Innovation Diamond

10-Slide Practical Summary

Machine Learning for Smarter Innovation

BSc Course – Student Reference

The Innovation Diamond: Framework Overview

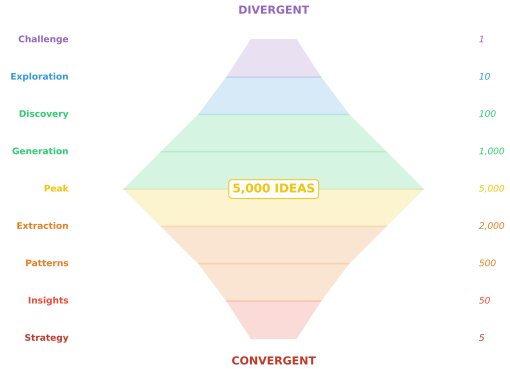
Core Concept:

- **Divergent**: Expand possibilities
- **Peak**: Maximum exploration
- **Convergent**: Focus on best

The Journey:

$$1 \longrightarrow 5{,}000 \longrightarrow 5$$

Challenge $\rightarrow$ *Ideas* $\rightarrow$ *Strategies*



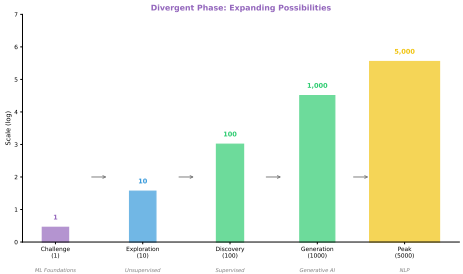
ML enables both creative expansion (generative) and strategic focus (discriminative)

Divergent Phase: Expansion Techniques

ML Foundations – Problem Framing
Define what success looks like. Choose metrics that align with business goals. Set up the learning task correctly.

Unsupervised Learning – Pattern Discovery
Find hidden structure in data without labels. Discover natural groupings and relationships humans might miss.

Supervised Learning – Feature Engineering
Transform raw data into predictive signals. Create features that capture domain knowledge and improve model performance.



Stage	Count
Challenge	1
Exploration	10
Discovery	100

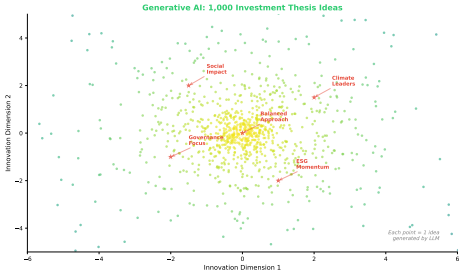
Divergent techniques expand from one challenge to hundreds of features and dimensions

Generative AI & NLP: Creative Expansion

Generative AI – Idea Generation (1,000)
LLMs generate diverse solution variants by learning patterns from massive text corpora. Prompt engineering guides creative output.

Topic Modeling – Theme Discovery
LDA automatically extracts latent topics from document collections. Reveals hidden themes across thousands of texts.

NLP & Sentiment – Text Processing
Transform unstructured text into structured insights. Analyze sentiment, extract entities, classify documents at scale.



Stage	Count
Generation	1,000
Peak	5,000

Generative techniques expand to thousands of possibilities beyond human capacity

Peak: Maximum Exploration (5,000 Possibilities)

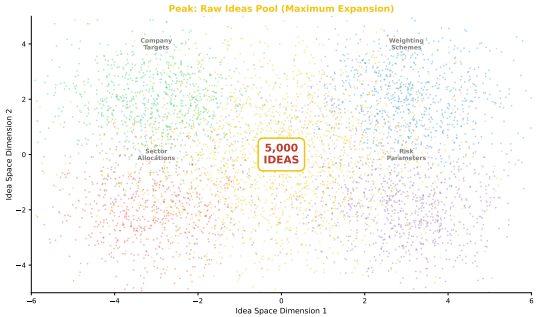
How 5,000 Emerges:

- Companies: 500+ targets
- Weighting schemes: 100+
- Sectors: 50+
- Risk parameters: 20+

Expansion Techniques Used:

- Unsupervised Learning
- Generative AI (LLMs)
- NLP & Sentiment Analysis
- Topic Modeling

Pitfall: Analysis paralysis



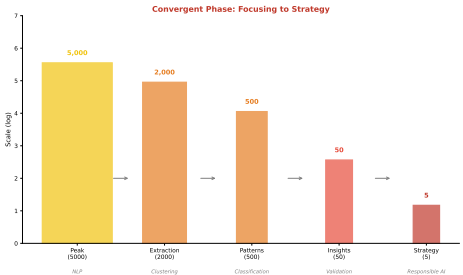
The peak represents maximum divergence – now convergent ML techniques must focus

Convergent Phase: Focus Techniques

Clustering – Grouping (5,000 → 2,000)
Group similar ideas together. Identify duplicates and redundant options. Silhouette scores measure cluster quality.

Classification – Ranking (2,000 → 500)
Assign ideas to feasibility and impact tiers. Decision trees split on key criteria. Random forests combine multiple perspectives.

Neural Networks – Cross-cutting
Deep learning finds complex patterns across both phases. Embeddings capture semantic similarity between options.



Stage	Count
Extraction	2,000
Patterns	500

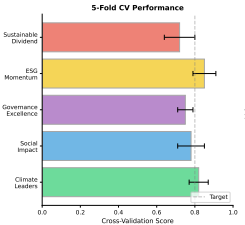
Convergent techniques systematically reduce possibilities to actionable strategies

Validation & Final Selection

Validation – Testing (500 → 50)
Cross-validation tests generalization on unseen data. Train on 80%, validate on 20%. Repeat to ensure robustness.

A/B Testing – Comparison
Statistical tests compare strategies head-to-head. Measure if differences are real or just noise. Require sufficient sample size.

Responsible AI – Selection (50 → 5)
SHAP explains why models make decisions. Feature importance identifies key drivers. Ensures strategies are fair and transparent.



Stage	Count
Insights	50
Strategy	5

Validation and explainability ensure final strategies are trustworthy and actionable

ESG Case Study: Complete Journey

The Challenge:
"Create a portfolio maximizing returns with genuine ESG impact"

Journey Numbers:

- **1** ESG portfolio challenge
- **10** sustainability dimensions
- **100** engineered features
- **1,000** LLM-generated theses
- **5,000** raw investment criteria
- **2,000** clustered approaches
- **500** classified patterns
- **50** validated insights
- **5** final strategies

Final 5 Strategies:

1. Climate Leaders Fund
2. Social Impact Blend
3. Governance Excellence
4. ESG Momentum Strategy
5. Sustainable Dividend Growth

All 14 ML techniques applied systematically through the Innovation Diamond

ML Toolkit Reference: All 14 Techniques

Topic	Phase	Key Capability	Purpose
ML Foundations	Divergent	Define objectives and metrics	Problem framing
Supervised	Divergent	Learn from labeled examples	Feature engineering
Unsupervised	Divergent	Find patterns without labels	Pattern discovery
Neural Networks	Both	Learn hierarchical representations	Complex patterns
Generative AI	Divergent	Create new content from prompts	Idea generation
NLP & Sentiment	Divergent	Process and analyze text	Text processing
Topic Modeling	Divergent	Extract themes from documents	Theme extraction
Clustering	Convergent	Group similar items together	Grouping
Classification	Convergent	Assign items to categories	Categorization
Validation	Convergent	Test on unseen data	Testing
A/B Testing	Convergent	Compare alternatives statistically	Comparison
Responsible AI	Convergent	Explain model decisions	Explainability
Structured Output	Convergent	Ensure reliable JSON output	Reliability
Finance	Convergent	Model risk and return	Risk modeling

14 ML tools for the complete innovation journey from challenge to strategy

Key Takeaways & Decision Framework

5 Key Insights:

1. ML **amplifies** human innovation
2. **Both phases** are essential
3. **Match technique** to phase
4. **Watch for pitfalls** at each stage
5. **Trust but verify** with validation

Common Pitfalls:

- Divergent: Analysis paralysis, noise over signal
- Convergent: Premature closure, overfitting

Decision Framework:

- Need to explore? → Unsupervised
- Need to predict? → Supervised
- Need to generate? → Generative AI
- Need to group? → Clustering
- Need to rank? → Classification
- Need to test? → A/B Testing

$$\mathbf{1 \rightarrow 5{,}000 \rightarrow 5}$$

The Innovation Diamond: ML-powered systematic innovation from challenge to strategy