Improving Entrepreneurial Decision Making with Bayesian Reasoning and Intelligent Assistance

Charles Fine,[1] Angie Moon[2]

1. MIT Sloan School
2. MIT Civil and Environmental Engineering

ABSTRACT

We propose to build a decision-making toolbox for entrepreneurs that complements existing tools and frameworks, while improving on information processing, using Bayesian reasoning. Many entrepreneurs face complex fast-clockspeed landscapes of product, technology, market, and environmental dynamics that require an almost continuous, iterative process of experimentation, observation, inference, and decision making. Our initial research examines two entrepreneurial decision domains, one in marketing and one in operations. (See, e.g., Fine, *et al* 2022) The first addresses responding to product-market experiment feedback for possible pivoting decisions, either to a different market segment or with a modified prototype. The second regards sourcing decisions for a new-venture's supply chain, where the choices include insourcing vs. outsourcing and local vs. global sources. (See, e.g., Phadnis and Fine, 2017) Our intent is to formulate these decision processes in their dynamic, iterative contexts, apply optimization and simulation to gain insight, and connect the decision models to LLM's both for data acquisition and for help in carrying the cognitive load required for the decisions in question. (See, e.g., https://orbit.mit.edu)

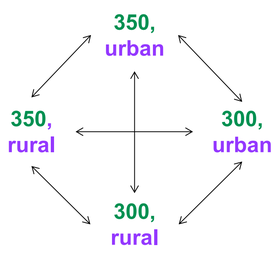
INTRODUCTION

The creation of a startup company – imagining and developing a product (or service) that is wanted or needed by society (individuals or organizations), designing and producing that product, as well as the organization to launch it, with perhaps the engagement of stakeholders such as investors, customers, employees, suppliers, distributors, regulators, etc., requires a huge amount of cognitive processing. We know that a great number of significant, positive contributions to our society and economy have come from the launch and development of entrepreneurial ventures. And we also know that many, many startup efforts fail, despite investment of significant amounts of human and financial capital. Perhaps many of these failures were "appropriate," in the sense that the proposed businesses would not have been able to justify the investment required. But many others, perhaps, represented highly meritorious ideas, but the founding team lacked some element of capability to bring their idea(s) to life by building the combination of a successful product, organization, and business model.

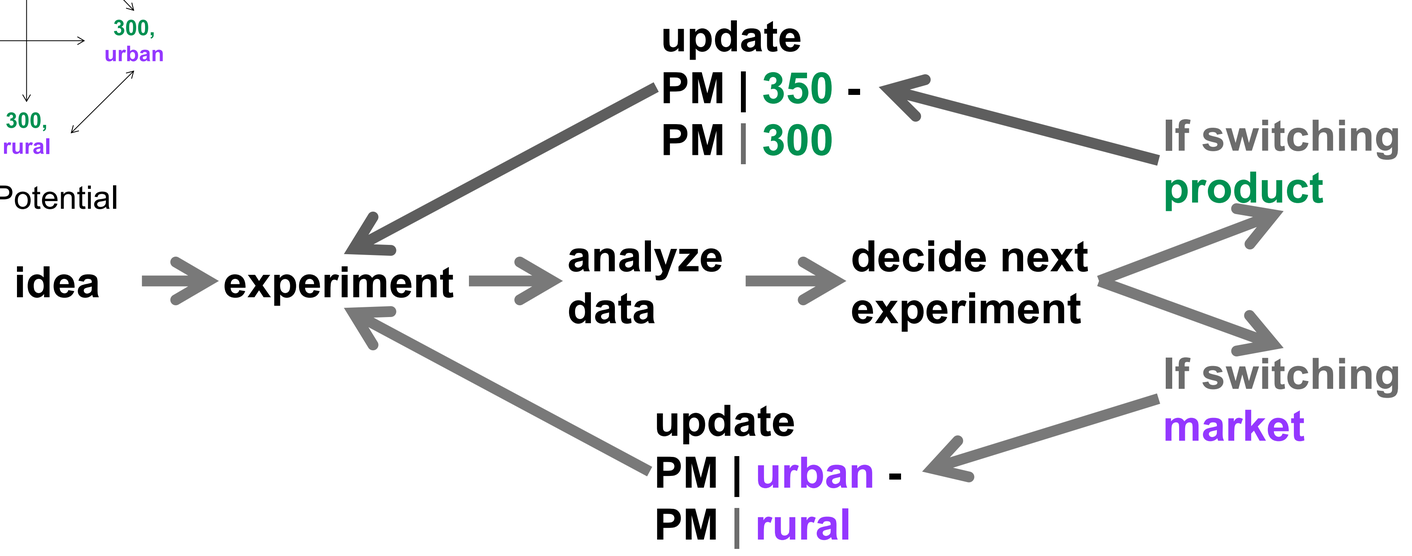
Entrepreneurs must navigate complex trade-offs across product development, market selection, and operational execution, often with limited information and resources. Traditional decision-making models often fall short in capturing the dynamic nature of these environments, where rapid technological changes and market shifts can quickly render strategies obsolete. This research proposes to address such entrepreneurial decision-making by applying Bayesian reasoning principles, augmented with LLM knowledge bases and cognitive processing. Bayesian reasoning, with its emphasis on updating beliefs based on new evidence, provides a framework for the iterative nature of startup adaptation / pivoting. Through two use cases, we demonstrate how the iterative cycle of experimentation and decision-making can be applied across different technological and market contexts. This approach allows entrepreneurs to systematically update their beliefs and strategies as they gather more information through marketing, prototyping, drug discovery experiments.

1. Marketing Experiments

Experiment choices:



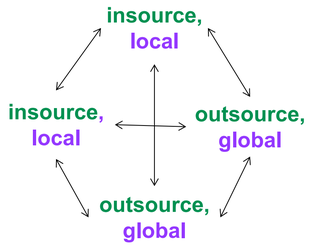
Performance Measure:
Market Adoption and Revenue Potential



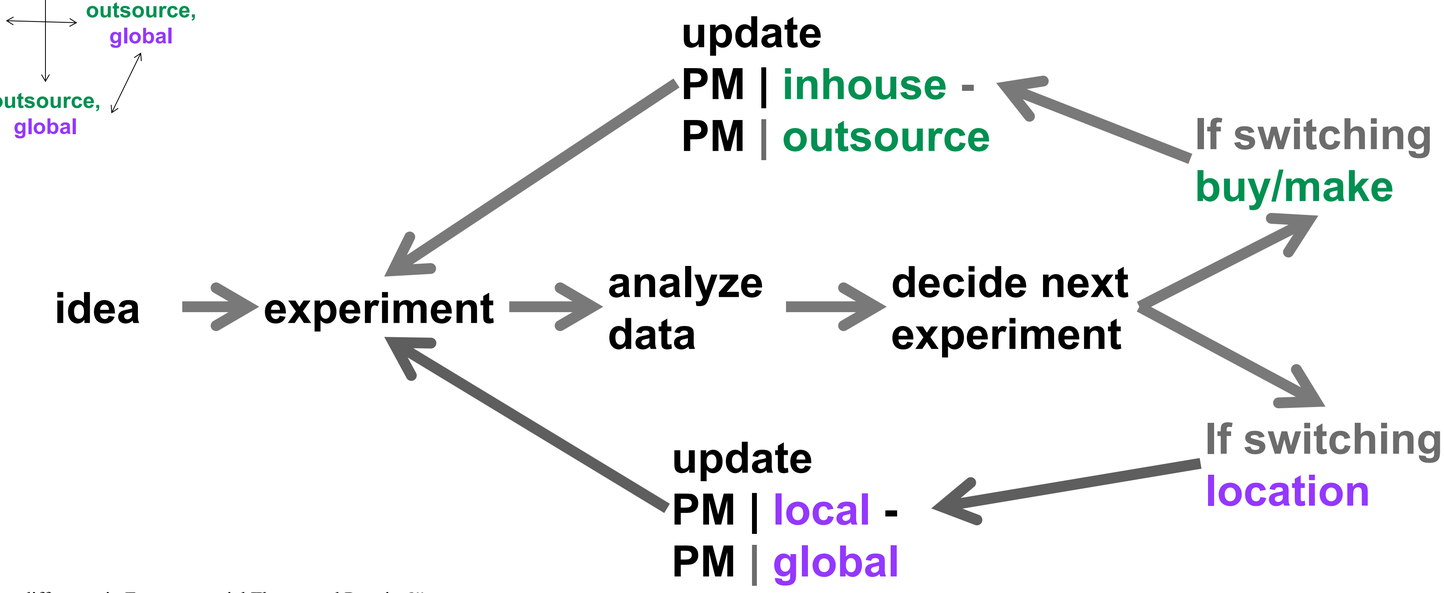
EV Startup choosing between developing an electric vehicle with a 300-mile range versus a 350-mile range, and targeting either urban or rural markets. The performance measure is Market Adoption and Revenue Potential, illustrating how entrepreneurs must balance product capabilities with market needs

2. Sourcing Experiments

Experiment choices:



PM:
P(time to scale<time to fail)



Case example: Tesla Roadster experiments in supply chain strategy: decision between in-house vs. outsourced production and local vs. global manufacturing. The performance measure is the probability of scaling before running out of funds, highlighting the critical balance between speed, cost, and quality in product development. (See, Fine, et al, "The Tesla Roadster (A): Accelerated Supply Chain Learning" 2014, at https://www.dropbox.com/s/krpwey95ivfiqzd/Tesla%20Roadster%20case%2029Oct2014%20for%20OpsEnt.pdf?dl=0)

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2. Phadnis, S, and C. Fine, "End-to-end Supply Chain Strategies: Parametric Study of the Apparel Industry," *Production and Operations Management*, 26(12), 2305-2322. ,2017.

3. Agarwal, et al, "Bayesian Entrepreneurship," MIT working paper, 2024, at https://www.dropbox.com/scl/fi/kzlamnq9nx9qkh274e40f/0-Bayesian_Entrepreneurship-WP-Updated.pdf?rlkey=cmx6arg7x821fzyvzevapc30z&dl=0

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