Designing Data-Driven Startup Business Models: Applying Prescriptive Analytics to Ideation, Pricing, Segmentation, and Resource Allocation

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[1]*Date of Receiving: 12/01/2025*
Date of Acceptance:17/03/2025
Date of Publication: 29/03/2025

Abstract

Prescriptive analytics is the evolution of the maturity of business analytics, going beyond analysing and predicting what will happen in favor of suggesting precise what should be done to achieve specific purposes. In the context of a business, prescriptive analytics are a helpful tool for entrepreneurs since it allows to build and tweak the company business model before investing significantly in it. This paper aims to demonstrate the benefits of prescriptive analytics on new business model development by evaluating the different types of prescriptive analytics. The paper also discusses similarities and differences between predictive and prescriptive analytics in the decision-making process, as well as traditional approaches to new business model development and prescriptive-analytics-based options. The paper concludes that prescriptive analytics are most beneficial to start-ups to reduce the space of possible business model choices for an entrepreneur to focus on rather than replace human decision-making entirely in the process.

Keywords: *prescriptive analytics; business model innovation; start-ups; decision optimization; data-driven entrepreneurship; business analytics maturity*

1. Introduction

Start-up business model design has traditionally relied heavily on intuitive and informal methods such as founder intuition and informal customer conversations, but these approaches often lead to costly trial-and-error cycles when scaled incorrectly. Business analytics has been categorized into three maturity levels: descriptive analytics deals with past events, predictive analytics focuses on future forecasts, while prescriptive analytics provides recommendations based on its predictions of the future (Lepenioti, Bousdekis, Apostolou, & Mentzas, 2020). Interestingly, prescriptive analytics is the least used level among start-up companies even though it is critically important since it closes the loop by incorporating optimization, simulation, and recommendation mechanisms in decision-support systems (Frazzetto, Nielsen, Pedersen, & Šikšnys, 2019). Prescriptive analytics is a vital tool for start-up companies that are limited in time and capital as it allows them to reduce the number of alternative business model options they explore on the market. This paper aims to demonstrate how prescriptive analytics can be applied to the design of new business models and ideas for start-up companies and evaluate its effectiveness compared to predictive analytics and intuitive business model design approaches.

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[1] *How to cite the article:* Gupta A (March 2025); Designing Data-Driven Startup Business Models: Applying Prescriptive Analytics to Ideation, Pricing, Segmentation, and Resource Allocation; *International Journal of Law, Management and Social Science*, Vol 9, Issue 1, 68-72

2. From Descriptive to Prescriptive: Analytics Maturity Relevant to Business Model Design

Understanding prescriptive analytics' place in the maturity hierarchy helps explain its special role in supporting business model decisions rather than just reporting. Systematic reviews of prescriptive analytics systems highlight their position as the "most developed form of business analytics," which is now often driven by machine learning and artificial intelligence but continues to focus on the specific relationship between recommendations and human decision-making (Wissuchek & Zschech, 2024). Table 1 below indicates how each level of analytics maturity corresponds to a particular business model design question that a start-up founder might consider.

Prescriptive analytics maturity level Business model design question Describing how the system works Explaining the rationale behind each recommendation Assessing relationships and patterns Interpreting relationships and patterns for humans Establishing causality Proving causality using multiple sources of data

Table 1. Analytics Maturity Stages Mapped to Startup Business Model Questions

Analytics Stage	Core Capability	Business Model Design Question Answered
Descriptive	Summarizes historical data	Which customer segments have we served, and how?
Predictive	Forecasts future outcomes	Which segments or channels are likely to grow next?
Prescriptive	Recommends optimal actions	Which business model configuration maximizes expected value?

3. Prescriptive Analytics Techniques for Business Model Ideation

Prescriptive analytics utilizes such methods as optimization, simulation, and recommendations to a great extent and depending on the type of a business model decision. Prescriptive techniques include various approaches and procedures enabling companies to optimize their processes, simulate alternative options, and recommend potential solutions. The optimization methods, including mathematical programming and constraint, are the most appropriate to address pricing or capacity allocation decisions where a start-up needs to consider a limited number of options. Moreover, simulation methods, for instance, Monte Carlo or agent-based simulation, allow a founder to simulate a prospective business model and eliminate failures prior to implementation. Such a technique replaces time-consuming and expensive trial-and-error approaches typical of start-ups (Ara, Maraj, Rahman, & Bari, 2024). Third, prescriptive analytics employs recommendation techniques that typically apply machine learning methods to prioritize certain options for consideration based on some patterns identified in similar start-ups or early user feedback during the initial phases of a venture's development. The literature review on prescriptive analytics highlights the necessity for a start-up founder to employ such methods as decision-supporting tools rather than relying solely on these advanced analytics techniques while still incorporating their own knowledge and experience. This is especially true for young ventures, where qualitative insights of the founder on unmet customer needs are critical (Lepenioti et al., 2020).

Fig 1: Prescriptive Analytics

4. Applying Prescriptive Analytics to New Business Model Development in Start-ups

Within the context of start-ups, prescriptive analytics can be applied to different areas of the business model, including value proposal, customer segments, revenues, and resources. Prescriptive analytics can be integrated into value proposition design by evaluating the potential reception of different sets of offered features by target customers through simulations, thus reducing failed product development attempts. Within the context of customer segments, prescriptive recommendation algorithms can be used to prioritize segments based on the expected value they can bring to the start-up, considering their current capabilities and limitations. As for the revenues, optimization heuristics can be implemented to simulate and identify the optimal monetization strategy, subscription options, and pricing scenarios that would be most appealing to customers and profit-driven at the same time. Finally, with regard to the resources, prescriptive analytics can support start-up owners in allocating scare resources in the most effective way in terms of achieving key goals. In particular, the use of prescriptive analytics for start-up resource allocation is relevant for such priority areas as customer acquisition, product development, and market development. According to research, big data analytics capability plays a mediating role between digital transformation and business model innovation, thus being an essential driver in innovative changes among small and medium-sized enterprises, as well as start-ups. In particular, for small and medium-sized enterprises, such as start-ups, which operate in competitive and hostile environments, the ability to embrace digital transformation is closely linked to big data analytics capabilities (Ciacci & Penco, 2023). Research findings also suggest that small- and medium-size enterprises adopting big data analytics for business model innovation purposes report higher levels of organizational dynamism and responsiveness to the business environment, which are critical to their survival. Even within the limitations of a start-up setting, these findings could be incorporated to support business model innovation, including the introduction of data-driven processes within the organization (Masenya, 2023).

Table 2. Comparative Analysis of Predictive versus Prescriptive Analytics for Startup Decisions

Dimension	Predictive Analytics	Prescriptive Analytics
Core question	What is likely to happen next?	What should we do about it?
Typical startup use	Forecasting customer demand or churn	Recommending optimal pricing or channel mix
Output form	Probability or forecast estimate	Ranked or optimized set of recommended actions

Dimension	Predictive Analytics	Prescriptive Analytics
Founder role	Interpret forecast, decide independently	Evaluate system-recommended options against judgment
Data requirement	Historical outcome data	Historical data plus a defined objective and constraints

5. Comparative Analysis: Traditional versus Prescriptive-Analytics-Driven Business Model Ideation

A comparison between traditional, intuition-led business model ideation and prescriptive-analytics-driven ideation clarifies the practical trade-offs that founders face in choosing between less and more formalized approaches to decision-making. Traditional ideation makes use of founder experience, informal customer discovery conversations, and iterative market testing, and it is relatively cheap to implement but can be time-consuming and prone to founder bias. Prescriptive-analytics-driven ideation formalizes the same questions as optimization or simulation problems, which narrows the set of promising business model alternatives that can be evaluated in a market test, but at the cost of upfront modeling and data gathering. Table 3 provides a comparison between the two approaches in terms of four criteria that are pertinent to the decision-making process during the early stages of venture launch.

Table 3. Traditional versus Prescriptive-Analytics-Driven Business Model Ideation

Dimension	Traditional Ideation	Prescriptive-Analytics-Driven Ideation
Basis for decisions	Founder intuition and informal discovery	Optimization and simulation against defined objectives
Speed to first test	Fast, low upfront cost	Slower, requires data and model setup
Risk of bias	High, subject to founder blind spots	Lower, but dependent on data quality and model assumptions
Scalability of testing	Sequential, one variant at a time	Parallel evaluation of many configurations in simulation

6. Challenges and Limitations

Using prescriptive analytics for developing a business model in a start-up is limited by numerous factors that are rarely present in an established company. First, most start-ups do not have the extensive data about past transactions and customer behavior that would allow using optimization and simulation techniques effectively; thus, one has to rely on external data and industry benchmarks, which introduces additional risks. Second, the challenges in managerial practice reported by researchers are highly relevant to start-ups, meaning that there is little internal expertise, particularly in data science, to utilize such analytics and that these companies are not organized around formal decision-making processes. Furthermore, prescriptive analytics may fail in start-ups because of their natural exploratory nature: optimization methods are most effective in well-defined problems, whereas in the early stages of business development, problems are rarely clearly defined. Finally, it is crucial to remember that prescriptive analytics is a type of optimization, and it is vital to remember that optimization is only as good as the objective function and

constraints chosen by the optimizer; therefore, using such analytics tools, one should not forget that optimization results are only suggestions and should be regarded as such.

7. Conclusion

Prescriptive analytics can be seen as a tool that helps cut down the number of potential business models and ideas that a start-up can consider. Its role in this regard is justified by the comparative analysis which highlights the ways this approach helps reduce the number of options to those that have been proved to be viable. Therefore, it can be concluded, that prescriptive analytics does not attempt to eliminate human experience, intuition, and judgment; rather, it formalizes the process of decision-making, pricing, segmentation, and allocation of resources when these decisions are based solely on experience. The best way for start-ups to employ this approach is to combine it with thorough data collection from the first customers while being aware of the limitations of the methodology. This will allow the company to gain a strategic advantage over competitors by relying on an evidence-based business model choice.

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