SUPPLY CHAIN RISK INDEX™ LEHIGH + CSCMP

Lehigh Business Supply Chain Risk Management Index

Quarterly Report

3rd Quarter / 2023

LEHIGH UNIVERSITY | College of Business

CENTER FOR SUPPLY CHAIN RESEARCH AT LEHIGH

CSCMP Council of Supply Chain Management Professionals

Educating and Connecting the World's Supply Chain Professionals.™

LEHIGH BUSINESS SUPPLY CHAIN RISK MANAGEMENT INDEX

Welcome to the **Lehigh Business Supply Chain Risk Management Index Report** developed by the Center for Supply Chain Research at Lehigh University and the Council of Supply Chain Management Professionals.

We launched this index in August of 2020 to better understand the different kinds of supply chain risks businesses face. **Supply chain professionals rated the likelihood that the risk in the 3rd Quarter of 2023 compared to the risk in the 2nd Quarter 2023 would likely increase, remain the same or decrease for 10 different Supply Chain categories.**

The Lehigh Business Supply Chain Risk Management Index (LRMI) value is a number between 0 – 100, where greater than 50 suggests increased risk, equal to 50 suggests the same risk and less than 50 suggests decreased risk. **The average LRMI for the 3rd Quarter is 65.18 which is an increase from the 2nd quarter suggesting a higher level of risk in the 3rd Quarter 2023.**

The table below reflects the 10 categories of risk from highest risk to lowest risk when evaluated independently as perceived by supply chain professionals.

If you would like to have additional information about the survey or to participate in the survey, please contact Dr. Zach G. Zacharia at zacharia@lehigh.edu.

Executive Summary

Cybersecurity is again the highest risk overall at 82.86, but this is a jump of 5 points compared to last quarter, suggesting cyber-attacks, data corruption, data theft, system viruses, and security platform controls are serious risks that supply chain managers are concerned about in the next quarter. Economic risk is again 2nd overall, and there has been a slight increase in risk to 75.96, suggesting the economy still remains an important risk in the 3rd Quarter. The next two risks have dropped slightly, but they are the same risks identified in the 2nd Quarter, namely Customer Risk and Government Intervention Risk. Interestingly, Environmental Risk has become a top 5 risk for the first time, which suggests natural disasters and extreme weather have become more worrisome for supply chain managers going forward. The average risk index has increased slightly to 65.18, which is still low compared to the average risk historically.

Risk Type	2nd Quarter 2023 Risk Index	3rd Quarter 2023 Risk Index	Trend
Cybersecurity and Data Risk	77.54	82.86	↑
Economic Risk	74.64	75.96	↑
Customer Risk	73.91	72.86	↓
Government Intervention Risk	71.01	70.19	↓
Environmental Risk	55.07	62.02	↑
Supplier Risk	60.14	60.95	↑
Technological or Competitive Risk	65.22	60.00	↓
Transportation Disruption Risk	50.70	57.08	↑
Operational Risk	59.15	55.66	↓
Quality Risk	53.52	54.25	↑
Average Risk Index	64.09	65.18	↑

The Risk Index is a number between 0 – 100.
The further the number is from 50 the greater the level of risk.
The arrow indicates whether the risk is increasing or decreasing in comparison to the previous quarter.

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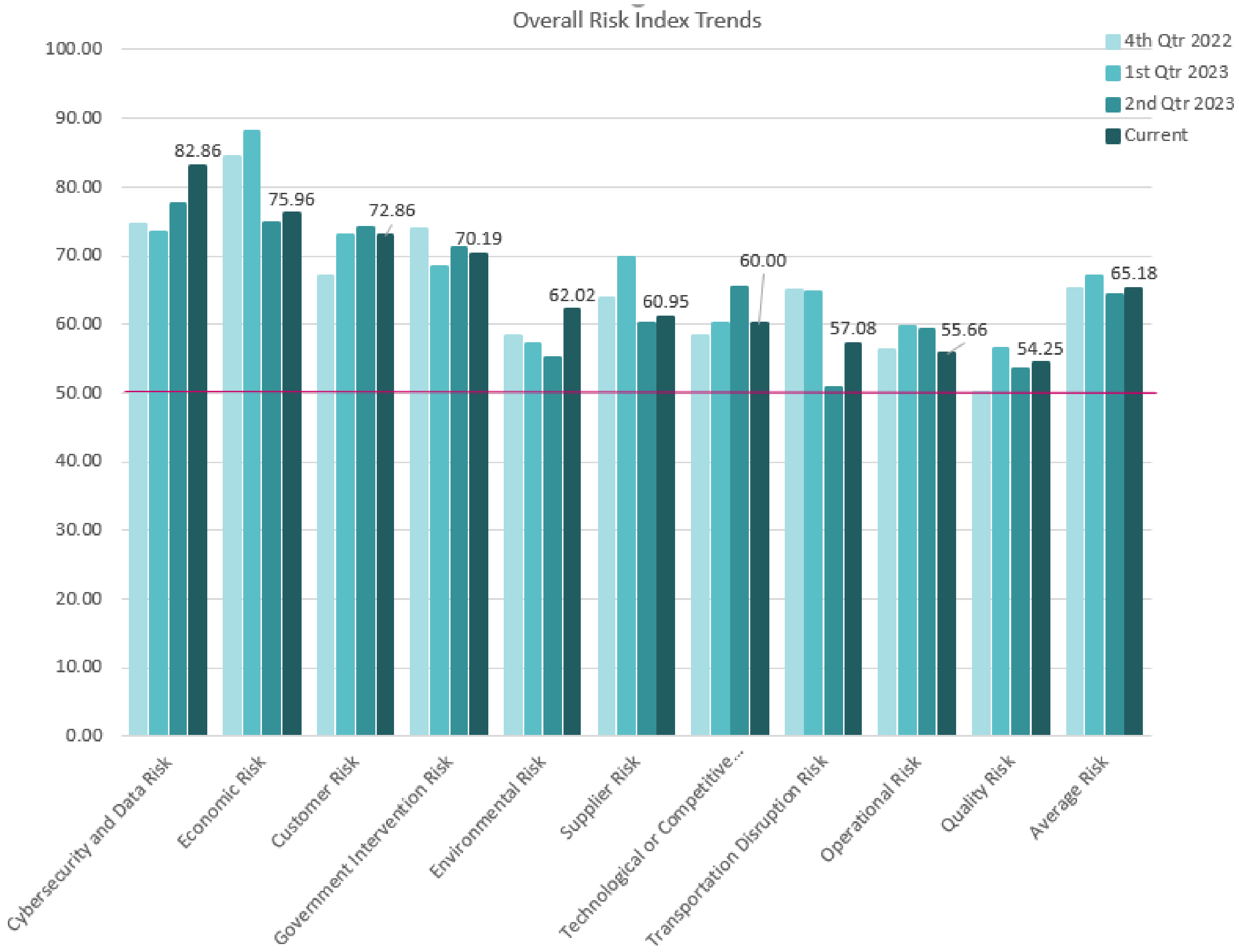
Did You Know?

The Lehigh Business Supply Chain Management Risk Index for the 3rd Quarter in 2023 is

65.18

LRMI Risk Index Over the Last Year

One of the advantages of examining supply chain risk is to consider how these risks change over time. The table below shows the changing levels of the risk across the 10 different areas of the supply chain this last year. It is also insightful to see that some areas of the supply chain are consistently seen as high risk and other areas of the supply chain as lower risk over the same 1-year time period.



Four Biggest Risks in Head-to-Head Comparison 3rd Quarter 2023

(Respondents are asked to compare across all 10 risks simultaneously, instead of rating one risk at a time.)

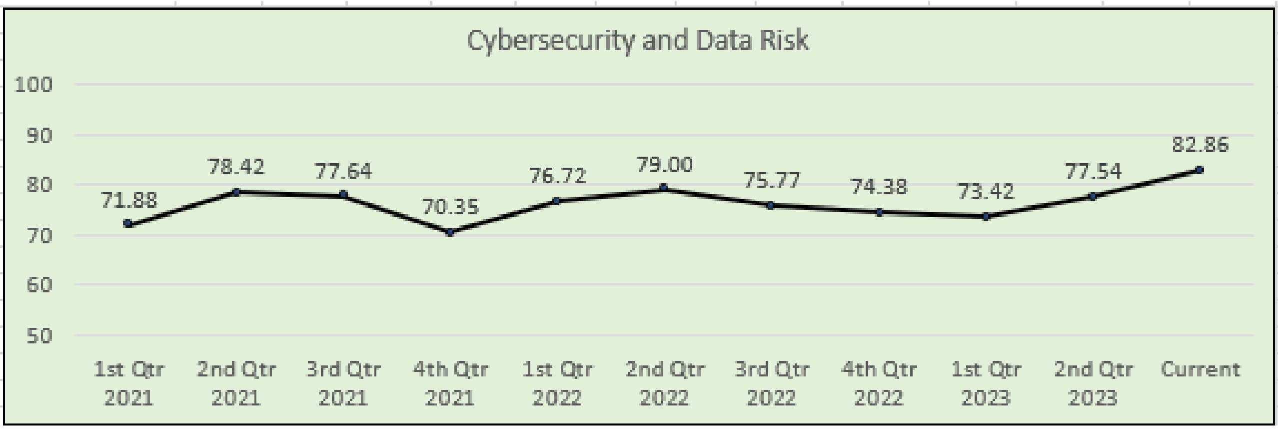
1. Cyber-security and Data Risk
2. Transportation Disruption Risk
3. Technological or Competitive Risk
4. Operational Risk

01 Cybersecurity and Data Risk

Some examples are: cyber-attacks, data corruption, data theft, system viruses, hardware and software issues and security platform controls.

Selected Comments:

- More systems, interfaces and reliance on e-commerce will be significant stress areas.
- More data risk is imposed due to modernization and migrating data to the cloud.
- Aligning with the right software systems provides added protection. Our systems are supported by Salesforce and Google, which go to extreme measures to protect users.
- The "bad guys" view online, remote/virtual workers who are less than adequately protected are easy pickings; they continue to innovate ways of infiltrating business and supply chain accounts.
- I believe cybersecurity is an ever increasing risk; as our political environment becomes more unstable, we become a bigger target.
- Introducing a new software product will always have bugs. Some of the unknown bugs could present cybersecurity risks.
- We constantly go through monthly cybersecurity risk training.
- AI misalignment, misjudgment or similar disruption.
- There has been a notable increase in both phishing and cyber attacks and attempts.
- Cyber issues have been on the rise. More hits, different methods - hacking is an innovative business; supply chains have been shown to be vulnerable.
- DoD measures are working to promote cybersecurity.
- This is a risk which will never go away. The cost to keep it in the background, however, is eating into margins.
- China and Russa are becoming bolder with the ransomware attacks and more expansive.

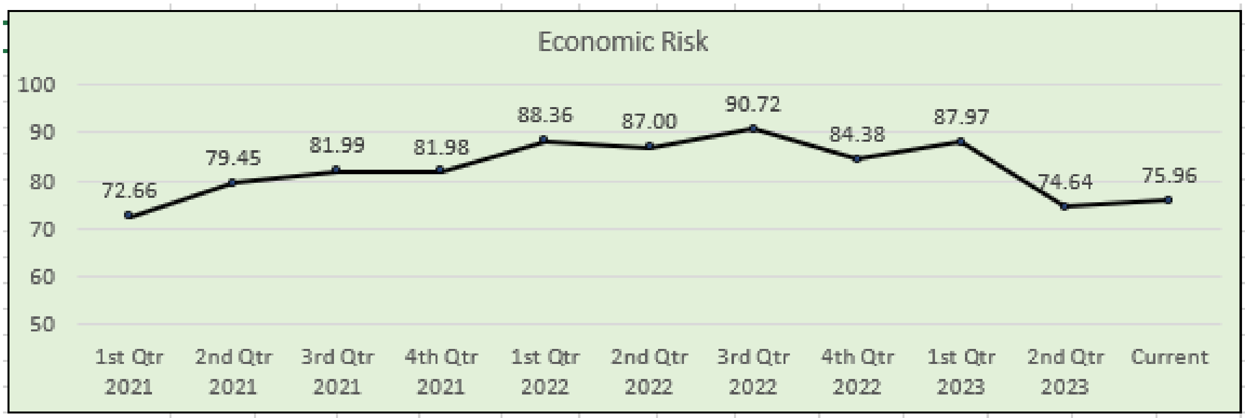


02 Economic Risk

Some examples are: increasing energy costs, commodity price volatility, labor shortages, sudden demand shocks, global energy shortages and border delays.

Selected Comments:

- Inflation, bank failure, and a continually out-of-touch Fed continue to drive economic risk.
- Resource scarcity, particularly of qualified labor.
- In the short term, I feel the economic risk will remain the same. If a deeper recession occurs, all buying behavior, both indidvidual and commercial, will decline...having an effect on all businesses, specifically small business.
- It is hard to predict this with an election coming up.
- Labor has been and remains a challenge since COVID began. Workers have experienced new work environments (work from home), higher rate increases with incentives, and more benefits. This is now the new norm and any company not adjusting will have difficulty retaining.
- Most of our growth is tied to price increases which isn't sustainable. Holding too much inventory and could see large amounts of salvage.
- The risk of recession is generating uncertainty for demand in the second half of the calendar year.
- As noted, decreasing customer demand is critical. This is driven by overall market risk.
- There is a growing concern regarding increased energy costs due to changing regulations.
- The disruptor is increased competition for the same resources, causing uncertainty in the work flow.
- Increasing energy costs, price volatility, and lack of skilled labor availability.

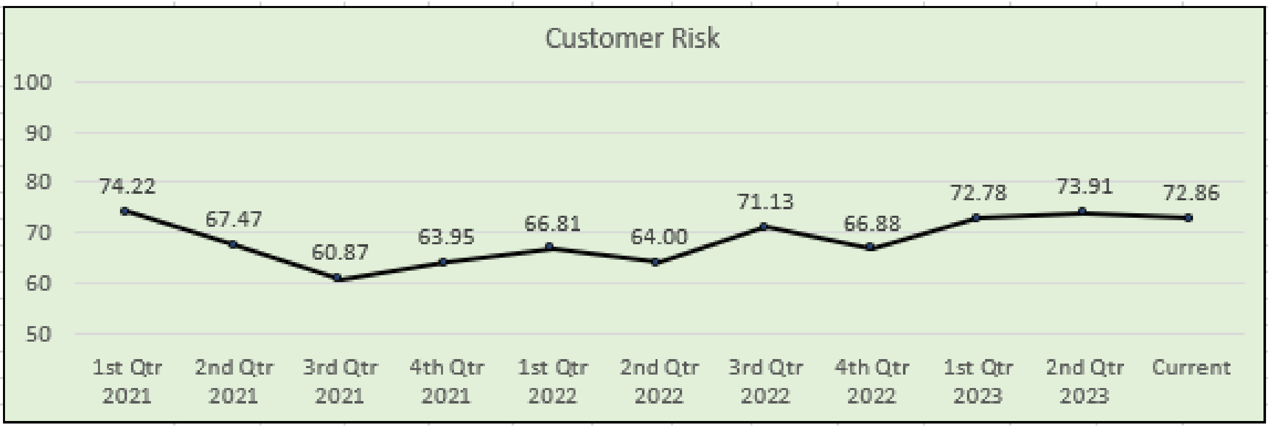


03 Customer Risk

Some examples are: fast changing customer demand, easy to lose customer loyalty, changing customer base demographics, hard to predict customer behavior and hard to service customer.

Selected Comments:

- For freight brokers, an excess of available capacity commoditizes the value-added service providers. Also see continued risks with respect to buyers changing companies.
- Consumer credit card debt is setting new high watermarks and that will be troublesome.
- Competition isn't increasing price at same levels.
- Consumers are diversifying their spending dollars due to more choices post-pandemic. Customers are also more consciously spending their money due to recession risks.
- Large amount of competition/competing brands in our industry is always a large risk.
- New products are always a mixed bag. We have the potential to anger existing or new customers if our product isn't ready in time or doesn't perform well.
- Our delivery times have increased by a day or, at most, two. I must tell our customers that there are not enough drivers/labor for UPS, USPS and FedEx.
- Increasingly political/sociological concerns are impacting customer purchasing choices.
- Demand continues to drop with little to no new business to mitigate it. Inventory is becoming a problem, either due to lack of storage space or high 3PL storage costs.
- Customer service will become even worse as computers and AI functionality replace human-to-human interaction.
- Customer demand quickly changes in response to OEM shortages.
- Right now, as a tier 2 or 3 supplier to a manufacturer, there is a huge reduction in demand for many items as the Mfgs over-purchased during COVID.
- Customer loyalty only exists though the next shipment. Some customers will start to look internally at the US, as China has proven to be unreliable over the past couple of years.

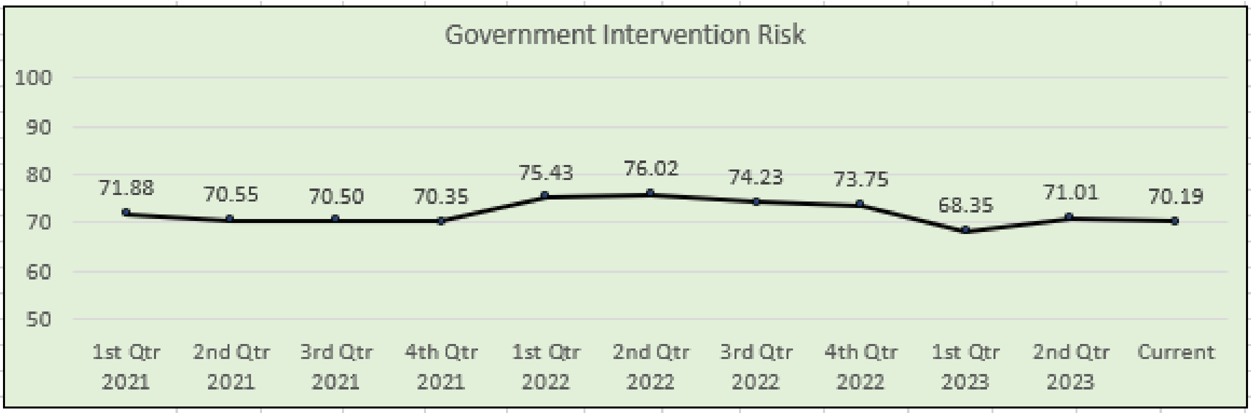


04 Government Intervention Risk

Some examples are: new regulations, tariffs/trade wars and governmental restrictions on source material, methodologies or technologies.

Selected Comments:

- Steel and aluminum tariffs have done nothing but raise prices for producers and consumers. Domestic companies are not reinvesting or attempting to grow; rather, they are making money grabs.
- Regulation has potential for being a growth constraint, coupled with isolationist views by countries.
- In the freight brokerage world, the potential of rate transparency and the AB5 independent contractor law could have a significant impact. The government doesn't realize the full scope of the effects these could have on the freight business.
- What are all the IRS agents doing? Just reported today - an increase in tax ID fraud.
- Poor US-China relations means that global trade could become more difficult.
- More regulation would benefit my company.
- Government intervention remains at an elevated risk due to global tensions (Russia's war in Ukraine, etc.) and a move toward more nationalistic policies.
- Potential for new FDA guidance on Biologics to affect processes and overall drug delivery timeframes.
- Given 2024 is an election year, potential political/regulation changes may rise.
- With DOT approval of our lab-based oral fluid drug test, we are more secure.
- As the next election cycle in the United States get closer, the turbulence of governmental impacts will only grow. Right now, the debt game is a problem that many are ignoring. When the deal was verbally approved, it got quiet when, in reality, there are lots of behind-the-scenes things which could ruin forward progression.

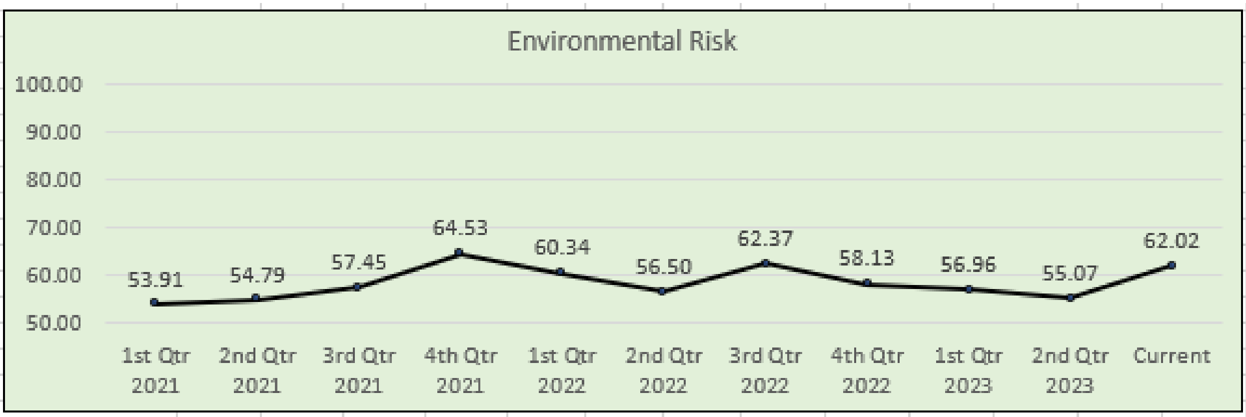


05 Environmental Risk

Some examples are: natural disasters, extreme weather, industrial accidents and pandemics.

Selected Comments:

- Natural disasters seem to be increasing.
- Increasing transportation accidents.
- Summer hurricane season combined with El Niño.
- Unpredictable, but always a potential that is difficult to prepare for.
- Global warming continues every year with increasingly more extreme weather in the last few years, resulting in increased risk.
- Climate change continues to impact here.
- Transportation is disrupted across the country after every major hurricane, snow storm, rain storm, wind storm, etc. Supply chain shortages will be exacerbated as more trucks are displaced due to weather disruptions.
- Lack of rain, too much rain, high or low temperatures greatly affect point of sale with our customers, which directly influences our volume.
- Again, things are changing rapidly, and our ability to "keep tabs" on those changes is insufficient.
- My company prioritizes environmental friendliness over running a successful business. As new requirements get implemented, they will significantly impact our performance.
- Storms, volcanos, earth quakes, and fires are all on the rise.

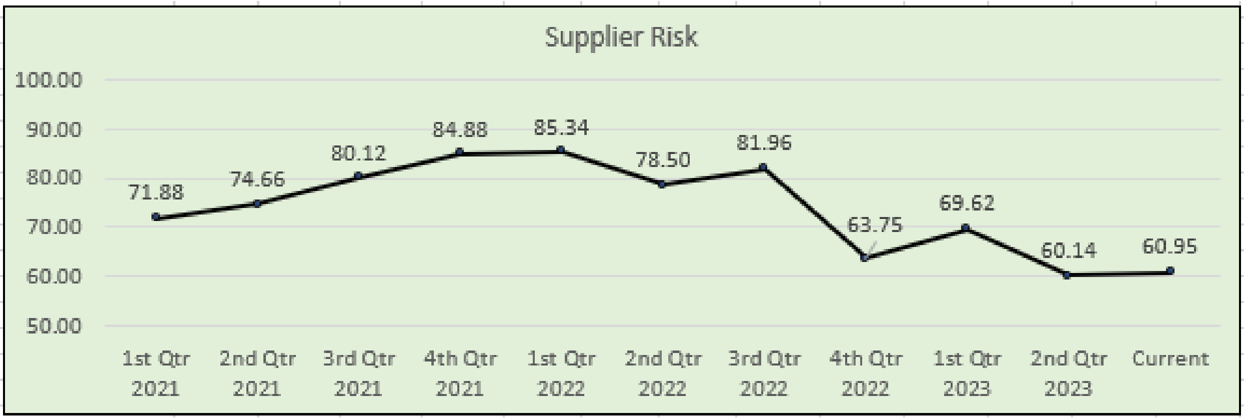


06 Supplier Risk

Some examples are: single/sole source supplier, suppliers from one geographic location, supplier quality issues, price volatility and counterfeit products.

Selected Comments:

- Resilience is a key opportunity area.
- Suppliers are now better equipped to meet their time commitments. Excess inventory is still on hand after raw materials were over-ordered in anticipation of high sales volumes.
- Suppliers are attempting to push through exorbitant price escalations. Our purchasing team is busy trying to combat these increases by seeking out alternative suppliers.
- Supply chains are becoming more stable in our industry. Believe risks will decrease.
- A significant effort is underway to qualify secondary sources.
- Supplier inventories have calmed down and inflation is more stable.
- Suppliers have continued to become more and more reliable as we exit the pandemic.
- Inflation is still a thing as everyone is trying to figure out where the breakpoint is on pricing before business volumes are impacted.
- We have had several clients that are looking into building a more robust supply chain with additional options for suppliers.
- Tesla is bringing some mining efforts in-house, as well as continuing to mitigate different supplier tiers.
- China supply risk is always an issue, as was seen with the chip industry during the pandemic. The US is incentivizing some companies to make products domestically, however, so much capacity has been shut down that it will take a couple of years to get this back. China sources should NEVER be single sources.
- Larger companies that I deal with (3M, Dupont, Dow) are increasing their minimum order quantities for certain materials due to dwindling customer demand.

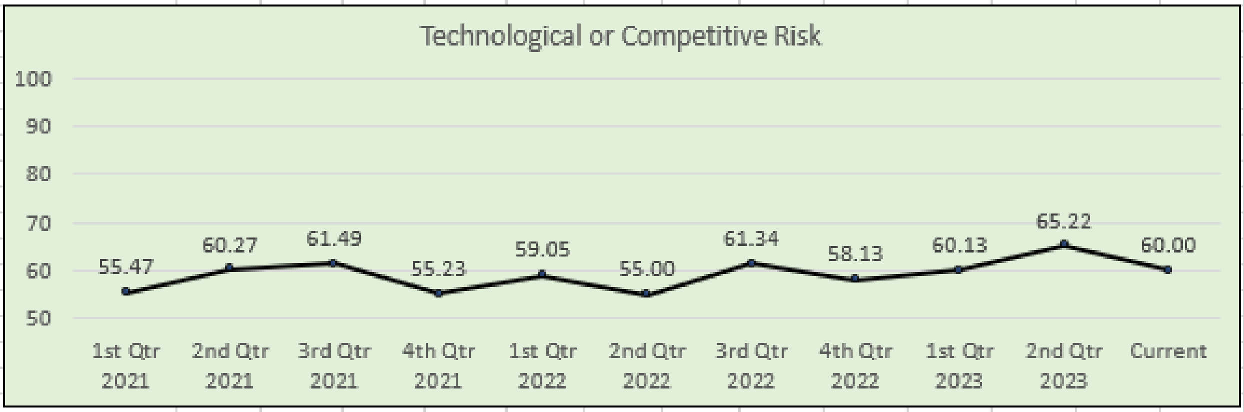


07 Technological or Competitive Risk

Some examples are: disruptive or replacement technologies, introduction of new competitor firms and ineffective or non-existent regulation for competitors.

Selected Comments:

- Our customers receive an abundance of solicitation calls from competitors when the market is down. We need to continue building relationships and customer loyalty in order to maintain our expected business levels.
- The caveat being the installation of adequate safeguards of AI errors and malicious use.
- Implementing a new AI routing tool to reduce costs and drive route efficiency.
- The expense of technology is a prohibiting factor in remaining competitive with the largest manufacturers. Customers expect the same levels and types of communications from us and we do not have the same tools/technology.
- These risks increasing with huge growth and advancements in AI.
- Digitization is on the rise, so many companies will be forced to innovate or risk losing market share to more efficient companies who are using strategic automation.
- Our lab-based oral fluid drug test was just DOT approved. This will give us an edge, so we don't have to worry about competitive risk.
- Recent trends show customers willing to accept lower quality for a more affordable price. This trend continues as customers seek cost reductions.
- Partnerships like the recent one with Ford CEO, Jim Farley, will become more common. As competitors improve, so does the EV to ICE ratio and, therefore, the infrastructure to support more of the products Tesla produces.
- At some point, we will see a substantial change in how technology costs are passed through to customers.
- AI is the biggest question mark on the horizon.

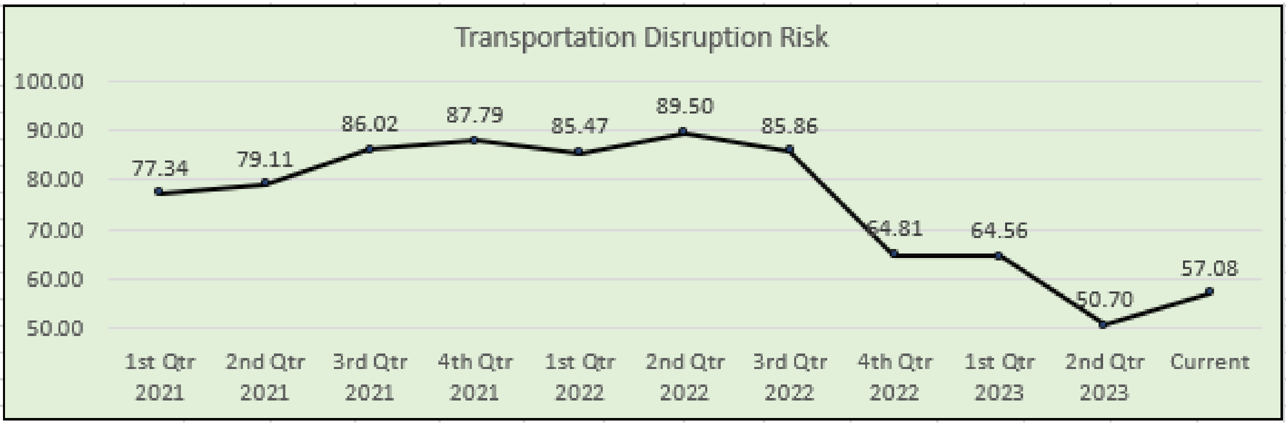


08 Transportation Disruption Risk

Some examples are: fuel prices, driver shortage, infrastructure and demand volatility.

Selected Comments:

- Slowing economic activity will reduce stress in this area.
- Labor situation with teamsters and ILWU will come to a head in Q3.
- Truckers' expenses continue to increase. Driver pay, cost of equipment, maintenance, fuel prices, insurance, etc. Yet rates are moving back to extreme lows in the last 3 years. Not sustainable for smaller companies with lack of capital and/or cash flow.
- Fraud and double brokering in the transportation space is becoming a national crisis. Fraudulent carriers are registering for MC numbers by the thousands every day and stealing commodifies wages, which forces smaller companies out of business.
- Summer tends to tighten the transportation market and transportation costs increase.
- Raw materials and subassemblies shipped from foreign countries, especially China, are at greater practical (transportation system) and political risk.
- Transportation risk from Asian suppliers to the US has gotten much better since COVID.
- Constant battle to secure short(er)-term leases/partnership agreements as many major transportation suppliers are in longer-term deals with companies in the retail space.
- The crash of freight rates is a problem growing on the horizon, as there may be issues for many carriers to be able to make cash flow and stay in business.
- Ukraine has been dominating fuel prices and supply. Europe is largely dependent on Russa for fuel, and shortages from the Middle East and other sources may be stretched. As other parts of the world demand fuel, the availability for US may be strained, unless produced here. Containers from China and elsewhere may be somewhat of an issue as time goes on and US / China relations are strained.

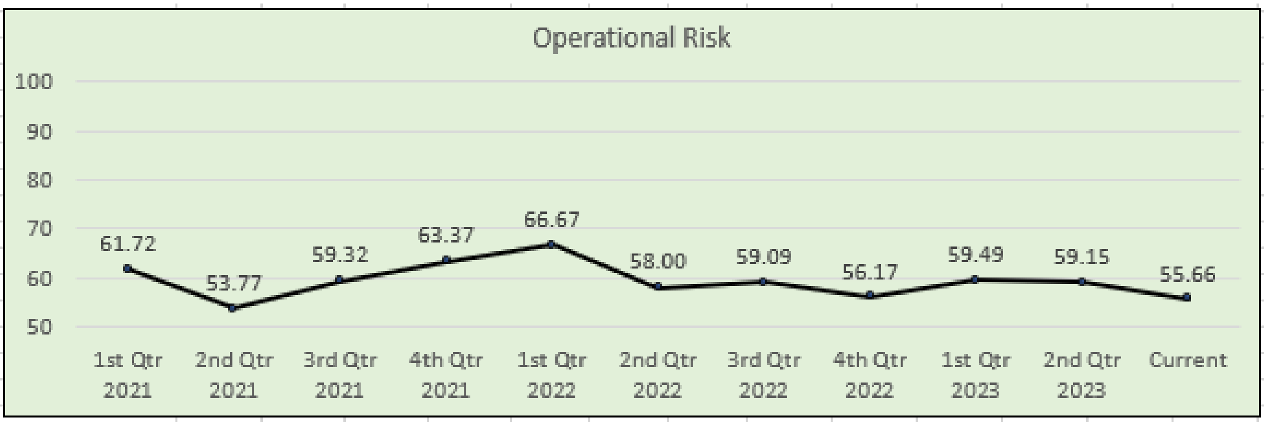


09 Operational Risk

Some examples are: site disasters, product counterfeiting, damage or disruption to physical assets and machine breakdown.

Selected Comments:

- Qualified labor availability to adapt to technology advances.
- All signs point to recession. Significant decline in international shipping. Continued lack of demand for trucking, leading to smaller owner operators being forced to close their doors.
- Double brokering of US TL Freight. Load Phishing of brokered truckload freight.
- Improvement in the global logistics markets have added capacity and made transportation easier and less risky.
- Heading into Peak Season.
- Uncertainty in economics and consumer behavior has increased risks in competitive activities and supply.
- We are still impacted by COVID-related problems with UPS and FedEx.
- Site disasters create operational risk. The chance of a significant disruption of supply chain logistics actually has decreased, but should an untoward event occur there would be an increase in disruption. This is a downside to consolidation.
- Product counterfeiting is always a problem. As supply falls, the chance of ""knock offs"" increases.
- Machine breakdowns are a constant issue, although some parts are becoming easier to get than they have been over the last several months.
- Increasingly, we have seen stabilization in this area.
- We will continue to grow in emerging markets in both the automotive and energy sectors. Infrastructure to support said growth is likely not at sustainable levels, thus requiring more resources and increasing failure modes.

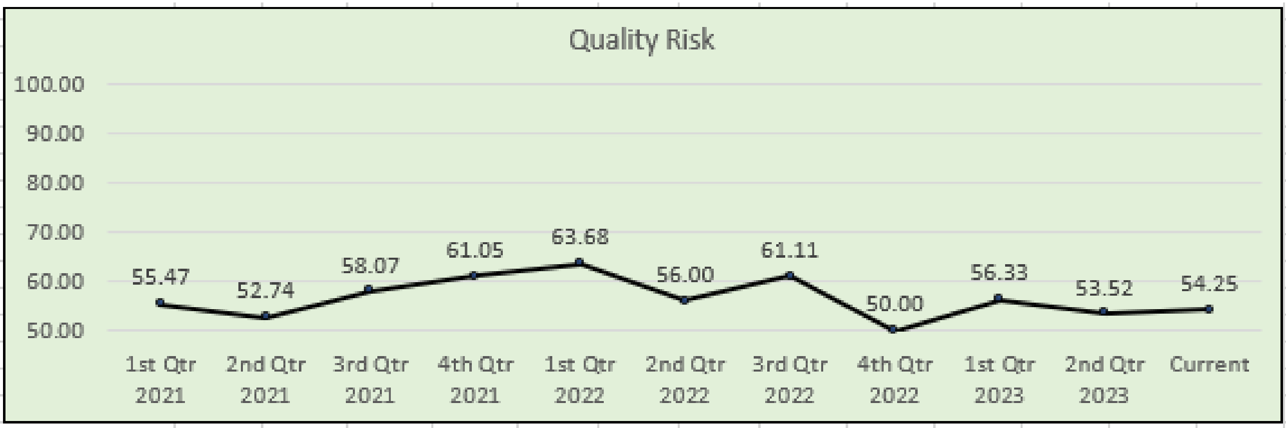


10 Quality Risk

Some examples are: lack of sufficient quality testing, changing quality standards, informal quality control documentation, customer safety issues and product recalls.

Selected Comments:

- Complication of product design provides a potential issue.
- With buying behavior down, companies must focus on quality to set themselves apart.
- Bad quality due to bad raw materials.
- The software/Tech sector seems complacent and happy about releases of product under the heading of agile development that aren't completely vetted and reliability tested. As such, we wind up with weekly updates to software. As it pertains to apps and computer programs, it's annoying. As it pertains to things AI, it's dangerous, and increases risk.
- Customers are trying to cut corners with regards to safety-won't hire needed staff.
- We are changing the system mechanically and within our WMS.
- We are rolling out a new product. Our core quality team will be focusing on the new product, and the quality of our legacy product could potentially suffer.
- Component quality has remained at a consistent level for our clients.
- New products and tech will lead to higher barriers to clear as it relates to quality. Additionally, those leaders specifically assigned to quality will need to deal with the ebbs and flows that come with growth.
- Quality hit a low during COVID with having to find emergency replacements of primary vendors, but is once again stabilizing.
- Very tied into supply chain from China. Quality and supply interruption based on Chinese government industrial park shutdowns for inspection. Taiwan will be a major issue if China invades.



Appendix A
Risk Index Summary

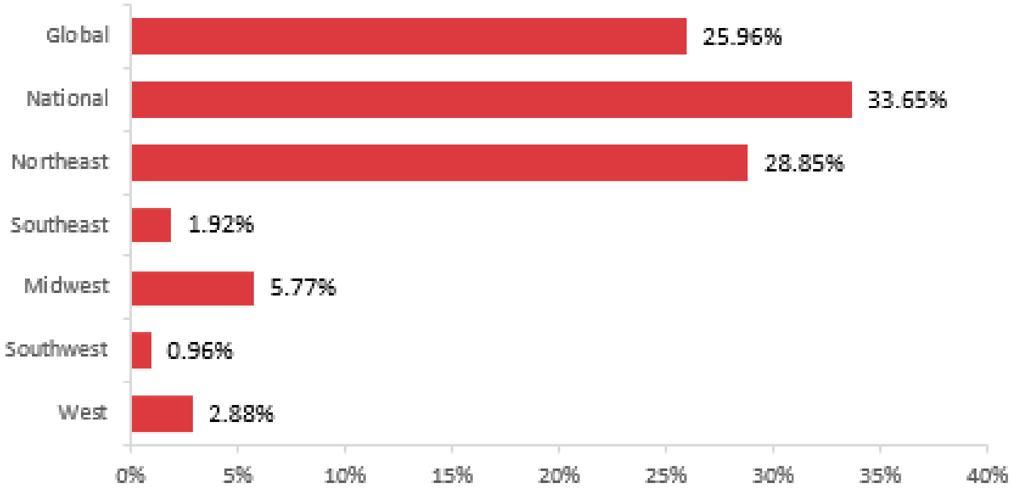
The Risk Index is a number between 0 – 100.
Risk Index ≤ 49 suggests less risk
Risk Index = 50 indicates no change in risk
Risk Index ≥ 51 suggests greater risk

The further the number is from 50 greater the level of risk.
LBRI = (P1 * 1) + (P2 * 0.5) + (P3 * 0)
P1 = percentage of answers reporting an improvement
P2 = percentage of answers reporting no change
P3 = percentage of answers reporting a deterioration

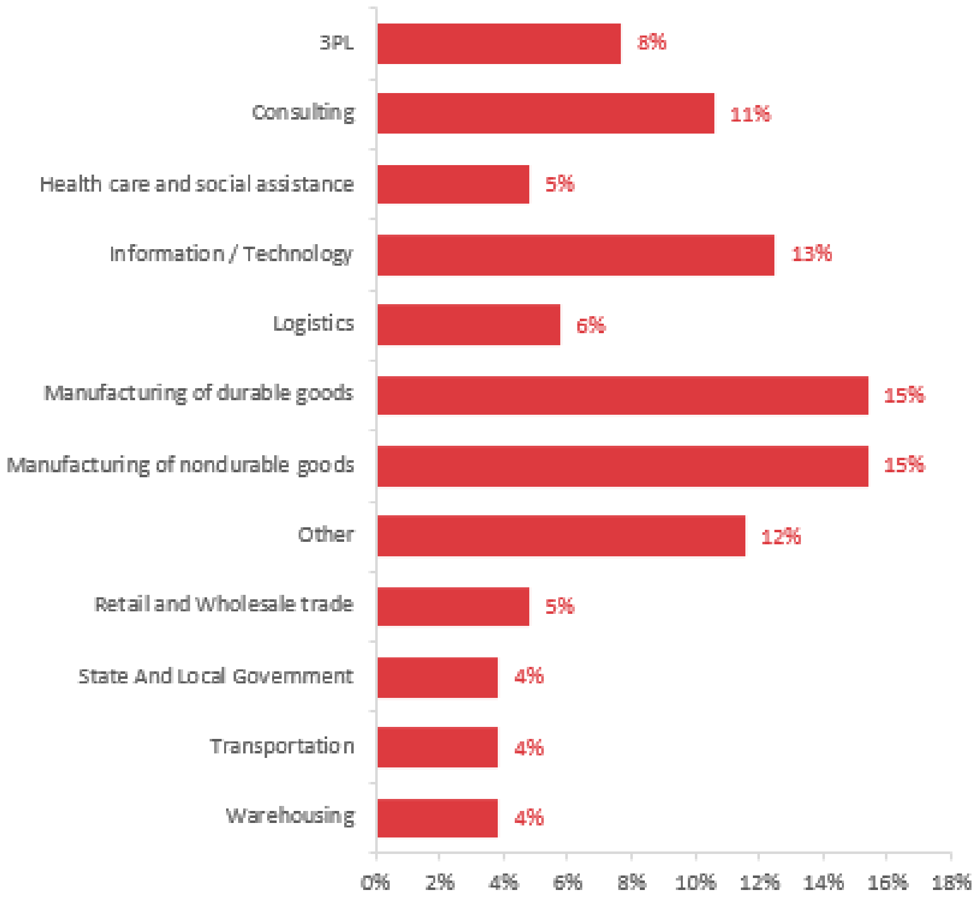
Appendix B

Survey Demographics

US Region

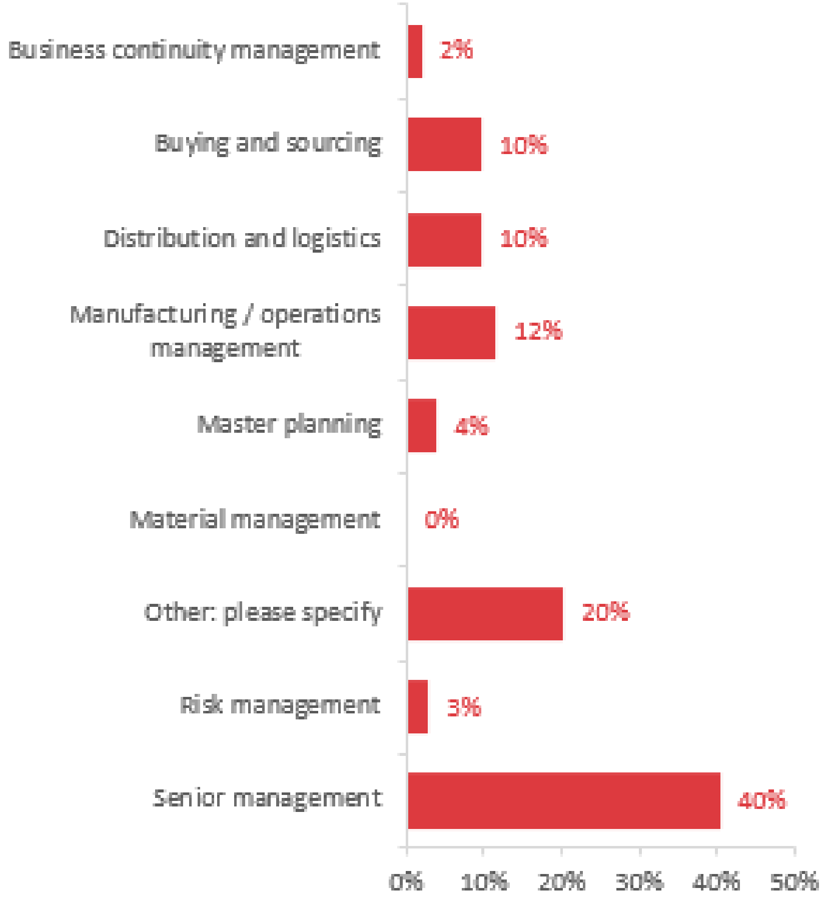


Industry

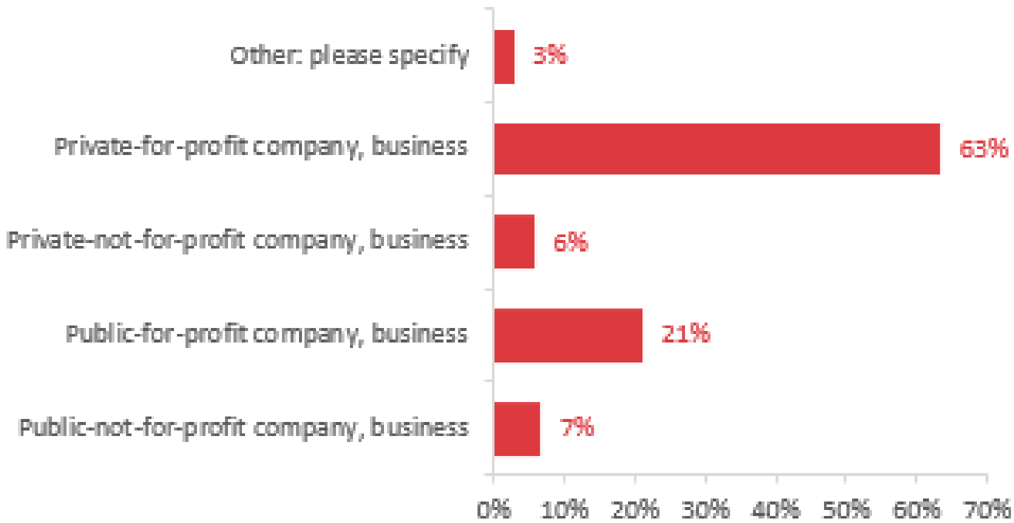


Appendix B
Demographics (continued)

Primary Role



Place of Employment



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Appendix B

Demographics (continued)