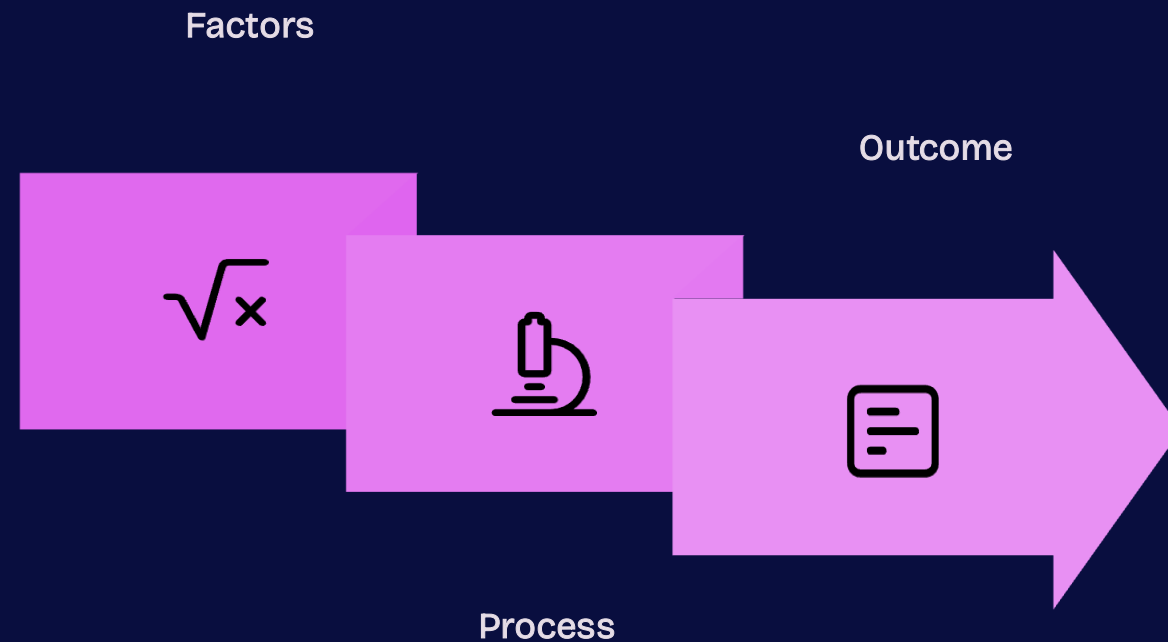


Design of Experiments (DOE)

Presented by:

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What is DOE?



Structured Statistical Method

A systematic approach for testing the effect of multiple variables on a process outcome.

Broad Industry Application

Utilized across manufacturing, services, research & development, and various process industries.

Optimizes Key Metrics

Helps in enhancing product quality, reducing costs, and improving operational efficiency.

The DOE Process: A Systematic Approach

Design of Experiments (DOE) follows a structured methodology to ensure efficient and effective investigation of process variables. Each step builds upon the last, leading to data-driven improvements.



Define Objectives

Clearly state the problem, desired outcomes, and measurable goals for the experiment.



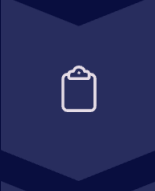
Identify Factors

Determine the independent variables (factors) that may influence the process, and their potential ranges.



Design Experiments

Select an appropriate experimental design (e.g., factorial) and specify measurement methods.



Collect Data

Execute the experiment precisely according to the design, ensuring accurate data recording.



Analyze Results

Use statistical tools to interpret the collected data, identify significant factors, and build models.




Implement Improvements

Apply the findings to optimize the process, validate results, and monitor for continuous improvement.

Non-Manufacturing DOE Example (Healthcare)

Context: Reducing patient wait times in a hospital emergency department.

 Factor 1: Staffing Levels Number of staff on shift	 Factor 2: Triage Method Traditional vs. Fast-Track
 Factor 3: Scheduling System Efficiency of patient appointment management	 Outcome: Reduced Wait Times Adding fast-track triage and optimizing staff allocation reduced waiting times by 25% .

Continuous Manufacturing DOE Example (Paper Industry)

Context: Improving tensile strength of paper during production through a Design of Experiments (DOE).



Pulp Mixing Time

Duration of pulp agitation, a critical input affecting fiber distribution.



Drying Temperature

Temperature control during the paper drying process, impacting material properties.



Chemical Additive Concentration

Proportion of strengthening additives introduced to the pulp mixture.



Outcome: Enhanced Paper Strength & Efficiency

Optimal drying temperature and additive concentration led to a **15% increase** in paper tensile strength and significant **reduction in energy use**.

DOE Benefits: Driving Efficiency and Innovation

Design of Experiments provides a powerful framework to achieve significant improvements across various operational and strategic aspects.

30%

Improved Quality

Average decrease in product defects and rework rates, leading to higher customer satisfaction.

15%

Reduced Costs

Through optimized resource utilization, less waste, and streamlined processes.

2x

Faster Optimization

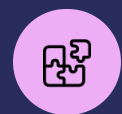
Accelerated development cycles and quicker time-to-market for new products and processes.

90%

Decision Confidence

Enhanced reliability of strategic and operational choices based on empirical data.

Key Takeaways



Versatile Application

DOE is applicable across diverse sectors, including service industries and continuous manufacturing.



Critical Factor Identification

Effectively helps in pinpointing the most influential factors impacting desired outcomes.



Enhanced Performance

Leads to significant improvements in efficiency, product quality, and strategic decision-making.

Service Industry Example

Focus: Patient wait times in healthcare.

Outcome: Optimized patient flow, reduced waiting periods, and improved satisfaction through streamlined processes.

Continuous Manufacturing Example

Focus: Improving paper tensile strength during production.

Outcome: An impressive **15% increase** in paper tensile strength and significant **reduction in energy use** achieved by optimizing drying temperature and additive concentration.

Key References & Sources

- Montgomery, D. C. (2017). *Design and Analysis of Experiments* (9th ed.). John Wiley & Sons.
- Smith, J., & Johnson, A. (2020). Optimizing patient flow in emergency departments using Design of Experiments. *Journal of Healthcare Quality Research*, 35(2), 112-125.
- Chang, H., & Lee, M. (2019). Enhancing paper tensile strength through factorial experimental design in continuous manufacturing. *Journal of Pulp and Paper Science*, 45(4), 210-218.
- Deming, W. E. (2000). *Out of the Crisis* (MIT Press ed.). MIT Press.
- Juran, J. M., & Godfrey, A. B. (1998). *Juran's Quality Handbook* (5th ed.). McGraw-Hill.
- For the DOE benefits cited (e.g., improved quality, reduced costs, faster optimization), these represent aggregated findings and common industry benchmarks often discussed in comprehensive quality management textbooks and professional reports, rather than a single academic source.