The Roadmap to Advanced Manufacturing

In 20 years, manufacturing is expected to advance to new frontiers, resulting in an increasingly automated and data-intensive manufacturing sector that will likely replace traditional manufacturing as we know it today.¹
Executive Overview

Advanced Manufacturing: A Success Strategy for the Future

For large, enterprise manufacturers, the ability to change and renew continuously has become an economic imperative. As a business evolves into maturity, it is necessary to revitalize, reassess and renew. This is why more and more enterprise manufacturers are turning to Advanced Manufacturing as a success strategy for the future.
In today’s highly competitive manufacturing landscape, there is little room, time or appetite for risk. Instead, it’s essential to show clear proof of time to value—shortening the time between initial expense and positive economic return. That’s why Advanced Manufacturing is dependent upon the following three critical factors for success:

- **Responsiveness to Customer Needs.** Advanced Manufacturing is all about keeping your customers’ needs in focus and in the center of your own planning. Roger Martin, in “The Age of Customer Capitalism,” published in the Harvard Business Review, says, “Customer satisfaction and listening to the customer is becoming more important than ever.”

- **Innovative Operational Processes.** The truth is that Advanced Manufacturing encompasses all aspects of manufacturing, including the ability to quickly respond to customer needs through innovations in production processes. Today, there is increasing convergence between manufacturing and services. With manufacturers integrating new smart service business models enabled through embedded software, wireless connectivity and online services, there is now less of a distinction between the two sectors than before. Customers are demanding connected product “experiences” rather than just a product.

- **Breakthrough Technologies that Drive Real Value.** Advanced Manufacturing and innovation go hand-in-hand, and as manufacturing advances, it is becoming even more and more knowledge-intensive. The U.S. Department of Commerce says, “It’s become obvious that Advanced Manufacturing is dependent upon breakthrough information technologies for next-generation processes.”
**Cincom + Microsoft Dynamics® AX: An ERP System for Advanced Manufacturers**

Cincom and Microsoft® have created an ERP system developed specifically for the needs of advanced manufacturers. The three critical success factors discussed on the previous page are why Cincom chose to take a modular approach to the many advanced capabilities that make up our Manufacturing Business Suite—all of which are built upon the popular Microsoft Dynamics AX platform.

Advanced Manufacturing means capturing opportunity in rapidly shifting conditions, and software that enables this is essential for success. Cincom + Microsoft Dynamics AX ERP together deliver an integrated enterprise-wide solution that helps your company, your distributors, your dealers and your customers make business decisions with greater confidence. The diagram above illustrates how advanced functionality from Cincom extends Microsoft Dynamics AX ERP for manufacturers of highly engineered products and services.

*The Cincom Project Supply Chain module provides project capabilities across the supply chain and production processes.*
The Roadmap to Advanced Manufacturing – A Step-by-Step Process View

The Roadmap to Advanced Manufacturing, discussed in the following pages of this paper, takes a high-level view of an enterprise. It covers the entire business operation and manufacturing process in detail, along with technology recommendations for each process. As we move through the Roadmap, we divide it into a number of parts and examine how the assorted parts work together. We discuss which technologies can best help advanced manufacturers remain competitive by:

- Performing at the highest level of accuracy
- Increasing speed at all levels of the enterprise
- Delivering as promised

Advanced manufacturers understand that future success is reserved for those who are responsive to customer needs, innovative in operational processes and well invested in technologies that drive real value. Join us as we take the journey together.

Foundation: A Robust ERP Solution

Since Advanced Manufacturing enterprises live and breathe by their ERP solutions, the journey starts here. The right ERP solution for advanced manufacturers is one that:

- Delivers mission-critical data in real time
- Provides a platform to share knowledge
- Simplifies collaboration, while being easy to use

Microsoft Dynamics AX is a robust system, including capabilities for financial management, business intelligence and reporting, supply chain management and human capital management.

“As Cincom is the only Microsoft Dynamics ISV focused on the needs of the complex manufacturer.”

- Morgan Wheaton, Director, Dynamics Global Partners, Microsoft Business Solutions

As a matter of fact, global enterprise organizations overwhelmingly identify Microsoft Dynamics as the preferred vendor for their next ERP investment.

Ovum Chart

Overall Preferred Vendor for Next Investment in ERP

- Oracle
- SAP
- Microsoft

A recent survey by Ovum Research reveals a significant trend in the ERP space: Global enterprise organizations overwhelmingly identify Microsoft Dynamics as the preferred vendor for their next ERP investment.

Cincom Intensifies Microsoft Dynamics AX ERP for Configure-to-Order (CTO) and Engineer-to-Order (ETO) Manufacturers

According to Inside ERP, “Not all ERP applications are appropriate for ETO manufacturers, but an ERP application specifically designed for ETO can offer multiple benefits and efficiencies. ETO manufacturers stand to gain a competitive edge if they can find the right ERP solution to help improve their business workflow.”

Microsoft Dynamics partnered with Cincom to extend the capabilities of Microsoft Dynamics ERP to meet the special needs of CTO and ETO manufacturers because we have deep industry experience sharpened from successfully serving these types of manufacturers since 1968. Cincom modules are designed specifically for manufacturers of highly engineered products and services. They intensify Microsoft Dynamics AX features with critical components for CTO and ETO manufacturers, such as advanced capabilities for:

- Configure-price-quote (CPQ)
- Estimating ETO projects
- Product data management (PDM)
- Project-based supply chain
- Indirect cost allocation (ICA)
- Project-based manufacturing
The Roadmap to Advanced Manufacturing – Process View

Get your complimentary 11x17 copy of the Roadmap to Advanced Manufacturing at: www.cincom.com/erp-roadmap
Strategic and Detail Planning

Business Planning
Prior to the beginning of every new fiscal year, companies begin strategic planning and budgeting. This forms the basis for measuring performance of the company over the coming year.

Since the market dictates the outcome, the planning process must include the voice of the customer as a stakeholder. Sales and marketing are brought into the plan as full partners. They provide relevant input into what is happening in the market and can represent the voice of the customer in every part of the process.

Aberdeen Group illustrates this process quite effectively in its report on Sales and Operations planning.

- Revenue planning is based on corporate goals, new products, market and needs identification and sales opportunities. Sales and marketing participate in the conversation based on their own experiences.

- This feeds the Demand Planning process. Forecasts are based on projected sales, sales and marketing collaborative campaigns and promotions and overall general business forecasts that are more reflective of the general business climate for the coming year.

- The next step is supply-chain planning. Labor, parts and supplies are quantified and form the basis for manufacturing and factory strategies, inventory strategies, material logistics and capacity planning within the production process.

- In the fourth step, Purchasing is charged with developing acquisition strategies to supply the operation with adequate material and minimal commitment of cash. Human Resources looks at how staffing requirements might be met and what existing resource can be used to fulfill the needs of the coming year. Recruitment costs are quantified and included in the overall plan.

- Finally, management evaluates the entire plan in light of revenue and profit targets, working capital and performance history, and specific KPIs are established to keep them informed of progress as the new fiscal year moves forward.

Managing Human Resources
The consumption of labor and the associated costs of maintaining a work force also need to be tracked and allocated across the individual projects and production effort. For manufacturers, the goal is to keep as many people productive as possible. HR oversees training and education, employee history and performance and of course, payroll—all functions handled well by Microsoft Dynamics AX and Cincom.
Designing Products and Services

The design of products and services is also collaborative in nature. Products can’t be developed in a vacuum. Customers again need to be involved in the process, or the risk of failure is increased greatly. However, customer input must be balanced with input from suppliers and employees to determine if the design requirements are within the capability of the company.

In some cases, almost everything is designed from scratch. Product engineers will attempt to reuse previous designs; existing or new bills of material (BOMs) are developed; and revised specifications, documentation and other specifics are updated. The need for replacement parts and service options are identified and established as sellable products on their own. External suppliers are identified, and externally sourced contributions to the finished product are established. Any special expertise or other human resources are also introduced into the process in this phase. Engineering and production planning sign off and make their accommodations for building their product.

Microsoft Dynamics AX and its partners expertly handle:

- Product design
- Research and development
- Computer-aided design (CAD)/computer-aided engineering (CAE) and product lifecycle management (PLM) integration
- Basic BOM maintenance – drag and drop or grid-based user interface (UI)
- Routings maintenance – quantity, set-up and run-time

Cincom adds critical product data management features specifically for CTO and ETO manufacturers to extend basic Microsoft Dynamics AX with enhanced capabilities for:

- Project-specific BOMs and routings
- Project item dimensions
- Multiple BOM types and BOM maintenance
- Engineering change management with workflow
- Item, BOM, route and document revisions
- Multiple active-item substitutes and alternates
- Centralized and decentralized engineering management
- Release management – pending, release, cancel
- Lifecycle phases
- Document management flowdown
Sales Execution

Configure, Estimate and Manage Product Sales
Selling and managing the sales process is guided by the business plan. Marketing drives messaging into specific markets either defined by geography or line of business. Sales reinforces that messaging through prospecting activities and campaigns.

Technology facilitates this process through CRM systems that support the identification of market-qualified contacts. These can be the focus of prospecting and promulgating the message associated with the marketing strategy. Guided-selling technology ensures that the message, target prospects, selling scripts, product data visibility and solutions are accurate and adhere to the business plan.

Two diametrically opposed forces contend with each other during this process. The customer’s requirements become more tightly defined and unique while the availability of ready solutions becomes more difficult to find. And customers today are less willing to settle for “almost perfect” solutions. Their needs are frequently more complex than ever, and that drives solutions that may be highly variable. The need for unique, engineer-to-order solutions is becoming more common.
Sales Models

Most manufacturers fall into one of the three sales models discussed below:

- **Catalog Sales** – These are sales of existing standard products sold at list price. Microsoft Dynamics AX supports these types of sales very well with standard customer care, marketing automation and sales force automation capabilities.

- **Configure-to-Order Sales (CTO)** – These involve more complex products that need to be configured according to the individual customer’s needs. Options involve standard compatible parts that are selected based upon customer specifications. Prices are built based upon the costs and availability of the options selected. This is where manufacturers begin to need some of the additional functionality that Cincom modules provide.

- **Engineer-to-Order Sales (ETO)** – These involve products that must be designed and engineered based upon customer input. They are customized to the needs of the buyer and require additional functionality to seamlessly support this type of sale. Cincom modules are designed specifically to support the sale and delivery of highly engineered products and services for this type of sale.

Process Flow for CTO and ETO Models

This is where Cincom’s modular family of advanced Microsoft Dynamics AX capabilities for complex manufacturing comes into play.

“We approached Cincom because we recognized them as experts in providing software for complex manufacturing.”

– Morgan Wheaton, Director Dynamics Global Partners, Microsoft Business Solutions

The CTO Sale

The configure-to-order sale involves a more complex process (shown below) than catalog sales. There has to be a discussion of specific needs related to specific parts of the product being purchased. Even though the eventual version of the product sold is made up of pre-configured options, each with a cost-driven associated list price, there are numerous variables and constraints driving the part-selection discussion.

Consider the purchase of an industrial fan. A company might offer four different sizes, powered by five different horsepower motors running off two different voltage levels. Depending on what kind of air you are moving, you might want a plastic blade, or aluminum or steel. Perhaps you want the fan to be reversible and to offer a one-speed version along with a three-speed version. Maybe your fan is rated for indoor or outdoor use, and you offer three different colors.

That’s over 2,880 different variations of the fan.

This type of complexity requires multiple-level bills of material and complex pricing. Your sales rep will need a user interface that is highly intuitive and mistake-proof.

The configure-price-quote (CPQ) capability driven by rules-based technology and easy-to-use user interfaces is needed. The selection logic and business rules supporting the configuration process must be impeccable and highly reliable. These enable sales reps to walk through the many options associated with complex products to produce a solution that is configured specifically for the individual prospect’s needs.

Configuration technology can be driven by a product and price database or preferably by a knowledge rules engine, as is found in Cincom’s configure-price-quote module, Cincom CPQ™. Highly complex products contain so many variables, usage constraints and other selection criteria that the maintenance of a part and price database in conjunction with the configurator is daunting. Cincom delivers a great deal of added value to Microsoft Dynamics AX with its CPQ functionality by replacing the maintenance activities associated with a massive product and part database with a simple set of user-based business rules. The business rules in Cincom CPQ are easy to maintain and ultimately more effective.
Here are some of the advanced CPQ capabilities that Cincom adds to Microsoft Dynamics AX ERP:

- Rules and constraints engine
- Products and services configuration
- Multi-level BOM generation
- Complex pricing rules
- Catalog-based pricing and selection
- Deployment flexibility: Web, mobile, native Microsoft Dynamics AX and Microsoft Dynamics CRM, e-commerce
- Custom UI

Unless your sales operation is exclusively inside, you will need mobile CPQ that's optimized for tablets, laptops or even smart phones. Customers want to “know now” when it comes to capability and price; therefore, your sales rep needs real-time access to back-office expertise while at the customer site.

Additionally, if you are a configure-to-order shop, you will need estimating capabilities for situations where your stock solutions or common configurations just don’t meet the customer’s needs. This doesn’t mean that you are redefining your company vision to include custom manufacturing. However, it will give you the capability to prototype efficiently and serve your customer effectively at lower risk while increasing your ability to address more highly specialized needs. Cincom provides this capability as well.

The ETO Sale

The engineer-to-order sale takes this beyond the realm of configuration into the realm of design. This is true custom manufacturing of highly engineered products and services.

During the ETO sales process (shown below), customers need a specific solution that is not addressed by standard products or part configurations. In this more-demanding arena, where the products are essentially designed from scratch, powerful estimating capabilities are needed. This is where the Cincom Estimating module extends the basic Microsoft Dynamics AX capabilities. With highly advanced estimating capabilities, Cincom supports the process with engineering, supply chain and production inputs to allow the accurate pricing and production planning of unique, new product solutions.

With Cincom Estimating, the sales estimators can access the manufacturing supply chain as well as engineering and product data-management functions to quickly create a unique product or service proposal with great accuracy. This is not based on a “guesstimate”, rather, a firm quote is produced based on real data. Once the proposal is accepted, the system initiates a sales order and invokes product data and engineering change processes that feed the MRP and production scheduling functions.

Regardless of your manufacturing and selling orientation, there are compelling reasons to add configuration and estimating capability to your tool box. RFP, quotes and proposals are generated quickly and with more accuracy using this technology. The pain of losing money on specials can be replaced by confidence in being able to fully address your prospect’s exact needs.

Here are some of the advanced CPQ capabilities that Cincom adds to Microsoft Dynamics AX ERP for highly engineered products and services:

- BOM-WBS hierarchy
- BOM and route drag-and-drop UI
- Trigger purchase request for quote (RFQ)
- Revisions and scenarios with “what-if” comparisons
- Product and project cost by cost category
- Indirect cost application
- Pricing
- Integration with sales order agreement, quote or order
Planning Materials and Resources
This is where Advanced Manufacturing steps up to organize the actual planning and scheduling of materials and resources. It all starts with the sale of products and the resultant order placed. The order received quantifies the parts and supplies required to fulfill the order. These requirements drive the development of a bill of material as well as any need for designed parts such as engineering change requests to modify existing parts or to acquire parts from an external source. External supplies are acquired and any needed service parts are built and provided. Microsoft Dynamics AX handles master scheduling, resource requirements planning and material planning and production control for standard manufacturing modes.

However, the ability to facilitate a project view is especially important with engineer-to-order products. As orders (projects) are pushed through the system, resources and effort peculiar to that product are reserved. Cincom adds advanced master planning capabilities to Microsoft Dynamics AX since it is especially important for ETO manufacturers to be able to segregate and view material plans by project and revision at this level.

This becomes apparent during resource requirements planning. During mixed-mode manufacturing, project and non-project jobs are going to simultaneously consume resources from common sources. Therefore, Cincom adds the ability to view consumables by project, assuring that cost allocations and effort reporting are accurately tied to the proper project or jobs.
Purchase to Payment
Material needs required are input from the planning resources operation. Requisitions, purchase orders and any needed expediting are triggered and initiated. Purchasing activity required for the project is tracked and documented by project. Specific approved vendors associated with the project are identified and orders are placed.

Maintaining a project orientation is desirable at this point because future billing and cost identification must be tied to effort and material acquisition specific to the project. This is necessary to establish exactly how much the project will cost from an expense point of view. Allocating these costs will drive the ability to document contract compliance, effort expended and material consumed.

Invoices from suppliers are matched to specific projects, payments are processed and accounts are reconciled. This will include human effort reporting and the generation of 1099 forms as required.

Here, Cincom adds the following capabilities to Microsoft Dynamics AX:
- Approved suppliers by project
- Project/activity-pegged purchase orders
Building and Delivering Products

Finally, the order or project is initiated and executed in the form of a project-pegged production order. All of the standard production processes are triggered. Reporting is operational to track critical manufacturing execution data. Labor, rework required, scrap and yield are all active as the build process begins. While Microsoft Dynamics AX handles basic manufacturing, shop floor control, labor and resource reporting and rework scrap and yield reporting very well, Cincom adds the ability for project/activity-pegged production orders for CTO and ETO manufacturing processes at this phase.

As the project consumes material and labor, inventory levels are continuously updated. Inventory control is tracking and counting physical inventory, execution velocity, finished goods completed and all consumables utilized. Cincom adds the ability to track inventory by project and revision as well as use-up effectivity capabilities.

As finished goods are completed and packaged, they are shipped to the customer. Logistical processes are managed at this phase in terms of documentation and scheduling. Field returns are received and documented, counts are verified and vendor receipts and returns are handled here. Journal vouchers move funding between units to balance out and account for services rendered and product delivered from within the company. Microsoft Dynamics AX excels here.

Quality control is driven, tracked and executed by practice and by contract requirement at the project level. Goods received, work in process and finished goods are all subject to quality control. Quality costs are tracked as well. Lot and serial-number traceability are maintained and documented. This data is critical for after-sale processes and eventual field service requirements, and Cincom also adds project-specific quality requirements here.

Project Orientation

The ability to view production through the lens of project management provides the manufacturer with the tools to measure, manage and produce special products as efficiently as possible. For custom shops, this should not be news. Project-based manufacturing is what custom engineered solution manufacturing is all about.

Cincom provides the ability to isolate costs, effort and resources associated with a given project (or product) by adding the following capabilities that are critical to project businesses:

- Project/activity-pegged production orders
- Inventory by project
- Inventory by revision
- Use-up effectivity
- Project-specific quality requirements

These capabilities are essential to establishing a real cost base, which is necessary for managing profitability. Additionally, the ability to manage the production process in terms of customer-specific quality specifications, authorized suppliers and other constraints require a project-based footing.
Business Performance Measurements and Reporting

Measuring Financial Results
Measurement is essential to executing Advanced Manufacturing. All of the typical financial processes are needed such as balance sheets, P&L statements and analysis, budgeting and variance reporting, tracking fixed assets reconciliations and balancing or consolidating multiple organization financials. Additionally, Cincom enhances the ability to post to the general ledger by project, which is necessary for advanced manufacturing.

Cost accounting is another area with very specific needs relating to Advanced Manufacturing. All of the actual and standard cost methods are available. Variance analysis is important for seeing how well budgeting is aligning with reality as a project or reporting period evolves.

However, the ability to identify, isolate and allocate indirect costs is important for understanding how general or overhead expenses can be applied to specific processes. The individual project consumes a portion of an individual’s labor expense, utility expenses and other costs. Allocation of these expenses is ratably applied to the individual project. Additionally, product costing by project, revision and posting by project are essential again for accurately matching expense and effort to a given project. Cincom extends all of these critical capabilities to project-based manufacturers.

Cash received, returns, collections, aging and invoicing are aligned with discounting, and statement generation, invoices generated and any account adjustments are handled within Accounts Receivable. These are all standard processes that Microsoft Dynamics AX handles well.

Part of the planning process should include a detailed requirement related to establishing what metrics are worth measuring. This shouldn’t be too difficult, but also care should be taken to not collect, store or report on meaningless statistics. Specific KPIs are usually common to certain types of industries. The important thing is to identify the metrics that are most helpful to those who are responsible for planning and managing the operation.

LNS Research recently published a listing of those metrics they felt mattered most to manufacturers. They organized their listing into sections relating to

- Customer experience
- Quality
- Efficiency
- Inventory management
- Compliance
- Maintenance
- Flexibility and innovation
- Cost reduction/profitability

Measuring of Financial Results

![Diagram showing business performance measurements and reporting process](image)

- **Business Stakeholders**
  - Plan the Business
  - Business Budgets
  - Financial Status Reports

- **Configure, Estimate and Manage Product Sales**
  - Product Cost

- **Purchase to Payment**
  - Supply
  - Outside Processing
  - Journal Vouchers

- **Measure Financial Results**
  - Regulatory Reports

- **Customers**
  - Build and Deliver Products

- **Regulatory Agencies**
  - Cash Receipts
This is a good way to organize your thinking in terms of figuring out what data or information has real value to your organization from the standpoint of measuring performance:

• If you are spending resources for measuring inventory that is minimal, and you are running a pure demand-driven operation, how valuable is measuring inventory turns to you?

• Does the data tell you anything useful?

• Would doubling or tripling your inventory turnover rate have any material effect on your cash flow?

• If a metric has no impact on your ability to manage, then why bother measuring and reporting it?

A project-management orientation is highly desirable for Advanced Manufacturing to be fully effective. The ability to manage production as a series of projects facilitates the development of and accurate view of the production processes. Scheduling, budgeting, forecasting, billing revenue recognition and performance measurement by project are all incorporated into the project-management function within Advanced Manufacturing, whether driven by preference or contract. Cincom adds critical indirect cost allocation and multiple rates capabilities.

**Conclusion**

Like any journey involving multiple stops, careful planning is needed to make sure that your route is well planned. The Roadmap to Advanced Manufacturing provides guidance for your journey to a better, more responsive, customer-centric and profitable business model.
**Cincom, Microsoft and a World of Expert Resources**

Cincom has been delivering innovative ERP and other enterprise-class software solutions for decades, and has helped many of the world’s leading manufacturers achieve extremely high levels of operational and financial performance. Microsoft is the world’s leading technology company and fastest-growing provider of ERP solutions.

Together, Microsoft Dynamics AX and Cincom have created an ERP system developed specifically for the needs of CTO and ETO manufacturers. It combines the comprehensive, functional scope and highly adaptable framework of Microsoft Dynamics AX and Microsoft Dynamics CRM with specialized selling, engineering, contract, project and aftermarket service capabilities from Cincom natively embedded throughout the system.

Many of Cincom’s extended capabilities are modular and can be added to Microsoft Dynamics AX individually to meet specific needs. However, when the full suite is combined with the proven breadth and user familiarity of Microsoft Dynamics AX, these capabilities deliver an advanced, end-to-end, highly industry-focused ERP solution that goes beyond anything available until now. Learn more at: [www.cincom.com/mbs](http://www.cincom.com/mbs).

“Cincom and Microsoft together deliver enterprise-level solutions for manufacturers of highly engineered products with far more depth than anything previously available.”

– Morgan Wheaton,  
  Director Dynamics Global Partners,  
  Microsoft Business Solutions
End Notes


About the Author

Craig Phillips has over 32 years of experience in the architecture, design, development and implementation of ERP systems and technologies in support of strategic business objectives. His core competencies include business architecture and IT project management, supply chain, cost and product lifecycle management business disciplines and structured analysis and systems design. He also has in-depth knowledge of the aerospace and defense industry, OEM, MRO as well as make-to-order and engineer-to-order manufacturing business practices. In addition, Mr. Phillips is an accomplished public speaker and published author.

Contact Us

To discuss ways that Cincom can help you gain and maintain a competitive advantage through technology, contact Gillis West at: gilliswest@cincom.com.

You may also be interested in this special report from Senior Cincom Fellow Melissa Cook.