



**“How Artificial Intelligence Can Mitigate Supplier Risk”
By Kristen Rodriguez**

**The Undergraduate Research Writing Conference
• 2020 •**

Rutgers, The State University of New Jersey

222 Hamilton
New Brunswick, NJ 08901-1004

December 9, 2019

Angela Klett
SVP IT Chief Financial Officer and Chief Procurement Officer
1 Nationwide Plaza
Columbus, Ohio 43215-2220

Dear Ms. Klett,

Re: Supplier Risk in Mutual Insurance Companies

Thank you again for attending my presentation at Rutgers University. My presentation covered the general aspects of my proposal for using Artificial Intelligence to mitigate supplier risk. This paper will give you a better understanding of the entire plan and project at hand and will give you a more in-depth look at how it could be accomplished. As you are the Senior Vice President of Procurement at Nationwide Insurance, your job centers around finding cost savings with every expenditure within the company. By implementing my plan into your procurement department, you can obtain savings within all areas of your business by reducing the supplier risk and limit some of the cost that is associated with human labor as well. This proposal will not only be helpful for you, but also for Nationwide Insurance Company as a whole and other Mutual Insurance Companies alike.

As you saw in my presentation, supplier risk could have a vast and long-lasting negative impact on a company. It would cause damage to Nationwide insurance that not only results in loss of revenue but also loss of customers. Artificial Intelligence, specifically Fuzzy ART, can help mitigate all of the risks associated with supplier risk. It could help Nationwide save money from potential damage and also save money on labor costs as employees will no longer have to spend time out of their day calculating the risks by hand. Even with these benefits and many more, most mutual insurance companies are not implementing Artificial Intelligence into their procurement department.

Nationwide Insurance could be the leading company in using Artificial Intelligence. The plan outlined throughout this paper will give step by step instructions on how to implement it and the different ways in which AI could benefit your company. I encourage you to look it over and contact me at any time with questions or if you want to schedule a follow-up meeting. I could be reached at (201) 668-0321 or emailed at kar336@scarletmail.rutgers.edu. Thank you again for giving me your time and commitment.

Sincerely,

Kristen Rodriguez

How Artificial Intelligence Can Mitigate Supplier Risk

A proposal to use Fuzzy ART as a means of saving mutual insurance companies time and money when dealing with supplier risk

Submitted By:

Kristen Rodriguez
Student at Rutgers University

Submitted To:

Angela Klett
SVP IT Chief Financial Officer and Chief Procurement Officer
1 Nationwide Plaza
Columbus, Ohio 43215-2220

November 8, 2019

If found, please return to:

Professor Audrey McGowan
Writing for Business and the Professions
Rutgers University New Brunswick

Abstract

This is a paper focusing on how Artificial Intelligence, specifically Fuzzy ART, could be used to help mitigate supplier risk in mutual insurance companies. This proposal has been meticulously researched for months with many scholarly sources backing the findings of it. Many mutual insurance companies are not taking their supplier risk seriously enough and do not have adequate measures put in place to protect their company from supplier risk. Supplier risk is the risk that a company could face if something were to happen to one of its suppliers. Supplier risk could have a vast and negative impact on a company possibly resulting in a loss of revenue, customers, and/or capital. Evidence to support this claim could be found throughout the proposal.

While some companies are currently using different forms of technology to help calculate and mitigate the supplier risk their company faces, this proposal explains how it could be taken one step further. By using Artificial Intelligence, the supplier risk that a company could face would be mitigated immensely and save the company valuable time and energy. Fuzzy ART is a form of supplier risk that allows for specific inputs to lead to specific outputs. These outputs are shown in a categorized form stating which suppliers the company should partner with and which suppliers have less risk associated with them. The different ways in which Fuzzy ART theory can help supplier risk are supported by multiple experiments and findings that could be found in this proposal. By reading this proposal, you will learn about the reasons why you should implement Fuzzy ART into your procurement department and how it could set you apart from competing mutual insurance companies.

Table of Contents

- Abstract..... i
- Table of Contents ii
- Table of Figures..... iii
- Executive Summary..... iv
- Introduction..... 1
 - Globalization: The Unforeseen Consequences on Supplier Risk* 1
 - The Expansion of Risk* 2
 - Consequences* 3
- Literature Review..... 4
 - Globalization with Supplier Risk*4
 - Reasons to Use Technology to Help Mitigate Supplier Risk* 4
 - Types of Technology Currently Being Used for Supplier Risk* 6
- Plan..... 8
 - The Fuzzy ART Algorithm* 8
 - Development and Implementation of Fuzzy ART* 10
- Budget. 12
- Discussion..... 13
- Works Cited..... 14
- Appendix..... 16

Table of Figures

Figure 1	1
Figure 2	3
Figure 3	9
Figure 4	9

Executive Summary

Supplier risk is a major problem that many companies tend to overlook. Supplier risk is a risk that a company could face if their supplier were to go out of business, supply a lack of quality products, have a breach, etc. There are many different forms of supplier risk including information technology risk, reputational risk, credit risk, geopolitical risk, and many more. Each of these risks could have a different impact on the company that the supplier is doing business with. There is a multitude of steps involved when dealing with supplier risk. The first one is to identify the risk, attempt to mitigate the risk, conduct ongoing due diligence to ensure the risk does not occur again and document the risk. These steps are conducted for every risk that every supplier has. If a company were to have over 10,000 suppliers, it would take many employee hours to calculate the risks by hand. This not only increases labor costs but also takes away time that employees could be working on something more valuable. If every risk that a supplier has is not identified, a company could face an immense amount of problems. For example, a company could face a breach and its customer's information could be leaked. During the first half of the year in 2018, nearly 25 million records were exposed every day, which is a 133 percent increase from the entire year of 2017 (Klugerman 3). This horrific statistic shows how problematic supplier risk could be and gives a look into how customers could be affected by it.

Many manufacturing companies are using technology to aid in mitigating their supplier risk. Technology could help discover the risks and interpret how to handle them. For example, J&J has been using an app called Elementum to track the risks. This app can help "designated corporate centers of excellence focus on specific issues and issue real-time reports on specific supply chain risks" (Shanley 7). Companies are able to know whether a natural disaster happened within minutes of its occurrence and know whether or not it could have impacted their suppliers. This is a huge step in helping to mitigate the risk associated with suppliers. It could take an employee a few days to calculate and discover the risk it could take out on their company, but technology allows it to be known within a much shorter amount of time. The time difference can save the company a valuable amount of effort and money that would have otherwise been wasted.

However, the technology can be taken one step further by using Artificial Intelligence. Artificial Intelligence is the ability for machines to perform tasks that would have otherwise been completed by humans, some of these include the ability to make decisions and compare and weigh options. AI mixes the mistake-proofing of technology with the decision making of humans allowing for a better overall and more compressive outlook. Fuzzy Adaptive Resonance Theory, also known as Fuzzy ART, is a specific type of Artificial Intelligence that uses an algorithm to calculate and sort data. Fuzzy Theory categorizes data, while Adaptive Resonance Theory allows for specific inputs and outputs to be made. By putting them together, you get Fuzzy ART which allows you to create your own form of categorization for any data you deem fit. This could be used specifically to categorize suppliers based on their risk. Fuzzy ART could specify which supplier would be best to work with and why. Mutual Insurance companies need to start taking their supplier risk management more seriously and by using Fuzzy ART they can take their supplier risk tracking to the next level.

Introduction

Globalization: The Unforeseen Consequences on Supplier Risk

As companies build and expand, their number of suppliers grow as well. Companies are no longer just conducting business within the borders of the country in which it is located. Manufacturing companies are building their products at offshore factories; Retail companies have their customer service hotlines located in other countries; Consulting firms have different branches of their companies dispersed across the entire world. Globalization allows companies to have economies of scale and increased competition. This competition improves the creativity and innovation that a company has, escalating its profits. As seen in Figure 1, as globalization increases throughout the years, the profit that a company receives increases as well.

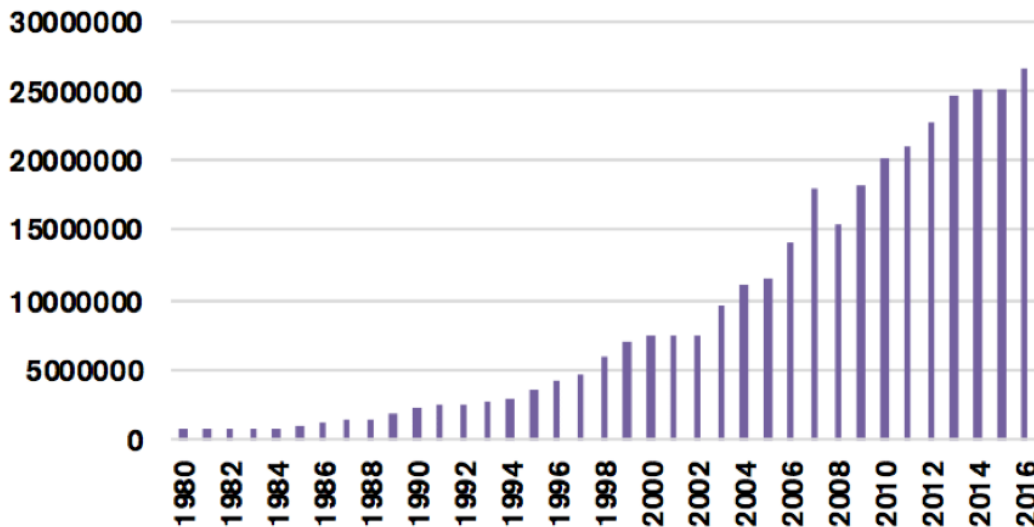


Figure 1: Globalization’s Effect on Income
(Erikson, Frederick)

Although expanding a company to different locations in the world may decrease labor costs and increase profit, it also exponentially complicates the supply chain of that company. Wright and Datskovka explain in “Addressing Supply Chain Risk” that “organizations have made cutting costs a priority and, as a result, many companies have not thoroughly evaluated the risks their supply chains pose to their businesses” (8). The risk associated with globalization becomes worse on a daily basis and could have detrimental effects on a company. For example, in the past when there was a flood in India, it would have no significant consequence on the companies located in the United States. But now that the world and the different companies located throughout it have become more interconnected, a natural disaster on the other side of the planet could significantly affect the daily operations of a business in America. Rituparna expands on

this crisis by writing, “From labor disputes, to unforeseen accidents and natural calamities, the production line is under constant threat, making the traditional approach towards identifying supply chain risk ineffective” (2). Since globalization is increasing drastically, the supplier risks associated with it increases as well. Insurance companies are not proactively alleviating this threat, leaving their companies open to possible hazards. Nationwide is a company that conducts business throughout the world, understanding and evaluating the growing supplier risk involved with it is no longer an amenity but a necessity.

The Expansion of Risk

As globalization becomes more prominent in the business world, the supplier risk grows, and the different forms of supplier risk grow as well. Supplier risk is the risk that a company could face if its suppliers do not perform their job correctly or are unable to conduct their daily operations because of an unforeseen disaster. There is an amplitude of different risks that need to be assessed for each supplier daily. The most common risks include geopolitical risks, IT risks, on-site risks, etc. In “Purchasing and Supply: An Investigation of Risk Management Performance,” Jukka and Katrina have put all the supplier risks into 5 distant risk categories which include disruption of supply risk, price risk, stock and schedule risk, technology risk, and quality risk (8). Each of these supplier risk categories could have different effects on a company. Keeping track of every risk is nearly impossible to do by hand when a company, like Nationwide, has over 10,000 suppliers. To properly do so, a company would need to have at least 100 employees working 24/7 solely on managing and mitigating the risks. As this is not feasible, companies are not able to protect themselves from all of the possible risks for every supplier that they have.

Most companies assess their supplier risk by looking into two distinct categories. The first one is the risk probability. The risk probability is the likelihood that the risk will actually occur. The company assesses this by conducting multiple assessments and tests on their suppliers. They also measure the amount of security that the supplier has in place to protect their information. The second category is the severity of the outcome. This means if the risk were to occur, the company would calculate how critical the outcome would be and how much it would affect the daily operations of their business. Figure 2 (on the next page) shows the total supply management risk on a graph with the risk probability on the y-axis and the severity/outcome on the x-axis. The risks are rated severe, moderate and low. The risk is rated severe if it is high for both categories, while the risk is rated low if it low for both categories. It is moderate if it is medium for either category or if it is low for one category but high for the other one. Most companies will only due further assessing and mitigating if the risks are rated as moderate or severe.

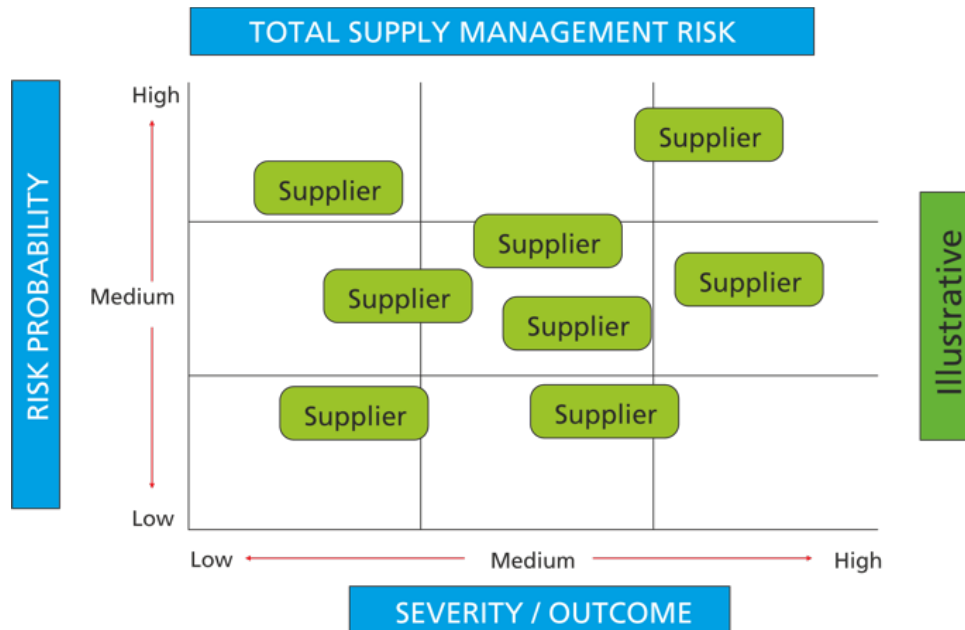


Figure 2: Total Supply Management Risk
(Supply Risk Management)

Consequences

If companies do not assess their supplier risks properly enough, they could be in trouble of losing customers, decreasing profits, or not being able to perform their daily operations. This was true for Capital One and as a result, over 140,000 Social Security numbers were leaked. Rob McLean, a reporter for CNN, explains how Capital One was hacked after the hacker “claimed to use a special command to extract files in a Capital One directory stored on Amazon’s servers” (12). This information breach of Capital One was a direct result of a supplier risk that it has with Amazon Web Services. If Capital One had properly and efficiently assessed the risk of its suppliers, this breach would not have happened, and thousands of people would not have had their Security Number leaked as a result. Properly assessing supplier risk has become an essential part of business operations for every company. If it is not done, companies open themselves up to an array of issues that could lead to possible bankruptcy. During the first half of the year in 2018, nearly 25 million records were exposed every day, which is a 133 percent increase from the entire year of 2017 (Klugerman 3). This staggering statistic shows how pertinent mitigating supplier risk is and the vast effect it could have on millions of people a day. Companies need to start focusing their efforts on supplier risk and begin using different, more sophisticated tactics to control it. Do you want to open yourself and Nationwide up to horrible repercussions of supplier risk or do you want to help shape how supplier risk is mitigated in insurance companies?

Literature Review

Globalization with Supplier Risk

As previously discussed, globalization increases the supplier risk that a company may be prone to. In Risk, risk management practices, and the success of supply chain integration, Wiengarten argues that “the advantages and positive effects of globally integrated supply chains may be threatened through various forms of risk, such as the opportunistic behavior of supply chain members, geopolitical risk, sovereign risks or exchange rate risks. All of these forms of risk may hinder companies to experience the full performance capabilities of their integrated supply chains” (5). Even with all of the benefits that globalization offers, the costs that are associated with the risks of the supply chain may outweigh the profits received from the benefits. No company in the world can receive all of the benefits from globalization with none of the risks. The best thing that a company can do is to mitigate the risks as best as possible by using whatever means they deem necessary.

Reasons to Use Technology to Help Mitigate Supplier Risk

Technology Can Help Prevent Some of the Risks Associated with Globalization

Since globalization has such a mass impact on supplier risk, companies need to start taking precautionary measures to prevent the risk from affecting the daily operations of the company. Technology is a solution that can help identify the risk while reducing the impact of it. Anges Shanley in “Shipping: Proactive Risk Management,” writes “a fragmented network of multimodal transportation services that are charged with moving more valuable, often irreplaceable, time - and-temperature sensitive products” can become less complicated with the use of technology (1). Technology can not only aid in helping to standardize the transportation of products, but it can also help employees visualize the risk involved with using certain types of services and transportation systems. Overall, technology can help a company to adapt to the changing environment that globalization has caused and will allow the company to avoid the risks involved with it.

A company will always face a certain amount of risk even if the supplier guarantees a product by a certain day or promises that they will finish a project the company had assigned to them previously. Different types of disasters could occur causing the supplier to halt their work which could end up impacting the company that had partnered with said supplier. Shanely explains that many companies have seen “Murphy’s law play out in every possible way, from fuel tanker fires shutting down airport terminals to volcanic ash clouds blocking air traffic for entire continents, to labor disputes and political conflicts disrupting shipping at ports” (2). All of these different disasters could cause an unknown amount of risk on a company and interrupt the daily operations of that company. Although many people assume that these disasters would only affect transportation and logistics companies, mutual insurance companies could be affected by these disasters immensely. For example, if an insurance company hired an accounting consultant headquartered in India and there was a drought, the consulting company would not be able to efficiently get their work done and it could impact the insurance company that hired them. The technology could effectively decrease the risk involved with this by informing the company

about the disaster within minutes of it happening and how the disaster could affect the supplier and therefore, the company.

How Technology Surpasses Employees

Technology has become an invaluable tool to help with supplier risk as it helps to identify and mitigate it in a faster and more efficient way than having employees do it by hand. As supplier risk evolves and becomes more prominent and inherent in an organization, how a company handles the supplier risk needs to evolve as well. Holly Rolland writes “with technology, companies can more easily incorporate risk management into critical business processes and improve performance. Technology solutions can provide several of the key features of a mature risk management program” (2). Technology is needed to adequately measure the risk associated with suppliers as it becoming more complicated on a day to day basis and companies need to keep up with the risk. Technology is the only solution that allows a company to identify and mitigate the risks while letting the employees not to have to spend as much time focusing on it.

Technology can be used to help with multiple steps in risk management. These steps include collaborative process support, audit and security, proactive automation, integration with performance, and the incorporation of early warning indicators (Rolland 3-10). By using technology to help with these steps in the process, employees do not need to spend as much time focusing on these aspects so a company could save on labor costs. Employees would spend an enormous amount of time completing these steps for every supplier, while technology can do it almost instantaneously. Rolland argues “Technology can provide companies with a single platform for automatically collecting and tracking key risk management issues” which can allow risk managers to focus on more pressing issues such as analyzing the risks (7). Technology allows for a more efficient flow of information related to risks which give employees more time to help analyze and mitigate the risks. As time is a very important component in ensuring a supplier risk does not have a significant effect on the company, technology is an important tool to help aid in reducing the time it takes to identify and collect information on the risk.

How Technology Helps to Analyze Risks

Technology has the ability to bring supplier risk management to the next level by being able to conduct all of the steps necessary to identify and analyze risks. Lori Chordas writes, “technology puts data at the forefront and provides risk analysis, monitoring, and modeling, data collection, storage and communication” (4). When some companies have over 10,000 supplies, there is a lot of data that is associated with the spend for each supplier, the number of products each supplier is providing, and the time and place in which the products are being delivered. All of these data points are hard to visualize and understand for employees. Technology, on the other hand, has no problem collecting and interpreting the data into actual results about the risk that the supplier would pose. Technology “also helps companies make sound business decisions for a complete range of risks, and to decide what controls to put in place” (Chordas 4). Technology not only helps to analyze the risks, but it can also help with deciding what to do when a risk presents itself.

Types of Technology Currently Being Used for Supplier Risk

SAS Risk Management for Insurance

SAS Risk Management for Insurance is a type of operational risk management solution that is aimed at insurance companies. It can help with life and property/casualty insurers to mitigate the supplier risk associated with their companies. Lori Chordas explains “SAS Risk Management for Insurance has become a vital tool for carriers to perform risk analysis and risk-based capital calculations” which can help “carriers reduce volatility by improving risk-decision strategies” (36-38). SAS Risk Management for Insurance is a helpful tool for insurance companies as it reduces the likelihood that mistakes could be made when calculating supplier risk. It also aids in risk decisions that could take employees a long time to discuss and review when deciding what the best approach is to mitigate the risk. Lori goes on to explain that “the solution also calculates Solvency II standard model requirements (minimum capital requirement and solvency capital requirement), and creates regulatory and management reports as required for the directive” (40). Solvency II is a directive in European Union Law that coordinates and balances all the regulations insurance companies have. SAS Risk Management for Insurance helps insurance companies to stay within the law when calculating risk which could save a company a lot of money for legal suits.

Elementum

J&J has been using an App called Elementum which helps to monitor and track risk in real-time. Shanley explains that Elementum “uses a cloud-based platform that allows manufacturers to manage specialized facets of supply chain, weather logistics, suppliers, or manufacturing” (8). All of these different facets included in the app gives J&J a more well-rounded view of the risk that their company faces. Being able to look into the risk a company may face needs to be done in a timely fashion or the impact that the risk poses could increase. This app allows an employee to access it anywhere they are located since it is cloud-based, which could save the company time and money. By using this app, “designated corporate centers of excellence can focus on specific issues and issue real-time reports on specific supply chain risks” (Shanley 7). By using this technology, the weight of assessing risks is taken off of the hands of the employees at J&J, which allows them to focus more on the different dimensions of risk. This has saved the company valuable time, and therefore, saved the company money. Not only does implementing technology help reduce costs, but it also decreases the potential harm that not identifying certain risks can do to a company.

Riskconnect

Riskconnect is a software company that provides its customers with integrated risk management solutions. Riskconnect offers an “integrated approach to global safety, risk and compliance management solutions on the world's leading cloud platform” (Riskconnect 1). Riskconnect looks at the impact of risk from a global perspective. This is important because of how much globalization is increasing. By viewing supplier risk from this perspective, a company is going to be more prepared for the risk and have better solutions that could mitigate the risk from all aspects across the globe. Riskconnect provides a platform with a modern user interface, enhanced navigation, pathways to help with critical workflow processes, and highlights of important fields (Riskconnect 3). With all of these features, Riskconnect helps its users identify supplier risk in an efficient and well-ordered way. As there are many different suppliers that a company could have,

the risks involved with all of them is confusing and hard to identify and navigate. By using Riskconnect, a company's risks could be laid out and outlined in an organized way that allows a company to view the most important risks that pose it.

The Plan: Using Fuzzy ART to Identify and Mitigate Supplier Risk

Although technology has become increasingly useful in identifying risks, taking it another step further will amplify the already great results of it. Using Artificial Intelligence to help mitigate supplier risks will take risk tracking to a whole new level. Gheorghe Tecuci defines AI as “the Science and Engineering domain concerned with the theory and practice of developing systems that exhibit the characteristics we associate with intelligence in human behavior” (1). AI allows the mistake-proofing of technology to be intertwined with the intelligence and decision-making of humans. This would allow for a better and overall more comprehensive outlook on supplier risk. Even though this is very useful, little to no mutual insurance companies are using AI to help them with supplier risk, so that means they are not using the availability of technology to its full extent. AI could become a transformational tool for supplier risk management changing how it is looked at throughout all insurance companies. Aydın Keskin explains “the user of AI systems only has to provide the information on characteristics of current situation, e.g. performance of a supplier on the criteria. The AI technologies subsequently make the actual trade-off of the users, based on what they have ‘learned’ from the experts or cases in the past” (19). As a result, AIs can handle complex and intricate data better than the normal risk assessing methods. Artificial Intelligence incorporates all of the important tools and knowledge needed to accurately assess possible and ongoing risks for suppliers. Supplier risk no longer needs to be a dreadful process, but necessary business operation. It has the possibility to become a useful and non-threatening aspect of businesses with the use of AI.

The Fuzzy ART Algorithm

As previously stated, AI is an important tool that could help identify and mitigate supplier risk, specifically the Fuzzy ART Algorithm. The Fuzzy ART Algorithm is a form of artificial intelligence that is designed to help supply networks and supplier risk associated with those networks. Fuzzy ART stands for Fuzzy Adaptive Resonance Theory and is classified under Artificial Intelligence as a neural network. Neural networks are primarily used for classification. Adaptive Resonance Theory was a theory set forth by Grossberg in 1976 and is comprised of an input layer and an output layer. ART is then incorporated with fuzzy set theory to create Fuzzy ART (Aydın Keskin 22-25). The Fuzzy ART Algorithm can be used in a variety of different ways, but the most useful way it can be used is by identifying the best suppliers and the possible risks for each one. Aydın Keskin goes on further describing Fuzzy ART by writing, “The suppliers are categorized by similarity degrees between them. The conventional methods are applied to rank the suppliers and select the most appropriate supplier” (48). Since this entire process is done by artificial intelligence, employee time is saved, and the risk of a mistake being made is eliminated. Overall, the Fuzzy ART Algorithm provides an unparalleled level of identification and mitigation to risk unlike any other method used in the past.

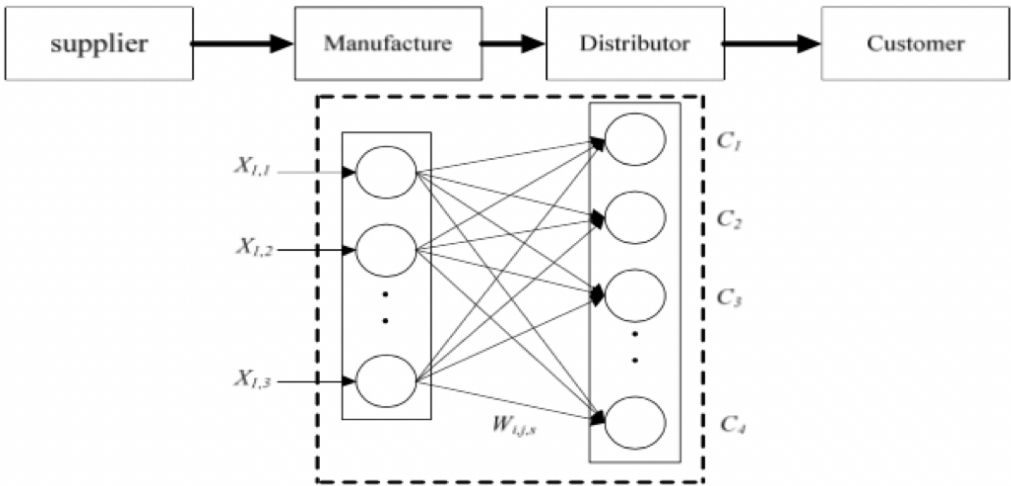


Figure 3: Fuzzy ART Network
 (Applying the Fuzzy ART Algorithm to Distribution Network Design)

Figure 3 shows how Fuzzy ART categorizes suppliers. It begins by showing the supply chain of a company from the supplier to the customer. The suppliers are categorized in the diagram above. Fuzzy ART uses the different inputs and data about the suppliers that the employee inputs and then calculates what the risks are involved with working with each supplier.

Figure 4 is what the employee will see after Fuzzy ART finishes the categorization. Fuzzy ART provides a Category label, Supplier, Category definition, and Priority measure. The category label displays all the different categories that Fuzzy ART categorized the suppliers into. The Supplier column shows all of the suppliers that are listed underneath the category. For example Supplier 1, Supplier 2, and Supplier 3 are underneath Category A. The next column is the category definition and that describes whether or not the category of suppliers is preferred or not. If a category is preferred, the suppliers listed under it have less of a risk associated with it. Priority measure is the calculated risk that Fuzzy ART came up with. The lower the priority measure, the better the supplier is to work with. Fuzzy ART displays this data in an organized way that would be easy for the employees to understand and grasp.

Category label	Supplier	Category definition	Priority measure
Category A	S1-S2-S3	Preferred	2.53
Category B	S4-S6-S10	Recommended	2.76
Category C	S5-S7-S8-S9	Not recommended	3.08

Figure 4: Fuzzy ART Final Categorization
 (The Fuzzy ART Algorithm: A Categorization Method for Supplier Evaluation and Selection)

Development and Implementation of Fuzzy ART:

The main purpose of this project is to have a more efficient way of analyzing and identifying the supplier risk that a company has. Implementing it as soon as possible will provide the best results and will allow for adequate time to evaluate the risks. This plan will be implemented in the Nationwide Headquarters located in Columbus Ohio. The project will be launched at the beginning of the year 2020. The following will show the development stage and the implementation stage.

Development:

Steps:	Tasks:	Deadlines:
Step 1:	1. Choose the manager who will lead the implementation of Fuzzy ART into the Procurement Department	January 1st
Step 2:	1. Inform the manager of your decision and receive their feedback on how they would go about implementing it	January 8th
Step 3:	1. Review all of the commodities within the procurement department 2. Pick one commodity to focus the implementation on	January 15th
Step 4:	1. Pick a select number of employees on how to use Fuzzy ART, specifically employees who work primarily with the commodity you choose	January 21st

Implementation:

Steps:	Tasks:	Deadlines:
Step 1:	1. Download Fuzzy ART onto workplace computers	February 5th
Step 2:	1. Train selected employees on how to use and analyze Fuzzy ART 2. Give time for employees to familiarize with the basics of Fuzzy ART and what inputs are necessary	February 8th
Step 3:	1. Implement Fuzzy ART into the specific commodity that you choose	March 2nd
Step 4:	1. Select the inputs that will categorize the suppliers for that commodity a. The inputs could be based on where the supplier is located, the amount of security they have in place, the quality of their products, etc.	March 5th
Step 5:	1. Allow Fuzzy ART to categorize the suppliers 2. Analyze the results of Fuzzy ART	March 10th

Step 6:	<ol style="list-style-type: none"> 1. Hand out the survey to employees who worked on Fuzzy Art 2. Review their answers 	April 1st
Step 7:	<ol style="list-style-type: none"> 1. If you like how Fuzzy ART works and categorized the suppliers of that commodity, implement it throughout the entire procurement department and all commodities involved 	April 7th
Step 8:	<ol style="list-style-type: none"> 1. Train all employees in the procurement department on how to use Fuzzy ART <ol style="list-style-type: none"> a. Include a training seminar 	April 27th
Step 9:	<ol style="list-style-type: none"> 1. Conduct on-going due diligence of Fuzzy ART and analyze the results 	April 30th and on

The development stage of the plan will allow for everything involved with Fuzzy ART and who will be using it to be set in place. The manager chosen to lead Fuzzy ART should have an extended amount of knowledge on the suppliers that Nationwide works with and have background knowledge on supplier risk. The reason why Fuzzy ART will only be implemented in one commodity at first is to see how Fuzzy ART works and it will give Nationwide time to debate whether or not they want to implement it throughout the entire procurement department.

As the training of employees for Fuzzy Art is very pertinent, a training seminar would be very useful. The few employees who are selected to use Fuzzy ART for the commodity would not have a seminar as there would only be a few of them. They would just learn about Fuzzy ART using the algorithm itself and putting in different inputs to understand the outputs. The training seminar would be implemented only when all employees in the procurement department need to be trained. The seminar would be half of the day, starting a 9 a.m. in the morning. Lunch will be provided at the end. A specialist for Fuzzy ART would be the headline speaker explaining all of the uses for it. There will also be a short panel for employees who used it in the past that will explain their experience with it. The deadlines for the plan are flexible, however, as previously mentioned it will be better to set up and use Fuzzy ART as soon as possible.

You will find the survey employees will fill out in the Appendix. It is a short survey that will allow Nationwide to learn if employees liked to use Fuzzy ART. This is important as employees will be the main ones working on Fuzzy ART and if there were any problems with it, they would be the first ones to know. The survey is anonymous as to not let bias sway the employee's answers.

Budget

This budget explains the cost of implementing, installing, training and promoting Fuzzy ART within Nationwide Insurance. The Fuzzy ART algorithm itself is free to download onto any computer. This would make the installation and implementation cost for Fuzzy ART free.

Training for the employees will be done through a training seminar, where selected employees will be taking off for the first half of the day to attend it. It would cost an average of 200 dollars per employee attending. This rate is based on the average pay per hour for employees working in procurement. On average, about 100-150 employees work in a procurement department for a big business like Nationwide. This is the reason for the variation for the final cost as the set number of employees attending the conference has not been decided yet. Catering for lunch will be done by Subway. The \$750 dollars include sandwiches, cookies, and drinks. Finally, the cost of hiring a Fuzzy ART specialist for the first half of the day would be 1,500 dollars. This amount is based on the average pay for a speaker at an event.

The promotion for Fuzzy ART includes handing out flyers for the training seminar and putting up posters of Fuzzy ART in Nationwide's headquarters. The cost per piece of paper is around 1 cent. If there were 300 flyers made, it would cost 3 dollars to make them. Having professionally made posters cost around 11 dollars per poster. If there were 10 posters placed throughout the office, it would cost 110 dollars.

Approximate Budget:

Budget Item:	Description:	Cost:
Training Seminar	<ol style="list-style-type: none"> 1. Time for Employees Attendance 2. Subway Catering for Lunch 3. Hiring of Fuzzy ART specialist 	<ol style="list-style-type: none"> 1. \$200 per employee attending 2. \$750 3. \$1,500
Promotion	<ol style="list-style-type: none"> 1. Flyers for Training Seminar 2. Posters 	<ol style="list-style-type: none"> 1. \$3.00 2. \$110
Fuzzy ART	Fuzzy ART's algorithm	Free
Total:		Between \$22,363 - \$32,363

Discussion

Supplier Risk is a very big problem for many companies. Although it has the possibility of having a huge negative impact on a company, most mutual insurance companies are not evaluating this risk properly enough. By implementing Artificial Intelligence, specifically Fuzzy ART, within a procurement department, a company will be able to save itself valuable time and money. Fuzzy ART could run many tests on potential suppliers and give back accurate results on the risk they pose. This would eliminate the possible mistakes that employees will make when conducting this themselves. It would also allow the identification of supplier risks to be done in a more efficient and timely way. Each day a risk is not identified and a new supplier is contracted without diligent research on their risks, the likelihood of losing money and customers increases immensely. Fuzzy ART is one of the only solutions that could help with this. It surpasses technology that is currently being used and will give mutual insurance companies an advantage that they did not have previously.

The price of Fuzzy ART may seem steep when you first look at it since it is 22,363 dollars. But if you view it from the perspective of not implementing it, you have the potential to lose hundreds of thousands of dollars if a breach or any other form of supplier risk were to occur. A company could lose a mass amount of revenue as Capital One did. They could also lose customers which would result in a loss of capital and trust within the community. The cost of all of these potential risks and problems far outway the cost of Fuzzy ART. The training and promotion of Fuzzy ART would be a one time fee. This means that there is no fee for continuing to use Fuzzy ART. This is important as companies move forward in their life cycle as competition increases and new companies begin to access better technology. Nationwide would already have the best form of technology at their hands without having to continually pay for the upkeep of it as other forms of supplier risk evaluation tools do. Fuzzy ART is well worth the cost and could end up saving Nationwide Insurance a lot of money.

Works Cited

Aydın Keskin, Gülşen, et al. “The Fuzzy ART Algorithm: A Categorization Method for Supplier Evaluation and Selection.” *Expert Systems With Applications*, vol. 37, no. 2, Elsevier Ltd, 2010, pp. 1235–40, doi:10.1016/j.eswa.2009.06.004.

Bhattacharjee, Rituparna. “Five Strategies to Manage Risks of Supplier Failure in Manufacturing.” *Lean Manufacturing | Manufacturing Global*, Rituparna Bhattacharjee, 26 Apr. 2017.

Chordas, Lori. “Better Ways: New Regulations and Market-Changing Events Are Driving Carriers to Risk-Management Technology solutions. (Technology: Risk Management).” *Best’s Review*, vol. 111, no. 12, A.M. Best Company, Inc., Apr. 2011.

Erikson, Frederick. “ECIPE.” *ECIPE*, Jan. 2018, ecipe.org/publications/the-economic-benefits-of-globalization-for-business-and-consumers/

Klugerman, Yaffa, et al. “7 Revealing Third-Party Risk Statistics Every CISO Should Know.” *Security Boulevard*, 8 Nov. 2018, securityboulevard.com/2018/11/7-revealing-third-party-risk-statistics-every-ciso-should-know/.

Mazaher Ghorbani, et al. “Applying the Fuzzy ART Algorithm to Distribution Network Design.” *Management Science Letters*, vol. 2, no. 1, Growing Science, Jan. 2012, pp. 79–86.

McLean, Rob. “A Hacker Gained Access to 100 Million Capital One Credit Card Applications and Accounts.” *CNN*, Cable News Network, 30 July 2019, www.cnn.com/2019/07/29/business/capital-one-data-breach/index.html

“Riskconnect Unveils New User Experience, Next Great Innovation in Risk Management Technology.” *Journal of Engineering*, NewsRX LLC, Apr. 2018.

Roland, Holly. "Using IT to Drive Effective Risk management.(Technology)." *Risk Management*, vol. 55, no. 1, Risk Management Society Publishing, Inc., Jan. 2008.

Shanley, Agnes. "Shipping: Proactive Risk Management: Technology Is Making It Easier to Stop Problems before They Can Affect Patients and the Bottom line.(Shipping Services)." *Pharmaceutical Technology*, vol. 40, no. 4, Advanstar Communications, Inc., Apr. 2016, p. 70,72.

"Supply Risk Management – Practical Ways to Face Down Risk and Uncertainty." *GEP*, 18 Mar. 2016, www.gep.com/white-papers/supply-risk-management-practical-ways-face-down-risk-and-uncertainty.

Tecuci, Gheorghe. "Artificial Intelligence." *Wiley Interdisciplinary Reviews: Computational Statistics*, vol. 4, no. 2, John Wiley & Sons, Inc., Mar. 2012, pp. 168–80, doi:10.1002/wics.200.

Wiengarten, Frank, et al. "Risk, Risk Management Practices, and the Success of Supply Chain Integration." *International Journal of Production Economics*, Elsevier Sequoia S.A., Jan. 2016

Wright, Jonathan, and Datskovska, Daniella. "Addressing Supply Chain Risk." *Financial Executive*, vol. 28, no. 6, Financial Executives International, July 2012, pp. 63–65, <http://search.proquest.com/docview/1030132081/>.

Appendix

Fuzzy ART Survey:

This survey is anonymous and will not judge your performance as an employee.

For each question give a rate from 1 to 10: 1 being bad and 10 being the best

1. How easy was it to use Fuzzy ART: 1 2 3 4 5 6 7 8 9 10
2. How did you like the results Fuzzy ART gave: 1 2 3 4 5 6 7 8 9 10
3. How likely will you continue to use Fuzzy ART to categorize suppliers:
1 2 3 4 5 6 7 8 9 10
4. How complicated was Fuzzy ART: 1 2 3 4 5 6 7 8 9 10

Answer yes or no for the following questions:

1. Would you recommend this to other companies to use: Yes No
2. Would you like to continue to use Fuzzy ART: Yes No
3. Do you feel that your time was well spent being trained on how to use Fuzzy ART:
Yes No
4. Did you like how the manager in charge of Fuzzy ART helped/managed the project: Yes
No

Any other comments on Fuzzy ART: