

Opening Up a New Front on Reducing the Real Cost of Manufacturing & Sourcing

Imagine successfully implementing an Enterprise Resource Planning (SUPPLYCHAIN /ERP) System. As a result, your company now has at its disposal full accountability of its production information over time, across all departments. Imagine enjoying measurable increases in productivity derived from leveraging this information reservoir of current and past data regarding parts lists, bill of materials, inventory, procurement, sales history and cost accounting.

But what about your Engineering and Company's Computer Aided Design and Drafting (CADD) repository, the thousands of "primitive" graphic drawing files, each containing up to thousands of components that drives your engineering, design and production operations? Unfortunately, due to CAD's graphic nature, this vast component of your information landscape and islands of automation continues to be ignored and "invisible" to the SUPPLYCHAIN /ERP. Now imagine your CAD database fully linked and integrated with your SUPPLYCHAIN /ERP system. What further productivity gains could be realized?

One thing is for certain. It is not technology that stands in your way. Mature CAD⇔SUPPLYCHAIN /ERP integration solutions are available from niche vendors. What is in the way is your company's lack of awareness that a solution exists to further leverage your SUPPLYCHAIN /ERP investment by fully integrating your engineering and manufacturing operations. Great claim, but just how does implementing CAD integration, referred to here as Graphic-Data Link (GDL) technology, further improve my company's profitability? The answer to this question begins with by examining traditional interfacing of manufacturing with engineering information management systems.

TRADITIONAL ENGINEERING INTEGRATION APPROACH

Background. Evolving out of the need to keep track of the digital design information being generated by the initial wide use of CAD/CAM technology in the early 1980s, Product Data Management (PDM) systems are used to manage engineering data and CAD files. Generically referred to here as PDM, different flavors have emerged including CSM (Component and Supplier Management) and MRO (Maintenance, repair and Overhaul) systems. PDM is primarily interested in what is being designed and revised.

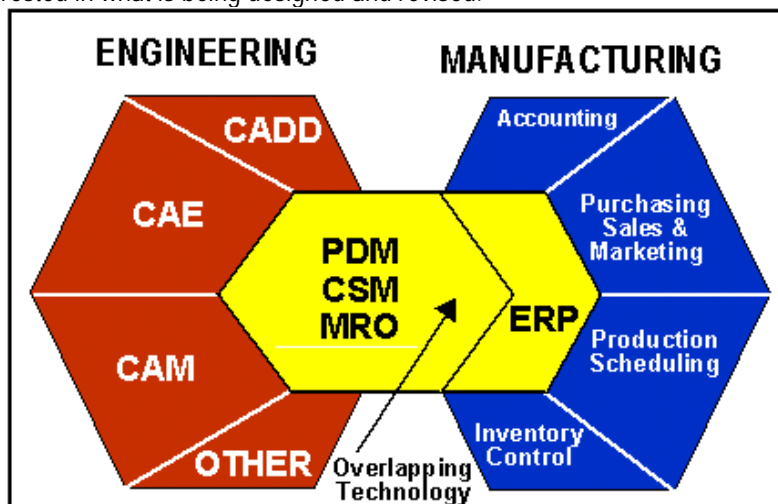


Figure 1. Many PDM functions are now incorporated in SUPPLYCHAIN /ERP systems resulting in overlapping technology.

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Beginning even earlier, born out of the manufacturing automation initiatives in the early sixties, Enterprise Resource Planning (SUPPLYCHAIN /ERP) systems are primarily interested in what is being manufactured. More contemporary offerings have migrated off the mainframe computers and into the NT market offering two very powerful bonuses to automated manufacturing operations:

- Standard business models based on very broad experience, easily adaptable to different kinds of manufacturing, can deliver far more productivity than legacy proprietary in-house models.
- Broadened functionality has recently eliminated much of the previous need to install large, redundant, tandem PDM systems.

Overlapping Technology. As shown in Figure 1, the overlap of midrange SUPPLYCHAIN /ERP (manufacturing operations under \$500 Million) and PDM software is extensive. One of the greatest areas of overlap between and PDM insists in product structure management. Product structures are at the heart of SUPPLYCHAIN /ERP System, defining parts and how they are put together on the shop floor. Likewise, the center of the typical PDM is system is structure management as well.

Traditional PDM Task	SUPPLYCHAIN /ERP	GDL
Inventory Control	X	X
Shop Scheduling	X	
Cost Accounting	X	
Bill of Materials		X
Parts Classification	X	X
Configuration Management	X	X
Process Flow Management	X	
CADD Data Management		X
Graphic Viewing and Redlining		X
Product Structure Management	X	X
Document Management		X
Sourcing	X	X

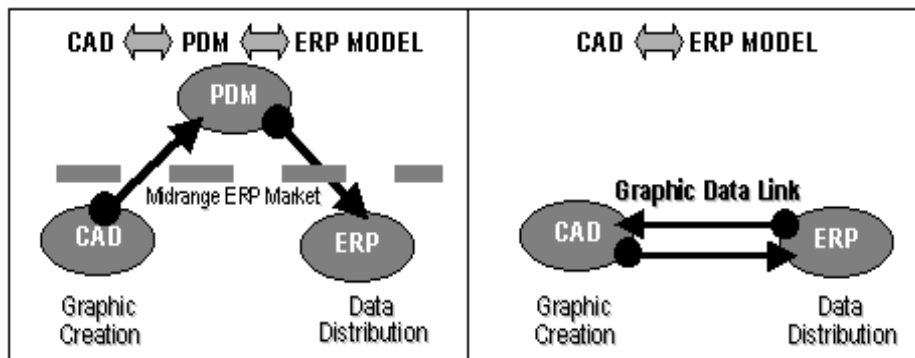


Figure 2. CAD ↔ SUPPLYCHAIN /ERP Integration Approach – Traditional vs. Graphic Data Link. Alternatively, Midrange SUPPLYCHAIN /ERP implementations and below can be practically accommodated by GDL

As SUPPLYCHAIN /ERP technology has evolved, it has greatly expanded its bandwidth of functionality. It is now possible to accommodate almost all PDM functions with a single SUPPLYCHAIN /ERP system from a single vendor. As shown in below in the table above and in Figure 1, industry standard Graphic Data Link products such as DesignDesk by AimaSoft, can now handle those tasks that are not addressed by commercial SUPPLYCHAIN /ERP

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systems. Instead of expensive large system PDM toolkits for handling design data management, modest priced GDL products meet this need by focusing only on interfacing graphic data with DBMS tables leaving all other manufacturing related functions to the SUPPLYCHAIN /ERP systems.

Traditional Configurations. As shown in Figure 2, the traditional CADD⇔PDM⇔SUPPLYCHAIN /ERP configurations still apply for large implementations supporting manufacturing operations with volumes of over \$500 Million per year. In these cases, big implementations with extensive associated (even proprietary) system integration requirements are cost effective since this major expense is spread across very large cash flows. However, for smaller operations, reasonable return on investments is prohibitive unless excessive SUPPLYCHAIN /ERP PDM integration costs are avoided. Fortunately, market pressures have, over time, resulted in attractive remedies to this problem. As seen on the right side of Figure 2, industry standard CAD⇔SUPPLYCHAIN /ERP integration is now possible for two reasons. As mentioned, the broad technology footprints of commercial Midrange SUPPLYCHAIN /ERP products have displaced many of the functions that previously required PDM technology. Evolving GDL products have displaced the rest. As a result, PDM products can be eliminated from midrange SUPPLYCHAIN /ERP implementations. In this way, the expensive PDM systems and their associated labor-intensive SUPPLYCHAIN /ERP integration are replaced by low priced GDL products with negligible SUPPLYCHAIN /ERP integration costs.

GDL: REMEDY TO OVERLAPPING PDM SUPPLYCHAIN /ERP CONFIGURATIONS

Integrated Data Model. The resulting configuration is a highly simplified platform for implementing low cost, highly effective SUPPLYCHAIN /ERP implementations. As seen in Figure 3, GDL enables manufacturers to base their plant operations on seamless links between Engineering and Manufacturing databases transparent to the data users. This is accomplished by tightly relating features in a CAD drawing or other graphic databases and corresponding database records in the Master Parts List and any other report supported by the SUPPLYCHAIN /ERP.

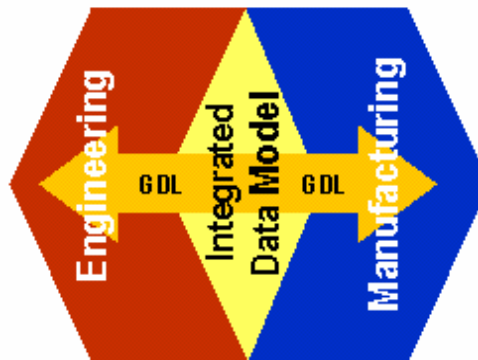


Figure 3. Direct Graphic Data Link (GDL) offers the full CAD ⇔ SUPPLYCHAIN /ERP Integration without overlapping technology.

Graphic Data Link Configuration.

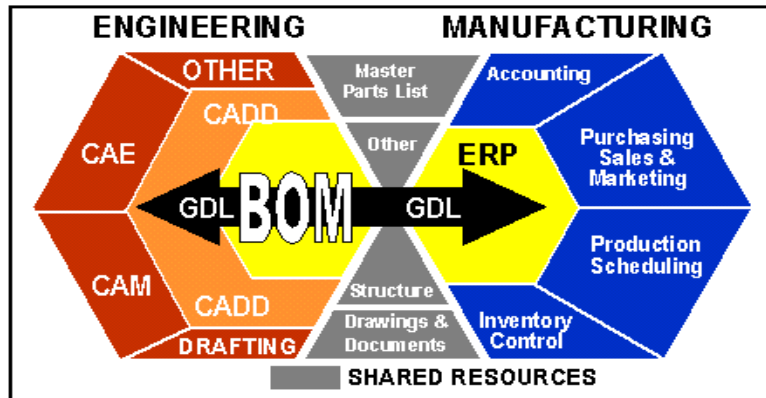


Figure 4. GDL offers a simple non-redundant approach to using the Bill-Of-Materials (BOM) to establish and share in common single sets of integrated information resources such as the Part Master, drawings and documents.

Figure 4 may look complicated, but it is simply a more detailed statement of the diagram above. Communicated are the same basic concepts of the GDL based CAD ↔ SUPPLYCHAIN /ERP model, just in greater detail. On the right are all Engineering's basic technology components – Computer Aided Design and Drafting (CADD), Engineering Analysis (CAE), Manufacturing (CAM) and others. On the right are all the typical tasks accommodated by the manufacturing (Operations, Accounting, Sales & Marketing and even Human Resources).

Shared Resources. Between these Engineering and Manufacturing are "Shared Resources", singular sets of documents, tabular databases, CAD and other Graphic files referenced common by both sides of the enterprise. Driving these common data sets is the Bill-Of-Material generation function of the GDL. The key is that these BOMs are not manually encoded. Instead the features in the CAD drawings automatically generate it. If the picture is right, the BOM is right. With another key function of the GDL keeping the Master Parts List reconciled with the BOM at all times, then if the picture is right, the linked SUPPLYCHAIN /ERP reports are right.

GRAPIC DATA LINK - DETAILED DESCRIPTION

The principles behind the GDL. The CAD operator assigns Unique ID Numbers to CAD features either as they are drafted or after the design is completed. It is therefore possible to add "intelligence" to primitive "legacy drawings"; CAD files created earlier as "dumb" drawings. As the unique ID is added to a CAD feature, a new record is added to a tabular BOM database outside of the CAD drawing. Commercial grade GDL products support the generation of a BOM reflecting all the intelligent features in multiple drawings by extracting feature information from multiple drawings in a single step even if the drawings are not active. As shown, records in the BOM are then linked to corresponding records in the Master Part List either by creating a new record in the Master Part List or by identifying the corresponding existing record. The SUPPLYCHAIN /ERP system takes over to do the needed book keeping so that all the SUPPLYCHAIN /ERP supported reports reflect the new or modified Part Master records. *The Graphic Data Link provides a transparent and seamless integration of the drawing files with the Master Parts List which, in turn, provides direct feeds to all the various SUPPLYCHAIN /ERP systems.*

This ID schema offers some powerful features to the manufacturing process. Due to this tight normalization all tables with the source CAD drawings and feature within the drawings, any record selected in any one of the SUPPLYCHAIN /ERP report displays can instantly cause the source drawing and the supporting specifications of the component part

to display. However, more important than the possible reduction in manufacturing time are the far greater savings that are realized through:

- Increased quality assurance against errors and lost time from rework delays.
- Waiting to get answers to questions
- Final assembly delays waiting for items mistakenly left out of the documents.

Simple Graphic Data Link offers powerful data retrieval and viewing environment. Selection of any data element in any SUPPLYCHAIN /ERP report instantly displays linked graphic data feature(s).

GDL: RESOLVING PROBLEMS

Resolving Multiple BOM Problem. The above model also remedies another major problem of traditional CAD ↔ SUPPLYCHAIN /ERP integration. Up till now, it has been based on two or more sets of BOMs. The one in the SUPPLYCHAIN /ERP reflects what has been manufactured or procured. The features in the CAD drawings reflect what has been designed or sourced. Eliminating multiple bills of materials is possibly the most important measure that an electronics manufacturer can implement to cut cost and improve quality assurance.

A major source of costly human (operator) error is the tedious manual extraction of information from CAD drawings to produce Bill-of-Materials, Part Master Records and other SUPPLYCHAIN /ERP/DBM. These "potential" costs are dwarfed by the excessive wasted time required to manually perform these tasks. Such antiquated practices are even more ridiculous when you factor in the cost of the continual manual updating of the DWG files to reflect constant changes in the SUPPLYCHAIN /ERP.

Synchronizing Design with Product Data. Design and data integration technology goes beyond simple document management by synchronizing design with product data to provide the right information at a single point of access and management. Once this information becomes a vital, proactive, and progressive process, endless opportunities are created for dramatic productivity improvements. For all these reasons, industry standard Bill-of-Material generation and Linking (Graphic Data Link) products are now available to accommodate this need in a complete and comprehensive manner. The following explanations provide a more detailed explanation of GDL and its positive implications to manufacturing operations.

Revision Process. More than any other advantage of CAD integration to automated manufacturing has been in the revision process. No matter how modern operations become, change orders will never go away. There will always be a design error that is not discovered until the job is underway on the shop floor. The difference with GDL is a highly reduced "headache factor" associated with implementing the needed change order. Previously, updating the SUPPLYCHAIN /ERP has been a tedious error-prone game of what's wrong with this picture as design staff first visually compared before and after drawings to identify changes. Then the same game has to be played again, this time looking for records in the manually created BOM that now had to be manually changed to bring the table in sync with the revised drawings. Now, when the CAD drawings of the redesigned assembly are completed, in one step:

- All records linked to these CAD features are purged from the Routing Sheet.
- New BOM of the new design is generated.
- SUPPLYCHAIN /ERP's Master Parts List and linked reports are repopulated with the new BOM listings.

With no human intervention, the SUPPLYCHAIN /ERP is transparently updated with a new set of records that perfectly record the component parts of the redesigned assembly. More important than the labor savings is the elimination of the previously greatest source of human error and cost overruns at all turns in the purchasing, manufacturing and distribution process.

IDEAL SPECIFICATION FOR GDL IMPLEMENTATION

Industry standard Graphic Data Link products can competently meet all Midrange CAD ⇔ MRP integration requirements if the selected GDL technology includes the following specifications:

1. Automatically extract information from graphic features within a CAD file to generate Bill-Of-Material files external to the drawing file. In addition, individual graphic features can be "tagged" with unique ID and attribute assignments that is used to automatically create new or update existing records in the linked BOM file.
2. BOM tables can be generated and/or updated by simultaneously extracting graphic information from features within multiple drawing files including nested blocks and Refs.
3. BOM data can be output in multiple formats, including direct to a database, eliminating the need to re-type data.
4. Link BOM tables to the SUPPLYCHAIN /ERP Master Parts List so that changes in the BOM are seamlessly and transparently (to the user) reflected in the SUPPLYCHAIN /ERP table.
5. Drag-and-drop parts directly into a CAD drawing directly by browsing the SUPPLYCHAIN /ERP Master Parts Table.
6. Drawing revisions are automatically reflected in the Master Parts Table with complete built-in quality assurance.

CONCLUSION

Graphic Data Link technology goes beyond simple document management by focusing on the essence of product data management. It synchronizes graphic and non-graphic data to provide the right information at a single point of data access and management. When this information becomes part of a progressive proactive process, many opportunities are created for productivity enhancement and cycle-time reduction. In summary, GDL can conveniently and effectively take on all the CAD integration needs of small to F1000 implementations. It is based on a tight linkage a features within CAD files with project BOMs and the SUPPLYCHAIN /ERP Master Part List. Once in place, it can accommodate all production processing and change orders on the shop floor. Any change in the SUPPLYCHAIN /ERP databases are automatically reflected in the BOM and the CAD drawings. Reciprocally, any design update of the CAD database is automatically reflected in the Master Parts List and all SUPPLYCHAIN /ERP reports. Such a comprehensive graphic ⇔ non-graphic data model provides a powerful stage for implementing unlimited applications for enhancing productivity in design and manufacturing.