Special orders

Engineer-to-order challenges for the industrial engineer

BY THOMAS R. CUTLER

LEAN IN THE ENGINEER-TO-ORDER (ETO) environment is quite different from repetitive manufacturing. According to Robert Hattin, president of Edson Packaging Machinery Ltd., "The biggest difference is that we deal with customized drawings derived from engineering standards and over time and with continuous improvement our newest iteration becomes the *de facto* standard."

ETO is a manufacturing philosophy, not just an engineering process. Finished goods are built to unique customer specifications. Assemblies and raw materials may be stocked, but are not assembled into the finished good until a customer order is received and the part is designed. ETO products are always unique and require a unique set of item numbers, bills of material and routings. These are usually complex industrial engineering projects with long lead-times. Customers are heavily involved throughout the entire design and manufacturing process for ETO products.

ETO manufacturers, working on a project-by-project basis with a high level of new engineering content, are faced with constant "changes" throughout a project cycle. Managing these changes efficiently often determines the success and profitability of each project. Unfortunately, the bottlenecks in design and purchasing and the lack of timely management data often erode expected profits.

Drawing and information management is critical. Clarity of what is being built in an engineer-to-order environment can no longer consist of a vague work order. Companies like Edson Packaging used to be a designer and manufacturer of packaging machinery. These firms are now driven by customer specifications, often including the automation components, shifting the organizations to a designer and integrator of packaging systems.

Hattin explained, "The big part of

what we manufacture is the metal frame, essentially a bracket builder to fasten other OEM [original equipment manufacturing] components on. And that is OK because we can spend our time on building cool systems using best components from around the world. It's allowing us to design global platforms that are exportable to any industrialized country *and* emerging markets."

Engineering often needs to release the design piecemeal to the plant in order to meet deliveries requiring special efforts to manage the bill of materials (BOM) interaction with the purchasing area. The plant often identifies areas where the design needs to be changed, requiring engineering to modify the drawings and the BOM and purchasing to change material orders. This dynamic engineering environment (known as concurrent engineering) requires a purpose-built business information system (BIS) that allows the ETO firm to modify and manage rapidly the impact of design changes at any time or point in the order-to-ship cycle.

An ETO firm seeking to qualify the suitability of an information system should investigate the following key topics in the areas of engineering and purchasing:

1. Is the system "interfacing" or is it "integrating" with the computer-aided design package?
2. Can the designer create a graphically presented structured BOM with unlimited levels?
3. How are pre-releases of BOM items (long lead items) to the purchasing and production departments handled by the designer?
4. How are partial releases (release of some, but not all, assemblies) to purchasing and production handled?
5. After the entire BOM is released to purchasing, how does the system handle design changes initiated by the plant or the client?
6. How does a designer "hold" certain BOM items and assemblies and allow the release of others to purchasing?
7. Can the designer quickly find previously purchased items (with costs) from a master file and "click and drop" all this previous information into the assembly BOM?
8. Does the system automatically present the net effect of item changes to purchasing (resolving quantity changes)?
9. Can the designer quickly find and copy BOM assemblies from other projects?
10. Can the designer easily add new BOM items with special attributes (such as "repairable item")?
11. Does the system free the designer from any other work other than producing the structured BOM?
12. Does the system automatically produce the key reports for the company without any additional work by the designer, such as a cutting list, spare parts list, where-used distribution list, parts-where used, summarized BOM, structured BOM, items on hold list and preliminary costs?
13. Does the system automatically produce a preliminary cost report of the structured and summarized BOM during the design process (to inform designers if the actual materials cost meets the estimated cost)?
14. Does all BOM information go to purchasing without any need to re-enter any information?
15. Does the system eliminate virtually all purchasing need-to-enter data?
16. Does the system allow purchasing to purchase like items from several jobs on one order?
17. Does the system provide project materials cost information when materials are ordered rather than when materials are received (so managers can react to cost overruns early in the project)?

Lean metrics in the ETO environment

Lean metrics or lean initiatives are quantified in ETO. Many firms look at hours, both in terms of engineering (mechanical, electrical, programming) and manufacturing. Careful data analysis, including the number of standardized sub-assemblies, is often one guidepost. These data force manufacturability and enhance quality since sub-assemblies need to be interchangeable.

Dennis Parass of Questica SE, a developer of enterprise resource planning tools, suggested, "ETO manufacturers have very different challenges than other manufacturers. One common trait that is unique to all ETO businesses is the need to deal with constant changes throughout the life of each project. Design changes, order changes and delivery changes all stall projects in engineering, complicate material ordering, delay manufacturing and increase project costs. Software systems for ETO manufacturers must break down the productivity roadblock by simplifying the handling of on-the-fly changes."

Nearly every order starts in engineering and to the frustration of management seems to stay there far too long. Designers are fearful of releasing bill of materials information too early because of the problem that change requests from the client or the shop can create for them. The result is that the purchasing area receives information too late and is unable to purchase in time or at attractive prices. Creating a system that allows designers to create BOMs quickly, that gives them the confidence to release data frequently, and that dynamically integrates with purchasing, will eliminate this bottleneck.

ETO business solutions must accommodate the unique industrial engineering challenges of custom design manufacturing by integrating all stages of

engineer-to-order manufacturing.

Previously Edson's enterprise resource planning (ERP) solution was a homegrown composite of disconnected databases, spreadsheets and forms. While logical, simple and moderately effective, it was traditional paper pushing. Engineering data was batch-oriented, as long as people did not interrupt the flow of information. People managed reactively and created a closed environment for 'who knows what,' especially anything to do with costs. The new ETO ERP system, according to Hattin, "is very open and people raise questions and make decisions proactively; there is no excuse for not knowing an issue."

Parass noted that many ETO manufacturers do not have industrial engineers that serve as formal planners or people who develop new processes. In an ETO business especially, engineering or design is the most critical. He urged, "The simple task of issuing drawings drives all other processes and activities. Purchasing (what and when), internal manufacturing and drawings need to be done in an optimized way that minimizes constraints and encourages product flow."

Hattin explained how Edson used to handle these issues prior to the ETO ERP approach.

"A typical machine would require over 500 mechanical drawings, with up to 20 separate parts on the same drawing. Engineers, being conservative, would do all the engineering to make sure that it all fit, then release a batch of 500 drawings, with at least 300 parts to buy imbedded in the bill of materials. Then someone, we think elves, would try and sort out where to start and what to do. If people are even remotely doing engineering in a batch format, they must stop doing that now."

A new way for ETO manufacturers

Today, Edson has simple planning white boards augmented by updated reports from the various departments, and every second morning for 45 minutes the operations team — with representation from engineering, manufacturing (primary and integration), project management, service and the operations manager — visits all projects and reviews service. There are measurable impacts.

Edson's business has tripled in 10 years, and they still have the same employee count for purchasing, accounting and project management. Hours, both in engineering and manufacturing, have decreased due to lean-based processes that are interconnected. The company is more profitable; it responds to customers' requests more rapidly to develop new automation systems that are near perfect right out of the box. It has changed how they do business and augmented a customer-centric focus.

Parass insisted, "Finding and using previous designs — modifying existing designs (customizing) — is far less risky and more profitable than creating a new design. Unfortunately, it is a common problem with ETO companies that the staff cannot find previous designs when they need to. Accessing past history not only will improve your estimate accuracy and profits but will speed up the order-to-ship cycle."

Indeed, industrial engineers and designers typically spend a major part of their time performing clerical tasks. Reducing these tasks not only speeds up the design process but also allows the firm to handle more business with the same staff. Similarly, when purchasing (which spends 35 percent to 50 percent of sales income) is freed of its paperwork to create requests for quotations, it can significantly lower material costs.

There are many other aspects of an ETO business that require a system specifically designed for this type of manufacture. Above all, the key and core requirement to speeding up the order-to-shipment cycle is a dynamic interface between engineering and purchasing.

These issues define lean in the ETO environment — eliminating waste for one-of-a-kind manufacturing projects.

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On the Web

SCHEDULING FOR SPECIAL ORDERS

In engineer-to order manufacturing, establishing and maintaining schedules from raw materials to finished goods and beyond calls for creative thinking and a robust systems approach.

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