

APPLICATION OF OPERATIONS RESEARCH IN PRODUCT PRICING AND PLANNING

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ABSTRACT

One of the primary motives of most businesses today is profit maximisation. The company develops its product mix, improves marketing activities and adopts pricing strategies that can maximise profits. Pricing the products has a lot of impact on the consumer's decision to buy that product. Operations Research consists of various tools that are used by the management to make price decisions for their products. The following research paper, analyses how various tools of Operations Research are used in the pricing strategies of products. It shows how important these tools are for framing prices of various products and services. The prices can be affected due to government policies, consumer's preferences, market trends, etc.

Keywords – Operations Research, Pricing, Tools, Profits.

INTRODUCTION

Considering various product lifecycle phases, income from various existing products will fall over a period of time. Business revenues and profits are anticipated to grow with present growth targets. Major decisions an organization has to make is how to price its products. Low cost product may not cover your costs or generate profits. Pricing the product too will lead to fall in sales and potential customers never turn into paying customers. This situation of declining sales from existing products and expected sales increase lined up to growth targets which creates a gap to be filled by new product introduction. (HA Simon) The field of sales management came from the operations research community and, quoting Talluri and van Ryzin (2004, p. 2), “is concerned with demand-management decisions and the methodology and systems required to make them.” The process of managing various demand decisions with science and technology implemented with disciplined performance and systems, and overseen by human analysts. Revenue management was first seen in the airline industry from the observation that a vacant seat after departure constitutes loss in revenue, because seats cannot be stored after the flight takes off. It has enjoyed huge success in practice during the past thirty years with major applications in the airline, travel sector and hospitality industries. Revenue management has now become an important and active area of research. Product Introduction and planning is the introduction of a new product into the market and occurs at the end of a successful product development model. Every year more than 30000 new consumer products are launched from which 95% of them fail to make good business in the market. Revenue management is one of the major reason for success of these products and research have had a significant impact and made important contributions respectively, to the management of the demand for consumer services, but they have comparatively less attention to the management of business pricing decisions. Business pricing in the research paper is interpreted in a broad sense and will also be referred to as pricing in business markets. Pricing strategies help a business person to answer various questions such as:

- How should one price my product?
- How will the revenue be affected with increase in the price?
- Sector that will be affected to if price changes appeared?
- Should the products be priced differently to achieve maximum sales of the entire line?

Operation research has long recognized the importance of price optimization. Various research can help explore pricing questions. Survey pricing evaluation can be thought of as a continuation that moves from

quick and easy but less precise to complicated but having more accurate methods. Among these methods include WTP(willingness to pay) and what price would a consumer pay for a particular product/price mix

RESEARCH OBJECTIVES:

- 1) To study the various factors affecting product pricing and planning.
- 2) Importance of operation research in product pricing and planning.
- 3) To undertake a comparative analysis of various research papers on applications of Operations Research in Business particularly, product pricing and planning.
- 4) To understand the impact of using various operation tools in Real Estate and various business sectors.
- 5) To study how Game Theory is used in product pricing.

RESEARCH METHODOLOGY

This research paper is qualitative in nature and exploratory in nature. Secondary method for data collection has been used. We have referred to various Research Papers, Articles and Websites on this topic. The research paper is an analysis of how Operations Research helps in product pricing of various products and services and its significance.

LITERATURE REVIEW:

We adopted a loosely structured method for the mechanics of surveying the literature. As a first step we created a superset of research papers related to product planning and pricing. We did this by searching the tables of contents of major research papers over the period.

The fundamental concepts of product planning and pricing stepwise:

- 1) The Planning Phase: A simulated new product venture based on hypothetical assumptions is illustrated i.e. a detailed discussion on the 63 tasks involved in a new product planning are listed and a diagram is drawn to show how the sequential and parallel tasks.
- 2) The Scheduling Phase: Followed by the planning phase, the scheduling phase focuses on assigning durations to the tasks illustrated, it helps to compute the total time taken for the completion of the project. The estimation of activity duration is a very important task in CPA.
- 3) The Control Phase: The control phase focuses on identifying areas that need immediate action and thus making the right decision to complete the project with speed and efficiency.

The research paper mainly focuses on the various factors affecting pricing and planning. It tells us about how to price a new product and product planning.

(Mu & Ma, 2007)

This paper shows how Game theory is used in the decision making for price properties.

BUSINESS VERSUS CONSUMER COMMERCE

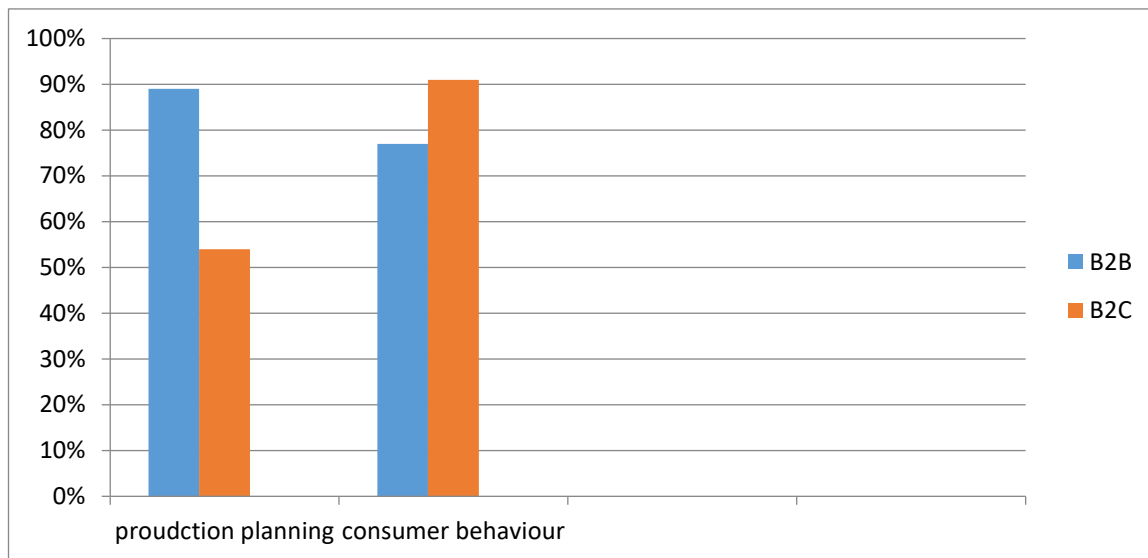
“there is a broad consensus between pricing scholars and economists that a pricing decision based on consumer value and consumer willingness to spend is of paramount importance and more stories of successful transformation prevail in the industry”

Heather and Heather (2013 scholar research consensus)

The terms B2B and B2C have been derived from the pre internet era based term called industrial and consumer commerce.

At prima facie, the most apparent difference between the two is the kind of market that they serve. B2C is the classic business targeting an individual consumer whereas B2B is more widespread, more intricately knitted and requires the employment of more resources and manpower because it serves not an individual but a business entity as a whole.

Instead of satisfaction or maximization of an individual’s needs and utility subject to budget constraints like a B2C model, the purpose of this model is to satisfy or maximize the profits, subject to capacity constraints. Where on one hand B2C focuses on demand constraints to drive its profits, B2B focuses more on supply side and production constraints



-derived from the data provided by Karmarkar (1996, pg-130)

These statistics are essential as they immediately imply that the valuation of a product by a B2B customer is driven by the additional value of profitability that a firm derives from purchasing a product.

For a B2C customer, this valuation is instead derived from the ever changing dynamics of the tastes, preferences and purchasing power of their individual customers

Often the thought process behind both these models is roughly the same as B2B also looks at its business entities as a cluster of many individual group of employees who represent that particular business unit.

Almost all of the B2B orders are placed via a team or a committee. it is a rare occurrence that these orders be placed on the basis of singularity. Usually, you'll have multiple people who need to approve the sale. One way to improve your chances of landing the sale is to provide the decision-maker with all of the relevant materials needed to make an educated decision.

Hence we can conclude that B2B is a broader concept for our research purposes because of the fact that its attributes consist of multi-dimensional features such as cost, flexibility and revenue. Each of which requires extensive implications of operations research.

(SECOMANDI, 2007)

CURRENT PRACTICES:

This section reviews the current business pricing practices. The pricing tools adopted by the firms, the strategies that the said firms employ in the computation of the mark-up price of the product units.

The common practices include:

1) Cost plus pricing:

Cost plus pricing is a pricing method that attempts to ensure that costs are covered while ensuring a minimum basis of return on profit for the entrepreneur. It is calculated by adding a fixed rate of return or mark up after considering all economical and opportunity costs while computing the costing of the product.

Cost-plus pricing is a common occurrence in markets that are dominated by a few firms (oligopolistic) markets and share similar production costs. In this situation, the firms share similar production costs and there is little to no scope for price wars and price based competition.

Game theory places a suggestion that if firms can collude without the references of them being made highlighted then the collusion can be made simpler and more convenient.

2) Value pricing:

The core concept behind the concept of value pricing is the infamous value equation, which depicts that value is generated when a consumer is able to buy something that is worth more than the price they pay for the said product. It is a psychological concept. The amount of value created is the difference between what they would have paid and what they did pay in actuality. Value for a company is its profit making.

In technical terms, "good value pricing" refers to any pricing strategy that tries to divide the value creation evenly between a firm and its customers. This is in contradiction to raising prices as high as consumers will spend or pushing them as low as the company can afford.

In day-to-day discussion between marketers, "good value pricing" colloquially refers to a product and pricing combination that offers robust features, but at a decent price..

2) The pocket margin waterfall:

Top Organisations invest their time and effort in a project to accomplish the following:

- Define the pocket margin waterfall elements they want to trace.
- Deploy a technological solution that automates the "crunching" of this allocation on a regular basis, and automates the analysis performed on the dataset.
- Develop a robust technique that uses the pocket margin waterfall analysis to drive performance improvement in the business.

3) Operations research based pricing:

The NBC and TCH implementations are two examples of the use of operations research methods to support the business pricing decisions.

At the beginning of each year, NBC faces the issue of selling advertising slots for the next broadcast year. NBC develops a detailed suite of models to forecast its air slots and propagandas in advance and manages to come out as the leader and dominator over its competitors by gaining a sustainable advantage over them.

The method does not constitute of a set of rigid rules and regulations but instead is made of loose guidelines that can be interpreted and re-interpreted in different ways.

4) Real option pricing:

This method of pricing is only applied to real assets and it values the asset cash flows by exclusively constructing profiles of companies that might use them in future and have used them in their past practices. This method is a branch of the operations research model method but instead it is more robust and effortless in nature .

This approach is widely applied in energy and commodity industries.

It is essential to note that all the above forecasting and management is done on one assumption that demand models are statistic in nature and are bounded by constraints of dynamism and finite choices.

GAPS BETWEEN THEORY AND PRACTICE

The models that have been explained above and also the ones that we use for our MBA studies are in reality in a polar opposite view of how the real business world functions.

The concept and the core remain the same but in truth, the models need to be constantly repaired, re-engineered and altered as per the changing market and consumer conditions.

The models dealing with product price setting decisions typically employ demand function based on the concept of price elasticity while it is clear that business, as opposed to consumer, demand is still price sensitive, the consumer on the other hand uses models that maximize their individual utility

The models discuss demand in a fairly simple manner and overlook the richness of business demand in the real world. (SECOMANDI, 2007)

DIRECT PRICE TECHNIQUES

Direct methods are about the willingness to pay (WTP) estimation. An approach of pricing research which comprises of asking the consumers to directly state their WTP for a product through a question format which includes open-ended questions. The customers answer the question: What is the highest price you would be willing to pay for product X?

The customers are supposed to purchase the given product if the price drawn from the lottery is less than or equal to his/her stated WTP. Since this can put them in a situation of loss and is a real gable, respondents

have full interest to give realistic stated WTP. However, this approach only works in certain special situations. A modified version of WTP is called incentive-aligned WTP.

A few advantages of the following method are their suitability for new products, easy to collect, and little prior knowledge required from the respondents. One major disadvantage is that respondents overstate their price sensitivity and capability.

PRODUCT/PRICE MIX MODEL

A way to find optimal prices is by using various pricing techniques used in Discrete Choice Models (DCM). These methods typically include aspects like brands, size, demographics, etc. This is best in situations when immediate responses are required. They are based on well-known factors and consumers make their decision on the basis of competitive difference among the factors or attributes present. The advantages of this approach are that it reflects the “real world” marketplaces with competing products, brands can be customized to match market reality; it avoids impossible combinations and is easy to administer. Among the limitations, we can mention that it is not practical to handle too many attributes.

VAN WESTENDORP PRICE SENSITIVITY MODELS

Van Westendorp (VW) “psychological price” modelling is specifically focused on finding an acceptable price as a quality indicator of the product. According to this, low pricing relates to low quality and high prices relate to high quality products. This is based on the assumption that price is balanced with value. It is worried about the specific prices at which the price is too high or too low or the product is too expensive or too cheap.

Significance

Need for this research paper Operations is a kind of science that is used in most of the companies to have a systematic preview of any of the activities of the company. Out of those, new product planning requires a lot of research and development in the same. This project is certainly the analysis of the process of the product planning which starts right from the idea of the product to its launching of the product with pricing of the product too. This is a long process and it requires heavy investment. This is because there is a lot of weightage given to the analytical tools. (RJ Vokurka - Journal of Operations Management) This research paper would, therefore, be helpful to any business start-up so as to get the idea of the process of production planning and pricing strategies, which are the specific areas of loop-holes or where there is a possibility for a company to concentrate more amongst the stages of the planning. They can also analyse the basic strategies and systems to compete with its fellow competitors in terms of their products.

WHAT IS GAME THEORY?

Game theory was originally developed by a mathematician John Neumann and his Princeton University colleague Oskar Morgenstern, an economist, to solve various problems in economics. In their book, “The Theory of Games and Economic Behaviour” (1944), they stated that the mathematics developed for physical sciences, which describes the workings of a disinterested nature, was an inadequate model for economics. They observed that economics was like a game. In this game, players anticipate each other’s moves and therefore requires a new kind of mathematics, which they called game theory. It is a theoretical framework for analysing social situations among competing players. In some aspects, game theory is an optimal decision-making tool of independent and competing actors in a strategic setting.

Game theory can be applied to a wide variety of situations in which the choices of players interact to affect the outcome. While concentrating upon various strategic aspects of decisions made, or aspects controlled by players rather than by pure chance, the theory both supplements and goes beyond the Classical Theory of Probability. It can be used, for example, to determine what political coalitions or business conglomerates are likely to form, the optimal price at which to sell products or services in the face of competition, the power of a voter or a bloc of voters, whom to select for a jury and the best site for a manufacturing plant. It can also be used to challenge the legality of certain voting systems.

In business, game theory is beneficial for modelling competing behaviours between economic agents. Businesses have several strategic choices that affect their ability to realize economic gain. For example, businesses may face dilemmas such as whether to retire existing products or develop new ones, lower prices relative to the competition, or employ new marketing strategies. Economists often use game theory to

understand oligopoly firm behaviour. It helps to predict likely outcomes when firms engage in certain behaviours, such as price-fixing and collusion.

Commonly used terms in game theory:

Game: Set of circumstances/situation that has a result that depends on the actions of two or more decision-makers/players.

Players: A decision-maker in the context of the game.

Payoff: The pay-out a player receives as a result of a particular outcome.

Information set: The information available at a given point in the game.

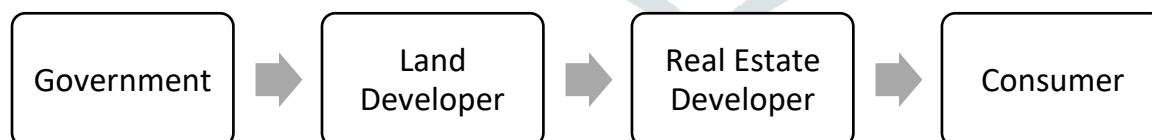
Strategy: A complete plan of action a player will follow given the set of circumstances that might arise within the game.

Equilibrium: The point in a game where both players (decision makers) have made their decisions and an outcome is reached.

Real estate industry in India is expected to reach US \$1 Trillion by 2030. By the year 2025, India's GDP will comprise 13 per cent in the real estate industry. The real estate stock in India is expected to reach 3.7 million square feet by the end of 2019, with an addition of about 200 million square feet during the year. There is an emergence of nuclear families, rapid urbanisation and increase in family income. They remain the key drivers for growth in all spheres of real estate, including residential, commercial and retail. More than 70 per cent of India's GDP will be contributed by the urban areas by 2020.

Currently the economy is facing a slowdown. According to the Real Estate Regulatory Authority, the number of registrations coming in from property developers and builders has come down in certain segments. Real Estate Regulatory Authority Karnataka's Chairman M.R. Kamble told The Hindu that while registrations for projects for plotted sites and affordable housing were "as usual", those for high-end villas and apartments were "relatively less". The sector has been affected by Demonetisation, introduction of GST and the current economic slowdown.

Price decision in the real estate industry includes various decisions to be taken. In this paper price decisions of real estate properties are taken for analysis. The real estate industry comprises of the government, land developers, real estate developers and consumers. The relation between these four players can be seen in the following diagram:



The land developer acquires the land from the government through auctions, bids, etc. He then develops the land and sell it to real estate developers. The real estate developers then sell it to the consumers in the form of buildings. The motives of all the players except the consumer is to maximise the profit. There can be two models: cooperative and non-cooperative model.

Non-cooperative game model

Here we establish a non-cooperative model consisting of two players, the government and the real estate developer. Both the players are unaware of each other's decision strategies. Suppose, the government's decision to increase the tax rates from 5% to 7% will increase their tax revenue by 400 crores. The real estate developer increases the sale price by 2%. This will increase its sales revenues by 400 crores. Both the players

are unaware of each other's decisions. The real estate developer wants to increase the sales revenue by 400 crores.

If the government increases the tax rates and the real estate developer increases the sales price both will have a benefit of INR 400 crores.

If the government does not increase the tax and the real estate developer increases the price, it will have a benefit of INR 400 crores.

The government will benefit INR 400 crores if they increase the tax rates and the real estate developer does not raise the sales price.

If both the players refrain from any changes, they do not have any benefits.

Government

**Real Estate
Developer**

	Increase	Constant
Increase	(400,400)	(400,0)
Constant	(0,400)	(0,0)

Solution:

The real estate developer always aims to increase its sales revenue. Here, the real estate developer assumes that government will increase the tax rates by 2%. However, even if the tax rates remain constant, the real estate developer still gains a benefit of INR 400 crores.

CONCLUSION:

This section summarizes the relevance of Operation Management in the context of the outlined future trends and patterns, examines the implications for Operation Management researchers in pursuing them, and talks about the pricing of business services as a timely application area with high potential practical impact.

Operation Management relevance.

OM is relevant to the outlined future trends for the following reasons.

1. At the industry level, the aim is to model the operations, that is, the supply and demand processes, of an entire industry or of multiple industries. While this has not been the main aim of OM researchers, this modeling effort can benefit from a managerial and decision support, as opposed to a public policy/economic, orientation in terms of the output of the analysis to be conducted.
2. At the strategic market level, detailed modeling of the operations of a firm's customers and of the operational implications of contract structuring decisions seems imperative to obtain a to the point representation of the firm's demand. Investigation of these issues can benefit from the extensive literature on supply chain management and contracting. At the tactical market level, the profile of the firm's capacity and inventory availability/replenishment over time becomes relevant to make medium-term pricing decisions. OM seems to be remarkably well positioned to contribute to the development of the outlined trends at the market level.
3. At the transaction level, having a grasp on current revenue management research and applications to address the negotiated nature of business transactions seems particularly attractive. In addition, the design of proper incentives to the sale force can build on the emerging literature on incentives in operational settings. This is also an area where OM is ideally positioned to contribute to the study of the outlined trends.

Pricing research is one of the major methodologies in custom research. There are a collection of approaches one can take and the exact method we recommend depends on the particular circumstances of the request. We described main features of Gabor-Granger, van Westedorp, and product/price mix models, their specifics and areas of the application in practical marketing research for evaluation of optimal prices for different products and concepts. Direct/indirect methods are not the most precise pricing techniques that are out there; they cannot really factor in competitive effects but only consider each product in isolation. The distinct choice techniques are much more flexible and accurate because they try to replicate real market conditions as close as possible, but on the other hand—they are complex in nature and technical and design support. The GG and VW models can also be used for each set of fixed variants and require a standard price which can be compared all across models and its combinations. It is the reason that the Gabor-Granger and van Westedorp models are widely used in practical marketing research for express analysis of optimal prices for different products and concepts.

LIMITATIONS

- Non-quantifiable factors: OR techniques provide an optimal solution only when all given elements related to a problem can be quantified.
- Money and Time cost.
- Implementation of decision is a sensitive task.
- Distance between manager and operations researchers.
- Dependence on an electronic computer and advanced technology.

FINDINGS

- Pricing strategies help a business person to answer various questions
- Planning is the key to success
- Game theory is of utmost importance in operation research
- Product planning requires a lot of research and development
- Operation research is helpful to any business start-up
- Helps in competing with fellow competitors in terms of the product in their specific industry.

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