



# OPERATIONS RESEARCH IN FOOD DELIVERY

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## ABSTRACT

*In this study, we look at how restaurants may pick amongst developing food delivery firms by analyzing Transportation challenges and the usage of Operations Research in food delivery companies. The model used identifies the source, which is the restaurant, from which the quantity of food will be delivered to the destination, which is the food delivery companies that want to grow their business by obtaining the maximum amount of quantity from restaurants that can be delivered through them so that they can earn a profit and the restaurants can aim for cost minimization. The development and use of a mathematical model aids in understanding the logical and systematic procedure and strategy that food delivery and businesses may use to make distribution decisions. However, because no specific statistics are utilized in this article, it just provides an overview of how transportation modeling might be used in the decision-making of food delivery firms and restaurants.*

**KEYWORDS:** *Operations Research, Optimization, linear programming, food delivery, cost minimization, online food delivery*

## INTRODUCTION

Food delivery platforms have gained immense popularity among consumers in recent years, as they offer a convenient and hassle-free way to order food from restaurants and fast-food chains.

Food delivery is similar to a courier service, where the ordered food is delivered from the restaurant to the customer by the restaurant staff or the delivery person of the delivery agent of the food ordering company. It depends on the medium the customer orders from.

Online food delivery assists individuals in ordering and receiving the desired food products at their doorstep. It involves browsing the website or application, selecting from a wide variety of cuisines available, and making the payment through different methods. The website/application updates the user about the expected duration of food preparation and delivery. These features, in concert with attributes such as ease, speed and precision of delivery, are increasing the demand for these services.

The market is currently expanding due to increased access to high-speed internet facilities and increased sales of smartphones. This is boosting the growth of the Indian online grocery delivery market along with an increasing labor force and rising income levels. Additionally, the increasing trend of on-the-go groceries and expedited home delivery models, which offer convenient ready-to-eat (RTE) cost-effective grocery delivery options, are driving demand for online domestic grocery delivery services. Contactless delivery service was introduced by Zomato, McDonald's, Inc., and Domino's Pizza, Inc. These services ensure that goods are delivered to customers hands-free and safely, with appropriate social separation. Third-party online grocery delivery has become a growing industry, sparking a "delivery revolution." New technologies such as self-driving cars are also being used to complete deliveries. Customers can pay online or in person, with cash or card, depending on the shipping company. Shipping charges are often charged for items purchased by customers. In some circumstances, there may be no shipping charge. Tipping is common when it comes to food delivery. Contactless delivery is also possible.

Other aspects of food delivery include catering and wholesale food delivery by food suppliers to restaurants, cafeterias, medical facilities and caterers.

## OR AND FOOD DELIVERY RELATION

The research paper reveals that food delivery is increasingly becoming a logistics game and finding restaurants in this industry is no longer a key competitive advantage. The dominance of the captive delivery model in the Indian market. There is a clear trend in customer and seller satisfaction, backed by excellent shipping speeds



and compliance with guarantees. This research paper aims to understand the use of his research methodologies in various operations in the Indian food delivery industry. Understand how food delivery services can operate more efficiently to minimize costs and maximize profits using the model outlined by transportation problems. The main purpose of this paper is to provide an overview of how operational research is important in today's food delivery industry, with the advent of the digital age and the industry's competitiveness from big players such as Swiggy and Zomato. We know that delivery platforms that do not act as a convenient, fast, and cost-effective intermediary between restaurants and end customers tend to lose market share due to lack of efficiency in their operations, concluding that operational research is essential to managing food delivery logistics.

Operation Research in Food Delivery aims to understand the use of different techniques of OR in the food delivery industry. An example of assignment type problem is used to analyze the effective application of OR in this industry.

Operations Research (OR) is an analytical problem-solving and decision-making method that is useful in a variety of organizations from a management perspective. In operations research, problems are decomposed into their basic components and solved in defined steps through appropriate mathematical analysis. When it comes to the food industry, OR is very helpful in solving transportation problems by finding the cheapest and fastest way to deliver food and raw materials. This further helps reduce production costs.

## OBJECTIVE

The research paper's goal is to discover the answers to the following questions:

1. How can the food business apply operations research to address the issues listed below
  - (i) Transportation Issue: Using model building, we will figure out how to deliver food from the restaurant's kitchen to the consumer while minimising transportation costs. Additionally, it will assist us in deciding on the delivery route that will cut down on delivery time. Additionally, reduce the number of trucks utilised to deliver food while minimising the duration of all routes and the distance covered.
  - (ii) LPP: We'll talk about how to use linear programming to make the most money possible. choosing the appropriate production level.
  - (iii) Because everything is predicated on assumptions, demand and supply projections were made using random number generation. Since there is no possible ideal solution to the issue, our approach is simulation-based.
  - (iv) In addition, we will talk about the network analysis issue as a network of food delivery changes is developed.
2. the dimensions and constraints of the issues and solutions.
3. Examining how the findings can benefit both restaurants and food delivery services at once

## LITERATURE REVIEW

According to Erera (2017), the methods of operations research can be applied to food delivery systems. This comprises a driver's movement AP and an order to drive AP. Through this, meal delivery costs and times may be perfectly adjusted, and cost-cutting can be done with the greatest possible efficiency to enhance profits. Names like Swiggy, Food Panda, Zomato, and Uber Eats have established their significance in the Indian sustainable ecology as of today, 2018. The identical statement would have sounded too absurd if it had been made in 2010 for such a start-up to even survive. Even though there was not much statistical support, the Indian market still gave rise to what is now the meal delivery sector. The average revenue growth rate through 2022 is predicted to be 11.8%. 2018. In this market category, start-ups have become increasingly prevalent. Swiggy and Food Panda were among the early adopters, but Zomato and now Uber Eats have joined them as competitors.. In the food business, product quality deteriorates over time, and supply chain operations management should take this into account. Utilizing operations management techniques to manage the supply chains for food results in benefits for the environment and society in addition to economic gain. 2020: In production industries, workforce planning is in second place behind machine scheduling in terms of many application scenarios. For high-volume industries, for instance, Berman et al. established a workforce and process scheduling model. The labour planning issue was addressed by Lee and Vairaktarakis for both serial assembly lines and mixed-mode transfer lines. The personnel planning problem in synchronous production systems was formulated by Vairaktarakis et al. 2021: According to a study by, they have highlighted the expansion of the Indian online food market, which has been facilitated by technological advancements such as rapid digitization and a rise in user numbers. To sum up, the goal was to increase the effectiveness of delivery executives in the restaurant business. The study concentrated on the need for the features of a training program.

## METHODOLOGY

Data is collected through secondary research, as the type of study does not lend itself to primary sources. We will identify the application of operations research in the food delivery industry, along with its benefits and applications to the restaurants considering home delivery and the food delivery companies, through secondary research.



## SOURCES OF SECONDARY RESEARCH

- Previously published Research Papers
- Articles

## ANALYSIS

### Food delivery industry in India

The online grocery delivery industry is one of the fastest growing sectors of the Indian e-commerce industry. Mobile applications were the primary way to access online grocery delivery platforms in 2020, but online prepaid methods accounted for nearly 80% of payments. Services in India are dominated by platform-to-customer delivery mode, with groceries delivered by the platform's own delivery leader, creating a more reliable and accountable service. Platform-to-consumer delivery modes account for nearly three-quarters of the market. The industry is dominated by Swiggy and Zomato. The two giants of the Indian food delivery industry account for over 65% of the industry. Growing market share in grocery delivery by the online segment in India is important for revenue generation. With many young people living in different cities, Indian food delivery apps quickly became popular among these users. Changing shopping preferences are boosting grocery delivery sales through online channels, contributing to the growth of the market.

## COMPETITION

The Indian food delivery industry is in a period of consolidation to survive and remain competitive in the market. Such consolidation is happening because smaller players want to exit the market and well-funded players want to stay on a growth trajectory. With relatively low barriers to entry due to unsophisticated business models, incumbent operators are under constant threat from new competitors entering the market, resulting in pressure on their already very thin margins. New entrants using artificial intelligence are also attracting investor interest. FoodPanda, Zomato, UberEATS, and Swiggy, the current big four in the food delivery industry, must continue to expand the reach of their restaurants and services and innovate their pricing models in order to remain competitive and thrive. It won't work. Due to high customer acquisition costs and low switching costs, the industry has high cash burn rates. Innovation in the form of product segmentation and backward integration (i.e., providing kitchens that meet customer tastes and preferences) makes the business model and food delivery industry sustainable.

## START-UPS

Food has successfully established itself as the most popular luxury item in every household and has proven to be an ample opportunity for growth for many businesses. Skip the long lines and enjoy delicious food. Getting food and leaving home to go to the store has become an outdated concept.

Gone are the days when choices were scarce, now we have all kinds of choices in abundance, in many different locations, and delivered safely to your doorstep.

There are many fast-growing and thriving start-ups in the market with the sole purpose of offering users something they've never tried before, each for a very generous amount.

From junk food to Indian cuisine to fitness food, there are all kinds of businesses making their customers aware of their existence and importance while gaining share in the Indian food industry, which is growing exponentially every year.

- Swiggy.
- Zomato
- Faasos.
- Biryani by Kilo.
- FreshMenu.
- InnerChef.
- Falafel Factory.
- EatonGo.

Online food delivery platforms are expanding choice and convenience, allowing customers to order from a variety of restaurants with a single tap on their mobile phone.

The most common form of delivery is when a consumer places an order at a local pizzeria or Chinese restaurant (although many other types of restaurants, especially in urban areas, offer delivery) and waits for the order to be delivered. A traditional model to wait for. Arranged the restaurant and brought the food to the door. This traditional category has a 90% market share, and most (nearly three-quarters) of these orders are still placed over the phone. However, like many other sectors, the rise of digital technology is changing the market. Accustomed to shopping online through apps and websites with maximum convenience and transparency, consumers increasingly expect a similar experience when ordering dinner. Two types of online platforms have



emerged to fill this gap. The first type is the "aggregator", which appeared about 15 years ago. The second is the "New Delivery" player, which hit the market in 2013. Both allow consumers to compare menus, scan and post reviews, and order from different restaurants with a single click. In the traditional delivery category, aggregators simply take orders from customers and forward them to restaurants that make their own deliveries. In contrast, the New Delivery player has built its own logistics network and provides deliveries to restaurants that don't have their own drivers. A new delivery opportunity is expanding grocery delivery to new restaurants and customers. Instead of competing directly with aggregators, new distribution players expand the overall market. However, in the future, even traditional low-end delivery restaurants may switch to new delivery models as it is more cost-effective to outsource their logistics. pose a potential threat.

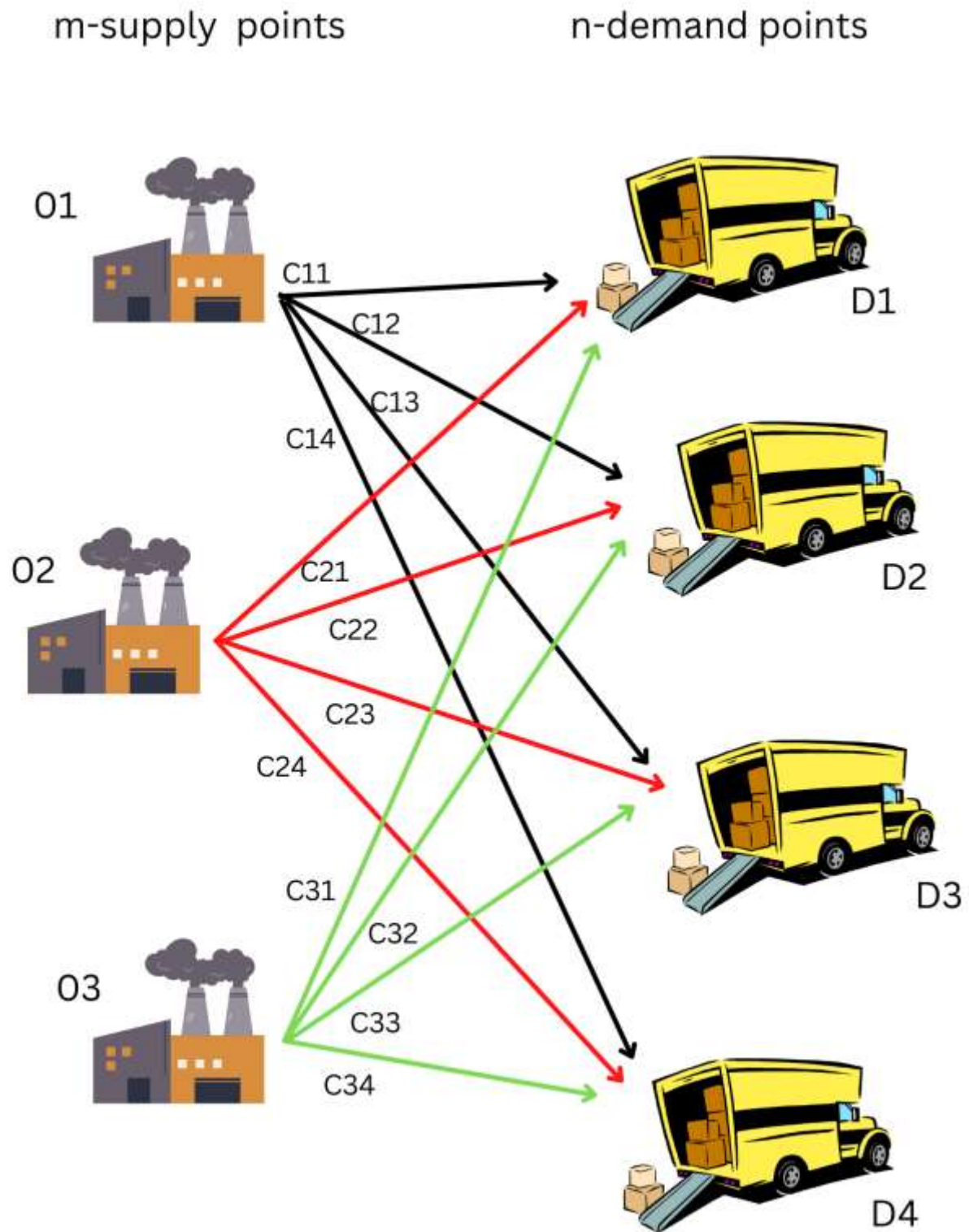
Online food delivery provides new opportunities for restaurants to reach new markets while increasing profits, as well as providing consumers with the convenience of having meals delivered to their home. Researchers have previously mostly concentrated on traditional retail, e-commerce behaviors and the characteristics of mobile applications. There has been little debate surrounding OFD consumers, and even less on the usage of mobile applications to order meals from restaurants.

Significant focus has been placed on the resilience of food supply chains in a catastrophe as the COVID-19 pandemic of 2020 plays out. Every industry in the world expects to see how the COVID-19 outbreak will affect the manufacturing industry, and the food industry is no different from other industries. As the world experienced numerous demand-side shocks such as panic buying and shifts in purchase habits, various supply-side disruptions were also seen. This was mostly due to a manpower shortage and disruptions in transportation and supply networks. Labor shortages were becoming increasingly widespread as a result of worker disease, self-isolation policies, and movement limitations imposed by various governments.

The objective of the Transportation Problem, a particular kind of Linear Programming Problem, is to reduce the cost of transporting a given good from a number of sources or origins (such as a factory or manufacturing facility) to a number of destinations (such as a warehouse or a store)

The typical simplex method cannot be used to solve transportation issues due to its unique structure. These issues require a unique approach to be solved. The place where shipments are sent out is where a transportation issue starts. The location where shipments are delivered is the destination of a transportation issue. The cost of shipping one unit of the cargo from the origin to the destination is known as the unit transportation cost.

Transportation problems can only be solved if the supply and demand are balanced; otherwise, the problem cannot be solved and must be solved by adding a dummy source or destination.



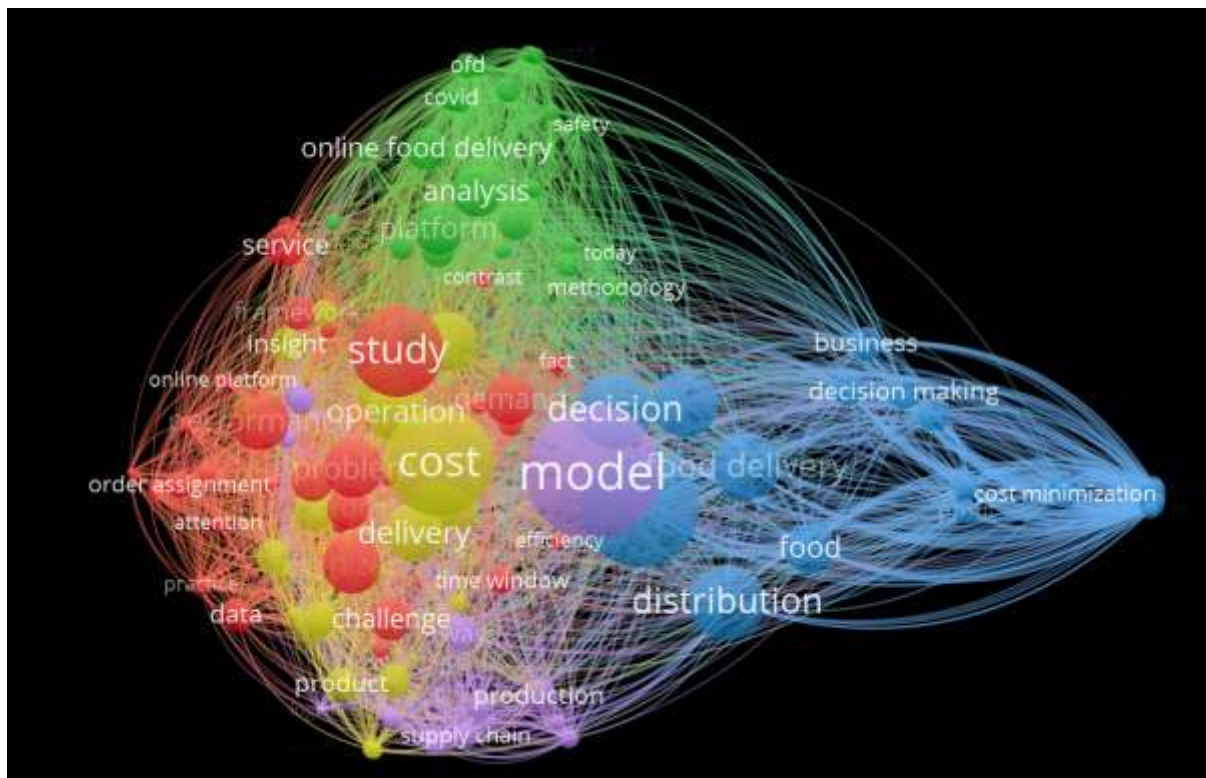
A simple transportation network is shown in figure 1. The m-supply points are the factories 01, 02, and 03, which are the source nodes, whereas the n-demand points are the warehouses D1, D2, D3 and D4, which are destination nodes. The existence of a path is represented by the arcs between nodes, and the values on the arcs represent the cost of delivering each unit product through that specific path.

### CRITICAL ANALYSIS OF LITERATURE

In this research paper, we discussed the main issues concerning the operations research management problems, followed by the challenges faced by the new companies that want to enter the industry. With the help of the major players operating in the market like Swiggy and Zomato, we tried to analyze the competitive landscape of the food delivery market.

Consumers today desire convenience and a variety of food delivery options at their doorsteps. To satisfy that demand and to increase their customer base and profits, mostly all restaurants and cafes have started delivering food. There are two options for delivery: either the restaurant sets up a new supply chain through which they offer the option of home delivery, with their staff bringing the meal to consumers, or the method that is currently in widespread usage is through third parties. There are now third-party delivery services like Zomato and Swiggy that are assisting businesses without the resources to build their own fleet.

### BIBLIOMETRIC ANALYSIS



This is the bibliometric analysis of 28 research papers.

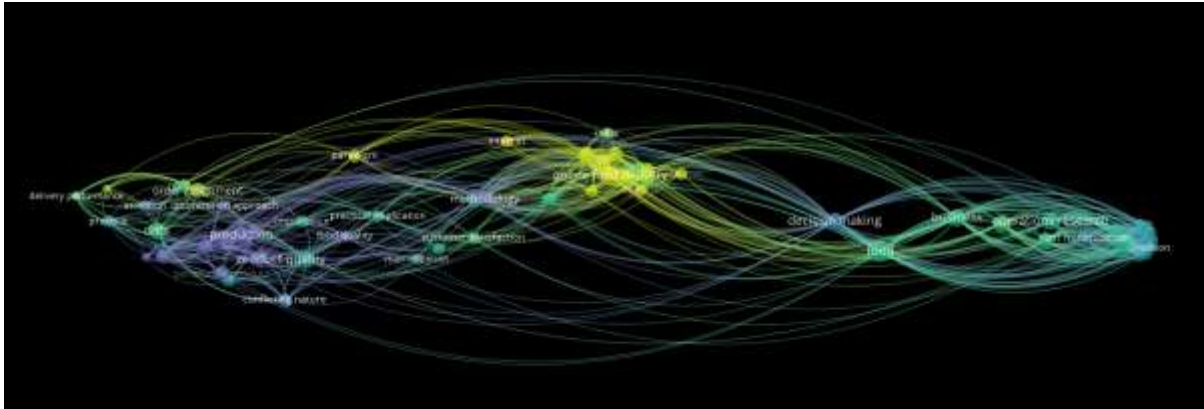
In the first cluster we see relation between cost and decision making. how cost management decision making creates a drive for better value at low cost to ensure deliveries are completed on time and set goals are achieved.

During covid-19, the cost of food delivery increased with affected decision-making process of a consumer.

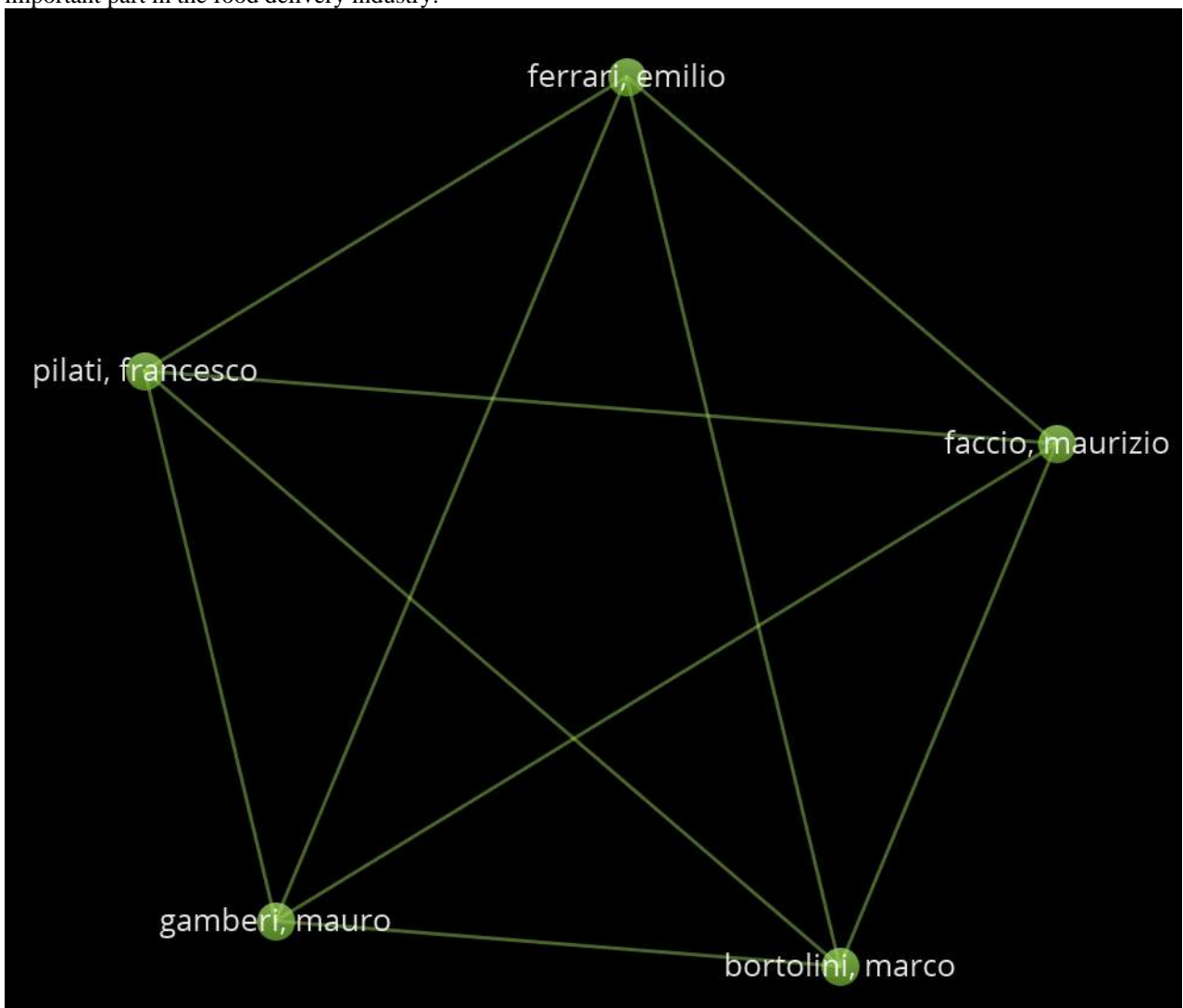
Cost efficiency is an important factor here. By saving money and improving a product efficiency can be obtained which most food companies focussed on during covid.

Covid pandemic further accelerated the trend of delivery because of which in-person dining has essentially been shut down. this resulted in change in distribution pattern of food delivery companies. it focussed more on online channels than offline channels

we also see relation between production and efficiency. even though they both are different things, but are interdependent on each other. Production efficiency helps food delivery companies determine their maximum capacity which they can achieve through optimum utilisation of resources.



This data map is created using the title and abstract of all the documents referred to by us during the research. This data map shows how all the keywords are closely related to each other. Each of them plays an important part in the food delivery industry.



These are the 5 major scientists who have majorly contributed in the research of Operations in the food delivery system.

### SALIENT CONCLUSIONS

Food delivery is a complex issue, and several considerations need to be made, including cost-effective delivery, cost-effective routes, food perishability, and selection of the best possible means of transport. The goal is to find the most practical, affordable, and successful algorithms while reducing process waste that may occur.



We aim to analyze the competitive landscape of the food delivery market with the help of the major players operating in the market such as Zomato and Swiggy.

- Maintaining customer loyalty
- Ordering food from multiple restaurants at the same time
- Using transportation and assignment problems in the food delivery industry
  - i) Transportation problem
  - ii) Assignment problem
- Transportation issues use model-building to understand how to minimize transportation costs.
- when delivering food from the kitchen of a restaurant to a customer. It also helps you guess which route to choose. In order to shorten the delivery date, we will shorten the delivery date.
- We used random number generation to predict future supply and demand, as they are all hypothetical. There is no optimal solution for this problem.
- It also discusses network analysis issues in building food delivery and modification networks.

## RESEARCH FINDINGS

With rapid technological advances, surgeons have many options. They need to be better informed about this applicability to the digital economy and the development of the necessary skills for e-business projects.

Information and communication technology.

Understanding these possibilities requires understanding the e-business landscape. The e-business landscape includes two main areas or departments: (1) consumer-oriented activities and (2) business-oriented activities, both supported by (3) an e-business infrastructure.

OR is used in the following four areas:

- (a) Business-to-consumer transactions of information goods and services, online financial services, and travel-related service applications;
- (b) Business-consumer transactions in physical goods and services, supply chain management applications, and electronic marketplaces;
- (c) Applications in network design and service quality improvement within network infrastructure and applications;
- (d) Software components packaged within decision-making technology software tools OR is needed in the electronic business because:
  1. OR helps reduce the amount of data that the digital economy generates.
  2. OR is highly analytical, so it can handle design, planning, and operational complexity.
  3. OR may use statistics, decision analysis, and probabilistic models to manage risk and address uncertainty.
  4. OR's modeling approach is highly reliable for deep understanding of business processes and problems.
  5. OR may run virtual experiments (analyses, simulations) without risking financial loss or damage to the company's performance.
  6. OR can provide decision-making technology in the operating software to process entire classes of decisions quickly, repeatedly, and automatically.

## CONCLUSION

Through our research, we studied the methods to improve the food delivery system. Thanks to COVID 19, there has been an increase in demand for food ordering, through which consumers get the food at their doorsteps. Some issues faced by the consumers are that they do not get food on time, have cost problems, and have multiple pick-up issues. So using operational research, we've got these problems solved using three methods. To reduce the time, we've got to reduce the gap, which we've done through the transportation problem, which provides a correct time to deliver food on time. Second comes the matter of achieving the minimum cost; for this, we've used the assignment problem, which helps us to own the minimum cost of order. Also, the last is the multiple pick-up problem; we've seen that no delivery app allows us to order from multiple restaurants at the same time. Due to increased competition, these companies try to offer lower prices and more benefits to restaurants in order for those restaurants to choose that specific delivery company for food delivery. For restaurants and cafes, too, the patron base will increase if they begin food delivery because they're going to be able to serve more consumers and also those regular customers that will not visit the restaurant every day. Moreover, choosing a 3rd-party food delivery company is going to be more beneficial than the business itself getting down to delivering because the value of hiring people for delivery, managing them, and arranging vehicles will boost the price. From the above analysis and research, we will conclude that research will be utilised by the business to see how they will decide between different food delivery companies to reduce the value and earn greater profit margins, and the way food delivery companies can compete by offering a low cost per unit to induce maximum food delivery through their company. We've got a little problem with certain assumptions and the way the application of the transportation problem may be applied to this problem in order that the business can meet its cost minimization objective. However, thanks to





the lack of quantitative data available, the figures of what proportion of costs are going to be minimised and what quantity is sold can't be determined, and thus further analysis is required to make a decision on whether this model is useful for the business or not and its impacts. There is an increase in demand for food being delivered to consumers' doorsteps, and looking out at this chance, many businesses are tapping this market at different terminals important chain, may it be supplying raw materials, providing logistics solutions, or processing food, and thus many companies are emerging, and eventually the competition between them is increasing. With increased competition, these businesses try to offer lower prices and more benefits to customers so that they will choose them over their competitors.

## FUTURE SCOPE

Food delivery and ordering trends are fast and impressive, demonstrating that consumers will increasingly turn to fast and convenient mobile apps. The previous eat-in culture has been complemented by snack bars and door-to-door delivery at almost every high-profile takeaway. Future trends are expected to increase reliance on grocery ordering and home delivery. There is a growing need for an efficient and easy-to-use shipment tracking app here.

Online technology has revolutionised the food ordering and delivery process for restaurants and eateries around the world. With the advent of innovative tracking apps, customers no longer need to place orders over the phone. Nor do you have to explain subtleties and preferences to restaurants that are sometimes neglected or misunderstood and cause discomfort and dissatisfaction. No more missed or misunderstood orders thanks to our new delivery tracking app that makes ordering and delivering food easy.

The Indian online food delivery market is expected to exhibit a CAGR of 28.9% during 2022–2027. Keeping in mind the uncertainties of COVID-19, we are continuously tracking and evaluating both the direct and indirect influence of the pandemic. These insights are included in the report as a major market contributor.

In 2023, the market is expected to grow and reach up to \$154.34 billion at a CAGR of 11.51%. In this industry, the number of competitors and businesses is increasing, and different options are providing better service to people. This could mean losses for already established companies such as Zomato, Swiggy, etc., but also increasing their business.

Eating out at restaurants has also had a big impact recently, with business volumes reported to have dropped by around 30-35%, with an even bigger drop for on-premises restaurants.

Online grocery delivery helps individuals order and receive the groceries they need at their doorstep. To do this, you will need to browse the website or application, choose from the various kitchens available, and pay in various ways. Notify users. These features and attributes such as ease of delivery, speed, and accuracy have increased the demand for these services in India.

## LIMITATIONS OF RESEARCH

- Due to the lack of accurate primary data, secondary sources are used as mediums to gather information. The insights might be influenced by conclusions from previous studies.
- Since secondary resources are being used, the authenticity of information on the internet is questionable. Consideration of resources chosen is thus imperative
- Factual figures and representations in a particular document may be reliable, but different sources may contain different information on the same topic.

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