SUPPLY CHAIN RISK INDEX™ LEHIGH + CSCMP

Lehigh Business Supply Chain Risk Management Index

Quarterly Report

1st 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 1st Quarter of 2022 compared to the risk in the 4th Quarter 2021 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 72.79 which is an increase from the 4th quarter suggesting an even higher level of risk in the 1st 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.

Executive Summary

Economic Risk is expected to increase substantially for the upcoming 1st Quarter 2022 and is the number one concern for supply chain professionals. Interestingly with a score of 88.36, Economic Risk has the highest risk index across all risk categories since the creation of the LRMI in the third quarter of 2020. Economic Risk has consistently been among the top 4 risk categories but there seems to be greater worries about inflation, increased energy costs and labor shortages that has made Economic Risk the number 1 risk next quarter.

Risk Type	4th Quarter 2021 Risk Index	1st Quarter 2022 Risk Index	Trend
Economic Risk	81.98	88.36	↑
Transportation Disruption Risk	87.79	85.47	↓
Supplier Risk	84.88	85.34	↑
Cybersecurity and Data Risk	70.35	76.72	↑
Government Intervention Risk	70.35	75.43	↑
Customer Risk	63.37	66.81	↑
Operational Risk	63.95	66.67	↑
Quality Risk	61.05	63.68	↑
Environmental Risk	64.53	60.34	↓
Technological or Competitive Risk	55.23	59.05	↑
Average Risk Index	70.35	72.79	↑

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.

Four biggest risks in 1st Quarter 2022

(When comparing across all 10 risks)

1. Economic Risk
2. Transportation Disruption Risk
3. Supplier Risk
4. Cybersecurity and Data Risk

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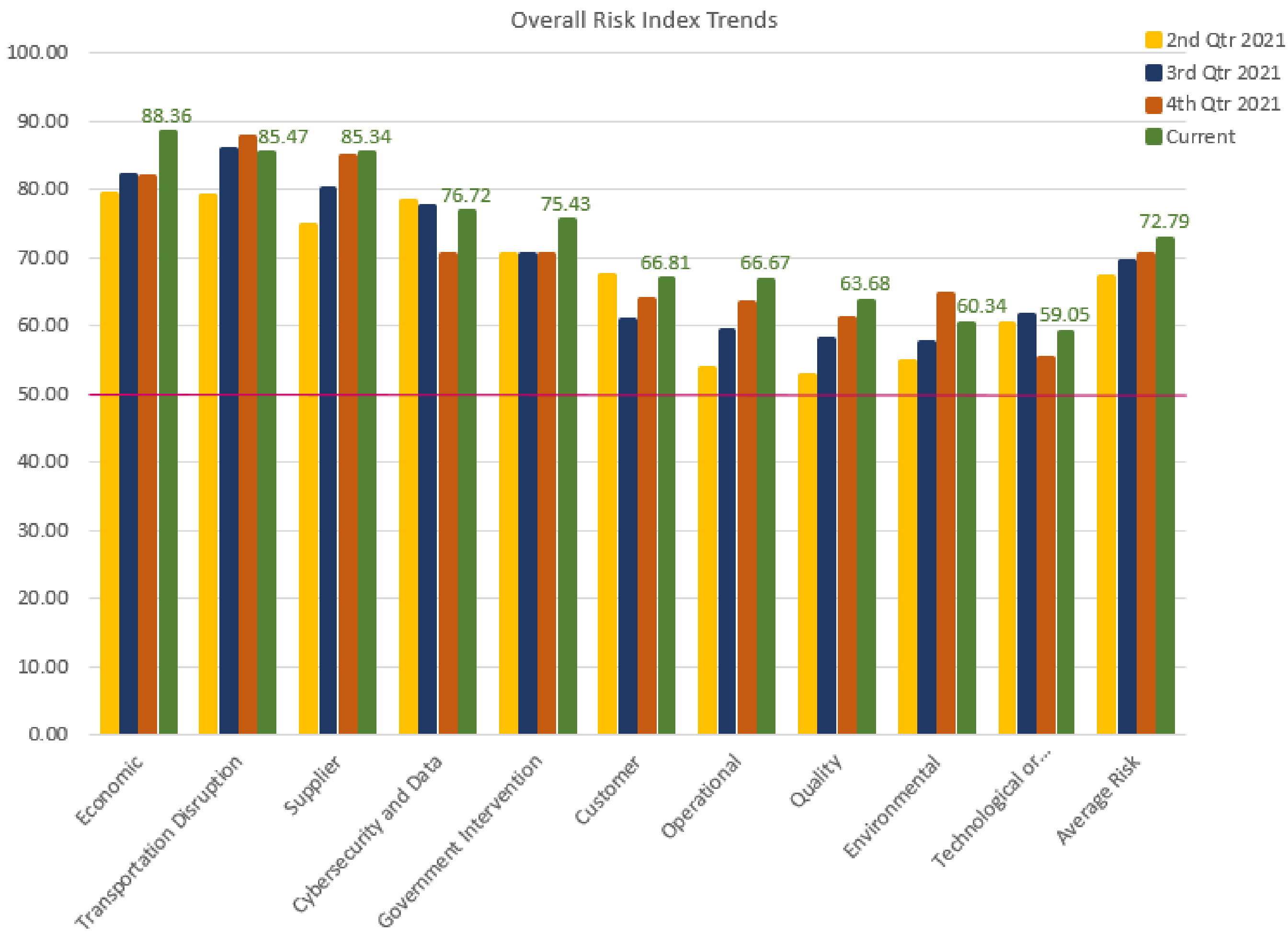
Did You Know?

The Lehigh Business Supply Chain Management Risk Index for the 1st Quarter in 2022 is

72.79

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.

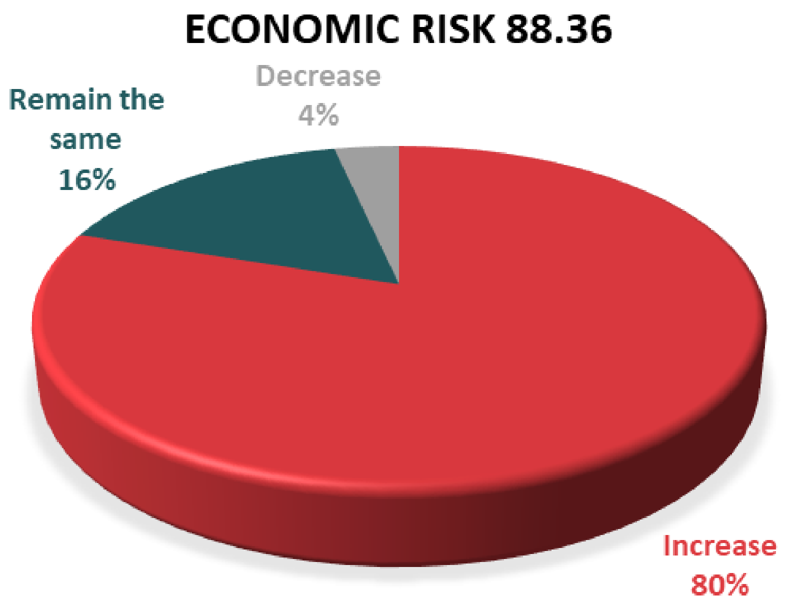


01 Economic Risk

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

Selected Comments:

- Inflation is going to be crazy over the next couple of years. It has been building for years.
- Keeping adequate labor has been a struggle for a year. Energy costs are skyrocketing.
- We have also seen a number of people leaving due to not wanting to work in office. We offer a hybrid work environment, however some employees do not want to assume the risk of coming in to the office part time. We do offer living wages and a great benefits package. That doesn't appear to be enough for some people though. This may be due to the fact that there was an extreme excess mortality rate within the country in the last year and a half.
- We are experiencing border delays and increased USDA checks at the borders for heat treatment marks on skids/pallets, and absence of pests and dirt.
- I expect more economic risk associated with Commodity price volatility, labor shortages, increasing energy costs, and global energy shortages. Border delays will stabilize. The demand "shock" has already happened. This means we're in a new demand "normal". Inflation is the highest it has been in over 30 years and it will get worse!
- Labor shortages, increased energy costs and border delays have not reached their peak. This depends on the enforcement of the vaccine mandate by the government.
- I really think we are trending toward a recession and major stock market correction.
- All energy factors create a larger risk.

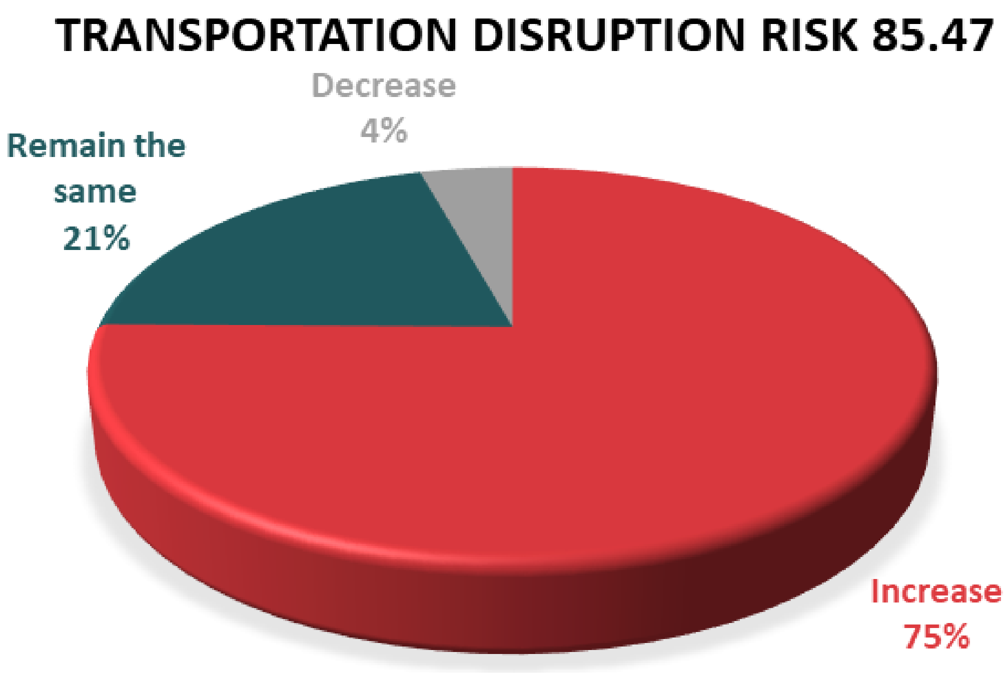


02 Transportation Disruption Risk

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

Selected Comments:

- We are experiencing driver shortage, increasing fuel prices, and due to increased demand and lack of supply, we are paying premium rates outside of contracted rates.
- Driver shortage is significant and getting worse. 80,000 drivers short in 2021 and predicted to be 160,000 short by 2030. Equipment is in high demand and equipment manufacturers are unable to fulfill their orders. All of these factors are compounded to create the unprecedented levels of trucking and shipping costs.
- Sea shipping is imbalanced and clogged especially all across the Pacific region. Planes, trains, and trucks are seeing overloaded demand trying to offset sea cargo delays.
- With the end of the holiday push from Asia, we expect increased capacity in the container market which will lower prices and decrease lead times.
- Inflationary fuel increases plus the infrastructure bill will attract drivers to construction jobs thus intensifying an already tenuous driver shortage. Also, mandatory COVID vaccine mandates will further drive a segment of drivers to other employers.
- With fuel prices and rate increases it will be harder to acquire long term customers and a more transactional environment may surface.

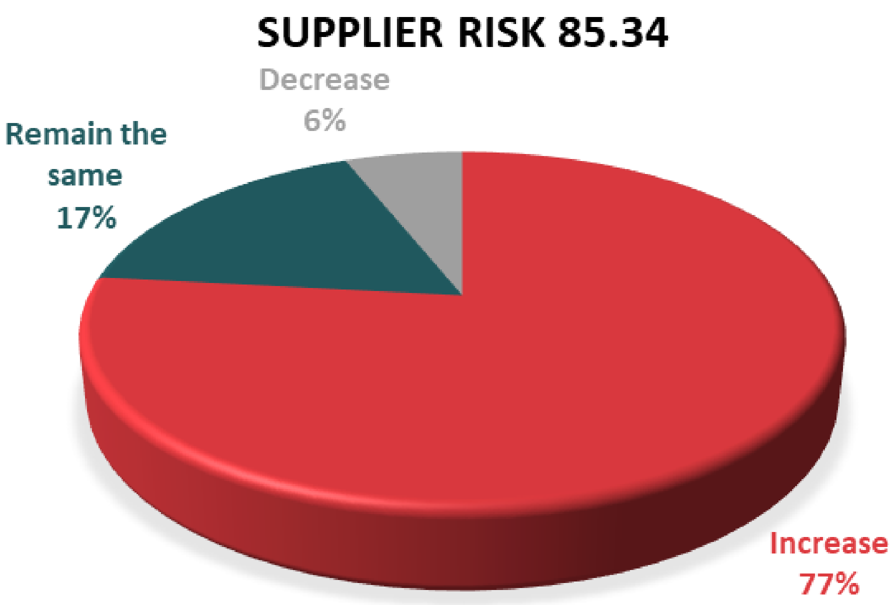


03 Supplier Risk

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

Selected Comments:

- Raw material pricing is a major issue. Component delivery from specific regions or as a sole source has delayed equipment manufacturing schedules.
- Already seeing many US companies with Asian suppliers set up secondary near shore sources of production to offset trans Pacific supply chain risk.
- The recent global IC shortages have exposed the over-reliance of a small set of factories in a single geographic location. They are the underpinning of the entire tech eco-system. Any supplier is at risk to be short of critical components and sub-assemblies.
- PPI is slow to respond but the increases are across most materials and services.
- Onshoring may begin in the latter half of 2022. That will take time and expertise.
- Due to the lack of workers and logistical issues many suppliers are not able to keep up with demand or meet shipping parameters they were able to a year ago.
- Limited carrier options, inflation and labor shortages will mean that major price increases and service disruptions will get worse as we enter the 1Q 2022.
- Delivery schedules, freight costs and raw material price increases have driven many to seek US suppliers. US suppliers are not ready for this shift and are at max capacity and are struggling to find workers in recent years as our culture has shifted away from this.
- Inflation, shortages, port congestion, labor shortages and short-sighted government regulations collectively increase. What is the potential for a recession and or major stock market correction?

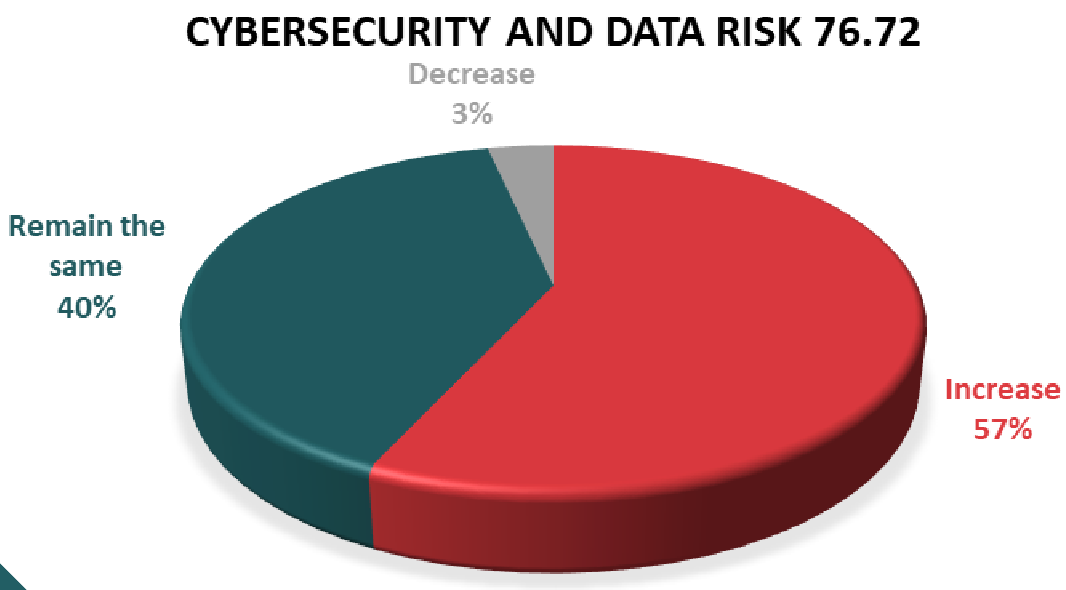


04 Cybersecurity and Data Risk

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

Selected Comments:

- Government seems to be paying more attention to the risk of ransomware attacks on private business. Over time, I'd expect to see more companies strengthen their defenses and governments across the world collaborate to arrest more of the sophisticated hackers.
- We are all at risk with hackers coming up with new ways to put our systems at risk.
- We take cybersecurity very seriously and risk is always increasing as technology generally improves.
- Investments in and around cryptocurrencies invite more sophisticated actors onto the scene which heightens the likelihood of cyber-attacks.
- Cybersecurity and Data Risks are increasing globally. This is due to the fact that those perpetrating attacks are often nation-state actors or are funded by them.
- Global hacker groups are pushing to exploit employees working from home and see it as more opportunities to penetrate security networks. According to my company's IT Security group, 50% of daily emails are blocked as suspicious.
- The easiest way to get into sensitive data is to use a supply chain partner's email sent to someone in your company. Educating your entire supply chain is vital.
- With the economy in some trouble and many people looking for money this appears to be an increasing risk at a consumer level as well as for small businesses.
- The risk of ransomware in particular is very concerning because the market does not seem to have created a meaningful way to mitigate or reduce the consequence of ransomware.

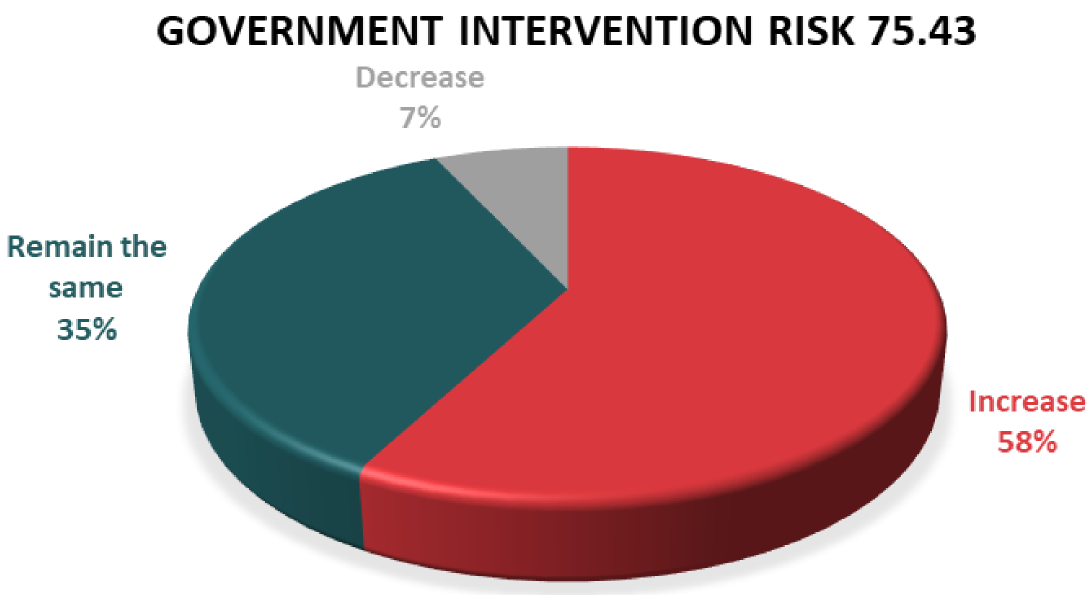


05 Government Intervention Risk

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

Selected Comments:

- We moved the US warehouse to a Foreign Trade Zone to minimize the Section 301 and 232 Trump Tariffs, which have not been eliminated by Biden.
- The current administration policies are killing small businesses while large corporations are thriving because of inflation and pricing increases.
- We could use a single US government agency regulating air, ocean and ground transport (intermodal) that could save us $100 billion or more and be more efficient.
- Current administration policies are disconnected from market economy realities.
- Regulations involving vaccine mandates will have a negative impact on retaining a consistent workforce. Current company mitigation procedures are working.
- The recent passage of the US Infrastructure bill will provide investment dollars in chip manufacturing critical to creating resiliency in the supply chain.
- New regulations on gas and oil extraction will make us more dependent on foreign sources. We need to continue to reduce our carbon footprint however as no real change will happen until alternative energy sources are convenient, easy to use and economical.
- Pressure to reduce oil production affects the availability of petroleum-based materials.
- I see increasing political tensions with China with respect to Taiwan that could result in either US economic sanctions or retaliatory measures from China to control the public stance of companies that do business in China over the course of the next year.

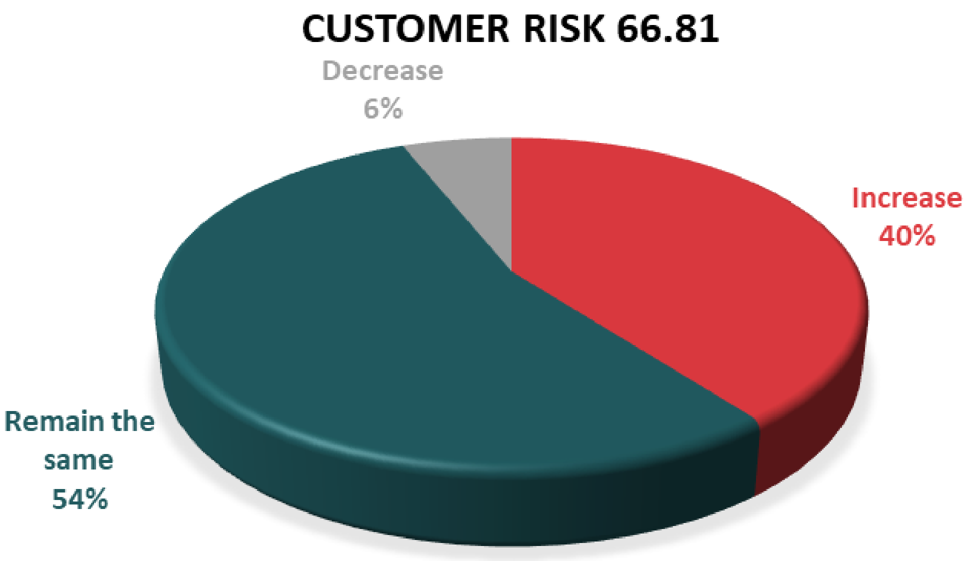


06 Customer Risk

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:

- Expect to see customers begin to lose patience with price increases, shortages and things to start to return to normal in 2022.
- No customer loyalty and will get worse as its survival of the fittest.
- Due to the pandemic customer forecasts are hard to determine and results in incomplete overall product mix. Makes it difficult to level volume.
- Customer have been holding off on making changes, so I see many clients thinking about how they can start making moves. There is lots of activity.
- Relationships and trust in these situations gets replaced with buying at lowest cost. Buying cheap in the current market is extremely risky in terms of quality and reliability.
- We can only hope that are clients remain loyal to us, as they have throughout Covid. If we can continue to offer good service and candidates we should be fine.
- We are asking clients to sign longer term agreements to help eliminate risk.
- Large, e-commerce customers face the greatest risks, carrier volume restrictions and significant double digit rate increases are guaranteed. SME's will also face significant price increases.
- Customers (specifically consumers) are facing massive price increases.
- Competitors are all feeling the same pressure regarding the supply chain and customers are learning to deal with longer wait times for brands they trust.

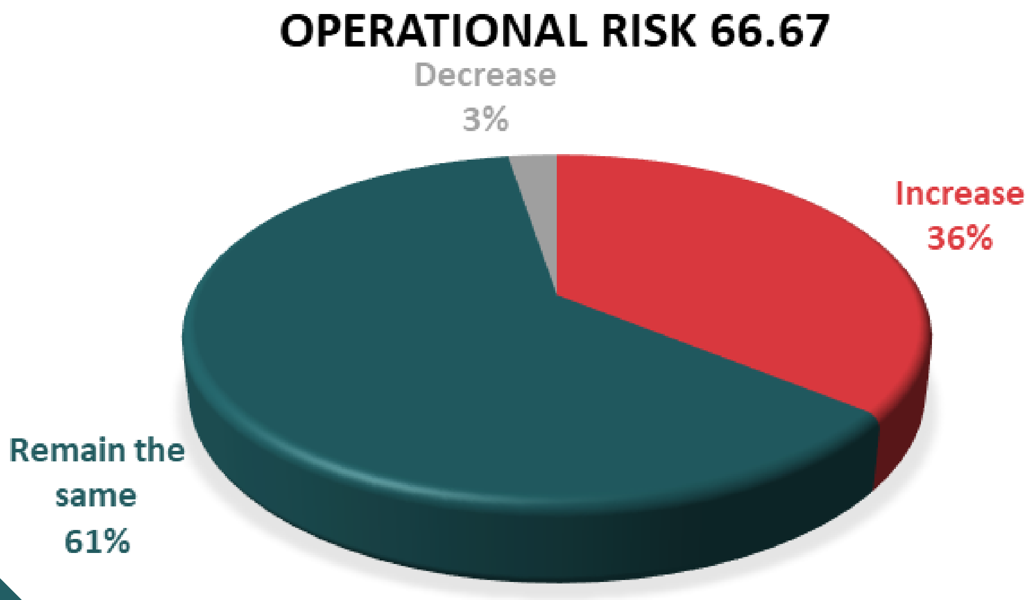


07 Operational Risk

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

Selected Comments:

- Government rationing of electricity in Asia started; parts required for machine maintenance harder to get, so if machines break down, delays in fixing; continued delays in receiving product from overseas; vaccine mandates causing people to leave jobs which will reduce production and cause service level issues to customers; spending is decreasing and all the product we've had on order will arrive in a "balloon-type fashion" and cause us to have excess inventory in 2022 so we will have to sell at a loss and/or perform layoffs.
- Counterfeiting is a major problem we encounter. Our customers are realizing that the counterfeit products are inferior and do not last as long as our certified parts.
- Raw material scarcity continues to broaden daily.
- Class 8 truck fleets are unreliable. Supply chain problems make downtime unacceptable.
- Risk will be because our product inventory is over priced compared to the present market trend of downward pricing.
- The biggest disruption at the ports dealing with final delivery of sea containers is not enough chassis (these are sitting under empty containers that have not been returned to the ports after delivery). The terminals regulate appts based on which steam ship lines can handle empty returns (and also have a pick-up available).
- Many clients are expressing concern regarding the availability of materials and the increased lead times for components. Resulting in many companies hoarding parts.

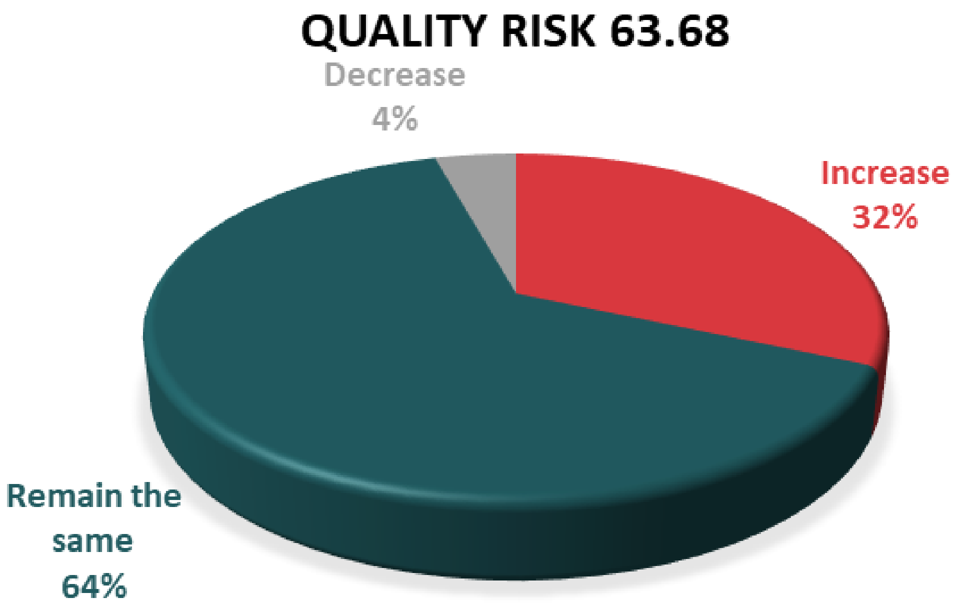


08 Quality Risk

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

Selected Comments:

- We are seeing material/component issues which is raising concerns over quality of products. Also manufacturers are citing work force shortages as problems.
- High worker turnover and concerns about holding existing staff to high standards (due to fear of turnover) will likely cause companies to suffer worse quality with any labor input.
- Changing quality standards.
- Adding new staff and training them to fit our culture as well as provide the same levels of service is a constant challenge to overcome.
- Upstream supply chain issues are leading to lack of materials. Quality risk is increasing as we look for replacements/substitutions.
- Supply Chain is stressed. Suppliers are pushing for more output, could impact quality. Risk of counterfeit or lower quality parts and materials entering the market place.
- We have ramped up our staffing in the 4th quarter. With the additional team members, we had increased risks in the 4th quarter because of training. This risk will decrease as the team members are fully trained and increase their hours in their roles.
- Increased safety risks due to declining driver quantity and quality.
- Customer demand and competition.
- Quality will deteriorate due to labor, parts and inventory shortages.
- Quality of raw material inputs.

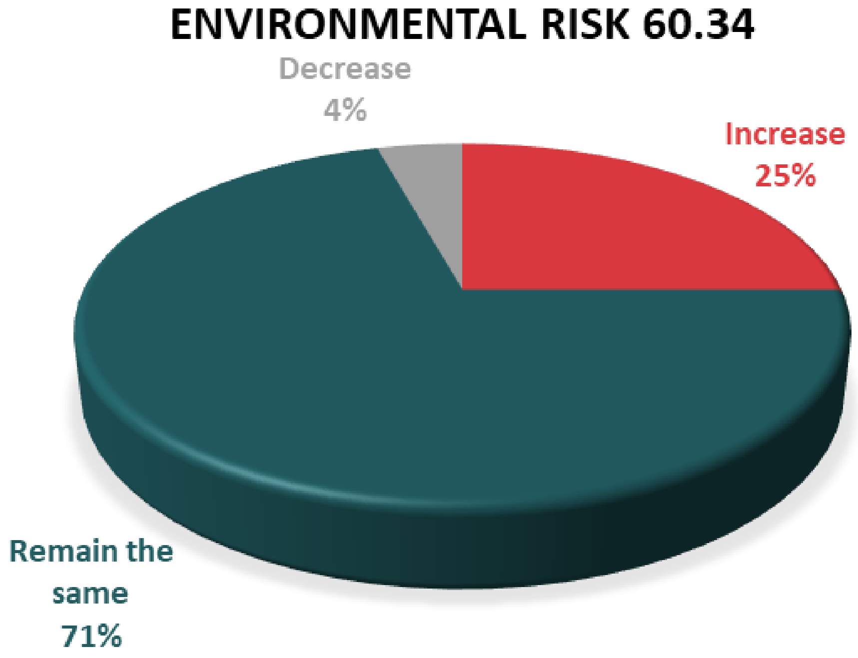


09 Environmental Risk

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

Selected Comments:

- Scientifically, weather does not equal climate. One climate science data point is thirty years. Sadly, this critical distinction is known by just a few people ... the majority of citizens equate weather with climate.
- Extreme weather events are a growing concern.
- If you call Covid a natural disaster, then risk will increase b/c of gov'ts reaction to it.
- We are seeing a downtrend in industrial accidents. We do anticipate that there may be additional COVID-19 surges. We consider this an environmental risk. We are not presently requiring vaccination, and are pending the government's requirements. We are limiting international travel, and we are offering a hybrid work environment.
- Could be a bad snow year in the Northeast.
- The winter months always have a way of creating additional challenges in the transportation industry.
- Climate change is only getting worse.
- Pressure on corporations to present the idea of a future that's relies on cleaner energy.
- There is no indication that the climate crisis is being addressed fast enough.
- These issues will always be with us. Most companies have plans for such things.
- Global warming is increasing risks everywhere and needs to be factored into prices.
- Weather is not the culprit.

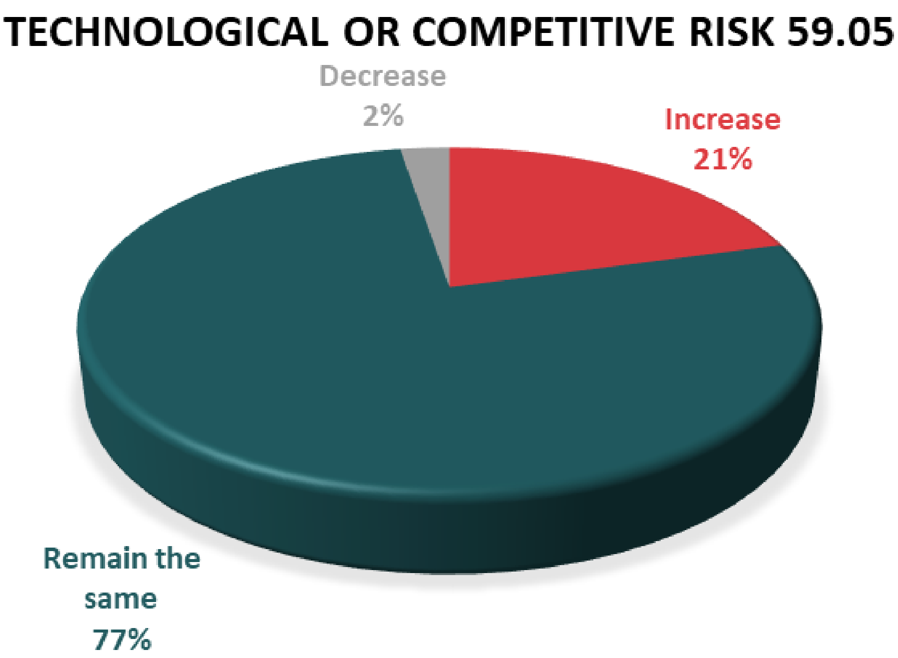


10 Technological or Competitive Risk

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

Selected Comments:

- Our competitors took a different route than us on inventory and are able to supply our customers better, so they will ultimately take more market share.
- More regulation will strangle us as its doing right now.
- Technology providers holding data hostage, there are people paying hundreds of thousands of dollars to get their data back from providers.
- My company competes with new entries constantly being added to our industry. Most trucking companies are starting brokerages. Technology makes us more efficient and provides us and our customers with better visibility and control.
- Any emerging tech or unforeseen competition will need to go through the scrutiny of the media and various platforms before it is seen as a threat.
- Work from anywhere is driving many innovations across industries.
- With AI the technology risk is major.
- We are test-converting our power plant to blended hydrogen fuel. We believe we are in the steady part of the curve technologically and ahead of the curve in considering new, environmentally friendly technologies.
- We will continue to roll out new offerings to our API suite.
- We continuously reinvest in our Technology.



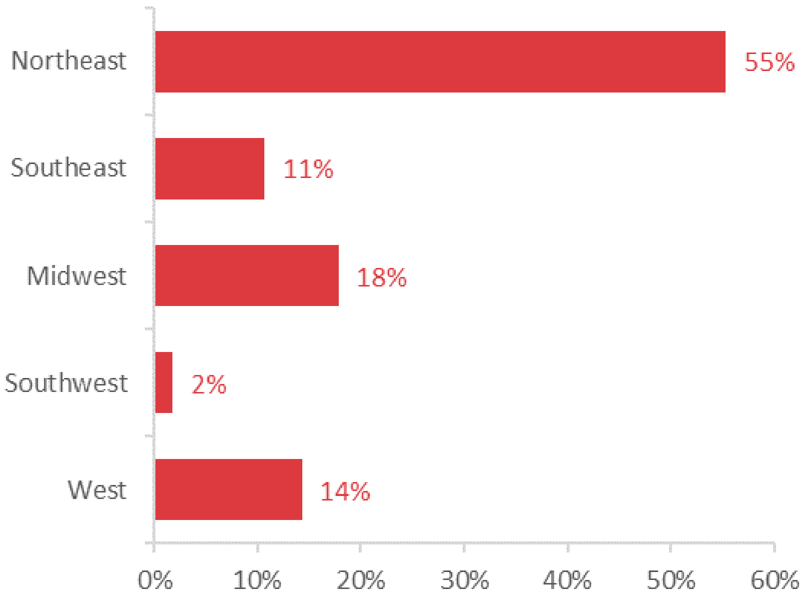
Appendix A
Risk Index Summary

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

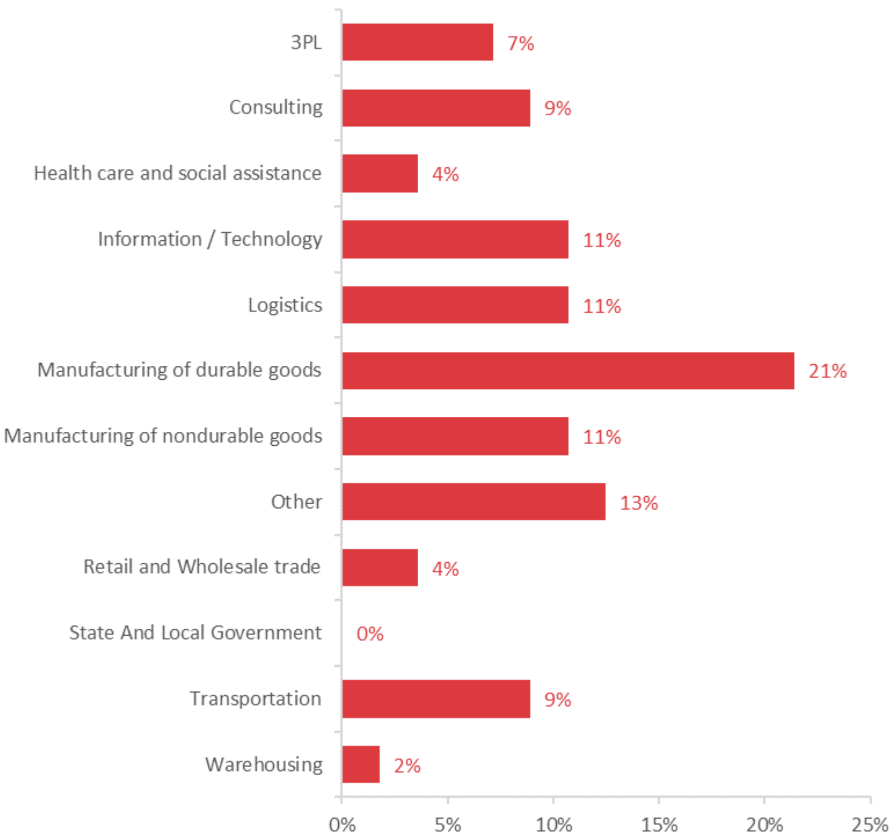
The further the number is from 50 greater the level of risk
LBRI = (P1 * 1) + (P2 * 0.5) + (P3 * 0)
P1 = percentage of answers reporting an improvement
P2 = percentage of answers reporting no change
P3 = percentage of answers reporting a deterioration

Appendix B
Survey Demographics

US Region

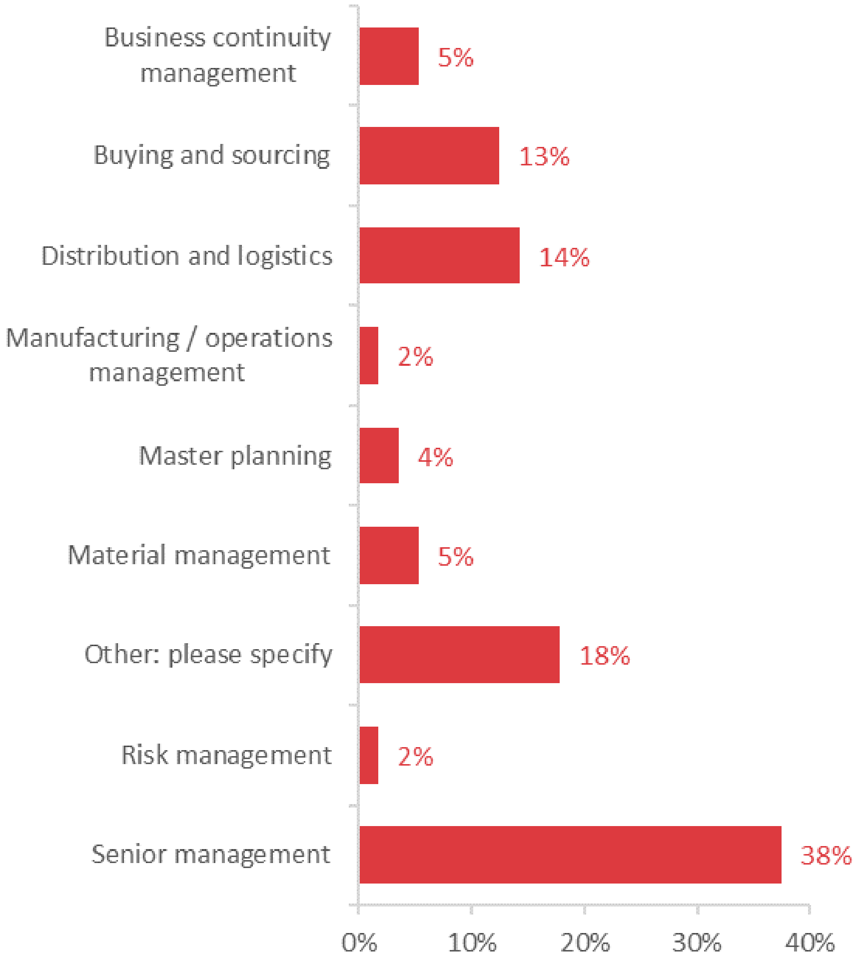


Industry

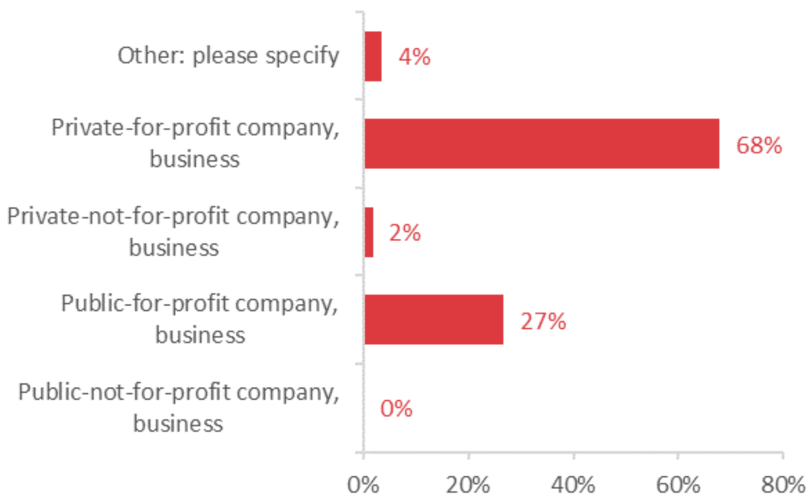


Appendix B
Demographics (continued)

Primary Role



Place of Employment



Appendix B

Demographics (continued)