Maintaining Excellence through Collaboration

The future of Integrated Logistic Support Services

The development of Internet-based technology provides the opportunity for unprecedented levels of collaboration in providing comprehensive and cost-effective logistic support services.

Business Drivers

During the 1990's defence budgets were reducing at approximately 3% per annum. In the main that decline has now slowed and in some cases stopped, but forecasts are for moderate growth and stabilization at levels of defence expenditure approximately 40% of those in the mid 80's.

All aspects of the Defence budget have been forced to reduce, with defence procurement and equipment support budgets being the most severely affected. Governments are now trying to address the common problem of increased maintenance costs and reduced availability from aging equipment.

Similarly in the commercial airline industry, the global Maintenance, Repair and Overhaul (MRO) business is faced with creating total service packages to attract future work, as airlines accelerate outsourcing and retire aging aircraft to minimize life cycle and transaction costs. Third-party service providers are challenging the market share traditionally dominated by the major airline subsidiaries and original equipment manufacturers (OEMs).

In a related development, the approach to equipment acquisition has also undergone significant changes in recent years. Contracts have moved towards greater continuity between the design and manufacturing phases. Increasingly major defence contracts include elements of life cycle support.

With budgets under increasing pressure, manufacturers and operators are being forced to develop new and innovative ways of managing their businesses, in order to remain competitive. Through-life information management is one of the major growth areas. It is now accepted that knowledge captured during product design and manufacture phases can be used to generate new business in 'downstream' product support related activities and services.

Effective through life information management is, however, far from simple. A wide variety of information is required to define, maintain and operate a product throughout its operating life. Maintaining a timely and accurate representation of the information is a major challenge, since the product configuration is constantly changing. In general, feedback systems detailing the 'as-maintained' configuration and equipment usage are not effective, leading to poor quality information on which to base decisions.

Information technology has become a key driver of strategy, management and operations. Recent developments in Internet technology, e-business and collaborative commerce (c-commerce) provides an opportunity for a new business model to be established, based on partnership and collaboration in a domain specific 'virtual enterprise'.

If the information management challenges can be met, it will protect the investment capturing and controlling the product life cycle support information and will open up a wealth of opportunities for new value-added customer services.
Collaborative Commerce becomes the new business model

As the Internet enables e-business and collaborative commerce (c-commerce) many of the traditional rules for doing business are being altered. The combination of evolving business drivers, changing customer demands and the evolution of enabling technology is producing a business revolution that is relegating enterprise-focussed systems to niche component status.

E-business connections are changing the way enterprises deal with partners, information access, services and speed as key differentiators. Web connections enable collaboration, making it critical to optimise business processes across enterprises rather than just within an enterprise. Success now depends on realigning inter-enterprise business processes to provide value by packaging customized services and products for each customer.

Enterprises are therefore changing from vertically integrated supply chains to inter-connected “ecosystems” of suppliers and customers.

Crucial to success as a player in this “net-liberated enterprise” will be an individual enterprise’s agility, both from business process and application perspectives. Enterprises will find that their traditional systems are not designed to support this emerging business model. For enterprises pursuing a virtual-enterprise strategy, a transition to integrated systems that support collaboration will be required.

In a recent Strategic Analysis Report2, Gartner predict that collaborative product development applications will replace static, web-enabled supply chain applications as the dominant application model by 2004 (with a probability of 0.8).

The journey of process improvement continues, from automation to integration and now, to collaboration. While collaboration, in the purest sense, has always been an integral part of business, the application of technology to collaboration is truly new. Applying these new collaboration technologies to business processes is the next area for process improvement.

Driven by an explosion of demands and opportunities - and enabled by Internet, component and integration technologies – c-commerce achieves dynamic collaboration among internal personnel, business partners and customers throughout a trading community or market. Enterprises harness the power of the Internet to gain revenue and profit improvement by going beyond information sharing and traditional supply chain models.

Integrated Information Systems continue to evolve

The evolution of integrated information systems continues unabated. As enterprises grapple with transformation from a focus on internal resource optimisation to a new focus on process integration and external collaboration, the value of the traditional Enterprise Resource Planning (ERP) paradigm is being questioned and the very understanding of ERP is undergoing a transition.

The result is the emergence of what Gartner has termed “ERP II,” which expands beyond enterprise-centric optimisation and transaction processing to a new focus on improving enterprise competitiveness. Forging strategies and deploying applications that enable the enterprise to share information and collaborate in communities of interest – i.e. to participate in collaborative commerce, the “glue” of virtual enterprises and the emerging model for e-business, accomplish this.
Gartner predict that the future generation of applications will adapt to the Internet-based world of today and tomorrow, through changes in functionality, technology and architecture.

- Functionality changes will become deeper and more specific to industry domain requirements
- Technology will evolve to leverage the Internet for both inter-enterprise connectivity and a unification of the end-user experience
- Architecture changes will allow for easier integration and interoperability

These changes will also cause vendors and user enterprises to evolve:

- Vendors will focus more specifically on domain requirements, providing feature-rich applications that emphasize complete process integration
- Enterprises, freed from the monolithic architectures of existing systems will create system deployment strategies that best fit enterprise needs – without relying on a single vendor to deliver all application components
- Standards for data exchange will become of increasing importance in facilitating integration and interoperability

**Importance of Standards**

One reason the original ERP vision was so powerful and desirable is that it provided the enterprise with a single data dictionary and a reliable transaction backbone, a role now taken for granted. In the rush to collaborative commerce, data and transaction issues have been de-emphasized as a mere technology issue that will be resolved. However, while this is less of an issue in vertical communities, it will be a showstopper within the horizontal and collaborative worlds.

Effective communication depends entirely on the quality of information, where quality is defined in terms of timeliness and accuracy. Thus, in a collaborative world, enterprises must compete not only on the basis of the availability, cost and quality of their products and services, but also on the basis of the quality of information that they can publish for consumption by collaborating partners.

In the product development world, collaboration between companies and across geographical boundaries is not new. Much progress has been made in recent years towards system integration and interoperability through the use of ISO 10303 - STEP (the STandard for Exchange of Product model data). This standard has been particularly effective in the exchange of geometry information between CAD systems.

Within the framework of the International Organisation for Standardization (ISO), a multi-national, joint government/industry group has worked to develop an information model that is aimed at the exchange of information related specifically to product support. The intention is to publish a full International Standard (AP 239) by October 2003. The Product Life Cycle Support (PLCS) initiative will extend STEP to support enterprise collaboration and effective implementation of integrated and inter-operable logistic support solutions. It is difficult to imagine how such enterprise collaboration could be practically achieved without such exchange standards being available.
Defining the Integrated Logistic Support Solution

Integrated information systems must start with an application strategy, setting the vision for integrating all relevant enterprise-centric, commerce-oriented business processes, without requiring a single-vendor approach.

As a deployment strategy, the solution must allow users to determine the degree of vendor centricity required to fulfill the enterprise’s process requirements and, via the integration capabilities native to Internet-based applications, include best of breed components.

Integrated logistic support solutions will include both capability specific to the enterprise domain, i.e. logistic support, and also the capability to connect the enterprise to key business partners directly or via a private e-marketplace. Again, the process footprint of the integrated support solutions includes all collaborative, operational and financial processes that have the enterprise at the centre.

The scope of the integrated solution will vary according to the product and the individual contract requirements. For complex high value products the requirements logistic support specific elements can be defined by a typical set of four core capabilities, as follows:

Support Engineering
Provides the capability to identify the support drivers and to plan the availability of facilities, resources and materials required to perform defined support tasks. Functionality includes:

- Designing for Support (Failure Mode and Effect Criticality Analysis (FMECA), Level of Repair Analysis (LORA), Logistic Support Analysis (LSA), Life Cycle Costing, Human Factors etc…)
- Defining and managing support system requirements and performance metrics
- Cost vs. Performance Modelling to allow optimisation of the support solution
- Electronic Technical Documentation related to product support
- Support System Design including:
  - Maintenance Planning
  - Resource Planning
  - Facilities Planning
- Support Data Analysis

Support Information Management
Provides the capability to maintain product definition information needed to support the product in line with the actual as-maintained product configuration information throughout its in-service life. Functionality includes:

- As-designed Configuration at type/class level
- As-Manufactured Configuration at the actual product actual level (baseline configuration)
- As-Maintained Configuration at the actual product actual level
- Configuration Change Management at the type/class and product actual levels
  - Configuration change issues and proposals
  - Justification for changes to product configuration
  - Information related to groups of changes and their inter-relationships
  - Schedule for implementing changes
  - Configuration Status Record of change implementation (what was fitted and when)
Support related product configuration information of relevance to the maintainer

Support Process Management (workflow and process tracking)

**Maintenance Management**
Provides the capability to schedule maintenance tasks and provide timely and accurate feedback on resource consumption, product status, failure and usage reporting. Functionality includes:

- Maintenance scheduling at the product actual level
- Fleet maintenance management at the class level
- Task planning and scheduling, including the generation of task instructions
- Task history defining status of work performed against the plan
- Feedback on time and resource usage linked to task and cost
- Product integrity statement (Failure and fault reporting, automated fault diagnosis)
- Feedback on As-Maintained product configuration (current state, location)

**Supply Chain Management**
Provides the capability to identify, procure, store and distribute materials linked to maintenance and facilities management plans. Resource management linked to skills availability matrix. Functionality includes:

- Spares provisioning capability including automated scaling and forecasting of spares
- E-procurement processes and systems (ERP, industrial repair and exchange)
- Comprehensive inventory control including vendor managed inventory
- Dynamic asset tracking
- Comprehensive warehousing and distribution facilities management
- In-store maintenance
- Financial and commercial management systems

These core elements are integrated with other engineering, commercial and financial systems to provide a comprehensive business solution that involves the customer, sub-contractors and suppliers in an Internet-enabled extended enterprise as described graphically in Figure 1 below.

![Figure 1: Internet-enabled Integrated Support Solution](image-url)
What does this mean for Industry?

In industry today the IT infrastructure is characterised by many systems that, in general, are not integrated and are therefore not able to exchange and share information. Those integrations that do exist have typically been developed to meet specific enterprise requirements and do not readily lend themselves to information exchange between partners or even between departments within the enterprise.

The current lack of integration leads to information being duplicated, its accuracy is often unknown and at best remains difficult to update and keep aligned to the actual product configuration.

In describing the future for Integrated Logistic Support Systems this paper focuses on the application of Internet-based technology to facilitate information being shared within an extended enterprise. This business model is preferred to a more conventional but now outdated concept of a monolithic information repository, sometimes referred to a Support Data Model, containing support information derived from a variety of sources.

Monolithic data architectures are difficult and costly to implement and they lack the flexibility and agility to respond to change. This is due mainly to the amount of interface customisation and development required. Experience gained in implementing conventional client/server architectures in the 1990’s has shown the concept of a large single data repository to be impractical.

The quantity and variety of information to be managed, the disparate source and nature of product and support information and the number of people and software applications involved all combine to create a complex operating environment, as depicted in Figure 2.

![Figure 2: Sources and uses of Support Information](image)

It should be recognised, however, that maintaining a timely and accurate representation of the information is a major challenge, since the product configuration is constantly changing as the asset is maintained throughout an operating life that can often be measured in decades.

Another major concern is the quality of feedback from in-service operations. Many different problems affect the area, for example:

- If the as-maintained configuration of an asset is not readily available to all involved, significant effort is wasted in planning and executing maintenance and upgrades.
If failure reports are not adequately tied to the precise context of the failure, errors can arise when assessing the failure data.

If information on manpower and resource consumption is not captured automatically, as work is undertaken, asset owners lack the means to assess the performance of the support solution or direct improvement initiatives.

In the age of “power by the hour”, and other “pay for service” contracts, such problems must be addressed so support performance can be demonstrated and support costs minimised. An Internet-based solution is the only practical solution to the creation of the ‘virtual enterprise’.

A future support solution would use a combination of de-facto Internet and neutral standards to facilitate the exchange of information between COTS applications, as shown in Figure 3.

Figure 3: COTS Information Exchange

When defining the systems architecture it is necessary to consider the need to manage information from a variety of programme types.

- Legacy programmes already deployed and being operated
- New programmes, ordered but not yet delivered, but where the design is almost frozen
- Future programmes where there is still great flexibility in design and specification

Any ‘Contracting for Support’ strategy must cover all three categories of programme in a coordinated way and this requires organisations on both the government and industry sides to work closely together.

In business terms, radical change of this nature is not simply matter of implementing a change in technology. Adopting the proposed business model will also require significant changes in process and organisation to ensure the anticipated benefits are realized.

Many of the practical change issues associated with process and organisation (e.g. security, intellectual property rights (IPR), configuration management etc…) are, however, already being addressed by projects seeking to implement shared data environments involving their customers, partners and the supply chain.
**How does this compare with what we have today?**

This table draws a distinction between the operating environment that typically exists today and the type of environment that is possible through the adoption of the PLCS standard.

<table>
<thead>
<tr>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process</strong></td>
<td><strong>Future</strong></td>
</tr>
<tr>
<td>Departmental focus with little visibility of the complete process</td>
<td>Business processes optimised across the extended enterprise</td>
</tr>
<tr>
<td>Mainly paper based</td>
<td>Electronic Workflow enabled</td>
</tr>
<tr>
<td>Islands of Information often duplicated in part, leading issues of configuration management.</td>
<td>Collaborative working with good process visibility and e-enabled information exchange</td>
</tr>
<tr>
<td><strong>Organisation</strong></td>
<td><strong>Future</strong></td>
</tr>
<tr>
<td>Small dispersed teams dedicated to part of the process</td>
<td>Virtual Team with the ability to introduce new players/specialists</td>
</tr>
<tr>
<td>Used to working in traditional hierarchical organisation</td>
<td>Dynamic organisation structure that is flexible and responsive to change</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td><strong>Future</strong></td>
</tr>
<tr>
<td>Fixed sites, based on historical industry links</td>
<td>No geographic boundaries or limitations to location</td>
</tr>
<tr>
<td>Limited supplier integration on site</td>
<td>Responsive to adding new partners and suppliers into virtual enterprise</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td><strong>Future</strong></td>
</tr>
<tr>
<td>Individual data repositories</td>
<td>Shared Data Environment</td>
</tr>
<tr>
<td>Duplication of data</td>
<td>Create data once, use many times</td>
</tr>
<tr>
<td>Significant delays in data update</td>
<td>Timely and accurate information</td>
</tr>
<tr>
<td>Limited feedback, significant delays and issues over quality</td>
<td>Improved quality and timeliness of feedback</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td><strong>Future</strong></td>
</tr>
<tr>
<td>Highly customized to individual needs</td>
<td>COTS with minimum customisation</td>
</tr>
<tr>
<td>Limited application integration</td>
<td>Integrated and interoperable</td>
</tr>
<tr>
<td>Vendor driven API</td>
<td>Compliant with neutral standards for data exchange</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td><strong>Future</strong></td>
</tr>
<tr>
<td>Independent IT systems with limited application integration</td>
<td>Internet/Intranet centric using de-facto standards for integration</td>
</tr>
<tr>
<td>Multiple user interfaces driven by application/customisation</td>
<td>Common user interface and point of access to system using browser</td>
</tr>
<tr>
<td>Monolithic infrastructure difficult and costly to change</td>
<td>Flexible and responsive to changes in technology</td>
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Benefits of adopting collaborative commerce for delivering Integrated Logistic Support Services

Enterprise collaboration and information sharing provide opportunities for sustainable business growth in the asset-intensive domain associated with logistic support of complex, high value products.

Recent developments in Internet technology, e-business and c-commerce provide an opportunity for a new business model to be established, based on collaboration between partners in a domain specific ‘virtual enterprise’.

Adoption of standards, such as PLCS, will reduce costs associated with information capture and exchange, as well as improving process and systems integration and inter-operability.

From the customer’s perspective, the potential benefits from the adoption of this new business are:
- Improved product availability and asset utilization
- Reduced cost of ownership
- Faster product improvement cycle through improved feedback

From the point of view of a Logistic Support Service provider the benefits are:
- Reduced cost of acquiring, maintaining and delivering product and support information
- Improved quality (timeliness and accuracy) and access to support information
- Process and system independence, integration and interoperability
- Improved flexibility and agility in accommodating information management technology changes
- Ability to maximize and protect the investment in life cycle product and support information

The proposed business model builds upon the momentum created by the customer requirement to establish Shared Data Environments for major defence projects.

Many customers see standards as the enabler for interoperability and effective information exchange. The following quotes indicate the importance placed on the use of Internet-based technology for collaboration and information sharing.

"The way we manage our business will have to be radically different in the 21st century if we are to realise the full potential of integrating technology, people and processes. The capture and retrieval of information will need to be seamless, through life from concept to disposal"
Sir Robert Walmsley
Chief of Defence Procurement, UK MoD Defence Procurement Agency

“We will aggressively exploit the potential of e-business, which will be the key to our business transformation programme…. With these new tools we will be able to drive down our costs significantly…Our e-business programme stems from a determination to transform the way in which we do our business, to simplify processes, free resources and improve our operational outputs to the front line.”

General Sam Cowan
Chief of Defence Logistics, UK MoD Defence Logistics Organisation

“The seamless exchange and access to combat support and financial information is as critical to the overall operational success of the Department..."
[US Dept of Defense] as the exchange and access to tactical data is to success on the battlefield.

To achieve operational success, we must do a better job of managing our information flow among the business areas within the Department [of Defense] as well as with industry.

The Honorable Edward C. “Pete” Aldridge
Under Secretary of Defence for Acquisition, Technology and Logistics
US Department of Defense

References
Reference 2: The Transition to ERPII: Meeting the Challenges, Gartner Strategic Analysis Report, R-14-0612, dated 27th September 2001