

Analysis on the Business Model of Medical Big Data Enterprises

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Abstract

Medical big data has gradually become a core production factor driving the digital transformation of the medical industry. Digital healthcare has achieved extensive application, while China's New Medical Reform brings both new opportunities and challenges to medical enterprises. Accordingly, medical big data enterprises have entered a tough stage of business model implementation. Currently, domestic medical big data enterprises are universally faced with prominent data silos, single profit models and imperfect compliance systems, and generic business models fail to fit the unique attributes of medical big data. Combining the resource attributes of the medical big data industry and market demand characteristics, this paper analyzes the existing bottlenecks and difficulties of business models adopted by relevant enterprises. Based on the business model canvas theory, this paper constructs a business model system matching the domestic industrial ecology from four dimensions: customer groups, profit channels, cooperation networks and integrated data compliance, and puts forward optimization and implementation guarantee strategies. This study aims to promote the sustainable development of medical big data enterprises, and offer theoretical references for similar medical enterprises to tackle difficulties in business model optimization.

Keywords

medical big data, business model, data compliance, digital healthcare, industrial ecology

1. Introduction

The Health China 2030 Outline clearly specifies accelerating the integration of medical data resources and promoting the market-oriented circulation reform of medical data elements [1]. Booming market demands, including intelligent hospital rating, intelligent public health prevention and control, and the construction of regional big data health centers have attracted continuous capital inflows, and investment scale in this sector keeps rising [2]. Different from internet consumer big data, medical big data is featured by privacy protection, government supervision, professional medical attributes and public welfare orientation, which makes it impossible to copy the conventional profit modes of general big data enterprises such as private domain traffic cultivation, traffic monetization and advertising revenue.

Existing academic researches mainly focus on technological research and development, industry governance and compliant data transaction of medical big data, while empirical studies on the systematic construction of business models for medical big data enterprises are insufficient. This paper fills the research gap, and is of great value in both theoretical application and industrial practice.

2. Current Situation and Core Pain Points of Domestic Medical Big Data Enterprise Business Models

Bai et al. thought that data assets have become vital strategic resources for digital economic development and digital China construction [3]. Although relevant policies have been issued and practical experience has been accumulated in many provinces, the industry still faces prominent problems, including fragmented data resources, insufficient standardization, mismatched supply and demand, and high compliance risks.

2.1 Inadequate Standardization and Shortage of High-quality Product

Most small and medium-sized enterprises are mainly engaged in basic outsourced businesses such as underlying data collection, screening and system operation and maintenance, with data sources mainly from hospitals. Inconsistent data formats and unified standards among different hospitals result in low-quality and non-standard medical data [4]. In addition, the scale of medical and healthcare big data is expanding at an explosive rate. Much of this data is of low value density, while some suffers from insufficient integrity and is characterized by complexity and redundancy. Big data enterprises are required to conduct extensive screening and processing, which creates certain obstacles to unlocking the value of data. Meanwhile, enterprises lack high-value-added products such as clinical algorithm models, specialized medical data models and integrated practical application solutions, failing to meet the research demands of pharmaceutical enterprises, tertiary hospitals and high-end scientific research institutions, thus leading to vicious price competition in the market.

2.2 Deficient Core Resources and Unbreakable Data Barriers

Serious cross-regional and cross-hierarchical data silos lead to single data acquisition channels for enterprises, while ambiguous ownership definition of medical data further hinders compliant data circulation. For example, medical health data provided by hospitals must be anonymized, and medical institutions only enjoy the right of operation and processing rather than full ownership of service-generated data [5]. Meanwhile, the industry suffers from a severe shortage of interdisciplinary talents with both statistical expertise and clinical medical knowledge, as well as lagging technological upgrading, which restricts data market circulation and weakens enterprises' core competitive advantages.

2.3 Single Profit Structure and Insufficient Profit Channels

Most enterprises rely excessively on government projects and daily operation and maintenance fees from hospitals. High-quality income sources, including high-end scientific research services and data-based insurance risk control, support account for a low proportion, which are mostly one-time businesses with poor sustainability. Corporate revenue is easily affected by policy changes, resulting in a single profit structure. Besides, imperfect pricing mechanisms and benefit distribution systems further increase the operational pressure of medical big data enterprises [6].

3. Relevant Concepts and Theoretical Basis

3.1 Definition of Core Concepts

3.1.1 Medical Big Data Enterprises

Against the backdrop of global informatization, big data has permeated all sectors, spawning a wide range of big data services and giving rise to an entirely new "digital economy". Medical big data is defined as massive volumes of data generated across the entire healthcare ecosystem, which mainly fall into three categories. First, clinical medical information and data: information produced in conventional medical services and collected through technical processing. Second, data from pharmacological research and life sciences. Third, personal

health big data [7]. All such information is tied to healthcare and wellness, encompassing data generated and exchanged throughout an individual's entire life cycle and the full production chain, covering physiology, psychology, production, daily life, ethics, the environment, public health, health management and other dimensions [8]. Processed data are deployed in a full spectrum of information-based services, including disease prevention, treatment, rehabilitation and health management [9].

For the purposes of this paper, medical big data enterprises refer to entities that serve the general public, medical service institutions, health authorities at all levels, pharmaceutical and medical device manufacturers, medical insurance organizations, and resident-oriented health management operators. This definition excludes internal data of public hospitals and information from non-profit public medical platforms.

3.1.2 Business Model of Medical Big Data Enterprises

There is no unified academic and industrial consensus on the connotation and essence of business models [10]. This paper agrees with the viewpoint that the core of a business model lies in enabling enterprises to realize value creation as operational entities, which is essentially a systematic institutional arrangement [11]. In addition, other scholars have pointed out that medical and healthcare data transactions are market value exchange activities carried out under the guidance of legal and compliance norms, with medical and healthcare data as the subject matter [12]. Therefore, from another perspective, the business models of medical big data enterprises still take big data as their core. Distinguished from ordinary big data enterprises, the business model of medical big data enterprises forms a complete closed loop of data value collection, value transformation and commercial profit acquisition, relying on medical data resources and algorithm technologies. Endowed with medical data elements, such enterprises possess market-oriented operational attributes, public welfare attributes of medical services and supervision attributes of personal health information compliance.

3.2 Basic Theoretical Support

Widely applied in various fields, big data has become a powerful engine to improve medical service quality and trigger a continuous innovative information revolution [13]. The operation modes of medical big data enterprises are constantly updated, which cannot be simply replicated from traditional business models. This research constructs targeted business models based on business model canvas theory, data element value theory and compliance governance theory.

First, the business model canvas theory proposed by Osterwalder consists of nine core modules: key businesses, key partners, value propositions, marketing channels, revenue sources, core resources, customer relations, customer segmentation and cost structure, which are applied in light of medical industry characteristics [14]. Among them, customer segments refer to diverse groups of individuals or organizations that an enterprise aims to engage and serve, as well as the connections formed throughout all production activities. Revenue streams are the gains obtained by the enterprise from target customers to sustain its basic daily operations. Key partners refer to a network of suppliers and collaborators indispensable for the effective operation of the business model. Unlike target customers, key partners constitute an important guarantee for enterprise operation. Key resources denote the most vital assets required to maintain smooth business model operation, and they serve as a core manifestation of an enterprise's competitiveness in market activities [15].

Second, the data element value theory defines data elements as effective factual information that plays a core role in enterprise production and operation [16]. Data has no intrinsic value in itself, and it can only be productized and value-realized through a series of transformation processes. Some scholars argue that the formation mechanism of data factor value falls into two dimensions. Firstly, data value is fundamentally derived from the quantity and quality of raw data. Following the data value cycle, raw data completes the whole progression from the factorization of data resources to data productization and value conversion. Secondly, the value of data factors is embodied by end users. Data products fail to generate direct economic and social benefits, and their value realization hinges on implementation in practical application scenarios. By means of optimizing resource allocation, underpinning corporate operational decision-making and magnifying the value of traditional production factors, data creates economic benefits in an indirect manner, and ultimately accomplishes the value monetization process of transforming data commodities into data assets [17]. This paper holds Bai's studies that the value realization of data elements is a dynamic monetization process based on the inherent value of original data, covering data screening, circulation and interaction, which constitutes the basic logic of medical big data value conversion [18].

Third, China has issued a number of national administrative regulations, which clearly encourage and standardize enterprises and public institutions to carry out innovative applied research on medical and health big data, and facilitate the construction of comprehensive health service application systems. In recent years, successive national policy documents have been released, which effectively standardize the industrial development environment of medical and health big data in China and greatly accelerate its industrial development pace. At present, China has initially established medical and health big data repositories and built a national population health information system, with the industrial development ecosystem of medical and health big data becoming increasingly sophisticated [19]. The Personal Information Protection Law requires information processors to establish complete personal information protection systems and regular audit mechanisms. The Data Security Law mandates market players to build full-process data security governance systems [20]. The Administrative Measures for Cybersecurity of Medical and Health Institutions put forward special compliance requirements such as annual risk assessment suitable for medical big data [21]. All medical big data enterprises must abide by legal norms to protect residents' personal privacy and stick to the compliance bottom line of business operation [22]. No matter what acquisition channels are adopted for medical and health big data, most of it involves personal privacy information, as well as key public health information, including disease transmission laws, regional epidemic trends and local population health conditions. If such data is not desensitized, any data leakage or illegal abuse will easily infringe upon people's rights and interests related to life and health, disrupt social public order, and even pose potential threats to national overall security. With the successive implementation of the above-mentioned laws and regulations, the legal system for data security governance in China has been gradually improved. The medical big data industry is continuously promoting the industrialization and popularization of privacy security protection technologies in the field of data circulation. Supported by sound and reliable technical systems, the industrial value of medical and health big data will become increasingly prominent.

4. Systematic Construction of Business Models for Medical Big Data Enterprises

Based on the core logic of business model canvas, combined with industrial practical dilemmas, policy compliance requirements and market supply-demand relationship, this paper reconstructs a localized business model from four core dimensions to balance profitability, compliance and long-term sustainability.

4.1 Refined Operation Based on Multi-dimensional Customer Segmentation

Traditional B-end and C-end customers are subdivided into four major target groups for precise market operation. Firstly, government clients including health commissions, medical insurance bureaus and disease control institutions are maintained through long-term strategic cooperation. Secondly, public medical institutions and grassroots medical groups are served by establishing medical big data analysis databases via data cleaning, so as to assist hospitals in realizing personalized precision medical services and realizing secondary utilization of desensitized internal medical data [23]. Thirdly, market-oriented clients such as pharmaceutical enterprises, commercial insurance companies and physical examination institutions are explored by setting up professional market teams to develop customized high-value business products. Fourthly, lightweight sinking health management services are launched for individual users such as chronic disease patients and elderly patients to build stable long-term service relationships.

4.2 Establishment of Diversified and Sustainable Profit Systems

The traditional single project profit mode is optimized to build a three-dimensional profit system including basic compliant income, high-value-added incremental income and sustainable derivative income [24]. (1) Basic compliant income: revenue from government platform construction bidding, one-time income of hospital data middle platform construction and annual routine operation and maintenance service fees [25]; (2) High-value-added incremental income: customized research service fees for pharmaceutical enterprises, authorized service fees of desensitized medical data, intelligent insurance risk control technical service fees and special scientific research cooperation fees with medical institutions [26]; (3) Sustainable derivative income: achievement transformation income of industry-university-research cooperation, health management membership fees from individual users, medical data consulting service fees and joint operation revenue sharing of regional medical digitalization projects [27].

4.3 Construction of Integrated Data Cooperation Network

By taking advantage of the high efficiency, openness, massive scale, diversity and high potential value of big data, enterprises can promote business function decoupling and strengthen interconnection among all market participants, so as to build a closed-loop industrial cooperation ecosystem centered on diversified market demands [28]. Upstream, compliant original medical data are collected from medical institutions at all levels; midstream, enterprises cooperate with universities and scientific research institutes to optimize algorithm models and cultivate professional talents; downstream, enterprises empower pharmaceutical enterprises, insurance institutions and health management organizations to launch data-based innovative products. Horizontally, stable cooperation mechanisms with government supervision departments and communication institutions are established to realize full-link integration of data collection, sorting, application and monetization, and break industry data isolation and collaborative barriers [29, 30].

4.4 Consolidate Operational Foundation via Integrated Compliance Resources

Medical big data enterprises shall strictly abide by national laws on medical data management, personal information protection and network security, and establish standardized internal control mechanisms covering data collection, desensitization, circulation and destruction [31]. Enterprises can obtain authorized desensitized medical data by cooperating with regional medical alliances, build standardized specialized medical data resource pools and acquire official data operation qualifications, so as to effectively avoid compliance risks and consolidate stable operational foundations [32, 33].

5. Discussion

5.1 Research Limitations

This paper mainly studies the general business model of domestic medical big data enterprises, without designing differentiated optimization schemes for start-up enterprises, leading enterprises and small and medium-sized enterprises. No mature business model for medical big data enterprises has yet taken shape in the market, which explains why this paper fails to enumerate, compare and analyze more types of business models. In addition, the business model constructed herein is derived by modifying partial elements of the Business Model Canvas. This study does not conduct an item-by-item analysis of the complete Business Model Canvas, nor does it develop a full-fledged canvas framework. Further research is therefore required to refine and explore the proposed business model.

5.2 Future Research Prospects

In follow-up research, empirical case analysis can be carried out combined with enterprise scale differences and regional medical resource endowments. In the future, with the continuous improvement of national medical data transaction mechanisms, optimized industry compliance systems and continuous supplement of professional talents, the business models of medical big data enterprises will gradually upgrade towards standardized data transaction and integrated AI medical large-scale model services, providing practical development ideas for the commercialization of the whole medical big data industry.

6. Conclusion

Restricted by industrial unified standards, public welfare attributes of medical services and data ownership compliance regulations, medical big data enterprises cannot adopt the traffic monetization mode of ordinary internet big data enterprises, and the industry is trapped in homogeneous products, single profit sources and high compliance costs. Based on business model canvas theory and data element value theory, this paper reconstructs targeted business models from customer segmentation, diversified profit acquisition, data cooperation network and compliance resource integration, and forms an integrated closed-loop service system covering government-oriented basic compliant services, high-value-added incremental services and people's livelihood-oriented sustainable services. This model effectively solves the profit dilemma and commercialization bottlenecks of the industry, and realizes the coordinated development of market-oriented profitability, public medical service supply and full-scale data security compliance.

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Conflicts of Interest

The authors declare no conflict of interest.

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