Lehigh Business Supply Chain Risk Management Index

Quarterly Report

4th Quarter / 2022

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 4th Quarter of 2022 compared to the risk in the 3rd 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 4th Quarter is 65.04 which is a decrease from the 3rd quarter suggesting a lower level of risk in the 4th Quarter 2022.**

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

For the first time since the creation of the LRMI in the third quarter of 2020, there has been a reduction in all 10 categories of supply chain risk. In addition, the average risk index of 65.04 is also the lowest it has ever been, suggesting an overall reduction in supply chain risk in the 4th Quarter. Economic risk has dropped significantly from quarter 3 but still has the highest risk index across all risk categories suggesting energy costs, price volatility, and labor shortages are still issues companies face. Transportation Risk and Supplier Risk, the second and third highest risk in Quarter 3, had the highest drop in risk across all risk categories, with almost a 20-point drop suggesting transportation and supplier risk is not as much of an issue as it once was. This drop in Transportation and Supplier Risk has enabled Cybersecurity and Data Risk and Government Intervention Risk to become more of a concern and among the top 3 risks for Quarter 4 in 2022.

Risk Type	3rd Quarter 2022 Risk Index	4th Quarter 2022 Risk Index	Trend
Economic Risk	90.72	84.38	↓
Cybersecurity and Data Risk	75.77	74.38	↓
Government Intervention Risk	74.23	73.75	↓
Customer Risk	71.13	66.88	↓
Transportation Disruption Risk	85.86	64.81	↓
Supplier Risk	81.96	63.75	↓
Technological or Competitive Risk	61.34	58.13	↓
Environmental Risk	62.37	58.13	↓
Operational Risk	59.09	56.17	↓
Quality Risk	61.11	50.00	↓
Average Risk Index	72.36	65.04	↓

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.

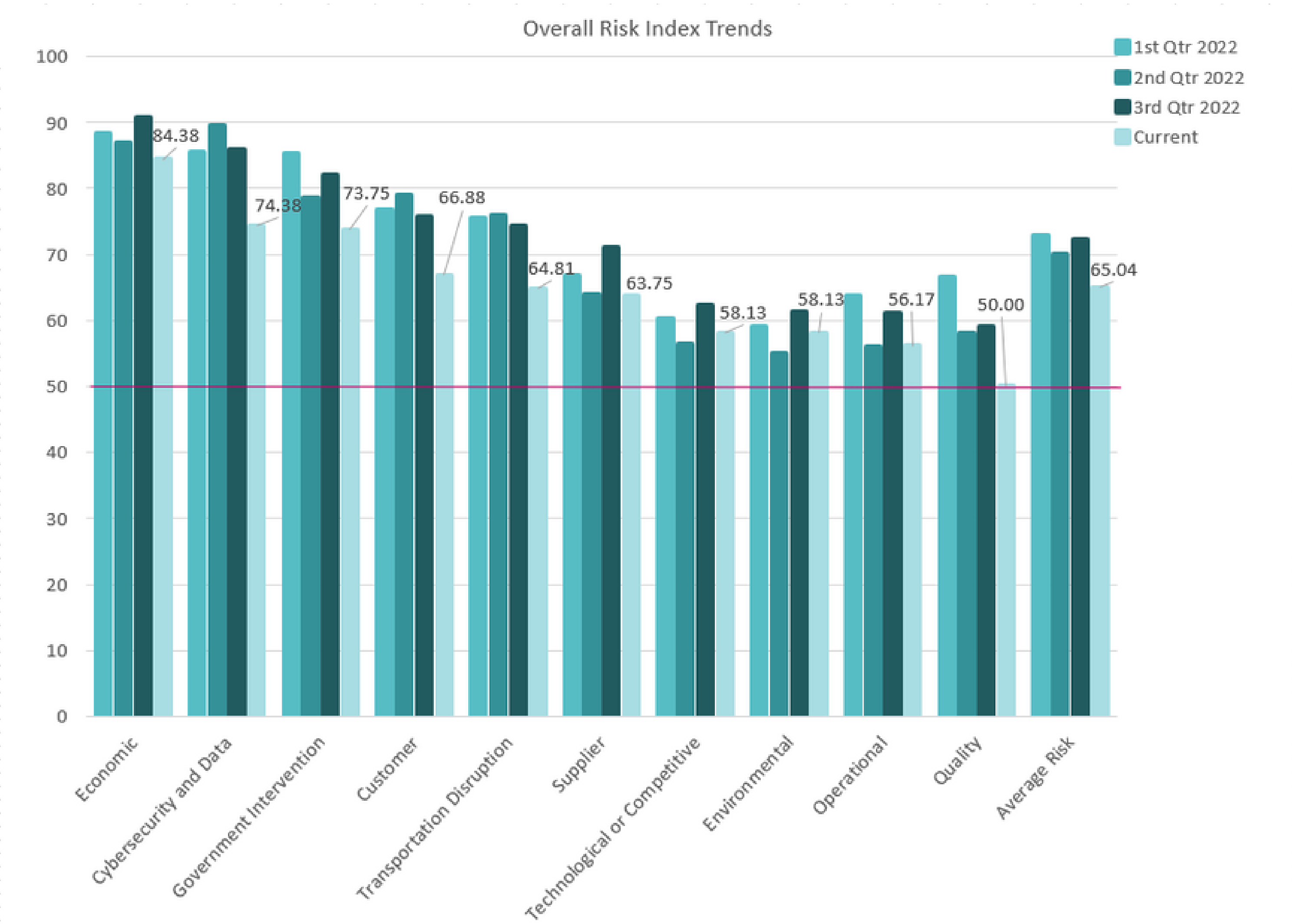
Did You Know?

The Lehigh Business Supply Chain Management Risk Index for the 4th Quarter in 2022 is

65.04

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 4th Quarter 2022

(When comparing across all 10 risks.)

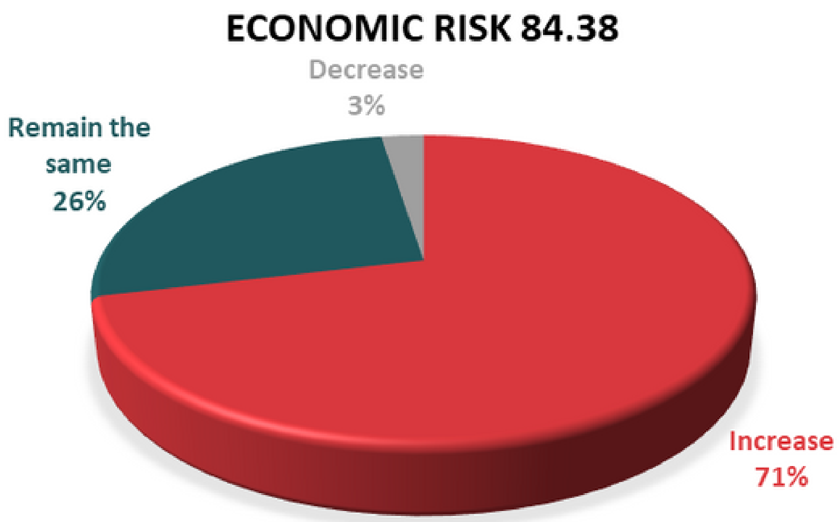
1. Economic Risk
2. Government Intervention Risk
3. Cyber-security and Data Risk
4. Transportation Disruption Risk

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:

- Commodity price volatility is driving the sudden inflation that thins profitability as each company absorbs some of it and not necessarily forwarding them all to their customers.
- It is not easy to find a new employee with the right skills and fit right now. Wages causes a lot of people to hop jobs. The wage increase of continued employment from 2021 to 2022 was about 3-4%, whereas job hoppers increased their wages as high as 12% from 2021 to 2022. Another issue in labor shortage is the skilled labor. This country had shipped many jobs overseas resulting the loss of skilled labor. With the pandemic, many of the skilled workers took early retirement, resulting the labor shortage. Improving the quality of education up to 12th grade should prepare individuals for real life world, but this would take a long time to see the results.
- Inflation, food and energy costs related to massive government spending is damaging the American family.
- The industry has settled from COVID times and seems to be as close to "steady".
- Energy costs will continue to go up due to misguided "green" initiatives that seem to pollute and cost more than standard solutions. Sustainability is imperative; but political shell games are tanking our economy.
- Remain at high level while global inflation remains very high and war in Ukraine and other issues weigh on global economies.
- We are a seasonal business so the 4th quarter is always poor compared to the 2nd and 3rd. Demand always goes down about 25-35%.
- Labor shortages are likely to impact productivity.

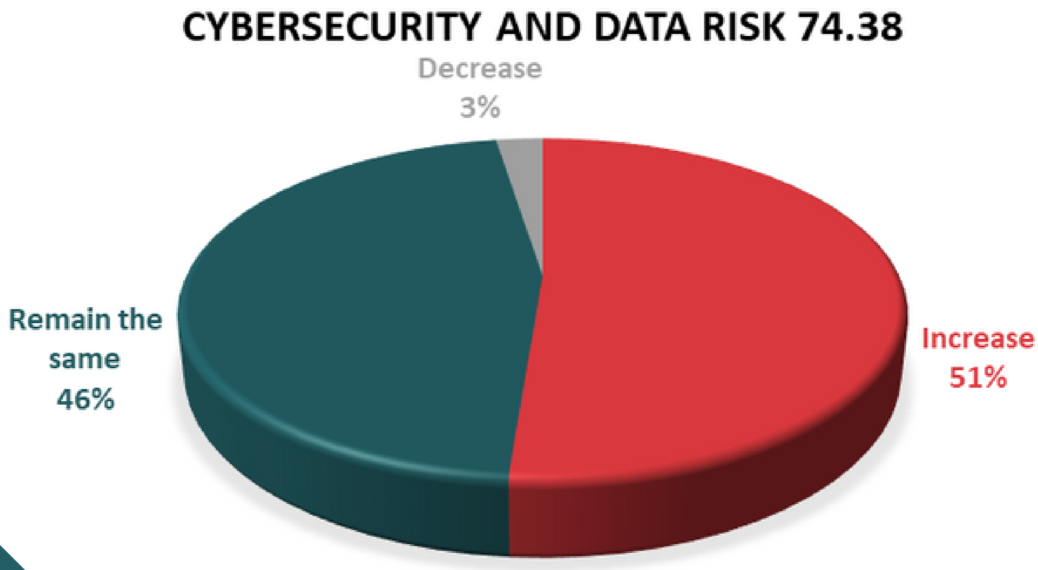


02 Cybersecurity and Data Risk

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

Selected Comments:

- Enhancement and sophistication of attacks on data and operations will increase risk.
- Requires more periodical cyber literacy training of employees to mitigate the risks as well as strengthening the hardware side setup is needed.
- Hackers are constantly coming up with new and creative ways to beat the system. Shame is that their knowledge could be used for the greater good.
- We have a team working on migration and short & long term security needs, so we should stay flat here.
- This is a quiet hidden problem that many companies do not talk about. It has happened to numerous organizations however they do not want their clients or suppliers to know because it questions all the electronic interchanges.
- Desperate state actors and election cycle (domestic) activities represent a discernible risk to our SaaS platforms & internal data in Q4.
- Hacks at our SC partners continue to get worse.
- Data theft, ransomware, and deep fake crimes remain a concern that will likely grow in the future.
- World instability is increasing cybersecurity risk.
- More sophisticated bad actors with limited counter resources.
- I'd like to say decrease but the threat of a new attack remains very real.
- Transit agencies such as mine are already facing this.
- There's a trade-off with cybersecurity and data breach risks because of the increased usage of cash. Cash saves money in some categories, and costs money in other categories.

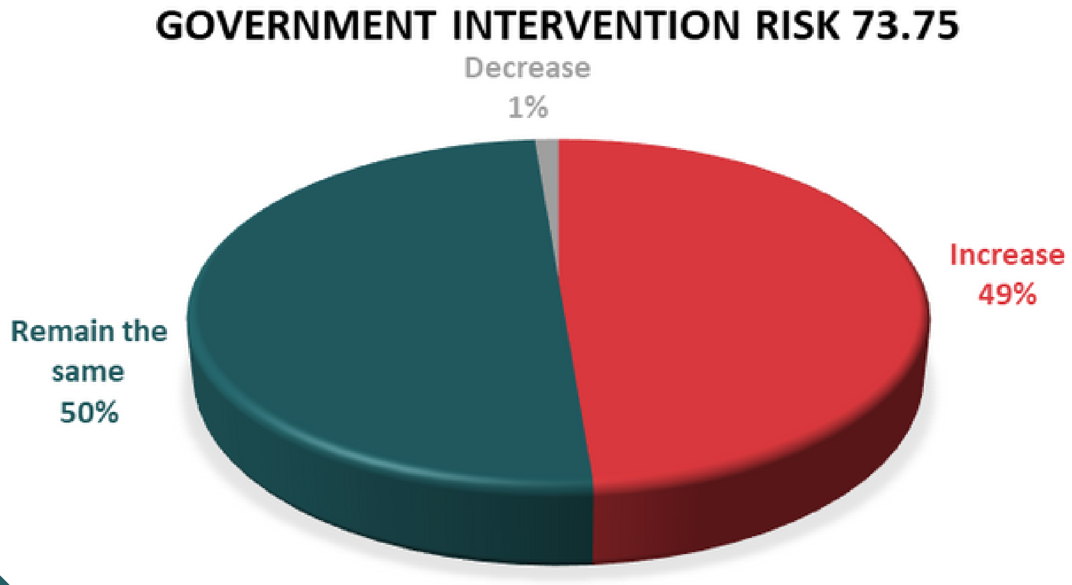


03 Government Intervention Risk

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

Selected Comments:

- Different administration imposing different regulations and tariffs. In the previous administration, they decided to impose additional tariff on imported steel, which was unfairly ruled on some of the more expensive steels too. The cost was also forwarded to tier 1s and OEMs. The tariff was lifted for EU last year with annual limit, and Japan is still in talk but not fully lifted.
- Current administration's absence of business experience and accountability is dangerous for America.
- Government implementing 'AB 5' gig worker law has thrown the legal status of 70,000 truckers into jeopardy, possibly imperiling the supply chain. Related to independent contractor status, two-thirds of California's port truckers could be forced off road, adding to the congestion of the largest ports in the US.
- Drug pricing pressure from Biden administration as a means to fight inflation.
- EPA regulations directly impact what we can, and cannot buy and sell. Open bills on environmental controls will determine our business strategy for the next years to come.
- Trend of improved, more stable government trade continues overall. Future risk of continued friction with China though.
- More restrictions on all things coming from China has injected a lot of risk into our supply chain. While we need to move away from China, it just takes time.
- Shifting governmental landscape. International chaos especially in the U.K.



04 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:

- Planning manufacturing has become increasingly more difficult in the past few years after OEMs started to struggle with semiconductor shortages. They suddenly change or cancel their release schedules, and the suppliers are left with too much inventory on hand. Ocean freight and intermodal transportation issues adds more problems to this. Dealing with tier 1 customers is even harder because they are also left with too much inventory with sudden production changes by OEMs. Too much inventory with less sales causes poor cash flow, causing customer payment delays as well. Customer payment has become more inconsistent in the past year.
- Customer pressure to contain costs will lead to volatility to maintain existing relationships. Customer base may be chasing unicorns with low-cost approach in the logistics industry.
- Turnover of decision makers is constant...causing long term customer relationships to be set aside for reasons such as cost control (rather than proven reliability).
- As inflation increases consumers have to make choices on what they are going to spend their money on.
- Not everyone is accepting price increases.
- We have taken a large part of the market as our competitor has closed. As a result, our foot traffic and business have increased, so customers have nowhere else to go.
- Inflationary pressure with customers.

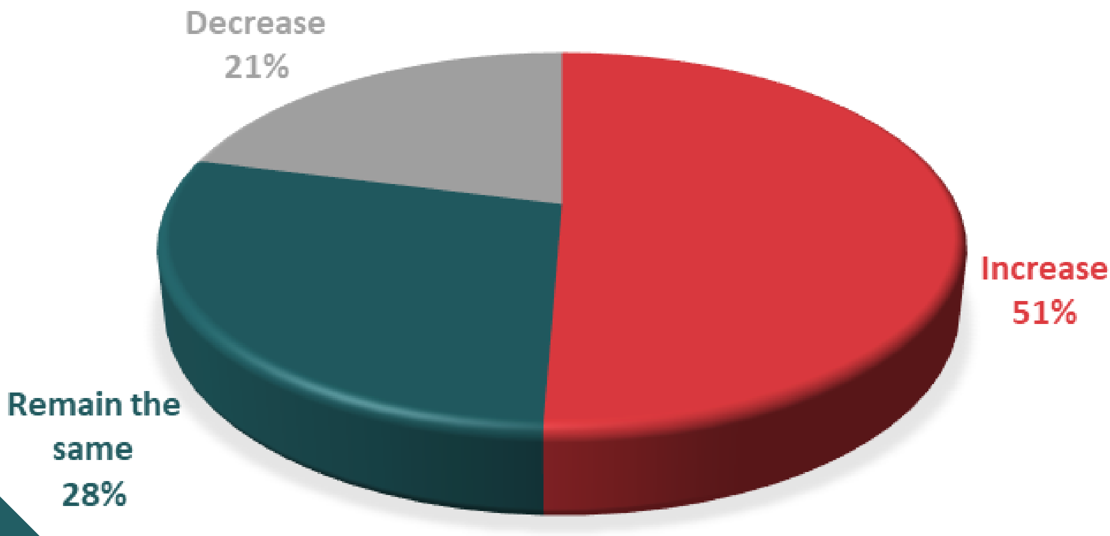
05 Transportation Disruption Risk

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

Selected Comments:

- Ocean freight and intermodal transportation will continue to be disrupted until the first half of 2023. Record high import volume causing imbalance between import and export in the U.S. is causing issues with ocean freight transportation worldwide. Needs to find ways to produce domestically and sustainably where possible, and improve the cost structure so the American consumers can consume made in the U.S.A. products.
- Fuel prices remain a serious concern, given the Biden Administration's foolish and not well thought out Energy policy.Federal, State, and Local governments are functionally bankrupt, so much needed improvements in road networks will suffer.
- Fuel prices will likely remain high, demand for trucking has decreased. This is likely due to over ordering during and after the pandemic after experiencing delays and supply chain issues that created hardships on manufacturers. As a result of the drop in demand for trucking, rates have dropped,causing difficulty for owner operator truckers as their fixed costs continue to rise. Many have considered closing their doors which could have long term effects on trucking supply.
- Our outbound partners have stayed steady, and our contracts in a solid state.
- Fuel prices are dropping but cost of freight has minimally been reduced. Fuel surcharges have remained higher as a percentage of freight invoices.
- Demand volatility likely to increase with recessionary pressures.
- Cost, equipment scarcity, and operator scarcity are growing problems.

TRANSPORTATION DISRUPTION RISK 64.81



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:

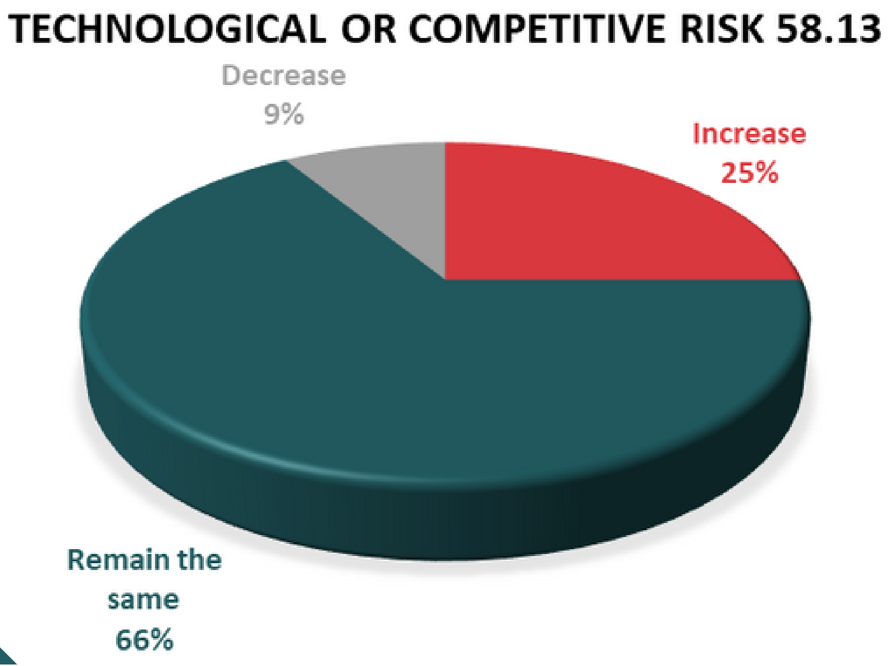
- The management commitment to the business and their take on contingency plans, a must-have skill in business management, appears to be crippling down after the pandemic. People work differently, they do not seem to care as much.
- Automotive suppliers are pressured to lower the prices despite cost of manufacturing increasing. Suppliers are forced to increase the prices but OEMs and tier 1s refuse to pay the increase even if it is added as surcharges and they're putting the suppliers' businesses at financial risk.
- Remains very difficult to obtain needed equipment to support growth.
- Supply chain issues are starting to ease and products are becoming more available with shorter lead times. Still not back to normal but Q4 should experience some improvement.
- Challenges faced in the heat of the pandemic have subsided to some extent.
- May suppliers are catching up on open POs.
- Suppliers have started to be gobbled up by larger companies or just closing.
- Global supply chain appears to be improving.
- Nearshoring and moving out of China have been good decisions for us.
- Port, receiving congestion issues do not appear to be improving.
- Wholesale inventory is filling up. The availability of most products is good.
- Lead time for product and changing delivery dates, while they are not good, they seemed to have stopped getting worse each week.
- Supply chain problems with suppliers are continuing and/or increasing in scope.

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:

- There has been little discussion as to how the Internet per se and new database technologies will affect supply chain development and management overall?
- My company competes with other logistics companies (which there is no shortage of), and also competes directly with trucking companies (who we essentially use as our vendors). Tons of competition, but standing on our service and communication to set us apart is vital. Providing visibility and easy to use software capabilities to customers is essential and becoming the new norm in logistics.
- EPA regulations continue to be a challenge for our industry.
- Technology is an empty bucket of cost. You spend money time and time again on it but does it ever really pay off. So many companies (AMAZON, Walmart, Target, etc.) are dictating technology which adds costs to the vendors. These costs are empty costs which just strip money off the top of margins from so many levels.
- We are ahead of peer CPGs for new product introduction that anticipates revisions to form of products in changing environment.
- New national firms are moving into the RI healthcare region and disrupting the market.
- Risks from overseas, i.e. China.
- Technology is technology, people/customers are craving human attention, touch, and genuine connection.

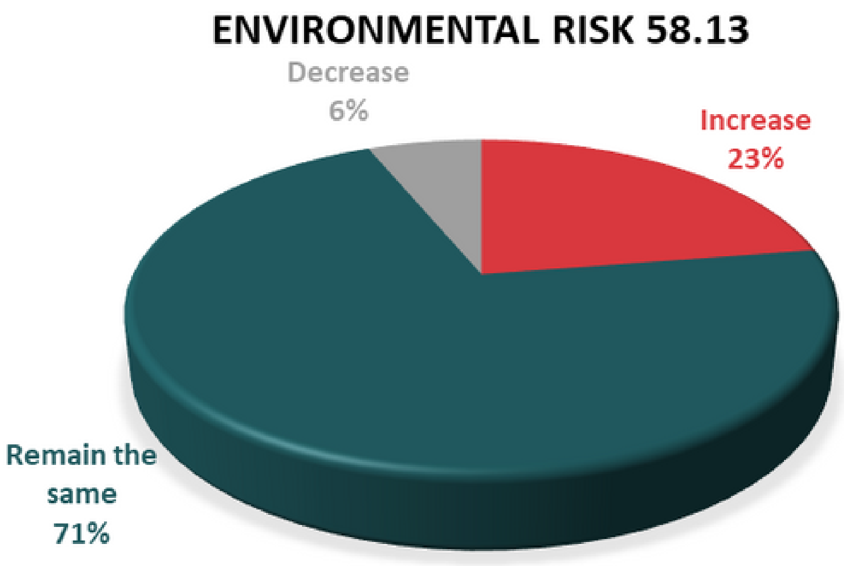


08 Environmental Risk

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

Selected Comments:

- Climate change is rarely discussed, but should be!
- Government leaders lack credibility around a serious Climate change strategy. John Kerry quoted in WSJ stating "Climate change reduces inflation," is not credible, or the work of an Administration serious about real solutions.
- Unpredictable, however a natural disaster could have a larger, more negative effect on our country now more than ever.
- People are concerned about extreme weather but the reality recently is that normal weather has had substantial impacts. If the north East were to get hit with some of the larger typical storms of previous years it would shut down the NE United States A localized storm of 1 inch of rain today has huge impacts. Imagine if we got those storms of 5 inches, 10 inches or even the 22 inches of rain fall.
- We chose to take action to harden against weather problems. Competitors who are screaming for more regulation in hopes of just avoiding the inevitable are already starting to have problems. We worry about risks and disruptions from more costly, worthless regulation in the name of fighting "climate change."
- Remain elevated as global warming drives more extreme weather/ floods/ droughts / etc.

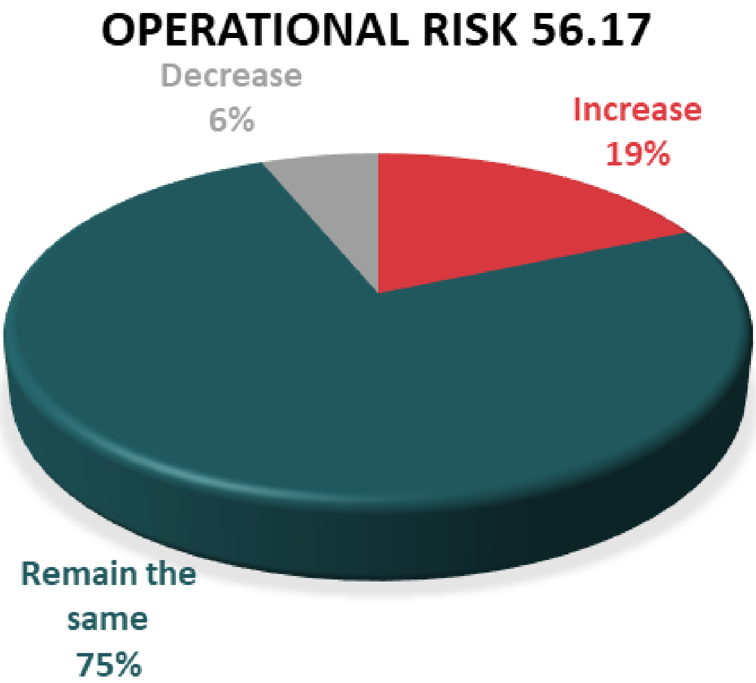


09 Operational Risk

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

Selected Comments:

- Manpower and spare parts are increasing difficult to find.
- We are expanding our building and are mid-construction. There will be great amounts of downtime for the conveyor and standard processing equipment as new pieces are added. This interruption will continue into Q1 of 2023
- It is still hard to get parts for existing machinery. And some of the parts are now coming from secondary markets.
- We are relying upon others for product storage.
- Increased operational risk from China & nationalist activities outside of the USA.
- Maintenance issues continue.
- Inflation is the biggest risk we have right now. Inability to properly project input costs.
- It seems like shippers are scrambling to make changes to their supply chains in an effort to drive savings and add structure to support future disruptions. This activity is adding complexity to existing operations.
- Natural disasters, climate change, Ukraine war, and latent Covid Supply Chain interruptions drive risk in my company's global supply chain.
- In e-commerce industry so risk is due to seasonal elevated throughput with black Friday and Christmas coming up.
- Cyber security threats.
- Less weather risk.
- Prices impact operations and with the combined effects of inflation and supply chain concerns, prices have increased all along the supply chain directly impacting labor.

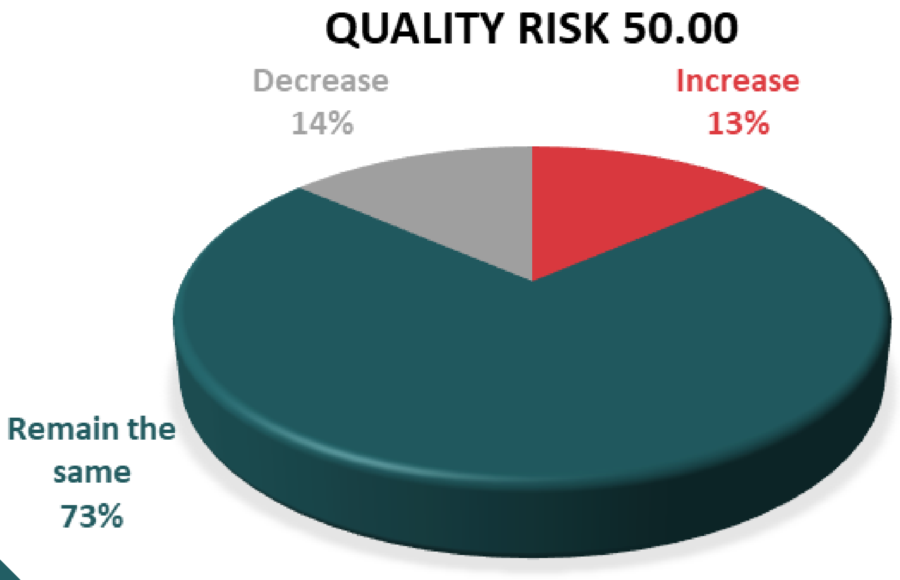


10 Quality Risk

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

Selected Comments:

- Staffing shortages appear to continue to be an issue in logistics. Port congestion continues to be an issue although word is beginning to spread that it may be getting closer to easing up.
- Added management to oversee inbound which should increase our accuracy in receiving the product, resulting in improved outbound quality.
- Many suppliers continue to push out on the edge quality levels. Tier 2 and tier 3 suppliers for components going into end items are closing unexpectedly and also consolidating creating additional issues.
- Introducing a new product line.
- Strain on personnel resources leads to increased quality risk.
- Reduction of quality personnel at companies.
- Actions to close quality risks are successfully done on time through 2022.
- In the e-commerce industry increased throughput with Black Friday and Christmas leads to more focus on getting items out and less focus on quality.
- Challenges with quality levels of ingredient sourcing.



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

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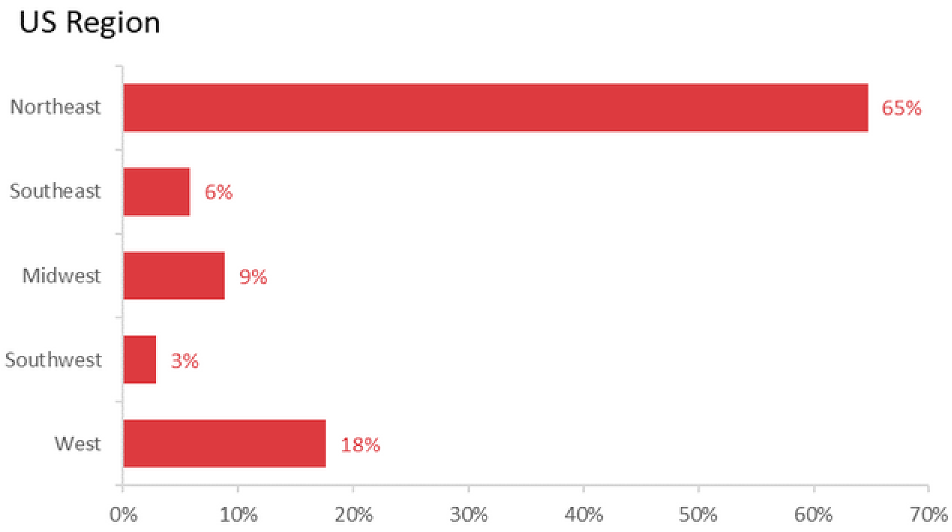
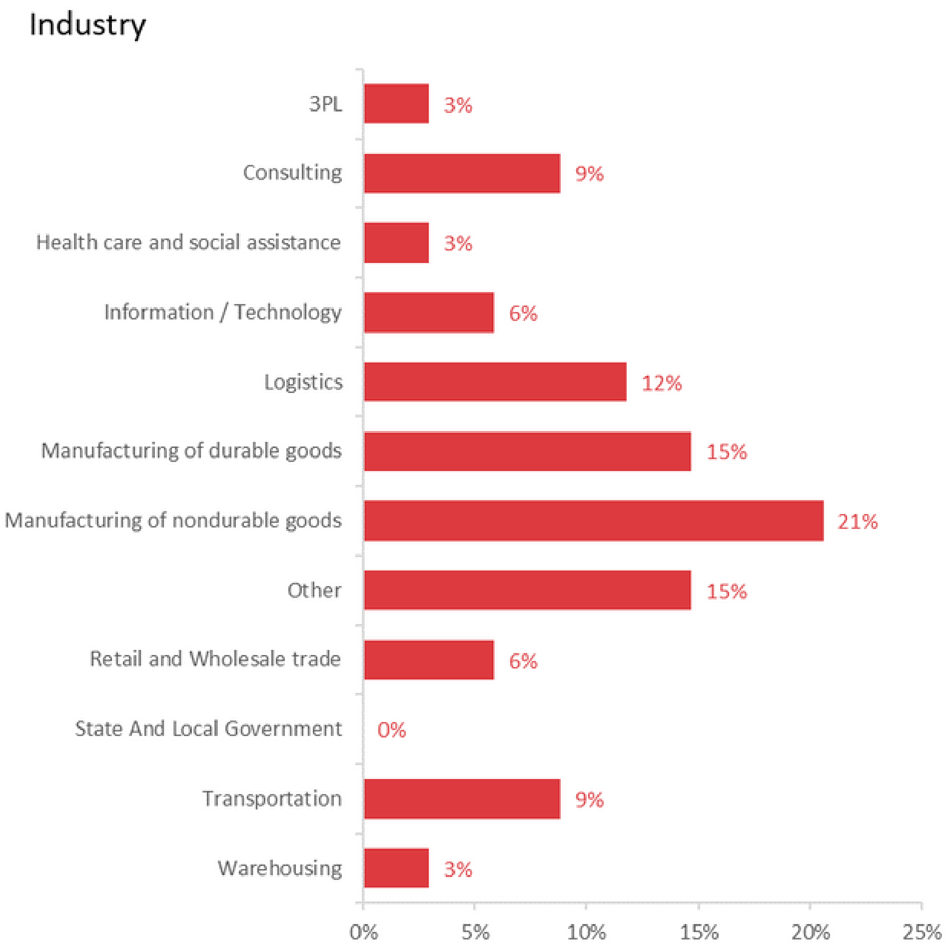
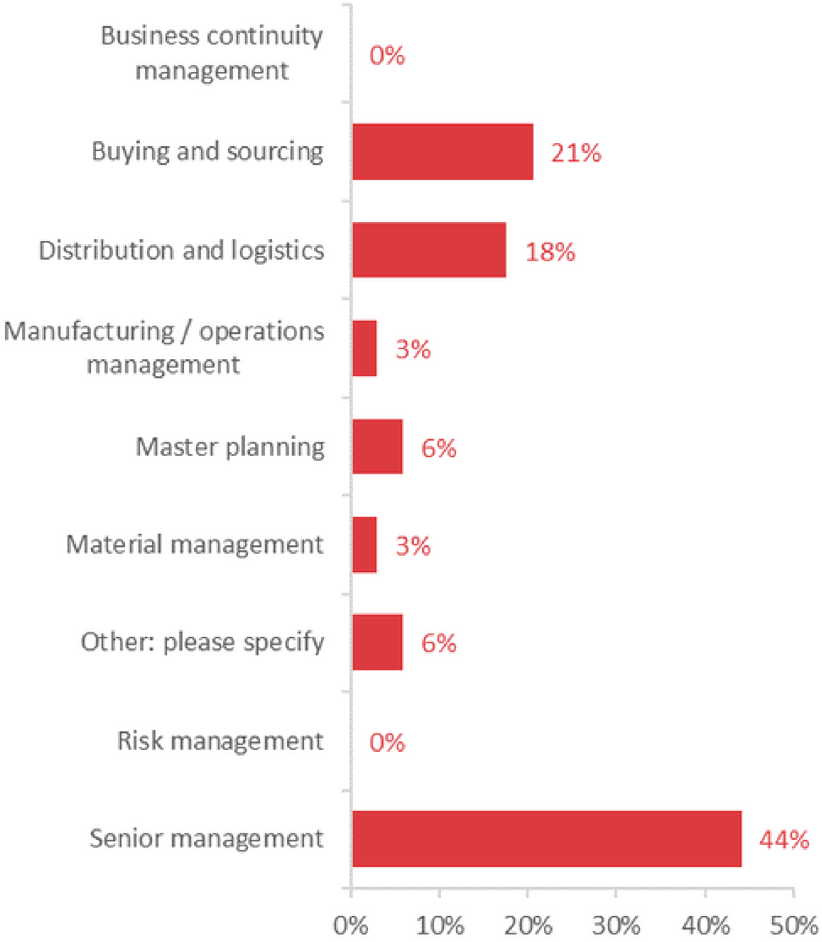
Appendix B
Survey Demographics





Appendix B
Demographics (continued)

Primary Role



Place of Employment

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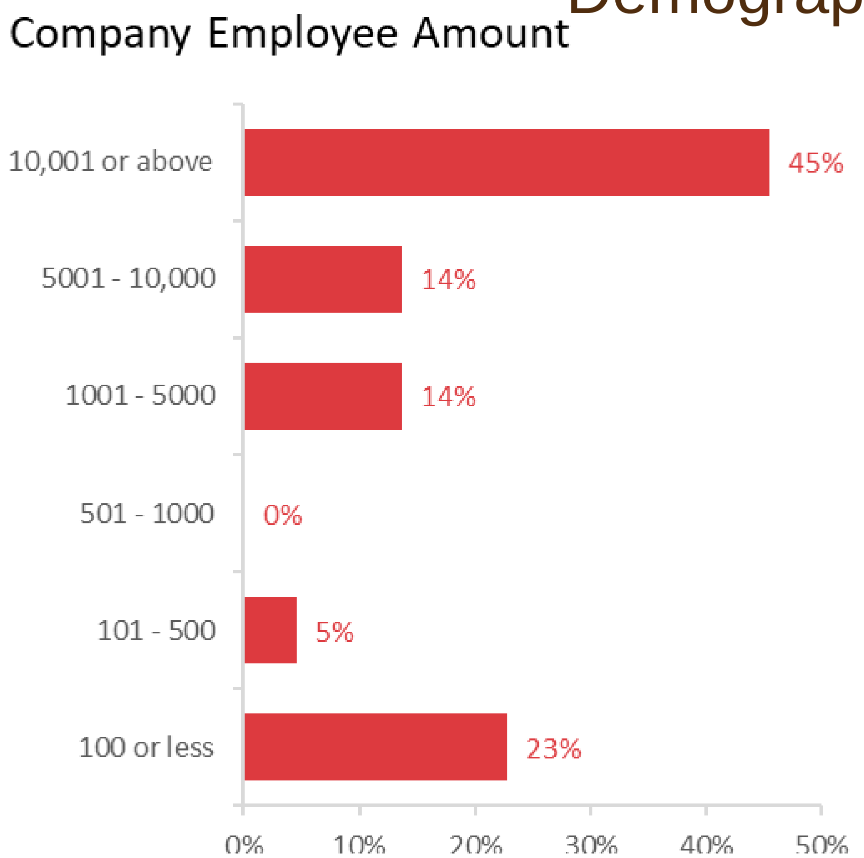
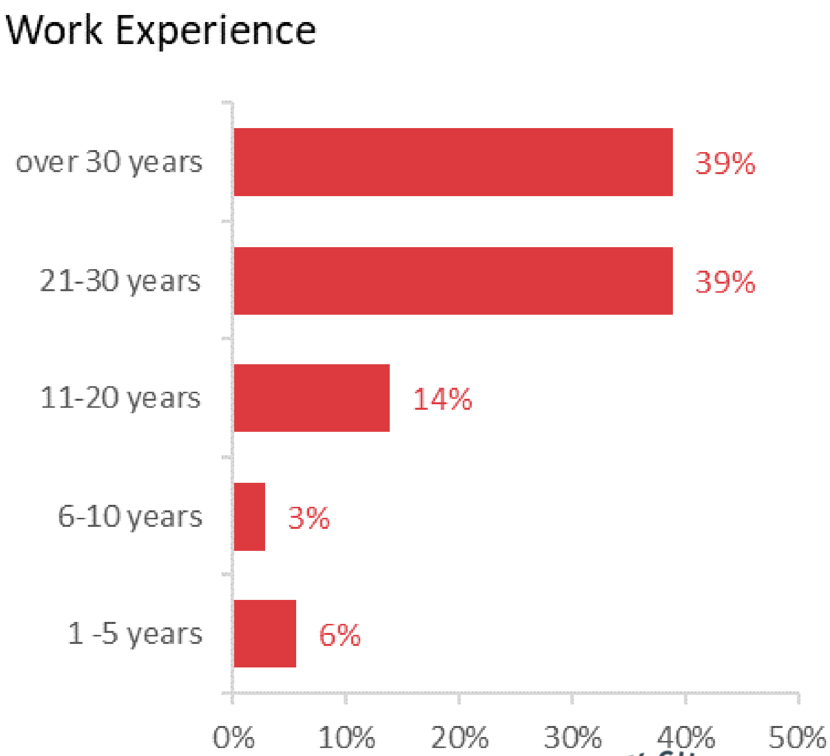
Appendix B

Demographics (continued)





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