# Lean Six Sigma Green Belt Certification Course




simplilearn

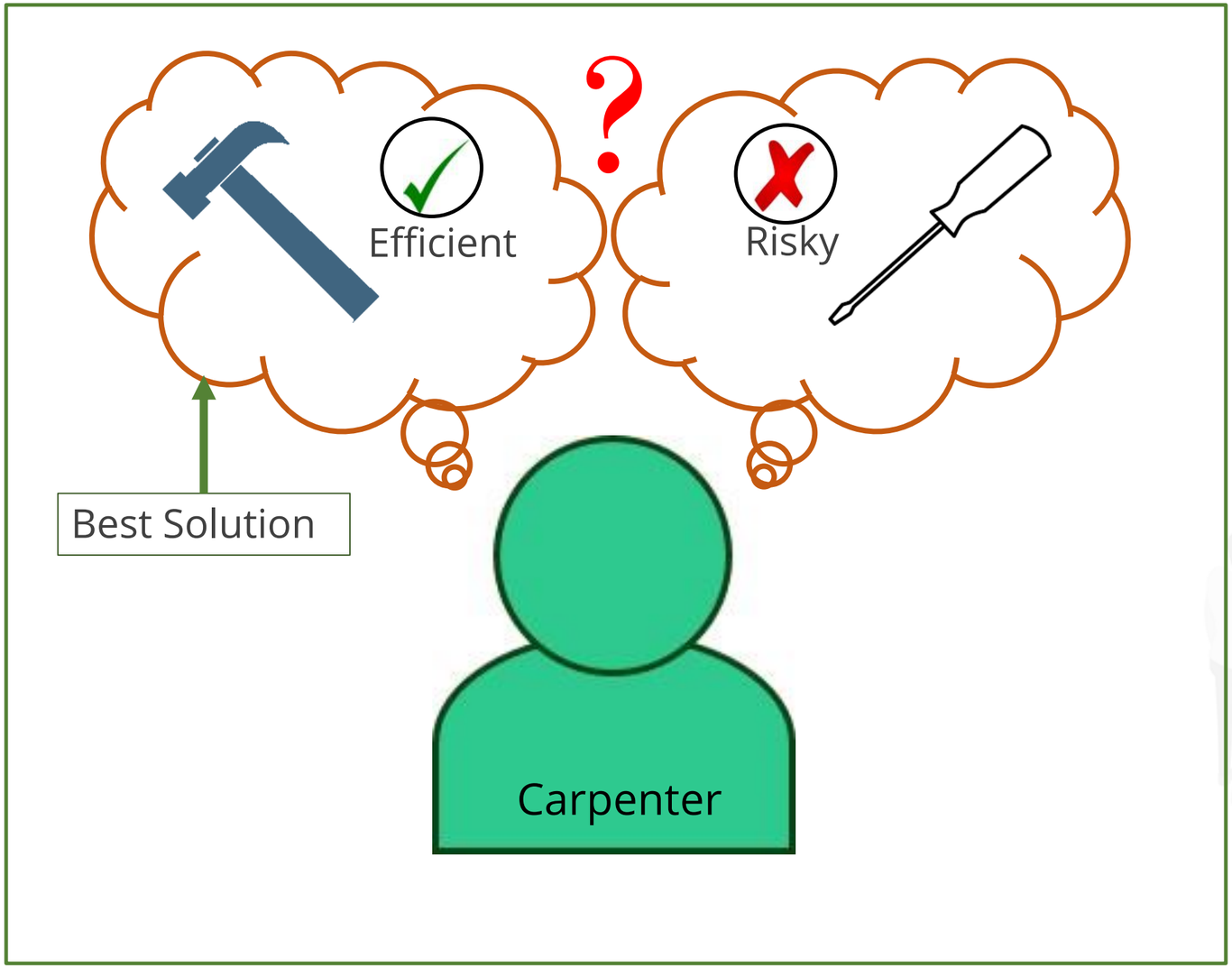
# Selecting a Solution

# Learning Objectives

By the end of this lesson, you will be able to:

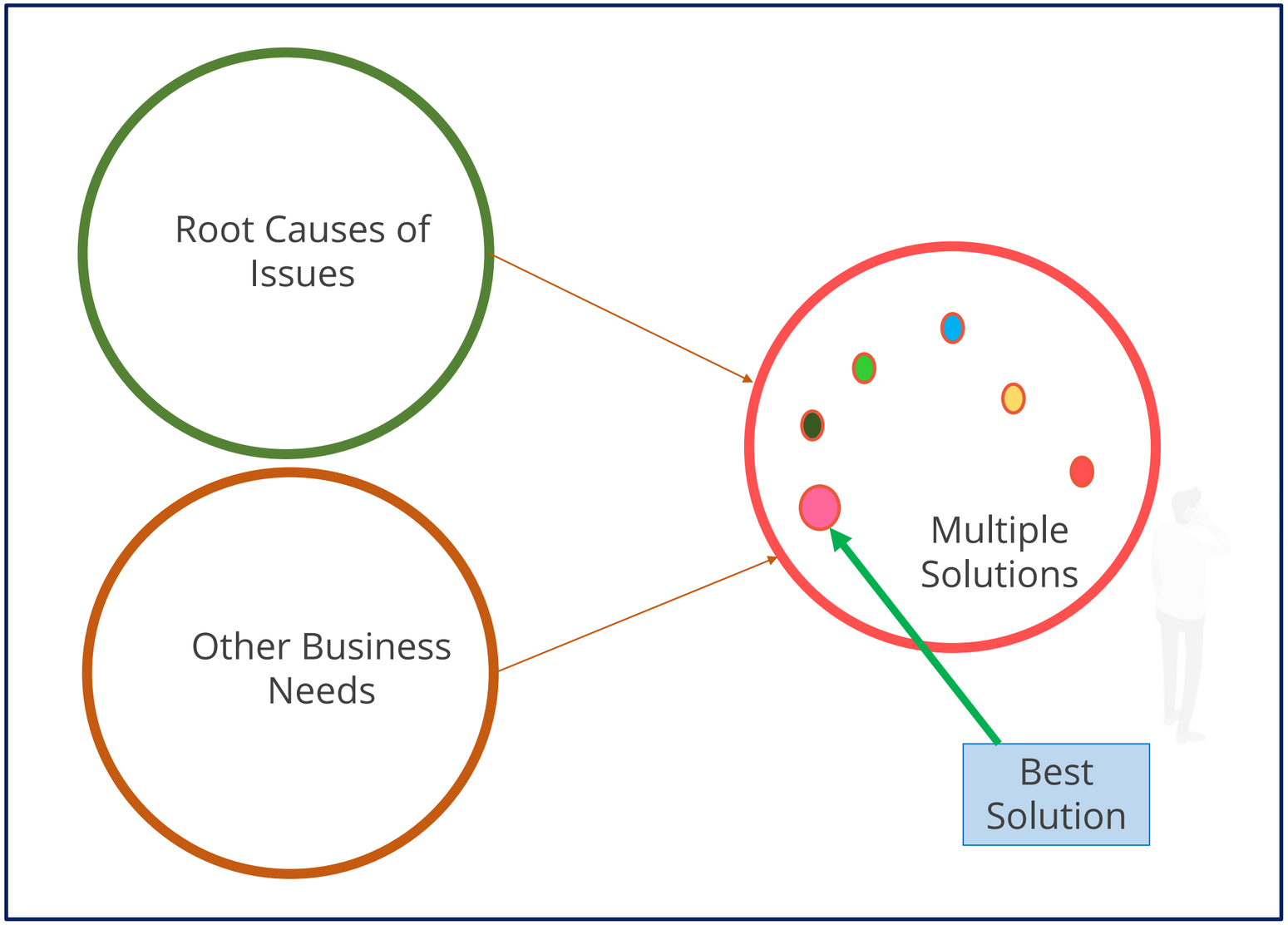
- Use Pugh Analysis to fix the root cause of an issue
- Explain the benefits of a Solution Prioritization Matrix
- Explain SCAMPER technique
- Differentiate between positive and negative brainstorming
- Evaluate the cost-benefit analysis of a solution
- Screen solution through piloting

# Scenario



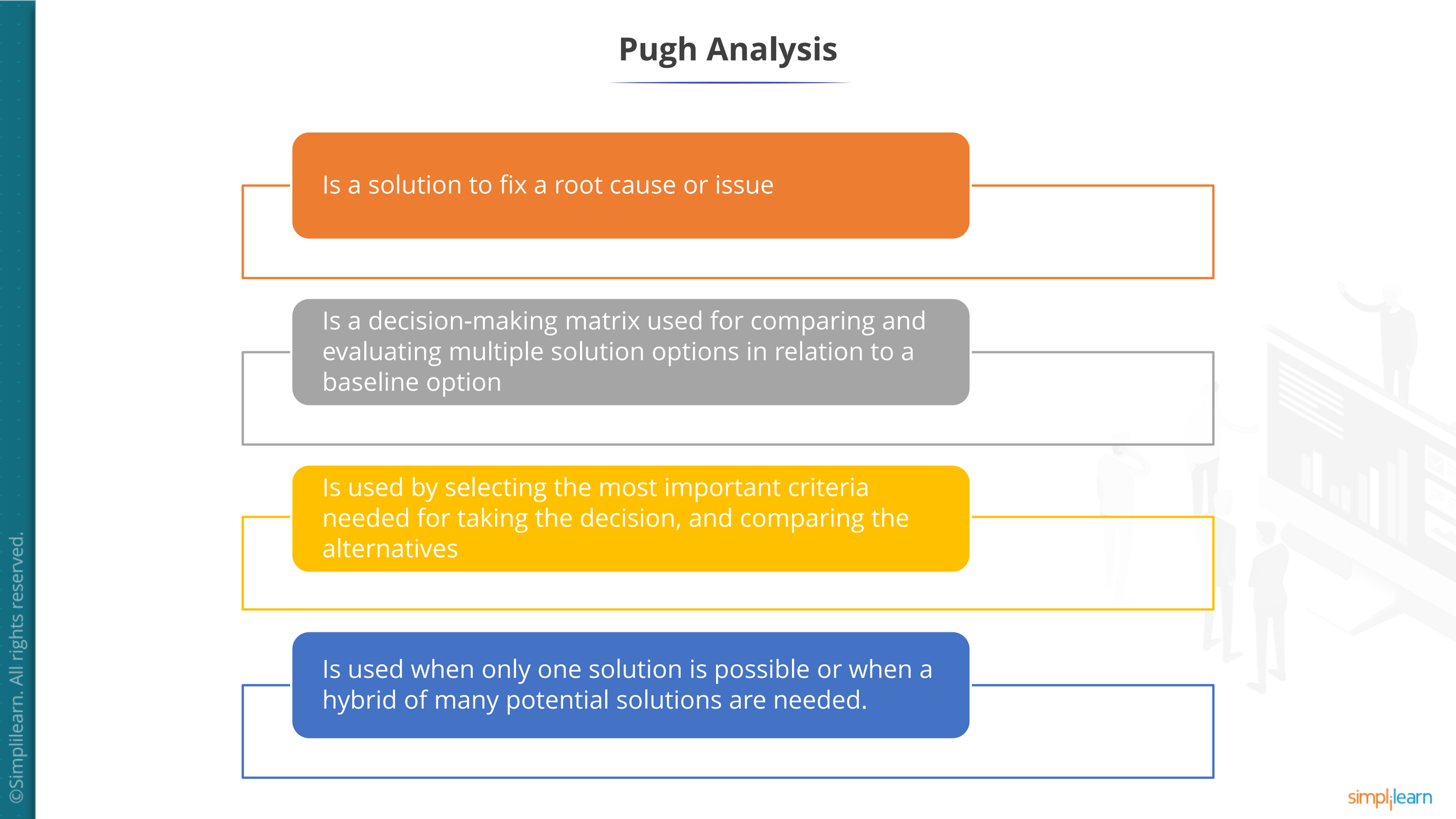
# Tools for Identifying the Best Solution

# Best Solution



# Pugh Analysis

- Is a solution to fix a root cause or issue
- Is a decision-making matrix used for comparing and evaluating multiple solution options in relation to a baseline option
- Is used by selecting the most important criteria needed for taking the decision, and comparing the alternatives
- Is used when only one solution is possible or when a hybrid of many potential solutions are needed.



# Pugh Analysis

Solution Options

| Criteria | Baseline | Weight | A | B | C | D |
|---|---|---|---|---|---|---|
| 1 | 0 | 2 | +1 | -1 | 0 | +1 |
| 2 | 0 | 4 | 0 | -1 | 0 | +1 |
| 3 | 0 | 3 | +1 | +1 | +1 | 0 |
| 4 | 0 | 5 | -1 | 0 | 0 | +1 |
| | | **Score** | 0 | -3 | 3 | 11 |

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The sum product of the values and criteria weight =
2*(+1) + 4*(0) + 3*(+1) + 5*(-1)

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| | | **Score** | 0 | -3 | 3 | 11 |

The sum product of the values and criteria weight = 2*(+1) + 4*(+1) + 3*(0) + 5*(+1)

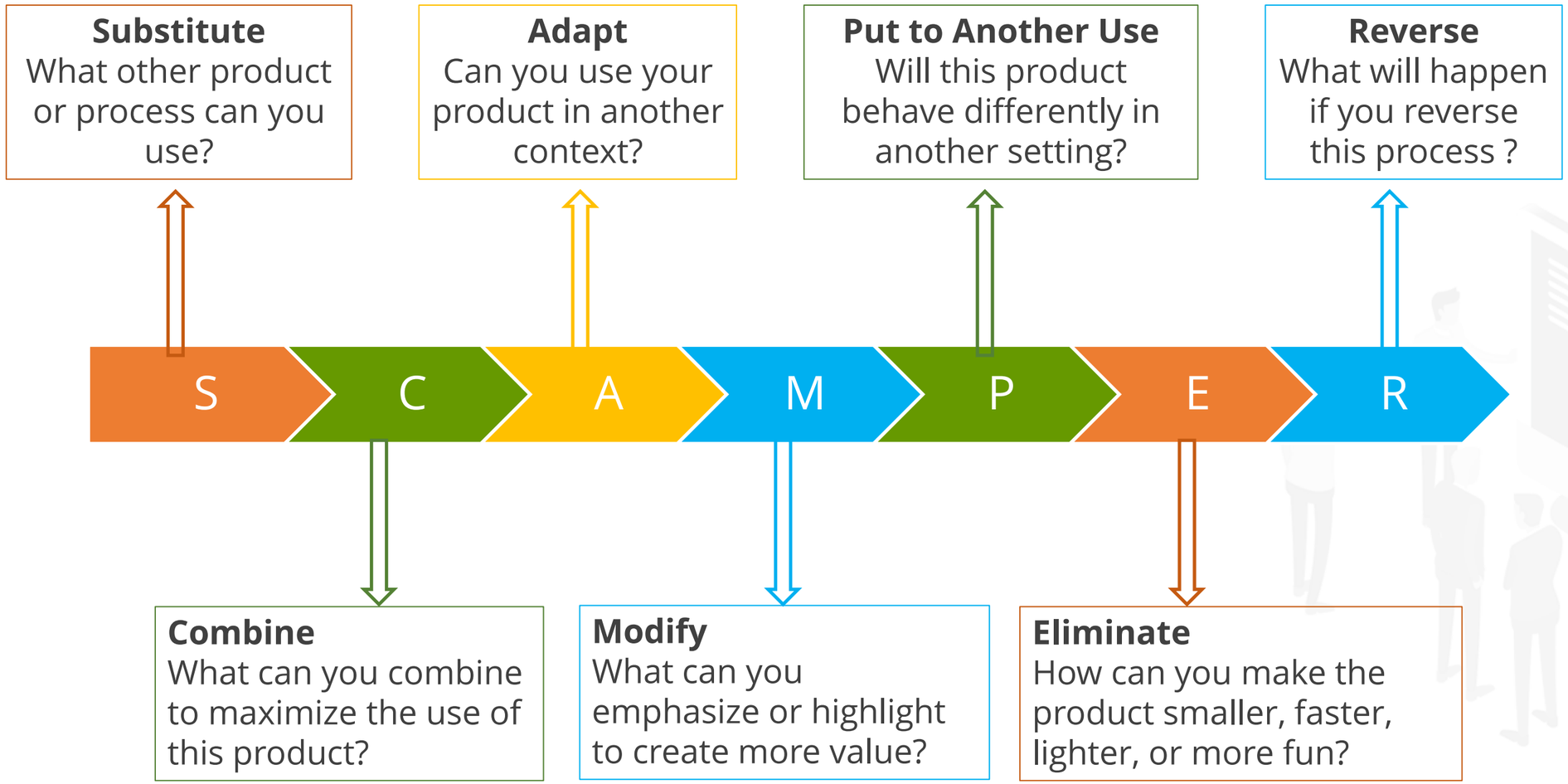
# Solution Prioritization Matrix

| CRITERIA SOLUTION MATRIX | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Title: | | | | | | | | | | | | |
| | | Criteria / Root cause | | | | | | | | | Row | % |
| | | Low cost | Use of technology | Potential saving | Increased speed | Decreased defects | Customer satisfaction | Minimum impact | Easy to implement | Quick results | Total | |
| | | a. | b. | c. | d. | e. | f. | g. | h. | i. | | |
| Solutions / Options | | Weight 0.075 | Weight 0.048 | Weight 0.303 | Weight 0.114 | Weight 0.167 | Weight 0.162 | Weight 0.023 | Weight 0.018 | Weight 0.090 | | |
| a | Error proofing | | | 0.051 | | 0.021 | | | | | 0.0717 | 15.3% |
| b | New equipment A | | | 0.007 | | 0.006 | | | | | 0.013 | 2.8% |
| c | New equipment B | | | 0.049 | | 0.025 | | | | | 0.0743 | 15.8% |
| d | New equipment C | | | 0.006 | | 0.004 | | | | | 0.0098 | 2.1% |
| e | New equipment D | | | 0.023 | | 0.014 | | | | | 0.0364 | 7.8% |
| f | New procedures | | | 0.027 | | 0.010 | | | | | 0.0372 | 7.9% |
| g | Barcoding | | | 0.092 | | 0.051 | | | | | 0.1431 | 30.4% |
| h | Cellularize Option 1 | | | 0.014 | | 0.009 | | | | | 0.0235 | 5.0% |
| i | Cellularize Option 2 | | | 0.035 | | 0.026 | | | | | 0.061 | 13.0% |
| Column total | | 0 | 0 | 0.303 | 0 | 0.167 | 0 | 0 | 0 | 0 | 0.47 | 100.0% |

http://www.foundasoft.com/index.php?option=com_content&view=article&id=163%3A403criteria-solution&catid=37%3Afoundalss-articles&Itemid=1

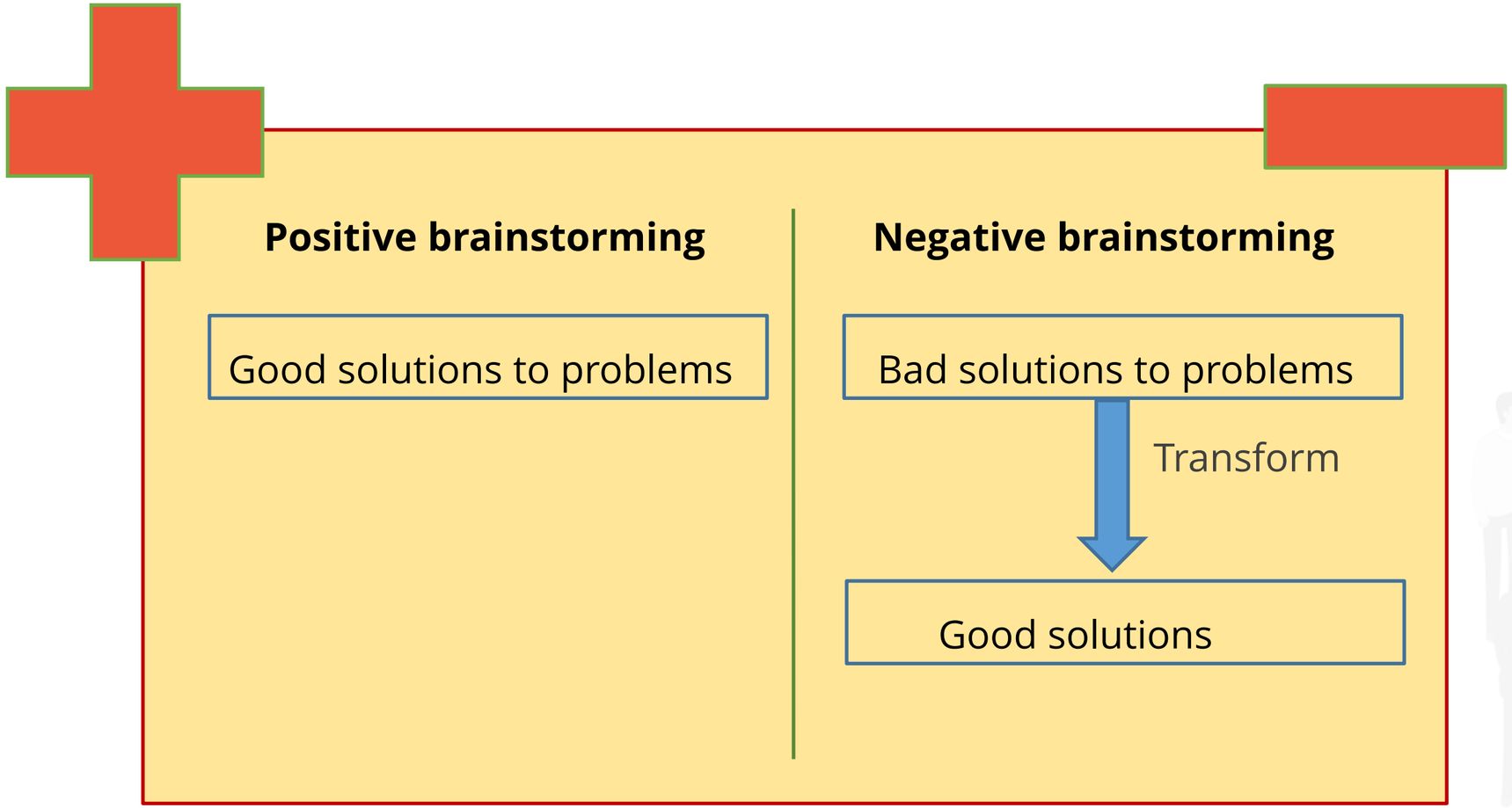
# SCAMPER

SCAMPER is a brainstorming technique that can be used to find a solution.




https://www.mindtools.com/pages/article/newCT_02.htm

# Positive Brainstorming and Negative Brainstorming




http://projectofhow.com/methods/negative-brainstorming/

# Negative Brainstorming

How can you improve the customer experience in the coffee shop?

Bad Solution

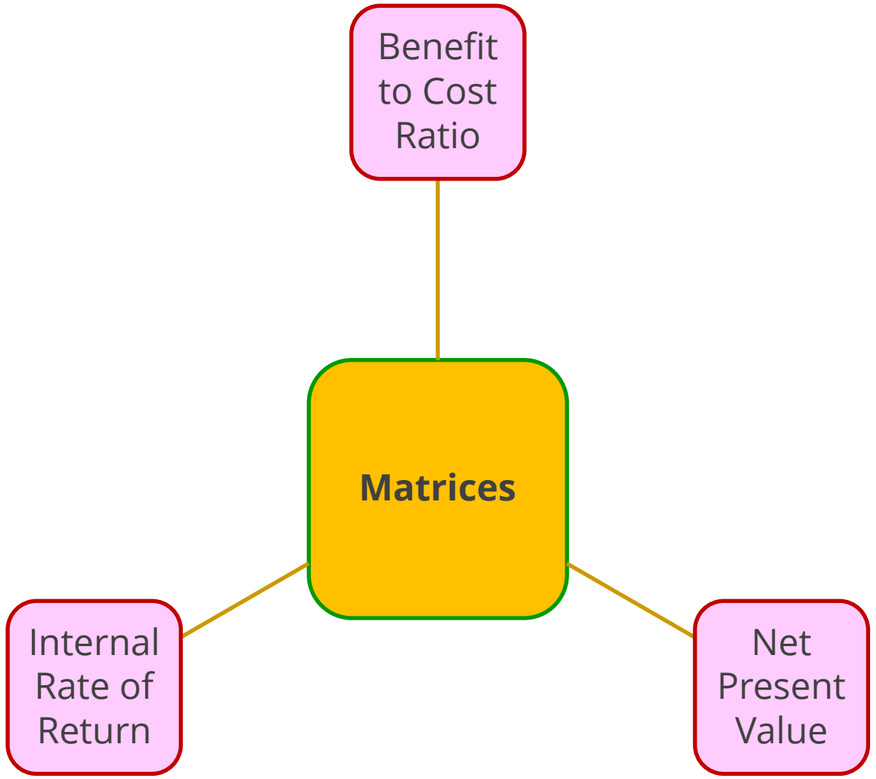
Ignoring patrons' requests for coffee refills


Transformed Solution

Ensuring that you attend to every customer request with delight

# Cost-Benefit Analysis

Every solution should be evaluated on the cost to implement it and the benefits realized from it.



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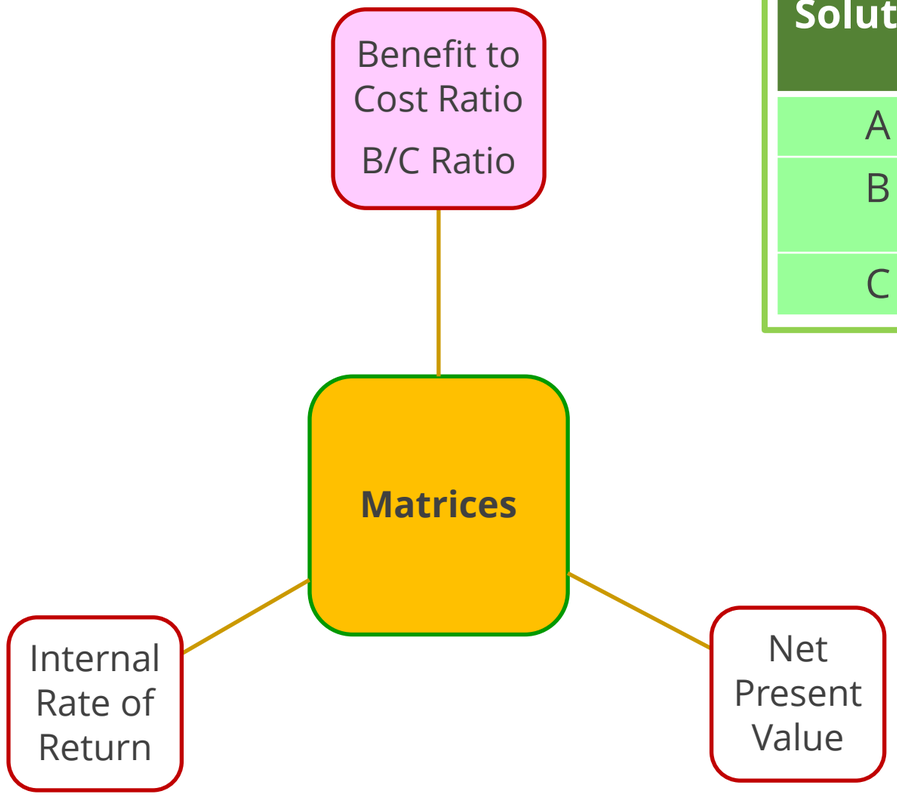
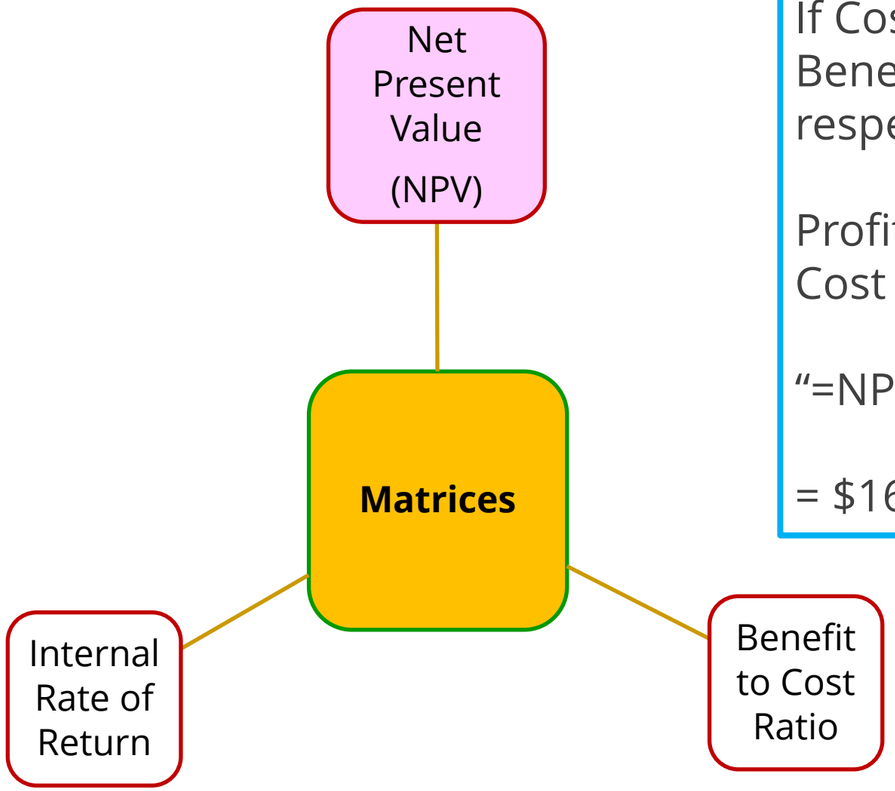



| Solution | Cost | Project Benefit | B/C Ratio |
|---|---|---|---|
| A | $10,000 | $20,000 | 2 |
| B | $25,000 | $100,000 | 4 |
| C | $5,000 | $35,000 | 7 |

# Cost-Benefit Analysis

Every solution should be evaluated on the cost to implement and the benefits realized.




If Cost = $20k, Discount Rate = 10%, Benefits for years 1-3 are $5K, $5K, $11K respectively

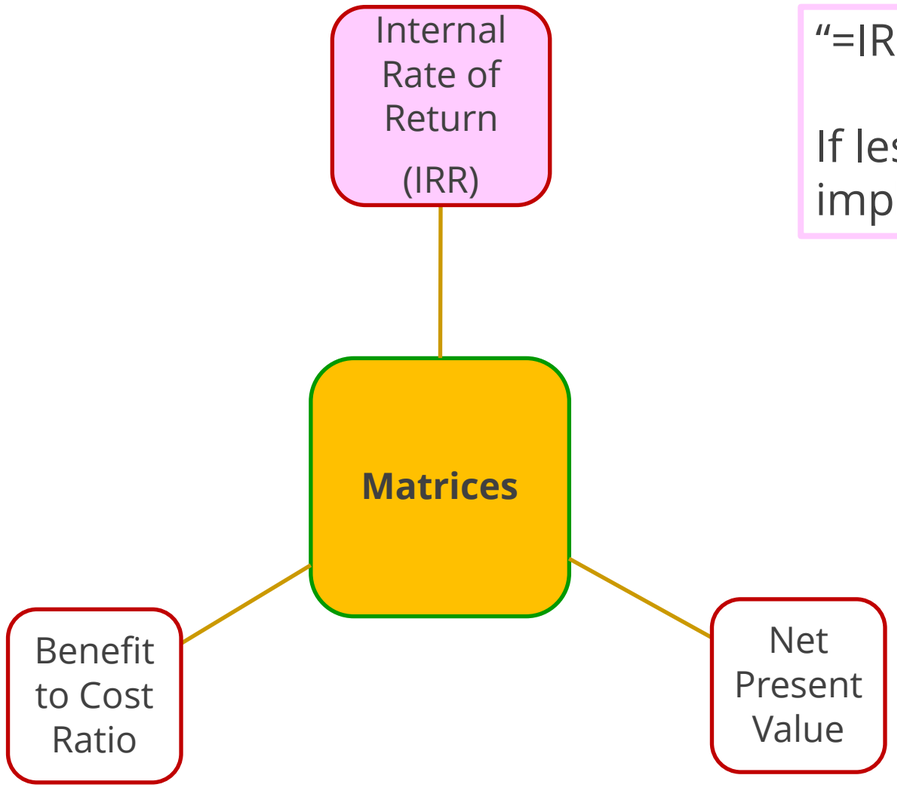
Profitability = NPV(Net Benefits) - Initial Cost =

“=NPV(0.10,5000,5000,11000)” - $20,000

= $16,942 - $20,000 = -$3,058

# Cost-Benefit Analysis

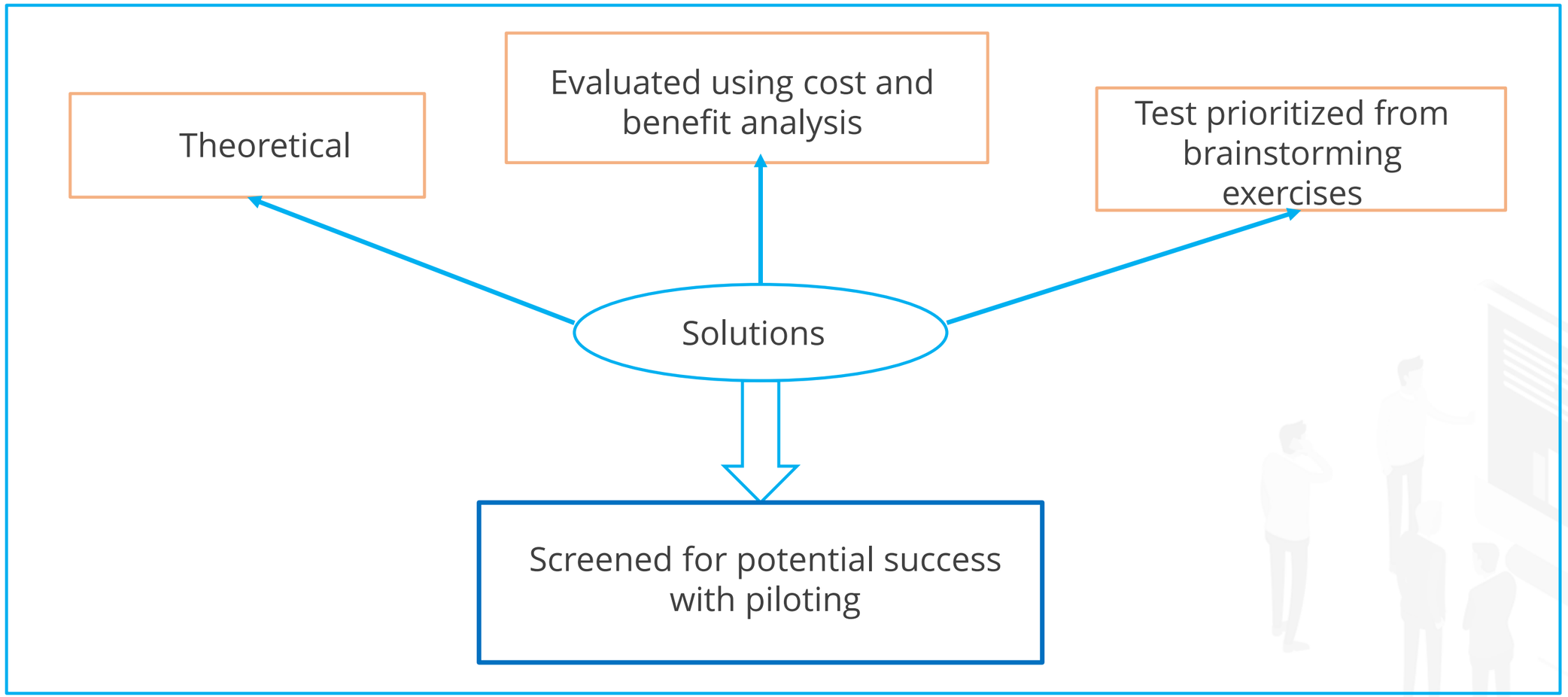
Every solution should be evaluated on the cost to implement and the benefits realized.




"=IRR(-20000,5000,5000,11000)" = 2%

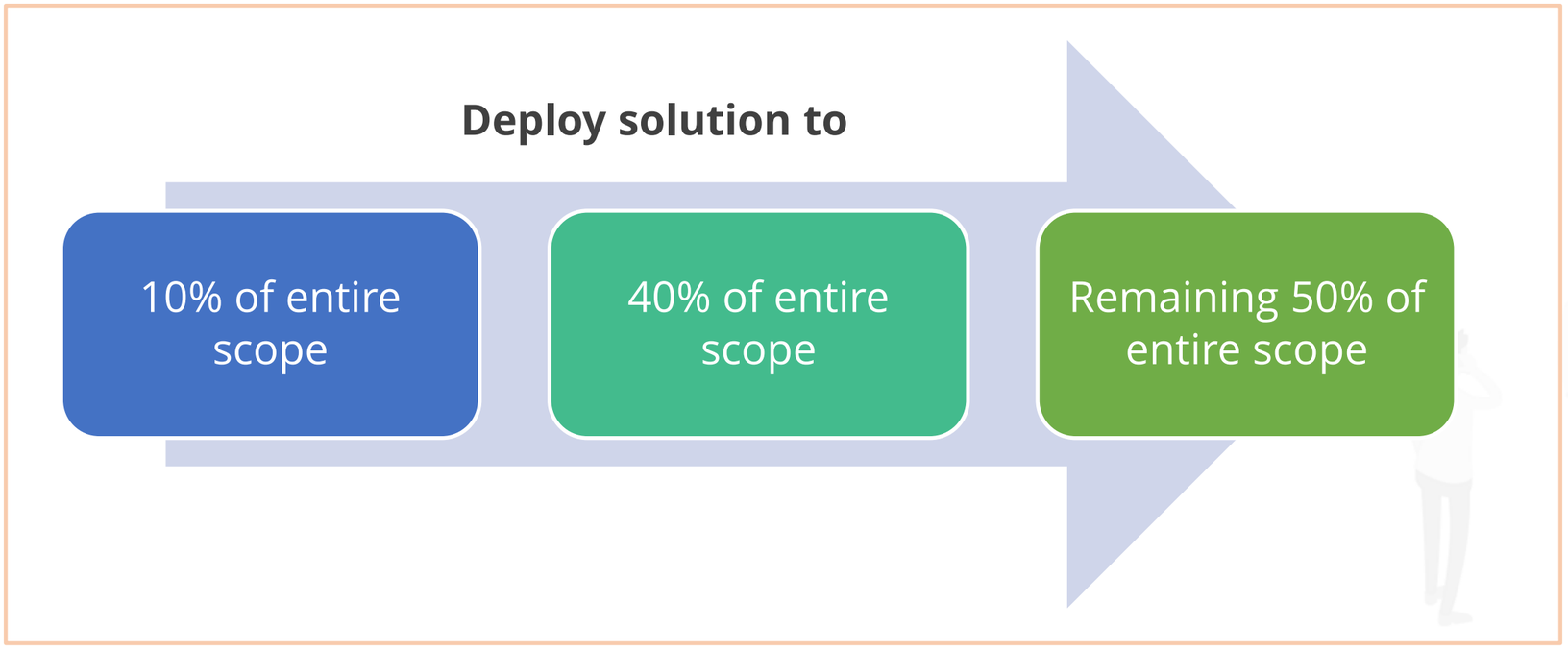
If less than cost of capital, solution is not implemented due to benefit constraints.

# Solutions Screening and Piloting



# Piloting

Piloting is deploying the solution or change in small teams or groups.



# Pilot Validation

At each phase in the pilot:

Post-improvement data

**paired t-test**

For a week

Pre-improvement data

The paired-t test should check

Has X changed significantly?

Yes

Has output variable performance changed?

Yes

Commence next piloting phase

A month after full implementation

Is the change effective? Revalidate with a paired t test.

# Key Takeaways

- Pugh Analysis is used to evaluate multiple options against each other in relation to a baseline option.
- In Solution Prioritization Matrix, each solution is weighted on its own merit.
- The SCAMPER tool helps by asking questions about existing products in the different SCAMPER categories.
- Positive and Negative Brainstorming are useful methods to generate solutions to problems.
- Cost and Benefit Analysis uses three matrices–Benefit to Cost Ratio, Net Present Value, and Internal Rate of Return.
- Solutions need to be screened for potential success with piloting.


# Knowledge Check

**Knowledge Check**

**1**

**Which of the following is NOT a solution selection tool?**

A. Pugh Matrix

B. Cause and Effect Matrix

C. Solution Prioritization Matrix

D. SCAMPER

**Knowledge Check**

**1**

**Which of the following is NOT a solution selection tool?**

A. Pugh Matrix

B. Cause and Effect Matrix

C. Solution Prioritization Matrix

D. SCAMPER

The correct answer is **B**

**The Cause and Effect Matrix is used to help determine relationships between X and Y variables and also identifies root causes.**

| Knowledge Check 2 | Which project should be selected? |
| --- | --- |

A. Cost = 10,000; Benefit = 20,000

B. Cost = 30,000; Benefit = 62,000

C. Cost = 15,000; Benefit = 40,000

D. Cost = 20,000; Benefit = 15,000

| Knowledge Check 2 | Which project should be selected? |
|---|---|

A. Cost = 10,000; Benefit = 20,000

B. Cost = 30,000; Benefit = 62,000

C. Cost = 15,000; Benefit = 40,000

D. Cost = 20,000; Benefit = 15,000

The correct answer is **C**

**B/C ratios for each in order is 2, 2, 2.7, 0.75. Option C has the largest ratio.**

# Lean Six Sigma Activities and Tools: Improve

## Activities

### Define

- Review Project Charter
- Validate High-Level Value Stream Map and Scope
- Validate Voice of the Customer & Voice of the Business
- Validate Problem Statement and Goals
- Validate Financial Benefits
- Create Communication Plan
- Select and Launch Team
- Develop Project Schedule
- Complete Define Tollgate

### Measure

- Process Map Flow
- Identify Key Input, Process and Output Metrics
- Develop Data Collection Plan
- Validate Measurement System
- Collect Baseline Data
- Determine Process Capability
- Complete Measure Tollgate

### Analyze

- Identify Root Causes
- Reduce List of Potential Root Causes
- Confirm Root Cause to Output Relationship
- Estimate Impact of Root Causes on Key Outputs
- Prioritize Root Causes
- Statistical Analysis
- Complete Analyze Tollgate

### Improve

- Develop Potential Solutions
- Evaluate, Select, and Optimize Best Solutions
- Develop 'To-Be' Process Maps
- Develop and Implement Pilot Solution
- Implement 5s Program
- Develop Full Scale Implementation Plan
- Cost/Benefit Analysis
- Complete Improve Tollgate

### Control

- Develop SOP's, Training Plan & Process Controls
- Implement Solution and Ongoing Process Measurements
- Confirm Attainment of Project Goals
- Identify Project Replication Opportunities
- Training
- Complete Control Tollgate
- Transition Project to Process Owner

## Tools

### Define

- Project Charter
- Voice of the Customer
- SIPOC Map
- Project Valuation (ROI)
- Stakeholder Analysis
- Communication Plan
- Effective Meeting Tools
- Time Lines, Milestones, and Gantt Charting
- Pareto Analysis

### Measure

- Process Mapping
- Data Collection Plan
- Statistical Sampling
- Measurement System Analysis (MSA)
- Gage R&R
- Control Charts
- Histograms
- Normality Test
- Process Capability Analysis

### Analyze

- Cause & Effect Matrix
- FMEA
- Hypothesis Tests
- Simple & Multiple Regression
- ANOVA
- Components of Variation

### Improve

- Process Flow Improvement
- Design of Experiments (DOE)
- Solution Selection Matrix
- Piloting
- Pugh Matrix
- Pull System

### Control

- Mistake-Proofing
- Standard Operating Procedures (SOP's)
- Process Control Plans
- Visual Process Control Tools
- Statistical Process Controls (SPC)
- Visual Workplace
- Total Productive Maintenance
- Metrics
- Team Feedback Session

# Improve Tollgate Questions

- ❑ What techniques were used to generate ideas for potential solutions?
- ❑ What narrowing and screening techniques were used to further develop and qualify potential solutions?
- ❑ What evaluation criteria were used to select a recommended solution?
- ❑ Do proposed solutions address all the identified root causes, at least the most critical?
- ❑ Were the solutions verified with the Project Sponsor and Stakeholders? Has an approval been received to implement?
- ❑ Was a pilot run to test the solution? What was learned? What modifications made?
- ❑ Has the team seen evidence that the root causes of the initial problems have been addressed during the pilot? What are the expected benefits?
- ❑ Has the team considered potential problems and unintended consequences (FMEA) of the solution and developed preventive and contingency actions to address them?
- ❑ Has the proposed solution been documented, including process participants, job descriptions and if applicable, their estimated time commitment to support the process?
- ❑ Has the team developed an implementation plan? What is the status?
- ❑ Have changes been communicated to all the appropriate people?
- ❑ Have 'learning's' to-date required modification of the Project Charter? If so, have these changes been approved by the Project Sponsor and the Key Stakeholders?
- ❑ Have any new risks to project success been identified and added to the Risk Mitigation?

**Note: With answers to these questions you are now ready to move to the Measure Phase.**