

**system design and  
management**

# **MIT SDM Systems Thinking Webinar Series**



**An Empirical Analysis of Supply Chain and Risk  
Management for Large Revenue Companies with  
Global Footprint**

**By Ioannis Kyratzoglou, SDM '11**

# About The Project Team and Acknowledgments

- Study was conducted at MIT and was sponsored by PwC, The Netherlands
- The Project Team consisted
  - Mr. Ioannis Kyratzoglou – Principal Investigator
    - MIT SDM '11 Fellow,
    - Principal Software Systems Engineer, The MITRE Corporation
  - Dr. David Simchi-Levi
    - Professor of Engineering Systems, MIT
  - Dr. Costas Vassiliades
    - Principal Manager, PwC, the Netherlands

# What we Will Cover ...

- Risks in Today's Supply Chains
- Nissan Case Study
- The Problem Statement
- The Empirical Study
  - Trends in Complexity
  - Customer Value Proposition
  - Sources of Risk
  - Supply Chain and Risk Maturity Model
  - Impact of Risk Disruptions to Business Performance
  - New Operations Principles That Deliver Value
    - Risk Process Mature Companies
    - Risk Strategy Segmentation
    - Risk Strategy Flexibility
- Online SCRM Maturity Assessment Calculator
- Summary

# Risks in Today's Supply Chains (1/2)

- Companies with global footprint face constant changes in the global economy and must forge plans amid great uncertainty
  - Encounter significant increase in supply chain risk
- Experts emphasized the importance of strategies such as:
  - Off-shoring and outsourcing – Auto manufacturers have products with multiple parts; their supply chain is geographically more diverse
  - Lean manufacturing; Just in time (JIT) manufacturing with low inventory levels;
- Rising labor costs in developing countries, volatility in oil prices, put at risk a firm's supply chain and its ability to compete

# Risks in Today's Supply Chains (2/2)

- The risk and complexity of global value chains are exacerbated by
  - Accelerating product /parts development clock cycles
  - Global distribution of production capacities (inventory positioning, counterfeiting)
  - Increased number of interfaces between supplier and partners (a network of nodes and connections)
  - Geopolitical and fiscal considerations.
- The Questions we need to ask are:
  - In the face of these supply chain risks, how do companies with global footprint prepare?
  - What are the new ways of systems thinking on how to manage and mitigate risks? and,  
Who is responsible for managing them?

# Nissan Case Study

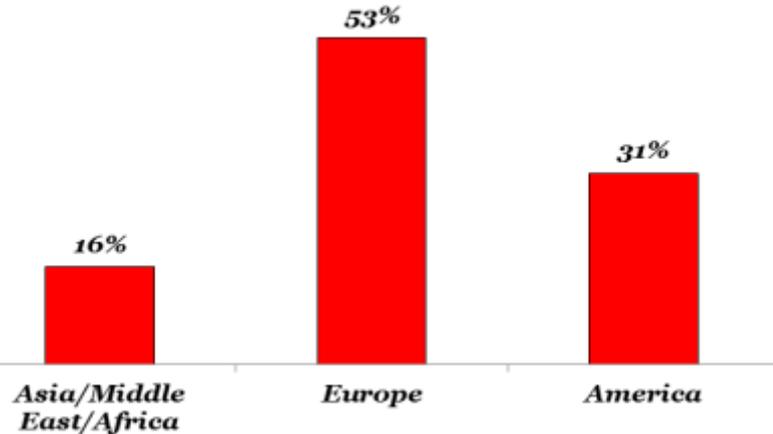
- Nissan Case Study<sup>1</sup>
  - 80 % of auto plans suspended production after the devastating earthquake in March 2011. Nissan perceived to be most impacted
  - Nissan's recovery was remarkable. In the 6 months that followed, Nissan production in Japan was 3.8% down compared to an industry total of 24.8%, but ended up with an increase in production of 9.3%
- How did Nissan manage successfully a disruption of this magnitude?
  - Deployed advanced capabilities both along the supply chain as well as the risk management dimension
  - Used flexibility in the supply chain structure – decentralization coupled with central control when required
  - Complete visibility upstream and down stream of their supply chain
  - Prepared business continuity plans
- Customer Value Proposition: Provide high quality and cost effective automotive products that enrich peoples' lives
- Operations Strategy:
  - Balance the manufacturing and sourcing footprint to sales footprint
  - Reduce supply-chain risk arising from production interruptions

# The Problem Statement

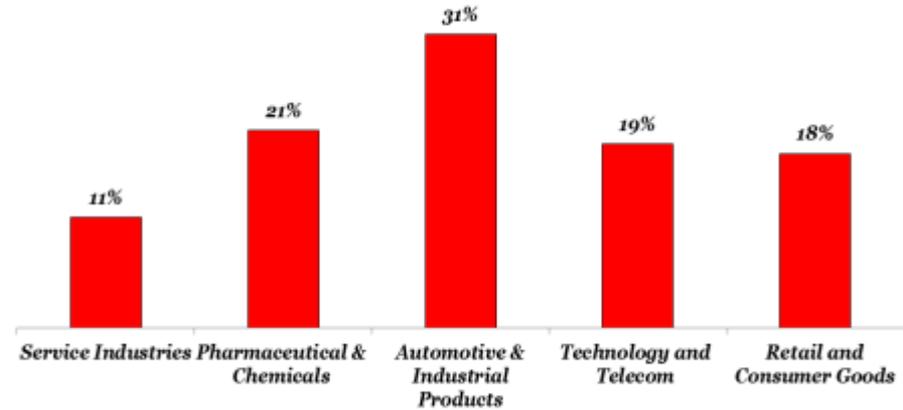
- Perform an Empirical Study on supply chain operations and risk management approaches of large revenue companies with global footprint. Specifically:
  - Describe company operations and financial performance in the face of supply chain disruptions;
  - Employ systems thinking to develop a supply chain and risk management maturity framework that will convert ideas, observations and research into a set of operations principles;
  - Develop four key operational principles that companies can use to make their global supply chain foot print more robust against potential sources of disruption
- Present how industry leaders can use this systems-based framework to better understand a company's position in the market relative to its competitors

# Study Demographics: 209 Companies (1/2)

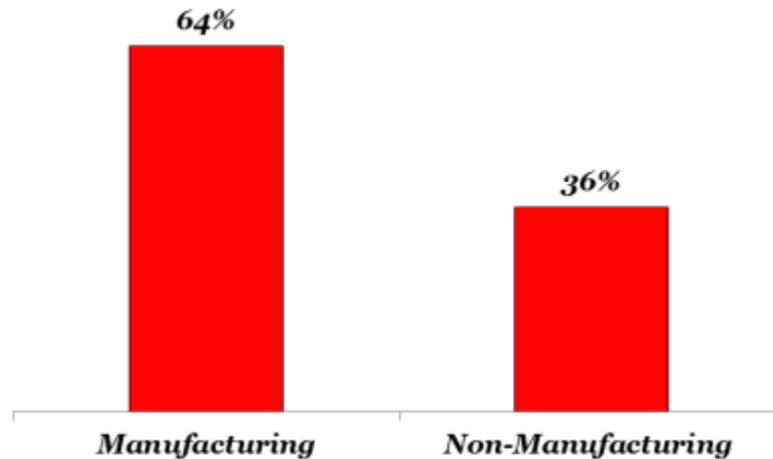
## Distribution of Participants by Region



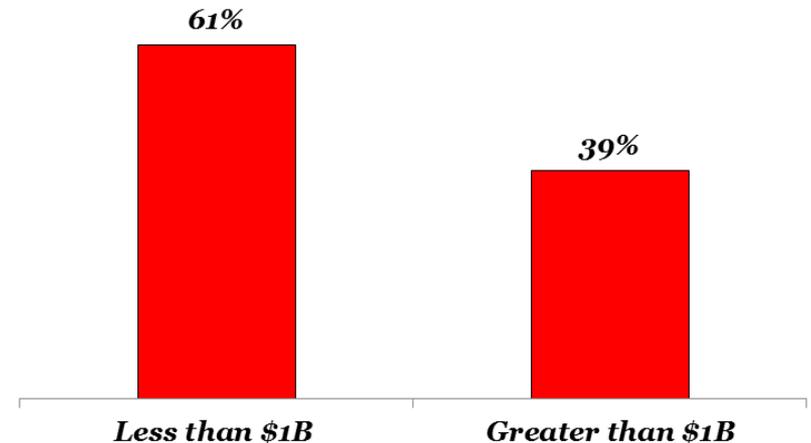
## Distribution of Participants by Industry



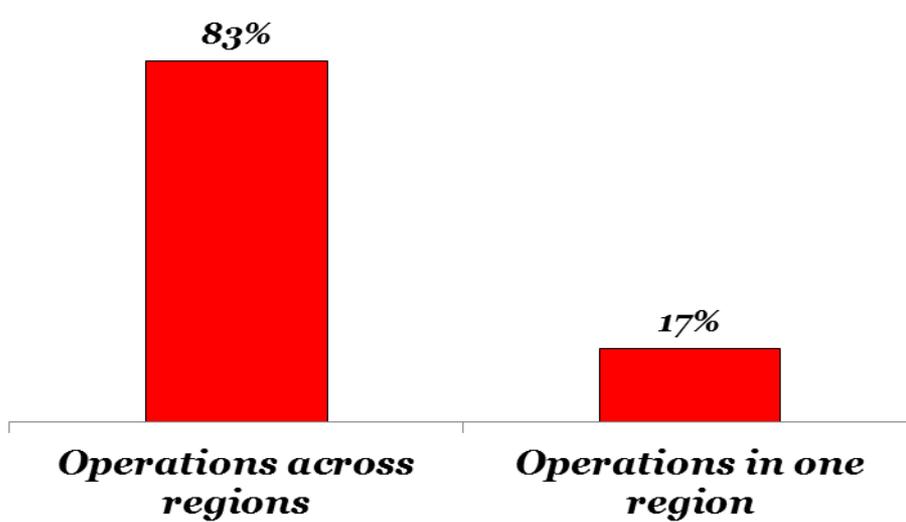
## Distribution of Focus



## Distribution of Participants by Revenue

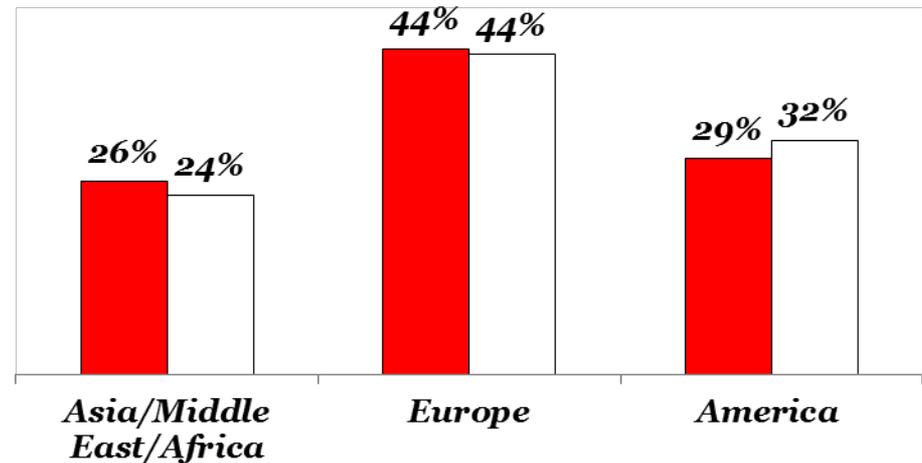


# Study Demographics: 209 Companies (2/2)



Distribution of Operations

Operations and Sales Volume by Region



■ Operations □ Sales



# Trends in Complexity

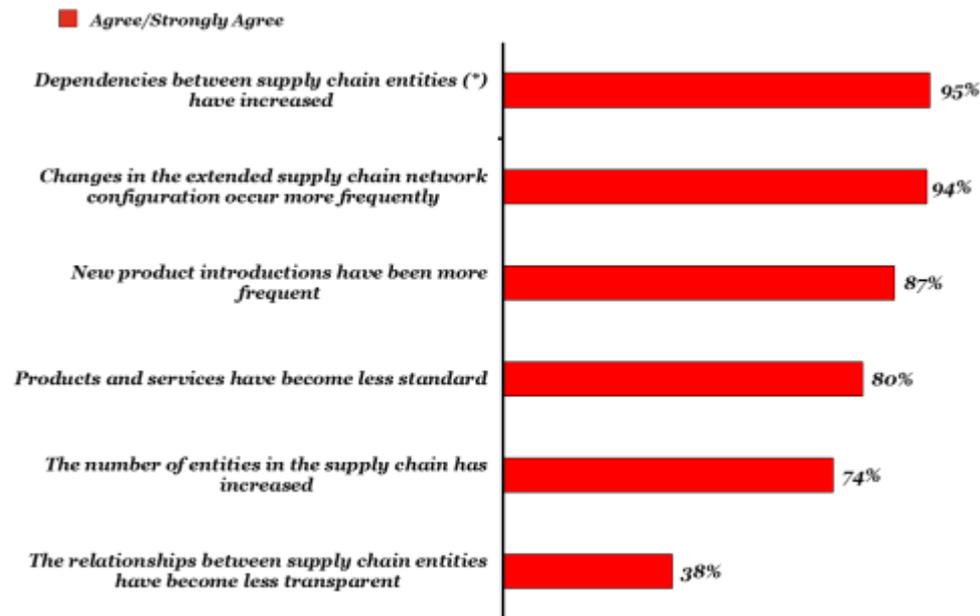
- Companies are conducting business today in changing and unpredictable environment. What has changed?
  - Supply chains have become more complex and the business environment they interact has become more uncertain
  - Demand and supply markets are larger and diverse.
  - Product development speeds are increasing leading to faster supply chain dynamics
  - Lack of product modularity and standardization
- Geopolitical and fiscal conditions, legal tax regimes, technology and the natural environments introduce uncertainty.
  - The sensitivity of the Global supply chains to such parameters renders them vulnerable to severe threats

# Trends in Complexity

- Complex systems feature large networks, many interacting agents, non-standard interfaces, fast dynamics and opacity. To get an indication on the trend we ask:

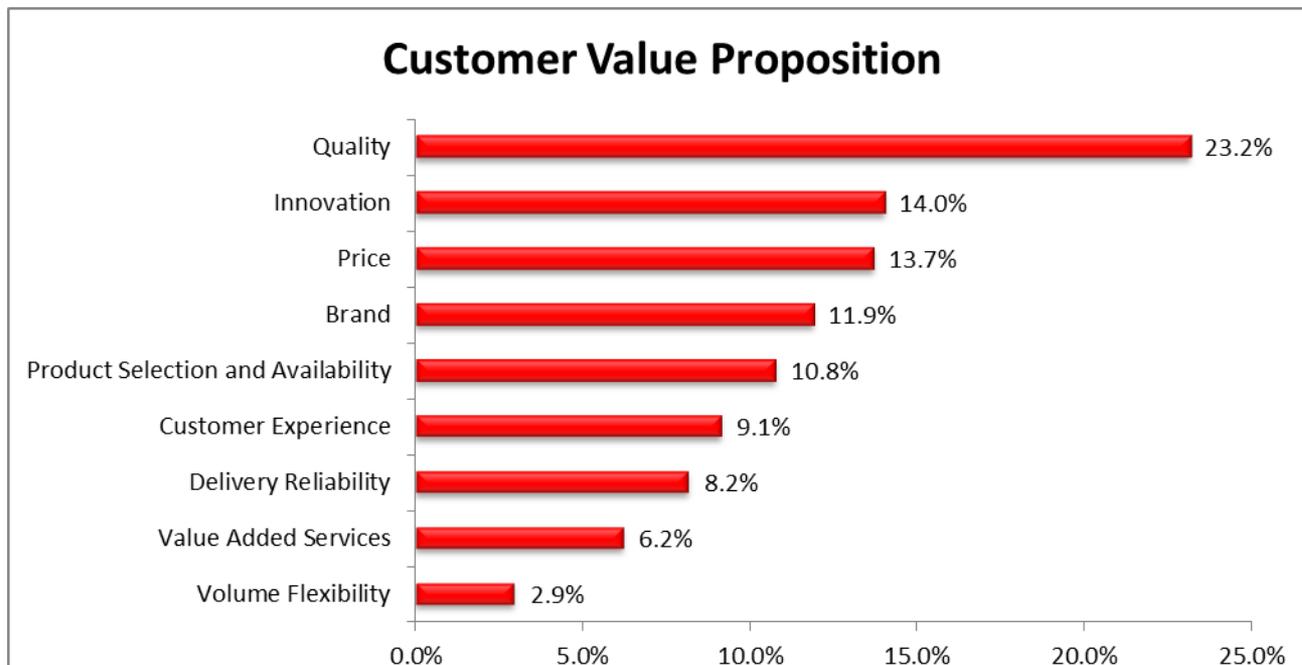
Is supply chain complexity increasing?

- Here is what each company participant told us on “how do complexity drivers have evolved over the past three years:



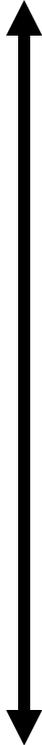
# Customer Value Proposition

- The way customers perceive Company's offerings
- Strong relationship between Customer Value Proposition and Operations Strategy
- Top four choices: Quality, Innovation, Price and Brand name



# Sources of Risk (1/3)

Unknown-unknown



Known-unknown

- Natural Disasters
- Geopolitical problems
- Epidemics
- Terrorist Attacks
- Environmental Risks
- Volatile Fuel Prices
- Rising Labor Costs
- Currency fluctuations
- Counterfeit part and products
- Port delays
- Market Changes
- Supplier performance
- Forecast accuracy
- Execution problems

Uncontrollable



Controllable

Sources of Risk <sup>2</sup>

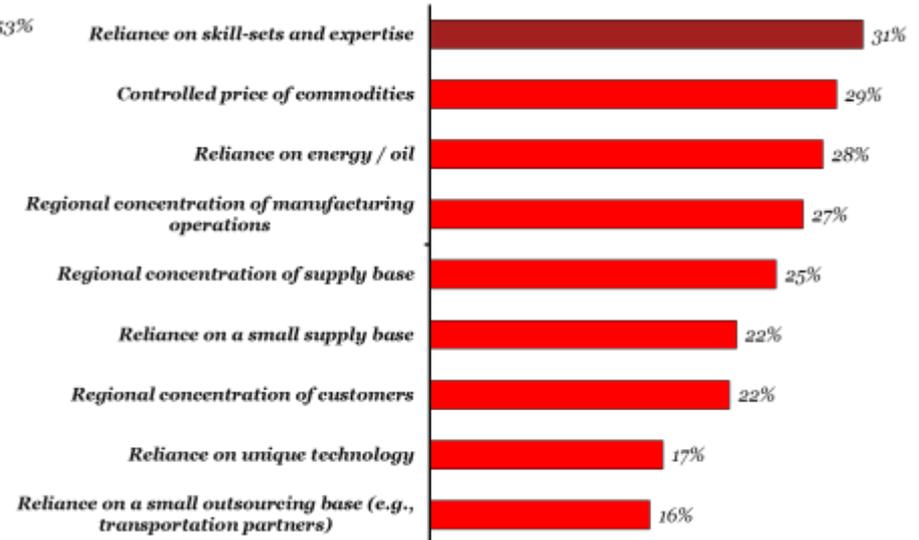
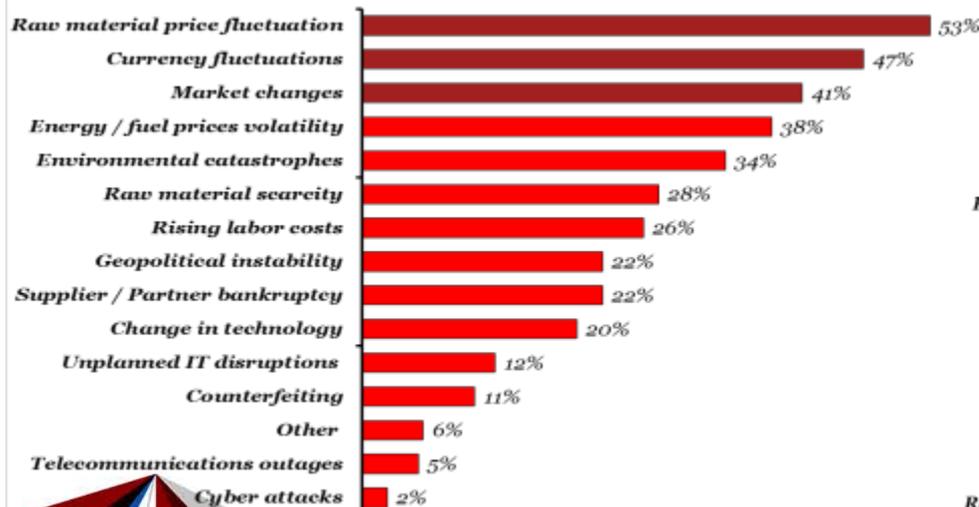
# Sources of Risk (2/3)

- To find out the level of exposure to diverse sources of risk we asked companies to tell us which incidents can potentially have the biggest impact on their supply chain:

1. Raw Materials prices
2. Currency fluctuations
3. Market Changes
4. Energy / Fuel Prices

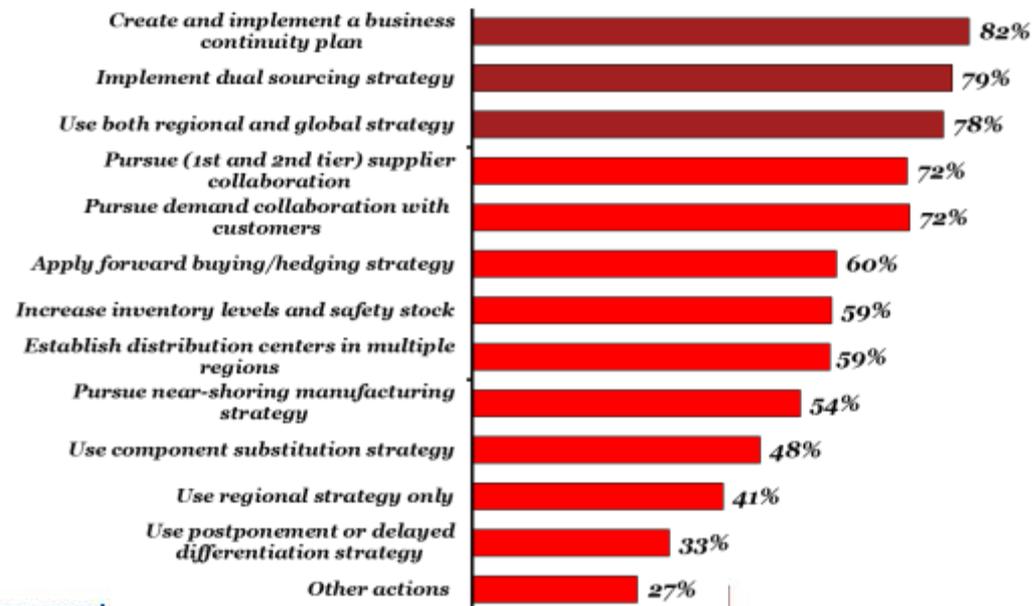
- We asked companies to indicate to which parameters their supply chain is most sensitive to. These are:

1. Reliance on skill and expertise
2. Controlled price of commodities
3. Reliance on energy / oil
4. Energy / Fuel Prices



# Sources of Risk: Mitigation Strategies (3/3)

- Actions they take either to reduce the exposure of their supply chain to potential disruptions or mitigate the impact:
  1. Create and implement a business continuity plan
  2. Implement Dual Sourcing Strategy
  3. Use both regional and global strategy
  4. Pursue a 1<sup>st</sup> and 2<sup>nd</sup> supplier collaboration



# The Challenge and the Questions

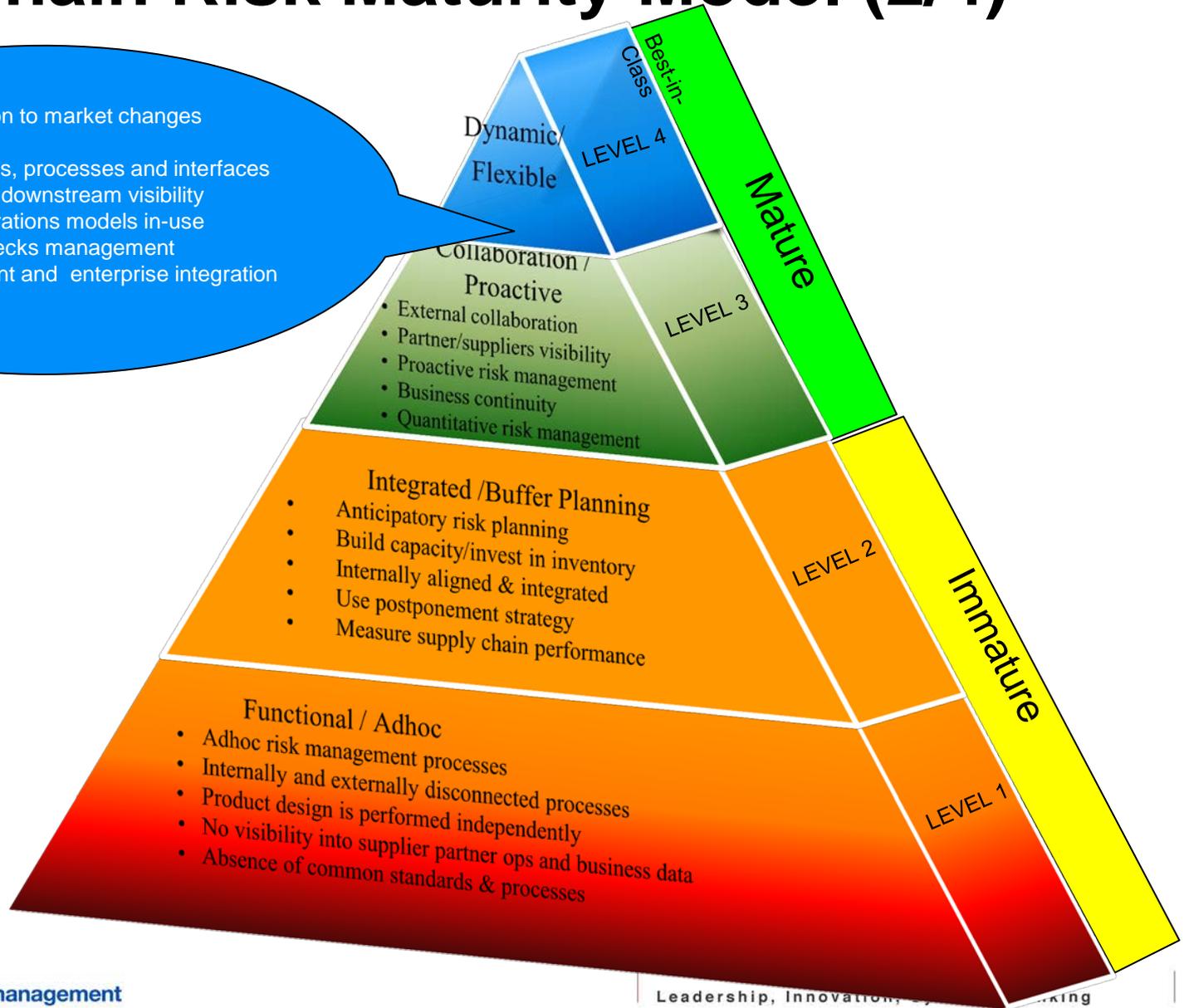
- Here is the Challenge
  - There are so many sources of risk that we do not know what will hit the supply chain in the next 12 months but .... I know that something is going to hit it
- The Questions are:
  - In the face of these supply chain risks, how do companies with global footprint prepare?
    - **How do I know where I stand ?**
  - What are the new ways of thinking to manage supply chain better?
    - Not only think about inventory service levels, response time but also take risk into account

# Supply Chain Risk Maturity Model: Four Levels of Maturity Along Two Dimensions (1/4)

- As illustrated in the Nissan case, to succeed in a complex, dynamic and changing environment, companies need to deploy capabilities along the supply chain management and the risk management dimensions.
- Applying systems thinking, four levels of maturity along two dimensions are developed:
  - 1. Level I: Functional supply chain management and Ad-hoc management of risk**
  - 2. Level II: Internal supply chain integration and positioning of planned buffers to absorb disruptions**
  - 3. Level III: External supply chain collaboration and proactive risk response**
  - 4. Level IV: Dynamic supply chain adaptation and fully flexible response to risk**

# Supply Chain Risk Maturity Model (2/4)

- Dynamic adaptation to market changes
- Invest in flexibility
- Common standards, processes and interfaces
- Full upstream and downstream visibility
- Sophisticated operations models in-use
- Timely SC bottlenecks management
- Complete alignment and enterprise integration



# Supply Chain Risk Maturity Model (3/4)

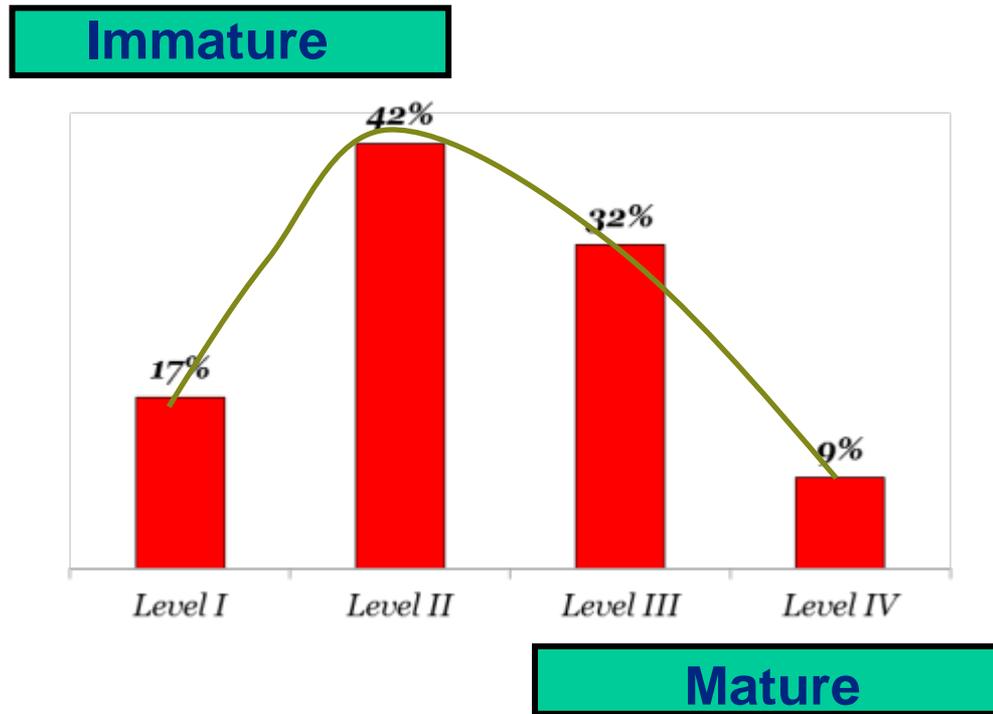
← Supply Chain Dimension Risk Management Dimension →

<b>Level I</b>	<p><i>Limited co-ordination between internal functions</i></p> <p><i>Resources are locally owned and managed</i></p> <p><i>Performance is measured separately based on functional KPIs</i></p> <p><i>Absence of integrated plans</i></p>	<p><i>Ad-hoc risk management processes</i></p> <p><i>No visibility into changes outside the functional domain</i></p> <p><i>No planning of redundancy buffers towards potential disruptions</i></p> <p><i>Can only absorb limited volatility around standard functional input parameters</i></p>	<b>Less Mature</b>
<b>Level II</b>	<p><i>Information sharing and common planning activities between internal functions</i></p> <p><i>Key resources and performance objectives are jointly managed</i></p>	<p><i>Positioning of redundancy buffers based on a common cross-functional plan</i></p> <p><i>Basic risk governance processes</i></p> <p><i>No visibility into emerging changes and patterns outside the company domain</i></p>	
<b>Level III</b>	<p><i>Visibility, information sharing, integration of key activities between supply chain partners</i></p> <p><i>Incorporation of external input into internal planning activities</i></p> <p><i>Supply chain rationalization</i></p>	<p><i>Use of sensors and predictors to proactively position response mechanisms</i></p> <p><i>Business continuity plans – Partner resilience monitoring</i></p> <p><i>Quantitative risk management</i></p>	<b>More Mature</b>
<b>Level IV</b>	<p><i>Alignment on key customer value dimensions across the extended enterprise</i></p> <p><i>Supply chain segmentation to match multiple customer value propositions</i></p> <p><i>Identification of emerging value chain patterns in complex dynamic environments</i></p> <p><i>Ability to adapt the supply chain to frequent changes in the value chain</i></p>	<p><i>Visibility, information sharing, integration of key activities between supply chain partners</i></p> <p><i>Incorporation of external input into internal planning activities</i></p> <p><i>Supply chain rationalization</i></p>	



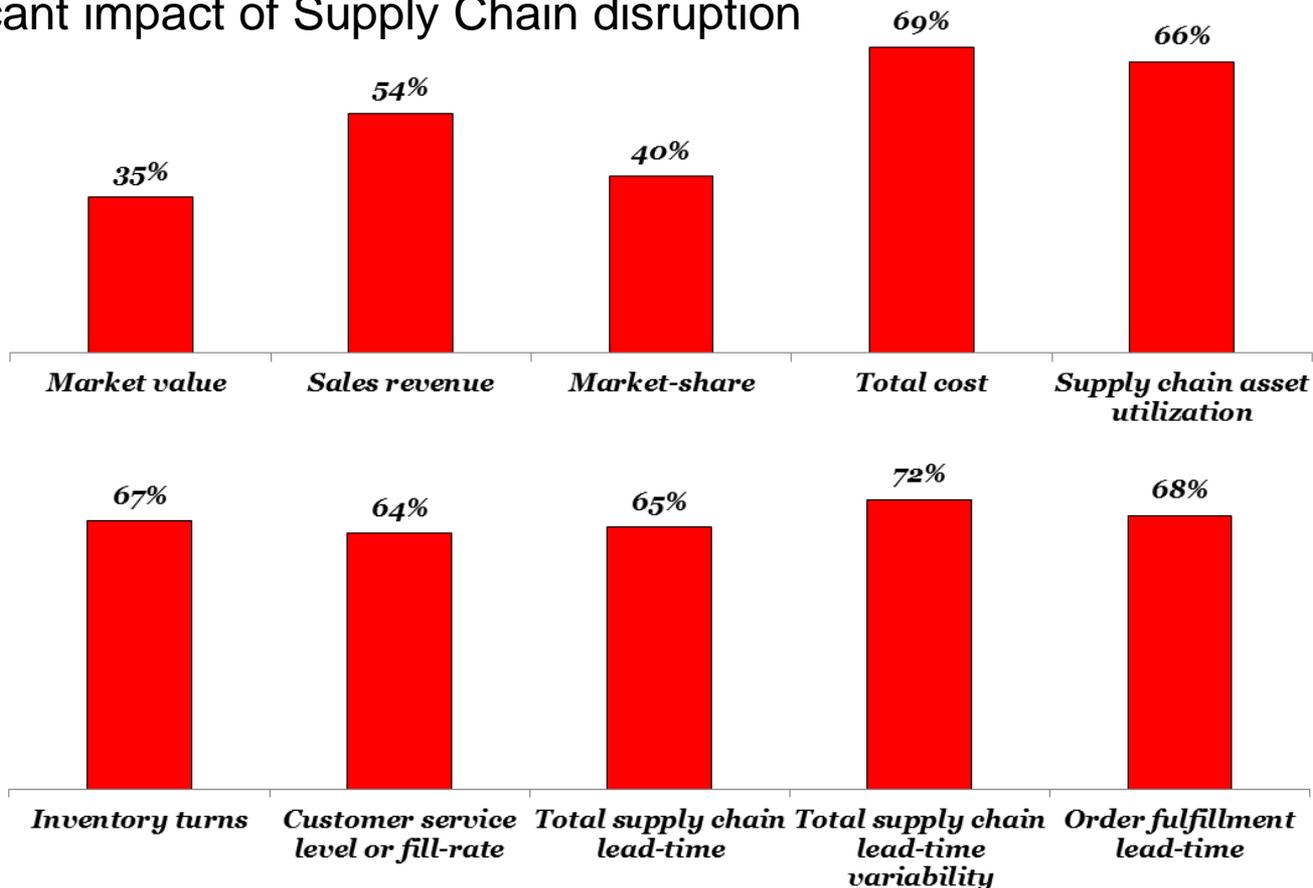
# Supply Chain Risk Maturity Model (4/4)

- Using this information we derived the overall maturity level of the companies below



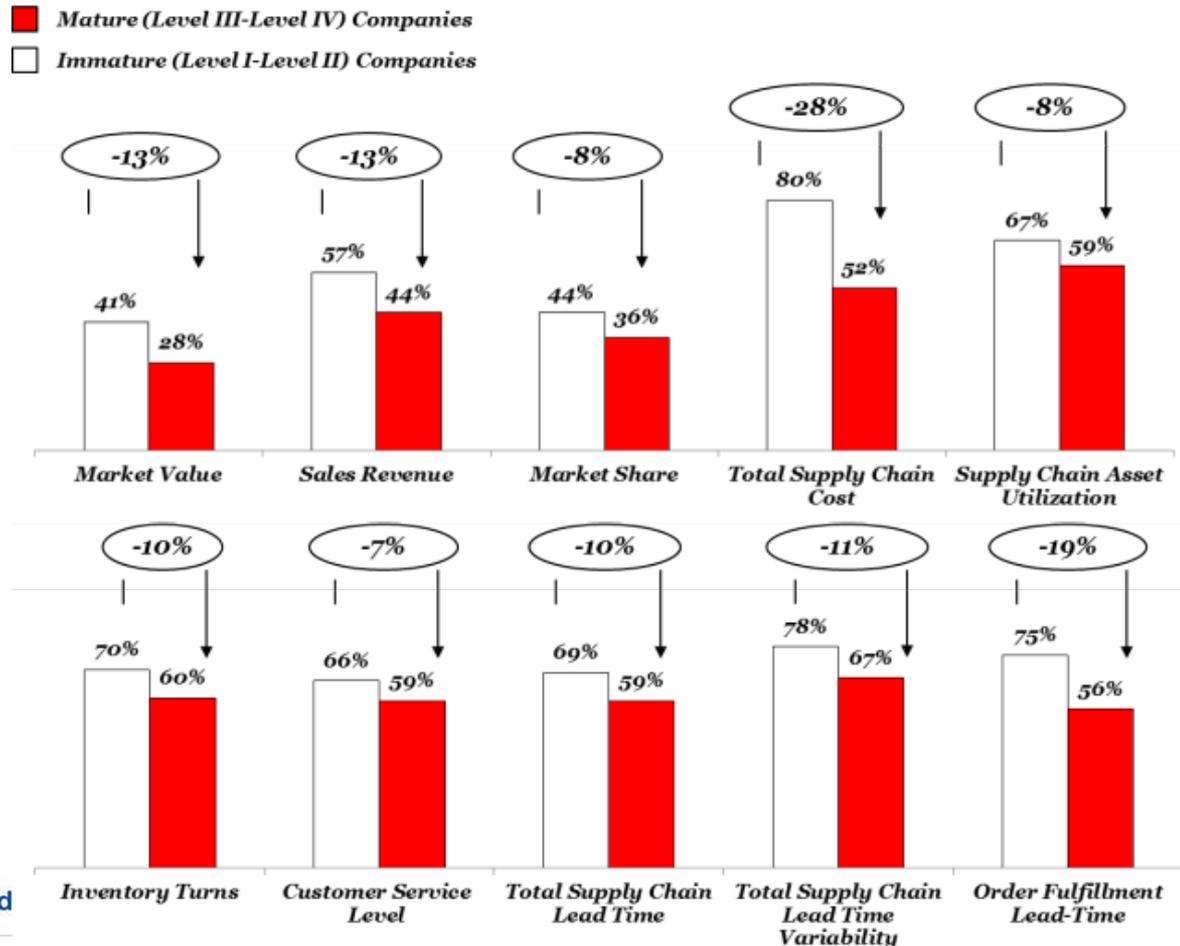
# Impact of Risk Disruptions on Performance

- Companies that faced at least three disruptive incidents over the last 12 months suffered a 3% or higher impact on their key performance indicators
- Significant impact of Supply Chain disruption



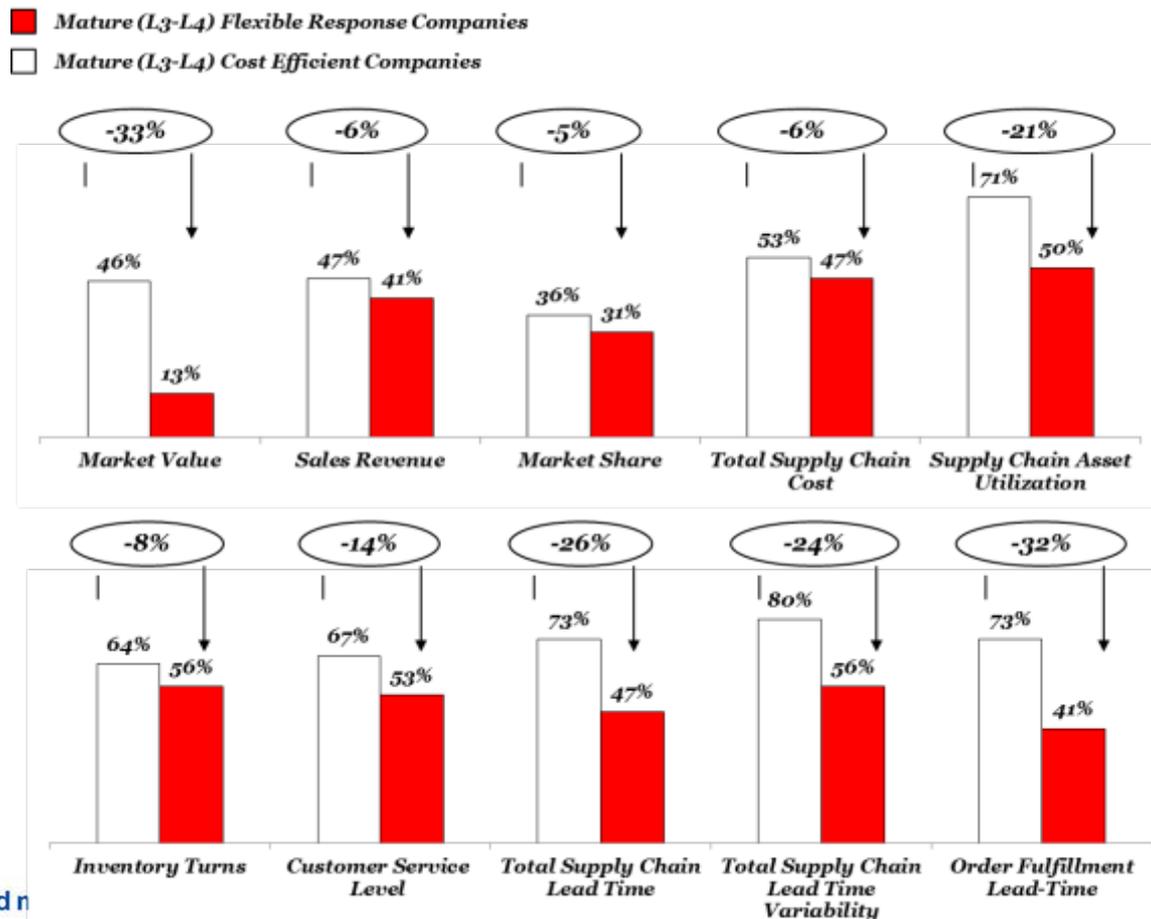
# Risk Mature Companies are Resilient

- Companies with mature risk process are more resilient to supply chain disruptions
  - Companies with more than 3 incidents that suffered an impact of 3% or higher on their KPIs as result of supply chain disruptions in the last 12 months



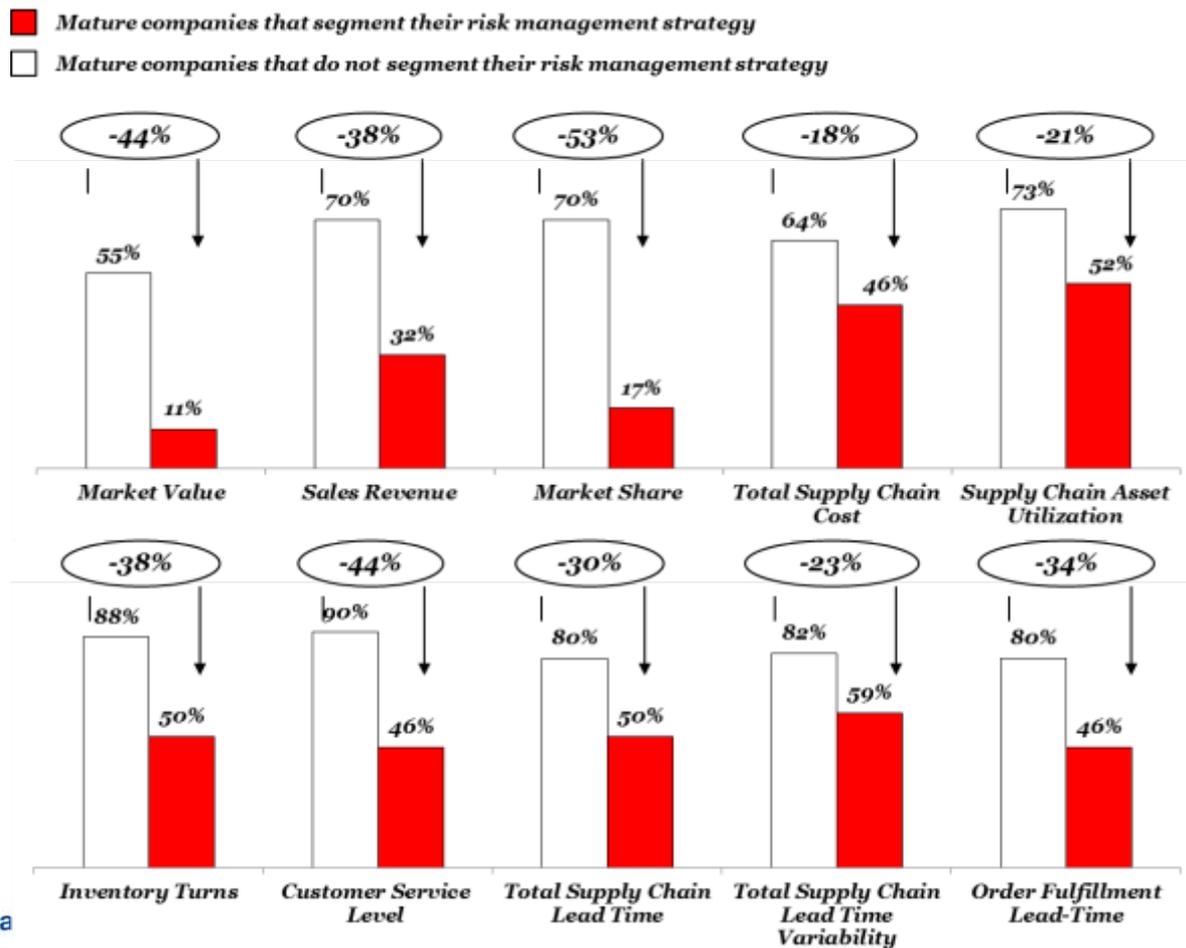
# Companies with Mature Flexible Supply Chain Strategies are more Resilient

- Companies that suffered a higher than 3% impact on their KPIs as a result of supply chain disruptions they faced in the last 12 months is significantly lower for the flexible-strategies group.



# Mature Companies who Segment their Risk Strategies are More Resilient (1/2)

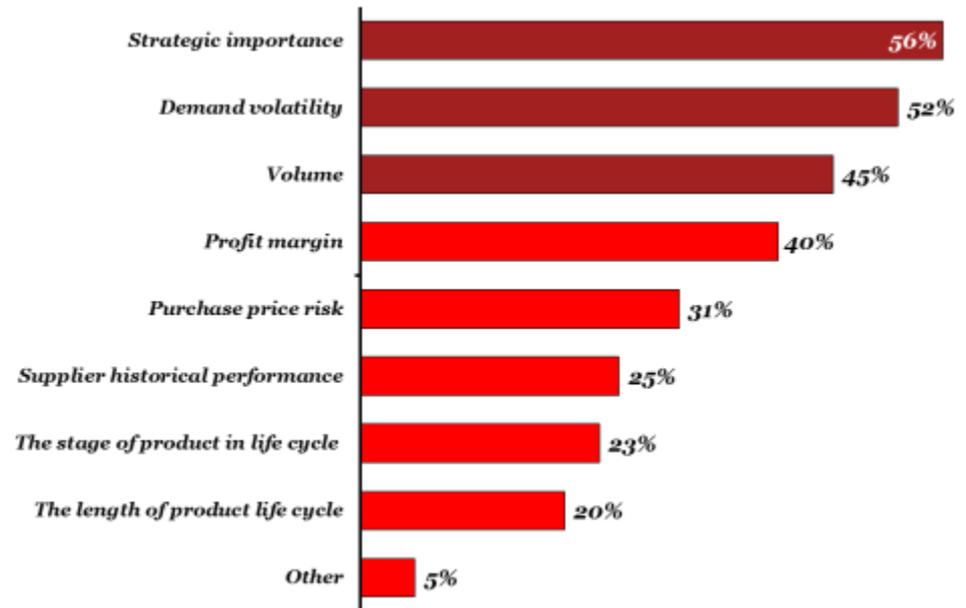
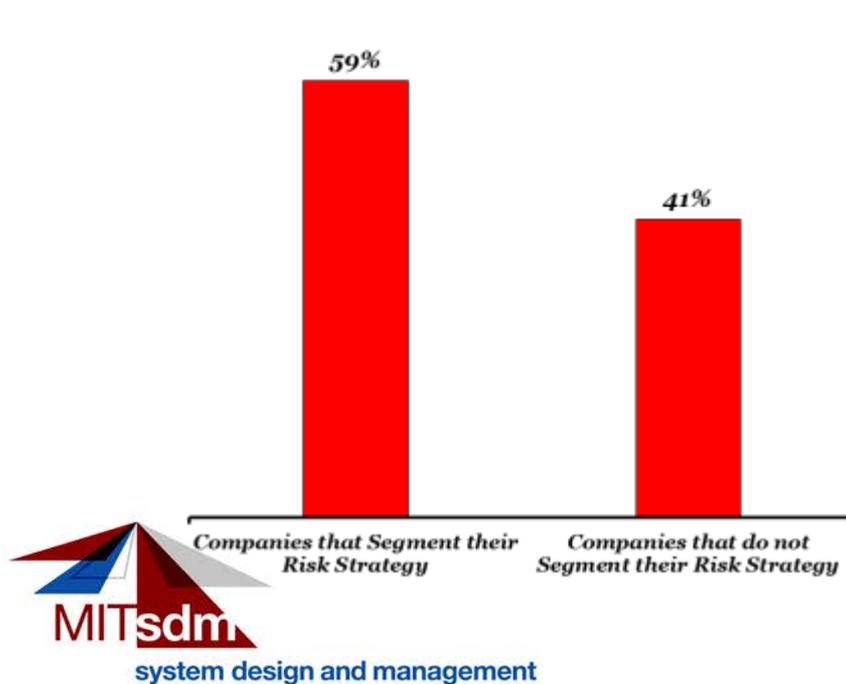
- Companies that suffered a 3% or higher impact on their KPIs as result of more than 3 supply chain disruptions faced in the last 12 months



# Mature Companies who Segment their Risk Strategies are More Resilient (2/2)

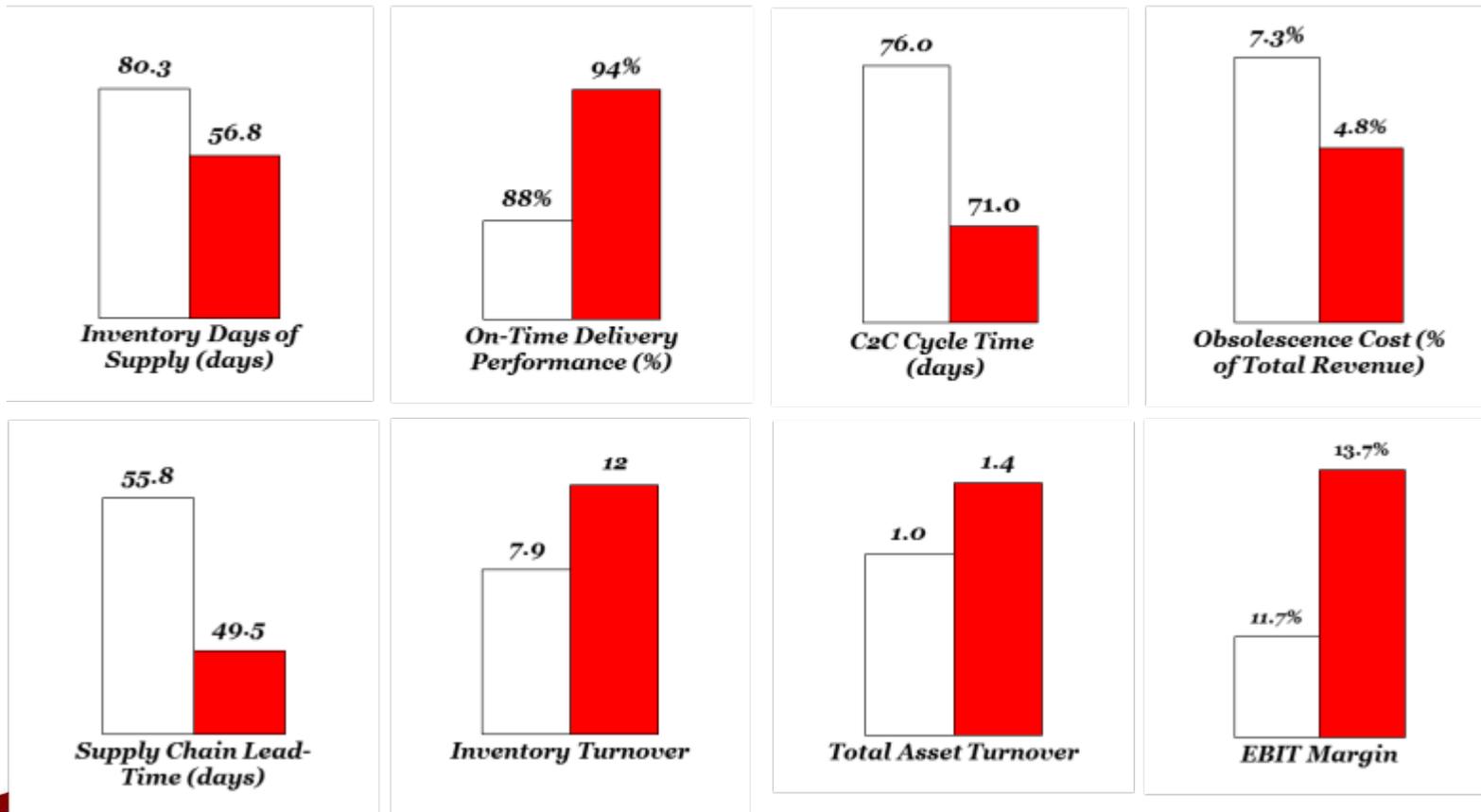
- Ask companies to indicate whether they actively pursue risk strategy segmentation:
  - Pursue risk segmentation (59%)
  - Do not pursue risk segmentation (41%)

- Ask them to indicate the differentiators in their risk segmentation strategy:
  - Strategic Importance
  - Demand volatility
  - Volume
  - Profit Margin



# Mature Companies Perform Better

- *Mature (L3-L4) Companies*
- *Immature (L1-L2) Companies*



# Summary (1/2)

- Supply chain disruptions have significant impact on company business and financial performance
- There are new breakthrough concepts in operations strategy to deal with supply chain risks for large revenue companies with global footprint.
- This empirical study shows that mature companies investing in acquiring advanced risk reduction enabler capabilities perform better
  - Companies with mature risk management processes are more resilient to risk disruptions than companies with immature risk management processes
  - Mature companies investing in supply chain flexibility are more resilient to disruption
  - Mature companies investing in risk segmentation are more resilient to disruptions than those that are not investing in risk segmentation
  - Companies with mature capabilities in supply chain and risk management do better along all dimensions of operational and financial performance

# Summary (2/2)

- Outcomes are **validated** with the 209 companies that participated in this study
- This is an important message to the CEO and CFO.
  - Managing risk is not only about operations and supply chain management but includes every aspect in a CEO's sphere of influence for product design, development, operations and sales.
  - Insurance is not the solution to address risk incidents; insurance does not cover everything
  - Operations and Supply chain innovation is about improving performance

# Online SCRM Maturity Assessment Calculator

- A company needs to be self-aware where they and their competition stand with respect to managing risks.
  - If the competition has a lower risk maturity capability level than your business, then this attribute is your competitive advantage over them
- A Supply Chain and Risk Maturity (SCRM) Calculator has been developed to assess each company's ability to respond to risks and identify its maturity level. It will be posted on the MIT Forum for Supply Chain Innovation Site:

<http://supplychain.mit.edu>