Collaborative Manufacturing Strategies:
Business Process Focus Yields Operational Excellence

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ARC’s Collaborative Manufacturing Model

Executive Process Control: Intelligence, Analytics, Strategic Decisions

BPM Solutions Orchestrate Business Processes
Executive Overview

Making business processes the focus of management’s attention can yield significant operational benefits. Managers can begin to think about new ways of doing business – not just to be more efficient, but in many cases a business process change can support a new strategic direction. A deeper understanding of a businesses’ processes generally comes from implementing them in systems and invariably uncovers hidden inefficiencies. The boundary-spanning nature of Business Process Management (BPM) systems allows managers to design process improvements that move beyond the limitations of standalone or legacy applications. Providing support for people as part of a controlled business process not only enhances their contributions, but also improves their job satisfaction. And because BPM systems can document and manage changes to the process themselves, it becomes relatively easy and predictable to make process changes in order to improve overall operational performance or respond to changing customer demands.

BPM solutions can help an enterprise in a variety of ways. Existing systems like ERP, WMS, and SCM can be integrated into higher-level processes. Wherever complex processes or workflows are employed, BPM solutions can be used to orchestrate, manage, refine, and optimize them. For example, the set of processes that comprise the fulfillment of a customer’s order as promised can be systematized, with controls and alerts in place to ensure that each order stays on track. This process typically spans a number of departments, workers, and partners, and companies can benefit from replacing unconnected, ad-hoc procedures with synchronized, rules-based business processes that involve workers and systems to their best advantage. Manufacturers should consider Business Process Management solutions any place where increased collaboration is likely to help reduce costs or streamline inefficiencies.

Another area where BPM plays an important role is in moving and synchronizing data among disparate systems throughout an organization. Very often, there is a set of specific processes and transformations that must occur in order to use the data correctly in each application, and base-level BPM systems support and enable these transformations. This is often done in conjunction with the design and implementation of complex inter-application logic.
Challenges for Manufacturers

Manufacturers rely on a number of software applications in the course of their daily operations. Each of these applications has its own unique logic and assumptions about how the business will run, who uses the application, what information must be shared, and many other details. Each embodies a set of business processes that may be consistent within the application, but are not necessarily optimized for the particular needs and peculiarities of a given manufacturing business. Inevitably, there are gaps and overlaps between deployed applications, and somehow procedures have evolved in each company to make everything work together after a fashion. These procedures often amount to inefficient workarounds or patches to disjointed processes.

Very often, the inefficiencies built in to these gap-crossing processes are not recognized as such. When they were first introduced, they may have been a small price to pay for gaining the benefits of a new application. Over time, the processes become ingrained and calcified. “We always do it this way.” In some cases, the original benefits may no longer be realized, but the processes continue.

In other cases, the applications themselves may introduce inefficiencies. For example, certain applications may have beneficial effects at the macro level for companies – say by reducing inventory levels – while placing a burden on users for extensive training, navigating multiple screens, remembering or writing down information from one screen to use in the next, and so on. This can go so far as to create a sub-culture of employees whose priority seems to be serving the application, rather than contributing more directly to producing goods for customers.

Another common difficulty is experienced when related processes run independently in time. Sales order promises and manufacturing schedules often exhibit discrepancies of this nature. Individual operations can be sub-optimized to be very efficient in their own right, yet still introduce delays or additional costs elsewhere. The time relationship between processes is frequently managed by manual procedures or interventions that are unrecognized until the people involved are unexpectedly unavailable, and things get out of whack. The situation is often managed by using standard process times, which unfortunately can then provide the cover to allow inefficiencies to creep in to critical revenue producing functions.
Sometimes the problem is more subtle. Many times, operations work, but are stubbornly resistant to speeding up. This can happen when unrecognized or competing bottlenecks constrain the processes involved. It may require performance monitoring and analytics to unlock these cases.

Underlying all of these examples is the fact that in today’s manufacturing enterprise, business processes themselves are not typically on the radar screen. They usually are not explicitly created, managed, documented, and refined. They are frequently ad-hoc solutions to problems, or processes copied by someone who has “done it before” in another setting or company. This shouldn’t be a surprise, because until very recently, there were very few alternatives, and the “know-how” involved in setting up operational processes was part and parcel of the competitive advantage of a manufacturing company.

Business processes are commonly designed to address specific problems, such as asset utilization or inventory turnover, and generally embody a parochial view of the issues. Input/output requirements are assumed to be inviolate, and control is limited to those variables accessible to the local group. While improvements can be made, performance under these parochial assumptions will always be limited. Going beyond these levels requires a broader view of the world and of what can be controlled.

Improving collaboration requires the ability to improve processes, by managing them explicitly and by leveraging additional information. Collaboration enables companies to develop expanded processes that understand the rationale behind inputs and outputs as well as how they may be adjusted to further improve internal operations. Do you have to satisfy all orders on the requested date or could you postpone some orders and gain efficiency from more optimal batching of production? Are spikes in demand the real variations in customer purchases that must be accommodated through additional safety stock or are they the effect of ordering policies that could be smoothed to gain better inventory control? Answers to these questions, and many others, enable manufacturers to develop improved processes that benefit their own operations while providing even better customer service. Implementing such solutions requires collaboration between parties and often means sharing information not previously available.

Processes that can benefit from collaboration are found throughout a manufacturing organization. Information and interfaces that can be used to improve these processes are equally diverse and demand that information
The best systems push the technology envelope and position their customers well to take advantage of developing technologies as web services. These solutions allow manufacturers to focus on their processes— not in the abstract, not as a paper exercise, but by embodying them in systems designed expressly for the purpose of orchestrating business processes.

Systems support seamless information flow across all organizational boundaries, within and outside of the enterprise. In some processes, such as Collaborative Product Design, user access to shared databases and shared applications can provide basic support. In other processes, such as Collaborative Inventory Management, information must be exchanged in high volumes and at high frequencies, requiring direct communication and careful synchronization between systems, applications, and people.

Managers in all areas of a manufacturing enterprise must anticipate the increased use of collaboration by their organizations. They must prepare their own operations to support the increased need for information and the seamless flow of this information across organizational and enterprise boundaries. To do this, they must understand the types of information exchanges that should be anticipated and the benefits of different information system architectures to support these requirements.

Various approaches to improving business processes have been tried. Many enterprise-level software systems achieve their results in large part by instituting predefined processes spanning various operations. A byproduct of this approach is that these enterprise-level software systems generally make companies change the way they normally do business, sometimes to a disadvantage. One can view the fashionable waves of management practice over recent decades as responses to the need for improving business processes. Practices like Quality Circles and Lean Manufacturing are cultural techniques to reinforce behaviors and introduce practices intended to improve processes. Until now, these philosophical socio-business techniques were the best bet for improving manufacturers’ processes and operational effectiveness, and these techniques do offer substantial benefits to manufacturers. But a new approach is now available, an approach that can act either as an alternative or as an extender to socio-business techniques.

The new approach takes advantage of “new” technologies that are now widespread, such as powerful computing, networking, and the Internet. The best systems push the technology envelope and position their customers to take advantage of developing technologies as Web services. These solutions allow manufacturers to focus on their processes, not in the abstract, not as a paper exercise, but by embodying them in systems designed expressly for the purpose of orchestrating business processes.
Performance Improvement Targets

Let us examine some familiar processes or problems and assess the potential impact of modern business process orchestration solutions in these areas. One can focus on three interacting loops in the Value Chain Domain. Order/Fulfillment represents the process of reaching out to customers, accepting orders, and ensuring that goods are delivered as promised. Materials Management is the process of connecting with suppliers, procuring the materials and ensuring that they arrive as needed by production. Scheduling/Production is a process that interacts with both the Fulfillment process and the Materials Management process. All manufacturers have these basic processes, but the degree of interaction, the time dependencies, and the information flows all vary widely, depending on the size of the enterprise, the manufacturing model, the position within the supply chain, global manufacturing requirements, degree of vertical integration, and other factors.

Order/Fulfillment Process

The customer-facing business loop consists of those processes involved in finding customers, accepting their orders, and ensuring that their goods are delivered as promised. This varies by manufacturer, but typically involves people in different departments using different standalone applications. For example, a customer service representative uses a CRM application while taking orders. A scheduler uses a spreadsheet or a more sophisticated Planning and Scheduling system to generate the work plan. A plant supervisor uses a Production Management System to direct and monitor the work. A Warehouse Manager uses a WMS application to track finished goods inventory and optimize stock movements. A shipping clerk and shipper use a 3PL system to arrange and track deliveries. In many manufacturing operations, these various applications are unconnected, and the

BPM systems can link independent operations into a controlled customer-facing process
business processes are ad-hoc and unsynchronized. Sometimes, things fall through the cracks.

BPM systems can link all of these processes and activities in order to “close the loop” and orchestrate all of the disjointed processes and operations to work together so as to better serve customers in the most efficient manner. BPM systems can ensure the timely execution of specific processes, streamline the extraction of data from various modules and applications, manage the procedures used to transform and transport data between systems, and to ensure that workers are effective process participants.

With BPM systems in place, the existing workflows can be supplemented with additional feedback loops. For example, the CSR can be automatically notified if work hasn’t started on a particular order in the expected time frame, or if something causes it to be rescheduled after work has begun. This enables a proactive intervention to address any schedule issues or notify the customer in advance if nothing can be done to rectify the problem.

**Materials Management**

The supplier-facing business loop consists of those processes involved in identifying suitable suppliers, placing orders, and ensuring that goods are received as needed for manufacturing. Again, this varies by manufacturer, but typically involves a number of people in different departments using different stand-alone applications. For example, an ERP/MRP system generates a required materials list. A purchasing agent uses a Supply Chain application to negotiate terms and issue purchase orders. At the receiving dock, goods are accepted and moved to the inbound storage area. Manufacturing withdraws the parts as needed.

As with the Order/Fulfillment process, Business Process Management systems can be used to link all of these processes and activities in order to “close
A BPM system can connect manufacturing workflows with external business processes

the loop” and ensure that materials arrive at the appropriate manufacturing station at the proper time. Where Kanban, VMI, Re-order Point, or other inventory management techniques are utilized, the BPM system can often enhance performance by introducing new feedback control opportunities. For example, the production supervisor can be automatically notified if notice of a delay is received for a particular order. Both the purchasing agent and the production supervisor could be automatically notified if received goods were damaged and possibly unusable. The additional control enables a proactive intervention to address any schedule issues and to develop workarounds where needed.

Scheduling/Production

The scheduling/production business loop consists of the processes needed to plan and execute plant floor operations. Details depend on the particulars of the manufacturing model involved, which also varies. Production supervisors, equipment and transport operators, planners, expediters, ERP/MRP, lab managers, and others participate in the workflows involved in day-to-day operations. Most often, the processes involved run independently, and process boundaries are where things are likely to go awry. BPM systems can synchronize all of these processes and ensure that optimal production decisions are made, taking into account order (demand) and materials (supply) constraints and opportunities.

It should be noted that in addition to interacting with the customer-facing Order/Fulfillment process and the supplier-facing Materials Management process, the Scheduling/Production process must interface with the Product/Process Design process and the Product/Process support processes.

Essential BPM System Capabilities

Business process management solutions provide companies with the functionality, user interfaces, and systems interfaces, to build, deploy, and
operate business processes. In general, six separate functions should be pro-
vided:

1. Model the Processes. Modern BPM systems provide a graphical
process design and modeling environment. These tools permit ana-
lysts or managers to develop specific business processes by modeling
individual activities, establishing connections of various kinds, se-
quencing relationships between activities, and defining the
touchpoints for workers. Look for change management/revision
management capabilities, security, and ease of connectivity to under-
lying systems in the best solutions. More advanced BPM tools will
automatically generate and maintain documentation from these
process models, and can publish them directly to an orchestrating
engine, enabling them to immediately run as designed. Also look for
compliance with modeling language standards such as BPEL4WS
and BPML.

2. Create Business Rules. Each process activity developed in the model-
ing phase as a high-level process is defined in more detail. In this
way, each “step” of the process can be spelled out, and conditions
can be established for determining successful completion, error con-
ditions, alternate paths, and other particulars.

3. Provide Connectivity to Applications. In order to
connect the abstract model of the business proc-
esses to the company’s systems, it is necessary to
connect to a variety of software applications. Two
aspects of this connectivity need to be addressed in
deploying a BPM solution: Adapters based on
standard technologies like XML and Java typically
provide the mechanism for interfacing to each ap-
plication, whether automatically or via some pre-
packaged templates. And data flow and connectivity are governed
by establishing data rules.

4. Provide Connectivity to Workers. Most business processes involve
people, and a business process management solution must support
human participation in business processes. Look for portal technol-
ogy and role-based and individual capabilities.
5. Run the Processes. In operation, an orchestration engine drives all of the processes, moving them from step to step (as well as from application to application) according to the logic implemented in the model, together with the appropriate business rules. It is important to be able to extend the power of the engine by linking and synchronizing multiple engines together. Backup and failover capabilities are crucial for critical processes and 24x7 operations. Another critical consideration is the capability to introduce new versions of processes with minimal disruption.

6. Optimize the Processes. Real business processes change over time. Once processes have been implemented in a Business Process Management system, it is important to monitor the performance and make changes or process improvements when necessary. Business process improvements result in operational improvements and enhanced business performance.

**Fuego Business Process Management System**

Fuego, a privately held company with headquarters in Dallas and offices in New York, Chicago, Raleigh, Houston, Buenos Aires, and Mexico City, provides a Business Process Management system that promotes a process-oriented and business-driven solution.

Their flagship product, Fuego 4, is well-suited to supporting the deployment, maintenance, and optimization of the Order Management, Demand Management and Forecasting & Scheduling processes within manufacturing and other industries.

Fuego’s Business Process Management System combines the functionality of tools providing Business Process Management, Business to Business collaboration, Enterprise Application Integration (EAI), and Web Services, all within the same framework. Fuego offers a Java-based development platform for quickly building or changing business processes. The company’s Process Designer breaks apart the middle application layer of the traditional 3-tier IT architecture by creating a process layer between the application and presentation layers. By doing this, Fuego’s Orchestration Engine can call up
underlying services from applications and deliver them regardless of their type (COM, CORBA, EJB, etc.).

By exposing business rules and logic in a separate process layer, the process is understandable and easily modifiable, even for non-IT people. Fuego’s Java-based platform generates a business process management supervisory application that enables trading partners, customers, employees, and existing applications to function as a single value chain.

**Visual Process Designer**

Fuego’s Process Designer is a well thought out graphical process modeling tool. It allows business analysts and others to model the activities, transitions and user roles associated with each business process. The Process Designer employs simple drag-and-drop process modeling, supports UML and other process notations, and incorporates deployment facilities for managing process versioning, abstract role-to-organization mapping, user role security enforcement and user role parametric binding. It automatically generates process documentation as well as runtime help documentation.

**Self-Generating Integration**

Connecting the designed processes to the installed systems can often be difficult and time consuming, but Fuego has a unique approach which simplifies the implementation. Fuego incorporates a self-generating component integration facility that automates the method of integrating and orchestrating disparate systems and applications. This functionality measurably reduces the time and cost associated with the integration of data, applications, presentations and Web services into a business process, and allows the creation of services from multiple internal/external applications. While traditional BPM and EAI products require the time-consuming creation or custom tailoring of unique adapters for each application, Fuego’s self-generating integration delivers plug-and-play adapters for common industry technologies, and supports all common standards. By introspecting metadata from an Application Programmer Interface (API), Fuego identifies both business services and incumbent data to create reusable process components.
**Single Orchestration Engine**

Fuego’s Orchestration Engine incorporates many of the capabilities of an integration broker, workflow engine, B2B integration and web services into a single engine. The engine executes and manages the orchestration of business services into processes according to the rules defined in the Process Designer’s customizable process model. It can be deployed to orchestrate services within a company or across a firewall in a B2B environment. Coordinated processes can themselves be exposed as Web Services, and the Orchestration Engine can execute those Web Services transparently across both internal and external processes.

It is in the nature of complex business processes to span traditional boundaries. Process designers will appreciate an engine such as Fuego’s that is deployable as a single solution or in parallel as a federation. They will also like the integrated fail-over and backup capabilities, support for process model modification, publication, and deployment with zero latency, and extensive version control capability.

**User Work Portal**

Business Process Management systems must consider the human side of the business equation. Fuego’s BPM solution employs a Work Portal designed specifically to encourage and support appropriate human participation within a business process. Fuego's Work Portal allows managers to define the roles and permission levels for employees at every stage of a business process. When employee action is required, the Work Portal creates a single work queue for all participants. Participants see work based upon their role and other security authorizations. The Portal makes it easy to filter, format and customize the ways in which personnel accomplish their tasks. The Fuego User Work Portal is a 100 percent compliant J2EE interfacing framework, and may be used standalone, or incorporated into an existing enterprise portal strategy.

**Audit and Analytical Tools**

Fuego’s Process Analyzer incorporates the Audit and Analytical Tools needed to document and evaluate the actual performance of business processes. The Orchestration Engine captures and stores information from the orchestrated services, which when evaluated by these audit and analytical tools, provides true enterprise-wide operational intelligence.
Notes:
**Analyst:**  Greg Gorbach  
**Editor:**  Ed Bassett  

**About the Author:**  As Director of Collaborative Manufacturing Research at ARC Advisory Group, Greg is a thought leader in Collaborative Manufacturing, and provides clients with strategic advice in the areas of Collaborative Manufacturing, Production Management, Implementation and Integration, Plant and Enterprise Portals, Business Process Management, and related areas. Greg has an extensive background in software and marketing management prior to joining ARC, and has worked in various roles for manufacturers as well as suppliers in many industries.

**Additional Reading:**

*Collaborative Manufacturing Management*, ARC Strategy Report, October 2001  
*Using Controlled Business Process Loops to Achieve OpX*, ARC Insight, August 28, 2002

Additional information is available on the Fuego website:  [www.Fuego.com](http://www.Fuego.com)
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