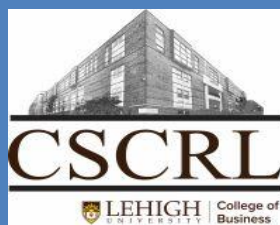


MANAGING SUPPLY CHAIN COMPLEXITY: AN INDUSTRY WHITEPAPER

While it is often an inevitable outcome of business decisions, unnecessary complexity should not be an accepted part of your supply chain. This reading explores the causes and remedies of supply chain complexity. Failure to manage complexity exposes an organization to a variety of risks.

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Supply Chain Management



A revealing way to appreciate how supply chains have changed over time is to visit a supermarket. During your visit be sure to stop by the Mediterranean bar, the florist, the bakery, the pharmacy, and the organic and gluten-free foods sections. Don't forget to visit the parts of the store that feature fruits, vegetables and seafood brought in daily from around the world, the pre-made and gourmet meals section, and the products targeted to the Hispanic, Asian, and Kosher community. Do you need toothpaste? One analysis found that consumers can choose from over 350 different SKU's of toothpaste. And, any parent knows that a trip down the diaper aisle with its dozens of choices can be a daunting experience. Supermarkets today typically stock 40,000-50,000 items, up from around 15,000 in the 1980's. Welcome to the world of supply chain complexity, a condition that affects virtually all industries, not just retail supermarkets. It is also a major driver of supply chain risk.

Why should anyone be concerned with complexity? The short answer is that most CEO's expect the internal and external complexity that their organizations face to increase. A study by the *IBM Institute for Business Value* revealed that 60% of CEO's say their organization currently experiences high or very high levels of complexity. Almost 80% say they expect to see high or very high complexity as they look out over a five-year horizon. A second finding is that more than half of CEO's express concerns about their company's ability to manage increased complexity.

The acronym VUCA (volatility, uncertainty, complexity, ambiguity) describes various elements that contribute to supply chain risk. This reading addresses the increasingly important topic of complexity (the C in VUCA) by defining the concept, describing why it can be a problem, and explaining why we have business complexity. It also presents strategies for addressing an emerging topic that risk professionals must confront, whether they recognize the need to or not.

WHAT IS COMPLEXITY?

Few rational people wake up in the morning and say, "My goal today is to make my organization unnecessarily complex!" Things usually do not work that way. But yet, we often find ourselves consumed by unhealthy levels and kinds of complexity.

What, then, is complexity? While we can define business and supply chain complexity in a variety of ways, a general perspective views something as complex if it is hard to separate, analyze, or solve. Another perspective views complexity as something with many parts in an intricate arrangement. Perhaps more revealing are the synonyms that describe the word complex. These descriptors include complicated, intricate, and involved. While there are academics and consultants who have attempted to define this concept, the word complexity, at least conceptually, should not be that complex.¹ It is often something that we know it when we see it. The following provides a diverse set of examples that shows the many faces of complexity. Unfortunately, there is usually no shortage of examples to illustrate this concept:

- A simple sounding proposal to begin collecting state sales tax on online purchases is not all that simple. At Overstock.com it took a team of 20-30 experienced IT professionals 9,142 hours over five months to install, test, and integrate the software that let the company properly calculate use tax in one additional state.²
- The merger between United and Continental Airlines still presented challenges years after it was announced. In technology alone, the two carriers had 1,400 separate systems, programs, and protocols. Workers were also represented by different unions with dissimilar work rules. It required almost a year of study to arrive at a single coffee to serve on the combined airline.³
- Spire, a data tracking service reported that U.S. consumers could select from 352 distinct types and sizes of toothpaste at retail outlets. The good news is this figure is down from 412 several years earlier.
- At one point 3M's picture hanging hooks, a relatively simple product made of plastic and strips of sticky foam, were part of a production process that, over 100 days, meandered more than 1,300 miles through four factories in four states. 3M's former CEO referred to these convoluted travels as "hairballs."⁴
- Hostess, the now-closed maker of Wonder Bread and Twinkies, made its final trip into bankruptcy in 2012. The heavily unionized company ended life with 36 plants and more than 500 distribution centers across the U.S., 372 collective-bargaining agreements, a dozen separate unions, several billion dollars in unfunded pension liabilities, 5,500 sometimes duplicative delivery routes, and 40 multi-employer pension plans.⁵
- After a fire destroyed the sole Japanese supplier that provided a critical P-valve brake part to Toyota, engineers came to realize that over time they had designed 200 P-valve variations, many of which had complex tapered orifices that required highly customized jigs and drills. This made the recovery from the fire even more challenging.
- Harvard University announced plans to outsource the management of most of its endowment assets and lay off roughly half the staff at the university's Harvard Management Company. The university could no longer justify the organizational complexity and resources required to support the investing activities of the portfolios that comprise the university's \$26 billion endowment.⁶
- The City of Los Angeles passed new rules that require developers to include affordable housing in new projects. The rules require up to 25% of units in rental properties and up to 40% in for-sale projects meet affordability guidelines. Developers must also pay construction wages on par with those required for public works projects, such as a carpenter making \$55 per hour; hire 30% of the workforce from within the city limits; set aside 10% of jobs for certain disadvantaged workers living within 5 miles of the project, and ensure 60% of the workers have experience on par with graduates of a union apprenticeship program. Developers contend that these new requirements will prevent new projects from even being started in Los Angeles.⁷

The issue is not necessarily whether something is complex, but rather at what point does something cross a threshold and become excessively complex? A comparison to cholesterol is one way to think about this topic. The human body has good and bad cholesterol, and even the bad cholesterol is tolerable until it reaches a certain level. Complexity is much the same way. Companies that understand how to manage certain kinds of complexity can use it to gain competitive advantage. Others are simply overwhelmed by it.

Types of Complexity

McKinsey researchers have studied the topic of complexity probably as much as anybody. They have concluded that two broad categories of complexity exist. The first category, *institutional* complexity, stems from strategic choices, the external context (such as regulations), and from major choices about organizational and operating systems.⁸ The second major category is *individual* complexity. Individual complexity deals with how hard it is for employees to perform their jobs. Employee role ambiguity, conflict, administrative burdens, duplicate roles, and ill-defined tasks and processes all contribute to individual complexity. More specific types of complexity can characterize industries and organizations:

- **Designed** complexity—this results from choices about where the business operates, what it sells, how it sells, to whom its sells, etc.
- **Inherent** complexity—this is intrinsic to the business and can only be removed by exiting a portion of the business
- **Imposed** complexity—this includes laws, industry regulations, and interventions by external organizations
- **Unnecessary** complexity—this results from a misalignment between the needs of an organization and the processes in place to support it. This is probably the easiest complexity to address

Organizations that learn how to manage and exploit complexity should generate additional sources of profit and gain competitive advantage. When managed well, complexity can also increase corporate resilience by enhancing the ability to adapt to change. On the individual side, McKinsey research has determined that companies reporting the lowest levels of individual complexity have higher returns on capital employed and returns on invested capital.⁹

An example of managing complexity comes from the retail world, where something called omni-channels has suddenly become big news. Major retailers are turning their stores into order-fulfillment centers where workers pick, pack, and ship online consumer orders, part of a complicated plan to grow their business. While filling online orders from stores instead of distribution or fulfillment centers adds channel complexity, these retailers expect to gain a competitive edge over online-only rivals by providing customers with greater ordering flexibility and service while offering the retailer an opportunity to better manage its inventory, service

levels, and order delivery times. Perhaps most importantly, these retailers hope to stay relevant to consumers.

One of the challenges with complexity is we do not have measures or tools to arrive at a complexity score. Within quality management if a process proving study reveals that a process has a capability (i.e., Cpk) of .8, we know that process is not capable of producing output that conforms to requirements on a consistent basis. In fact, the Cpk value can even be used to estimate the parts per million (ppm) defect level for that process. Fact-based tools and methodologies are readily available and known. No such tools, at least at this time, specifically “score” complexity, making it difficult to operationalize this concept.

WHY COMPLEXITY IS (OFTEN) BAD

An overly complex product or business process usually brings with it an impressive list of less than desirable outcomes. Consider how an overdesigned product, for example, can affect product quality. The case against product complexity during product design is a strong one since it can be shown mathematically that overly complex designs affect product quality levels. Let’s illustrate this with an example.

Assume a design team creates a product with seven components, each with an average reliability of 99%. The overall reliability of this product is $.99^7$, or 93%. This corresponds to a 70,000 part per million (ppm) defect level (7% defects per one million opportunities). Next, a design simplification project eliminates the need for two of the components, making the overall reliability $.99^5$, or 95%. A new predicted defect level of 50,000 ppm defects represents almost a 30% reduction from the original defect level. Further assume that another improvement project increases the average reliability of each component to .995. The overall reliability now becomes $.995^5$, or 97.5%. This further reduces the ppm defect level to 25,000 ppm. These numbers, which are nowhere near Six Sigma levels, are used to show how complexity in product design leads to higher predicted defect levels. More components, which results in not only more defects but also more suppliers and greater supply chain complexity, create more opportunities for error.

Few would argue with the notion that complexity usually increases business costs. A cost that is associated with complexity, and one that is rarely calculated, is complexity’s opportunity cost. Employees who deal with the effects of complexity simply are not able to focus their attention toward more productive pursuits. Unfortunately, economists have yet to develop a way to calculate a “complexity tax.” And, it is somewhat futile to argue that cost accounting systems provide much help here. As mentioned, we have yet to see any key indicators that address business complexity well.

Complexity often works against speed and flexibility, two attributes that increasingly define world-class companies. Without question the way that companies compete today is different

than just a few years ago. Characteristics such as speed and flexibility (what some call dexterity) are becoming as important to competitive success as quality and cost capabilities. It should be somewhat intuitive that excessive complexity inhibits these important capabilities.

Even after conceding that certain types of complexity are a natural part of the business landscape, it is safe to conclude that other types of complexity should not be welcome. The one perspective we should all share is that at some point unwelcome complexity increases costs and affects organizational performance, often with no corresponding return. And, higher costs and diminished performance elevate the risk that a company will no longer remain competitive.

HOW ORGANIZATIONS BECOME COMPLEX

Most executives understand that complexity is not something that is in short supply. This is ironic given that no company has a stated objective or strategy of becoming unnecessarily complex. For a variety of reasons, however, it is often the state that we find ourselves. It is often the cumulative result of many actions and decisions taken over time.

Complexity often evolves at a pace that ensures it does not draw any unusual attention. The tendency to become more complex over time represents something we will call “complexity creep.” At some point the realization sets in that steps have to be taken to regain control, or else the risk of being consumed by complexity becomes very real. The causes of complexity are widespread.

Marketers Gone Wild

Product proliferation has resulted in a large increase in SKU’s moving through supply chains. With product proliferation a company has made a conscious decision to extend its brand offerings or develop entirely new products to retain or attract customers. While new products and product extensions hopefully create market excitement and growth, there is no question they also lead to greater business complexity. In reality, SKU proliferation occurs for a variety of general reasons. These include:¹⁰

- Nimble, responsive companies are striving to meet ever-changing market opportunities and competitor demands
- Businesses that create excessive amounts of new products are chasing an impossible dream of being all things to all people
- Companies have ineffective product exit strategies
- Organizations use an innovation metric that rewards SKU proliferation as proof of innovation

Engineers Gone Wild

One of the most visible sources of complexity involves products that are overdesigned by engineers. Overdesign may mean a product has too many components, more features than what the customer wants or can use, or are overly complex to produce or distribute. Failing to check whether a previous component is available for reuse during product design, using custom designed components when standard components are available, or failing to leverage commonalities across product platforms can also contribute to excessive product and supply chain complexity. It is not that engineers necessarily endorse complexity. They simply tend to treat product designs as an opportunity to create the next Mona Lisa.

More Efficient Product Development Processes

Although it may seem counter-intuitive, complexity can be a consequence of faster and more efficient product development processes. While shorter development times, on average, are a good thing, an interesting consequence of improved development processes is the ability to introduce more new products using fewer, if any additional resources. And, more new products mean additional complexity. As product development processes becomes more efficient, the complexity related to product proliferation often increases.

Lack of Process Thinkers and Ill-Defined Processes

A process is a set of interrelated tasks or activities designed to achieve a specific objective or outcome. Even though this is a straightforward idea, organizations often suffer from a shortage of process thinkers because most individuals are trained to think functionally or to focus on specific tasks. Unfortunately, organizational processes almost always cross functional boundaries. Complexity arises when individuals try to optimize their work within a process they do not understand or cannot conceptualize. Even those individuals who understand processes sometimes fall into the same trap as engineers. They tend to over-engineer a process rather than simplify it.

Strategic Choices

Some organizations choose to be complex. They make strategic choices about introducing new product lines or expanding into new geographic regions. No one would dispute that FedEx is a more complex organization today compared to when it served only the U.S. market. Expansion brings complexity, and that's the way it will always be. Successful companies learn how to manage the institutional complexity that results from strategic choices.

Continuous Reorganizations and New Programs

Continuously reorganizing governance structures or introducing new programs are often seen as a way to show visible progress toward some real or perceived challenge. Continuous

reorganizations, however, also can lead to chaos, confusion, and complexity. The same is true about new programs. It seems like every challenge can be overcome with a program that has a clever acronym, often with a new position assigned to it. Programs to improve quality, reduce costs, improve customer satisfaction, enhance supplier relationships, promote diversity, or improve employee morale and retention are constantly being added, revised, and sometimes deleted. A constant churning of programs breeds not only complexity; it also breeds cynicism.

Bureaucracy

Bureaucracies are systems of administration characterized by red tape and a proliferation of rules, procedures, and positions. It would be hard to argue that bureaucracies are not complex. They stifle innovation, lengthen decision making times, and erect barriers to change. Being referred to as a bureaucrat, at least in most circles, is not a compliment. While we often think that bureaucracy relates to government, corporate structure and governance, particularly at larger corporations, can rival some of the worst public bureaucracies.

Most individuals find that bureaucracies stifle their individual goals. Tim Cook, the CEO of Apple summarized clearly his views regarding bureaucracy when he said,

“No bureaucracy. We want a fast-moving, agile company where there are no politics, no agenda. When you do that, things become pretty simple. You don’t have all of these things that companies generally worry about. You don’t have silos built up where everybody is trying to optimize their silo and figuring out how to grab turf. It makes all of our jobs easier so we’re freed up to focus on the things that truly matter.”¹¹

Mergers and Acquisitions

Probably the quickest way to create complexity, not to mention anxiety and role confusion, is through mergers and acquisitions. The M&A process almost always features a complex set of legal and financial issues. After the ink is dry on an agreement it becomes evident how much duplication, overlap, and even conflict exists between the combined entities, a complexity that does not go away simply because the legal part of the process is complete. When brought together organizations bring different cultures, systems, policies, procedures, suppliers, customers, employee contracts, and part numbering schemes. Some companies, such as Oracle, have created a competitive advantage by assimilating newly acquired companies quickly into the corporate portfolio. Mastering the complexity brought about by mergers and acquisitions is an example where managing complexity creates a business advantage.

Increased Government Oversight and Regulation

New laws and regulations such as Dodd-Frank; conflict mineral rules; the Food Safety Modernization Act; assorted anti-terror Acts; anti-slavery laws; new regulations resulting from catastrophes; and rulings by regulatory entities have combined to make business much more complicated. It is safe to say that those who make these new regulations are not the ones who have to live by them.

Has the tendency of governments to issue thousands of regulations year after year had an effect on business? A survey published annually by The World Bank ranks countries according to their ease of doing business. In 2009, the U.S., for example, ranked third in the overall ranking in terms of the ease of doing business. In 2016 the U.S. had slipped to 8th place. Each year *Forbes* conducts an analysis to identify the best and worst countries to conduct business. In 2007, the U.S. was ranked as the most business-friendly nation. By 2016, the U.S. had slipped to 23rd, hardly a proud achievement.¹² Within one measure of red tape the U.S. ranked as the 45th worst in the world.

In 2009, it required 40 days on average to get a construction permit in the U.S., now it requires 81 days; 300 days on average to enforce a contract, now it is 420 days; and the cost to register property was .5% of the property's value, now it is 2.4%.¹³ It is safe to conclude that the cumulative effect of these regulations has created a burden on business. The U.S. alone issued well over 20,000 new regulations in the period from 2009-2016.¹⁴ The U.S. Association of American Railroads estimated that in 2015 paperwork costs to comply with safety regulations issued by the Federal Railroad Administration required 25 million labor hours (over 5% of all labor hours worked in the industry) and \$1.5 billion in costs.¹⁵

Complexity Equals Job Security

It should come as no surprise that some individuals, and even organizations, have a vested interest in keeping complexity alive and well. Some will fight vigorously against anything that seeks to make life simpler. We all know someone who works hard to protect the status quo by resisting even the most reasonable change. These individuals may earn their living formulating or enforcing the many rules, policies, laws, and regulations that others must follow. Or perhaps they earn their living managing supply chains that probably should not be as complex as they have become. What would happen to accountants, lawyers, and IRS personnel if tax returns were simplified to one-page? We have complexity because some people want complexity—they owe their livelihood to it.

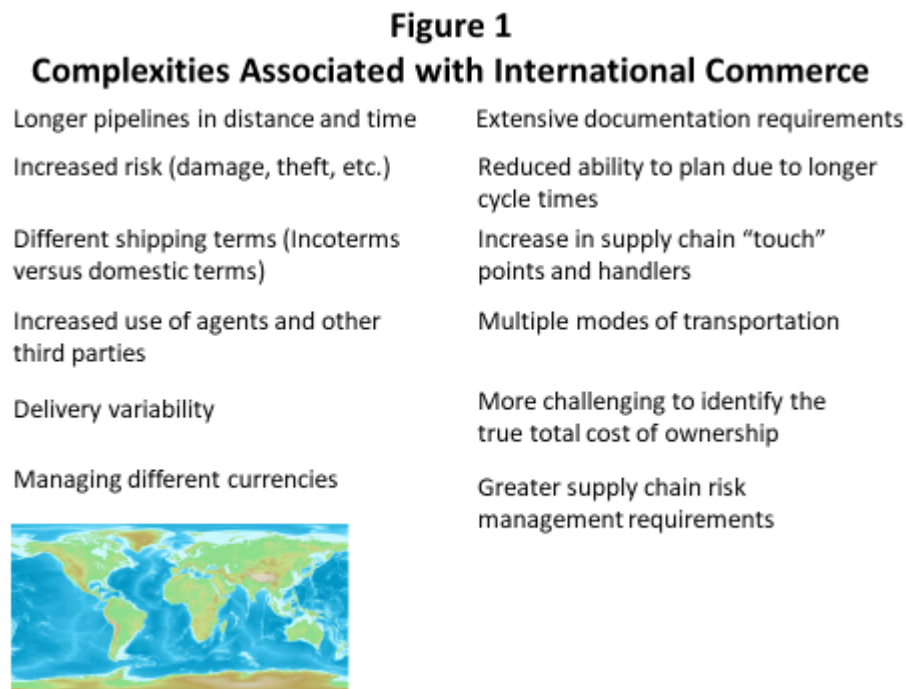
Complacency

At some point most organizations, particularly larger ones commit a sin that brings forth a swift and painful outcome. That sin is complacency, which reflects a high level of self-satisfaction with the status quo, often with an unawareness of actual dangers or deficiencies. Complacent

organizations have no idea of the costs or risks associated with being overly complex, nor do they probably care, at least in the short run. A lack of urgency leads these organizations to ignore the subject until it is far too late.

Let's Go Global

Statistics showing a steady growth in international commerce over the last 25 years are impossible to refute. While most international decisions likely reflect sound courses of action, something that is often overlooked is the impact these decisions have on supply networks. Figure 1 illustrates some of the supply chain issues that arise when doing business on a worldwide basis, issues that are not nearly as prevalent with domestic supply networks. Unfortunately, few companies fully account for total costs when making global decisions.



Other areas where complexity may arise due to worldwide supply chains include working across different cultures, language and communication barriers, different legal systems, time differences, unreliable information, countertrade demands, a total landed cost that never equals the unit cost of what is purchased, and increased risk management requirements, particularly regarding the protection of intellectual property and currency fluctuations. Globalization brings with it no shortage of issues to manage, which increases complexity. Some observers argue that a fair portion of the increased risk and complexity faced by businesses today are largely a result of globalization.

WAYS TO BATTLE COMPLEXITY

In some ways the battle against complexity is a logical progression after lean, which is a mature concept that is often applied narrowly as a battle against waste. Most sources address complexity by putting forth general rather than specific ways for tackling this issue. While these approaches are well and good, they are rarely specific enough for really understanding how to battle complexity. Complexity management should focus on eliminating bad complexity while exploiting the kinds of complexity that can lead to competitive advantage.

The first step in this battle is recognizing that complexity exists and that it must be managed. Fortunately, some powerful ways exist for addressing complexity once a firm moves beyond the awareness stage.

Simplify Product Designs

Simplified product designs offer one of the fastest ways to reduce business complexity and risk. Besides the many supply chain benefits that accrue from simplified product designs, the bottom line is that customers appreciate simplicity. Although it has been an electronic eternity since Apple introduced the iPhone, the iPhone has remained a hot-selling item. Besides being “cool,” some analysts attribute part of the product’s success to the simplicity of its design and use.

Product design is the time to think about simplification. Industry leaders understand the power of the product development process to satisfy some important objectives. Pre-design objectives can involve setting targets for quality, reliability, serviceability, sustainability, end-of-life recycling, target cost, assembly, cycle time, and simplicity of design and use. The concept phase of product development is also the time to think about how to tackle overly complex designs and production processes.

An interesting example of simplification of a service offering involves Fed Ex. Fed Ex Freight has launched a simpler way to ship based on dimension and distance. The shipment includes a flat rate up to 1,200 pounds regardless of what the customer ships within the box. The system is being marketed to customers who normally do not use less-than-truckload (LTL) shipping. The new system is easier for customers to understand from a rate perspective compared with the more complex National Motor Freight Classification system.¹⁶ Indications are the new freight system is a success as customers enjoy the simplicity of not having to rely on the more complex freight classification system. As one Fed Ex manager stated, “I want it to be so simple that my 9-year old can do it.”¹⁷

Standardize and Reuse Components

Few supply managers would dispute the notion that custom designed components almost always cost more than standardized components. And, customized components are often not as readily available when demand patterns shift. They are usually provided by a limited number of suppliers (often one) that may be unable to respond when market conditions change. Related to the idea of standardized components is the reuse of components. Reuse means using a component that is available from a previous use or design.

A way to address any complexity that comes with over-customization is to make standardization and reuse key objectives during product design. A word of caution, however, is required here. Excessive use of standard and reused components creates a risk that customers will not be able to differentiate a new product from a previous product, or one product line from another. As an automotive design engineer noted during a research interview, “If a customer feels it, touches it, sees it, or smells it then it better look new and improved. And it better not look like what we have already designed or look like our other models.” Some companies rely on reuse engineers and supply management personnel as a check and balance to ensure designs are not over-engineered, resulting in excessive customization when a standard or reuse item would work just as well.

Become Rational

Rationalization is the process of determining the right mix and number of something to maintain. It is a powerful concept that has wide application across every part of a supply chain. It is also a concept that offers one of the best ways to battle complexity. While rationalization should be ongoing, it is usually of most interest when executive leaders finally realize they have too many of something. A number of years ago Procter and Gamble, announced its desire to eliminate 20,000 suppliers from its worldwide supply base and reduce the number of distribution centers it maintains from 400 to 200.¹⁸ At some point the marginal cost of one more of something outweighs the marginal contribution of that next “something.”

Areas where companies should continuously evaluate the right mix and number of something to maintain include the supply base; component SKU’s; product lines and product features; customers; contracts; retail outlets; distribution centers; production sites; and engineering centers. Figure 2 identifies a range of benefits from maintaining a supply base that has been rationalized to a manageable level. The rationalization process almost always offers benefits that reduce complexity, many of which were never even considered beforehand as benefits.

Figure 2
Benefits of a Rationalized Supply Base

<ul style="list-style-type: none"> • Fewer contracts to negotiate or purchase orders to write • Fewer material releases to suppliers • Less effort expended to process fewer material receipts • Easier material traceability • Better communication and relationships with suppliers, thereby offering the possibility of greater trust • More attention given to supplier selection, thereby improving the effectiveness of that process 	<ul style="list-style-type: none"> • Lower purchase prices due to leveraging of volumes with fewer suppliers • Fewer supplier performance reports or scorecards to issue • Fewer supplier performance review meetings • Improved supply base performance as lower performers are removed from the base • Fewer accounts payable transactions • Easier to identify early involvement candidates
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Recently, General Motors decided to rationalize its portfolio of countries and regions where it conducts business. In 2017, GM sold its European operations to Peugeot. And, more markets and countries could eventually exit the GM portfolio. Why did GM sell its European operations? A combination of factors, including buyers with fickle tastes and new government regulations, convinced executive management that Europe would not be a profitable market for the foreseeable future. The CEO of GM said, “Our overall philosophy is that every country, every market segment has to earn its cost of capital.”

Standardize and Redesign Processes

Process design and redesign efforts should have the removal of waste and complexity as a primary objective. Process modeling using ANSI symbols and value stream icons two recommended approaches when designing and redesigning work processes. Once an organization is able to conceptualize itself in terms of its core processes, steps can be taken to ensure those processes are efficient, effective, and consistent (i.e., standardized) across operating units.

A center-led group should assume responsibility for designing processes that build in best practices and eliminate duplicate effort. It is hard to justify having every work center develop essentially its own set of processes. The complexity that results from sub-optimal processes and duplication should not be a source of pride. Unfortunately, some interpret this to mean that every location or group must conform to a narrowly defined process with no deviation or flexibility allowed. Standard processes should provide a best-practice framework or platform that allows modifications where necessary, particularly when working across different geographic locations.

Use Information Technology

We often take for granted the use of information technology (IT) to make life less complex. Whether we bank online, use ATM machines to get cash, renew library books, shop for the holidays, renew prescriptions, or rely on powerful search engines to find information in a fraction of a second, the use of IT grows daily. Amazon's one-click feature is an example of removing transaction complexity from the online buying experience.

Whether stated or not, most IT applications are designed to remove, simplify, and streamline transactions. They also make the transfer of data from one system to another seamless while making information more transparent. Given that IT is a complexity killer, organizations will continue to be relentless in their search for IT applications that simplify the supply chain and the transactions that flow across it. Information technology supports something called "complexity transfer." Systems rather than the users assume the complexity.

Streamline the Legal Review Process

If your legal department is a source of frustration and complexity, welcome to a group that has quite a few members. This frustration is often the result of a contract review process that can take months rather than days. For whatever reason, the legal review process for contracts is often excessively complex. Supply managers at a major logistics company were dismayed to find the longer-term agreements they negotiated with suppliers required months to work their way through the legal review process. They were even more dismayed to see many months of contract benefits unrealized as original contract terms remained in place.

Streamlining the review process can happen in several ways. One way is to create contracts that are not overly complex. Most suppliers do not appreciate 50-page contractual agreements. While he was at IBM, the late Gene Richter reduced contracts from 40 pages on average to six pages. Another approach involves the use of preapproved contract language. Instead of reviewing an entire contract, lawyers review and initial only the changes that are made during contract negotiations. The legal department can also designate a representative to review contracts, presumably resulting in better response times. Finally, metrics can be compiled that track review times. The point here is that ways exist to take complexity out of the legal review process.

Modify the Organizational Design

We often overlook the fact that the features that comprise an organization's design can directly reduce organizational complexity. Research findings are clear that early supplier involvement on product design teams helps avoid complex rework as products move through the design process. Co-location models simplify patterns of communication as support personnel work in

close proximity to their internal and sometimes external customers. And, cross-functional teams bring different perspectives together to make important decisions, usually enhancing the quality of the decision-making process.

An example of using organizational design to address complexity can be found at Boeing. The company has 9,000 employees outside the U.S. based in 70 countries that face challenges daily involving the laws, regulations, and customs of individual countries and jurisdictions.¹⁹ Boeing has created five regional teams to support individual sites and business units. The purpose of these teams is to serve as “one-stop shops” to support Boeing business units as they operate internationally. Previously, each site or unit was forced to navigate some very complex issues on its own. Now, regional teams, acting much like Centers of Excellence, provide expert support to these locations, most of which are involved with different kinds of programs. Boeing is using its organizational design to minimize the complexities of international business.

Survey Stakeholders

One way to identify where complexity exists is to ask stakeholders directly. Try asking suppliers, customers, and employees directly if your company is doing anything that makes their life unnecessarily complex. With online survey technology readily available the barriers to using these surveys are low. Is it possible that your material planners change release quantities to suppliers right up to their delivery due date? Does your company have an online ordering system that confuses customers? Are employees frustrated over how to enroll in a benefits program? A survey of suppliers conducted on behalf of two OEM’s asked suppliers what these OEM’s were doing to make their relationship overly complex. Suppliers provided dozens of responses that offered specific ways to reduce business complexity. If suppliers, customers, and employees take the time to provide feedback, then the requestor must ensure that feedback is reviewed and acted upon.

Develop Simple Rules

A body of research is emerging that counters the notion that complex algorithms and models are always more effective than simple rules of thumb or guidelines when making organizational decisions. Furthermore, a hypothesis put forward is that complex situations create so many possible courses of action that individuals become confounded, often to the point where they delay decisions, default to the safest option, or avoid making choices altogether. Research suggests that simple rules equal, and at times exceed the effectiveness of more complicated analyses across a range of decision areas. Simple rules are most useful when the challenge is not to perform a process repeatedly and efficiently, but rather when a need exists to adapt quickly to changing circumstances.²⁰ While the analysis and data that lead to the rules may be sophisticated, and at times will even be complex, the resulting rules should be elegant in their simplicity as they provide guidance to users.

An example of simple rules involves the retailer Zara, a company that is synonymous with fast fashion. Since its inception the company's founder has insisted the retailer always follow two simple rules—inventory at stores must be replenished twice a week and stores must receive their orders within 48 hours.²¹ These simple rules are adhered to even as the retailer expands globally, thereby influencing the design and placement of Zara's production facilities.

Empower Employees

To empower means to give an individual or team decision-making authority. What most managers fail to recognize is that a failure to empower a team or individual to perform basic tasks or make decisions (up to a point) usually leads to individual complexity. A newly-hired MBA at a global manufacturer was surprised to find that he could not organize a meeting without going through a cumbersome process to obtain a manager's signature. Unauthorized meetings of non-managers violated company policy.²² Treating competent adults like untrustworthy children likely ensures these individuals will not stay very long.

The ideas put forth here for battling complexity are varied and specific. While the first part of addressing any problem is recognizing that a problem exists, the other part involves addressing the problem. In the words of a risk manager, it becomes necessary to identify ways to mitigate the effect of unwanted complexity. Fortunately, a set of relatively low-cost ways are available to address complexity.

CONCLUDING THOUGHTS

Complexity is not something that magically goes away by itself. Unfortunately, we often fail to grasp the extent or seriousness of complexity on supply chain performance. This is due partly to accounting systems that are incapable of capturing the true costs and impact of complexity. Complexity costs are scattered across different entities and buried within dozens of overhead accounts. Organizations that are serious about battling complexity will put forth a concerted effort.

While it is often an inevitable outcome of business decisions, and there is no question that firms that learn how to manage certain kinds of complexity can gain an advantage over their less competent competitors, unnecessary complexity should not be an accepted part of your business structure. If this is true, why is bad complexity a way of life at so many organizations?

REFERENCES

- ¹ B. Kogut, "Introduction to Complexity: Emergence, Graphs and Management Studies," *European Management Review*, 4 no. 2 (2007): 67-72; M. Milgate, "Supply Chain Complexity and Delivery Performance: An International Exploratory Study," *Supply Chain Management*, 6, no. 3 (2001): 106-118.
- ² P.M. Byrne and J.E. Johnson, "The Rights and Wrongs of Taxing Internet Retailers," *The Wall Street Journal*, July 23, 2012, from <http://www.wsj.com>.
- ³ M.J. Credeur, "Making United and Continental Fly in Formation," *Bloomberg Business Week*, (July 1, 2011): 23-24.
- ⁴ J.R., Hagertry, "3M Begins Untangling its Hairballs," May 16, 2012, *The Wall Street Journal*, from <http://www.wsj.com>.
- ⁵ D.A. Kaplan, "Hostess is Bankrupt...Again," *Fortune*, 166, no.3 (July 2, 2012): 63.
- ⁶ J. Chung and D. Lim, "Harvard Outsources Endowment," *The Wall Street Journal*, January 26, 2017, B1.
- ⁷ C. Kirkman, "Builders Balk at New Rule," *The Wall Street Journal*, November 18, 2016, A3.
- ⁸ S. Haywood, J. Spungin, and D. Turnbull, "Cracking the Complexity Code," *The McKinsey Quarterly*, (May 2007): 86.
- ⁹ J. Birkinshaw and S. Heywood, S., "Putting Organizational Complexity in its Place," *The McKinsey Quarterly*, (May, 2012): 2.
- ¹⁰ J. Thatcher, "Managing a Rising Tide of SKUs," apics.org/magazine, (March/April 2017): 16.
- ¹¹ J. Tyrangiel, "Tim Cook's Freshman Year," *Business Week*, (December 10-16, 2012): 69.
- ¹² "Forbes Leader Board: The Best Countries for Business," *Forbes*, (February 28, 2017): 22. For the complete rankings of 139 countries, go to forbes.com/best-countries-for-business.
- ¹³ B. Stephens, "Doomed to Stagnate?" *The Wall Street Journal*, December 20, 2016, A21.
- ¹⁴ B. Stephens, A21.
- ¹⁵ E. Hamberger, "Freight Railroads Are Braking for Regulatory Creep," *The Wall Street Journal*, June 15, 2016, retrieved from <https://www.wsj.com/articles/freight-railroads-are-braking-for-regulatory-creep-1465943599>.
- ¹⁶ Ari Ashe, FedEx Freight Adds Pricing Option Based on Distance, Dimensions, *Transport Topics*, (July 18, 2016): 3.
- ¹⁷ A. Ashe, "Fed Ex Pleased with Response to Freight Box for LTL Pricing," *Transport Topics*, (April 10, 2017): 6.
- ¹⁸ P. Teague, "P&G is King of Collaboration," *Purchasing*, 137, no. 9 (2008): 46.
- ¹⁹ B. Seil, "Excellence without Borders," *Boeing Frontiers*, 11 no. 8 (2012): 40-41.
- ²⁰ D. Sull and K. Eisenhardt, K., "Simple Rules for a Complex World," *Harvard Business Review*, 90 no. 9 (2012): 69-74.
- ²¹ V. Walt, "Meet the Third-Richest Man in the World," *Fortune*, 167, no.1 (January 14, 2013): 74-79.
- ²² L. Ryan, "5 Ways to Ensure Mediocrity in Your Organization," (May 17, 2010), from www.finance.yahoo.com/career-work/article.

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