

# The Optimization Solution

**Pierfrancesco Manenti discusses the increasingly important role of optimization in helping the process industries drive business under increasingly complex and dynamic market conditions.**



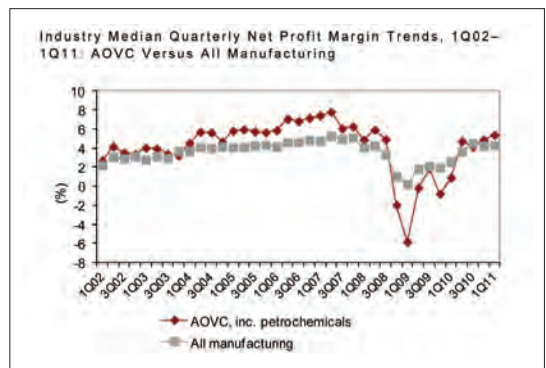
Process industries – or the asset-oriented value chain (AOVC), according to IDC Manufacturing Insights – include manufacturers that produce base materials and commodities, such as oil and gas, chemicals, polymers, specialty chemicals, pharmaceuticals, pulp and paper, and metals. Finished products in these industries are often commoditized and are produced from inflationary raw materials at asset-intensive production facilities. Production processes are strictly regulated and plants and assets represent substantial capital investment.

In the past few years, the dramatic growth in emerging economies has boosted demand for commodities, with the AOVC benefiting strongly from the subsequent higher commodity prices. The benefits on net profit margin are clearly evident in our benchmarking database in which IDC Manufacturing Insights tracks growth metrics from more than 800 publicly traded global firms (see Figure 1). Looking at the historical behavior of net profit margins for the AOVC and comparing it with the overall manufacturing industry, we see higher than average net profit margins before the 2008/2009 economic crisis began.

In the wake of the economic downturn, however, the AOVC entered a new economic phase – one characterized by shifts in global demand and extreme variability in raw material prices. The combination of a high level of variability with the pressure on product commoditization led to lower than average and volatile net profit margins over the last three years (see Figure 1).

This trend toward dynamic market conditions, shifts in global demand, product commoditization, and subsequent increasing complexity in doing business is expected to continue, and asset oriented manufacturers will look for opportunities to lower their breakeven points whenever possible.

IDC Manufacturing Insights' 2011 U.S.-based survey found that more than 31 percent of AOVC organizations recognized “increasing productivity” as their most critical business initiative (see Figure 2). A significant 27 percent of organizations also wanted to launch business initiatives aimed at “increasing revenue”. AOVC organizations – pressured by lower than average net profit margins – need to do more with less to ensure profitable growth.



**Figure 1: The last few years have seen the process industries impacted by shifts in global demand and extreme variability in raw material prices.**

Besides prioritizing productivity and revenue increases, nearly 15 percent of respondents also aim to launch initiatives to expand into new geographic regions/countries. What emerges from this research is that asset-oriented companies have a need to balance investments in emerging markets with greater focus on increasing profit margins.

If growth opportunities can be found in emerging economies and in more innovative products, profitability in the AOVG hinges primarily on two basic issues – the cost of raw material inputs and supply chain/manufacturing asset efficiency and effectiveness.

Over the next few years, asset-oriented organizations will be focusing their priorities to better:

- **Ensure profitable growth:** in domestic markets through product innovation and increased productivity, and in emerging markets by locating assets closer to feedstocks or closer to demand.
- **Rethink supply chain strategies:** to transform into demand pull versus supply push – essentially manufacturing to demand, which offers better margins and higher levels of customer satisfaction.
- **Optimize across a broader spectrum of operations:** to deliver better overall margins, AOVG organizations will implement global optimization rather than optimizing only at the unit level.
- **Rationalize existing assets:** through an appropriate combination of consolidation, decommissioning, new asset construction, and JVs to optimize overall performance based on material supply and end markets.
- **Innovate products:** via segmentation and portfolio optimization, serving specialty markets in lower volume, with higher mix, higher margin, more specialization, and better customer service.

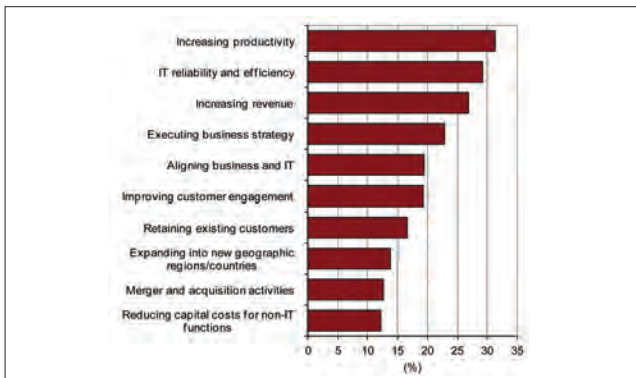


Figure 2: Increasing productivity came out tops in a recent IDC Manufacturing Insights survey of critical business initiatives.

## Critical challenges

We recently interviewed Dow Chemical, a major global manufacturing player in the AOVG. We asked about its most critical business issues and about the role optimization plays in its organization.

Increasing complexity in the AOVG was the key driver for Dow Chemical to undertake its journey toward optimization. To be able to manage value chain complexity, increase profitability, and contain aggressive competition, Dow Chemical developed a long term strategy to dramatically change its operational model.

The key driver in this change was the desire to become more responsive to customer fulfillment needs especially in the company's Performance business portfolio, which was enhanced by the acquisition of Rohm & Haas.

In doing so Dow is transitioning to more of a specialty chemicals player while still maintaining its legacy portfolio of businesses by entering into JVs in pursuit of an "asset light" strategy. The shift in strategy allowed Dow to concentrate on higher-margin segments

of the AOVG, increase intimacy with clients, and share costs and risks on capital assets for low-margin high-volume manufacturing processes.

Optimization capability is essential to achieving a higher level of supply chain responsiveness. In the last downturn the importance of optimization to Dow Chemical was clearly demonstrated. While other companies were reducing their expenditure for many critical initiatives, Dow Chemical continued to invest strategically in optimization and other relevant technologies such as process modeling and simulation.

Optimization is, in essence, a way to evaluate multiple scenarios that lead to cost minimization and to maximize opportunities – an essential capability in a rapidly changing and hypercompetitive marketplace. During the downturn, optimization enabled the company to continue to run its business in what was a new and challenging environment, helping it to identify ways to maximize revenues and reduce costs.

Optimization is not only essential just during a downturn; in fact, having an optimization capability in an upturn means improving a number of critical business metrics, ranging from margins to customer satisfaction levels. It is therefore an essential vehicle to create differentiation and support a higher level of competitiveness. To systematically implement this across multiple businesses, Dow created a Center of Operational Excellence – a corporate team run by a network of practitioners from multiple plants worldwide and aimed at sharing best practices.

Given the shift in emphasis from base chemicals to specialty chemicals, Dow concentrated its optimization efforts in implementing advanced process control (APC) initiatives with the help of aspenONE Manufacturing applications from AspenTech. The novelty of this APC implementation relates to its standardization across multiple plants worldwide.

Using standardized APC tools supported by a consultative approach by the practitioners team, Dow's production capacity increased by 11 percent, unit-variability decreased 45 percent, off-spec fell to zero, start-up time dropped by 60 percent, emissions plummeted over 80 percent, and the feed rate increased by eight percent (source: 2009 AspenTech Global Conference).

Dow has found that using advanced control and optimization applications improves production capacity by three to five percent, and decreases energy intensity by four to six percent. Indeed, Dow's cumulative savings from advanced control and optimization were in the US\$1 billion region in 2009.



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## What is Optimization?

In mathematics, optimization refers to the selection of the best solution from all available alternatives. In the simplest case, this means solving problems in which one seeks to minimize or maximize the value of functions.

In business, the fundamental application of optimization is to implement a strategy or a plan that is as effective and efficient as possible. In the end, it is about optimizing business functions to achieve superior financial and operating results.

End benefits are both quantitative (improved margins and profitability, increased throughput and yield, reduced energy

consumption and carbon footprint) and qualitative (improved agility to respond to changing business and operating conditions, enhanced collaboration and knowledge sharing, and implementation of best practices).

In an asset-oriented organization, the critical areas of the business that require optimization are engineering, manufacturing, and supply chain operations. Leading AOVC companies rely on process optimization software applications to deliver optimal performance and improve decision making.

### Going global

Over time the manufacturing industry has passed through a series of dramatic transformations. Firms have evolved from being “international” – centralized management and operations with physical distribution channels, to “multinational” – each region having its own product variations and management.

Now companies are looking to become “globally integrated”, where locally tailored products and services can be designed anywhere, produced anywhere, and sold anywhere (see Figure 3).

Leading AOVC companies began this journey a number of years ago and are well on their way; IDC Manufacturing Insights sees the need for the whole AOVC community to embark on these initiatives in order to compete effectively in a rapidly shifting and increasingly complex global market. There are two underlying trends supporting asset-oriented organizations in their journey to becoming globally integrated:

- **Product dynamics** – products must fit changing customer expectations in a global marketplace. Customers are spread over multiple global markets, both emerging and established, and have different expectations in terms of product features, quality, and compliance. Asset-oriented manufacturers need to move away from just producing base materials, and must embrace the opportunities offered by specialty products that meet specific customer needs in low volume/high mix.
- **Production network dynamics** – customer fulfillment is becoming the new guiding principle for the asset-oriented value chain. In fact, as customer retention is key, improving overall service level is a critical differentiating trait in the global marketplace. To better serve their clients, asset-oriented manufacturers need to move away from the traditional approach of having single large plants associated with single products, serving clients worldwide. They will have to manage a network of multiple smaller plants globally located and near to where demand is generated.

The combination of these two trends creates the emergence of a new approach to manufacturing management in globally integrated asset oriented organizations. This is what IDC Manufacturing Insights calls “global multi-enterprise optimization”. To guarantee appropriate product quality and customer service, asset-oriented manufacturers will need to manage the global network of production assets as if it were a single virtual factory that consolidates multiple capabilities in order to design, plan, and coordinate execution globally.

The most critical capability for a globally integrated asset-oriented firm as defined in Figure 3 is its ability to optimize the global network of production assets dynamically to fulfill customer demand in the face of extremely dynamic business conditions.

This is confirmed by the results of a recent supply chain survey of US-based asset-oriented manufacturers. The most critical supply chain priority is the reduction in total supply chain costs, followed by improving demand forecasting and supply chain responsiveness.

The result is a tremendous amount of pressure on balancing manufacturing and supply chain cost reduction with achieving higher responsiveness to customer needs across the entire network of global assets. Essentially AOVC organizations are moving from a supply push to a demand pull and are looking to further extend their optimization capabilities.

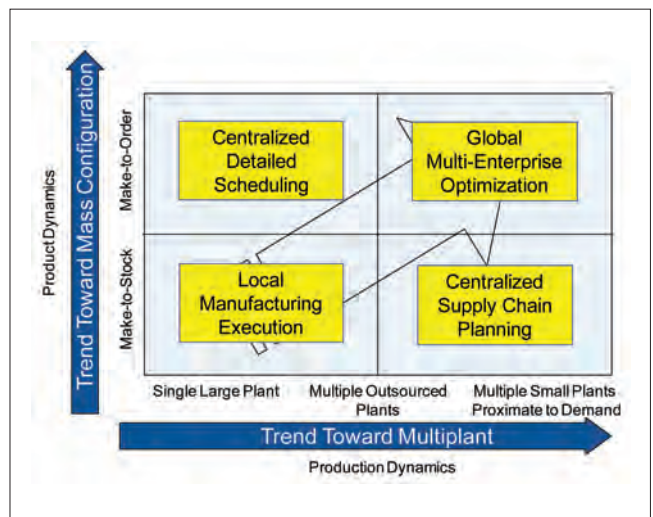


Figure 3: The critical capability for a globally integrated asset-oriented firm is the ability to optimize its network of production assets to fulfill dynamic customer demand.

### The maturity model

IDC Manufacturing Insights has developed a maturity model for the manufacturing industry (see Figure 4). In the early days of manufacturing, optimization wasn't essential. Profitability in manufacturing was based on economy of scale, high-volume production of blockbuster products, and low-cost raw materials.



However, later on, increasing attention to higher product and production quality represented a considerable shift in manufacturing managers' thinking. Driven by the need to win against the competition and satisfy mature customer fulfillment needs, quality required the implementation of advanced process control (APC), distributed control systems (DCS), and quality management systems to stabilize, improve, and optimize single production processes and assets within single manufacturing plants.

Efficiency, meanwhile, requires factory-specific planning, optimization, and control. Leading manufacturing organizations have greatly increased their productivity, working hard to optimize single local factory production processes and supply chains. Although this has been essential, in many cases it created what we call the "productivity-vise", where productivity gains, when outpacing market growth, create idle capacity which puts downward pressure on prices and results in the need to improve productivity even further.

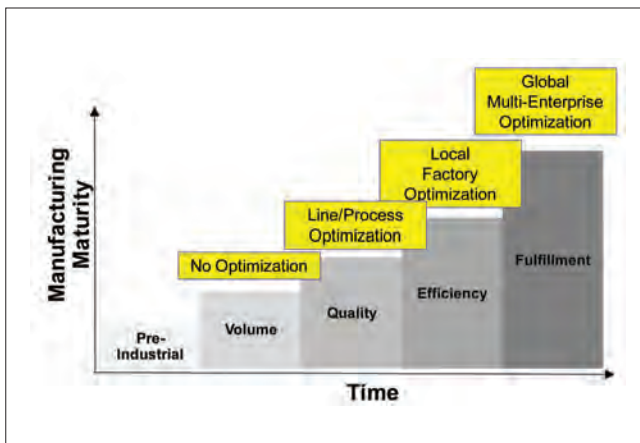


Figure 4: Manufacturing optimization maturity model.

So the next step for leading organizations is to go beyond mere plant-specific productivity and adopt a holistic approach to the global manufacturing network that sees *customer fulfillment* as the guiding principle. This requires that AOVC organizations consider plants and assets as nodes in the global supply chain. This shift is connected to the need for manufacturers to change their mindset from "capacity" to "capability" – ensuring the capability of fulfilling customer needs rather than making sure production capacities are fulfilled.

## Essential guidance

IDC Manufacturing Insights offers the following advice to asset oriented organizations:

### 1. Become globally integrated.

Follow the leaders and start your journey toward becoming globally integrated (see Figure 3). IDC Manufacturing Insights believes that embarking on this transformation is essential to compete effectively in a rapidly shifting and increasingly complex global market.

### 2. Transform into demand pull.

To achieve this, rethink your supply chain structure to transform it into demand pull versus supply push, essentially manufacturing to demand, which offers better margins and higher levels of customer satisfaction. This requires AOVC organizations to consider plants and assets as nodes in the global supply chain.

Benefits of a higher level of optimization are improved operational performance and faster response to market opportunities. ”

### 3. Optimize

The most critical capability for a globally integrated asset-oriented firm today is its ability to optimize the global network of production assets dynamically to fulfill customer demand, in the face of extremely dynamic business conditions. Increase your optimization capabilities to meet the tremendous pressure to balance manufacturing and supply chain cost reduction with achieving higher responsiveness to customer needs across the network of global assets. The main reported benefits of a higher level of optimization from the interviews we made are improved operational performance and faster response to market opportunities, leading to increased margins across the value chain.

### 4. Make organizational changes

Although IT plays an essential role in the success of optimization initiatives, take care about necessary organizational changes in the business before implementing optimization software. Leading AOVC organizations can realize long-term benefits in creating new organizational structures, in breaking up information silos, and in a higher level of collaboration among different functions.

### 5. Establish a center of operational excellence

To implement optimization smoothly, in a standardized fashion and at an acceptable price, establish a center of operational excellence. The center prioritizes activities, provides guidance and training across the organization, and motivates widespread employee participation. Dow, for example, created a center of operational excellence, a corporate team run by a network of practitioners from multiple plants worldwide. Across worldwide operations, this center is linked to rapidly share and disseminate best practices.

### 6. Adopt optimization software

To achieve a substantial level of optimization, AOVC companies must rely on process optimization software. Key areas of process optimization software applications are engineering, manufacturing, and supply chain operations.

Process optimization software underpins AOVC critical business processes to deliver optimal performance in the face of extremely dynamic business conditions. The software forms the basis for process improvements and optimizes decision making. It is also the tool where centers of operational excellence implement and standardize their best practices to be diffused across the global network of assets.

**CEA**

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