Abstract
This research project will examine case studies of companies that adopted the JIT methodology to comprehend the factors influencing its success or failure. The factors that affect the benefits and risks will be discussed and risk mitigation strategies will be proposed. Computer simulations using Arena will be created to collect data on the benefits and risks of varying inventory sizes and to determine the ideal order quantity to ensure the risks do not outweigh the rewards. It is crucial to first understand the benefits, risks, and influencing factors before implementing JIT inventory management or any process change so that the potential benefits can be maximized, and the risks are accounted for and mitigated. This is important now more than ever with an increasingly complex and globalized supply chain and after the major supply chain disruption of COVID-19. This research aims to produce insights that would benefit organizations considering JIT inventory management and will answer the question of How can computer simulation determine the optimal inventory purchase amounts?

Case Study Analysis
JIT inventory can improve manufacturing profits in many ways. One highly successful case was Harley Davidson which reduced inventory by 75%. Quality issues were found to be reduced by 68%, productivity increased by 50%, manufacturing space was reduced by 25%, and inventory costs were reduced by 75%. [1] There are risks, however. When an earthquake struck Japan in 2016, an unnamed Malaysian manufacturing plant, which operates using JIT and 2-week levels of inventory, was left unable to receive the semiconductors (SC) they used. Production was at a standstill for almost 85 days. For each day of downtime, an estimated $1 million was lost. They also received $20 million in other inventory deliveries they had ordered, but could no longer use due to the SC shortage. Since this event, the company has focused on better assessing the risk of their critical part suppliers and having secondary sourcing for critical components. [2]

Risk Mitigation and Influencing Factors
One way that companies mitigate the risk of inventory out of stock while using JIT strategies is by using low inventory in their manufacturing facilities, but not in the entirety of their supply chain. They use stockpiles, especially for the most vulnerable parts of their supply chain. An example of this is Toyota, the pioneer of JIT. Toyota has warehouses dedicated to holding large amounts of parts needed to manufacture cars, and ships the parts to manufacturing facilities as needed. Toyota also often stocks completed vehicles to be reduced by 68%, productivity increased by 50%, manufacturing space was reduced by 25%, and inventory costs were reduced by 75%. [1] There are risks, however. When an earthquake struck Japan in 2016, an unnamed Malaysian manufacturing plant, which operates using JIT and 2-week levels of inventory, was left unable to receive the semiconductors (SC) they used. Production was at a standstill for almost 85 days. For each day of downtime, an estimated $1 million was lost. They also received $20 million in other inventory deliveries they had ordered, but could no longer use due to the SC shortage. Since this event, the company has focused on better assessing the risk of their critical part suppliers and having secondary sourcing for critical components. [2]

Input Assumptions
This simulation assumed a delivery lead time of 14 days from the order time, with a triangular delay distribution, with a low of 0, a mode of 0, and a high of 18. It also used an assumed production demand of 1 per 2400 minutes with a standard deviation of 4. The holding costs used were $0.1 per item day, and the production profit used was $10 per day. Each of the assumptions could easily be replaced with known data from the process being studied to find the optimal order quantity for that specific process. One limiting factor is that the educational arena license only tolerates 150 units of inventory at a time, however, each unit can be considered a certain quantity of inventory. For example, 1 inventory unit in the arena could represent 5000 for accurate results in a process with large volumes as long as the processing time is adjusted to match.

Arena Simulation

Conclusions
Computer simulations are a good way to assess optimal purchase quantities and inventory resupply levels over a period of time. Delay times and manufacturing times frequently vary, and a simulation allows for random inputs from a given distribution, which shows how the process will be affected by a change over long periods of time. The inputs needed for an inventory simulation are order quantity, order lead time plus order delay distribution, process time and deviation, and additional inventory reorder level. The key outputs received are manufacturing process utilization and item time in inventory. The costs associated with downtime is 1-utilization* profit over a time period. The cost of holding costs the average item time in inventory* holding cost. When these two costs are added together, the total cost of that inventory level is found. The simulation used in this research simulated 10,000 days of operations and found the optimal inventory order quantity for these inputs to be 11. Although there was 7% downtime at this level compared to only 11% at 12, this is due to the rapid increase of time in inventory after 11 units overtaking the downtime costs, which demonstrates that the benefits of JIT inventory management outweigh the risks. When implemented properly, many businesses see cost savings that far exceed their risk when they implement JIT inventory management.

References