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Stop Treating Your Global Supply Chain Like a Corporate To-Do List

Systems Engineering Formalizes What Supply Chains Hate to Admit: You Cannot Optimize One Piece Without Affecting Every Piece

by

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We are at a point in global supply chain design that systems engineering is the only way our uncomprehensive global supply chains survive reality.

Let's get one thing straight: most global supply chains aren't designed - they're *assembled*. They're stitched together from supplier contracts, trade restrictions, legacy ERP systems, spreadsheet workarounds, past hiring decisions, multi-year labor agreements, locked-in transportation solutions, legacy automation, and capital investments... and those dreaded late-night "*alignment calls*." And for a while, that patchwork holds. Until it doesn't.

The pandemic didn't "*break*" supply chains. It exposed what they really were: *fragile, overly optimized, and fundamentally misunderstood systems*. Pandemic induced disruptions didn't just tweak the landscape, it rendered much pre-2020 supply chain thinking obsolete. If you're still managing supply chains as a series of functions instead of a system, you're not optimizing - you're gambling. You may be hopeful – but you are still gambling.

The Uncomfortable Truth: Complexity Already Won

Modern supply chains aren't linear. They're sprawling, multi-tiered, global ecosystems. One disruption - whether a frozen refinery or a geopolitical shock - creates ripple effects across the entire network. This isn't theory. This is the operating environment.

Traditional management methods - more dashboards, more meetings, more coordination - try to fight this complexity with human effort supported now with AI scenario tools. But effort doesn't scale. Systems do. As one recent perspective bluntly puts it: "*you don't scale a supply chain through hard work - you scale it through system design*." And that's where systems engineering steps in.

Systems Engineering: The Discipline Most Supply Chains Pretend They Don't Need

Systems engineering isn't about tools. It's about thinking in "*architectures*" instead of tasks. At its core, it forces you to confront reality. It forces supply chains to grow up. It replaces gut feel with requirements, accidents with architecture, and firefighting with designed behavior. It defines the interfaces where failures actually occur, where models tradeoff before reality punishes you, it embeds resilience instead of bolting it on,

and it forces organizations to operate as a unified system rather than a collection of silos. Without it, global supply chains aren't engineered - they're improvised. It reminds supply chain participants, up and down the food chain that:

- Suppliers, logistics, inventory, and customers are not separate, independent agencies - they are interdependent components.
- Decisions don't act locally - they propagate.
- Enterprise performance isn't the sum of parts - it's an emergent property of the whole

Systems engineering formalizes what supply chains hate to admit: *You cannot optimize one piece without affecting everything else.* That matters because global supply chains today operate under constant tension - cost vs. resilience, speed vs. flexibility, efficiency vs. redundancy. Without a systems framework, these tradeoffs are blind. And as every decision maker knows, "*blind*" doesn't work when every decision has in it a degree of compromise.

Coordination Can Be a Crutch: *Architecture Is a Solution*

Most organizations still rely on coordination as their primary control mechanism - status updates, escalation paths, shortage meeting, ineffective S&OP review sessions, poorly constructed unit forecasts... and the heroics behaviorally deployed to address these control and feedback mechanisms . It works - until scale kicks in. Then coordination becomes the bottleneck:

- Decisions slow down
- Accountability blurs
- Data fragments
- Variability explodes

Systems engineering on the other hand, replaces coordination with designed behavior:

- Clear system boundaries established in advance
- Defined information flows, with decision access and decision rights clearly defined... again, in advance
- Explicit ownership (accountability) of decisions AND explicit responsibility of execution, again defined in advance
- Integrated data models that employ integrated data quality assurance tools

In other words, the "*system*" runs because it's built to run - not because people are keeping it alive.

The Hidden Killer: *Fragmented Data*

Ask any supply chain leader what they don't trust, and you'll hear the same answer: *the input data*. Planning signals live in one system, execution in another, and context in someone's inbox. The result? Teams spend more time validating information than acting on it. This is why you have so many independent spread sheets serving operational roles even after your company invested millions of dollars implementing state-of-the-art ERP systems.

Systems engineering in supply chain management, on the other hand, treats data as part of the architecture - not an afterthought. It demands a single system of record, because without a shared truth, there is no system - only noise. It accomplishes this by integrating constant statistical analysis of input data efficacy. Think about this: *would you make a different decision if you KNEW the data that morphed into the information you utilize to make a decision, was provably 63.8% accurate?*

This is why a state of resilience is so hard to achieve. Resilience isn't a feature. It's a design outcome. For years, supply chains optimized for cost efficiency - lean, just-in-time, minimal redundancy. Then reality hits. Disruptions didn't just cause delays - they caused systemic failure:

- Single-source dependencies collapsed
- Logistics bottlenecks cascaded
- Demand volatility overwhelmed planning models
- Technology advancements created obsolescence
- Demographic, geographic, and psychographic shifts moved whole markets

The shift now is clear: *resilience is non-negotiable*. But resilience isn't something you "add." It's something you engineer into the global supply chain design:

- Redundancy where it matters
- Flexibility designed into network design
- Scalability – both up and down
- Visibility designed into and across ALL global supply chain elemental tiers
- Scenario modeling and analysis before - not after failure

Systems engineering provides the methodology to do exactly these things.

The Real Battleground: *Integration Across Silos*

Every CEO I know emphasizes a critical point in their all-hands meetings - supply chains, and indeed whole companies, must move "*beyond the silo*" to deliver growth, resilience, innovation, and sustainable economic performance. This is not just a cultural issue. It's a systems problem. But silos exist because systems aren't integrated:

- Marketing seeks to optimize and prioritize markets and customers
- Product development seeks to optimize product performance
- Finance seeks to optimize costs
- Operations seek to optimize throughput
- Procurement seeks optimizes purchase spend and supplier reliability to the next level in the chain
- Quality Assurance seeks to never have product return
- Master Production Scheduling (MPS) seeks to optimize deployed tangible conversion assets
- Logistics seeks to optimize movement

- Human Resources seeks to optimize... actually, I am not sure here!

And as a result - *no one optimizes the supply chain system*. Systems engineering forces cross-functional integration - not as collaboration theater, but as a structural requirement. It defines how components interact, not just how teams communicate.

If You're Not Designing The System, You're Designing Failure

Here's the part most organizations don't want to hear:

If your supply chain relies on people constantly "fixing things," you haven't designed a system-you've outsourced it to human effort.

And effort has limits. Global supply chains today demand:

- Scalability without chaos
- Speed without fragility
- Efficiency without blind spots
- Resilience without paralysis

Those outcomes don't come from incremental improvements. They come from intentional architecture... Systems engineering to be precise.

Core Elements of Systems Engineering: Why Supply Chains Desperately Need This:

Mission & Requirements Definition

What It Is:

Define what the system must do - performance, constraints, cost, risk, and success criteria... ahead of execution.

Why It Matters in Supply Chains:

- Most supply chains fail *before they start* - because nobody clearly defines what "good" looks like.
- What service level is non-negotiable?
- Where do you tolerate cost vs. speed tradeoffs?
- What disruptions must the system survive?
- Systems engineering forces explicit requirements - not vague goals.

Critical Takeaway:

If you don't define requirements, your supply chain optimizes for whatever is easiest - not what matters.

System Architecture & Network Design

What it is:

The structural blueprint - how ecosystem components (suppliers, factories, warehouses, transport partners, distribution channels, and data systems) fit into the greater supply chain system and interact.

In Supply Chains:

- This is where you decide:
 - Network topology (centralized vs. distributed)
 - Inventory placement
 - Supplier redundancy
 - Information flow architecture

Key insight:

Architecture is destiny. Once you pick it, everything else is a constraint.

Critical Takeaway:

Most supply chains aren't architected - they're historical accidents with contracts attached.

Interfaces & Integration

What It Is:

- Define how subsystems connect and communicate:
 - Technically
 - Organizationally
 - Culturally
 - Behaviorally
 - Physically
 - Digitally
 - Operationally

In Supply Chains:

- ERP ↔ WMS ↔ TMS integration
- Supplier ↔ manufacturer ↔ distributor data exchange
- Demand signals ↔ execution systems

Why It's Critical:

The most significant failures rarely happen *inside* nodes - they happen between them.

Critical Takeaway:

Supply chains don't break at components - they break at interfaces.

Modeling, Simulation, and Trade Studies

What It Is:

Use models to evaluate design alternatives and tradeoffs before committing.

In Supply Chains:

- Network optimization models
- Inventory simulations
- Risk scenario modeling (port closure, supplier failure, demand spikes)

Why It Matters:

You can't "test" a global supply chain cheaply in real life - so you simulate it.

Critical Takeaway:

If you're not modeling your supply chain, you're running experiments on your customers.

Lifecycle Thinking (Design → Operate → Evolve)

What It Is:

Design with the full lifecycle in mind - deployment, operation, maintenance, and eventual redesign.

Important Connection To Your Internal Material:

Pre-pandemic designs became obsolete due to systemic shifts - this is a lifecycle failure, not just an operational one.

In Supply Chains:

- Initial supply chain design is only Phase 1
- Continuous adaptation is built-in - not reactive
- Systems must evolve with markets, tech, and geopolitics

Critical Takeaway:

A static supply chain is a dead supply chain - it just doesn't know it yet.

Verification & Validation

What It Is:

- *Verification*: Did we build the system correctly?
- *Validation*: Did we build the *right* system?

In Supply Chains:

- Are planning outputs accurate? (verification)
- Does the system meet customer expectations under stress? (validation)

Critical Takeaway:

Most supply chains are "verified" (they run), but not "validated" (they fail under real conditions).

Risk, Resilience, and Reliability Engineering

What It Is:

Systematically identify, quantify, and mitigate risks.

In Supply Chains:

- Single-source dependency analysis
- Geographic risk exposure
- Buffer vs. efficiency trade studies
- Scenario planning

Critical Takeaway:

Resilience is not a backup plan - it's a design parameter.

Data Architecture & System of Record

What It Is:

Define how data is structured, governed, and shared. It's all about information rights and decision rights.

Critical Connection to Supply Chains:

- Unified planning signals
- End-to-end visibility
- Real-time execution feedback

From Current Thinking:

Fragmented data slows decisions and destroys trust - forcing teams to “*coordinate reality*” instead of acting on it.

Critical Takeaway:

If your data isn't integrated, your supply chain isn't a system - it's a rumor.

Governance & Control (Feedback Loops)

What It Is:

How the system monitors itself and adapts.

In Supply Chains:

- Exception-based management
- Control towers and “*mission control*” information sharing
- KPI feedback loops
- Autonomous decision rules

Critical Takeaway:

Systems should self-correct, not rely on escalation chains.

Integration Across Silos (Human + Technical Systems)

What It Is:

Systems engineering integrates technical systems *and* organizational structures.

Aligned With Your Internal Content:

Stresses that supply chain leaders must move “*beyond the silo*” to deliver real value.

In Practice:

- Procurement, operations, logistics aligned through system design - not meetings
- Shared objectives are embedded in the system itself

Critical Takeaway:

If your organization is siloed, your system design failed... period.

Final Takeaway: *Systems Engineering Is No Longer Optional*

The convergence between systems engineering and global supply chains is accelerating, especially as automation and digital ecosystems reshape logistics and manufacturing. The companies that win won't be the ones with the most suppliers or the fastest shipping lanes. They'll be the ones that actually understand what they've built. They will be the ones that design (or perhaps, redesign) global supply chains to serve complex and unpredictable supply. They will replace the need for a precise system with a reality of an adaptive global system.

About Alan G. Dunn



Alan G. Dunn is currently President of GDI Consulting & Training Company and founder of the Manufacturing Executive Institute (MEI). He is also the creator and lead-instructor of the 18-month **Next Generation Global Supply Chain Leadership Development Program** at the California Institute of Technology's (Caltech) Center for Technology & Management Education (CTME), where he has taught since 1984. Mr. Dunn also serves on the University of California at Riverside's (UCR) Advisory Board for Transformative Leadership in Disruptive Times.

Previously, Mr. Dunn was a Vice President at Gemini Management Consulting (now Capgemini) and a Partner at Coopers & Lybrand (now PwC). In both positions, he led large technical manufacturing teams through innovative productivity enhancement projects. Mr. Dunn has participated in >190 significant manufacturing and distribution projects inside >120 companies. He has worked in 24 countries on 6 continents, and across most manufacturing sectors. Mr. Dunn has delivered >850 discrete training sessions over his career.

Mr. Dunn specializes in supply chain management, strategic planning, manufacturing management, operations management, leadership development, cost management, and business finance. He is curious and passionate about everything in the manufacturing and distribution industries. This curiosity and passion have led him to lead 6 significant supply chain research projects, author >70 published articles, create >15 significant consulting methodologies and develop >100 training courses for professionals in the manufacturing & distribution industries. It is Alan's deep depth and breadth in the global supply chain body-of-knowledge that provides him with an ability to assemble and lead highly capable teams to solve problems thought to be unsolvable.

Over his 46-year career in global supply chain consulting, Mr. Dunn has served on the Boards of Directors of numerous public, private and non-profit companies. He is the recipient of the National Association of Corporate Directors (NACD) prestigious "*Director of the Year*" award in 2007.

Alan is a career-long volunteer for the Association of Supply Chain Management (ASCM), having served as the President of the Orange County Chapter in 1984 and Chairman of ASCM in 2015. He was inducted into the "*ASCM New England Supply Chain Conference Hall of Fame*" in 2022. Mr. Dunn has spoken to nearly all the APICS/ASCM chapters and at the ASCM international Conference >20 times.

Mr. Dunn has a degree in business management from California State University, Fullerton, where he occasionally lectures in the business school.

About GDI Consulting & Training Company

GDI Consulting & Training (GDI) provides practical solutions to complex business and managerial problems in manufacturing and related industries. Our firm has successfully assisted clients around the world for more than 40 years, having performed more than 188 projects in over 118 companies in 24 countries. GDI applies specialized and common-sense solutions... *not overly intellectualized approaches*... too numerous types of challenging client problems in manufacturing and distribution industries, including:

Complex Problem Solving	Core Business Process Re-Engineering
Factory & Distribution Facilities Layout & Design	Enterprise Performance Metrics & Compensation Systems
Cost Management Systems	Organization Design & Improvement
Operational Due Diligence	Business Strategy Formulation
Quality Management Systems Design & Implementations	IT Data Integrity & Reliability Improvements
Factory & Distribution IT Systems Design & Implementation	Process Flow Design & Implementation

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We can bring numerous professional services to our manufacturing and distribution clients... all focused on improving the trajectory of people & enterprise performance.