Hybrid Manufacturing Operations for Flexibility and Resilience

Executive Summary

Innovation vs. Status Quo

Try something new that might (or might not) be better versus sticking with what you've got (despite known shortcomings.) That's often the fundamental choice facing management teams wrangling with strategic and operational decisions. Questions of capital investment frequently involve a trade-off between consolidating or diversifying existing locations, facilities and/or equipment.

Here's the thing: there's often no clear right or wrong answer. Numerous pros and cons accompany either strategy. Diversification may spread risk, but it often comes with higher operating costs. Consolidation improves efficiency but increases concentration risk. It also does little to address evolving markets, raw material supply threats, talent resource conditions as well as a host of other factors.

COVID has further complicated manufacturing. Successful companies have learned to become more flexible and to take quick action as a steady stream of disruptions have rippled through the economy. The prosperous, easy-to-manage 2010s have been supplanted by the disrupted 2020s. This new reality further complicates the advantages and disadvantages of traditional consolidate vs. diversify strategies. This guide will take a look at various operational and financial considerations for both.

Ultimately, management must decide which scenario – consolidate, diversify or implement a 'hybrid' alternative – serves their stakeholders best. Management also must be able to articulate the reasons behind their decision to be better prepared for economic uncertainty and disruption. We hope these insights will help these management officials in explaining to stakeholders – owners, brand value, employees, consumers and suppliers – what scenario has been chosen and why.

> *We need to figure out how to really create a much more robust not as lean, supply system that has some give to it."*
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> Nancy Foster, VP of Quality and Patient Safety Policy, American Hospital Association. *The New York Times*, May 31, 2022.

Introduction

COVID-19 has starkly revealed the downside to relentless efforts by companies to seek incremental efficiencies from their supply chains and operations. Instances of impaired resilience and limited flexibility have led to production disruptions stemming from unreliable raw material supplies and labor resources. Companies have struggled to quickly shift from one market to another. They have also struggled to consolidate brands, offerings and packaging to meet pandemic-induced changes in consumer buying habits. What was expected to be a short-term problem for manufacturers has turned into a long-term disruption with a series of independent, yet interrelated events, all triggered by COVID.

It's Natural and Understandable

Our natural biases (including normalcy bias, status quo bias and the availability heuristic) all help us understand the conventional belief, held by many management teams, that the future will resemble the past. Several generations of managers have been taught to relentlessly pursue cost savings through efficiency. While incremental opportunities to materially impact the bottom line have become rarer, the quest for greater efficiency remains the dominant management mindset.

"It's worked for decades." We never expected the world to change so significantly. Therefore, we stayed the course. To do otherwise would likely have evoked incredulity from investors and advisors who demanded continuous cost reductions. "Don't fix what isn't broken," as the old adage goes. Then, suddenly and dramatically, the world changed in 2020. A renewed awareness of risk management has been triggered as a result.

COVID was initially about worker safety and packaging challenges. Subsequent disruptions included labor shortages, logistics challenges and ingredient inflation. We can no longer assume the future will resemble the past. Best in class managers now ask, *what else could happen to disrupt our operations?*

Manufacturing Risk Management

> *The peculiar and exceptionally unstable organization of the critical state does indeed seem to be ubiquitous in our world."*
>
> Ubiquity: Why Catastrophes Happen, by physicist Mark Buchanan

Business decisions tend to focus on risk (we don't know what is going to happen next, but we do know what the distribution looks like) when, in fact, uncertainty (we don't know what is going to happen next, and we do not know what the possible distribution looks like) has proven to be a much bigger challenge.

Risks have known probability distributions and likely outcomes of events. We can take proactive steps to mitigate risks through system design or with buying insurance. For instance, we know that, based on the number of miles driven on company vehicles, there will likely be X number of accidents. We don't know when they will occur, or on which roads or with which drivers, but we can reasonably expect they will occur based on past history. Management can mitigate that risk with safe driving training, systematically eliminating left turns (as UPS' routing software implements), holding replacement vehicles in reserve and purchasing insurance. Similarly:

- The risk of a dust explosion in a facility is greater when high levels of ambient dust is present than in another facility with lower dust levels thanks to better equipment design.
- The risk of contaminants entering food products during production can be mitigated with careful process design, automation and ingredient quality control.
- Likewise, the risk of a production disruption can be reduced through redundant facilities and equipment.

Keep in mind that mitigating risk generally adds costs to production so every management team must address the cost/benefit of each investment. In the examples above, the exercise is relatively easy since these costs are quantifiable.

Uncertainty is different. We don't know what we don't know. When a production line is designed to run raw cane sugar, management anticipates it will flow from Brazil uninterrupted. Still, a trade dispute could suddenly arise. This event could cut off the supply, which would force the manufacturer to buy material from a new source or even substitute a different type of sugar. Perhaps the new sugar runs identically, differently or maybe it simply won't run at all. In this example, you cannot reasonably anticipate either the scenario or the outcome.

Other examples of uncertainty in the recent past include:

- **Gluten-free -** In 2005, someone building a new bakery wouldn't have known that Celiac disease would become perhaps as much as 600% more prevalent — leading to a gluten-free movement that would change ingredients and baking dramatically. That new bakery, built only 15 years ago, will need a lot of change to stay up to date.

- **COVID-related demand changes –** Pandemic shutdowns drew sharp contrasts among food processors — those that supplied institutional buyers saw business collapse, while those that supplied consumers saw demand soar. The pandemic also led to a reduction in brands or features as retailers stocked fewer varieties.

- **Workforce disruptions -** Automation, which has long been a solution aimed at improved quality and efficiency, served companies well in 2018 as labor markets tightened. In 2020, automation enabled these same companies to continue operations, while others experienced production disruptions due to COVID-induced labor shortages.

The more one thinks about uncertainty, the more scenarios management could prepare for. Preparing for all of them would be impractical and an inefficient use of always-limited resources. Unfortunately, when we are faced with a complicated task like uncertainty, we often ignore it altogether and end up only worrying about the risks that we know. In most businesses, mitigating risk is usually given far more attention than mitigating uncertainty. This trend is especially common when managers try to determine the appropriate amount of factory diversification or consolidation for efficient production.

Before we address efficient production, let's look closer at both diversification and consolidation for manufacturing plants.

Factory Diversification or Redundancy?

One of the most common approaches companies use to manage risk and uncertainty is through diversification of manufacturing locations. The number of manufacturing plants a company operates can come about in a variety of ways. The question is, how many manufacturing plants do you need? What is the most effective number exactly? Diversification can be expensive and when cost control is needed, manufacturing plant consolidation is a classic management strategy. So, it's a fundamental question: how many manufacturing plants are needed to balance risk and cost? Let's start by looking at how new plants are 'created'.

Greenfield factories are often proposed as the solution to many problems. Despite increased friction in zoning, permitting and communities, greenfield factories in a new part of the country are often seen as the best solutions for a variety of manufacturing problems. These issues include increased demand, new products and modernization. A greenfield plant is a clean slate — an opportunity to start fresh. It can solve many problems, but the upfront cost is high. The criteria used to justify the ROI (capacity, sales growth or efficiency targets) may never be realized and is often never validated.

Factory diversification can also be a byproduct of **business acquisitions.** The strategic goal is often focused on acquiring new brands, growing market share or other high-minded pursuits. In the end, one thing is sure to happen — the acquisition of new plants. Let's look at a pertinent example:

A global confection company sought to expand their footprint in the United States. They purchased well-known, but undervalued brands from other companies, which resulted in numerous and very diverse manufacturing plants throughout the United States. Ultimately, the business is bigger, but also far more operationally-complex.

Diversification can also come about when regional supply chain considerations (availability of ingredients, access to markets) are the deciding factors. A major flavor company expanded their product portfolio when they bought a well-known New Orleans-based brand and their factory. Significant investment was needed to bring this 'new' plant up to the acquiring company's production and quality standards.

All of these diversification decisions are based on sales growth projections primarily, which can carry optimistic momentum. Too often, pre-deal forecasts focus on increased demand, tax considerations or labor rate reductions rather than operational complexity. Once the investment is complete and the new factory is operational or the merger is complete, the projections used to justify the investment are rarely revisited. It takes a major event to trigger such a review. These events can include poor financial results, a change in ownership or management, government regulation or a tax policy change. In other words, the foundational assumptions upon which risk and uncertainty mitigation rest often go unchallenged between the time the investment is made and when a crisis is at hand.

> **The result is that systemic risks become embedded assumption in normal business instead of factors to continuously evaluate, understand and potentially mitigate.**

One other consideration before moving on: we often visit factories that appear to exist in a state of suspended animation, reflecting best practice, technology and mindset of the time when they were built. Owners have allowed them to gradually become inefficient and obsolete due to lack of capital investment. Necessary improvements are delayed or ignored. The cost of capital or lack of attention from management limits prudent investment and process improvements. Action is lacking as the comfortable umbrella of grandfathered regulatory standards support the status quo. AZO has seen many investment plans abandoned due to higher costs attributable to design changes required by NFPA regulations which were not required (i.e. grandfathered) with legacy equipment.

This short-term thinking results in manufacturing plants that are outdated and stagnant. Such status quo facilities often appear at the top of the list when restructuring or even shutdown is needed. This is not inevitable. Modest, continuous investments often generate outsized returns when process equipment is brought to nearly state-of-the-art condition. Projects like controls upgrades, improved dust control and installation of VFD (variable frequency drives) are examples of small, affordable and impactful investments in existing facilities. Even large capital improvements in legacy plants are still less costly and carry less risk than overly optimistic greenfield investments. Unfortunately, many companies overlook this type of low-hanging fruit.

COVID Consciousness

COVID and the Russian-Ukrainian war have severely disrupted the global economy. In 2020, COVID was an economic shock resulting in shutdowns, labor shortages and logistic challenges. As the World economy normalized in 2022, the invasion of Ukraine by Russia created a second major economic shock with new challenges and re-energized COVID related disruptions. COVID was the first big rock thrown into a calm pond followed by a second rock (the Ukrainian war) that both added to and increased the prior disruptions. We're only beginning to recognize the impact of a global pandemic on business planning. Several generations of senior management will carry the scars of 2020's economic shocks and will, as a result, weigh manufacturing resilience, efficiency and optionality quite differently than their predecessors.

A long period of economic normalcy ended with COVID. Manufacturers were faced with labor, packaging and logistical headaches never experienced before. Each challenge required businesses to react and evolve their production processes. Consumer demand reduced spending on travel and dining while increasing spending on home improvements. It took time but the world learned to slow the spread of COVID and developed vaccines. We ultimately learned to live with COVID. Two years into the pandemic, with many problems solved, a second disruption occurred in Ukraine which created an entirely new set of problems for manufacturers.

The Russian invasion, while horrific for the people of Ukraine and Eastern Europe, has significantly disrupted the world energy and commodities markets. Economic sanctions have reduced Russian oil and gas supplies, resulting in tight supplies and surging prices not seen since the 1970s oil embargo. Agriculture and metal commodity prices have likewise risen due to reduced Russian supplies. These disruptions triggered a second set of economic disruptions including raw material shortages, inflation and inventory gluts.

COVID and the Ukrainian war each presented a unique set of economic challenges, but they were also interrelated, which amplified one another. Some companies benefited and others were hurt. We have also seen company fortunes quickly change, as winners become losers, and losers winners, sometimes very quickly. The prosperous, easy to manage 2010s have been replaced with the disrupted 2020s. Flexibility and quick action have become required manufacturing skills.
Manufacturing disruptions since March 2020 include:

- **Labor –** The COVID outbreak strained production labor, initially with illness (or the threat of) and later with turnover. Low paying, physically demanding and technical positions were especially hard hit with high turnover and scarcity.

- **Packaging –** Travel restrictions caused commercial sales to collapse while retail sales skyrocketed. Many manufacturing plants dedicated to commercial products were forced to shut down or rapidly increase consumer production when demand quickly shifted (e.g., toilet paper).

- **Logistics –** Shipments from China were disrupted by both producer and shipper shutdowns which later led to supply shortages for downstream manufacturers. Disruptions at Chinese and American ports interrupted the steady flow of containers as ship arrivals were no longer predictable. Ports became clogged, which then disrupted inland distribution.

- **Raw material shortages –** US and European manufacturers with lean inventories were forced to deal with inconsistent deliveries, resulting in slowed or lost production. Consumer demand for goods remained strong, due to government stimulus, but vendor supply problems resulted in low inventories and high prices Autos remained at the factory, incomplete for want of computer chips.

- **Inflation –** Simmering inflation due to too many dollars chasing too few goods exploded as energy costs skyrocketed with Russian sanctions. Sanctions also impacted commodity prices. Higher logistics costs increased the price of just about everything, resulting in inflation rates not seen in 40 years. Sales remained strong, but costs rose faster.

- **Inventory glut –** As the pandemic waned and economies reopened, consumers shifted purchases from goods to services, leaving retailers with too much stock. Household goods which flew off the shelf during COVID began to pile up in warehouses. Companies that were yesterday's winners became today's losers.

As the West begins to live with COVID, the Chinese have taken a different approach. Their Zero COVID policy has been very effective in reducing hospitalizations and deaths, but at what economic cost? Zero COVID has resulted in intermittent, but economically harmful, business shutdowns which continue to snarl production and logistics. How long can an export-driven economy continue with unreliable production and delayed shipments? This could be an on-going disruption for manufacturers around the world.

A global pandemic is an extreme disruption. Still, areas prone to flooding, tornadoes, hurricanes and earthquakes are known but often overlooked when it comes to risk management. There are uncertainties that could also influence our future, such as chronic water shortages, workforce challenges, unpredictable utility costs and other impacts related to climate change. Fickle customers can now change buying preferences at an ever-greater velocity, but this risk is not new. At times, risk and uncertainty do overlap.

Consolidate or Diversify

That brings us to the difficult question that every manager must face: should you consolidate your manufacturing platform or does your key production facility need diversification? It is our uncomfortable reality. There is no simple best alternative.

As with ESG (environmental, social, governance) issues, companies must reconcile philosophical imperatives with traditional business considerations. There are compelling pros and cons to either approach:

Pros to Consolidation

Assuming stasis, consolidation is the path to maximum efficiency. Benefits include:

- Reduced operating cost and simplified operating structure.
- Less plant, equipment and staff to acquire, manage and maintain.
- Investment in state-of-the-art equipment and software is consolidated.
- Management attention is focused on fewer locations (or one single location).
- Consolidated procurement can reduce cost and the number of ingredients to be purchased and inventoried.

Example: A Canadian baker recently announced a project to consolidate four smaller legacy bakeries into a single “super plant” in Ontario. The new plant is expected to produce all the current products with a 40% reduction in the number of ingredients and a 30% reduction in labor cost.

Pros to Diversification

Stasis may be transient and change can happen quickly. In periods of rapid change, diversification may offer a wider choice of options and manufacturing flexibility. Benefits include:

- Unexpected shutdowns are localized and production continues elsewhere.
- Internal competition between plants can drive innovation and development of best practices / corporate CoE (center of excellence).
- There is often designated spaces to test and pilot new products, processes and technology. This helps to fast-track new product development.
- Regional consumer tastes and preferences can be leveraged to a broader audience, expanding the brand and reach.

Example: An American building products supplier produces its entire product line in a single manufacturing plant in Pennsylvania. Three satellite plants (located across the Sun Belt in Georgia, Texas and California) produce the highest volume products for local demand near the most active construction markets.

Cons to Consolidation

The cons for each category are more than just the inverse, although that's a good place to start.

- Capital investment can be significant and has a long timeline.
- Transferring production from legacy manufacturing locations to the new "super plant" can involve significant process changes, validation hassles or brand quality variability.
- Loss of redundancy — all your eggs are now in one basket.
- Lack of redundancy means systems must be 'bulletproof' - engineered for 100% availability and utilization.

Example: An American food processor uses a single plant as the sole supplier of French fry coating mixes for 10 potato processing plants. The mix plant was designed to produce six recipes when built; it currently supplies over 20 recipes. Demand (higher volume and new flavors) has outgrown current capacity. Management is now looking to add capacity with a new mix plant (in a new location), which will simultaneously add redundancy and flexibility for exotic small-batch coatings.

Cons to Diversification

Redundancy is expensive!

- Fixed and some semi-variable costs are higher with duplicate facilities.
- There are more machines and software to maintain, replace and upgrade.
- Consistency and quality can be difficult to maintain across multiple facilities with distinct cultures and processes.
- Legacy plants may end up in a death spiral as capital funding is allocated to more contemporary plants

Example: The liquidation of Interstate Bakeries exemplifies how too much diversification can lead to business failure. Too many legacy plants equipped with out-of-date equipment and systems were located in locations with limited expansion opportunities. Other issues, like inflexible labor rules, lack of capital for greenfield projects and shifting consumer tastes doomed the 100-year-old company. While Interstate had many issues, its high cost of production severely limited management's options to turn the company around. Shutdown was a somber end for a well-known brand.

Manufacturing Optionality

Just as Warren Buffett views cash as a call option on every other class with no expiration date, we at AZO work to help manufacturers think of their process automation and manufacturing decisions as 'options' on manufacturing viability. Our aim is to help guide them through periods of uncertainty.

Ideally, manufacturing decisions should:

- Support current, specific, known and reasonably-anticipated needs
- Eliminate or mitigate risks
- Create a flexible framework to allow companies to adjust to changing supply, economic, market, regulatory and customer preference conditions

The third point is key. AZO encourages companies to look beyond reflexively embracing either of two options. Current technology and production methods have advanced, so the traditional distinction between consolidation or diversification has become a fallacy of false choice. Companies no longer need to choose one or the other. Rather, they have options to manage complexity while designing resilience into their operations. They can invest in optionality on viability using a hybrid approach.

A Flexible “Hybrid” Alternative — NexGen Factories

The hybrid approach, which has succeeded in many companies, actually relies on a combination of approaches:

- Modest diversification of locations provides macro-level resilience
- Company-wide harmonization of systems and machinery provide micro or local efficiency and flexibility

A Practical Roadmap — A Seven Step Process

Sound intriguing? Maybe too big an ‘optional project’ to add to your plate right now? Building flexibility into a plant certainly will take some work, but it doesn’t have to be a huge project. You may even decide not to advance beyond the research and planning stages if options are limited. We recommend the following seven-step process to expand your thinking on how to mitigate both risk and uncertainty.

1. Inventory the current operation (facilities, equipment, capabilities) by product, customer, market, etc., labor component, downtime, etc.
2. Inventory risks and uncertainties that the board and senior management believe merit planning. Think beyond your normal operational challenges (e.g.,. black swans).
3. Inventory market trends — demographics (age, distribution, habits, health, etc.), societal, trade and regulatory. How will this impact demand?
4. Consolidate research around recent and current technology trends that relate to your processing including mechanical systems, logistics, distribution, quality, etc.
5. Develop an ideal hybrid solution — think of it like a zero-based budget-type exercise for operations, unconstrained by recent or current execution and perceived budget limitations.
6. Build a gap analysis comparing your current operation vs. the ideal in terms of the hybrid approach.
7. Identify themes/goals and technology requirements to close that gap — ranging from the strategic goal to discrete technical upgrades (e.g., to harmonize locations so completely that staff could move seamlessly from one to another).

Clearly, there's nothing radical here. The key is a framework to:

- Understand the goal — a hybrid solution, which provides more resilience in the face of risk and uncertainty
- Codify the current state in a set of clear understandings of overlapping conditions
- Articulate the reasonable and ideal future state
- Identify and fix the gaps

If left to an ad hoc approach – all too often the usual approach – questions as simple as replacing fork truck batteries or upgrading processing controls end up slipping down the capital allocation priorities every year. After all, based on the way things are today, why replace something that isn't broken? The real question is, what would happen if the part fails? How long will it take to correct the problem? Our seven-step approach drives a rigorous analysis and results in a more realistic understanding of potential risks and uncertainty. Capital investment decisions can then follow a well-considered plan that can be rationally executed.

Conclusion

Managing a business requires inevitable trade-offs. A company's ability to navigate and endure both known risks and unknown uncertainties depends on many factors beyond management's strategic vision and operational excellence. Optimizing for uncertain and fast-changing market conditions requires a blended approach of diversification and harmonization.

Best in class manufacturing operations, therefore, achieve higher levels of functional resilience and diversification with fewer separate facilities. That's the engineering hybrid solution to the financial and operation-related tensions between factory consolidation and diversification. It's a NexGen factory solution.
