

The Application of Artificial Intelligence Technology in Assisting R&D Project Initiation

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Abstract: This paper reviews the latest advancements in artificial intelligence-assisted R&D project initiation, aiming to provide intelligent solutions for R&D management. It thoroughly examines the value of artificial intelligence technologies in four core areas: intelligent requirement analysis, technical feasibility assessment, market prospect forecasting, and automated risk identification. Furthermore, it proposes three forward-looking trends—enhanced intelligence, the establishment of industry standards, and deeper human-machine collaboration. These insights are expected to improve project approval success rates and shorten initiation timelines, driving a paradigm shift in R&D management from experience-based to data-driven decision-making. The review highlights how artificial intelligence, through machine learning, natural language processing, and data mining, effectively addresses chronic challenges in traditional initiation processes such as inefficiency, delayed decisions, and resource misallocation. It also identifies critical hurdles, including data quality, model interpretability, and organizational transformation, offering a vital reference framework for the future of intelligent R&D development.

Keywords: Artificial intelligence; Project initiation; Management

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1. Introduction

R&D project initiation is a critical step toward project success, shaping its direction, objectives, technological approach, and resource allocation. Scientific and well-structured initiation enables organizations to clearly define R&D goals, market positioning, and expected outcomes, ensuring alignment with corporate strategy and market demands—thereby minimizing investment risks and enhancing both efficiency and success rates. However, traditional R&D initiation processes face numerous challenges, including low efficiency, reliance on subjective judgment, imprecise market analysis, and suboptimal resource allocation. These issues often lead to project delays, budget overruns, or even outright failure.

With the rapid advancement of artificial intelligence (AI) technology, these longstanding challenges are now

becoming addressable. Currently, more than 78% of technology-driven enterprises have deeply integrated AI into their R&D initiation frameworks—a trend that continues to accelerate. AI empowers smarter, data-driven decision-making by forecasting market trends and technological feasibility based on historical data, significantly reducing uncertainty. It can automatically analyze patents, academic literature, and market reports to support technology pathway selection, identify potential risks, and optimize resource distribution, thereby increasing the precision of R&D investments. Furthermore, AI enables dynamic resource management, allowing real-time adjustments to budgets and staffing based on project progress, maximizing R&D efficiency. As a result, AI is emerging as an essential tool in modern R&D management, driving more effective and intelligent innovation strategies ^[1].

2. The role of AI in project initiation

2.1. Enhancing R&D project initiation efficiency

The rapid advancement of AI technology has brought unprecedented convenience and innovative support to R&D project initiation. As a core driver of digital transformation, AI empowers the project initiation process through three key technological pillars. First, machine learning (ML) enhances the scientific rigor and foresight of R&D decision-making by building high-precision predictive models, combined with clustering analysis and intelligent classification algorithms. Second, natural language processing (NLP) enables smart parsing of vast volumes of textual requirements, automatically extracting key technical indicators and supporting real-time expert consultations through intelligent Q&A systems. Third, data mining leverages advanced techniques—such as association rule analysis, time-series pattern recognition, anomaly detection, and customer segmentation—to uncover strategically valuable insights from complex datasets. The integrated application of these AI technologies not only significantly shortens the traditional R&D project initiation timeline but also dramatically improves success rates through data-driven intelligent analysis. With continuous breakthroughs in cutting-edge technologies like deep learning, AI is reshaping the entire R&D management workflow, emerging as a core competitive advantage and a pivotal enabler of innovation. For instance, Mooghal *et al.* demonstrated how AI can greatly enhance the efficiency of Ki-67 (a prognostic biomarker) assessment in molecular subtyping of breast cancer, serving as a powerful assistant for pathologists and potentially transforming breast cancer diagnosis and treatment by enabling faster, more accurate Ki-67 analysis. This substantially accelerates the efficiency of R&D project initiation ^[2].

2.2. Intelligent demand analysis

In the process of initiating R&D projects, accurately capturing market and user needs is crucial. AI technologies enable in-depth mining and analysis of vast amounts of textual data, user feedback, and market research, facilitating intelligent demand analysis. By leveraging natural language processing, AI can perform semantic analysis on textual information from sources such as social media, industry forums, and customer reviews, identifying user pain points, expectations, and latent needs. AI also enables segmentation and clustering of diverse user demands. Based on multidimensional data—including age, gender, location, and consumption behavior—users can be grouped into distinct segments, allowing for a deeper understanding of each group's unique requirements. This empowers companies to precisely target different user segments during new product development, enhancing market fit and product relevance. Furthermore, AI supports real-time monitoring of evolving market demands. As technology advances and society changes, customer needs continuously shift. By

continuously gathering and analyzing relevant data, AI can promptly detect early signals of changing demand patterns. For instance, Ding *et al.* suggest that applying AI in the food market enables better alignment with customer expectations ^[3].

2.3. Assessment of technical feasibility

Assessing technical feasibility is a critical step in initiating R&D projects. Artificial intelligence can evaluate a project's technical viability by comprehensively analyzing factors such as current technological capabilities, trends in technological advancement, and the competencies of the research team. By leveraging machine learning algorithms, AI can process vast amounts of scientific literature and patent data to understand the present state and cutting-edge developments in relevant fields. It can also simulate and anticipate potential obstacles and challenges during the R&D process. Through mathematical modeling and simulation systems, AI can replicate research and development scenarios, forecasting the likelihood of success and associated risks for various technical approaches. Furthermore, AI can assess whether a team's technical expertise is sufficient to support project execution. By examining team members' educational backgrounds, professional experience, publications, and patents, AI can quantitatively evaluate the team's technical proficiency. For instance, Claudino *et al.* applied AI techniques to analyze athletic performance and injury risk, while also examining the specific AI methods adopted across different sports disciplines ^[4].

2.4. Market outlook forecasting

Accurately forecasting market potential is crucial for initiating R&D projects. Artificial intelligence can analyze diverse information—including market data, industry trends, and consumer behavior—to predict a project's market viability. AI also evaluates competitive dynamics, assessing a project's position within the market landscape. By examining competitors' product features, market share, and marketing strategies, AI identifies a project's strengths and weaknesses. Furthermore, AI can uncover latent market demand and emerging opportunities by analyzing societal trends, technological advancements, and shifts in consumer lifestyles. For instance, Yu *et al.* leveraged AI techniques to explore the fermented beverage market, significantly enhancing product competitiveness ^[5].

2.5. Automated risk identification

In the process of initiating R&D projects, various risks may arise, including technological, market, and financial risks. Artificial intelligence can monitor project progress and the resolution of technical challenges to promptly identify technological risks. By analyzing shifts in market demand, competitor activities, and changes in policies and regulations, AI can predict the likelihood and impact of market risks. Through assessment of budget execution, funding sources, and expenditure patterns, AI is capable of detecting financial risks. Companies can leverage these early warnings to optimize financial management and ensure smooth project execution. AI can also classify and prioritize risks, enabling project teams to focus on critical issues and enhance the likelihood of project success. Additionally, AI supports the identification of food safety risks. For instance, as noted by Mu *et al.*, AI can detect bacteria and fungi in food, thereby improving food safety ^[6].

3. Challenges ahead

3.1. Data quality constraints

In terms of accuracy, 10–20% of clinical trial data in the pharmaceutical industry contains recording errors.

Regarding completeness, critical data is often lost in chip testing due to equipment failures. On timeliness, rapid iteration in the software industry renders outdated data misleading for decision-making. These issues directly impair the training performance and predictive accuracy of AI models, forming a key bottleneck that limits the quality of R&D project initiation.

3.2. Model interpretability

Current AI models, especially deep learning systems, suffer from the “black box” problem, making it difficult to clearly explain the rationale behind predictions such as drug development success rates. This lack of interpretability makes risk assessment challenging for decision-makers, significantly restricting the deeper integration of AI into R&D decision processes.

3.3. Organizational resistance to change

The implementation of AI faces three major organizational barriers: operationally, many employees resist automated project approval workflows; in terms of talent, there is a shortage of data scientists, and R&D staff require new skill training; culturally, a conservative mindset leads employees to rely more on traditional experience. Additionally, departments may resist AI adoption out of concern that it will diminish their decision-making authority. These factors collectively hinder the effective application of AI in R&D management.

4. Future development trends

4.1. Advancement in intelligence

AI in R&D project initiation is poised for a transformative leap—from basic data analysis to autonomously identifying complex patterns. Progress in natural language interaction will enable more efficient human-machine communication, significantly reducing coordination costs during project initiation. By 2030, intelligent AI systems are expected to boost R&D success rates by 30%.

4.2. Establishment of industry standards

There is an urgent need to establish unified standards for AI applications in R&D. Addressing collaboration barriers caused by inconsistencies in current evaluation methods, future standards will streamline critical processes such as data quality control and model assessment—establishing clear requirements for data sources and defining unified metrics like accuracy rates.

4.3. Deepening human-AI collaboration

AI will evolve into an intelligent partner for human researchers. In the initial project planning phase, AI can uncover global research data to suggest innovative directions, while researchers apply domain expertise to refine these proposals. During execution, AI continuously monitors progress and flags potential risks, enabling researchers to adapt strategies in real time.

5. Conclusion and prospects

AI-assisted project initiation is gradually transforming traditional R&D management. Through intelligent analysis, forecasting, and decision optimization, it significantly enhances both efficiency and success rates in research

and development. Despite ongoing challenges related to data quality, model interpretability, and organizational adoption, continuous technological advancements, standardized frameworks, and deeper human-AI collaboration are paving the way for broader AI integration. In the future, AI will further drive R&D decision-making toward data-driven, intelligently collaborative models, offering stronger support for technological innovation and industrial upgrading.

Disclosure statement

The author declares no conflict of interest.

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