IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2026

DOI: 10.17148/IARJSET.2026.131102

# A Dynamic Learning-Curve-Based Break-Even Point Framework for Cost Optimisation and Sustainable Profitability

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Research Scholar

**Abstract:** Break-Even Point (BEP) analysis has long been recognised as an essential management accounting tool for profitability assessment, pricing decisions, production planning, and cost control. Despite its widespread application, empirical evidence regarding the relationship between the systematic adoption of BEP analysis practices and organisational performance remains limited. This study examines the influence of break-even analysis practices, particularly cost analysis, contribution margin evaluation, and break-even forecasting, on business success and sustainability. It investigates how these practices support managerial decision-making, improve resource allocation, strengthen financial planning, and enhance an organisation's ability to respond to market uncertainties and competitive pressures. The study also considers the potential contribution of effective BEP practices to profitability, operational efficiency, financial resilience, and long-term business sustainability. By examining the relationship between the adoption of BEP analysis and organisational performance, the research seeks to provide empirical insights into the value of integrating break-even analysis into routine management practices. The findings are expected to contribute to management accounting literature and offer practical guidance to entrepreneurs, managers, and business owners seeking to improve financial performance and achieve sustainable growth. The study further provides a basis for developing an evidence-based framework for the effective application of BEP analysis in business decision-making.

**Keywords:** Break-even Analysis, Cost Analysis, Contribution Margin, Forecasting, Business Success, Manufacturing Companies, Services Companies, Correlation Analysis, Break-even Point (BEP), Cost-Volume-Profit (CVP) Theory, Profitability, Pricing Decisions, Production Planning

## INTRODUCTION

Break-Even Point (BEP) analysis is a fundamental quantitative technique in managerial accounting, financial planning, and production and operations management. It determines the level of sales or production at which total revenue equals total costs, resulting in zero operating profit. Traditionally, BEP is calculated using fixed costs, variable cost per unit, and selling price per unit. This analytical approach supports managerial decisions concerning pricing strategies, cost optimisation, production planning, investment appraisal, product relaunch, capacity utilisation, and sustainable business growth. However, conventional BEP models generally assume that cost structures and selling prices remain constant within the relevant operating range, thereby producing a single break-even threshold for a specified set of conditions.

In todays, dynamic business environments, this assumption may not adequately represent the evolving relationship between production volume, operational efficiency, and cost behaviour. As organisations accumulate production experience, employees develop technical proficiency, processes become more efficient, resource utilisation improves, and production-related errors and waste may decline. These improvements can be represented through the learning curve effect, which describes the systematic reduction in labour hours or unit production costs as cumulative output increases. Consequently, the variable cost per unit may decrease over time, while fixed costs, production capacity, and other cost components may also change as the organisation expands or optimises its operations.

Integrating the learning curve into BEP analysis introduces a dynamic perspective on the conventional break-even concept. When unit costs decline with cumulative production experience, the contribution margin may increase, potentially reducing the sales volume required to achieve break-even. Under such circumstances, the break-even threshold may no longer be adequately represented by a single static value; instead, it may vary according to cumulative output, production experience, cost efficiencies, technological improvements, and prevailing market conditions. The resulting relationship between learning rates and BEP has important implications for production scheduling, investment planning, financing decisions, contract bidding, pricing, and resource allocation. Nevertheless, the direction and

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magnitude of this change depend on the behaviour of fixed costs, selling prices, demand, capacity constraints, and the specific learning-curve model employed.

Furthermore, a dynamic BEP perspective can strengthen managerial decision-making by incorporating operational learning into financial forecasting and performance evaluation. Businesses can use learning-adjusted BEP estimates to assess new-product risk, establish realistic sales targets, determine production and workforce requirements, evaluate marketing expenditure, optimise manufacturing capacity, and formulate product relaunch strategies. Such analysis can also support sustainability objectives by identifying opportunities to reduce material consumption, labour requirements, production waste, and energy usage without compromising product quality or operational resilience.

Despite the established importance of BEP analysis, conventional approaches may not fully capture the cumulative effects of organisational learning and continuous process improvement. This creates an opportunity to develop an integrated analytical framework that combines traditional cost-volume-profit relationships with learning-curve parameters and dynamic cost behaviour. Accordingly, this study examines the relationship between learning effects and break-even dynamics, with the objective of establishing a more adaptive approach to profitability assessment, operational planning, and investment decision-making. The proposed approach seeks to extend the conventional static BEP model towards a learning-adjusted framework that better reflects evolving production conditions and supports long-term business competitiveness and sustainability.

## CONCEPTUAL REVIEW

### Definition of BEP

Breakeven point is a condition where the company does not make a profit and does not suffer losses. According to Noor (in Razak et al., 2015: 2) breakeven point analysis is the main return point or level of production where the company does not experience losses but also does not make a profit. Break-even point analysis is useful to find out the break-even point of the company where revenue equals the costs incurred by the company.

According to Martono and Harjito (2015) break-even point analysis or break-even analysis is an analytical technique to study the relationship between costs, profits, and sales volume. Based on some of the opinions above, it can be argued that the break-even point analysis is a tool used to determine the break-even point of the firm, where the firm does not experience losses and does not make profits. Break-even point analysis can be described as the minimum revenue that must be achieved by the firm in order to obtain the targeted profit

### Definition of Cost-Volume Profit Analysis

Adenji (2008) states that cost-volume-profit analysis are predetermined costs, target costs or carefully pre planned costs which management endeavours to achieve with a view to establishing or attaining maximum efficiency in the production process. According to him, cost-volume-profit analysis is cost plans relating to a single cost unit. Because cost-volume profit analysis purports to be what cost should be, any deviation represents a measure of performance. The predetermined costs are known as cost-volume-profit analysis and the difference between the cost-volume-profit analysis and actual costs are known as a variance.

Drury (2000) defines cost-volume-profit analysis as predetermined cost; they are cost that should be marred under efficient operating conditions. The cost-volume profit analysis may be determined on a number of bases. The main uses of cost-volume-profit analysis are in performance measurement, control, stock valuation and in the establishment of selling prices. Cost-volume-profit analysis is a target cost which should be attained.

Cost- volume- profit analysis, according to Glautier et al (2001), is the systematic examination of the inter-relationship between selling prices, sales and production volume, cost, expenses and profits. The above definition explains cost-volume profit analysis to be a commonly used tool providing management with useful information for decision making. Cost volume-profit analysis will also be employed on making vita and reasonable decision when a firm is faced with managerial problems which have cost volume and profit implications.

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Cost- volume- profit analysis according to Hilton R.W (2002:230) is a mathematical representation of the economics of producing a product. The relationship between a products revenue and cost function expressed within the cost-volume-profit analysis are used to evaluate the financial implication of a wide range of strategic and operational decisions.

According to Garrison et al (2003) cost-volume-profit analysis is a study of inter-relationship between the following factors: princes of products, volume or level of activity, per-unit variable cost, total fixed cost, mix of products sold. Also state further the cost-volume-profit analysis is a key factor in many decisions including choice of products lines, pricing of product, marketing strategies and utilization of productive facilities.

**BEP formulas**

Break-even analysis is commonly expressed using the following formulas.

$$\text{BEP (units)} = \frac{F}{P - V}$$

$$\text{BEP Revenue} = \frac{F}{(P - V)/P}$$

Where:

- (F) = total fixed costs
- (P) = selling price per unit
- (V) = variable cost per unit
- (P-V) = contribution per unit

Beyond calculating the minimum sales required to cover costs, the Break-Even Point (BEP) can support strategic planning, entrepreneurial resilience, market-risk assessment, product lifecycle management and long-term business sustainability.

## BREAK-EVEN POINT ANALYSIS AND MANAGERIAL DECISION-MAKING

Break-Even Point (BEP) analysis is an important managerial accounting technique that supports strategic planning, cost control, pricing decisions, production planning, and profitability assessment. It enables management to determine the minimum sales volume required to cover total costs, estimate the production and sales quantities needed to achieve target profits, and evaluate the relationship between cost, volume, and profit under different operating conditions.

BEP analysis also assists organisations in identifying profitable products and services, optimising product portfolios, and allocating resources more effectively. By examining the effects of changes in sales volume, production costs, and selling prices, management can assess the potential impact of market fluctuations and operational uncertainties on profitability. Furthermore, it helps determine the margin of safety, indicating the extent to which sales can decline before the organisation incurs operating losses.

Another significant application of BEP analysis is pricing strategy. When a firm reduces its selling price to stimulate demand or strengthen its competitive position, management can estimate the additional sales volume required to maintain its existing profit level or achieve a desired profit target. Similarly, the analysis supports the evaluation of minimum viable selling prices, cost-reduction strategies, and alternative production plans.

Despite its usefulness, the effectiveness of BEP analysis depends on the accuracy of cost classification, sales forecasts, and assumptions regarding selling prices and production costs. Therefore, integrating BEP analysis with market assessment, sensitivity analysis, and adaptive decision-support mechanisms may enhance its relevance in dynamic business environments.

In this context, the present study focuses on the cost–volume–profit relationship and profitability position Industries. The study seeks to examine how BEP analysis can support production planning, pricing decisions, cost management, and profitability improvement. The findings may provide practical insights for improving managerial decision-making in the selected block-manufacturing factories and may also offer useful guidance to other businesses operating within the same industry.

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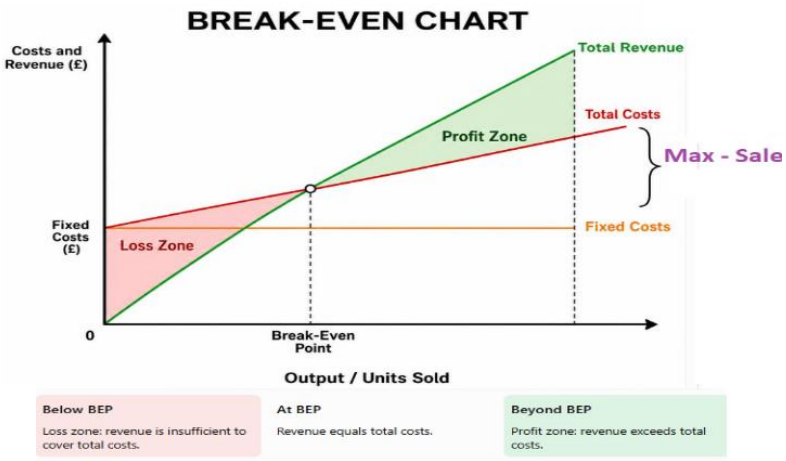
Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2026

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**Below and Beyond BEP**

The concept of Below and Beyond Break-Even Point (BEP) explains two critical stages of business performance: operating below the sales level required to cover costs, and progressing beyond that level towards profitability, resilience and sustainable growth.

- **Below BEP:** Total revenue is less than total costs, resulting in an operating loss.
- **At BEP:** Total revenue equals total costs, resulting in neither profit nor loss under the model's assumptions.
- **Beyond BEP:** Total revenue exceeds total costs, resulting in an operating profit.




**Business Strategies below and beyond BEP**

| Dimension | Below BEP: recovery strategies | Beyond BEP: growth strategies |
|---|---|---|
| Cost management | Reduce avoidable costs and wastage | Improve efficiency without compromising quality |
| Pricing | Review discounts and contribution margins | Optimise pricing and product value |
| Sales | Recover lost customers and improve conversion | Expand customer segments and markets |
| Product strategy | Reassess weak products and consider relaunch | Scale successful products and extend their lifecycle |
| Operations | Avoid excess inventory and unused capacity | Expand capacity when demand justifies it |
| Cash flow | Preserve liquidity and control receivables | Build reserves and reinvest carefully |
| Market risk | Reduce customer and supplier concentration | Diversify revenue and strengthen market position |
| Sustainability | Protect essential long-term capabilities while reducing costs | Invest in durable, efficient and circular operations |

**Positioning Beyond BEP – After Profit**

Moving beyond BEP should not mean increasing sales at any cost. The next stages involve managing profitability and building a resilient business.

1. **Profitability**: Generate positive operating profit and maintain healthy contribution margins.
2. **Financial resilience:** Build liquidity reserves and manage debt and cash-flow risk.
3. **Scalable growth**: Increase capacity and sales when incremental returns justify the investment.
4. **Product lifecycle extension**: Improve, upgrade, relaunch or refurbish products to create additional value.

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5. **Sustainable competitiveness**: Improve resource efficiency, customer retention and long-term market position.

**Importance of BEP**

BEP is important because it translates business costs and revenue into a practical measure of financial viability. It helps management understand how much must be sold, where costs can be improved and which strategies may support profitability.

However, achieving BEP does not guarantee long-term success. Managers should combine BEP with cash-flow analysis, demand forecasting, market-risk assessment, return on investment and sustainability indicators to make sound decisions

- **Entrepreneurs:** Estimate minimum viable sales.
- **Pricing decisions:** Understand the effect of price changes on profitability.
- **Cost control**: Identify opportunities to reduce fixed and variable costs.
- **Investment planning**: Assess sales requirements before committing resources.
- **Risk management**: Measure the distance between actual sales and BEP.
- **Business sustainability**: Monitor whether the business model can cover its operating costs.

**Major Importance of BEP**

**1. Determines the minimum sales target**

BEP identifies the minimum number of units or amount of revenue required to cover business costs.

**2. Supports cost management**

It helps managers understand how fixed costs, variable costs and operating expenses affect profitability.

**3. Improves pricing decisions**

BEP analysis shows how changes in selling price and unit contribution influence the sales volume needed to cover costs.

**4. Facilitates profit planning**

Businesses can estimate the sales required to achieve a target profit and compare alternative operating strategies.

**5. Reduces financial risk**

BEP helps assess the vulnerability of a business to falling demand, rising input costs and competitive price reductions.

**6. Supports product launch and relaunch**

Managers can assess whether a new or redesigned product is likely to recover its launch investment at realistic sales levels.

**7. Guides investment decisions**

BEP provides a useful starting point for evaluating new machinery, additional capacity, expansion and entrepreneurial ventures.

**8. Promotes business sustainability**

By connecting costs, demand and revenue, BEP helps businesses assess whether their operating model can remain financially viable over time.

**BEP Importance across business functions**

| Business function | Application of BEP |
|---|---|
| Finance | Budgeting, profit planning and cost recovery |
| Marketing | Pricing, promotions and sales targets |
| Operations | Production planning and capacity utilisation |
| Entrepreneurship | Startup feasibility and survival planning |
| Product lifecycle management (PLM) | Product introduction, relaunch, extension and withdrawal |
| Strategic management | Expansion, diversification and resource allocation |
| Sustainability | Assessing the financial viability of resource-efficient investments |

**BEP Impacts at Different Levels**

- **Micro level — Entrepreneur**

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Decisions on startup funding, pricing, staffing, inventory, and survival.

- **Meso level — Organisation and industry**
  Decisions on production capacity, product portfolios, supply chains, investment, and competitive strategy.
- **Macro level — National economy**
  Potential links with enterprise survival, employment continuity, productive investment, and economic resilience. These wider impacts are indirect and require empirical testing rather than being inferred from BEP calculations alone.

**Key BEP Indicators**

Managers can monitor the following indicators alongside the standard BEP calculation.

| Indicator | What it reveals |
|---|---|
| Break-even sales volume | Minimum unit sales needed to cover costs |
| Break-even revenue | Revenue required to cover costs |
| Contribution margin ratio | Share of sales available to cover fixed costs and profit |
| Margin of safety | How far actual or forecast sales exceed BEP |
| Target-profit sales | Sales required to achieve a specified profit |
| BEP attainment time | Time taken to reach break-even under stated assumptions |
| Cost sensitivity | Effect of cost changes on BEP |
| Demand sensitivity | Effect of sales-volume changes on profitability |
| Product contribution | Relative contribution of each product towards covering fixed costs |
| Cash-flow coverage | Ability to meet payment obligations as they fall due |

The margin of safety, for example, can be calculated as:

**Margin of Safety= Actual Sales - BEP Sales**

A low margin of safety indicates that a relatively small fall in sales could push the business into an operating loss.

**Factors Influencing Break-Even Point (BEP)**

The Break-Even Point (BEP) is influenced by internal business decisions and external market conditions that affect fixed costs, variable costs, selling price and sales volume. Identifying these factors helps businesses reduce financial risk, improve profitability and move beyond break-even.

**1. Major factors influencing BEP**

**A. Fixed costs**

Rent, salaries, insurance, depreciation and other fixed operating expenses.

**Effect**: Higher fixed costs generally increase BEP.

**B. Variable costs**

Raw materials, packaging, unit-level labour, commissions and shipping costs that vary with output or sales.

**Effect**: Higher variable cost reduces contribution per unit and generally increases BEP.

**C. Selling price**

Product pricing, discounts, promotions and competitive pricing pressure.

**Effect**: A higher selling price generally lowers BEP, provided demand and unit costs remain unchanged.

**D. Market demand and sales**

Customer preferences, market size, seasonality, purchasing power and sales conversion.

**Effect**: Demand determines whether the required BEP sales volume is achievable; it does not directly change the basic BEP formula unless it affects price, costs or product mix.

**E. Production capacity and technology**

Plant size, automation, capacity utilisation, maintenance and production efficiency.

**Effect**: Automation may reduce variable costs but can increase fixed costs; the net effect on BEP depends on the investment and savings.

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**F. Supply chain and procurement**

Supplier prices, freight charges, availability of materials and inventory practices.

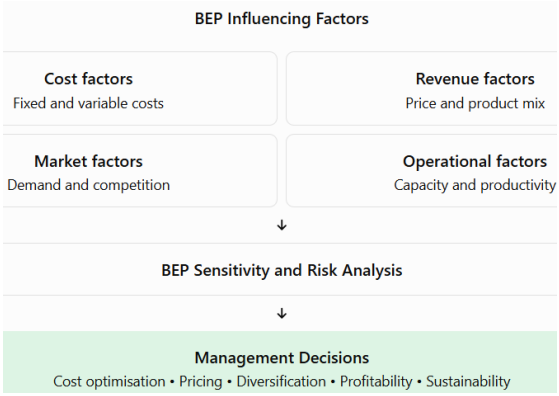
**Effect**: Input-price increases or supply disruptions can increase variable costs and raise BEP.

**Internal and External BEP influencing factors**

Internal factors are generally more directly controllable by management. External factors often require forecasting, contingency planning and strategic adaptation.

| Internal factors | External factors |
|---|---|
| Fixed-cost structure | Market demand fluctuations |
| Production efficiency | Inflation and interest rates |
| Selling price and discount policy | Competitor pricing |
| Labour and material productivity | Supplier market conditions |
| Product mix | Customer purchasing power |
| Technology and automation | Government regulations and taxes |
| Inventory management | Economic conditions |
| Marketing and distribution costs | Market disruption and new technologies |

**BEP INFLUENCING-FACTOR FRAMEWORK**

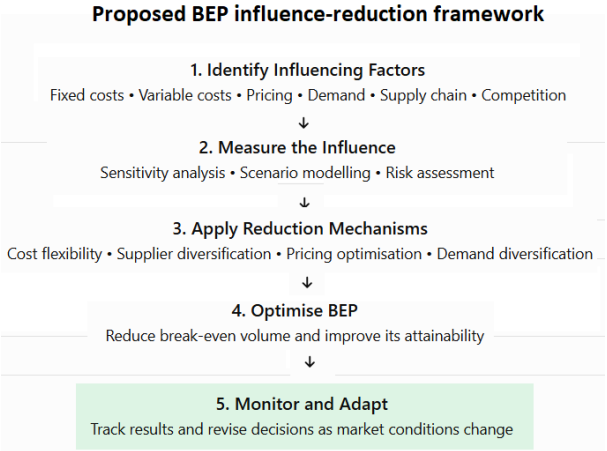



**BEP Influence-The Reduction mechanism**

A BEP influence-reduction mechanism is a systematic approach to reducing the sensitivity of a business's break-even point to changes in costs, pricing, market demand, supplier conditions and operational performance.

The objective is not only to lower BEP, but also to make it more stable and achievable under changing business conditions.

**Proposed BEP influence-reduction framework**




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**Mechanisms for reducing the Influence of individual factors**

| Influencing factor | Reduction mechanism | Expected effect |
|---|---|---|
| High fixed costs | Leasing, shared facilities, phased investment | Lower fixed-cost burden |
| High variable costs | Lean operations, waste reduction, bulk purchasing where economical | Higher contribution margin |
| Price fluctuations | Value-based pricing, product differentiation, controlled discounting | Protect contribution per unit |
| Demand uncertainty | Market diversification, customer retention, demand forecasting | Improve BEP attainability |
| Supplier dependency | Alternative suppliers, negotiated contracts, qualified substitutes | Reduce input-cost and disruption risk |
| Production inefficiency | Automation, preventive maintenance, process improvement | Lower unit costs or improve capacity |
| Product concentration | Diversified product portfolio and services | Reduce dependence on one product |
| Market competition | Differentiation, service quality, customer loyalty | Reduce pressure to cut prices |
| Inventory risk | Better demand planning and inventory control | Reduce holding costs and obsolescence |
| Product lifecycle decline | Redesign, relaunch, refurbishment or timely discontinuation | Improve lifecycle economics |

**Measuring the effectiveness of the proposed mechanism**

Useful performance indicators include:

- **BEP reduction:** Percentage change in break-even sales volume.
- **BEP stability:** How much BEP changes under realistic cost and market scenarios.
- **Margin of safety:** The difference between actual or forecast sales and BEP sales.
- **Contribution margin:** The amount available per unit to cover fixed costs and generate profit.
- **Recovery time:** Time required to return to break-even after a disruption.
- **Profit resilience:** Ability to maintain positive profit under adverse scenarios.

An important distinction: lowering the calculated BEP and reducing its sensitivity to external shocks are related but different objectives. A robust mechanism should address both.

**BEP Performance Measure**

BEP performance measures are quantitative indicators used to evaluate how effectively a business reaches its break-even point, controls costs, improves profitability, manages risk, and sustains operations.

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**Key BEP Performance Measures**

| Performance measure | Formula | What it measures |
|---|---|---|
| 1. BEP in units | $F/(P-V)$ | Units required to cover costs |
| 2. BEP revenue | $F/CMR$ | Sales revenue required to break even |
| 3. Contribution margin | $P-V$ | Contribution per unit toward fixed costs and profit |
| 4. Contribution margin ratio (CMR) | $(P-V)/P \times 100$ | Percentage of sales available to cover fixed costs |
| 5. Margin of safety | Actual sales – BEP sales | How far sales can fall before losses begin |
| 6. Margin of safety ratio | $(Sales-BEP)/Sales \times 100$ | Relative protection against a sales decline |
| 7. Target-profit sales | $(F+\text{target profit})/(P-V)$ | Sales needed to achieve a profit target |
| 8. Time to break-even | Time until cumulative contribution covers relevant costs | Speed of financial recovery |
| 9. BEP attainment ratio | Actual sales / BEP sales × 100 | Progress relative to break-even |
| 10. Cost variance | Actual cost – budgeted cost | Cost-control performance |

Here, (F) = fixed costs, (P) = selling price per unit,
(V) = variable cost per unit, and (CMR) = contribution margin ratio.

## ADVANCED BEP PERFORMANCE INDICATORS

**A. Financial performance**

- BEP reduction percentage
- Profit after BEP
- Return on investment (ROI)
- Contribution margin improvement
- Cash-flow coverage

**B. Time performance**

- Time to market (TTM)
- Time to break-even (TTBE)
- Development-to-recovery time
- Launch delay
- Payback period

**C. Operational performance**

- Production cost per unit
- Capacity utilisation
- Defect and rework costs
- Inventory turnover
- Production efficiency

**D. Risk and resilience**

- BEP under adverse scenarios
- Demand volatility
- Supplier cost exposure
- Customer concentration
- Recovery time after a disruption

**E. Sustainability performance**

- Energy cost per unit

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- Waste and material recovery costs
- Carbon cost per unit
- Product lifecycle profitability
- Cost of regulatory non-compliance

**BEP Performance Dashboard**

An entrepreneur or manager can monitor the following indicators monthly.

| KPI | Desired direction |
|---|---|
| BEP units | Lower, where commercially viable |
| BEP revenue | Lower, where commercially viable |
| Contribution margin | Higher |
| Margin of safety | Higher |
| Time to break-even | Shorter |
| Cost variance | Near zero or favourable |
| Sales forecast accuracy | Higher |
| BEP under stress scenarios | Attainable under plausible adverse conditions |
| Product lifecycle profitability | Higher over the complete lifecycle |
| Quality and sustainability compliance | Maintained or improved |

A lower BEP is not automatically better if it requires damaging quality, sacrificing customer value, or making unsustainable investments.

**BEP Ecosystem**

A Break-Even Point (BEP) Ecosystem is an interconnected system of business factors, stakeholders, resources, market conditions, technologies, and management decisions that collectively influence an organisation's ability to cover its costs and achieve sustainable profitability.

For entrepreneurs, the BEP ecosystem extends beyond calculating costs and sales. It examines how customers, suppliers, competitors, finance, operations, government policies, and technology interact to determine the time and conditions required to reach break-even.

**BEP Ecosystem Framework**

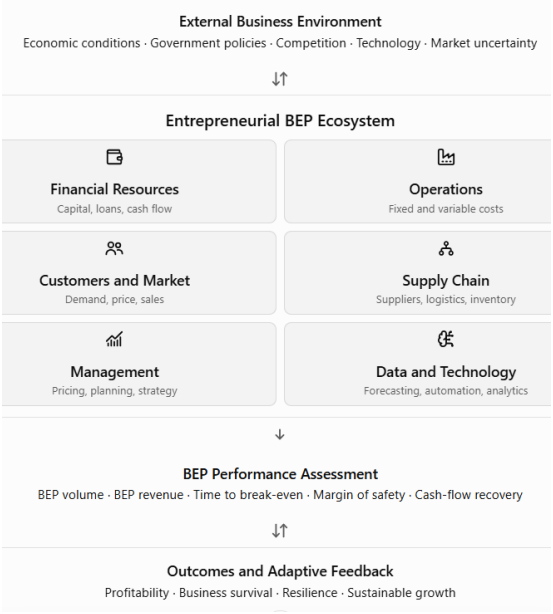
**The ecosystem is dynamic:** changes in market demand, input prices, financing, or productivity affect BEP, while performance results inform subsequent management decisions.

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## Major Components of BEP Ecosystem

| Component | Key factors | Influence on BEP |
|---|---|---|
| Financial ecosystem | Equity, loans, interest, working capital | Determines funding capacity and financial risk |
| Cost ecosystem | Rent, salaries, materials, utilities | Determines total cost structure |
| Market ecosystem | Demand, customer preferences, competition | Influences price and achievable sales |
| Supply-chain ecosystem | Suppliers, logistics, inventory | Influences unit costs and delivery reliability |
| Operational ecosystem | Capacity, productivity, technology | Influences efficiency and cost per unit |
| Entrepreneurial ecosystem | Skills, experience, networks, innovation | Influences decision quality and adaptability |
| Regulatory ecosystem | Taxes, licences, labour and environmental requirements | Influences compliance costs and operating constraints |
| Digital ecosystem | Accounting software, BI, analytics, AI | Improves monitoring, forecasting, and decision-making |

## Functioning of BEP Ecosystem

The ecosystem can be understood through six connected stages:

1. **Resource mobilisation:** Obtain finance, equipment, skills, materials, and technology.
2. **Cost and revenue assessment:** Identify fixed costs, variable costs, prices, and realistic demand.
3. **BEP calculation:** Estimate the sales volume and revenue required to cover relevant costs.
4. **Strategic intervention:** Adjust costs, pricing, marketing, operations, and product mix.
5. **Performance monitoring:** Compare actual sales, contribution, costs, and cash flow with targets.
6. **Adaptive improvement:** Update decisions as market and business conditions change.

## Mathematical model of the BEP ecosystem

For a single product, the basic operating model is:

$$Q_{\text{BEP}} = \frac{F}{P - V}$$

Where:

- (QBEP) = break-even quantity
- (F) = fixed costs for the defined period
- (P) = selling price per unit

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- (V) = variable cost per unit

An extended conceptual model can represent the ecosystem as:

$$BEP_t = f(F_t, P_t, V_t, D_t, K_t, E_t)$$

Where (Dt) represents demand conditions, (Kt) operational capacity, and (Et) external environmental factors. This is a conceptual relationship; a research study would need to define measurable variables and estimate their effects empirically.

**SWOT Analysis for BEP Ecosystem**

| SWOT factor | Example in the BEP ecosystem | Strategic response |
|---|---|---|
| Strength | High contribution margin | Expand profitable sales |
| Strength | Efficient production process | Improve capacity utilisation |
| Weakness | High fixed-cost commitments | Reduce overheads or use flexible capacity |
| Weakness | Poor cash collection | Improve credit and collection policies |
| Opportunity | Untapped customer segment | Test targeted market expansion |
| Opportunity | Automation or process innovation | Evaluate cost savings against investment |
| Threat | Rising material prices | Diversify suppliers and review pricing |
| Threat | Declining demand | Reforecast BEP and control discretionary spending |

**BEP Ecosystem Performance Indicators**

Entrepreneurs and researchers can measure ecosystem performance using:

- **BEP sales volume:** Units required to cover costs.
- **BEP revenue:** Sales revenue required to cover costs.
- **Time to break-even:** Time required to reach the specified break-even condition.
- **Margin of safety:** Actual sales minus BEP sales.
- **Contribution margin ratio:** Contribution divided by sales revenue.
- **Operating cash-flow adequacy:** Ability to meet cash obligations.
- **Capacity utilisation:** Actual output relative to practical capacity.
- **Cost variance:** Difference between actual and budgeted costs.
- **Business survival and sustainability:** Continued operation and financial resilience over time.

**Various BEP Analysis**

Break-Even Point (BEP) analysis can be classified into several categories according to the purpose of analysis, cost structure, business model, time horizon, uncertainty, and managerial decision requirements. These categories help businesses evaluate profitability, control costs, plan production, set prices, and assess financial sustainability.

**Major Categories of BEP Analysis**

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IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2026

DOI: 10.17148/IARJSET.2026.131102

| No. | Category | Purpose |
|---|---|---|
| 1 | Basic Break-Even Analysis | Determines the sales volume at which total revenue equals total cost. |
| 2 | Cost–Volume–Profit (CVP) Analysis | Examines the relationship between cost, sales volume, and profit. |
| 3 | Profit-Target BEP Analysis | Determines the sales required to achieve a specified profit. |
| 4 | Cash Break-Even Analysis | Estimates sales needed to cover cash operating expenses. |
| 5 | Accounting Break-Even Analysis | Determines the sales needed to cover accounting costs, including relevant non-cash expenses. |
| 6 | Multi-Product BEP Analysis | Calculates break-even sales for businesses selling multiple products. |
| 7 | Pricing-Based BEP Analysis | Assesses the effect of price changes on break-even sales. |
| 8 | Cost-Reduction BEP Analysis | Examines how cost optimisation changes the break-even point. |
| 9 | Investment BEP Analysis | Evaluates the sales needed to recover an investment or additional fixed costs. |
| 10 | Product Lifecycle BEP Analysis | Assesses break-even requirements during development, launch, growth, maturity, and decline. |

**1.Basic Break-Even Analysis (BEP)**

Break-Even Analysis is a financial management technique used to determine the level of sales at which a business's total revenue equals its total costs. At this point, the business makes neither an operating profit nor an operating loss.
It helps entrepreneurs determine the minimum sales required to cover costs and plan for profitability.

$$\text{BEP (Units)} = \frac{F}{P - V}$$

Where:

- (F) = Total fixed costs
- (P) = Selling price per unit
- (V) = Variable cost per unit
- (P-V) = Contribution per unit

**2. Cost-volume-profit (CVP) analysis**

Management makes many critical decisions that affect a firm's profitability and is often interested in knowing the impact of a certain decision on the firm's profitability. For example, it is not unusual for managers to be excited about an installation of a new, more efficient plant based on an optimistic sales forecasts and promise of a larger market share. However, it is necessary to understand how this decision will affect the firm's profitability. Cost-volume-profit (CVP) analysis can help managers assess the impact of their decisions on profitability. CVP analysis involves studying the interrelationships between costs, revenues, level of activity, and profits. Thus CVP can answer questions like what happens to the profitability if the fixed costs increase due to expansion, or how many units need to be sold before the firm can cover its cost and profit from expansion.

**Basic Elements of C-V-P Analysis**

The Basic elements of C-V-P analysis are cost, volume and profit. These three fundamental elements determine the value creation for the business in the long run. A good understanding of cost and volume helps the business to manage its profit efficiently. Let us understand the basis of these three fundamental elements of C-V-P concept.

**Cost** The first important business element is cost. Every business incurs certain cost initially and also as it carries out its business. These costs are the expenses related type making the product or providing a service. **Volume** The second most important element of the business is volume. I.e., how much it will produce and sell. The business must know beforehand how much to sell in order to determine how much to produce.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

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**Profit** The last element is the profit of the business. A business must know how much a profit it has generated by delivering a certain number of products and services to the customers. Generally, the profit is determined as selling price of the product less cost of manufacturing the product.

**Principles and Assumption of Cost-Volume-Profit Analysis**

Underlying the operation of cost-volume-profit analysis is a principle which states that "at the lowest level of activity cost exceed income but as activity increases income rises faster than cost and eventually the two amount are equal, after which income exceed cost until diminishing returns bring cost above income once again. This principle describes cost-volume-profit analysis with curvilinear. Cost and revenue curves which thought theoretically sound lack practicability. Accountant found the need to bring in additional information relating to cost behavior and sales policy, this was to ensure that practical model be develop out of this principles. The followings are the underlying assumptions of cost-volume profit analysis according to Horngen et al (2006)

**The behaviour and revenues is linear.**

- Selling price is constant.
- All cost can be divided in to their fixed and variable element.
- Total fixed cost remains constant.
- Total variable cost is proportional to volume.
- Volume is the only drive of cost.
- Prices of production inputs (e.g. materials) are constant.

**Methods of Cost-Volume-Profit Analysis**

There are two main approaches used in analysis of cost-volume-profit. They include:

• The Graphical Approach

• The Algebraic Approach

**The Graphical Approach**

The cost-volume-profit graph can be very useful because it highlighted cost-volume-profit relationship over wide range of activity and give managers a perspective that can be obtained in on other way. Such graph is referred to as preparing a break even chart. This is correct to the extent that breakeven point is clearly shown on the graph. Garrison et al (2003).

**The Profit Graph**

This is another approach to cost-volume-profit graph. It is sometime preferred by some managers because it focuses more directly on how profit change with changes in volume. It has the added advantage of being easier to interpret than the traditional approach. It has the disadvantage of not showing as clearly how cost are affected by changes on the levels of sales.

**The Algebraic Approach**

The issues involved on this approach are the putting of marginal income statement format in formula, the incorporation of the contribution concept into the marginal costing income statement formula and the mathematical arrangement, re-arrangement and evaluation of some of the basic cost –volume-profit factors. (unit selling price, unit variable cost' fixed cost' sales volume). The marginal income statement employs the marginal costing technique where too much attention may be given to variable costs at the expense of disregarding fixed costs; in the long run fixed cost must be recovered.

**The formulae and ratios that constitute then algebraic approach include the following;**

• The net income ratio

• The contribution margin equation

• The variable cost ratio

• The contribution margin ratio

• The tax adjusted ratio

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**The Net Income Equation** This is a form of marginal costing statement used in processing cost-volume-profit data. Marginal costing differentiates between fixed costs and variable cost. In decision making, marginal costing is used simply because fixed cost is considered as a sunk cost or historical cost which is incurred whether profit is made or not.

The formula is stated thus;

**NI=S- VC – FC**

This can be regarded as;

**S= VC + FC +_NI**

Where:

S = sales

VC = variable cost

NI = Net income

At break-even point, the equation changes because at that point, net income is zero, (no profit or loss).

Therefore **s = F / S – V**

The net income includes the break-even point, margin of safety and profit and loss at a given level of activity and it is computed thus:

**IN = Sn – Vn – Fn**

Required quality to be produced and sold to obtain a target income; in order to compute the quality required to be manufactured and sold to obtain a target income this equation must be used:

**Q = FC + NI / CM**

Where: CM = S – V.

**The Contribution Margin Equation**

Contribution margin is the amount by which revenue exceed the variable cost of producing that revenue. Contribution margin per unit is the different between selling price and variable cost per unit. Horngren et al (2006). Contribution margin is very important in decision making and it states that the planner ought to think in terms of contribution margin rather than in terms of absolute profit. It should be noted that each additional unit

sold of a particular product contributes to a margin towards profit.

The contribution margin equation could be stated thus

**Cm = S - V**

Where:

Cm= contribution margin

S= sales

V= variable cost

In contribution margin approach break-even point is calculated as

**FC / CM**

Sales unit to earn a desired profit to be

**FC + Target profit / CM**

**The Margin of Safety Equation**

Margin of represents the difference between break-even point and budgeted activity level. It indicates how much sales may decrease before a company will suffer a loss. Adeniji (2004). The formula for calculating margin of safety is:

a. **Most (unit)** = Budgeted unit – Break –even Point (unit).

b. **Most (sales volume)** = Budgeted sales – Break-even point (Sales volume)

**The Contribution Margin Ratio (CMR)**

This is the ratio of contribution to a particular sale value is describe as contribution margin ration. Also referred to as profit-volume ratio. It is designed to measure the level of contribution derivable from a specific amount of sales. It will be determined as follows.

**a. CMR (unit) =** Selling price – Variable cost per unit / Selling price

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**b. CMR (Total) =** Total sales – Total variable cost / Total sales

**c. CMR =** Fixed Cost + Profit Contribution + Variable cost

**Note: -** This occurs where selling price is completely omitted.

**d. CMR =** Change in Profit / Changes in sales volume

**Uses of Cost-Volume-Profit Analysis**

Besides providing management with general information on the cost-volume-profit relationship of their firms, accountant can be also use it to provide management with useful information necessary for selling, certain planning, control and special decision problems. The decision areas where this analysis is done include: - profit planning budgetary control, control, product replacement, pricing decision, selecting of distribution channels, setting volume, sensitive retain on investment target, entry into foreign marking performance measurement. (Meigs and Meigs ,1996)

Major Uses of CVP Analysis

| Use | Purpose |
|---|---|
| 1. Break-Even Analysis | Determines the sales volume at which total revenue equals total costs. |
| 2. Profit Planning | Estimates the sales required to achieve a target profit. |
| 3. Pricing Decisions | Evaluates how changes in selling prices affect contribution and profitability. |
| 4. Cost Control | Identifies the effect of fixed and variable costs on profit. |
| 5. Sales Volume Planning | Determines the quantity of products that must be sold to meet financial objectives. |
| 6. Product Mix Decisions | Helps prioritise products based on their contribution margins, subject to resource and demand constraints. |
| 7. Make-or-Buy Decisions | Supports comparisons between internal production and external purchasing costs. |
| 8. Investment Decisions | Estimates the sales needed to justify additional fixed costs or capacity investments. |
| 9. Risk Assessment | Measures the margin of safety and evaluates vulnerability to declining sales. |
| 10. Business Expansion | Assesses the profitability implications of entering new markets or increasing production capacity. |
| 11. Performance Evaluation | Compares actual sales and profits with planned targets. |
| 12. Business Sustainability | Helps evaluate whether a business can maintain sufficient sales and contribution to cover its costs over time. |

**Limitations of Cost-Volume- Profit Analysis**

Cost-Volume-Profit (CVP) Analysis is useful for-profit planning and break-even decisions. However, it has several limitations because actual business conditions are often more complex than the assumptions used in CVP models.

CVP analysis is a useful planning tool, but its results depend on assumptions about costs, prices, sales volume, and product mix. Combining it with forecasting, sensitivity analysis, cash-flow management, and continuous data monitoring can make managerial decisions more robust.

**Methods to Reduce / Overcome CVP Limitations**

| Limitation | Recommended improvement |
|---|---|
| Changing costs and prices | Update estimates regularly and use flexible budgets. |
| Demand uncertainty | Apply market research, demand forecasting, and scenario analysis. |
| Multiple products | Use weighted-average contribution margins and test alternative sales mixes |
| Inflation and economic volatility | Conduct sensitivity analysis and periodic cost reviews. |
| Long-term investment costs | Integrate CVP with capital budgeting and lifecycle costing. |
| Uncertain outcomes | Use probability-based models or Monte Carlo simulation where suitable. |
| Inaccurate data | Integrate accounting systems, ERP, and business intelligence tools. |
| Cash-flow risk | Combine CVP with cash-flow forecasts and working-capital analysis. |

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**CVP Limitations**

Major Problems of CVP Analysis

| No. | Problem | Explanation |
|---|---|---|
| 1 | Fixed-cost assumption | Fixed costs may increase when a business expands capacity or opens new facilities. |
| 2 | Variable-cost instability | Material, labour, energy, and transportation costs may fluctuate. |
| 3 | Constant selling price | Prices may change because of competition, discounts, inflation, or customer demand. |
| 4 | Sales-volume uncertainty | Actual demand may differ from forecasts, making planned BEP inaccurate. |
| 5 | Cost classification difficulties | Some costs are semi-variable or mixed and cannot be easily classified as fixed or variable. |
| 6 | Multiple products | Different products have different contribution margins, and changes in sales mix affect BEP. |
| 7 | Linear relationship assumption | Costs and revenue do not always change proportionately with production volume. |
| 8 | Capacity constraints | Limited machinery, labour, storage, or production capacity may prevent a business from achieving its target sales. |
| 9 | Short-term focus | Traditional CVP analysis may overlook long-term investment, product development, and strategic costs. |
| 10 | Inflation and economic changes | Inflation, interest rates, exchange rates, and taxation can change the cost and profit structure. |
| 11 | Inventory complications | Production volume, sales volume, and inventory changes can complicate profit calculations. |
| 12 | Uncertainty and risk | Traditional CVP calculations do not automatically account for uncertainty in demand, price, or costs. |
| 13 | Qualitative factors | Customer satisfaction, product quality, employee welfare, and environmental impacts are not directly measured. |
| 14 | Data accuracy | Incorrect estimates of fixed costs, variable costs, selling prices, or sales forecasts lead to misleading results. |

**3.Profit-Target BEP Analysis**

Profit-Target Break-Even Point (BEP) Analysis is a managerial accounting technique used to determine the quantity of products a business must sell to cover its costs and earn a specified target profit.

Traditional BEP analysis identifies the sales level at which profit is zero. Profit-target analysis extends this concept by calculating the sales volume required to achieve a desired level of earnings.

**Formula for Profit-Target BEP**

$$Q= F+T / P-V$$

Where:

- (Q) = units required to be sold
- (F) = total fixed costs
- (T) = target profit
- (P) = selling price per unit
- (V) = variable cost per unit
- (P-V) = contribution per unit

For a target profit expressed as a percentage of sales, the required revenue depends on the target's definition. If the target is a specified operating profit margin \(m\):

$$S = F / CMR-m$$

Here, (S) is required sales revenue, (CMR) is the contribution margin ratio, and (m) is the target operating profit margin, expressed as a decimal. This formula requires (CMR>m).

**Profit-target BEP analysis supports:**

1. **Production planning:** determines how much output is needed for the desired earnings.
2. **Pricing strategy:** evaluates whether the target profit is feasible at a proposed price.
3. **Cost optimisation:** measures how cost reductions change the sales target.

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4. **Sales forecasting:** compares target sales with expected market demand.
5. **Investment decisions:** estimates the volume needed to justify new equipment or product launches.
6. **Performance evaluation:** compares actual sales and profit with management targets.

**4.Cash Break-Even Analysis**

Cash Break-Even Analysis determines the level of sales at which a business generates enough cash contribution to cover its cash operating costs and other specified cash expenses. At this point, the business's cash inflows cover the relevant cash outflows, leaving no cash surplus or shortfall from the activities included in the analysis.

Unlike accounting break-even analysis, cash BEP excludes non-cash expenses such as depreciation. It is useful for assessing short-term liquidity, working-capital needs, business survival, and the ability to meet cash commitments.

**Formula**

**Cash BEP (units)** = Fixed Cash Costs / (Selling Price per Unit-Variable Cash Cost per Unit)

Where:

- **Fixed cash costs:** Rent, salaries, insurance, and other fixed costs paid in cash during the period.
- **Selling price per unit:** Revenue received or expected per unit sold.
- **Variable cash cost per unit:** Cash costs that vary with each unit produced or sold.
- **Contribution per unit:** Selling price minus variable cash cost.

For **Cash BEP in sales revenue:**

**Cash BEP Revenue**= Fixed Cash Costs Cash / Contribution Margin Ratio

The analysis should use a consistent period and clearly specify which cash payments are included.

**Applications of Cash BEP**

1. **Liquidity management:** Estimate the sales required to cover cash commitments.
2. **Entrepreneurial survival:** Identify minimum viable sales during the early stages of a venture.
3. **Working-capital planning:** Estimate the cash burden associated with operations.
4. **Cost optimisation:** Assess the effects of reducing fixed cash expenses or variable costs.
5. **Product launch decisions:** Evaluate whether expected sales can cover launch-related cash expenditure.
6. **Risk management:** Test the impact of lower demand, rising input prices, or delayed customer payments.
7. **Investment decisions**: Examine whether operating cash contribution can support future cash commitments.

**5. Accounting Break-Even Analysis**

Accounting Break-Even Analysis determines the level of sales at which a business's total revenue equals its total accounting costs, including both cash expenses and non-cash expenses such as depreciation. At this point, the business reports zero accounting operating profit or loss.

It helps managers evaluate product profitability, production targets, pricing decisions, cost structures, and the financial viability of business operations.

**Formula**

For a single product:

**Accounting BEP (units)} = F / P-V**

Where:

- (F) = total fixed accounting costs, including depreciation
- (P) = selling price per unit
- (V) = variable accounting cost per unit
- (P-V) = contribution per unit

**For accounting BEP in sales revenue:**

**Accounting BEP Revenue = F / Contribution Margin Ratio**

The contribution margin ratio is:

**P-V/ P**

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These formulas assume a constant selling price and unit variable cost, a defined relevant period, and a stable product mix where applicable.

**Applications**

1. **Production planning:** Establish the minimum sales volume required to avoid an accounting operating loss.
2. **Pricing decisions**: Evaluate how changes in selling price affect the BEP.
3. **Cost optimisation**: Assess the effect of reducing fixed or variable costs.
4. **Product selection**: Compare the financial viability of alternative products.
5. **Investment evaluation**: Examine how depreciation from new equipment affects the accounting BEP.
6. **Profit-target planning**: Estimate the sales required to achieve a specified operating profit.
7. **Performance measurement**: Monitor the margin of safety and the distance between actual sales and BEP.

**6. Multi-Product BEP Analysis**

Multi-Product BEP Analysis is a financial management technique used to determine the total sales revenue or sales volume required for a business selling multiple products to cover its total fixed costs without making an operating profit or loss.

- It considers the different selling prices, variable costs, contribution margins, and sales proportions of individual products.
- The most important factor is the sales mix. A shift toward products with higher contribution margins can reduce the overall break-even revenue, whereas a shift toward lower-contribution products can increase it.

**Formula**

The weighted-average contribution margin ratio is:

$$WACMR = \sum_{i=1}^{n} w_i \left( \frac{P_i - V_i}{P_i} \right)$$

The multi-product break-even revenue is:

$$BEP_{\text{Revenue}} = \frac{F}{WACMR}$$

Where:

- (F) = total fixed costs
- (wi) = proportion of total sales revenue contributed by product
- (Pi) = selling price per unit
- (Vi) = variable cost per unit
- (WACMR) = weighted-average contribution margin ratio

This calculation assumes the sales-revenue mix remains constant over the relevant period.

**Applications of Multi-Product BEP Analysis**

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

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**Major Applications**

| Application | How it is used |
|---|---|
| 1. Product portfolio planning | Identifies how different products collectively contribute to covering fixed costs. |
| 2. Product selection | Helps prioritise products with stronger contribution margins, subject to demand and capacity constraints. |
| 3. Pricing decisions | Evaluates the impact of changing prices on overall break-even sales. |
| 4. Sales-mix optimisation | Assesses how changes in the proportion of products sold affect the overall BEP. |
| 5. Cost management | Identifies products whose variable costs reduce total contribution. |
| 6. Resource allocation | Supports decisions about machinery, labour, materials, and production capacity. |
| 7. New-product introduction | Estimates the additional sales required to support the costs of launching new products. |
| 8. Product discontinuation | Evaluates whether removing a product improves profitability, considering avoidable costs and lost contribution. |
| 9. Business expansion | Estimates the sales revenue needed when introducing new product categories or entering new markets. |
| 10. Risk management | Measures exposure to falling demand or an unfavourable sales mix. |
| 11. Budgeting and forecasting | Establishes sales targets across products to cover fixed costs and achieve planned profits. |
| 12. Sustainability decisions | Evaluates the financial viability of greener products, recyclable materials, and energy-efficient production. |

### 7.Pricing-Based BEP Analysis

Pricing-Based BEP Analysis is a managerial decision-making technique used to determine how selling-price changes influence the sales volume or revenue required for a business to cover its total costs.

- It helps managers establish a viable selling price, evaluate discounts, assess competitive pricing strategies, and balance profitability with market demand.
- The central principle is that a selling-price change affects the contribution earned per unit and, consequently, the break-even point.

**Core formulas**

For a single product:

$$BEP_{\text{units}} = \frac{F}{P - V}$$

Where:

- (F) = total fixed costs
- (P) = selling price per unit
- (V) = variable cost per unit
- (P-V) = contribution per unit

The minimum selling price required to break even at a specified sales volume (Q) is:

$$P_{\text{BEP}} = V + \frac{F}{Q}$$

To achieve a target operating profit (T ):

$$P = V + \frac{F + T}{Q}$$

These formulas assume fixed costs and variable costs remain stable over the relevant range. In practice, a price change may also affect customer demand, competitors' responses, and the variable cost per unit.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

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**Applications of Pricing Based BEP Analysis**

Major Applications of Pricing-Based BEP Analysis

| Application | Business use |
|---|---|
| 1. New product pricing | Estimates the price needed to recover product launch and operating costs. |
| 2. Price reduction decisions | Determines how many additional units must be sold to offset a lower selling price. |
| 3. Price increase decisions | Evaluates how higher prices can reduce the required break-even sales volume. |
| 4. Competitive pricing | Assesses whether a market-driven price can cover costs and provide an acceptable return. |
| 5. Discount management | Evaluates the profitability impact of promotional offers and seasonal discounts. |
| 6. Target-profit pricing | Calculates the price required to achieve a specified operating profit at a planned sales volume. |
| 7. Product relaunch | Helps establish a viable price for redesigned, upgraded, or repositioned products. |
| 8. Market segmentation | Supports different pricing strategies for customer groups when costs, demand, and willingness to pay differ. |
| 9. Capacity utilisation | Evaluates pricing options to improve utilisation of available production capacity. |
| 10. Business sustainability | Tests whether prices can support operating costs, investment recovery, and long-term viability. |

**8.Cost-Reduction BEP Analysis**

Cost-Reduction BEP Analysis is a managerial accounting technique used to evaluate how reducing fixed costs, variable costs, or both changes the sales volume required for a business to break even.

- Its primary objective is to improve contribution margins, reduce financial risk, accelerate the achievement of profitability, and support sustainable business operations without compromising product quality or customer value.

**Core formula**

For a single product:

$$BEP = \frac{F}{P - V}$$

Where:

- (F) = fixed costs
- (P) = selling price per unit
- (V) = variable cost per unit
- (P-V) = contribution per unit

After cost reduction:

$$BEP_{\text{new}} = \frac{F - \Delta F}{P - (V - \Delta V)}$$

Where (Delta F) is the reduction in fixed costs and (Delta V) is the reduction in variable cost per unit. This assumes the selling price remains unchanged and the cost reductions are sustainable.

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**Applications of Cost-Reduction BEP Analysis**

Major Applications

| Application | How it helps |
|---|---|
| 1. Fixed-cost optimisation | Reduces rent, administrative expenses, and unnecessary overheads. |
| 2. Variable-cost reduction | Lowers material, labour, packaging, and production costs per unit. |
| 3. Supplier negotiation | Reduces purchasing and logistics costs through better contracts and sourcing. |
| 4. Production efficiency | Minimises waste, rework, downtime, and resource consumption. |
| 5. Automation | Evaluates whether technology can lower unit costs enough to justify additional fixed costs. |
| 6. Inventory management | Reduces storage, obsolescence, and inventory-handling costs. |
| 7. Outsourcing decisions | Compares internal production costs with external service or manufacturing costs. |
| 8. Product redesign | Simplifies product components and manufacturing processes without compromising quality. |
| 9. Energy efficiency | Reduces electricity, fuel, and utility costs. |
| 10. Business recovery | Helps loss-making businesses lower their BEP and move toward profitability. |
| 11. Product portfolio management | Identifies products whose cost structures require redesign or reconsideration. |
| 12. Sustainability | Evaluates waste reduction, circular materials, and resource efficiency alongside financial returns. |

**9.Investment BEP Analysis**

Investment Break-Even Point (Investment BEP) Analysis determines the level of sales, operating contribution, cash flow, or time required for an investment to recover its initial cost and associated investment-related expenses.

It helps managers evaluate whether investments in machinery, automation, technology, new products, business expansion, or research and development are financially viable.

Investment BEP can be measured in two main ways:

- Operating BEP: The sales level at which operating revenue covers operating costs.
- Investment recovery BEP: The cumulative cash flow or contribution required to recover the initial investment and other relevant cash outlays.

These measures are related but not identical. A project may reach its operating BEP while still taking several years to recover its initial investment.

**Core formulas**

**A. Investment recovery in units**

If the initial investment is (I), and each unit generates an incremental contribution of (P-V):

$$Q_{\text{investment BEP}} = \frac{I}{P-V}$$

This simplified formula assumes the investment is recovered entirely from incremental contribution, with no additional fixed costs, taxes, financing costs, or timing effects.

If the project also incurs additional fixed costs (F) over the recovery period:

$$Q = \frac{I+F}{P-V}$$

Use this version only when (I) and (F) refer to the same defined recovery period and are not double-counted.

**B. Payback period**

For a project generating a stable annual net cash inflow:

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Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2026

DOI: 10.17148/IARJSET.2026.131102

$$\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Annual Net Cash Inflow}}$$

This estimates the time required to recover the initial investment when annual cash inflows are constant. If inflows vary, calculate cumulative cash flow year by year.

**APPLICATIONS OF INVESTMENT BEP ANALYSIS**

Major Applications of Investment BEP Analysis

| Application | Purpose |
|---|---|
| 1. New business investment | Estimates the sales needed to recover start-up and operating costs. |
| 2. Machinery and equipment | Evaluates the production volume required to justify purchasing equipment. |
| 3. Technology adoption | Assesses whether automation, software, or digital systems can recover implementation costs. |
| 4. Business expansion | Estimates the sales or additional contribution needed to recover expansion expenditure. |
| 5. New product development | Evaluates the units required to recover research, design, testing, and launch costs. |
| 6. Product relaunch | Measures whether redesign, rebranding, or marketing investment is financially recoverable. |
| 7. Replacement decisions | Compares the costs and expected benefits of replacing old equipment or systems. |
| 8. Make-or-buy decisions | Compares investment in internal production with outsourcing alternatives. |
| 9. Renewable energy investment | Estimates the savings or operating benefits needed to recover energy-system investment. |
| 10. Capacity expansion | Assesses the additional output needed to justify higher capital and fixed operating costs. |
| 11. Research and innovation | Estimates the commercial sales needed to recover development expenditure. |
| 12. Investment risk assessment | Tests how changes in sales, price, costs, or implementation time affect investment recovery. |

**10.Product Lifecycle BEP Analysis**

Product Lifecycle Break-Even Point (BEP) Analysis is a financial decision-making approach that evaluates the costs, revenues, contribution margins, and profitability of a product across its entire lifecycle—from development and market introduction to growth, maturity, decline, and eventual withdrawal or relaunch.

Unlike conventional BEP analysis, which often examines a single period, Product Lifecycle BEP Analysis considers how costs, prices, sales volumes, and investment recovery change over time.

Its purpose is to help management determine:

- When a new product is likely to recover its development and launch investment.
- How quickly the product can reach operating profitability.
- Which lifecycle stage requires cost optimisation or pricing adjustments.
- Whether to expand, redesign, relaunch, or discontinue a product.
- How to maintain long-term product and company sustainability.

**Formulas for Product Lifecycle BEP**

**A. Operating BEP**

$$BEP_{\text{operating}} = \frac{F}{P - V}$$

This identifies the sales volume needed to cover the product's fixed operating costs during a specified period.

**B. Lifecycle investment recovery**

The more comprehensive measure is cumulative lifecycle cash-flow break-even: the point at which cumulative net cash flows from the product equal or exceed the initial investment and subsequent net cash outflows.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

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$$\sum_{t=0}^{T} NCF_t \geq 0$$

Where (NCFt) is the product's net cash flow in period (t), including relevant development, launch, operating, maintenance, and end-of-life cash flows. The first period satisfying this condition marks cash-flow recovery.

**C. Simplified lifecycle recovery in units**

If price and unit contribution remain constant:

$$Q_{\text{recovery}} = \frac{I + \sum F_t}{P - V}$$

Where (I) is the initial investment and (Ft) represents additional fixed cash costs over the defined recovery period. Avoid double-counting costs already included in (I).

## APPLICATIONS OF PRODUCT LIFECYCLE BEP ANALYSIS

**Major Applications**

| Application | Purpose |
|---|---|
| 1. Product investment recovery | Determines the sales or cash flows required to recover initial development and launch expenditure. |
| 2. Product pricing | Evaluates prices needed to recover costs over the expected product life. |
| 3. Product design optimisation | Compares designs based on manufacturing, maintenance, and end-of-life costs. |
| 4. Time-to-market decisions | Assesses how launch delays affect the time available to generate revenue and recover investment. |
| 5. Production planning | Estimates required production and sales volumes across lifecycle stages. |
| 6. Product portfolio management | Compares the financial viability of different products and product families. |
| 7. Product renewal and relaunch | Evaluates whether upgrades, redesigns, or new marketing expenditure are likely to recover their incremental costs. |
| 8. After-sales service | Includes warranty, repairs, spare parts, and service-support costs in lifecycle profitability. |
| 9. Sustainability decisions | Assesses the financial implications of durable design, recycling, reuse, and lower-waste production. |
| 10. Product withdrawal | Helps determine when a product should be discontinued or replaced, considering avoidable costs and future contribution. |

**BEP Strategies**

Break-Even Point (BEP) strategies are managerial approaches used to reduce the sales volume or revenue required to cover total costs, improve profitability, manage business risk, and support sustainable growth. They help entrepreneurs and organisations move from loss-making operations towards profitability.

**Major BEP Strategies**

**1. Cost-Reduction Strategy**

Reduce fixed and variable costs through lean operations, automation, waste reduction, energy efficiency, and better supplier negotiations.

**Objective**: Lower the sales volume needed to break even.

**2. Pricing Strategy**

Review selling prices, discounts, product bundles, and value-based pricing to improve contribution per unit without unnecessarily reducing demand.

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**Objective**: Increase contribution margin.

**3. Sales Growth Strategy**

Expand customer acquisition, improve retention, increase repeat purchases, and strengthen distribution channels.
**Objective**: Achieve BEP sooner through higher sales.

**4. Product Portfolio Strategy**

Focus on products with strong contribution margins, review loss-making products, and optimise the product mix.
**Objective**: Improve overall business profitability.

**5. Operational Efficiency Strategy**

Improve capacity utilisation, inventory management, production scheduling, and supply-chain coordination.
**Objective**: Reduce waste, idle capacity, and avoidable expenses.

**6. Investment and Financial Strategy**

Evaluate capital expenditure, leasing versus buying, working capital, financing costs, and investment recovery periods.
**Objective**: Improve investment recovery and financial resilience.

**7. Customer Acquisition and Retention Strategy**

Use referrals, targeted digital marketing, repeat-purchase offers, and customer relationship management to generate profitable sales.
**Goal:** Reach BEP sooner through sustainable demand.

**BEP Advanced Applications**

**A. Dynamic BEP**

Recalculates the break-even target when costs, selling prices, sales volumes or product mix change.
**Application**: volatile markets and changing business conditions.

**B. Predictive BEP**

Combines historical sales, demand forecasts and cost projections to estimate future break-even risks.
**Application**: startup planning, seasonal businesses and new products.

**C. Product lifecycle BEP**

Evaluates the financial feasibility of product development, introduction, growth, maturity, relaunch and withdrawal.
**Application**: Product Lifecycle Management (PLM).

**D. Sustainable BEP**

Incorporates relevant energy, material, waste-management and lifecycle costs into financial feasibility decisions.
**Application:** sustainable manufacturing and circular economy initiatives.

**BEP and Economy: Break-Even Point in Economic Development**

Break-Even Point (BEP) and the economy can be studied at two connected levels: the financial sustainability of individual businesses and the wider economic effects of business activity on employment, investment, productivity, and national growth.

At the business level, BEP identifies the sales required to cover costs. At the economic level, analysing BEP across industries can help explain how businesses respond to inflation, interest rates, consumer demand, taxation, supply-chain costs, and economic uncertainty.

**Central idea:** Businesses that can reach and sustain their BEP are generally better positioned to continue operating, invest, employ workers, and contribute to economic activity. However, reaching BEP alone does not guarantee long-term business or national economic growth.

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**Economic factors influence BEP**

An important distinction is that economic conditions affect both the calculated BEP and the business's ability to achieve it. For example, falling demand may not change the basic BEP formula if prices and costs stay constant, but it makes the required sales volume harder to achieve.

| Economic factor | Effect on businesses | Potential BEP impact |
|---|---|---|
| Inflation | Increases wages, materials, energy, and overhead costs | Raises BEP if costs rise without offsetting price increases |
| Interest rates | Raises borrowing costs and may reduce consumer spending | Can raise BEP or reduce the likelihood of reaching it |
| Taxation | Changes operating costs, cash flow, and net returns | Depends on the type of tax and how it enters the cost model |
| Consumer demand | Affects sales volume and pricing power | Changes the likelihood of achieving BEP |
| Exchange rates | Changes imported input costs and export competitiveness | May raise or lower BEP |
| Unemployment and wages | Influences consumer purchasing power and labour costs | Effects vary by industry |
| Technology adoption | May reduce unit costs but require initial investment | Can initially raise fixed costs and later lower BEP |
| Government infrastructure | May improve logistics, access, and productivity | Can reduce costs and expand achievable sales |
| Competition | Can pressure prices and margins | Lower contribution per unit generally raises BEP |
| Supply-chain disruptions | Increase input costs or interrupt production | Can raise BEP and delay break-even attainment |

**BEP as a tool for National Economic Development**

BEP analysis can support economic decision-making across several levels.

**1. Micro and small enterprises**

Helps entrepreneurs assess viability, pricing, investment requirements, cost structures, and business survival.

**2. Industrial development**

Supports capacity planning, manufacturing investment, technology adoption, export competitiveness, and resource allocation.

**3. Rural and regional economies**

Can help assess the viability of agro-processing, local enterprises, rural industries, and employment-generating projects.

**4. Public investment and infrastructure**

Adapted cost-recovery and utilisation analysis can inform infrastructure and public-service decisions, although social benefits often extend beyond financial BEP.

**5. BEP and the national economy: an important distinction**

Traditional BEP is a firm-level accounting concept. It is not, by itself, a measure of GDP growth, national income, or economic equilibrium.

**BEP Optimisation Techniques**

Break-Even Point (BEP) Optimisation refers to the systematic use of cost management, pricing, operational improvements, sales strategies, and data-driven decisions to reduce the sales volume required to cover costs and accelerate the achievement of profitability.

The main objective is to lower the BEP, increase contribution margins, reduce business risk, and improve financial sustainability.

**Advanced BEP Optimisation Techniques**

For larger businesses and research applications, optimisation can go beyond simple cost reduction.

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- **Sensitivity analysis:** assess how BEP changes when price, fixed costs, or variable costs change.
- **Scenario analysis**: compare optimistic, expected, and pessimistic sales and cost conditions.
- **Linear programming**: optimise product mix when labour, machinery, materials, or budgets are limited.
- **Predictive analytics**: forecast demand and identify the likely time to reach BEP.
- **Dynamic pricing**: adapt prices to demand, competitive pressure, and available capacity.
- **Lifecycle cost optimisation**: integrate development, manufacturing, maintenance, and end-of-life costs.
- **Risk-adjusted BEP**: estimate the range of break-even outcomes under uncertain costs and sales.

**Major BEP Optimisation Techniques**

| Strategy | Management action | Expected BEP impact |
|---|---|---|
| Fixed-cost optimisation | Reduce rent, overheads, and unnecessary administrative costs | Lowers BEP |
| Variable-cost optimisation | Reduce material, labour, energy, and logistics costs per unit | Lowers BEP |
| Contribution improvement | Improve price-cost difference | Lowers BEP |
| Demand development | Increase sales volume and customer retention | Helps reach BEP sooner |
| Product-mix optimisation | Shift sales towards higher-contribution products | May lower overall BEP |
| Break-even forecasting | Use demand and cost forecasts to plan production | Improves risk management |
| Lifecycle management | Review launch, growth, maturity, and decline costs | Improves long-term recovery |
| Digital transformation | Use analytics, automation, and real-time cost monitoring | Can improve cost and decision control |

## CONCLUSION

This empirical study confirms a positive relationship between the adoption of Break-Even Point (BEP) analysis practices and organisational performance. The findings suggest that firms that systematically conduct cost analysis, evaluate contribution margins, and prepare break-even forecasts are better positioned to make informed managerial decisions, control operating costs, allocate resources efficiently, and respond to competitive pressures. These practices enable organisations to establish realistic sales targets, assess financial risks, improve pricing decisions, and monitor profitability. Consequently, the effective application of BEP analysis may contribute to improved operational efficiency, financial stability, competitive advantage, and long-term business sustainability. However, the strength and generalisability of this relationship depend on the study design, sample characteristics, and empirical evidence. This finding supports further investigation of BEP analysis as a management decision-support mechanism, particularly among entrepreneurs and small and medium-sized enterprises (SMEs).

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IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2026

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