MSCI 432 PROJECT

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1 INTRODUCTION

An existing service organization that is selected for this project will be the previous co-op firm Amazon. The work done here was for a software engineering internship in the summer of 2020 on the Amazon Freight team [1]. Amazon Freight is a shipping service across North America and Europe where a fleet of owned trailers and technology are used to ship full or less than full truckload freight across Amazon's network. More specifically, this service uses $53'$ dry haul vans and over 30,000 trailers and carrier partners to ship the loads at competitive rates and with 24/7 shipper support. The work done for the internship was the development of an invoice management system to manage and track shipper invoices across the network. For this project, the focus will be on the various operational processes that come with such a service like this, and suggestions will be made to improve upon some of these processes. This section of Amazon's business is slightly different from what it is most known for, namely that of online retailing, warehousing, and delivery, however, many of the concepts still apply in this case. More specifically, capacity planning, facility layout, quality, supply chain, and circular economy will all be addressed in this project with respect to Amazon Freight, and improvements will be suggested for many of their current processes.

In addition, the following aspects of the service will be critically reviewed: environmental concerns, issues around sustainability, and operational adaptability (especially in the post-pandemic situation). Concepts learned throughout the term will be pulled in and related to these topics to help assess them. Moreover, the following improvements will be suggested for how this section of the company should: procure their materials, handle finished goods transportation (including reverse logistics), and correctly deal with warehousing needs. Including these new aspects from Phase 2 will allow the service of the company to further improve its efficiency in its production and operations, which in turn will result in more revenue generated by this service. In particular, addressing concerns regarding its impact on the environment and sustainability will promote growth in this service and prolong its longevity as a viable option in the shipping industry. By improving in sustainability, they will be able to market themselves as environmentally friendly, which may further give them an edge over their competitors. In terms of the handling of materials, finished goods, and warehousing, improving in these areas promotes increased efficiency of their processes, allowing them to carry out their operations with less use.

2   PROBLEM STATEMENT

As this is a relatively new side of the business, namely that of freight brokerage, there are currently many limitations with this service. The biggest limitation is that it only supports full truckload, and does not support multi-stop shipments, intermodal, ocean, personal shipments, flatbed, LTL, small parcel, residential, drayage, and offer lift gates. As a result, many potential customers are immediately turned away since the service cannot support their type of shipment, hence, a loss of revenue in this case. Moreover, there are some items that cannot be accepted by this service such as hazardous materials (HAZMAT), those requiring refrigeration, and other prohibited goods. Although this is understandable, with respect to safety and the laws, however, this nonetheless is still a decline in revenue due to loss of potential customers. Lastly, the most common logistical issues with this service are the customer support, that is, assisting the shippers when problems occur. The most prominent issues are when the shipments do not arrive on time, or when they are shipped to the wrong location, as there is not much support they can provide.

In addition, issues are present with respect to its environmental impact, namely that of the pollution such a service like this one causes. In particular, when shipments are being passed over between locations, i.e., at an Amazon-based changeover site or at its destination, the truck must be kept running until the transfer process is complete. And depending on how long the transfer takes, the truck could be running idle for a very long time, causing unnecessary air pollution. In terms of sustainability, this service in particular is not quite as sustainable as it could be yet, mostly due to how new it is and how it operates in a rather niche market. It is heavily dependent on a specific set of customers, and as a result is significantly catered towards them, as they are their primary customers. It is more difficult than it should be right now to onboard and gain new customers due to its niche use case, and is a more specialized service as opposed to the more common Amazon services. In terms of its operational adaptability, especially post-pandemic, the service actually benefits from the current situation, as more people and companies are turning to official and more reliable shipping services to be able to ship products during these difficult times. Therefore, the service should look to take advantage of this unprecedented situation to be able to acquire more customers and gain their trust. In terms of procuring materials, handling the transportation of finished goods, and dealing with warehousing needs, the service should continue to find ways to be more efficient in all of these areas. In particular, how it transports its goods is the main function of this service, so improvements should always be made here.

3   POTENTIAL SOLUTIONS

As mentioned in the previous section, there are three main problems with this service: limitations on shipment type, limitations on allowable shipment items, and lack of quick and meaningful customer support. For each of these problems, concepts from capacity planning, facility layout, quality standards, supply chain management, and circular economy can be applied to come up with potential solutions for these problems. The mapping of problems to potential solutions are as follows:

Problem	Potential Solutions
Shipment Type Limitations	Capacity Planning, Supply Chain Management
Shipment Item Limitations	Facility Layout, Circular Economy
Lack of Effective Customer Support	Quality Standards

For shipment type limitations, concepts from capacity planning and supply chain management can be applied to solve this problem. The biggest reason Amazon Freight only supports full truckload freight is because they do not see the need and demand for the other shipment types. This is partially correct, as full truckload is the most prominent shipment type, however, this has problems when it comes to scale. As this service scales and grows over time, it is important that the company eventually adapts these other methods to be able to support more customers. As more shippers learn about this service, more potential customers will be lost due to a lack of shipment type availability. With that being said, concepts of long-term capacity and demand, effective capacity planning, and assessing capacity alternatives will be addressed. Another issue with supporting various shipment types is that the technology is just not yet there to do so, and there are not any immediate plans to provide it. This is a problem because as mentioned previously, this will lose customers over time, resulting in a loss of revenue. There are clear benefits for developing this technology, and concepts from supply chain can back this up. More specifically, the information technology used in supply chain management, the benefits of e-commerce in the transportation industry, and concepts in logistics can explain why adding support for these various shipment types will benefit the company in the long-term.

For shipment item limitations, concepts from facility layout and circular economy are applicable here. The main pain point here is that some items for shipment cannot be supported such as items that are too big, too fragile, or require a specific environment or conditions. This problem can be tackled by looking at two ideas: improvement of the delivery trucks themselves,

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and improvement of the conditions of the destination. The easier solution would be to develop upgrades for the trucks to be able to support these kinds of items. Some ideas could be to add padding for items that are too fragile, install specific heating or cooling machinery for items that require it, and maybe even increase the size of the trucks to accommodate larger items. As such, assuming the truck is the facility in this case, improvements to the facility layout, having a fail-safe service process, and dealing with variable task times and bottlenecks are solutions for this problem. Moreover, the concept of circular economy applies here, a principle that aims to redefine growth, focusing on positive society-wide benefits. It is based on designing out waste and pollution, keeping products and materials in use, and regenerating natural systems [2]. This is an important concept to keep in mind when trying to widen support for additional items. Items that are too wasteful to natural resource use should be accounted for, and possibly denied if deemed to be too harmful for the environment. If transportation of these items results in more pollution than necessary, this may become a net negative should these items be considered. If there is less wasteful method of transporting these items, such as by air, then that may end up being the better option, even if it means losing out on potential revenue here.

Finally, for the lack of quick and effective customer support, concepts from quality standard apply here. The problem with customer support for this service is that it is difficult to come up with a solution that will satisfy everyone. The four parties involved here are Amazon Freight, the shipper, the source, and the destination. For example, if the destination client complains that they have not yet received the shipment, the company does not yet know right away whether it is still at the source, or on route to its destination. Similarly, issues could arise such as the shipper transporting the shipment to the wrong destination or being delayed due to traffic or an accident. Furthermore, if the shipment is intended to move through multiple locations to get to its final destination, the delays could propagate leading to massive wait times. With all these issues, the company is at a loss here, because they can only do so much as to informing them of the current status of the shipment. They do not have any control over the situation and are only forced to trust that shipments are transported on time. With that being said, improvements can be made with regards to the quality of the customer support. In particular, concepts from the Total Quality Management methodology can be applied to help solve this problem. In addition, the various ideas from problem solving, process improvement, and quality tools can be utilized to solve some of these issues with respect to customer support and management.

Moving onto the issues identified for Phase 2: harmful pollution generation during changeover phases, lack of stability due to difficult onboarding and operating in a niche market, failing to capitalize on the benefits of the pandemic, and not being able to quickly optimize the efficiency of handling finished goods for transportation. For each of these problems, concepts from inventory management, aggregate operations planning (AOP), material requirements planning (MRP), and project management can be applied to generate feasible solutions for these problems. Similar to Phase 1, the mapping of problem to potential solutions:

Problem	Potential Solutions
Changeover Pollution Generation	Inventory Management
Lack of Onboarding Stability	Project Management
Failing to Capitalize on Pandemic Benefits	Material Requirements Planning
Not Optimizing Transportation Fast Enough	Aggregate Operations Planning

For changeover pollution generation, concepts from inventory management can be applied to solve this problem. For this service, the inventory in this case is the stock of goods being held within the trucks themselves. The major issue here is that for each changeover, the company has to verify all the items are present in the truck before it can continue its shipment, which causes problems with respect to environmental concerns. In particular, the changeovers happen rapidly, to increase efficiency of the service and minimize any delays that occur, so as a result, the trucks are left running in idle while the items are being verified. This system is a poor use of inventory management, in that there is currently no other way to track and validate the items. To solve this problem, the company should implement some sort of automated tracker, which goes along with the trucks, and provides quick and accurate detailing of the items inside. This is a form of tracking and inventory control which will allow changeovers to happen significantly faster, thereby reducing the amount of idle time of the trucks, resulting in less environmental pollution.

For the lack of onboarding stability and niche market operation, concepts from project management can be applied to solve this problem. One pain point of this service is its inability to effectively onboard new customers, which impacts its ability to grow, thereby affecting the sustainability of the service. This is a significant impact on its long-term viability and growth; therefore, the company should employ the following project management techniques in order to improve this area. There exists a list of projects for improvement of this aspect of the service: implementing an incentive program for new shippers, providing real-time service to new

shippers, and introducing a difficulty rating for shipments. Each project would improve the service's ability to generate new customers, therefore, they should employ project planning and communications planning to analyze in what order the projects would most optimize the stability of the onboarding process. To schedule these projects, they should utilize project scheduling tools such as WBS's and Gantt charts, as well as use a precedence network to determine the most optimal way to carry out these projects.

For the failure to capitalize on the benefits stemming from the pandemic, concepts from material requirements planning can be applied to solve this problem. In particular, sometimes, the amount of shipment delivered was either less or more than expected due to issues like incorrect invoices or a change of material requirements. This results in wasted efficiency, as the items would have to either be stocked at its current destination to be dealt with later or continued on its journey or brought back to its original location. This was more prominent during the pandemic, where needs were much more dynamic and constantly changing because of it. This problem can be addressed with a simple material resource plan, one that is common and accessible between all parties of the shipments, so that the quantities of incoming goods are agreed upon and as expected. With such a document like this, there is no possibility of changing the amount of expected goods, an act that is especially prominent during this pandemic, so by having a system like this in place, they not only resolve their issues now, but also in the future for any subsequent unprecedented situations.

For the lack of effectively optimizing general transportation and the handling of finished goods, concepts from aggregate operations planning can be applied to solve this problem. More specifically, the company should look to use the strategies involved in aggregate services planning, namely, to take advantage of yield management and the variability in demand for shipment needs with respect to the season. Yield management is the strategy of making the price of the service variable based on the supply and demand of it. In this case, this service is relatively even across the seasons, as customers tend to require shipment services irrespective of the current season. However, there tends to be more demand around the times of the summer and of Christmas, as people need to ship items that are specific to summer such as lawn maintenance equipment, or specific to Christmas such as large-scale presents. As a result, the company should look to increase the prices around these in-demand times and decrease during downtime. This would lead to more optimized transportations and a better handling of these goods.

4 DISCUSSION

For shipment type limitations, long-term capacity and demand, effective capacity planning, and assessing capacity alternatives can help reason why supporting more shipment types is important. Long-term capacity directly impacts the ability of a company to meet future demand, and since the company plans to scale this service up, it is important to eventually provide this variability in its service. Planning for the long-term also minimizes costs and use of resources, something that is highly sought after at Amazon, as frugality is one of their leadership principles [3]. Long-term also affects competitiveness; their biggest competitor is Uber, as they also have a shipping service known as Uber Freight [4]. If Uber implements some of the shipment types that Amazon do not offer, they will directly lose customers to their biggest competitor. Effective capacity planning should be utilized to forecast the future demand of the shipment types not yet offered. They should prioritize in what order they begin to implement new shipment types, based on their projected forecasts. This will lead to maximizing the number of new customers they receive and scale faster in the future. Supporting higher shipment variability adds flexibility into the system and helps mature the product into a more robust service. By allocating some work towards this system, they further satisfy consumer demand and ultimately bring in more capital for the company. With respect to the technology behind this, there are already robust systems setup to help support this service. There is a Management Information System (MIS) to help track the shipments and invoices for each shipper, as well as Electronic Data Interchange (EDI) setup to provide near real-time updates for the status of shipments. As such, these are very useful tools that should continue to be supported and worked on. These tools improve the companies' competitiveness, quality, and overall logistics.

For shipment item limitations, improvements to the facility layout, having a fail-safe service process, and dealing with variable task times and bottlenecks can help improve their item support. As mentioned previously, there are various ways in which the delivery trucks themselves can be modified to allow for more items. Examples include developing trucks with larger storage space to transport larger items, adding padding or supports to the inside to account for fragile items, and implementing heating or cooling systems to house items that depend on specific environments. Although this seems costly at first, these changes would be able to accommodate more customers, and perhaps in the long-term, generate more revenue, and end up outweighing that initial cost of adding these new solutions in the first place. A fail-safe service

process is one that suggests that the service provider (Amazon Freight in this case) has a great incentive to ensure that the process is fail-safe, i.e., not prone to failure. When implementing these changes, it is important that these new systems are thoroughly tested to ensure they are safe. Once they are known to be safe, they become robust and reliable systems that the shippers do not have to worry about during their shipments. This promotes customer trust and keeps them happy and away from competitors. Variable task times are task times changing due to external events such as mechanical failures and delays in transport due to traffic. In the case of environment dependent items, some of these items may only be able to be in transport for a certain amount of time. As such, build in and consider this time when estimating time of arrival for the shipments. If a certain item cannot last as long as it takes to get it to its destination, then do not let the shipment happen. Although this loses out on revenue, this ensures safety of both the items as well as the shippers, which results in more gains in customer trust.

For improving customer support, the Total Quality Management (TQM) philosophy, as well as problem solving, process improvement, and quality tools from quality standards applies here, and can lead to more effective help and communication between the company and the shippers. The TQM approach involves finding out what the customer wants, designing the service that meets their wants, and keeping track of the results. In this case, customer support can be improved by simply listening to the customers and incorporating some of the feedback they give. Another leadership principle Amazon follows is customer obsession, and this is a good example of that. By obsessing over the customer (the shippers in this case), the company would tailor their development and feature work toward their customers and be able to give them exactly what they want. For example, if the customer mentions that support needs to be faster, the company can consider fixing this by streamlining aspects of the support system or by training and hiring more customer support workers. Customer feedback can be treated as data and collected to be analyzed. If trends are found in this data, then the company can prioritize in what order to improve aspects of customer support. For example, if the most prominent issue is how long it takes for support to figure out where a shipment on route currently is, then the company can consider putting more resources into improving the shipment tracking technology. More importantly, once improvements are implemented, the company should monitor their solutions. If indeed they are helping, then this proves that their solutions to the problems have worked. Lastly, the company could periodically interview their customers (shippers) for feedback.

For changeover pollution generation, the automated inventory tracker is an effective method for reducing the pollution caused by this service. The tracker would work by keeping count of all the items currently in the truck, and automatically update any items once they get added to or removed from the truck. This is better than the current method of manual inspection because it saves time at the changeover port, which in turn leads to less idle time of the truck and overall, less time spent at the port, which leads to less pollution generated by the truck. Effective inventory management involves some sort of system to plan for and manage these items, and as with many stocking and inventorial applications, it is generally more efficient to have an automated process as opposed to a manual one. As long as the tracker is safe and accurate, it will perform no worse than normal human verification. Thus, it will require some company resources and development time to be able to implement such a system, however, in the long-term, this is an investment that is worth it to undertake. So, initially, the growth of the service will slow down as a result of the shift in the company's use of resources, but once it is fully implemented, it will eventually show positive results with respect to saving time and producing less waste. In terms of the changeover locations themselves, there does exist a small inventory that contains any unintentional items from previous shipments as well as items that are commonly shipped across those lanes that act as safety stocks. As a result of the possibility of shipments missing items, it is particularly important that these safety stocks are not outdated and available for use. If certain shipments are missing items but the changeover stations have them in stock, then the verifiers can quickly replace those items for the shipment. This not only results in a full and complete shipment, but also reduces the idle time of the trucks. More specifically, the time it takes to replace said items is much less than the time it takes to process missing items. Therefore, it is important to carry the optimal amount of safety stock to not only replace any missing items, but also to minimize the amount of holding costs as a result of this safety stock.

For the lack of onboarding stability and niche market operation, the use of project scheduling tools like WBS's and Gantt charts, as well as utilizing a precedence network, are effective ways to carry out the projects aimed at improving the onboarding experience. Namely, the three projects are: implementing an incentive program for new shippers, providing real-time service to new shippers, and introducing a difficulty rating for shipments. For each project, a WBS or Gantt chart can be constructed that illustrates how long each would take and the resources required to complete each of them. This would help them determine how it can be fit

into their current schedule, and whether or not it would be worth it to shift around already scheduled tasks in order to more optimize the use of their time. Investing in the projects mentioned above directly improve the quality of the onboarding experience as well as the retention rate of newer shippers. In particular, by offering incentives for newer customers, there would be a higher likelihood of them staying with the service. This is also true if further providing more specialized services for them. Moreover, another technique to assist in the scheduling of these projects is the use of PERT/CPM, that is, the creation of a precedence network. This is relevant because there exists an overlap between the projects, as all would require a common shipper network with similarities such as tracking the status of shippers. For instance, all three projects rely on the shipper status system to be functional, thus, they are dependent on that finishing first, acting as the source of the precedence network. Then, the projects diverge in their needs and requirements, and as such, the company can reallocate resources as necessary. For example, the have all the developers working on the main shipper system, and then split them up according to skill level and difficulty of the projects as required.

For the failure to capitalize on the benefits of the pandemic, a shared material resource plan is an effective way of dealing with this problem in the future. This service is special in that it actually gained usage rate during the pandemic, as consumers needed ways of delivering shipments while still meeting the rules and regulations put in place for the pandemic. Thus, with more demand came more instances of incorrect shipments as a result of missing or excess items. Therefore, the proposed solution is the development of a universal, or commonly shared material resource plan which ensures the status of goods on the shipments and allows the changeover stations to have more or less safety stock on-hand to ensure shipments are properly executed.

For the lack of effectively optimizing general transportation and the handling of finished goods, implementing the concept of yield management is a viable way of improving efficiency of deliveries. With spikes in summer and winter, and declines in spring and fall, there exists a pattern that can be taken advantage of by yield management. That is, setting the price higher on peak periods with the intention of maximizing revenue. Currently, the system offers the same pay year-round, which could steer away consumers during off-seasons, as well as not make as much as it could have during peak seasons. This indirectly affects the efficiency of transportations because the pay also scales off how big the shipments are, so it would be ideal for the company to pay more when shipments are larger and more prominent.

5   CONCLUSION

In this project, a previous internship at Amazon Freight was used to critically assess and suggest improvements for its various operational processes. This part of the business provides shipment services to allow shippers to transport full truckloads of goods across North America and Europe. The concepts of capacity planning, facility layout, quality standards, supply chain management, and circular economy were used to tackle some of the issues with this service. Three main problems were identified: limitations on the type of shipment, limitations on the shipment items that are allowed, and the lack of effective customer support for the shippers. For each problem, various potential solutions were generated using the concepts mentioned previously. For shipment type limitations, capacity planning concepts like long-term capacity and demand, effective capacity planning, and assessing capacity alternatives were used. In addition, supply chain management ideas such as the information technology used in supply chain management, the benefits of e-commerce in the transportation industry, and concepts in logistics were utilized. For shipment item limitations, the problems were dealt with by considering improvements to the facility layout, having a fail-safe service process, and dealing with variable task times and bottlenecks. Moreover, ideas pertaining to maintaining a circular economy and being in line with Amazon's leadership principles help in fixing some of the itemization issues. Lastly, for increasing the effectiveness of customer support, various quality standards methodologies like the Total Quality Management (TQM) philosophy, as well as general problem solving, process improvement, and quality tools, aid in finding ways to improve upon the companies' customer support system.

For Phase 2 of the project, four more problems were identified: harmful pollution generation during changeover phases, lack of stability due to difficult onboarding and operating in a niche market, failing to capitalize on the benefits of the pandemic, and not being able to quickly optimize the efficiency of handling finished goods for transportation. For each problem, similar to Phase 1, various potential solutions were generated, but instead using concepts from inventory management, aggregate operations planning, material requirements planning, and project management. For harmful pollution generation, inventory management in the form of an automated inventory tracker was suggested to combat the prolonged idle times of the trucks due to manual verification, causing unnecessary pollution from the trucks. For the lack of onboarding stability, the utilization of project scheduling techniques, as well as the use of a precedence

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network, from project management, were proposed ways to effectively implement the stability improving projects. For failing to capitalize on the pandemic benefits, a shared material resource plan from material requirements planning was suggested to employ clear and accurate information between all parties, which is meant to prevent the sheer number of incorrect shipments as a result of increased services for the pandemic. For not being able to quickly optimize transportation methods, the concept of yield management from aggregate operations planning was suggested as a way of maximizing revenue based on the peak seasons, resulting in dynamic reactionary pricing as opposed to static pricing.

6 LIMITATIONS

Limitations exist with respect to figuring out solutions for the first two problems. With shipment type, it would take a while to implement the systems to be able to support it. Development resources would have to be allocated to making it, which will take development work out of the main full truckload system. There are also problems with logistics, as the destination would have to account for more shipment types, which could cause issues. For accommodating more shipment items, this most likely requires large changes to the trucks themselves, which will be costly. A cost analysis is required here to determine whether or not it is worth it to invest in these changes, especially in the long-term.

For Phase 2, limitations exist for the first three problems. With the automated inventory tracker to help combat pollution generation, there exists a large initial investment cost to this solution. Most prominently, development time must be dedicated to creating this system, which will take time out of other products of the service. With respect to the project scheduling for ways to improve the onboarding stability, there are limitations when it comes to how much can actually be implemented. More specifically, the amount and quality of the projects that can be done are dependent on how much resources the company actually has. Thus, the scheduling techniques are limited on aspects like how many employees are available for use, as well as how much time to reasonably allot for these tasks. Lastly, implementing a material resource plan to help address the discrepancies as a result of unprecedented events like the pandemic have its limitations. Most notably, since it is shared amongst all corresponding shippers and changeover employees, it needs to be constantly updated and accurate to real-time, which requires a dedicated team of full-time developers, an expensive investment.

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