CIMdata

Eurostep's Share-A-space

Product Lifecycle Collaboration through Information Integration

October 2007

A CIMdata Program Review

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through Information Integration

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Eurostep's Share-A-space

"Product Lifecycle Collaboration through Information Integration"

Today's globally competitive and heterogeneous business environment often requires the quick and efficient formation of virtual organizations, where their various product lifecycles, associated processes, and organizations are integrated. This CIMdata authored Share-A-space Program Review describes Eurostep's solution to this problem domain and provides a review of Share-A-space's ability to support the real life challenges faced when working within a complex and ever changing extended enterprise across a product's lifecycle. Share-A-space provides a business process neutral environment that enables organizations of all shapes and sizes to work together throughout a product's life. It provides an approach to information integration and consolidation of heterogeneous systems, processes, and data models that is somewhat unique and is where many of Share-A-space's strengths lie. Share-A-space is not just a data repository where data mapping is defined with one or more systems. Its underlying capabilities for information consolidation allow it to comprehensively manage and apply changes to the data it manages no matter where the changes originate. Overall, Share-A-space's architecture provides a flexible and scaleable collaborative solution for today's enterprises that have joined together to define, deliver, and support complex products and projects.

1. Introduction

On a basic level, all organizations understand that their intellectual assets (i.e., their product and process related knowledge) provide their foundation for innovation and process transformation. They also understand that without creating, capturing, and leveraging these assets, their organization's ability to innovate and be successful is limited at best. For years this fundamental concept has been promoted and enabled on an organization-by-organization basis by many Product Lifecycle Management[1] (PLM) solution providers. Unfortunately, many of these solutions and the resulting implementations have not been able to fully support the complexities of the engineering supply chains and multi-company structures that are the reality of today's global business environment.

Today's high-tech, automotive, aerospace, and several other industrial sectors are comprised of literately hundreds, if not thousands, of overlapping, interconnected, and heterogeneous organizations that continuously and virtually evolve. To succeed, these virtual organizations must be able to quickly form through the integration of multiple companies and their product lifecycles, associated processes, and organizational groups in the most appropriate and efficient manner. Also, today's business environment often requires companies to rapidly change their business strategies, partnerships, and processes so that they can survive in the current highly competitive global economy. In many cases, they also need to be able to directly and/or indirectly support their products throughout their entire lifecycle—from concept to replacement, disposal, and recycling. For most companies it is no longer acceptable to release a product to the market and forget about it. Lifecycle product management is a critical issue and one that severely challenges most companies. The complexity associated with these new ways of working cannot be well addressed with relatively static processes and support systems. They require more flexible and dynamic solutions that can absorb and enable business changes—not impede them.

History should prove that those companies that can adapt to market changes rapidly, while at the same time providing world-class support for their in-service products, are those that best take advantage of both their own and their partners' intellectual assets. This extended enterprise approach to intellectual asset management is critical if companies want to succeed in a highly leveraged supply chain. In these types of supply chains, companies cannot afford to only optimize themselves; they must find ways to optimize the entire chain. Critically, they must find ways to leverage each company's strengths and knowledge for the betterment of the entire extended enterprise.

[1] A strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life—integrating people, processes, business systems, and information. (CIMdata's definition)

The Advent of Flexible PLM Solutions

Over the past several years, the PLM market has seen a new breed of flexible PLM solutions begin to emerge to meet the needs described above. Share-A-space, from Eurostep, is one of these new solutions. Share-A-space is not intended to be a day-to-day work-in-process data management technology, but rather a business process neutral environment where organizations of all shapes and sizes can work together throughout a product's life; an environment where virtual organizations and teams can drive change and configuration management across the lifecycle processes, and organizational boundaries. Its approach to information integration, consolidation, and access control is somewhat unique and this is where many of Share-A-space's strengths lie.

Share-A-space has been designed to operate across extended, widely distributed and heterogeneous enterprises. In such cases users need to have access to what are often large blocks of product related information that are developed and used at numerous locations This includes finding and gaining access to the right information about a product or project at any stage in its lifecycle, while ensuring that business rules applicable to both the data and users are defined and enforced.

Share-A-space provides a data rich environment where rapid access is provided to product- and project-related knowledge for enterprises that have to conduct their product development and lifecycle support activities in a distributed and changing environment. Share-A-space's approach enables organizations to automatically maintain their product and project information in a system independent format based on the broadly accepted standard for PDM information STEP AP203/214/PDMschema as well as the Product Life Cycle Support (PLCS) standard, ISO10303-239 (STEP AP239), so that it can be quickly accessed without worrying about system dependent data models and applications. This approach allows for the separation of data and its structure from the applications that create and use it. As a result, applications can be changed without affecting other parties' ability to access the data.

This CIMdata authored Share-A-space Program Review describes Eurostep's solution and provides a review of its ability to support the real life challenges faced when working within a complex and ever changing extended enterprise across a product's lifecycle.

2. Company Background

Eurostep, which was founded in 1994, currently employs approximately 65 people, many of which hold advanced degrees (i.e., masters and doctorates) in engineering and other technical fields. Eurostep, with headquarters in Stockholm, Sweden, is well known in the PLM industry for providing software and consulting services on a global basis that focus on information interoperability solutions based on the STandard for the Exchange of Product model data[2] (STEP). Eurostep's STEP experts primarily work out of offices located in Sweden, the United Kingdom, and Finland. Eurostep has recently opened up offices in France and the United States to support its growing business in those countries.

Eurostep's reputation as one of the leaders in the STEP domain is well deserved. Many individuals from their group have been actively involved in the STEP standardization process for years. This involvement includes ongoing work with the ISO standards group on AP214, AP233, and AP239, to name just a few of the ISO standards where their participation has been significant. Their work on AP239, for example, includes both program and technical management. In addition, Eurostep actively participates in a number of other standards bodies and is a member of PROSTEP, PDES Inc, OASIS, and OMG organizations.

Eurostep's understanding of STEP doesn't start and end at the theoretical or standards definition level. They also have extensive experience implementing many of these standards in real world solutions, such as Share-A-space (their primary software solution), SAP R/3 from SAP AG, and ENOVIA from Dassault Systèmes. Eurostep's practical experience implementing STEP has allowed the organization to gain a good understanding of a number of industries, including Aerospace & Defense (A&D); Automotive; Telecommunications; Architecture, Engineering & Construction (AEC); Infrastructure (e.g., organizations that manage large scale facilities, such as airports), Process Industry, and Pharmaceutical.

Eurostep has also gained a solid reputation in the PLM industry as a partner to a number of PLM solution providers, including IFS, Technia, LogicaCMG, Volvo IT, and Microsoft. It is important to note that Eurostep is also known in academic circles through their partnerships with various institutes, including Royal Institute of Technology (KTH) and Chalmers University of Technology.

3. Summary Assessment

Overall, our impression is that Share-A-space is a solid PLM-enabling technology that supports a number of critical business needs faced by companies as they seek to leverage their selected business partners throughout a product's entire lifecycle. Share-A-space appears to be an excellent tool to support secure asynchronous

[2] An evolving international product data representation standard (ISO 10303).

collaboration both within an organization as well as throughout an extended enterprise with all of its various participants. It complements many existing engineering and product-related solutions like Requirements Management, CAD, CAE, PDM, ERP, Integrated Logistics Support (ILS), Technical Document Management, and others, and provides the possibility for these domain specific solutions to deliver additional value to the enterprise and its business partners.

Share-A-space is built on a robust set of STEP standards, including the STEP Product Life Cycle Support (PLCS) initiative, a standard that promises to become a key enabler for process improvements and transformation in several service-focused industries such as aerospace & defense, automotive, machinery, and telecommunications. Having had the opportunity to review a number of production Share-A-space implementations (see section entitled "User Assessment"), it is clear that Share-A-space meets many end-user requirements. The companies we interviewed reported that the solution was easy to install with a low initial investment and that they were able to relatively easily plug it into their existing Information Systems (IS) / Information Technology (IT) architectures.

At its core, Share-A-space is a STEP-based (AP214, PDM schema (AP203, 210, 212), AP239/PLCS, and AP233) information integration, consolidation, and sharing solution. It has been designed to support secure asynchronous collaboration and data consolidation in an extended enterprise environment, including the enablement of change and configuration processes that span organizations, processes, and lifecycles. With PLCS as its key enabler, it has been designed to support the management of product related data throughout a product's complete lifecycle—from requirements to in-service support (see Figure 1).

On one level, Share-A-space is a Web-based Enterprise Application Integration (EAI) technology—in that it can be seen as a data hub and a set of system adapters that bring together information from multiple heterogeneous systems. But more importantly, it is a collaborative workspace where heterogeneous organizations can work together with a shared set of data that describes their common product; no matter where they are in the lifecycle or in the extended enterprise. Clearly, Share-A-space is not just an EAI tool that focuses on processing data-related transactions, but rather it is a data-centric solution that focuses on information consolidation and integration in a heterogeneous business and product context. This context removes organizational-specific processes so that virtual organizations can communicate and leverage data without having its members continually re-engineer their processes and data model definitions for each new product and/or extended enterprise effort.

In many ways, Share-A-space is one of a few new PLM-enabling technologies being provided in the market that seek to separate product-related data from the product-related creation and management processes, while at the same time directly supporting the need to drive change and configuration management across heterogeneous organizational, process, and lifecycle environments. There is no doubt that Share-A-space and similar PLM solutions will play an important role in extending the concepts of PLM into the lifecycle supply chain of many industries without forcing companies to modify the way they work internally.

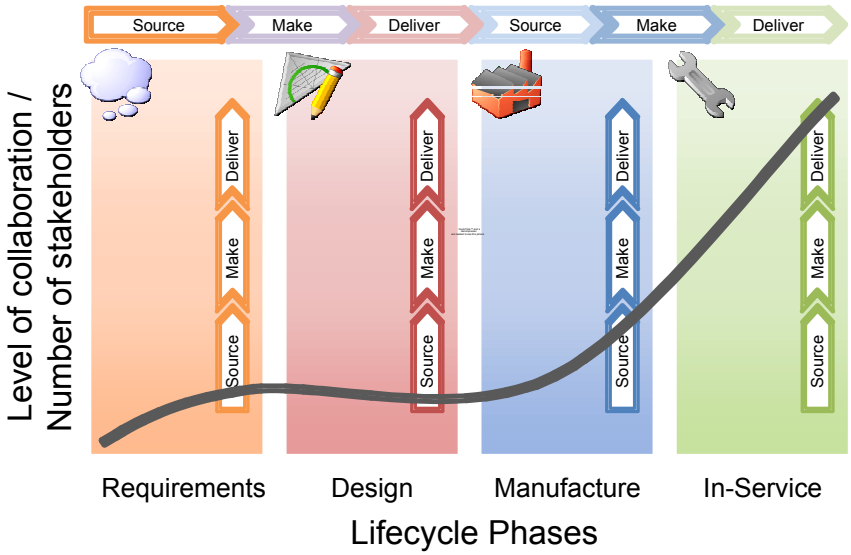

Figure 1—Share-A-space: Supporting the Complexity of the Entire Product Lifecycle

4. Share-A-space's Position in the PLM Market

Today's PLM solution market is crowded with PLM enabling technologies of all types—all competing for a piece of this rapidly expanding market. Currently, CIMdata's research organization tracks approximately 300 PLM solution providers on a regular basis, of which more than 40 of them provide what CIMdata classifies as *comprehensive collaborative Product Definition management* (cPDm) solutions. These solutions primarily provide broad-based product data management functionality, e.g., vault management, product structure management, classification management, workflow management, etc. Many of these are best suited for single enterprise

deployment. Share-A-space is intended to add value in heterogeneous environments of all sizes—the more complex the enterprise (e.g., the greater the distribution of systems, data, users, organizations, etc.), the greater the opportunity. Share-A-space has been designed so that current systems remain in place but at the same time data is consolidated and made both compliant to standards as well as easily available for authorized business partners throughout the virtual organization it supports.

Share-A-space's Key Differentiators

Unlike most commercially available cPDm and other enterprise-class information management solutions, Share-A-space provides a neutral, standards-based repository for shared product information, and a "business process neutral" environment for connecting multiple information sources of partners (internal and external) who need to collaborate in a virtual and controllable workspace. This is accomplished through the implementation of a fixed object schema making it a "pure" data sharing mechanism that is independent of, and not encumbered by, the different and often conflicting business processes used by the partners. As a result, Share-A-space can provide rapid and unambiguous information consolidation, integration, and exchange between systems with different business logic, while also providing audit and persistent configuration management capabilities across business domains.

Share-A-space differs from most other PLM technologies on the market today because it provides a repository for long-life product information that should endure for the lifetime of the project or product because of its standards-based neutral data structure that is not dependent on the unique processes used by any specific company. It should not only endure over time but also through the changes that will occur to the virtual organization's partners, information systems, and business processes.

Business Operating Model Support

Share-A-space's approach that integrates organizations, processes, and lifecycles, eliminates the need to rationalize and force changes in systems, processes, and data constructs of heterogeneous organizations. Share-A-space enables this by allowing the individual processes and systems of each organization to operate normally, while consolidating and rationalizing the mutually shared information within its repository. Because of this, Share-A-space is an appropriate solution for a number of business operating models. One is where a company has a number of distributed divisions and organizations that need to perform significant portions of work-in-process and/or lifecycle support on a product, each in a stand-alone manner.

Another business operating model for which Share-A-space is applicable is where significant portions of product design, development, and lifecycle support are outsourced to suppliers who need to work within their own systems environment. Each supplier needs to integrate, exchange, and/or consolidate the OEMs information with their local, proprietary information for access and use by their user communities without having to work with their OEMs' systems.

A third situation for which Share-A-space is quite appropriate is one in which product information is created by a series of contactors who then maintain that information while the product itself is used and maintained by another organization. This situation is very common in the aerospace and defense industries.

A fourth identified source of the need focuses on integrating information created in different organizations in support of mergers and acquisitions (M&A). The strongest motivational factor for M&A is often the expected synergies from the economies of scale reached as a result of the integration of the companies. These synergies, and thus profits, are often not realized as quickly as intended, because of the difficulties in integrating the information systems. These difficulties can be minimized by the use of Share-A-space.

In each of these situations, both local and remote product-related information needs to be integrated and consolidated into a single, logical information repository, complete with the appropriate lifecycle information management rules (i.e., change and associated configuration management rules). This information repository needs to be able to manage all the relevant information, not just the product's bill of material, but all the related product information, e.g., requirements, specifications, 3D-models & drawings, instructions, software, maintenance manuals, spare parts lists, serialized product configuration, etc.

When users have a single source of product information with which they collaborate that provides both the information they need and ensures that the information is clear, concise, and valid, they are more likely to be efficient and have the time to innovate. This type of environment enables local, site-specific processes to be maintained while ensuring that information created remotely but used and possibly changed locally, is also updated as required throughout a product's life. Share-A-space can enable such an environment.

Virtual Organization Support

Share-A-space is not the main place where information is created, but rather where information is consolidated and collaboratively shared. Share-A-space focuses on building and managing relationships among information that

comes from multiple companies and multiple systems throughout an extended, virtual enterprise.

As these virtual organizational constructs evolve, solutions will need to do the same. They will need to be able to support the complexities of multiple information identifiers (e.g., multiple parts numbers that identify the same part), a large variety of software integrations and hardware platforms, company unique processes, user administration across legal entities, and business ethics (e.g., Intellectual Property Rights issues) and security as they evolve.

As companies continue to form and morph their suppliers, partners, and customers in their extended intellectual supply chains, the opportunities and need for Share-A-space and other product-centric, neutral collaborative platforms will increase. The platforms that will more likely survive over time, will be those like Share-A-space, that can de-couple information from the heterogeneous business processes that are often used to create and management it.

Potential Benefits

Some of the benefits associated with Eurostep's approach to information consolidation, integration, and exchange include the fact that a "big-bang" approach to system implementation is not required. This is because existing data authoring systems remain in place, and provide Share-A-space with the information that it consolidates. Companies utilizing Share-A-space also benefit from the fact that it is a standards-based tool that greatly minimizes the risk that it will not be able to support a product's or project's complete information lifecycle. The third, and probably most important benefit is that Share-A-space provides a company with the keys that can unlock the true value of an extended enterprise's complete set of product related information (i.e., its intellectual assets).

5. Eurostep's Share-A-space Program

Eurostep's Share-A-space program (i.e., the development, consulting, implementation, sales, and other services supporting the Share-A-space solution) has organically grown into a well-rounded set of services all designed to support their clients before, during, and after a Share-A-space implementation. As mentioned earlier, Eurostep currently employs approximately 65 people. Most of these employees are very "well versed" in STEP, PLCS and its implementation within real business enabling PDM and PLM environments. Eurostep's practical experience led them to the understanding that traditionally, business rules are required to determine the structure of information. As a result, each company's rules can be different, thereby making traditional approaches to managing the data not just complex, but often not supportable by many of the traditional PDM/PLM software solutions. Based on their experience, Eurostep strongly believes that information and the business rules associated to it must be separated.

The Share-A-space solution was initially launched with the objective of supporting collaborative design practices across an extended supply chain. Share-A-space's original concept was based on the idea that multiple supply chains in the overall product lifecycle required data management capabilities that were separate from the business processes. This concept has grown into today's Share-A-space solution where product information can live in a neutral structure that is not dependent on the unique processes used by any specific company. Eurostep's experiences from customer projects have convinced them that this approach is very powerful, as well as flexible.

Eurostep has developed a solid business program around Share-A-space to support its sales and implementation. In the area of sales, Share-A-space is primarily sold through a direct sales channel with an indirect sales channel providing support in a few regions. The direct sales channel is used to support specific geographic markets, primarily where Eurostep has offices (e.g., Sweden, UK, Finland, Germany, France, and the United States) and to companies who will contribute to the development of Share-A-space's functionality (e.g., BAE Systems Hägglunds, FMV, and the Swedish Defence Materiel Administration).

An alternative sales model that holds promise for Share-A-space is the Internet Service Provider (ISP) approach. With this approach information technology service providers, such as Volvo IT and LogicaCMG, host Share-A-space and market the solution as a service at a "neutral" location. Since Share-A-space is a neutral data repository for virtual organizations, this approach appears quite sensible.

Share-A-space is primarily sold for a "per month rental fee" (i.e., right to use licenses) including software maintenance, full support, and software upgrades. The actual price to be paid varies depending on the number of project rooms, which are called "A-spaces," the software modules installed (e.g., Base, Effectivity, Engineering Change, Workflow, Physical Product Maintenance, Physical Product Configuration, Requirement Management, and Maintenance Design and Planning), and the number of users who have access to each A-space. Each implementation of Share-A-space can have one to many A-spaces, with each A-space managing one project (see Figure 2). Licensed (i.e., installed on a company's hard-

ware) or hosted services are available for the typical installation.

Benefits resulting from Eurostep's rental pricing approach for Share-A-space include the fact that the entrance level price is kept low. Once Share-A-space is installed, it is relatively easy to expand its usage by opening new project rooms (A-spaces) within the same installation without paying a significant amount of money each time. This approach allows a customer to increase or decrease its usage and only pay for actual usage over time.

During the implementation of a typical Share-A-space solution, the customer's resources, and often a systems integrator's resources, supplement Eurostep's team. Eurostep's implementation approach is focused on providing STEP and Share-A-space best practice support during the implementation process while allowing other organizations to provide the general IT skills. Eurostep has stated that they believe it is important for them to stay focused on Share-A-space solution development and STEP expertise, and not to become a traditional systems integrator. CIMdata is happy to see this approach and believes that this combination should provide Eurostep's customers with the most effective implementation support.

Finally, it should be mentioned that Eurostep's software development resources have done a commendable job. They have artfully taken, leveraged and expanded the appropriate STEP standards and Web-based technologies to deliver a robust and relatively easy to use set of functionality. By leveraging a robust data model, Eurostep's development staff, which is comprised of a number of highly educated individuals, has been able to focus its attention on the user experience, the overall flexibility of the solution, and ease of implementation. Eurostep reports that a typical Share-A-space implementation only takes a few weeks to be fully operational. In addition, they have been able to supplement their efforts through key development agreements with a few of its customers. As a result, Eurostep's virtual development organization is much larger than it would appear from the outside.

6. Share-A-space Functional Assessment

The roots of Share-A-space trace back to 1999 when Eurostep began to develop technology that would support STEP-based data collaboration and integration. Share-A-space was first released in early 2001. The currently available version of Share-A-space is Release 5.5

At Share-A-space's core is a rich STEP model. The earlier releases of Share-A-space leveraged the STEP AP214 data model. But with the advent of the PLCS (AP239), Eurostep saw and seized on the opportunity to develop and deliver a full lifecycle-based collaborative product data integration, consolidation, and exchange platform. In many ways Eurostep has gone one step further with AP239. For example, they have added a significant amount of detail on top of the AP239 definition, such as a rich security schema and other software specific system behaviors. Additional areas of extension include information maturity (i.e., the ability to define lifecycle states on managed objects), organizations, and a number of generic structure and modeling engines through the use of super types.

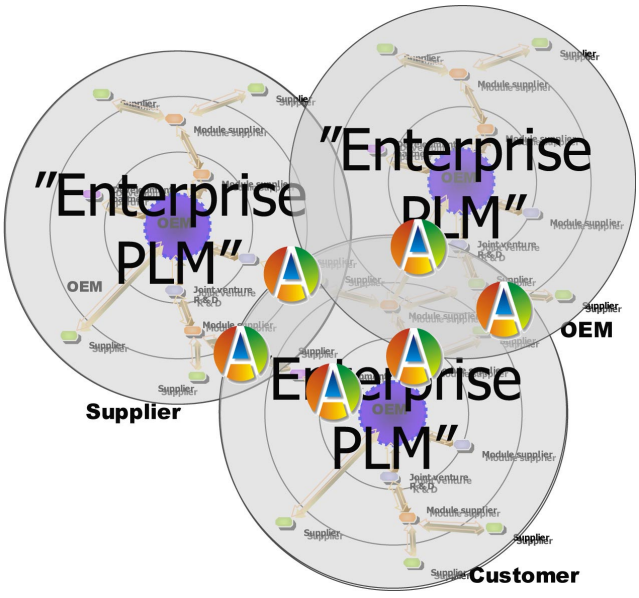

Figure 2—Internal and External Facing A-spaces

Share-A-space's leverage of the STEP standard is extensive. The solution takes advantage of some 500 entities with heritage from the STEP standard. Eurostep has kept these STEP entities as explicit objects within the database. This has allowed them to enable specific access rights down to the individual object level, thereby allowing access rights to be defined by the owners of each object. This decentralized object ownership approach allows for a high level of flexibility and for links between objects to be created, controlled, and changed rapidly. These capabilities all play a critical role in Share-A-space's ability to deal with the complex data, process, and organizational interrelationships (both dependent and interdependent) among the participants in a virtual enterprise (illustrated in Figure 3).

The complexity that Share-A-space manages should not be underestimated. Typical organizations that form virtual enterprises have their own, usually highly tailored, product lifecycles, processes, and data model definitions. For the virtual organization to work efficiently across such a heterogeneous environment, technologies that

wish to consolidate data and enable collaboration ultimately must be able to not only consolidate the data but also manage the configuration of it for the lifecycle of the products related to it. This means the technology must enable audit and persistent configuration management capabilities. It is upon these requirements that Share-A-space was designed and constructed.

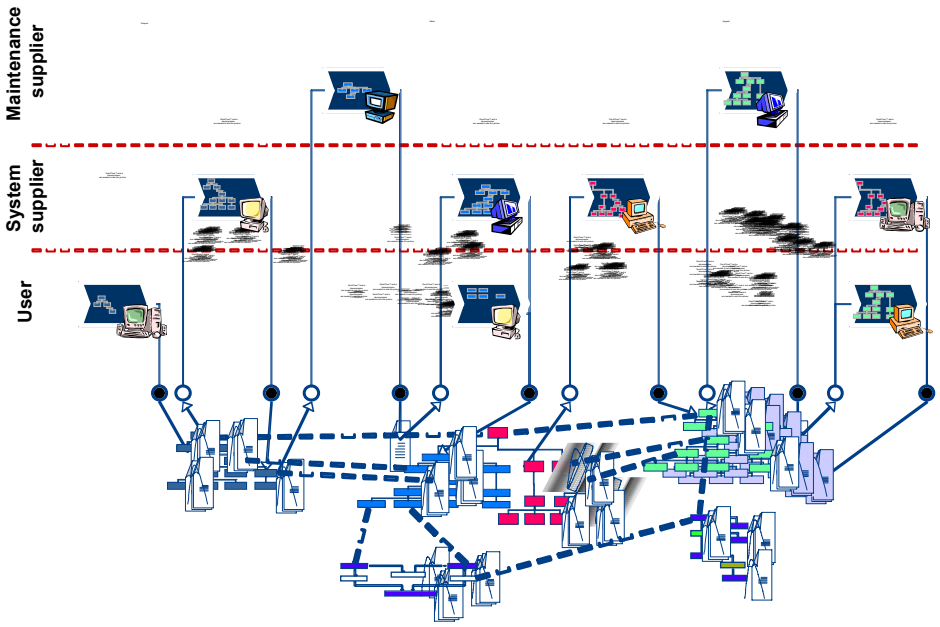

Figure 3—The Complex Reality of Today's Virtual Organizations

One of Share-A-space's key strengths, which allows it to support the complexity illustrated in Figure 3, is its implementation of this rich STEP-based object schema. Not only does this provide the business process independence needed by today's virtual enterprises, but it also provides a very rich reference framework. As a result, other lifecycle information models can relatively easily be mapped onto the shared environment without any schema extension or customization. As a side benefit, any data stored in Share-A-space becomes STEP and PLCS compliant and this is an attractive way to "get to STEP and PLCS" instead of trying to upgrade in-house legacy systems.

Core Features

Fundamentally, Share-A-space provides data consolidation on an extended enterprise level. This enables incremental changes to product data to be quickly captured from authoring systems, integrated into the shared total product definition and published, thereby supporting multiple views throughout a product's entire lifecycle. In addition, Share-A-space is a data sharing "hub" that provides a lower-cost alternative to costly maintenance of direct interfaces between multiple enterprise systems (e.g., PDM, ERP, SCM, etc.).

Key Share-A-space design features include:

- Oracle database based on the ISO10303-214 and -239 standards enabling a rich and neutral information repository
- A model driven software design, enabling fast and information model consistent development
- An independent data consolidation engine for advanced information access
- Support for multiple data exchange formats based on either STEP technology or straight text based formats

Key Share-A-space functionality features include:

- Context dependant identification allowing for multiple, yet unique identifiers
- Context dependant part structure handling allowing for view separation of structures
- Context dependant associations of properties, documents, parts, etc., for managing complex information constructs
- Information ownership driven access rights control

Architecture

Share-A-space's architecture (see Figure 4) takes advantage of XML for data communication and a robust set of Web-based technologies.

Eurostep has explicitly defined and implemented approximately 500 data objects in the database. In comparison, some of today's major commercially available enterprise software systems only implement 30 to 50 data objects. The data model enables Share-A-space to represent and consolidate information gathered from multiple sources without disturbing the integrated systems and processes. Eurostep reports that they use the STEP EXPRESS model to define the database. This also allows them to use the EXPRESS model to drive Unified Modeling Language (UML) definitions that are in turn used by IBM Rational's UML software programming tools to support the development of the application server's functionality. This development approach has apparently allowed Eurostep to quickly and easily extend Share-A-space's capabilities as the STEP standards have evolved. This is important since the database is used to define and manage product data and links between the

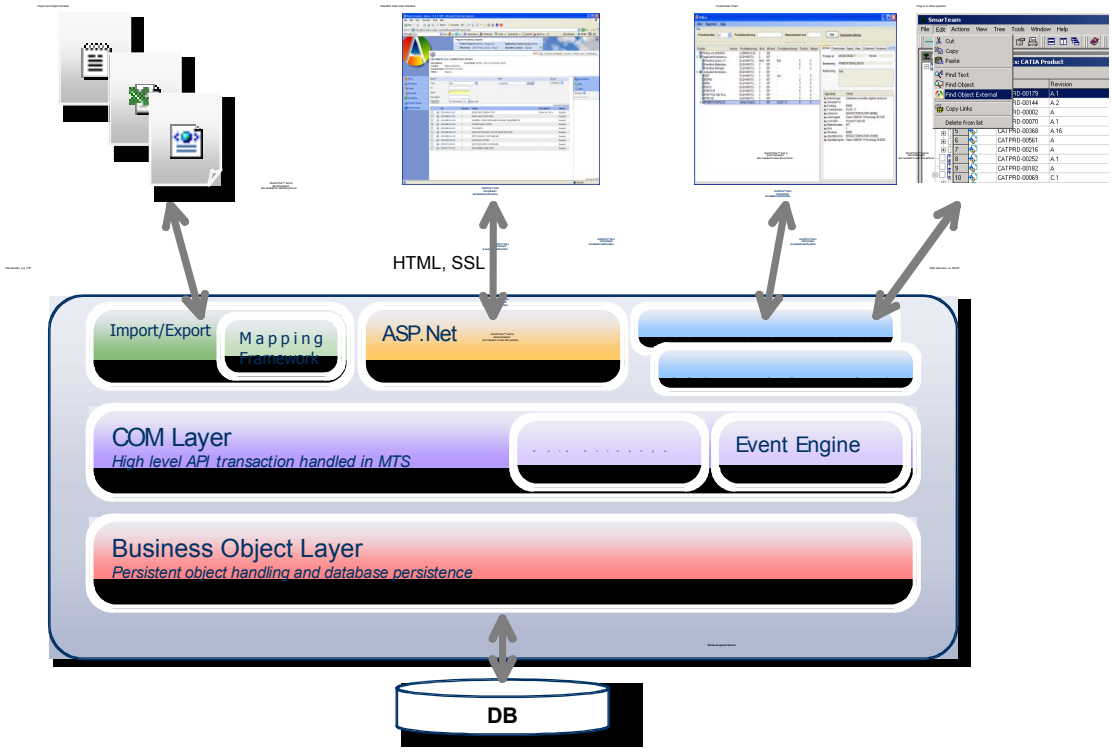

Figure 4—Share-A-space Architecture

managed meta-data utilizing Eurostep's enhanced STEP compliant data model. It is also important to note that files can be referenced by the meta-data, and that they are stored in a secure file system managed by Share-A-space.

In a typical configuration, the Oracle database is run on a Linux, UNIX, or MS Windows server with the Share-A-space application server run on a separate MS Windows machine. Eurostep reports that this configuration supports load balancing and robust security practices.

The application server supports Share-A-space's layered architecture. Examples of layers include a Business Logic Layer and a Presentation Layer, leveraging the .NET Framework. The Business Logic Layer manages the core business rules of the application, while the Presentation Layer manages user interaction rules. The combination of these rules governs the behavior of the application.

On the client side there is only the requirement for a web browser such as MS Internet Explorer or Firefox. This is because the application layer leverages Active Server Pages (ASP.NET) that publishes pure HTML. There is no client install, but Cookies are downloaded at runtime. Information is communicated to the user interface, which can support any language and is tailored on a user level through the use of a configurable XML file (currently configured for English), via a Secure Socket Layer (SSL) with 128-bit encryption. Eurostep reports that other types of encryption can be plugged into the architecture if needed, like a smartcard solution confirming the identity of a user against an identity server, a Virtual Private Network (VPN) wrapping all access to the Share-A-space Server, or other similar mechanisms.

The Web Service layer of the architecture is the most commonly used integration mechanism. This mechanism allows for XML data transfer from and to any Web-enabled system. The Web Service layer currently supports the OASIS PLCS PLM Web Services based on ISO10303-239 and the OMG PLM Services based on ISO10303-214. The Web Service layer can either used as an API allowing for remote control of Share-A-space or as a traditional Service Oriented Architecture (SOA) component. When used as an API, specialized clients, analysis tools, and interfaces can be built on top of it. When used as a SOA component, Share-A-space's Web Services together with its event engine can be used to orchestrate information driven change processes across the SOA environment.

For those customers who wish to leverage Share-A-space's managed information and write reports, STEP's Part21/28 import/export logic is supported, as well as a standard XML interface.

Packaging

As previously mentioned, Share-A-space functionality is delivered through a number of software modules. Each of these modules provides a number of capabilities that support different lifecycle product management require-ments. All implementations of Share-A-space include the

Base module. This foundation module provides support for product composition and "where-used" capabilities, as well as the ability to manage multiple product structures (e.g., as-designed, as-planned, as-serviced, etc.).

Other modules include:

- *Engineering Change* module includes advanced support for the complete change process, from an engineering change request to an approved engineering change order.
- *Effectivity* module supports management of effectivity in different views and for different participating organizations in a manner that provides past, present, and future control.
- *Workflow* module allows each partner within a Share-A-space A-space to follow his/her own approval process and simultaneously stay coordinated with the approval process agreed upon for the collaborative project.
- *CAD Viewing* module supports viewing of models created in all major CAD systems. This module leverages Actify's SpinFire viewer. Eurostep reports that other viewing tools can easily be integrated.
- *Physical Product Configuration* module focuses on managing serialized and non-serialized in-service products. It supports relationships between in-service products and their designs and other supporting documentation. The module also supports effectivity management.
- *Physical Product Maintenance Management* module supports the management of maintenance tasks to be performed on an in-service product. The module also supports the management of all maintenance related documentation and product configuration information.
- *Requirement Management* module supports the management of early phase information and systems engineering processes. Focus evolves around system, function, and requirement information. This module provides full traceability from requirements to in-service support.
- *Maintenance design and planning* module provides maintenance task and schedule handling. Planning information can be managed within both design and in-service support lifecycle phases.

CIMdata expects Eurostep to continue to expand the number of modules in subsequent releases of the software.

To complement the Share-A-space server solution Eurostep provides a product suite of prepackaged interfaces and software for interface development. By using these tools, standards compliant information exchanges are rapidly created. These exchanges support Share-A-space collaborative solutions as well as stand alone applications. Examples of tools include developer tools supporting ISO10303-239 PLCS for the Java Platform, C# and C++. For PLM software such as SAP R/3, PTC Windchill, RequisitePro and DOORS prefabricated interfaces are offered.

Concluding Remarks

Overall, Share-A-space's architecture provides a flexible and scaleable collaborative solution for today's enterprises that have joined together to define, deliver, and support complex products and projects. Its implementation is fairly straightforward. In fact, very little work has to be done to set up Share-A-space. Most of the work focuses on defining the links to the systems feeding and receiving information from/to Share-A-space. With its robust data model already built-in, most of the other implementation decisions deal with defining how changes to the data will be applied once the solution is actively used.

It is important to note that changes are bi-directional in nature (i.e., they can originate within Share-A-space or within a feeding system and then applied to the data managed by Share-A-space). As a result, each Share-A-space implementation defines the change process rules to be applied to the data and structures managed by the solution. It is important that this is done in this manner so that data ownership and access to information as it changes throughout the product lifecycle is properly and proactively handled.

7. User Assessment

Share-A-space was initially implemented in June 2001. According to Eurostep, there are now quite a few comprehensive implementations that can be assessed. During the development of this program review, CIMdata reviewed four such implementations—Volvo, BAE Systems Hägglunds (BAE Systems), and Saab Bofors Dynamics. Each one of these provides a good example on how Share-A-space is being used to solve real business issues in today's highly complex business environments. In addition, Eurostep participates in a number of industry-funded initiations (e.g., VIVACE).

Volvo

This implementation supports a number of engine development projects between seven different Volvo Group companies and three different Deutz (an engine design organization) departments. Each of these projects requires communication of engine structures and documents between specific Deutz and Volvo organizations. As usual, each group has different ways of managing the structures and use different supporting information systems. To overcome these complexities and to replace their paper-based information communication mechanisms, Volvo and Deutz implemented Share-A-space.

Problem Statement

For the Share-A-space implementation to be successful it had to support the integration, consolidation, and exchange of three product structures—design, sales, and spare parts. In the case of Volvo/Deutz, three different groups are responsible for each of these structures that must be managed, linked, and updated as changes are applied throughout the design and service life of an engine. It is the Deutz motor design department that provides Volvo with a design structure. The sales department provides information about the current offering of engines (possible-to-order), and the spare part department provides information about available spare parts for engines produced.

To make things more complicated, these structures are delivered at different points in time during the development cycle. Volvo in turn uses these structures to produce their spare-parts structure.

Implementation Described

During the implementation of this Share-A-space installation, Eurostep worked with all the parties involved to define the way they would collaborate. The basic idea behind this Share-A-space implementation was that it would provide a common area where all the communicated information would be available and visible to both companies. This common area was defined so that it could store and display all relevant information, and manage and control changes to it. If needed, data can be exported to internal systems, using STEP or text files, as well as being made visible through basic reporting functionality provided. The information supported by Share-A-space in this implementation includes:

- Parts including part properties from Design, Sales and Aftermarket
- Design structures, assemblies
- Sales structures
- Spare part structures
- Spare part Drawings
- Engineering Drawings
- Engineering Change Orders

Beyond defining the data within the scope of the implementation, Eurostep also helped the organizations define their data management responsibilities, which are as follow:

- Deutz provides information concerning Design, Service, Drawings, Design Changes Notices, Documents, and other product-related items. They are responsible for providing and updating the information in the shared A-space.
- Volvo is responsible for retrieving and using the provided information in the proper manner, as defined by the agreed upon change rules.

This structure allowed information managed by several systems within Deutz to be used by several systems within Volvo without having to manually intervene and transform the information. Benefits received by both companies are reported to have been significant and almost immediate.

BAE Systems Hägglunds

BAE Systems Hägglunds (Hägglunds) is a Swedish-based manufacturer of combat vehicles. This BAE Systems' group has more than 1,100 employees and primarily designs and produces light-armored combat vehicles for the Swedish, Finnish, Dutch, British, and Swiss armies.

Problem Statement

As is the increasing case in today's complex defense market, defense contractors have to be able to produce and support vehicles locally. As Hägglunds has transitioned from a Swedish defense contractor to an international one, they have faced the complexities and challenges of working within an increasing dynamic structure of suppliers and customers. This situation was highlighted when Hägglunds won a significant contract from the Swiss army in 1999.

This contract has resulted in them identifying and working with more than eighteen local partners throughout the lifecycle of the Swiss combat vehicle. To make things "worse", each one of these partners had their own unique business processes and product data systems.

Some of the major provisions of the contract included the requirement that Hägglunds manufacture most of the vehicles in Switzerland, and provide maintenance of the fielded vehicles for ten years. This second provision, even if one company does all the work, is difficult to support. Let alone if there are more than dozen suppliers involved. To add another level of complexity, Hägglunds' solution had to be able to support the configuration management of the design data as well as the in-service data and relationships among them (see Figure 5). Like many companies who have tried to support these distinctly different business environments, a new approach to lifecycle management is often required. In many ways this is what led Hägglunds to invest in a Share-A-space solution.

Implementation Described

Hägglunds Extended Enterprise MANager (HEEMAN) solution is based on Share-A-space. It has allowed Hägglunds to leverage their manufacturing and support partners in Switzerland and to publish product data to them in a timely manner. In summary, HEEMAN allows

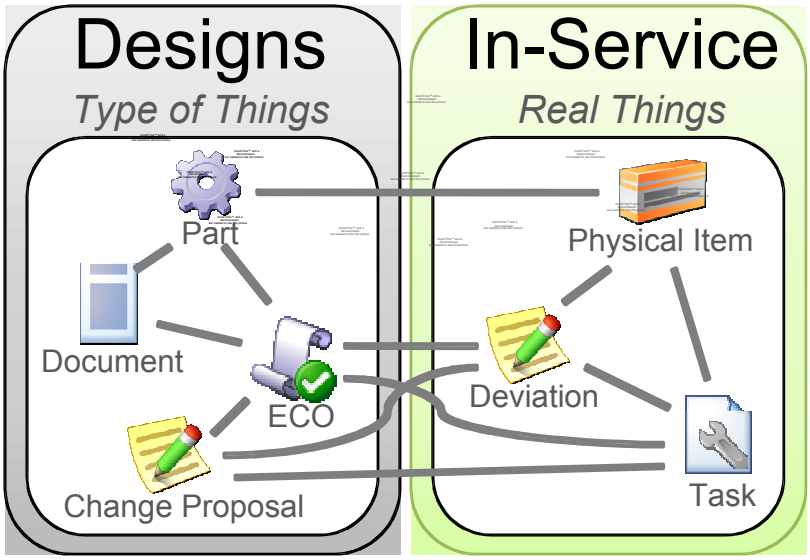

Figure 5—The Interrelationships Between the Design and In-service Worlds

Hägglunds to support the following collaborative use cases:

- Local Manufacturing, including the transfer of product structures, design specifications and drawings to suppliers
- Translation of Technical Publications, including the distribution of SGML text files to contracted supplier for translation
- Modification Service/Configuration Management, with a focus on in-service information like serialized product structure change management and status accounting

In general, Share-A-space provides a shared information platform for all parties involved in the Swiss army contract. It has been integrated with a number of Hägglunds' systems, including an internal homegrown product data management system, a document management system, and their Baan ERP system. Finally, Share-A-space provides Hägglunds and its partners with a common information repository were in-service product structures can be managed throughout each vehicle's in-service life.

Hägglunds' Share-A-space implementation also is reported to have proven to be an efficient environment for storing published product lifecycle configuration information, without the overhead of an enterprise PDM system.

Saab Bofors Dynamics

Saab Bofors Dynamics (Saab) is a supplier of precision weapon systems for the Swedish defense organization as well as other countries. Saab Bofors Dynamics is recognized for advanced defense systems that meet the evolving requirements for precision delivery of the appropriate firepower. Saab Bofors Dynamics prides itself on designing and producing high-performance state-of-the-art systems that are reliable and designed to operate in all combat environments.

Problem Statement

Saab, which has advanced engineering and manufacturing scattered across multiple sites, is the result of the merger of several companies and business units. Saab's stated goal is that the operation should run according to their "One Company" vision. To support this, Saab made the decision some years ago to implement a company-wide system for Enterprise Resource Planning (ERP); this has been an important step in pursuing their goal. The ERP system is successfully operating and has functionality to support PDM/PLM at the corporate level.

The company's multiple autonomous beginnings have resulted in the use of different engineering data systems and processes. Their challenge has been to actually integrate and harmonize these businesses and their supporting engineering software packages and associated processes.

Implementation Described

Saab's implementation of Share-A-space illustrates many of the data integration and consolidation strengths that it offers. In Saab's implementation, Share-A-space acts an information broker. It sits between a number of their PDM systems and their enterprise IFS ERP system, acting as a master data consolidator and integration mechanism. In this implementation Share-A-space is used as an IT middleware. As a result, it has no individual users—only system users.

These examples clearly illustrate the flexibility and capabilities of Share-A-space. Eurostep has done a good job focusing on solving a number of problems that arise when working in an extended enterprise environment. In the cases described herein, Share-A-space was implemented relatively quickly and was reported to have produced benefits almost immediately. These examples demonstrate that Share-A-space can add value to an existing PLM environment and provide functionality that has been difficult, if not impossible, to enable in the past. In addition, these examples show how Share-A-space can be used as a backbone for an extended enterprise's

information management strategy that directly supports a virtual organization's need to drive change and configuration management across the lifecycle, its associated processes, and organizations.

VIVACE Project

Eurostep participates in several research and development projects that focus on how to work in a virtual enterprise. CIMdata believes these kinds of forward-looking projects are of vital importance for Eurostep to further develop an understanding of the value Share-A-space delivers. One such project is VIVACE (Value Improvement through a Virtual Aeronautical Collaborative Enterprise). VIVACE is funded by the European Commission under FP6. Sixty-five partners from eleven countries are currently participating in this international project.

The main result of the project is expected to be an aeronautical collaborative design environment and associated processes, models, and methods. The VIVACE project's objectives are to develop advanced capabilities for knowledge enabled engineering, multidisciplinary design, optimization design to decision objectives, and engineering data management. In addition, the project is meant to define the requirements for a Distributed Information Systems Infrastructure for large enterprise and Collaboration Hub for heterogeneous enterprises. Eurostep has provided Share-A-space as an information integration hub. Additional information related to this project can be found at www.vivaceproject.com.

8. Conclusion

Share-A-space is solid PLM-enabling technology that supports extensive, secure, and complex information integration, consolidation, and exchange in the context of real worldwide virtual organization. CIMdata is impressed with Eurostep's approach and are happy to see the success that their approach to systems integration has provided for a number of their customers.

Share-A-space is a product-centric, neutral partnership platform that de-couples information from business processes. It has proven its ability to support existing PDM systems and provide value throughout a product's entire lifecycle—from requirements definition and product design to in-service support and decommissioning. Its functionality not only supports asynchronous collaboration during a product's design but also during a product's in-service configuration management/product structure management support period. Share-A-space's capabilities in this area would not be possible if it was not for its architecture that takes advantage of STEP's robust Product Life Cycle Support (PLCS, STEP AP239).

It should be noted that Share-A-space is meant to provide a business process neutral environment where organizations of all shapes and sizes can work together throughout a product's life. Its approach to information integration and consolidation of heterogeneous systems, processes, and data models is somewhat unique and this is where many of Share-A-space's strengths lie. Share-A-space is not just a data repository where data mapping is defined with one or more systems. Its underlying capabilities for information consolidation allows it to comprehensively manage and apply changes to the data it manages no matter where the changes come from; something traditional transaction-based systems are not able to easily perform.

Share-A-space addresses unique extended enterprise issues by being fundamentally designed to support this situation. Eurostep has designed the software as a collaboration tool in all its aspects, an approach that is different from tweaking an enterprise's current PDM/ERP solution. Eurostep's rich STEP heritage provided the background necessary to build this new breed of PLM-enabling technology. Finally, Share-A-space appears to be an excellent tool for secure asynchronous collaboration both within an organization as well as throughout an extended enterprise.

CIMdata is impressed with what Eurostep has done and it is encouraged to see a number of excellent real world Share-A-space implementation examples. CIMdata looks forward to tracking the evolution of the STEP AP239 standard and is happy to see that Eurostep has put it into practical use. There is no doubt that Share-A-space holds the keys to a number of different and difficult extended enterprise information integration, consolidation, and exchange issues. Many of which center around the clear need to provide consolidation and configuration control that enable audit and persistent configuration management capabilities across business domains. Finally, CIMdata looks forward to seeing and evaluating additional experiences from companies implementing Share-A-space in the future.

About CIMdata

CIMdata, a leading independent worldwide firm, provides strategic consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM). CIMdata works with both industrial organizations and suppliers of technologies and services seeking competitive advantage in the global economy by providing world-class knowledge, expertise, and best-practice methods on PLM solutions. CIMdata also conducts research, provides subscription services, produces several commercial publications, and offers industry education through international conferences in North America, Europe, and the Asia-Pacific region.

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