

A Study on the Challenges Faced by Game Companies in the Big Data Era: The Case of Tencent Games

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Abstract. Big data technology has profoundly transformed the design, development, and operational models of the game industry, ushering in both opportunities and challenges. With the Chinese game market now surpassing 310 billion yuan in size and continuing to grow, the influence of big data is more significant than ever. This paper aims to delve into the challenges that gaming companies face in this data-driven era, using Tencent Games as a case study. The research focuses on three critical issues: First, the problem of game lag is caused by the massive volume of data processing in game development and operation. As games become more complex and data-driven, ensuring seamless performance becomes increasingly difficult, leading to frustrating experiences for players. Second, the study addresses digital ethics concerns, particularly the use of big data in ways that might infringe on user privacy or promote unhealthy gaming habits. Lastly, the paper examines the risks associated with an over-reliance on big data for decision-making, where companies may prioritize data-driven insights at the expense of creativity and innovation. By analyzing the root causes of these challenges, this paper provides practical and effective solutions that can help gaming companies like Tencent navigate the complexities of the big data era while maintaining a competitive edge and ethical standards.

1 Introduction

1.1 Research background

With the rapid development of science and technology, big data has become an important force to promote innovation and progress in various industries, especially in the game industry. Big data has profoundly changed the design, development, and operation of the game industry. "China Game Industry Report 2023" points out that the size of China's game market reached 310 billion yuan, an increase of 8.5% [1]. In this huge and continuously growing market, learning to use big data to enhance competitiveness is a compulsory course for every game company. Tencent, as a leader in China's game market, has a broad user base and strong technical strength and has rich experience in utilizing big data in the game industry

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1.2 Literature review

Many scholars have done research in related directions. In terms of the application of Big Data in game Development, Xu pointed out in his book *How Big Data and AI Drive Economic Development* that big data technology plays a crucial role in game development. It is especially outstanding in the personalized customization and optimization of game content [2]. Li et al. say in *State-of-the-Art of Research on Big Data Usability* that in the context of wide application of big data, Data security and privacy protection have become the focus of the game industry. Game companies should take strict measures to ensure the security of player data during collection, storage, and use [3]. In *Motivations for Play in Online Games*, Nick Yee discusses the use of big data technology to analyze players' behavior patterns and then predict their motivations and preferences to help optimize advertising and user experience [4].

The current research status shows that most scholars have a strong interest in the game industry but pay little attention to the intersection of big data, a new technology, and the game industry. This is discussed in the Preface to the *Game Research Reader* [5].

1.3 Research framework

This paper first analyzes the application of big data in game companies and then analyzes the main problems that game companies face when using big data. Then, further discuss these problems, research the reasons behind them, and finally give a solution.

2 Case description

2.1 User behavior data analysis

User behavior data analysis: Tencent deeply analyzes user behavior in games through big data technology and optimizes game design and operation strategy on this basis. In the case of "Peace Elite", Tencent collected data on players' playing time, map preferences, weapon preferences, and so on. Then, build on that, refine existing game mechanics, and monetize skins based on player preferences. This data-based approach to decision-making not only improves user retention and satisfaction but also generates more revenue for Tencent, helping it stay ahead in a highly competitive market [6].

2.2 External competitive product data monitoring

Tencent will not only use big data to analyze its own products but also to monitor the market performance of rival products, collect and analyze other game companies' revenue information, advertising effectiveness, new game models and technologies, and user feedback data so as to evaluate competitors' strengths and weaknesses. These data allow Tencent game executives to more accurately grasp the game industry trends in order to adjust their own strategies. It is this monitoring of competitive product data that allows Tencent to react quickly and continuously optimize its products in the fierce market competition.

2.3 Cross-platform data fusion

With the development of cloud gaming, Tencent is gradually applying big data to optimize the cross-platform gaming experience. In the view of Ma Xiaoyi, senior vice president of Tencent, Tencent Games will take technology, talent, and responsibility as the chassis to

realize value exploration through different categories of products and work with all game players and practitioners to build a harmonious development of the game ecology and explore the possible path for the industry to fit the future [7]. Tencent uses big data to integrate data from multiple platforms, such as PC, mobile phones, and TV, to provide players with a consistent and seamless gaming experience. This data fusion not only enhances the user's gaming experience but also provides Tencent with a more comprehensive user portrait, enabling it to meet the needs of users across different platforms more accurately. For example, Tencent has optimized the loading speed and interface design of cross-platform games by analyzing user behavior across different platforms, thus ensuring that players can still enjoy a smooth gaming experience when switching devices. This cross-platform data integration not only improves player satisfaction but also lays a solid foundation for Tencent's layout in the cloud gaming field.

3 Analysis on the problem

3.1 Problem identified analysis

3.1.1 Problem 1: Network performance and user experience challenges

Big data can help optimize server performance, but in practice, many domestic game products still have problems such as delays, delays, and dropped calls, which indicates that the role of big data in improving user experience is limited. Game big data needs to be based on a large number of servers, and it also needs to cooperate with operators. Server and carrier stability is not entirely reliable. In January 2024, Tencent's "League of Legends", "Dungeon and Warriors", "Peace Elite", "Cross the Fire", "Gold Shovel Battle" and other game servers crashed and dropped during the game process. The relevant person in charge of Tencent's game technology replied on the Intranet that it was due to the operator's network failure [8]. In addition, the fact that 95% of gaming users have experienced network issues suggests that data-driven optimization may not be fully addressing user experience issues.

3.1.2 Problem 2: Data ethics and player manipulation

Big data can help game companies better understand the behavior of game players, but it also creates a data ethics problem. Tencent Games, for example, has long used player habits to design mechanics that make players spend more time and money. 1. By designing complex monetization mechanisms and limited-time offers, Tencent exploits players' psychological weaknesses to encourage them to recharge frequently. 2. Tencent uses psychological principles such as the "sunk cost effect" to induce players to invest time and money to maintain a competitive advantage continuously. 3. Tencent enhances the social nature of games, incentivizing players to increase their activity and spending in order to collaborate with friends or surpass others on leaderboards. These actions have seriously damaged the corporate image of Tencent Games and caused players to have a strong sense of distrust.

3.1.3 Problem 3: Limitations of data-driven decision making

Tencent Games relies on big data for customized development, a strategy that has helped them achieve significant results in their existing markets. For example, Gold Shovel Battle used user behavior data to customize new championship games and arenas, significantly increasing daily Active users (DAUs) and total revenue. Similarly, PUBG Mobile relies on

data-driven refresh strategies, such as the introduction of new modes and features, to drive year-over-year growth in DAU and revenue. However, over-reliance on big data can pose some problems, especially when it comes to innovation. Big data often reflects the existing preferences and behaviors of users, which can lead to a tendency for development teams to fine-tune existing products rather than try bold new ideas. This trend may limit the room for innovation in products, making it difficult to break out of existing models.

3.2 Reasons analysis of problem

3.2.1 Reason 1: Network performance and user experience challenges

Although Tencent Games uses big data to optimize game performance, the root cause is the instability of servers and operators. Big data can help analyze player behavior and optimize the allocation of game resources, but the actual operation of games is still highly dependent on servers and network infrastructure. If the server load is too high or there are fluctuations in the carrier's network, such as delays or disconnections, players will still experience delays. The stability of the operator's network is not always controllable, especially in certain areas or during peak hours. There may be poor data transmission, resulting in decreased game performance.

While big data can help Tencent optimize game performance, its limitation is that it cannot fully solve the problem of server and network infrastructure. Big data can analyze and predict network bottlenecks and alleviate the load to a certain extent, but if the network itself is unstable or the server hardware fails, the problem can still occur. This means that while data-driven optimization can improve the user experience to a certain extent, it cannot cope with the technical problems of the server or carrier, so the phenomenon of stuttering still exists.

3.2.2 Reason 2: Data ethics and player manipulation

Lack of legal regulation: In many countries and regions, the legal regulation of the game industry, especially in-game purchases, data use, and user privacy protection, is relatively lagging. This lack of regulation leaves game companies without clear legal constraints and norms when using big data to analyze and manipulate player behavior. In the absence of effective regulation, gaming companies may be emboldened to use big data to design potentially exploitative mechanisms to drive consumer behavior and increase revenue. This phenomenon not only poses a threat to the rights of players but also exacerbates the seriousness of data ethics issues.

Technology development and data accessibility: For game companies, collecting data is a very simple matter. Whether it's through player behavior data in games or social platforms, mobile devices, and other third-party data sources, gaming companies can get a detailed portrait of their users. This easy access to data allows companies to make accurate predictions and psychological analyses of player behavior and design more appealing game mechanics accordingly.

3.2.3 Reason 3: Limitations of data-driven decision making

One-sidedness caused by data dependence: Data-driven decisions rely on quantitative analysis of player behavior, often ignoring factors that are difficult to quantify, such as player emotion, psychology, and experience. Although the data can show how long a player plays, how much money they spend, and how often they use game strategies, it does not provide a

deep understanding of the player's inner needs or true emotional feedback on the game content.

Over-optimization can harm the user experience: By being data-driven, game companies may design complex monetization mechanisms or reward systems that incentivize players to top up or engage frequently. However, this over-optimized strategy, while it can increase revenue in the short term, can hurt the player's experience. For example, frequent payment prompts, limited-time offers, etc., can lead to fatigue, boredom, or even negative emotional reactions, which can reduce player satisfaction and retention.

Limitations on the ability to innovate: Data-driven gaming companies may be limited in their ability to innovate. Data analytics are often based on established behavior patterns and past data, which can lead companies to optimize existing successful models at the expense of innovation and bold experimentation. The gaming industry needs continuous innovation to attract players, but data-driven decisions can prompt companies to pursue short-term profits and invest less in innovation and original content.

4 Suggestions

4.1 Suggestion about Network performance and user experience challenges

Improve server hardware configuration and scalability: Game manufacturers should upgrade server hardware configuration and add more server nodes to improve processing power and load resistance. Tencent has adopted high-performance ARM/X86+GPU servers to meet the computing power needs of edge computing and cloud gaming while ensuring low latency and high throughput [9]. Manufacturers can also consider introducing elastic scaling technology. This technology can allocate computing power based on real-time network traffic, and when the number of visits reaches a certain threshold, the system automatically adds servers.

Game makers can also deploy edge and cloud computing to reduce latency. Edge computing shortens the data transmission path by deploying computing resources and content delivery networks (CDNs) at the edge of the network to keep data processing and content delivery as close to the user as possible, which in turn allows game vendors to sink data processing and content delivery to local servers closer to the player, ultimately reducing latency by reducing the data transmission path.

As a new gaming trend, cloud gaming is also gradually becoming a way for game manufacturers to solve game delays. Cloud gaming allows game vendors to run game computing on high-performance servers in the cloud, which can shift the computing burden of games from users' local devices to powerful cloud servers. Powerful cloud servers can provide higher-quality game graphics and a smooth gaming experience. Moreover, cloud game services can dynamically adjust computing resources according to real-time demand, ensuring stable service even under high load [10].

4.2 Suggestion about Data Ethics and Player manipulation:

Clarify data collection and use standards: Governments should establish laws and regulations to establish detailed data collection and use specifications and confirm the legality, necessity, and transparency of game data use. The law should require companies to provide clear notification and consent mechanisms when collecting data and limit the scope of data collection to the extent necessary. This mechanism helps to prevent excessive collection and improper use of data.

Data storage and protection: Regulations need to specify security standards for data storage, including measures such as data encryption, access controls, and regular security audits. Implementing strong data protection measures can significantly reduce the risk of data breach and abuse [9]. These measures will ensure the security of player data during storage and prevent unauthorized access or disclosure.

4.3 Suggestion about Limitations of data-driven decision making

To address the challenges posed by an over-reliance on big data in game development, companies can adopt a more diverse approach to analytics. By combining traditional data analysis with qualitative research methods such as user interviews, focus groups, and community feedback, companies can gain a more holistic understanding of their players' emotional needs and real-time reactions. This broader perspective allows game developers to design content that resonates more deeply with their audience, leading to more innovative and engaging gameplay experiences. Relying solely on data analytics can sometimes lead to overly formulaic or impersonal game designs, but by incorporating diverse methods, companies can mitigate these drawbacks and foster creativity.

In addition to diversified analytics, encouraging internal innovation and experimentation is crucial. Game companies can establish dedicated departments, such as a Game Innovation Lab, where development teams are free to explore bold, new ideas without the constraints of existing data-driven rules. These labs can focus on creating entirely new game mechanics and gameplay experiences that may not be immediately backed by data but have the potential to revolutionize the market. For example, Tencent could incentivize these teams with innovation bonuses, rewarding those who take calculated risks and develop groundbreaking projects. This approach not only fosters a culture of creativity and experimentation but also helps the company maintain a competitive edge by staying ahead of market trends and delivering fresh, compelling content to players.

5 Conclusion

There are three important issues facing the game industry in the context of big data. First, despite the blessing of big data, game latency is still serious. This is because servers and vendors are not stable, players have different online times every day, and there may be a lack of computing power during peak periods. Gaming companies can deploy more servers to increase computing power and edge and cloud computing to reduce latency. Second, in the context of big data, game companies sometimes use player data to make excessive profits, which raises digital ethical issues. Faced with such a situation, governments should clarify standards for data collection and use and strengthen regulations related to data storage and protection. Third, game companies rely too much on big data to make decisions, which ignores the real thoughts of players and limits the innovation of game models. Game companies should take a more diverse approach to decision-making, communicate more with players, and encourage innovation to avoid the lack of innovation that comes with fully data-driven decisions.

This article provides feasible solutions for video game development companies represented by Tencent Games to solve problems of high latency, data ethics, and over-reliance on data decision-making.

The research method in this paper has certain limitations, mainly using secondary data rather than primary data. In future research, more first-hand information should be obtained through a questionnaire survey or walking interview.

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