Lehigh Business Supply Chain Risk Management Index

Quarterly Report

1st 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 developed this index to better understand the different kinds of supply chain risks businesses face. **Supply chain professionals rated the likelihood that the risk in the 1st Quarter of 2023 compared to the risk in the 4th Quarter 2022 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 1st Quarter is 66.96 which is an increase from the 4th quarter suggesting a higher level of risk in the 1st 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.

SUPPLY CHAIN RISK INDEX™ LEHIGH + CSCMP

Executive Summary

Economic Risk and Cybersecurity are again the two highest risks in the 1st Quarter of 2023, the same as the previous quarter. This suggests supply chain professionals are again worried about the economy with increasing energy costs, labor shortages as well as cyber-attacks and data corruption. Interestingly, Government Intervention which was ranked 3rd last quarter has dropped significantly in risk, so there is less worry about new regulations, while Customer Risk and Supplier Risk increased from last quarter. The average risk index increased only slightly in this quarter compared to the last quarter.

Risk Type	4th Quarter 2022 Risk Index	1st Quarter 2023 Risk Index	Trend
Economic Risk	84.38	87.97	↑
Cybersecurity and Data Risk	74.38	73.42	↓
Customer Risk	66.88	72.78	↑
Supplier Risk	63.75	69.62	↑
Government Intervention Risk	73.75	68.35	↓
Transportation Disruption Risk	64.81	64.56	↓
Technological or Competitive Risk	58.13	60.13	↑
Operational Risk	56.17	59.49	↑
Environmental Risk	58.13	56.96	↓
Quality Risk	50.00	56.33	↑
Average Risk Index	65.04	66.96	↑

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.

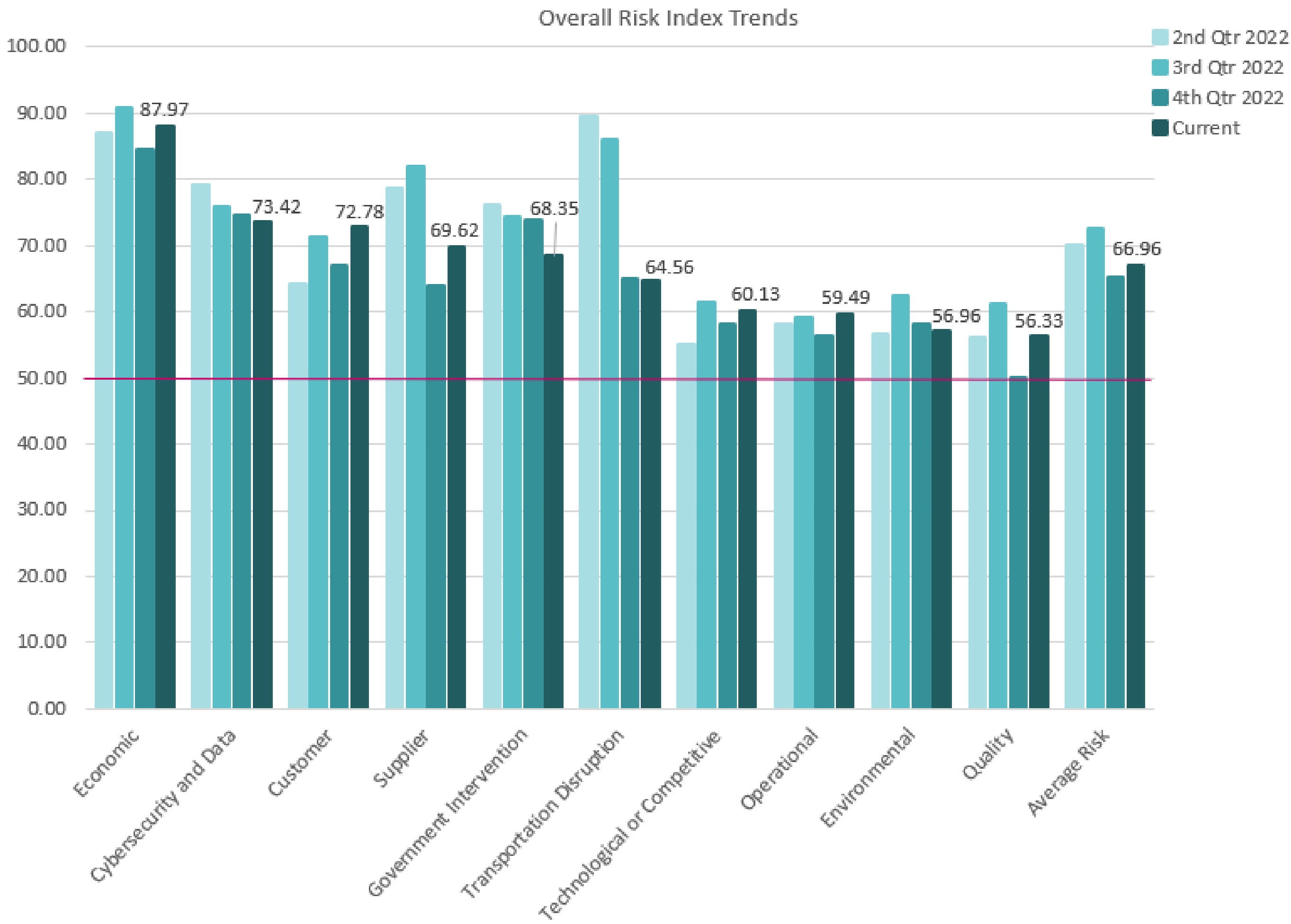
Did You Know?

The Lehigh Business Supply Chain Management Risk Index for the 1st Quarter in 2023 is

66.96

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 1st Quarter 2023

(This enables respondents to compare across all 10 risks simultaneously, instead of one risk at a time as found above, which provides a numerical ranking)

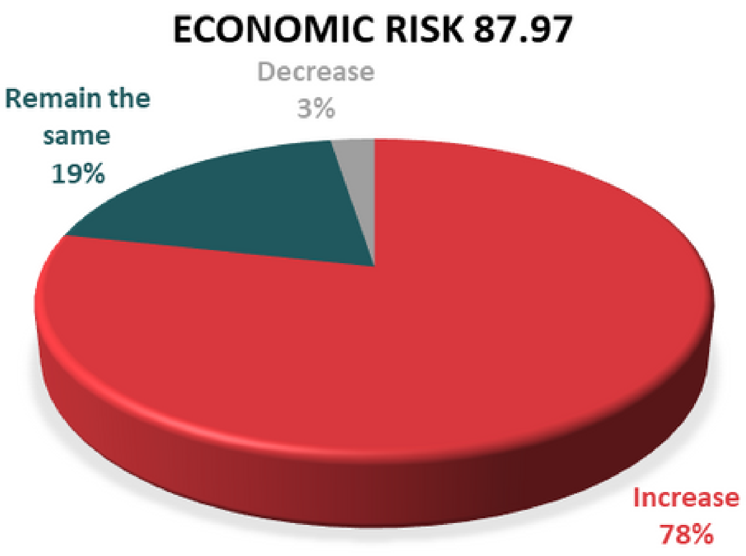
1. Economic Risk
2. Customer Risk
3. Supplier Risk
4. Transportation Disruption Risk

01 Economic Risk

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

Selected Comments:

- Global macro factors like war in Ukraine and oil output are key price drivers and remain at high risk level.
- The inflationary environment will cause a second recession in 2023.
- Increased volume at our plant means a hugely increased demand for labor, which is already a problem.
- Still have shortages at our factories and increasing COGS.
- Shutting down one energy system before its replacement and its infrastructure is in place is irresponsible.
- We see a sudden demand in February/March, and use temporary labor to handle it. Temporary labor is very unreliable.
- Continued inflation in the US. Strength of the US Dollar. European Union and UK facing high inflation, fuel shortages, and little progress against climate change. Economic growth in China slowing down.
- Inflation is crippling and showing signs of slowing but it will not slow enough to make a major impact in the first quarter of 2023.
- Labor shortages will continue to exist across the country, and energy costs will continue to rise.
- Recession will lead to layoffs which could increase the size of the labor pool looking for work. With more supply of labor, labor costs may tighten up. Energy costs have increased, but we are seeing some pricing drop on utilities (electric/gas.) Diesel costs remain high keeping transportation costs ($/mi) high.

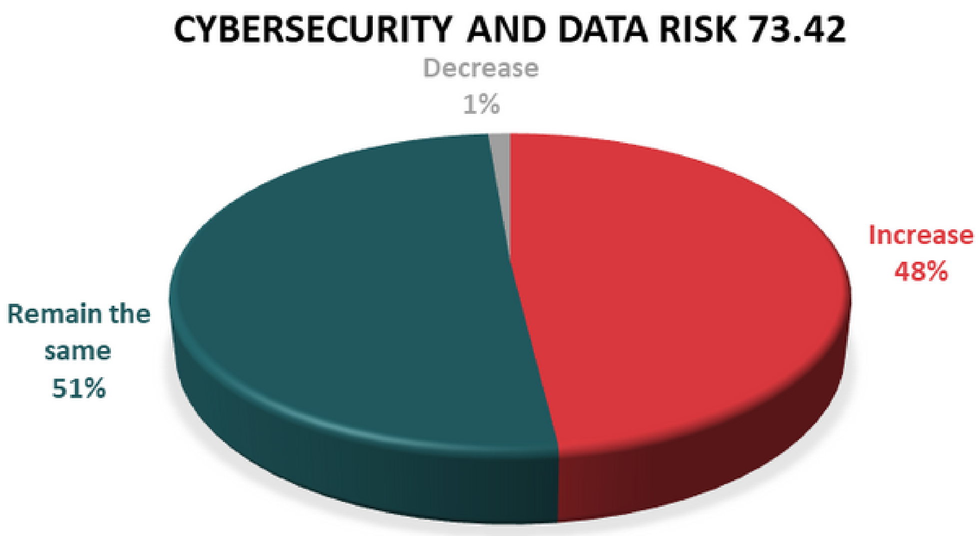


02 Cybersecurity and Data Risk

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

Selected Comments:

- For the past couple of years there were major companies that had been shut down because of it but it did not go public. The next major wave will be very public as that is the leverage the hackers will be pursuing to get their payoffs.
- The war in Ukraine, increased misinformation, and an array of cyber-attacks are combining to increase risk.
- With job reduction and higher turnover, there is higher likelihood that there will loosening of adherence to IT policy opening the door to cyber criminals.
- Cybercrime efforts, participants and methods are constantly changing- cybersecurity must keep pace.
- Always a risk and will always assume it is getting worse not better. We feel we are leading in defending ourselves but this is always a risk.
- We have seen this recently hit the plumbing industry with Uponor and they will be reeling for at least 6 months. With the ease of how this was done and no ability to combat such a risk why would it not continue?
- This will continue to increase and is an ongoing threat.
- FTX collapse, bad press about blockchain, political misinformation, reorganization of Twitter, chaos in the world of infotech.
- Some good measures, such as fake phishing e-mails, orchestrated by the IT department, will train employees to be more vigilant.
- This seems to be a bigger concern each and every day. An affiliate of ours, that we integrate with was hacked over Christmas, 2021. The impact was disastrous and this was despite plenty of security precautions and anti-malware software, etc.



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:

- Inflationary environment will create customer instability, as lower cost solutions are sought.
- Customers are expecting prices to decrease as inflation isn't as high, could cause distrust from customers.
- During covid, capacity was very tight so there was an odd shift to service and reliability being most important (which is extremely rare) ...it has since shifted back to the usual price-centric buying behavior.
- Business changes due to Covid have been a boon to our business industry, so we anticipate greater demand.
- Consumer demands are changing and retailers have the wrong inventory.
- Macroeconomic conditions along with changing consumer and customer demand in our industry make this a high risk to manage.
- Our main customers are big box stores. Consumer behavior in the garden products industry has drastically changed during covid, but in recent months, we have seen "pre-pandemic" type volume.
- Backorders and lack of materials is causing customers to change suppliers more frequently than prior to the pandemic.
- Our customer risk is sitting solely on the impact of inflation and the Fed's motions to combat it. Consumer spend has reduced, and quarterly earnings to Wall Street have been disappointing. Possibility of layoffs, reduced volumes, too much inventory, etc. More and more pressure to find savings and push automation.

04 Supplier Risk

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

Selected Comments:

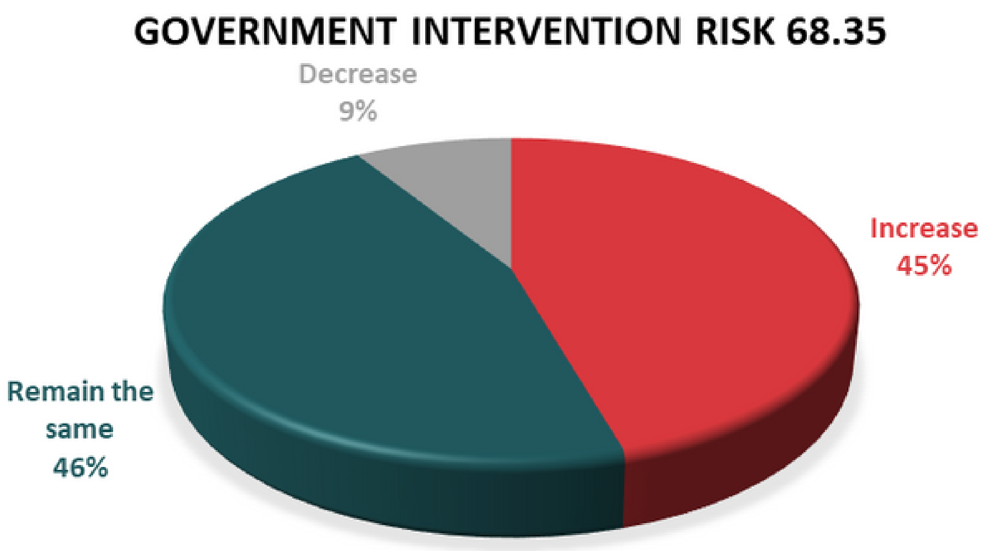
- Without a change in government policy, costs will continue to increase for fuel, food, and shelter.
- Suppliers are having problems staying afloat and there will be more and more who go bankrupt in the coming years.
- Availability of raw materials has improved and all the manufacturers that moved from 'Just In Time' to 'Just In Case' have been overstocked with inventory this past year and still to date, allowing suppliers the ability to catch up a bit.
- China as a single source will be reevaluated, causing shifts in manufacturing location.
- Weakness in general from almost 3 years Covid/Supply Chain Issues/Recession.The supplier base is stressed.More will fail or have problems.Inflation is slowing up but still increasing.
- Increases due to delivery schedules, supplier capacity, etc.
- Continuing price inflation.
- We are going from a single source supplier of exotic metals to dual sourced.
- Disruptions have improved but prices continue to be volatile.
- More products will come available as demand decreased through Q4-2022 into Q1 of 2023.
- Inflation and component part shortages increase.
- Covid has forced us to respond by "not putting all our eggs in one basket." Diversifying suppliers regionally. Sea containers from APac are significantly cheaper than they were a year ago.$2k vs $20k+.

05 Government Intervention Risk

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

Selected Comments:

- Current administration will aggressively impose new regulations.
- The Biden Administration continues to revel in creating new red tape for businesses large and small without concern for whether the rules created actually generate value.
- Who knows what the next great bad idea will be to come out of Washington or for that matter from any political group around the world.
- Some of the independent contractor laws such as AB5 could create enormous supply issues in trucking. While it has only been passed in a few states, it could be detrimental if adopted throughout the country. While I was lobbying against this in DC for our industry, I learned that many lawmakers weren't even aware of the effect it had on trucking.
- The split of Republican (House) and Democrat (Senate) in the USA will reduce intervention in the USA. Intervention in Europe is still possible with privacy and monopoly regulation. China's intervention in markets has been disruptive and decreased the desirability of China as a manufacturing location.
- Environmental related regulatory oversite continues to grow - plastics, PFOAs, circular packaging, etc. China covid policy impact. Ukraine war impact is settling to a "normalcy."
- The idea of "friendshoring" is real and depending on which way the Government moves can determine whether we will have issues or not.
- The ongoing war in the Ukraine with Russia and the looming conflict with China/Taiwan will be a concern for this category.
- Difficult local government has a major factor on location decisions.

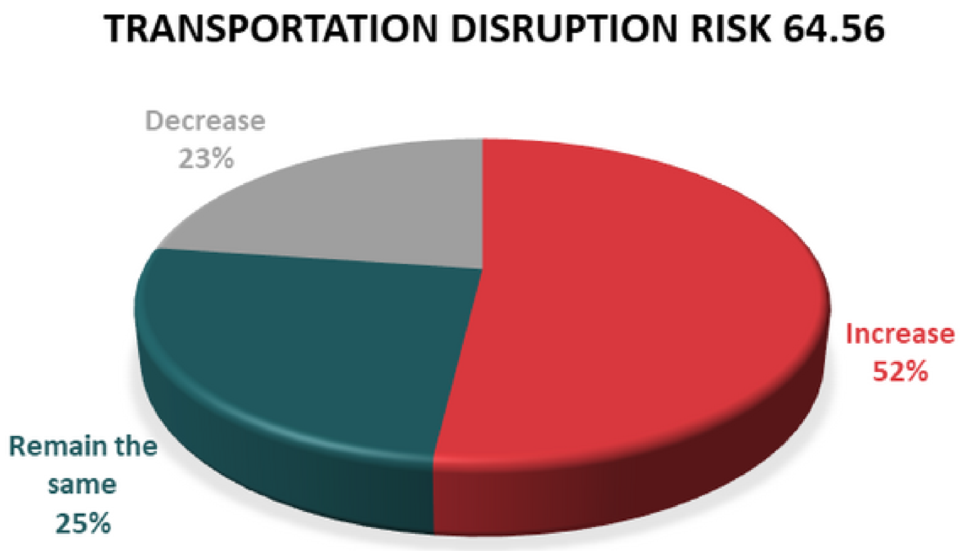


06 Transportation Disruption Risk

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

Selected Comments:

- Diesel fuel inventories remain at record lows, with prices at record highs. The Biden Administration seems to be paralyzed by the green grifters.
- Potential for rising fuel costs.
- Truckers are getting tired of being treated poorly by shippers and receivers.
- Fuel prices, driver shortage, infrastructure and demand volatility are all factors that have been huge issues this year, with no sign of improvement in the short term.
- We foresee supply chain going through a slinky effect for several more quarters, and the war in Ukraine will keep fuel prices volatile for the near future.
- Q4 is our busiest quarter in terms of shipping so we should see some relief in Q1.
- The retail inventory mix is not right and companies must shed inventory and replace it with the correct product mix.
- Fuel, driver shortage and infrastructure are already expanding issues that impact demand as the customer struggles to provide any dependable demand forecasting. The bullwhip effect is alive and well.
- I expect fuel prices to decline.
- I believe that demand on transportation has softened and continue to decrease throughout next year.
- Hard to say with some of the rail challenges, but with Port backlogs reduced/gone, and freight volume balancing across Houston through the east coast, we expect to see it improve.

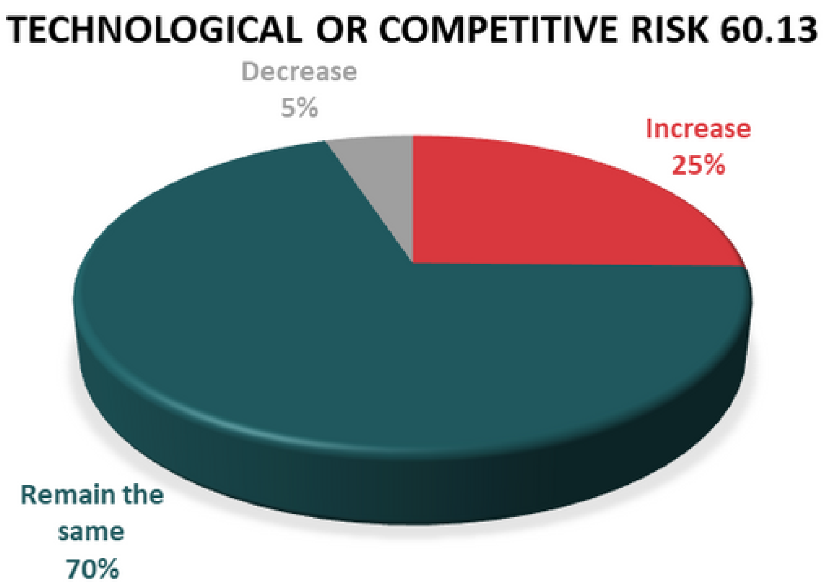


07 Technological or Competitive Risk

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

Selected Comments:

- Given the external challenges, our firms are choosing to stay with what they know and already exists. Safety in performance.
- Technology is an extremely costly necessity which does not bring any return value to the operation. It is a leach on operations cash and just another expense. But it is being mandated more and more if you want to work with a major retailer, Amazon, Shipbob or any other similar platform.
- In the freight brokerage industry, there seems to be a constant increase in the number of new competitors entering the space. Even most trucking companies have started their own brokerages to secure business that they are otherwise unable to cover on their own equipment.
- All companies are spending more to reach a nirvana of digital transformation, a few will obtain a real advantage that starts with the customer experience and ends with better financial performance.
- The government presents the greatest risk to progress here.
- Technology has been a huge focus since COVID - since the workforce has pivoted to wanting to be remote and wanting to have flexible work schedules. 5G technology is in beta testing; EV production is behind schedule but will disrupt transportation industry in 2023 or 2024 if the infrastructure can build-out fast enough.

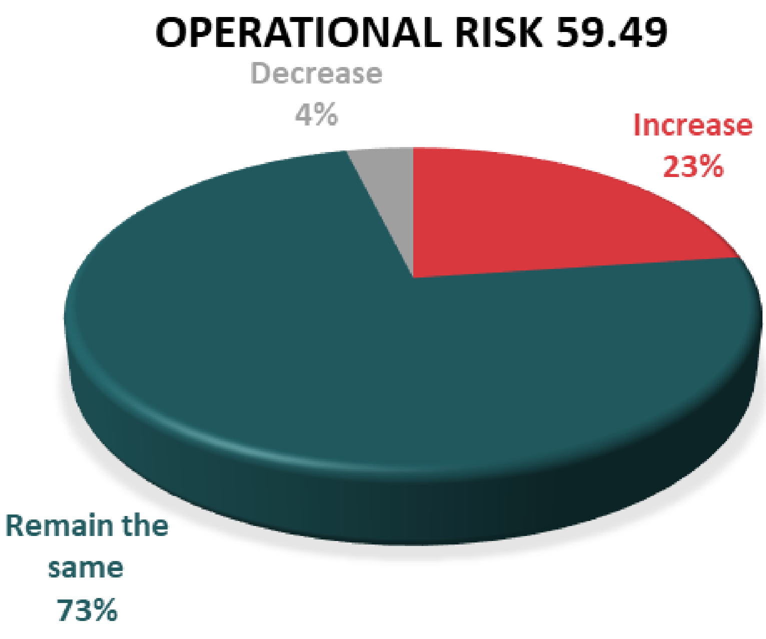


08 Operational Risk

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

Selected Comments:

- Follow on effects of rail disruption.
- We have had plenty of time to shore up our internal capabilities.
- With the uncertainty in society right now it is becoming even more difficult to maintain a stable workforce.
- Poor road conditions, unexpected traffic delays, heavy snowfall create additional work and often times aren't properly understood or accounted for by customers.
- Continue to move out of China as we see China as the highest operational risk due to tariffs and geopolitical issues.
- We need to improve our equipment maintenance program. We have equipment that all of our products require to be running or we will be shut down. Our maintenance is not planned or thought out. We need to be more proactive.
- May be Covid related impact, but difficult to judge at this point.
- Biggest risk is public perception and governmental actions to limit ability to operate. Trip counts on vehicles, lighting controls, etc.
- Our risks include slowed demand but still some "lumps" in supply from APAC to and from our US Ports. Inventory continues to swell in distribution centers with real estate "overflow" options limited due to many markets having <3% vacancy. The Lehigh Valley's 130M feet of industrial warehouse space is considered <1% vacant. Any facilities being advertised are at lease rates considerably higher than we've ever seen before.

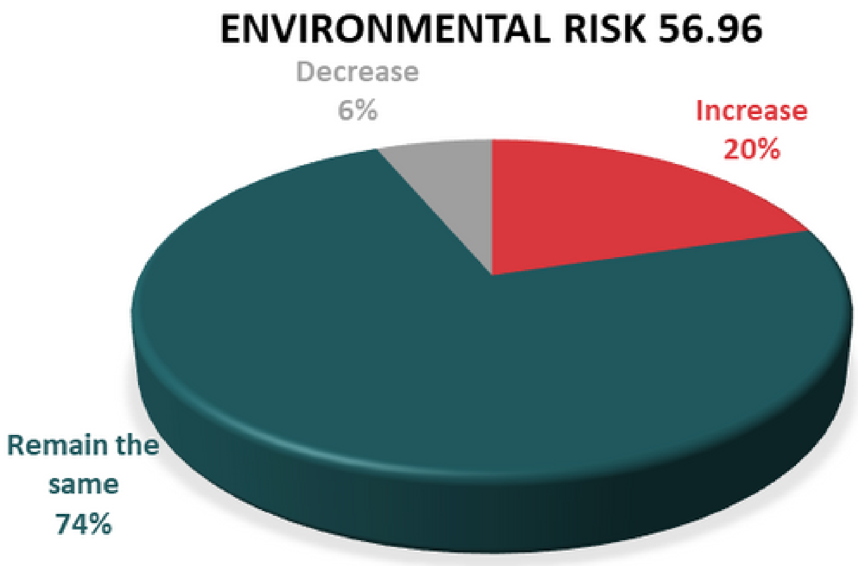


09 Environmental Risk

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

Selected Comments:

- Hard to predict natural disasters and the like, but we know they will happen. Certain areas are better equipped to deal with them than others, but the results become unfortunate to so many.
- Q1 tends to bring more severe weather which impacts transit and operations.
- Global warming is real and causing flooding, risk of widespread destruction, and the shutdown of manufacturing and port facilities.
- We are more concerned with climate change extremism than we are with actual climate change. Hopefully people will stop being duped by the "climate emergency" grift. We need to - and are - making strides toward sustainability. Real changes are being implemented and will take time.
- The only risk to the environment is presented by COP27 and the environment grift. We need to do better to be greener, but it is not the end of the world despite what some gullible, useful idiots might think.
- Winter weather during this period can cause issues in our northern areas, due to ability of labor to reach our warehouses. It can also delay pickups of our orders/delivery of product.
- This risk is always increasing no matter what. Anybody who says their risk is decreasing is either profiting from disaster or lying.
- I think we are more cognizant to environmental risk than we've been in the past. we've looked at our end-to-end supply chain and reduced the fragility of the suppliers, specifically in APAC. Environmentally, we've been focused on government and civilian and organizational pushes to reduce carbon footprints through renewable sources.

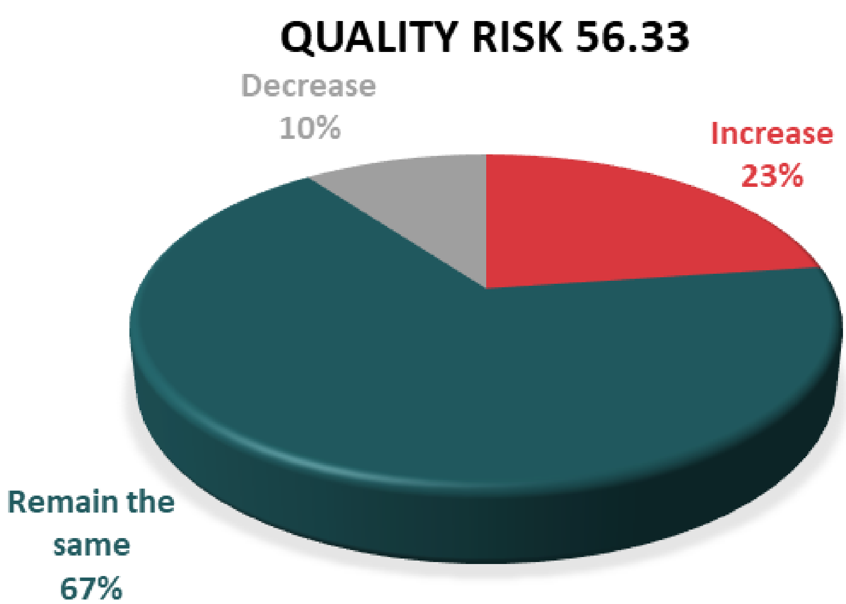


10 Quality Risk

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

Selected Comments:

- The government-fueled inflationary environment may cause some customers to chase lower costs over quality.
- The continued lock downs in China have impacted not only manufacturing but shipping and other logistics. The extension of the conflict between Russia and Ukraine as well as the splatter effect over other European areas has created ripple effects across that continent. Both are just forcing suppliers to make do with what they have available and can get through the system no matter how poor the quality.
- Trucking demand is still declining, which opens up more options and alternatives in terms of carrier choices. It also will continue to drive down pricing.
- Supply chain constraints mean that our vendors are working with new or replacement components/raw materials, which we have concerns over certifying.
- Experienced, trained professionals are at a premium.
- On boarding a lot of new suppliers as we move out of China.
- We are seeing more product recalls than in the past, prior to the pandemic.
- Shortage of quality and trained labor.
- Any time we hold more inventory than optimal or our Days of Supply increases, there is risk of quality errors and shrink. When warehouses fill beyond 85%, there is often extra handling and process exceptions that lead to shrink.



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)

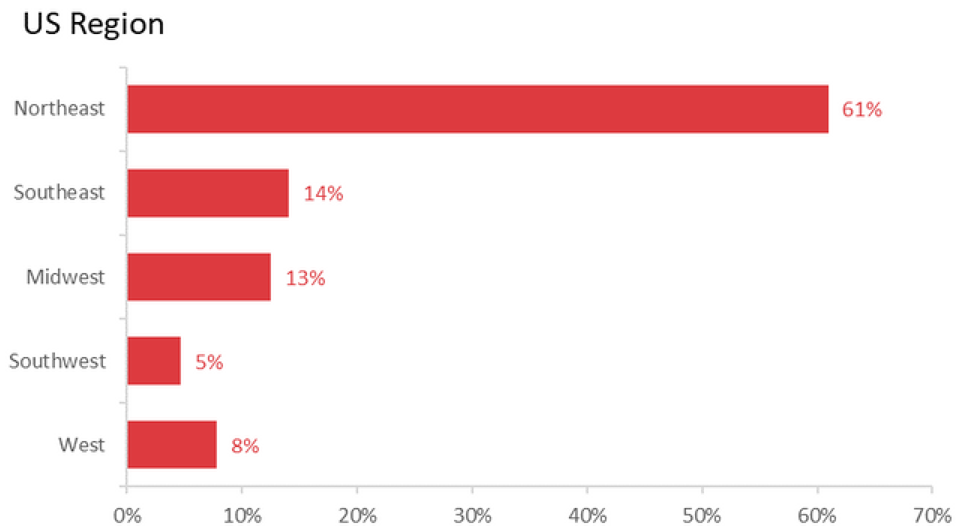
P1 = percentage of answers reporting an improvement

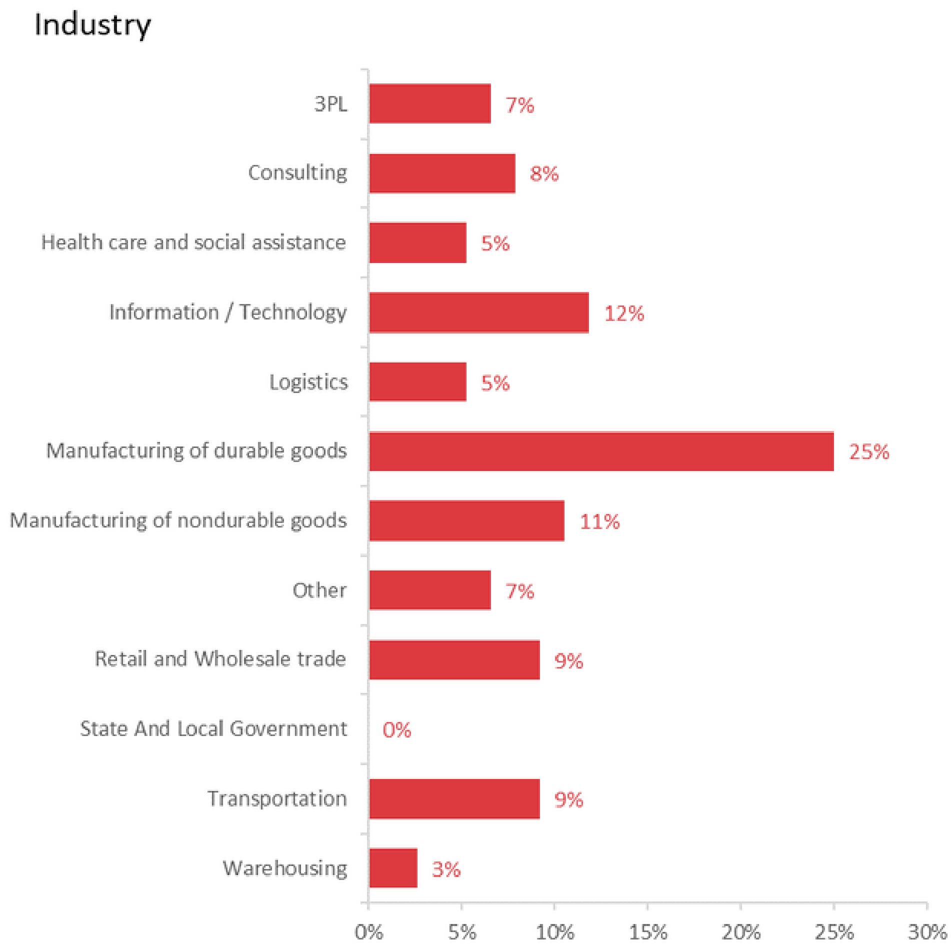
P2 = percentage of answers reporting no change

P3 = percentage of answers reporting a deterioration

Appendix B

Survey Demographics

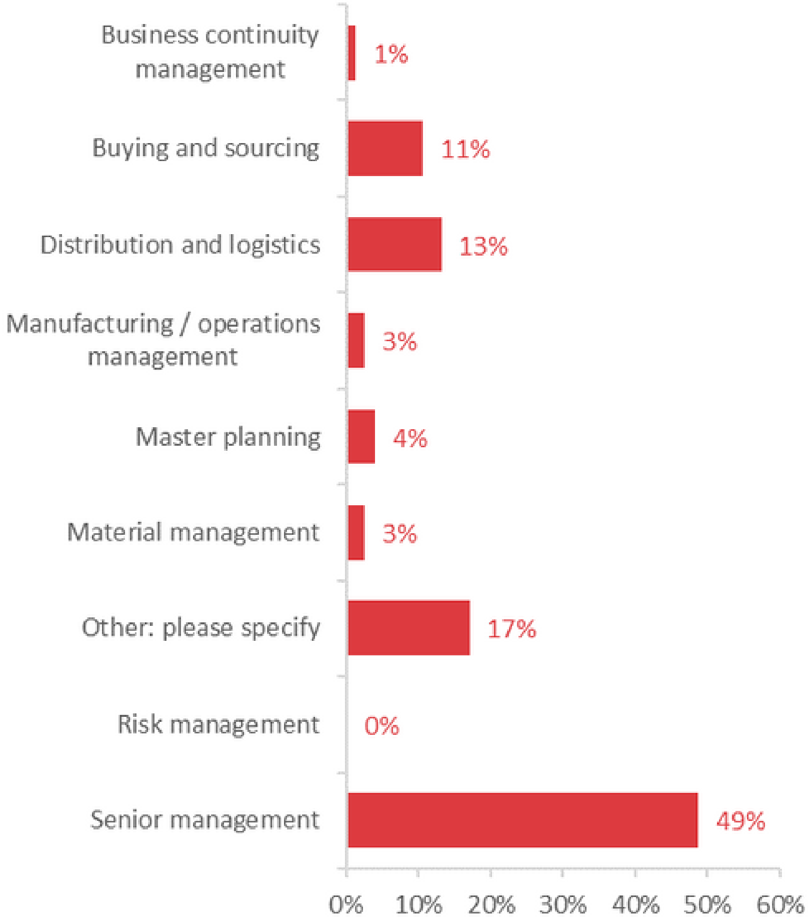




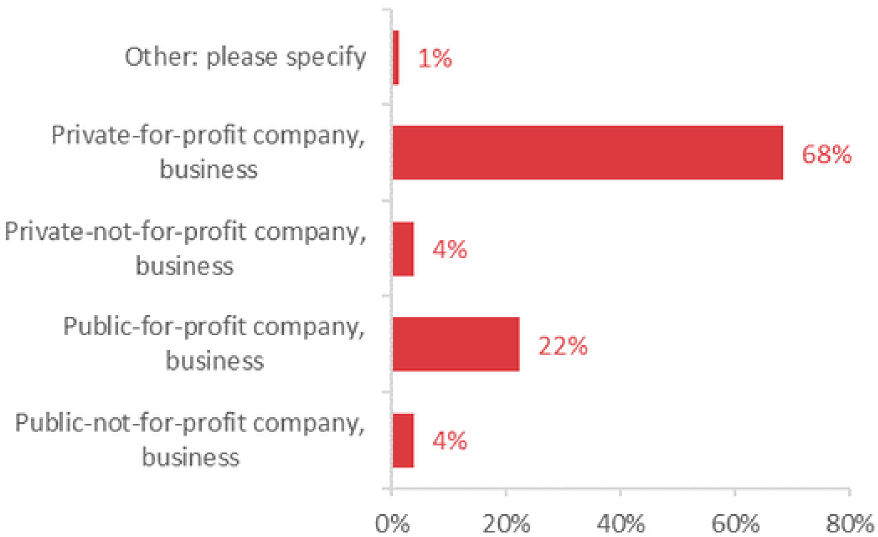
Appendix B

Demographics (continued)

Primary Role



Place of Employment



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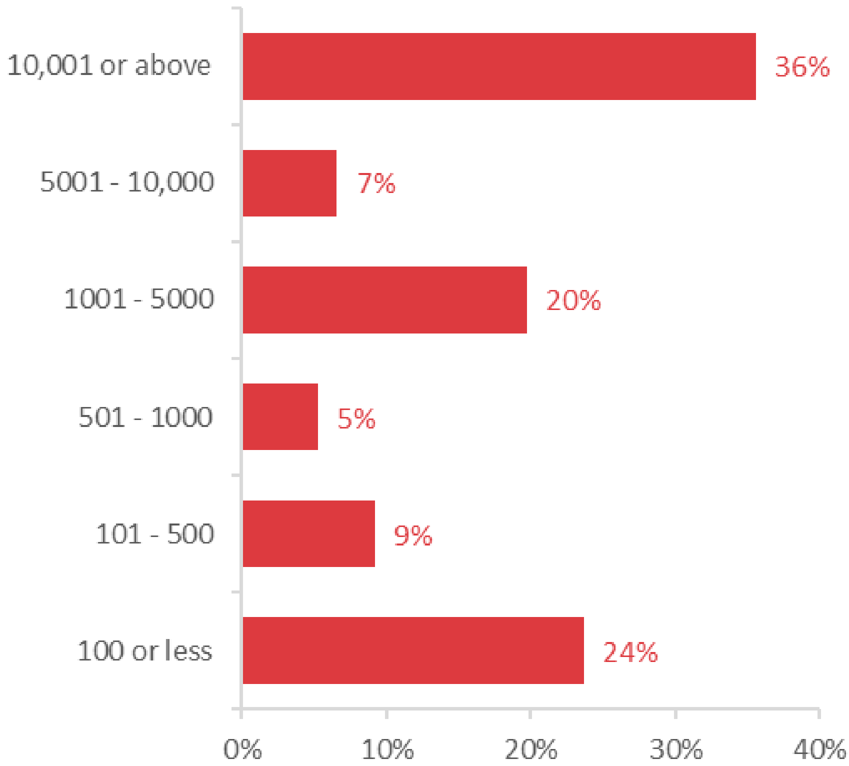
Appendix B

Demographics (continued)

Company Employee Amount



Work Experience