heterogeneous systems, it has been essential that a standards-based architecture be implemented. The Common Object Request Broker Architecture **(**CORBA) standard has worked well as the application integration baseline for this new system

1. INTRODUCTION
This report describes the middleware framework that supports application integration for the Define and Control Airplane Configuration/ Manufacturing Resource management (DCAC/ MRM) program (hereafter referred to as the "program"). The program is a breakthrough business process redesign initiative that will improve the Boeing business processes used to produce airplanes and further reduces costs, cycle time and defects. This initiative will significantly enhance the company's ability to deliver more value to its customers. The program is designed to simplify and improve internal processes for handling airplane configuration data. These processes will enable the Boeing Commercial Airplane Group to generate the data defining a customer's requested configuration for an airplane to meet their particular requirements. Data such as the types of seats, galleys, avionics, and engines will be used to turn a "basic" airplane into one specifically configured for a customer. A major goal is to simplify and improve the manufacturing processes that are driven by the airplane configuration data. The program is the largest re-engineering project of its kind with overall improvements centered on common processes, simplified systems, and accurate data.

2. SYSTEM ARCHITECTURE
To implement application integration for the program, technologies are needed to tie together the systems that provide enterprise resource management, product data management, manufacturing process management, and database management.

Like many companies, Boeing prefers to buy rather than build computing systems and to use the best products available for a particular need. The program emphasizes the use of Commercial-Off-The-Shelf (COTS) software packages. Since most COTS applications are written to be self-sufficient and completely autonomous, integrating them is a major objective that is not easily achievable. The basic tactic used by the program is to utilize an application integration (AI) framework, which provides required quality of service (QoS) attributes for large distributed enterprise systems. These QoS objectives include scalability, flexibility, and maintainability, and were met by designing the framework using standards-based integration products. Both CORBA and Message Oriented Middleware (MOM) are utilized as transports and enable the services required. This framework, described in the next section, is the supporting infrastructure that unifies the disparate COTS applications into a single, holistic business system.

3. APPLICATION INTEGRATION ARCHITECTURE AND FRAMEWORK
At the beginning of the program, CORBA integration frameworks did not exist in the marketplace. The program set out to develop a middleware infrastructure with the goal being to eventually migrate to a completely commercial solution. The program's resultant AI framework is a full-function, integration infrastructure that has been developed as a key piece of the program's computing architecture. A significant feature of the AI framework is that it is built on the enterprise's business object model, referred to as the Conceptual Object Model (COM). The Boeing COM is an object hierarchy of key business entities, providing inheritance and object relationships. Using the COM encourages communication through terminology that is shared by business process teams and information technology (IT) personnel. It also focuses on business objects, thereby enabling interfaces to be expressed with business model semantics. An integration business object in this architecture is a CORBA object that represents a business entity such as a process plan or bill of material.

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3.1 An Abstract Framework

The AI framework "abstracts" its interfaces by layering the services for supporting interactions between applications. This insulates the business applications from the underlying complexity of the network and operating environments, and promotes the simplification of the development process. Developers do not need to be concerned with the technical infrastructure of the network or the locations of resources used, enabling them to focus on implementing business logic.

3.2 Framework Characteristics

The AI framework provides value-added services, processes and technologies that support the program's integration requirements.

3.2.1 Reusable Integration Patterns

The AI framework supports reusable patterns with both synchronous and asynchronous communications modes, which are used extensively within the program.

3.2.2 Transactional Integrity

Transactional integrity is accomplished in the AI framework through the use of middleware components, specifically the MOM and the CORBA event services products. Together, they provide guaranteed message delivery, auditing, transactional recovery, transaction monitoring, and data consistency tools.

3.2.3 System Management Facility Integration

The framework captures events into a database audit log table, as well as communicating in real time with Hewlett-Packard's (HP) OpenView VantagePoint Operations. If there are failures during the course of data updates, the audit log is used to reconcile inconsistencies. Furthermore, the audit log generates metrics that support monitoring integrated system health. The communication with the VantagePoint product enables real time notification of middleware problems or early notification of potential problems. This facility to support performance management was an easy extension of the overall framework. Applications do not need to change in order to benefit from these monitoring capabilities. In addition, a different system management product can be introduced without impacts to applications. Thus, centralized management and monitoring services are built into the framework. As a footnote, the actual reliability for the program in the last few years has exceeded that of Boeing's mainframe legacy systems.

3.2.4 Performance Engineering

Performance is the measurement of resources required to perform an operation. The most common performance metric measures the elapsed time needed to perform an operation. However, performance also measures utilization – the relative return on the use of a resource. Good performance depends upon a sound architecture and sound implementation. The framework provides measurement characteristics that enable optimal performance.

3.2.5 Loosely-Coupled Interfaces

The AI framework provides a loosely coupled integration approach, which allows product upgrade or replacement without disrupting the rest of the system. Though the AI framework is primarily based on CORBA, which is synchronous by nature, it is not necessarily tightly coupled. As mentioned above, the abstraction layering removes development complexity from an application programmer's perspective. In addition, the AI framework contains asynchronous capabilities including the store/forward and guaranteed message delivery. Distributed-object technology was the key enabler. Applying CORBA led to an innovative system integration approach that aided in the design of a reliable information structure providing great flexibility

4. LESSONS LEARNED

Lessons that have been learned over the course of the program include the following:

- Distributed object-oriented technology has worked very well as the IT model for the program, with CORBA key in implementing this model.
- One of the benefits of the distributed object-oriented use of CORBA has been the ability to easily manage scalability by simply adding hardware and software components.
- The application integration framework has been the key piece for the system and performance management initiatives.
- Because of the size of the program, a "System Integration" organization has been established rather than implementing integration within each application project.
- Highly skilled developers have been relatively easy to find to join the development organization due to the industry standards approach, which diminishes the impact of personnel turnover.
- The CORBA vendor that Boeing selected was instrumental in helping with the integration strategy and implementation of the product.

5. FUTURE DIRECTIONS

The future of the AI framework involves replacing all possible in-house written services with available commercial packages and migrating to a standards-based, component, integration framework. Although no product fully deploys the CORBA 3 specification, a number of features are available today. The migration to CORBA enabled products are part of an overall move to a fully standards-based, component framework where plug and play can be achieved. The ultimate goal is to implement the CORBA Component Model (CCM), but the marketplace is driving to a hybrid implementation of this via Java 2 Enterprise Edition (J2EE). J2EE application servers are becoming the virtual operating system for new systems. Within the J2EE specification are many similarities to CORBA, such as messaging, events and naming services. Fortunately, within the OMG standards body, as well as in Sun Corporation's J2EE specification committees, there is a desire to cooperate rather than compete. In addition, there are initiatives underway within Boeing to investigate internet-enabled portals and gateways that will support a complete enterprise application model.