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The Effects of Route Optimization Software to the Customer Satisfaction

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Abstract

Route optimization, which is a result of the advancement of technology today, makes companies profitable within months. The aim of this study is to explain the relation between route optimization software and the customer satisfaction. Route optimization softwares become widely used by the companies and this study touches briefly on the subject of the relation between route optimization software and customer satisfaction level. While explain this relation, the study described route optimization software, how it works and its execution areas. Hereafter, the article start to explain customer satisfaction and route optimization software's effects on customer satisfaction and conclude the study. In the drafting and writing process of this article, the topic is detaily searched and analyzed.

Keywords: Route optimization, customer satisfaction, software

1. INTRODUCTION

As of today, the usage of technological advancements by the companies are significantly increase because they are pretty simple and make the job easier than it seems. In addition to that, after the applying process of technology, companies become profitable within months. Altought the transition seems scary and risky process by the business owners and managers, the results are worth to take that decission because the technological advencements are generally increase the competetive advantage of companies in the presence of their rivals. Earlier to take transition decision, better the market pozition in an industry.

Recently, as the technology improve, companies start to benefit from it. One of these technologies is the route optimization. Route optimization simply sequencing the adresses that need to be visit and bring visibility to your deliveries. It counts all the constratints like fleet size/capacity, number of addreses to deliver, number of addresses to pick-up. In addition to these constraints it is also count the road blockages, park restrictions and even weather warnings. After the dispatcher import addresses into the system and then algorithmis start to find the best route and sequnce the addreses, withinn seconds it gives you the optimal route for your deliveries. According the features that provided by the route optimization company that the company choose, the dispatcher of a company can add and drop addresses and

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send the optimized route to the drivers' phone. This facility provides same-day delivery and/or same-day pick-up options. Route optimization has also green side which is trend concept for any business in these days [1]. The reason of green delivery is that with the optimized routes, drivers spend less time in traffic and they make less kilometer so that trucks consume less fuel which also decreases the carbon emmision. So that less fuel usage is just not cutting your cost but also decrease the carbon emmision and keep our environment green for the generations to come. This situation is kind of win-win for both the company and the environment. In addition to that, route optimization saves your time. Instead of manually dispatching all the routes whics takes to many times to organize, you can simply click one botton and it dispatch all the adresses perfectly and gives you more accurate results. Thus, as a delivery business you can give more time on other important functions of your company [2].

Customer satisfaction has important signafigance of any kind of companies because consumers are the main sources of your profit and no one wants to loose their satisfaction or trust. One of the way of customer satisfaction is making fast and safe deliveries. Even if its possible making same day deliveries would led to high level of customer satisfaction. This is where route optimization came into place. Route optimization facilitates same-day delivery option by doing so the companies can increase their customers' level of satisfaction. Moreover, the visibility of the deliveries has also positive impact on customer satisfaction because customers can know in which time period their cargos going to be delivered and plan rest of their day accordingly. The delivery time window also allows customer to determnine his/her own delivery time period. For instance a customer can choose as a delivery time period between 5 p.m. to 6 p.m. and the delivery company can optimize the route accordingly [3].

Chu et al. discussed how an online meal delivery platform can improve the performance of last mile delivery services using multi-source data. Delivery time is a critical but uncertain factor for online platforms, which are also considered to be the main challenges in order assignment and forwarding service. To overcome this challenge, they propose a data-driven optimization approach that combines machine learning techniques with capable vehicle routing optimization. Machine learning methods can provide more accurate predictions and are gaining more and more attention in the field of operations research. However, unlike the traditional predict and then optimize paradigm, they used a new intelligent predict then optimize framework generated by the decision error instead of the prediction target prediction error when applying machine learning [4].

Bányai proposed a real-time scheduling optimization model focusing on the energy efficiency of the operation. After the study is a systematic literature review, this article introduces a mathematical model of last mile delivery problems including scheduling and assignment problems. The aim of the proposed model is to determine the optimal assignment and scheduling for each order so as to minimize energy consumption allowing to increase energy efficiency. Next, a heuristic based on black hole optimization, whose performance is validated by different benchmark functions, is described. The scenario analysis in the proposed model validates the model and evaluates its performance to improve energy efficiency in last mile logistics [5].

Eskandaripour and Boldsaikhan reviewed numerous research findings on drone last-mile delivery in recent years, selecting a collection of mostly articles from 2011 to 2022. They analyzed their data in terms of key technical challenges such as routing, cargo distribution optimization, battery management, data communication and environmental protection. These challenges

have been seen to be interrelated in terms of enabling eco-friendly, efficient, lean, last-mile drone delivery [6].

Liu's study aimed to solve the last mile deployment of rural e-commerce logistics (RECL) for the survival of the third-party logistics enterprise. Taking into account the characteristics of RECL (long transport chain and low consumption density), a route optimization model for last mile distribution of RECL was established to maximize the profit of the state-subsidized logistics enterprise. The analysis results also show how the number of vehicles affects the maximum profit of the logistics enterprise and the scope of the RECL logistics network [7].

Ferrer et al. proposed a compromise programming model for multi-criteria optimization for humanitarian organizations to carry large amounts of aid for distribution after disasters. At this point, the proposed model includes multiple and often conflicting performance criteria for the last mile distribution, such as handling, time (deprivation), cost, scope, equity and safety. The proposed model is the first multi-criteria model capable of generating a tool program in humanitarian aid delivery. The proposed multi-criteria optimization is tested with a realistic test case based on the 2010 Pakistani floods [8].

2. ROUTE OPTIMIZATION AND USAGES AREAS

Recent technological advencements led to new opportunities for companies in every sector. It is important to keep track those opportunities and take the risk of applying process for your company. The businesses who took that risk and apply new technologies have gained competetive advantage over their rivals.

One of those technological advencements is route optimization. Route optimization tries to reduce the total distance that each truck made and increase the efficiency of deliveries. What mean by efficiency of deliveries is that it cuts cost via spending less hour in the traffic and decreases fuel consumption. It takes less time to dispatch all the addreses that need to be visit and increase the accurateness of the addreses because the human factor is not involved in dispatching process, if the dispatcher import all the addreses without making any mistakes then the algorithim sequence those addreses in a perfect manner [9].

The algorithims that help to optimize routes are playing crucial role here. Route optimization is a combinatorial optimization problem that aims to get around a given number of points with the least cost. For its solution, many heuristic algorithms that are used in many areas have been developed. The reason for the development of heuristic algorithms is that the route optimization problem is a problem that cannot be achieved with any algorithm. It is difficult to optimize Route optimization in polynomial time and close to optimum results can be found with the help of heuristic algorithms [1].

In addition, it brings flexibility to your deliveries. Every delivery includes different constraints for example their size, delivery time window, the tempurature range etc., and route optimization software counts all these constraints, algorithims work accordingly as a result it brings the optimal option for your deliveries [10].

Moreover in flexibility part urgent situation can happen in any company. There could be managerial crisis, liquidity crisis or environmental crisis. These can happen at any time and companies should be ready to all of these issues. In delivery companies the risk of crisis is much more because they are dealing with customers and they have fleet that anytime could led to a problem. For instance, one of driver can get sick or one of the truck could breakdown in that situatuion the dispatcher can easily assign the duties of the sick driver to other drivers, share the duties

and it does not let any delays and inconvenience in delivery process [11].

Also in dispatching process one of the trucks could breakdown in such situation it is important to have back-up plans, in such situation route optimization comes with life-saving feaute the re-optimization tool. Re-optimization allows the dispathcer to assign duties to any driver in the mission. However, this feature is not facilitated by all of the route optimization software companies. The companies who offer this quality generally charge higher prices compare to the others. That is why it is important to choose the right route optimization software company for your business [12].

Applying new technologies to your company is important but it also important that choosing the right company to use technology. There are several route optimization software companies and they are becoming more and more. The important decision that companies decide is which route optimization software company to work with. There are several factors that you need to consider before make an agreement with route optimization software company.

First thing that you need to consider is whether the optimization company's facilities is matching with your delivery portfolio and comes with a solution to your problems. If the route optimization software company supply all of your requirements you can move forward and consider other important factors. The next thing that you should care about is the useness of the software. It should not requires high level of training and examining because they are all cost for the company. That is why it should be easy to learn and use like a dailiy used applications WhatsApp, Twitter, Youtube. In addition to reason of easy to use is that the users of this software (dispatcher(s) and drivers) are avarage people, they do not have any technical knowledge about route optimization software that is why the software itself should be easy to use and the users can get what they want easily and quickly.

Other important factor when we try to find best fit route optimization software to our company is that it should has accurate estimated time of arrival information. This is an important indicator because consumers like to see their deliveries' situation and they want to arrange their job according the arrival time of their delivery. More accurate estimation time of arrival information more you have satisfied customers which laterly mention in this article.

If all other requirements supplied, you should look for other important indicator which is efficiency of route optimization software. The map view of the software should be clear for the dispatcher and drivers so that there would not be any mistake made by them. Also the addresses must be clearly registered in order to prevent any wrong cargo delivery.

Last and may be the most important thing that you should consider before get route optmization software is application programing interface (API) integration. API integration is crucial because the dispatcher optimize the route on computer however in order to send this information to the drivers phone the route optimization software company needs to have mobile application that is available on ios and android application markets. The availability of the application is not enough by itself, it has to be working without any misinformation and error because only one single mistake can effect the whole delivery chain.

Route optimization software has been using by different industires with different purposses. However, surely these industires have one common goal which is to reduce cost and increase the efficiency of transportation. This is the main reason of having route optimization software by various of industryies and hundered of businesses.

Route Optimization has basic usage areas such as logistics and fleet management, food delivery services, health services, waste collection, and marketing. One of the sectors where route optimization is used the most is logistics. It is vitally important for the company to calculate the most ideal route, especially for long-distance cargo delivery [13].

By using route optimization, logistics companies can reduce the number of vehicles and drivers they have, thus reducing fuel budgets. Route optimization automates and distributes workloads across your fleet. GPS tracking devices connected to vehicles in the fleet track the location of these vehicles and collect historical data. Route optimization enables efficient weekly long-distance planning, including overnight stops and planned breaks. This routing also complies with regulations in various countries and regions.

Demand for ordering food from outside has surged, especially since the pandemic. Therefore, route optimization is a necessary path for both service quality and carrier safety in ordering food industry. Route optimization is also used in the food distribution sector, where delivery is made by motor courier, by determining the most efficient routes with routes calculated based on real road distances [13].

In a dynamic and competitive industry like the food industry, efficiently serving consumers is critical. Many food delivery companies face many challenges, including find the fastest routes and fulfill orders in a timely and appropriate manner.

One of the best use cases for route optimization is the healthcare industry. Route optimization isn't just for time-consuming emergencies. It also increases the efficiency of medical facilities in regular home visits to provide preventive health services. For example, routing injection teams to operate during the Covid-19 period can greatly improve the efficiency of healthcare also it helped to slow down the inflected people rate with the increasing rate of vaccination.

Moreover, route optimization allows healthcare workers to spend more time with their patients, thus improving the quality of testing and service and reducing costs as in other areas because healthcare workers get paid for the servie that they make not for travelling. In addition to that, it helps to make appointments more predictable. All these factors increase customer satisfaction and improve the quality of healthcare services.

Route optimization, which was started to be implemented in the city of Homestead in Florida, gave very positive results. The most appropriate point in the city and when to collect waste can be determined with a geographic information system (GIS) based route optimization modeling software. For this, parameters such as the amount of waste produced, the number of houses and workplaces served, and the distance from the collection point to the storage facility are used. In this way, the waste collection time from each region can be shortened [14].

Thanks to route optimization, municipalities can increase the number of waste collection points without increasing staff or building new facilities. Additionally, route optimization has benefits such as maximizing staff efficiency, reducing service costs, and significantly reducing fuel consumption [15].

Route optimization has also great impact on improving your marketing strategy. Marketing departments that have to work in the field can achieve great success with the right route optimization technology. Route optimization allows businesses to easily monitor changing market dynamics and customer status. This allows us to better understand our geographical distribution areas and specialize in the specific conditions of each region. Marketers are good at dealing with unexpected changes. Last-minute booking requests, varying weather conditions,

or transportation delays. In short, fast and effective route automation is critical for businesses that rely on field-based workforces, especially in times of change and uncertainty [16].

3. THE RELATIONSHIP BETWEEN ROUTE OPTIMIZATION AND CUSTOMER SATISFACTION

The term customer satisfaction is become an important parameter for almost every company because customers are the one who is the biggest source of profit to companies. In the absence of even one customer, companies need to find someone else to maintain its profit. In such situation the effect of one customer is also getting bigger and bigger with the help of again technology. The reason of that impact is social media and the online-shopping applications.

One single customers dissatisfaction has an impact on almost hundereds of potential buyers and it led you to lost those potential customers. In such situation, potential buyers are searching for buyers feedbacks, photos of the product and comparision videos. If they see any disturbunce about product, service or difficulities in delivery process, they would give up on that product. In addition to effect of social media and online shopping applications, a bad experince of a customer can effect the inner circle, familiy and friends and it again led to decrease in the sales of company. The researchs shows that customers are willing to pay more on the product just for having better customer service. They can even give up on the product that they used to buy just for better traited. This situation shows that having satisfied customers has great impact on companiy's succes. Therefore, resolving customer complaints and ensuring customer satisfaction required overcoming pretending. Companies that develop various strategies to ensure customer satisfaction in the sector can achieve their goals. Increasing this satisfaction level is possible by meeting the customer's needs and meeting their wishes [17].

Today, meeting customer demands in the shortest time and at the least cost is the most challenging task of maintaining any supply chain. The most challenging process in the sustainability of the supply chain is to meet customer demands in the shortest time and at the least cost. To solve this challenge, the vehicle routing problem (VRP) plays an important role in logistics. While a single warehouse is designed for customers in a modeled VRP, in real life a single warehouse will not be sufficient to meet customer demand or customer satisfaction. In this context, Rajak et al. proposed a model that solves the customer satisfaction-based multi-depot vehicle routing problem (MDVRPCS). Since MDVRPCS is an NP-hard problem, ant colony optimization (ACO) has been proposed to solve MDVRPCS. The proposed algorithm has been tested for well-known problem examples in the literature. The results show that the algorithm can obtain good optimal solutions [18].

Dynamic vehicle routing and scheduling problem is a well-known complex combinatorial optimization problem that has received great attention in recent years. Barkaoui presents an algorithm in his work that clearly aims to improve customer satisfaction, presenting a new strategy for integrating anticipated future visit requests during plan creation. An evaluation of the proposed algorithm was performed using a pre-designed hybrid genetic algorithm for the dynamic vehicle problem with time windows, which we modified to achieve customer satisfaction across multiple visits. The simulations and the value of the revisited algorithm utilizing the new strategy are compared and its effect on the level of customer satisfaction is clearly shown [19].

In their study, Zhang et al. proposed a route optimization model based on customer time satisfaction of the instant distribution system, since the actual factors in the instant distribution service scenario are not sufficient in the current distribution route optimization. The model proposed in the study includes real

factors in instant delivery such as flexible time window, pay-to-order mechanism, time required for seller to prepare goods before delivery, and delivery consolidation. In the developed model, a multi-objective optimization framework based on the customer's total cost function and time satisfaction was created. Double layer chromosome coding based on supplier-to-node mapping and access order was performed and non-dominant sequencing genetic algorithm version II (NSGA-II) was used to solve the problem. According to the numerical results, when the customer's time satisfaction is taken into account in the instant delivery routing problem, customer satisfaction has increased effectively and the balance between customer satisfaction and delivery cost has been achieved by Pareto optimization [20].

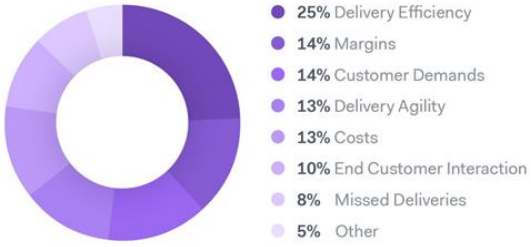

Figure 1 Bigges Last Mile Challenge [21]

A survey was conducted with 194 managers from leading global logistics providers in the industry and 129 supply chain managers from retailers, manufacturers and brands [12]. Participants in this study were asked questions about changing consumer behavior and increasing shipping costs. In the table formed by the answers, it is seen that the growth of e-commerce has led to a 33% increase in B2B (Business to Business) last mile delivery demand and a 67% increase for B2C (Business to Customer) businesses in the same period. Accordingly, with the increase in the volume of last mile deliveries, which is one of the biggest challenges, it becomes difficult to maintain efficiency and manage costs.

According to the graph that emerged as a result of the research in Figure 1, 25% of companies today cite "Delivery Efficiency" as the biggest challenge in the final stage [16]. This is followed by “margins” with 14%, “Customer Demands” with 14%, “Delivery Agility” with 13%, “Costs” with 13%, “End Customer Interaction” with 10%, “Missed Deliveries” with 8% and "Others" with 5%. With the conclusion drawn from here, it is seen that the biggest difficulty is delivery efficiency.

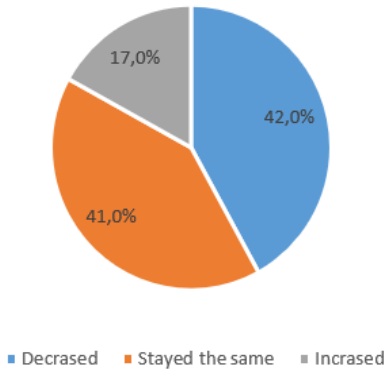

Figure 2 Margins of companies in last mile [21]

In the survey, the increase, decrease and stay of the margins of the companies that used last mile route optimization in the last 18 months were examined. As a result of the research, some surprises were found in the data obtained for the last mile challenges. For example, margin protection of companies and increased costs are ranked significantly lower than delivery efficiency. This can be caused by final rate increases among some of the major last mile providers causing last mile rates to vary. As can be seen in Figure 2, which was created in the light of the data obtained, the providers stated that the companies saw fixed or increasing margins the most, and only 42% had their margins decreased, 41% remained the same, and increased 17% [21].

The relationship between route optimization software and customer satisfaction is quite interesting topic to search about because it is kind of win win situation for both parties - customer and company-. It is a “win” for companies because with the help of the route optimization software, they can decrease cost

which include fuel, total distance, work shifts and increase the efficiency of deliveries. It is also a "win" for customers because it promotes on-time deliveries, visibility of the delivery, same-day delivery or pick-up options, accurate estimated time of arrival (ETA), customer update facility and preference of way to update [22].

The first effect of route optimization software to the customer satisfaction is on-time deliveries. On-time deliveries has significant effects on customer satisfaction because almost every customer would be happy if their cargo delivered at time. No one wants delays and cancels in their deliveries. Route optimization software offers this facility via powerfull algorithims that sequance the addreses and reduce the total distance. With the help of route optimization software delays that caused by delivery company almost become impossible because it has accurate estimated time of arrival data which is another effect that I detaily explain in the coming effects. On-time deliveries become almost impossible espacially in the Covid-19 era because the amount of online orders has increased significantly and delivery companies had hard times to supply that demand.

At that time, the importance of route optimization solution become apparent for delivery companies and for the satisfaction of the customers. In addition to pandemic era, in some important days in the year, cargo companies become too busy like valentines day, mothers day, chrismist era etc. and cargo companies cannot succesfuly deal with all the deliveries without the help of route optimization software. Moreover, the black friday madness become popular all over the world and online shopping plartforms are vanguards of this period that is why people show overfondness to discounted products and there is congestion in delivery process and lot of delays and cancels happen in the delivery process. As a result customers became aggrivied and there is absoulitly no satisfaction. Therefore route optimization software effects the whole delivery process in a good way and increase the number of on time deliveries even in the peak times resulted with satisfied customers.

The second effect of rotue optmization software to the customer satisfaction is visibility of the delivery. This feature of the route optimization software increases the customer satisfaction because the customers can know exactly where their cargo is and want to get updated by the delivery company. If delivery company leave the customer in the dark and does not give any information about his/her cargo then customer would be disturb in that situation. This problem led to decrease in customer satisfaction. In order to prevent this, route optimization software comes with the feature of real-time tracking with the help of this feature customers can exactly now where their cargo is and if any urgent situation happen they can see that situation in the tracking page. In addition to that, the customers can see their drivers name, the vehicle type and the status of their cargo. Even this tracking page has not crithical importance, it gives customer confidence and make away with their concuesness while improving customer satisfaction [23, 24].

Another effect of route optimization software to the customer satisfaction is same-day delivery or pick-up options. This effect may be the most important tool for customer satisfaction because the avaibility of same-day delivery or pick-up shows that your system is working fluently there is not any problem and in particularly you are fast at your deliveries. Ten years ago, if you say same-day deliveres are possible then no one ever going to believe you but now it becomes even normal to our ears. Thanks to route optimization software, the delivery points can re-arrenge with the option of "re-optimizing". If there is any same-day delivery option, the dispatcher can re-optimize the route and make the same-day delivery or pick-up possible. However, this feature is not available all the route optimization software companies. If same-day deliveries are important tool for the

companies then they should choose the company with offers re-optimization feature in its software product [25, 26].

The accurateness of estimate time of arrival has crucial effect on the customer satisfaction. Better estimation means more satisfied consumers in that equation. Every late delivery is not different than the failed delivery for all the delivery businesses that is why delivery businesses needs to deliver customers' cargos on time. Estimation of arrival could be very important in that sense because consumers can arrange their daily plans accordingly and they want their cargos in the estimated time of arrivals. Therefore, early deliveries even could be a problem because as the consumer make their plan according the estimated time of arrival, he/she could not be at home for recieving the package. Late deliveries is already problem for the consumer and it means failed delivery for business owner. So that route optimization software helps the delivery businesses to have better guess on estimated time of arrival and it increases the consumer satisfaction. In addition, some customers may want to recieve his/her delivery before/after certain hour or between certain hours, in that sense route optimization software allows the dispatcher the plan the route accordingly. The dispatcher needs to enter these parameters and just need to click optimize botton. The algorithims itselfs handle the rest and plan the route according the needs of the customers [27].

The last feature of route optimization software that effect customer satisfaction is the customer updating. Customer updating is an intregrated system tool with the route optimization. Sometimes despite the fact that all of your effort and plan, things can go bad and unlucky which resulted with late deliveries. At that time the communication with customer is essantial because the customer generally wonder what happened to his/her delivery. If as a delivery company, exceed the estimated time of arrival then it needs to update to its customer. Route optimization software offers this facility in its system. Generally this system is which means customer can also leave message to the courier like "leave it to door" and couirier will act accordingly. Moreover, there are bunch of ways to update the customer. The company can update the customer via e-mail, phone or sms according to preference of the customer. Generally most preffered way to update is SMS because it is quick and fast way to comunicate and the clients can get notification within seconds. It does not disturb you in your daily life like phone call and you can have it wherever you are you do not need internet connection for receiving SMS. As a result, communication and informing the customer increase the satisfaction level and promotes the usage of route optimization software among delivery companies.

4. CONCLUSION

In conclusion, the effects of technology to the businesses are seal their fate. The businesses which has applied this technological advencements to the their business became sector leaders and keep the competetive advantage against their rivals. On the other hand, companies which unable to apply those developments into their system cannot hold in competetive area of the sector and either bankrupted or lost their market position.

In order to keep track latest technological advencements, companies always looking for additional value activity actions. What can they bring to the company that maximizes its profit or minimizes cost. They should also looking for increasing efficiency in their work. Route optimization comes at that stage. It brings reliable, efficient and appliable solutions to delivery companies. Roiute optimization software minimizes cost via reducing fuel consumption and travel time which also led to decrease in carbon emmisons to the environment. Moreover, it increases the efficiency of deliveries which means that it requires less time to dispatch the addresses and less time to reach that addreses

with accurately. Additionally it is easy to apply to the companies. The only think that you business is to buy the software as a service product and let them do the rest. When compare its cost with the money that the business spend without the help of route optimization, the company company even become more profitable with the help of this software product.

Customer satisfaction side of the route optimization software is the topic that mainly covered in this article. Route optimization software has huge contribution to customer satisfaction in that respect. Nowadays it is hard to achiave customer satisfaction because customers can lot of alternatives and even in a single mistake the companies can loose a customer. To prevent such kind of situations, companies need to serve their customers as they deserved. Route optimization software is such a good opportunity for the companies that want to achiave customer satisfaction. It render benefits of on-time deliveries, visibility of the delivery, same-day delivery or pick-up options, accurate estimated time of arrival (ETA), customer update facility and preference of way to update. All these factors which explained detailly in the article contributes the customer satisfaction while decreasing the overall cost. Thanks to route optimization software the firm and the customer side are both satisfied.

Overall, route optimization software is a quite good option for delivery companies that is provided with the help of the technological advencements. Companies who use this route optimization software can get the benefits like reducing delivery cost, increasinf efficiency of deliveries and increasing number of profit. Thus, route optimization software has huge contribution on customer satisfaction. It makes happy faces for you and creates plased and loyal customers for the businesses. Route optimization sofware can bring the companies to the next level without taking any risk.

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