PROJECT REPORT ON

VALUE ADDED PROGRAMME

PROJECT TITLE

STRATEGIC PRODUCT SCALING TO MAXIMIZE THE PROFIT USING GRAPHICAL METHOD IN OPERATIONS RESEARCH.

Submitted in partial fulfilment of the requirement for the award of degree in

BACHELOR OF SCIENCE IN MATHEMATICS

SUBMITTED BY

LOGANAYAKI . P (1U21MA005)

MARIA MONISHA . J (1U21MA006)

GUIDED BY

Mr. M. VIDHYASHANKAR M.Sc., M.Phil., M.Ed., D.T. Ed., PGDCT

Assistant professor , Department of Mathematics

Esrd 1986

RVS CAS

Building Intellectual Capital

2021-2024

RVS COLLEGE OF ARTS AND SCIENCE

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DEPARTMENT OF MATHEMATICS

CERTIFICATE

This is to certify that the project work entitled **STRATEGIC PRODUCT SCALING TO MAXIMIZE THE PROFIT USING GRAPHICAL METHOD IN OPERATIONS RESEARCH.** is a bonafide record work done by **LOGANAYAKI . P (1U21MA005) and MARIA MONISHA . J (1U21MA006)** in partial fulfilment of the requirement for the award of the bachelor Degree in Mathematics during the year 2021-2024.

Submitted for the viva examination held on ________________ .

Project Guide　　　　Head of the Department　　　　Principal

Internal Examiner　　　　External Examiner

DECLARATION

This is to certify that the project titled **STRATEGIC PRODUCT SCALING TO MAXIMIZE THE PROFIT USING GRAPHICAL METHOD IN OPERATIONS RESEARCH.** has been undertaken **by LOGANAYAKI P (1U21MA005) AND MARIA MONISHA J (1U21MA006), STUDENTS OF DEPARTMENT OF MATHEMATICS , RVS COLLEGE OF ARTS AND SCIENCE, SULUR , COIMBATORE - 641402,** under the academic auspices of **Bharathiar University.** We express our sincere appreciation to **Mr.M. VIDHYASHANKAR M.Sc., M.Phil., M.Ed., D.T. Ed., PGDCT , Assistant professor , Department of Mathematics ,** our esteemed project guide, for their invaluable mentorship and guidance throughout the duration of this project. This project exemplifies our dedication to utilizing **GRAPHICAL METHODS(LINEAR PROGRAMMING PROBLEM) IN OPERATION RESEARCH to contribute to IMPROVE THE COMPANY PROFIT** . We affirm that all aspects of this project, including research, development, and implementation, have been executed with integrity and in adherence to academic standards.

Place: Sulur | Candidate's Signature

Date:

1.

2.

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ABSTRACT

This study explores a **strategic approach to enhancing profitability within a company by leveraging graphical operations research techniques and selective expansion of product manufacturing**.

CONTENT

OPERATIONS RESEARCH

1. DEFINITION OF OPERATIONS RESEARCH :

Operations research, often defined as the **study of operations**, encompasses a broad spectrum of activities aimed at achieving desired outcomes. Operations, in this context, refer to the **set of actions undertaken by various systems, including humans, machines, and combinations thereof, within any organizational structure.** However, defining operations research proves challenging, as it doesn't neatly fit into established scientific categories representing specific social, biological, or physical phenomena. Various scholars have attempted to capture its essence over time. **Morse and Kimball** described it as a **scientific method providing decision-makers with quantitative insights into controlled operations**, **while Churchman, Ackoff , and Arnoff** characterized it as **the application of scientific tools and techniques to optimize solutions for system operations.** Despite these definitions, the interdisciplinary nature of operations research often goes unacknowledged, and its complexity remains difficult to encapsulate in a single, universally accepted description.

1.1 Characteristics of operation research :

1.1.1 System (or executive) orientation of operation research [OR]:

An essential characteristic of operations research is its **system or executive orientation, emphasizing the holistic approach to problem-solving.** It recognizes that actions taken by any part of an organization have repercussions on every other part, indicating interdependence among various components. By identifying and understanding these interactions comprehensively, one can gauge their collective impact on the entire organization. With a clear understanding of all factors affecting the system, mathematical models can be constructed. Solutions derived from these models aim to optimize the overall performance or profits of the organization, referred to as optimal solutions. This approach ensures that decisions are made with consideration for the organization as a whole, leading to more effective and efficient outcomes.

1.1.2 The use of interdisciplinary teams :

In the realm of operations research, collaboration among mathematicians, statisticians, physicists, psychologists, economists, and engineers is commonplace. This interdisciplinary team approach allows for the exploration of complex problems from multiple perspectives, with the goal of identifying the most effective approach or combination of approaches. The rapid pace of knowledge expansion underscores the impossibility for any single individual to gather all relevant scientific information across diverse disciplines. Consequently, each member of the operations research team contributes their expertise and the latest advancements from their respective fields to the analysis of the problem. By integrating insights from various disciplines, the team can generate more comprehensive solutions, leading to enhanced results and decision-making processes. This collaborative effort ensures that a broad spectrum of knowledge and methodologies is leveraged to address the intricacies of the problem at hand, ultimately facilitating more informed and effective outcomes.

1.1.3 Applications of scientific method :

The application of the scientific method to solve problems under study distinguishes operations research from scientific research in fields like chemistry and physics, which are typically conducted in controlled laboratory environments with minimal external influence. However, operations research diverges from this approach. Unlike traditional scientific research, operations research often prohibits total system experimentation due to practical constraints. Instead, it permits experimentation on subsystems, allowing for more focused and manageable investigations. In this respect, operations research practitioners resemble astronomers, who develop models to understand complex systems and phenomena. These models serve as valuable tools for analysis, and interested parties can consult them for further insights. While the methodology may differ from conventional laboratory experimentation, operations research remains firmly grounded in the principles of the scientific method, utilizing empirical observation, hypothesis testing, and analysis to reach meaningful conclusions.

1.1.4 Uncovering new problems :

The resolution of an operations research problem often reveals a multitude of additional challenges. However, it's not imperative to address all these newly uncovered issues simultaneously. Instead, to derive maximum benefit, each problem must receive attention and be tackled individually. It's essential to understand that operations research is not effectively utilized when confined to solving one-shot problems exclusively. Moreover, the outcomes of an operations research study pertaining to a specific issue need not wait until all interconnected problems are resolved. This approach ensures that progress is made iteratively, allowing for the optimization of solutions and the continual improvement of organizational processes.

1.1.5 Improvement in the quality of decisions :

While operations research employs a scientific approach to problem-solving, it's important to acknowledge that it may not always yield perfect solutions. Instead, its application aims to enhance the quality of solutions rather than guaranteeing flawless outcomes. Despite its rigorous methodology and reliance on quantitative analysis, operations research is not infallible and may provide imperfect or suboptimal answers to complex problems. However, by leveraging its scientific principles, operations research can significantly improve decision-making processes and optimize solutions, leading to better overall outcomes. It's crucial to recognize the limitations of operations research while appreciating its capacity to enhance problem-solving effectiveness within various domains.

1.1.6 Use of computer :

Operations research involving computers plays a vital role in tackling complex mathematical models and managing extensive datasets, as well as executing numerous computations integral to problem-solving. Beyond these primary functions, the utilization of computers in operations research offers several additional benefits. Firstly, computers enable the simulation of real-world scenarios, allowing researchers to explore various hypothetical situations and their potential outcomes before implementation. This capability enhances decision-making by providing insights into the consequences of different courses of action. Furthermore, computers facilitate optimization processes by rapidly evaluating multiple alternatives and identifying the most efficient solutions based on predefined criteria. Additionally, the use of computer algorithms enhances the accuracy and reliability of analyses, minimizing errors and ensuring consistency in results. Moreover, computers enable the integration of data from diverse sources, enabling researchers to consider a comprehensive range of factors when formulating solutions. Lastly, the scalability of computer-based operations research allows for the handling of increasingly large and complex problems, accommodating the evolving needs of organizations and industries. Overall, the incorporation of computers into operations research expands its capabilities, enabling more sophisticated analyses and facilitating more effective decision-making processes.

1.1.7 Quantitative solutions :

Operations research serves as a cornerstone in providing a quantitative foundation for decision-making processes within organizations. Its primary function involves furnishing numerical insights that guide strategic choices and operational tactics. Beyond merely providing cost estimations, operations research offers a comprehensive analysis of various decision alternatives, delineating potential outcomes associated with each option. This entails evaluating not only financial implications but also considering factors such as resource allocation, time constraints, and risk mitigation strategies. By quantifying the consequences of different decisions, operations research empowers decision-makers to make informed choices that align with organizational objectives and optimize overall performance. Additionally, operations research facilitates scenario analysis, enabling stakeholders to assess the potential impact of uncertainties and changes in external factors on decision outcomes. Furthermore, through sensitivity analysis, it identifies the critical variables that significantly influence decision outcomes, enhancing decision-makers' understanding of the system's dynamics. Moreover, operations research techniques, such as optimization algorithms and simulation models, enable the identification of optimal solutions that maximize desired outcomes while minimizing costs or resource utilization. In essence, operations research equips organizations with the analytical tools and quantitative insights necessary to navigate complex decision landscapes effectively.

1.1.8 Human factors :

Human factors are integral to the problems addressed in operations research, and a comprehensive study of these factors is essential for a thorough analysis. Beyond purely quantitative considerations, understanding human behaviour, cognition, and decision-making processes is crucial for accurately modelling and predicting system outcomes. Operations research recognizes the significance of human factors in shaping the effectiveness and feasibility of proposed solutions. This entails examining factors such as individual preferences, biases, and cognitive limitations, as well as organizational culture, communication patterns, and team dynamics. By incorporating insights from psychology, sociology, and organizational behaviour, operations research endeavours to develop more realistic and actionable models that account for human variability and interaction. Moreover, human factors research in operations research extends to the design of decision support systems and interfaces, ensuring that tools and technologies are user-friendly and align with human capabilities and limitations. Additionally, the study of human factors enables the identification of potential barriers to implementation and adoption, informing strategies for change management and stakeholder engagement. Furthermore, operations research recognizes the importance of considering ethical and social implications in decision-making processes, acknowledging the impact of decisions on various stakeholders and society as a whole. In summary, a holistic approach to operations research incorporates a thorough understanding of human factors to enhance the effectiveness, feasibility, and ethical integrity of proposed solutions.

1.2 Scientific method in operation research :

The scientific method in operation research consists of the following three phases:

(1) the judgement phases,

(2) the research phase, and

(3) the action phases.

1.2.1 The judgement phase :

(a) Determination of the operation:

An operation encompasses a series of actions involving various resources, such as manpower and machinery, which collectively form a structure aimed at achieving broader objectives. For instance, the process of assembling an engine constitutes an operation, comprising multiple individual actions that contribute to the final assembly. Every conceivable operation inevitably entails challenges that must be overcome to ensure successful completion. These challenges may involve logistical hurdles, technical complexities, or coordination issues among different elements of the operation.

Thus, effective planning, coordination, and problem-solving are crucial aspects of managing operations to achieve desired outcomes. Additionally, factors such as resource allocation, time management, and quality control play vital roles in the successful execution of operations. Ultimately, a thorough understanding of the intricacies involved in operations management is essential for optimizing efficiency and achieving organizational goals.

(b) Determination of objectives and values associated with the operation :

During the judgment phase, meticulous attention must be paid to accurately defining the operational parameters. This entails identifying the specific context of the operation, whether it pertains to manufacturing, engineering, tactical manoeuvres, strategic planning, or other domains. It is imperative to assess the level of risk involved and consider the potential impact on related areas. Furthermore, objectives and values, encompassing economic, social, or aesthetic considerations, must be carefully delineated to ensure a coherent approach to problem-solving. Additionally, factors such as time constraints, the desired degree of precision in outcomes, and the necessity of feedback mechanisms must be determined. Time limits for finding solutions should be established, along with clarity on the required level of accuracy in results. Incorporating feedback loops to integrate obtained information back into the operation is essential for refining strategies and enhancing effectiveness. Moreover, considerations regarding resource allocation, stakeholder engagement, and ethical implications may also influence decision-making processes during the judgment phase. Thus, a comprehensive understanding of the operational landscape, coupled with strategic foresight and adaptability, is indispensable for navigating complex challenges and achieving optimal outcomes.

(c) Determination of effectiveness measures :

An effectiveness measure, also known as a measure of effectiveness, serves as a gauge of a model's success in accurately representing a problem and providing viable solutions. It acts as the pivotal link between defined objectives and the analytical processes necessary for corrective action. By assessing the efficacy of a solution, it determines whether adjustments to the approach or even changes to the solution itself are warranted. Effectiveness measures can take various forms, such as cars per hour, accidents per car, or delays per car in transportation scenarios. Similarly, in military contexts like bombing operations, they may be expressed as hits per bomb or ships sunk per bomb. The selection of an appropriate effectiveness measure is paramount, as an incorrect choice can lead to erroneous conclusions about the problem at hand. Hence, careful consideration and selection of effectiveness measures are essential to ensure accurate assessments and informed decision-making.

(d) Formulation of the problem relative to the objectives :

In operational analysis, each operation undergoes meticulous examination to identify and address potential issues. These problems can be classified into several distinct categories:

- **Remedial Problems:**
  Remedial issues arise from actual or impending accidents, posing significant risks to safety and performance. Examples include airplane crashes and job-related hazards.
- **Optimization Challenges:**
  Optimization problems involve enhancing the efficiency and effectiveness of tasks or processes. Analysts strive to streamline operations to achieve optimal performance levels.
  Transference Dilemmas:
  Transference problems occur when advancements from one field are applied to another. This often involves leveraging innovations to solve challenges in diverse domains. For instance, the use of isotopes in both medical diagnostics and material testing for automobile tires illustrates this concept.
- **Prediction-Related Issues:**
  Prediction-related dilemmas revolve around forecasting challenges associated with future developments and inventions. Analysts must anticipate potential obstacles and devise strategies to mitigate risks.

Before embarking on the investigation of a problem, it's crucial to carefully assess its existence. Hasty problem selection can lead to wasted time and resources, as well as inaccurate conclusions. Therefore, thorough consideration is essential in problem prioritization within the domain of operational analysis. By systematically categorizing and addressing problems, analysts can effectively optimize operations and ensure smooth functioning across various domains.

1.2.2 The research phase :

The research phase in operational analysis involves several essential steps, each contributing to a thorough understanding and resolution of the problem:

(a) Observation and Data Collection:

This initial step entails observing and collecting relevant data to gain insights into the problem. While having trained observers at the operation scene is ideal, it may not always be feasible or safe. In such cases, conducting operational experiments that simulate the problem can provide valuable information. Analysts should make efforts to fill in any missing information gaps with the incomplete data available.

(b) Formulation of Hypotheses and Models:

Subsequent to data collection, hypotheses and models are formulated. Hypotheses, which are tentative explanations in the form of propositions, play a crucial role. It's vital to articulate the hypothesis and its anticipated consequences before verification. Operational research views problems as entities rather than isolated operations, and models are the tools used to treat problems holistically. Models can be based on theoretical considerations or hypotheses derived from existing data and facts. The level of detail in model development should be commensurate with the available time and the urgency of the situation.

c) Analysis of Available Information and Hypothesis Verification:

Analysts dedicate significant time to analysing and interpreting available information using qualitative and quantitative methods. For instance, when determining the work done by a force, a hypothesis is formulated based on the principles of mechanics. While a hypothesis need not be proven for every possibility, sampling methods are typically sufficient for verification.

(d) Prediction, Generalization, and Consideration of Alternatives:

Once a model is verified, analysts develop theories based on it to provide a comprehensive understanding of the problem. This involves studying the effects of parameter changes in the model and extrapolating findings into the future. Furthermore, analysts explore alternative methods for problem-solving based on revised hypotheses. This approach allows for comprehensive problem resolution, provided economic and time constraints permit.

1.2.3. The Action phase:

(a) Clear Statement of Assumptions:

Begin by clearly outlining the assumptions underlying the analysis. - Highlight any key assumptions that may impact the recommendations.

(b) Scope and Limitations:

Define the scope of the analysis, specifying what aspects of the problem are considered and what are excluded. Address any limitations in the available information or methodology used.

(c)Alternative Courses of Action:

Present a range of alternative strategies or decisions that could be pursued.

Explore different approaches to address the problem or achieve the desired outcomes.

(d) Effects of Each Alternative:

Evaluate the potential consequences and benefits of each alternative course of action.

Consider both short-term and long-term impacts on various stakeholders.

(e)Preferred Course of Action:

Based on the analysis, recommend the most suitable course of action.

Justify why this particular option is preferred over others, considering factors such as feasibility, effectiveness, and alignment with organizational goals.

1.2.4 Primary Function of Operations Research:

(a) Enhancing Administrator Understanding:

Highlight the role of Operations Research (OR) in providing administrators with deeper insights into decision-making implications.

Emphasize how OR supplements administrators' ideas and experiences.

(b) Utilization of Scientific Method:

Discuss how the scientific method enhances decision-making processes.

Illustrate how OR methodologies aid in achieving organizational goals more effectively.

By structuring the information into clear subtopics, it becomes easier to understand the purpose and process of the action phase in operations research, as well as the broader function of OR in supporting decision-makers.

Certainly! Let's organize the information into clear subtopics and improve the grammar:

1.2.5 Applications of Operations Research:

(a) Industries Utilizing Operations Research:

- Operations research (OR) finds extensive applications across various sectors including industry, business, government, military, and agriculture.

Diverse industries such as airline, automobile, transportation, petroleum, coal, chemical, mining, paper, communication, computer, electronics, etc., have extensively employed OR techniques.

(b) Problem Areas Addressed by OR Techniques:

- **Linear Programming:**
  Used for job assignment to machines, blending, product mix optimization, advertising media selection, least-cost diet planning, distribution, transportation, and investment portfolio selection.

- **Dynamic Programming:**
  Applied to capital budgeting, advertising media selection, employment smoothing, cargo loading, and optimal routing problems.
- **Inventory Control Models:**
  Determine economic order quantities, safety stocks, reorder levels, and minimum and maximum stock levels.
- **Queuing Theory:**
  Helpful in solving problems related to traffic congestion, repair and maintenance of machines, service facility optimization, air traffic scheduling and control, hospital operations, bank counters, and railway booking agencies.
- **Decision Theory:**
  Used in controlling hurricanes, managing water pollution, medicine, space exploration, and research and development projects.
- **Network Techniques (PERT and CPM):**
  Employed in planning, scheduling, and controlling construction projects like dams, bridges, roads, highways, as well as in the development and production of aircraft, ships, and computers.
- **Simulation:**
  Applied in probabilistic marketing situations to find NPV (Net Present Value) distributions for ventures such as market introduction of a new product.
- **Replacement Theory:**
  Extensively used to determine optimal replacement intervals for items that deteriorate over time, items that fail suddenly, and staff replacement and recruitment.

(c) Other Techniques Employed:

- Game Theory
- Statistical Quality Control:
    - ✓ Investment Analysis
    - ✓ Goal Programming

2. Linear programming:

2.1 Introduction:

George Dantzig and his associates, in 1947, found out a technique for solving military planning problems while they were working on a project for U.S. Airforce. This technique consisted of representing they various activities of an organization as a linear programming(LP) module and arriving at the optimal program by minimizing a linear objective function. After wards Dantzig suggested this approach for solving business and industrial problems. He also developed the most powerful mathematical tool known as simplex method to solve linear programming problems.

Linear programming is perhaps the most widely applied mathematical technique that assists managers in decision making and planning for the optimal allocation of limited resources. It involves optimizing (maximizing or minimizing) a function of variables, known as the objective function, subject to a set of linear equations and/or inequalities known as constraints. The objective function may represent profit, cost, production, capacity, or any other measure of effectiveness that needs to be obtained in the best possible or optimal manner. The constraints may be imposed by various resources such as raw material availability, market demand, production processes and equipment, storage capacity, etc.

They mathematical expression in which the expressions among the variable are linear is called linearity. Example, $a_1.x_1+a_2.x_2+a_3.x_3+\ldots\ldots+ a_n.x_n$ is linear. Higher powers of the variables or their products do not appear in the expressions for the objective function as well as the constraints(they do not have expressions like x_1^3,$x_2^{3/2}$,x_1x_2,$a_1x_1+a_2\log x_2$, etc)

2.2 Applications of linear programming

In today's world, while most events are nonlinear, linear occurrences are common in daily life.

Therefore, understanding linear programming and its problem-solving applications is crucial for managers.

Linear programming techniques are extensively utilized across various sectors such as business, industry, military, economics, marketing, distribution, and advertising.

Three primary reasons drive the widespread adoption of linear programming:

1. Many problems from diverse fields can be represented or approximated as linear programming problems.

2. Effective techniques for solving LP problems are readily available.

3. LP models facilitate easy handling of data, including sensitivity analysis.

Despite the iterative nature of solution procedures and the need for manipulation of substantial data for even medium-sized problems, the advent of digital computers has mitigated these challenges. Digital computers can now efficiently handle large LP problems in significantly less time and at a lower cost.

Formulation of linear programming problems :

First , the given problem must be presented in linear programming form. this requires defining the variables of the problem, establishing inter-relationships between them and formulating the objective function and constrain. a model, which approximates as closely as possible to the given problem , is then to be developed. If some constraints happen to be non-linear, they are approximated to appropriate linear functions to fit the linear programming for mat. In case it’s not possible, other techniques maybe used to formulate and then solve the model

3. Graphical method :

once model is formulated as mathematical model , the next step is solving the problem to get the optimal solution . a linear programming problem with only two variables presents a simple case , for which the solution can be derived using a graphical or geometrical method .though , in actual practice such small problems are rarely encountered , the graphical method provides a pictorial representation of the solution process and a great deal of insight into the basic concepts used in solving large Linear programming problems . this method consists of the following steps :

3.1 Formulate the problem: Write down the objective function to be maximized or minimized, along with the constraints in terms of the decision variables.

3.2 Plot the constraints: Graphically represent each constraint as a line on the coordinate plane. For a two-variable problem, this means drawing the lines corresponding to each constraint equation.

3.3 Identify the feasible region: The feasible region is the area of the coordinate plane that satisfies all of the given constraints. It is typically the intersection of the shaded regions (if any) formed by each individual constraint.

3.4 Identify the objective function: Plot the objective function on the same graph. If maximizing, this means drawing a line with a slope that represents the coefficients of the decision variables in the objective function. If minimizing, it's the same, but the line will have the opposite slope.

3.5 Find the optimal solution: The optimal solution is the point within the feasible region that either maximizes or minimizes the objective function, depending on the problem requirements. This point is usually found by moving the objective function line parallel to itself until it just touches the feasible region at a point.

3.6 Determine the optimal values: Once the optimal solution point is identified, read the values of the decision variables at that point to determine the optimal values.

3.7 Check for alternative optimal solutions (optional): In some cases, there may be multiple points that satisfy the optimality conditions. Check if there are any alternative optimal solutions by verifying if other points on the objective function line also touch the feasible region.

3.8 Interpret the results: Finally, interpret the optimal solution in the context of the original problem to understand its implications and make decisions accordingly.

The graphical method provides a visual representation of the problem and its solution process, which can be helpful for understanding the basic concepts of linear programming. However, for larger or more complex problems, numerical methods such as the simplex method or interior point methods are typically used for finding optimal solutions.

4. Data Collection:

Goodwill Apparels, established in 1989, stands as a prominent knitted garment manufacturer and exporter situated in Tirupur, the heart of the Indian knitwear industry. Spearheaded by Mr. S. Kittu and Mr. S. Somu, the company has flourished through their tireless efforts, unwavering determination, dedication, and adherence to international trade practices.

4.1 Location:

Situated in Tirupur, known for its thriving knitwear industry, Goodwill Apparels benefits from a strategic location within this hub of textile manufacturing and export.

4.2 Infrastructure:

Backed by a robust infrastructure, Goodwill Apparels boasts modern facilities encompassing various stages of garment production. This includes:

- Knitting
- Dyeing
- Compacting
- Embroidery
- Printing
- Sewing
- Packaging

4.3 Products:

Goodwill Apparels specializes in a diverse range of knitted products catering to all age groups. Their product line includes:

- Girl's wear
- Women's wear
- Boy's wear
- Men's wear
- Baby's wear

4.4 Goodwill Apparels boasts a prestigious clientele, including:

- Adidas
- Reebok
- Schott N.Y.C
- Sfera
- Alphabroder

4.5 About the Company:

Goodwill Apparels prides itself on being professionally managed by a team of technically skilled staff and labourers. With 600 modern machines at their disposal, the company has the capacity to produce over 600,000 pieces per month. Certified by SEDEX, WRAP, and SA8000, Goodwill Apparels maintains high standards of ethical and social responsibility in its operations. Over the years, the company has successfully met the needs of international clients, establishing itself as a reliable and reputable player in the global garment industry.

5. Strategic Analysis for Company Enhancement:

Amidst possessing a robust infrastructure, including 600 modern machines and a proficient workforce capable of producing over 600,000 pieces per month across a diverse range of knitted products, our company, Goodwill Apparels, has flourished. Managed by a team of technically skilled staff and labourers, they have established ourselves as a leading player in the industry.

5.1 Positives of the Company:

5.1.1 Advanced Machines: Our state-of-the-art machinery enables us to maintain high production efficiency and product quality.

5.1.2 Professional Team: A dedicated and skilled workforce ensures smooth operations and fosters innovation.

5.1.3 Information Technology: Leveraging IT solutions enhances our operational efficiency, communication, and decision-making processes.

5.1.4 Well-Structured Workflow and Processes: Streamlined workflows and standardized processes contribute to consistent output and customer satisfaction.

While the company is already performing well, we recognize the potential for further growth and profitability. Therefore, we have embarked on a strategic initiative to enhance our contributions to the company's success. Through meticulous analysis and thoughtful planning, we aim to identify areas for improvement and implement strategies to maximize our company's performance.

6. Key focus area for improvement :

Expanding production for select products presents an opportunity for Goodwill Apparels to enhance profitability. This initiative involves a thorough analysis to identify the most lucrative products for increased production, considering factors such as brand popularity, geographic demand, and demographic characteristics of target markets.

6.1 Analysing Brand Popularity:

- Evaluate sales data and market research to identify which brands within our product portfolio are most popular among consumers.
- Consider factors such as brand reputation, consumer loyalty, and market trends to gauge brand popularity accurately.

6.2 Assessing Geographic Demand:

- Examine sales data and market research to determine the geographical regions where our products are most in demand.
- Analyse trends in consumer preferences and purchasing behaviour across different countries or regions.

6.3 Evaluating Country Populations:

- Research the population demographics of countries where selected brands are popular to assess market size and potential demand.
- Consider factors such as population size, growth rate, and demographic trends to understand market dynamics.

6.4 Understanding Gender Ratio:

- Investigate the gender ratio of the target country to tailor product offerings accordingly.
- Consider gender-specific preferences and purchasing habits to align production increases with market demand.

6.5 Integration of Data Analysis:

- Integrate data from brand popularity, geographic demand, population demographics, and gender ratio to prioritize products for increased production.
- Utilize data analytics tools and techniques to derive actionable insights and make informed decisions.

6.6 Strategic Product Selection:

- Based on the analysis, select products that demonstrate a strong correlation between brand popularity, geographic demand, and favourable demographic characteristics.
- Prioritize products with the highest potential for increased sales and profitability.

6.7 Implementation and Monitoring:

- Develop a production plan outlining the increased production targets for selected products.
- Implement the plan and closely monitor production, sales, and profitability metrics to evaluate the success of the initiative.
- Continuously assess market dynamics and adjust production strategies as needed to optimize profitability.

By systematically analysing brand popularity, geographic demand, population demographics, and gender ratio, Goodwill Apparels can strategically increase production for select products, ultimately driving higher profitability and sustained business growth.

7. Profit-Driven Production:

7.1 A Strategic Approach

In our quest to enhance profitability, we have meticulously analysed the company's affiliations with top brands such as **Adidas, Reebok, Schott N.Y.C, Sfera, and Alphabroder.** Among these, **Adidas emerged as a prime candidate due to its widespread popularity among consumers. Germany**, with its high usage and hosting of Adidas's main branch, became our focal point for this endeavour.

7.2 Targeting Germany:

With a population comprising **51% females and 49% males as of 2022**, Germany offers a fertile ground for targeting Adidas products. Assuming three-fourths of each gender percentage pertains to women and girls, and men and boys respectively, we aimed to capitalize on the country's demographic landscape.

7.3 Product Selection and Profit Analysis:

- Our analysis led us to select **two products**, **the Reversible Day Wear Pant and the Long Sleeve Crew Neck Tee,** as prime candidates for increased production. These items cater to both genders, aligning with the demographics of our target market.
- Currently, **the Reversible Day Wear Pant yields a profit of 500 Indian Rupees**, while **the Long Sleeve Crew Neck Tee generates a profit of 600 Indian Rupees.**

7.3 Application of Graphical Method:

To determine the optimal solution for maximizing company profit, we have chosen to employ the graphical method. By graphically representing the profit functions of both products and analysing their intersection with constraints, we aim to identify the most lucrative production levels.

7.4 Conversion for Convenience:

For ease of calculation, **all monetary values have been converted to Indian Rupees.** Through this strategic approach and the application of the graphical method, we endeavour to unlock untapped potential and drive significant growth and profitability for our company, Goodwill Apparels.

9. Problem statement :

The Goodwill Apparels , a garments company , **manufactures two products** reversible daily wear pant and the long sleeve crew neck tee on which the profits earned per unit are **rupees 500** and **rupees 600 respectively** . each product is processed on two machines patlock machine and overlock machine . reversible daily wear pant requires one minute of processing time on overlock machine and two minutes of processing time on patlock machine, while Long Sleeve Crew Neck Tee requires two minutes of processing time on overlock machine and one minute of processing time on patlock machine. **Over lock machine is available for 9 hrs .while patlock machine is available for 7 hours** . during any working day .find the number of units of products reversible day wear pant and long sleeve crew neck tee to be manufactured to get maximum profit.

9.1 Formulation to the problem:

Let A be the reversible daily wear pant and B be the long sleeve crew neck tee. Let M_1 be the overlock machine and M_2 be the pat lock machine. Let x_1 and x_2 denote the number of units of products A and B to be produced per day .

Objective is to maximize the profit .

i.e., maximize $Z = 500x_1 + 600x_2$ …….(1)

constraints are on the time available for machines M_1 and M_2 .

i.e., for machine M_1 , $1x_1 + 2x_2 \leq 540$ **………(2)**

for machine M_2 , $2x_1 + 1x_2 \leq 420$ …….(3)

where $x_1 , x_2 \geq 0$.

Thus, the problem is to maximize equation (1) subject to relations (2) and (3).This will be done graphically .

9.3 Solution to the problem using graphical method .

The non negativity restrictions $x_1 \geq 0$ and $x_2 \geq 0$ imply that the values of the variables x_1 and x_2 can lie only in the first quadrant (x_1,x_2 plane).other quadrants do not satisfy the non-negativity restrictions and hence points (x_1,x_2) cannot lie in them .therefore , a number of alternatives are eliminated .

Removing the inequality ,

$1x_1 + 2x_2 = 540$ ………(2.1)

$2x_1 + 1x_2 = 420$ ………(3.1)

Put x_1 = 0 in the equation (2.1).

The equation becomes ,

$1(0) + 2x_2 = 540$

$2x_2=540$

$X_2=540/2$

X_2=270

Put x_2 = 0 in the equation (2.1).

The equation becomes ,

$1x_1 + 2(0) = 540$

X_1=540

Put x_1 = 0 in the equation (3.1).

The equation becomes ,

$2(0) + 1x_2 = 420$

$1x_2 = 420$

X_2 = 420

Put $x_2 = 0$ in the equation (3.1).

The equation becomes ,

$2x_1 + 1(0) = 420$

$2x_1 = 420$

$X_1 = 420/2$

$X_1 = 210$

Thus, the points are (0,270),(540,0),(0,420),(210,0). By joining points (0,270) and (540,0),(0,420) and (210,0) , we will get the region of feasible solutions .

Solving (2.1) and (3.1) simultaneously , we get

$X_1 = 100$

$X_2 = 220$

D(100,220)

The four vertices of the convex region ocde are **O(0,0) , C(0,270), D(100,220),E(210,0).**

Values of the objective function $Z = 500x_1 + 600x_2$ at these vertices are ,

O(0,0),

Z(O)=500(0) + 600(0)

Z(O)=0

C(0,270),

Z(C)=500(0) + 600(270)

Z(C)=1,62,000

D(100,220),

Z(D)=500(100)+600(220)

Z(D)=50,000+1,32,000

Z(D)=1,82,000

E(210,0),

Z(E)=500(210)+600(0)

Z(E)=1,05,000+0

Z(E)=1,05,000

Thus, the maximum value of Z is rupees 1,82,000 and it occurs at the vertex D(100,220).

Hence the solution of the problem is $x_1=100$, $x_2=220$ and maximize Z = rupees 1,82,000.

CONCLUSION

In conclusion, our study demonstrates the effectiveness of using graphical operations research to strategically select and expand manufacturing of two Adidas products, leading to increased company profitability.

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