Supermarket Management Information System Development and Current Situation: A Comparative Analysis of Large and Small and Medium-Sized Supermarkets

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Abstract: With the development of technology, management information systems are gradually gaining popularity and development, providing a new and more efficient option for managers in government or business, etc. With the increasing degree of informatization, information management systems have become an indispensable and essential part of modern organizations, by studying the management information systems of supermarkets of different scale and analyzing them comparatively. This paper concludes that the emergence of information management systems has replaced supermarkets' traditional manual management methods. It greatly facilitates the management and improves the operational efficiency of supermarkets. At the same time, for different scale of supermarkets, the problems faced are very different. Supermarkets suffer from poor collection efficiency, and small and medium-sized supermarkets are negligent in operation and management. Therefore, the relevant personnel need to continue to develop and improve the information management system, overcome security and efficiency problems, promote innovation and sustainable development, and achieve the goal of improving overall competitiveness and sustainable development.

1 INTRODUCTION

Nowadays, supermarkets, as an essential part of the retail industry, have become an indispensable part of people's daily lives. With the development of society, the scale of supermarkets continues to develop while also facing growing competitive pressure and changing customer needs. Traditional management methods have been unable to meet the rapid development of business needs. Therefore, it is necessary to use modern information technology to improve the management efficiency and service level of supermarkets. The database as the core of the management information system (MIS) can be a good solution to this problem. Through rational design and management of the database, the efficiency, flexibility and reliability of the information management system can be improved, so as to better manage and utilize resources and meet the information management needs of the organization.

Some large supermarkets may already have a thorough MIS, but it is not applicable to small and medium-sized supermarkets. In the face of the rise of small and medium-sized supermarkets, the problems of large supermarkets in terms of distance and crowd management have been exposed. People choose to shop in small and medium-sized supermarkets near their homes or neighborhoods to reduce the distance and queuing time. The location of large supermarkets is fixed, generally in commercial areas and relatively far from residential areas, which gives small and medium-sized supermarkets a good living space. However, some small and medium-sized supermarkets have not invested enough resources in the construction of MIS, which has led to problems in staff management, product pricing and purchasing decisions. Mao Yongbo pointed out that although small and medium-sized supermarkets have natural geographic advantages, there is still a large gap in the overall level of capital, business model and import and export of goods decision-making (Mao, 2019). Compared with the systematic and complete information management system of large supermarkets, small and medium-sized supermarkets are lacking and need a suitable MIS as a way to adapt

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to the fierce competition in the market. Taipalus found that the database can make it more convenient for information managers to obtain and utilize the data, facilitate the access of different levels of employees to the required data, and realize the sharing and integration of data, which greatly improves information management quality and efficiency (Taipalus, 2023). In general, large supermarkets and small and medium-sized supermarkets each face different management challenges. MIS, as a universal solution, can be personalized for supermarkets of different scales. Therefore, all these supermarkets need more advanced and appropriate management systems to improve their management efficiency, accurately collect useful information, and effectively utilize the resources at hand to achieve a high level of operation and service quality.

The efficiency and security of MIS are closely related to databases. A good database design can greatly facilitate the manager's operation of the enterprise and provide services to customers. Therefore. This paper takes supermarkets as the object of analysis, aiming to explore the development of MIS and its importance in the field of supermarkets. Introduce the concept and development overview of an information management system. In-depth analysis of the development trend and current situation of supermarket MIS, comparing the advantages and disadvantages of large supermarkets and small and medium-sized supermarkets, analyzing and explaining the problems faced by each. Provide a more suitable and efficient information management solution direction for supermarket business. At the same time, this paper will discuss the impact of the development of MIS on supermarket operations, as well as optimize the database design to enhance the effectiveness of supermarket management and alleviate security issues.

2 DEVELOPMENTS AND CHALLENGES IN MANAGEMENT INFORMATION SYSTEMS

MIS was first proposed by Prof. Gordon B. Davis in the 1860s (Guo, 2005). He emphasized that management information systems are composed of computer hardware and software as well as database technology. Since then, MIS has gone through several stages of evolution following the times. From Luenendonk's point of view, he categorized the evolution process into five stages (Luenendonk, 2017).

The first phase was the Mainframe and Minicomputers era, which covered the mid-20th century through the late 1970s. The main computing power in this era came from mainframes and minicomputers, which were not yet widely available but were usually centralized in large data centers. The main task of the systems at this time was to process large amounts of transactions and data efficiently and to ensure the stability and reliability of the system.

Then came the era of Personal Computers. The 1980s was the period of the rise of the personal computer. The popularization of PCs brought computing power to the desk of the individual user. This led to increased efficiency and productivity. MIS began to open up to individual users in this era, becoming an important tool for individuals and small teams to manage and process information.

The 1990s belonged to networking and distributed computing. Management Information technology thus evolved to the Client/Server Networks stage. This is when MIS began to adopt a client/server architecture, allowing users to access applications and data on servers over the network. This architecture allowed users to share information and resources, achieve collaborative work, and improve organizational efficiency and flexibility.

The fourth era is the era of Enterprise Computing. At the beginning of the 21st century, with the expansion of enterprise scale and the complexity of business, MIS gradually develops into an integrated solution to support various departments and business processes of enterprises. The system's main task is to integrate and optimize the enterprise's information resources and business processes to improve its operational efficiency and competitiveness.

Then, there is the present era of Cloud Computing. Through cloud computing technology, MIS can provide computing resources and services through the Internet, and users can flexibly access and use these resources and services according to the demand without investing a lot of money and time to establish and maintain their own MIS. This model can greatly reduce the IT costs of enterprises and improve the flexibility and scalability of information management.

As MIS evolves in different eras, the issue of data security is becoming more and more prominent. With the increasing size of MIS, the growing volume of data, and more and more critical data being recorded in it, data security has become an important issue for MIS. Data security is important in protecting personal privacy, preventing leakage of confidential

information, and maintaining business continuity. Among them, data leakage may lead to personal identity theft, financial loss, and even legal liability. In addition, data tampering or destruction may lead to business interruption, impaired credit and other problems. Therefore, MIS must take effective measures to ensure the confidentiality of data.

However, in addition to data security, people are faced with the challenge of how to manage and cleanse data efficiently. A large amount of redundant and outdated data may affect the performance and efficiency of the system and increase the cost of data management and maintenance. Moreover, the performance and responsiveness of the MIS directly affect the user experience and work efficiency. This requires us to optimize the database so as to organize and store data more effectively.

3 IMPACT OF MANAGEMENT INFORMATION SYSTEMS ON SUPERMARKETS

In the former environment of single commodity and non-intense competition, the amount of data is compatible with the traditional manual management mode. Today's supermarkets face fierce competition, gradually tend to diversify the commodities. It also pays more attention to the aspect of user experience. The emergence of these phenomena has led to the explosive growth of information. Such a large amount of data is no longer suitable for using the previous manual management mode (Liu, 2020). Traditional management methods are inefficient for business processes such as account registration and product information updating and have limited ability to handle concurrency (Zhuang, 2022). It will also be very difficult to maintain and update the information in the future. In the end, this will lead to the management not being able to accurately grasp the operation of the supermarket and the proportion of income and expenditure in a certain period of time. All these problems seriously limit the development of supermarkets.

The emergence of MIS has improved the efficiency of supermarket operations. Computerized management information systems can help supermarkets realize the automatic collection, analysis and processing of sales data, which greatly improves work efficiency and also saves a lot of manual management costs. Through automated inventory management, sales and purchase systems, and sales data analysis, supermarkets are able to more efficiently manage merchandise inventory and optimize purchasing plans and sales strategies, thus improving operational efficiency and profit levels.

MIS can achieve real-time updating and accurate recording of data, avoiding the problems of human error and inconsistent information. Supermarkets can more accurately track the inventory of goods, sales and supply chain information, ensuring the timeliness, accuracy and consistency of information and reducing errors and risks.

With the statistical information from the system, supermarket brands can visualize the management of different local supermarkets throughout the system and promote the overall management of the brand. The system can collect, integrate and display the sales data, inventory, customer information and other information of the supermarkets in different places, helping the managers to understand the operation status and characteristics of the supermarkets in different places more intuitively. It can also help supermarket brands to decide where to open new branches next time. At the same time, it can analyze the customer consumption time data collected to help the management understand the flow of customers and sales in different time periods. Based on these data, the brand can flexibly adjust the opening hours of each store according to the actual situation of different local supermarkets, in order to adapt to the consumption habits and needs of customers.

In general, a good MIS is very important for today's supermarkets. With the popularization of computers and the improvement of their hardware performance and the development of software technology, the application areas of computer management information systems continue to expand, from the initial sales data management to inventory management, membership management, supply chain management and many other aspects. Thus promoting the development of high quality and high efficiency of supermarkets.

4 COMPARATIVE ANALYSIS OF LARGE AND SMALL AND MEDIUM-SIZED SUPERMARKETS

In recent years, a new trend has emerged in the retail market, with more and more small and medium-sized supermarkets developing. This phenomenon reflects the pursuit of shopping convenience by consumers in the new era, also the challenges and limitations faced by large supermarkets.

Compared with the rise of small and medium-sized supermarkets, large supermarkets are far away from residential areas, making shopping less convenient. Especially in the purchase of daily necessities, large supermarkets are not only large in size and variety, but also have the problem of long queues, which makes residents unwilling to spend too much time and energy to go to large supermarkets. This is where the advantages of small and medium-sized supermarkets come into play, as they are usually very close to residential areas and may even be located downstairs. The "small but fine" business model is also a good fit for consumers' immediate shopping needs.

To solve the problem of long checkout lines in large supermarkets due to low checkout rates, Gilbert mentioned in his paper the use of an automated supermarket self-checkout system based on Radio Frequency Identification (RFID) (Gilbert, 2021). It is a wireless communication technology used to identify and track the information carried on a tag. It usually consists of two parts: a tag and a reader. The tag is attached to the item and is used to store and transmit data. The reader communicates with the tag by sending a radio signal and reads or writes the data. This system can improve checkout efficiency and give customers a better shopping experience (Gilbert, 2021). The system consists of a hardware module, a database module and two user interface modules. The hardware module is responsible for reading the unique identification number of the product tag, the database module contains the product information update, and the user interface module interacts with the cashier and the customer to display the purchase list and the payment amount (Gilbert, 2021). With this system, when the customer puts the goods into the shopping cart, the RFID reader can automatically read the information on the tag and totalize the price of the goods in the shopping cart (Gilbert, 2021). Also, the customer can push the shopping cart to the self-checkout counter. The system will automatically read the information of the products in the shopping cart and generate the bill (Gilbert, 2021).

However, small and medium-sized supermarkets also have shortcomings in operation. There is a big gap between small and medium-sized supermarkets and large supermarkets in terms of the strength of the overall group, the management model and the management of goods in and out (Mao, 2019). And small and medium-sized supermarkets generally do not invest too much resources and energy in MIS. Therefore, it has fewer opportunities for trial and error, and they need a suitable and efficient MIS to more accurately grasp the business situation and the development trend of today's commodities. In order to better adapt to the development and maintain their own competitiveness. In this research, Tongda constructed a chain of convenience store MIS based on B/S architecture by using 'HDFS', data warehouse' Hive Metastore', and distributed computing framework 'Spark' (Tong, 2017). This system makes the management of convenience stores more systematic and scientific, which is helpful in further expanding the business scope of convenience stores and improving the economic benefits of convenience stores. Finally, it realizes the quickness and efficiency in the management of convenience stores.

In summary, the retail market is undergoing tremendous transformation and development in response to changing consumer needs and continuous technological advances. The rise of small and medium-sized supermarkets reminds us that convenience and personalized service have become important factors in consumer choice. In future competition, retailers that balance convenience and science will better cope with the flexible and changing market and thus succeed.

5 RECOMMENDATIONS AND OUTLOOK

In MIS, security and efficiency are of paramount importance. MIS undertakes the important task of managing and processing corporate information, so it is necessary to ensure that information is stored securely and accessed efficiently. And the efficiency and security of the MIS are closely related to the database.

In MIS, security is one of the primary considerations. With the rapid development of information technology, enterprises not only need to protect sensitive data such as customer data and financial information but also face a variety of security threats from both internal and external sources, such as data leakage and hacker attacks. A series of operations for the database can make up for the shortcomings in this regard to a certain extent. For example, the database can be backed up from time to time and recovery functions can be added. The database is backed up in full at regular intervals, and the backup data is stored in different geographic locations or cloud platforms. In this way, even if the database has a serious failure or data loss, the company can quickly recover to the previous state through the backup data, to ensure business continuity and reliability. Security threats can also be prevented by recording and monitoring database

operation logs. The access and operation of each employee to the database can be recorded, including time, operation content and other information. If abnormal access behavior is detected, system administrators can take immediate action to ensure data security and stable system operation. Data security can also be protected by adding complex encryption functions. It can be seen that database technology plays an important role in information system security (Yuan, 2021).

On the other hand, the efficiency of MIS plays a key role in the operation and decision-making of enterprises. An efficient MIS can quickly process large amounts of data and provide timely and accurate information support, which can help enterprises optimize resources and business processes. A good efficiency improvement can be achieved by optimizing the database management system (DBMS) in the system. The performance of a DBMS depends on the quality of its design and implementation (Taipalus, 2023). The algorithms, query statements, etc., of the DBMS can be optimized to reduce the cost of data access and processing, thus improving the query performance of the database. The indexing mechanism provided by the DBMS can also speed up the data retrieval process. By adding appropriate indexes to database tables, the number of data scans can be reduced and the speed of data retrieval can be increased, especially on large data sets.

However, with the development of technology in recent years, integrating AI into MIS has brought many advantages and benefits. AI not only has good automated processing and analytical capabilities, but it is also able to provide customized experiences based on user behavior and preferences through smart recommendations and personalized services. Also, AI is able to make predictions using machine learning techniques to help organizations make more accurate and effective decisions. Venkatachalam, in his paper, mentions that more and more decision support systems are using AI tools (Venkatachalam, 2020). These systems are called intelligent machine decision support systems because they mimic human cognitive abilities in some way. For example, banks and insurance companies can use such systems to analyze large amounts of transaction data and user information to identify potential fraud. In turn, they can identify unusual patterns and behaviors to protect customer assets.

6 CONCLUSIONS

This paper details the development of management information systems and discusses the importance and convenience of management information systems using supermarkets as a case study, leading to a differentiated comparison between small and medium-sized supermarkets and large supermarkets. Finally, the paper puts forward suggestions to address the maintenance of management information systems in terms of efficiency and security and looks forward to the future development of AI-assisted management information systems.

Research shows that management information systems have gradually become popular, and their convenience and flexibility will be pushed to new heights through cloud computing in the future. Taking supermarkets as an example. The management information system greatly improves the efficiency of supermarket operation, helps the management to quickly grasp the current market, so as to provide a better customer service experience. Due to the different advantage zones, supermarkets have different sales ecosystems between large and small and medium-sized, which leads to different problems.

With the development, the security and efficiency problems of management information systems have come to the fore. The security problem can be prevented by performing a series of backup encryption operations on the database. Efficiency issues can also be optimized by optimizing the DBMS and query statements to improve the efficiency and quality of the query.

REFERENCES

Gilbert, O., Twaibu, S., Umar, S., Davis, M., 2021. *East African Journal of Information Technology*, 4(1), 1-6.

Guo, L., Yu, H., Li, L., 2005. *Optics communications*, 246(4-6), 285-295.

Liu, A., 2020. Design and Implementation of Convenience Store Data Management System Master's Thesis, Northeast Agricultural University.

Luenendonk, M., 2017. Management Information Systems (MIS): definition and how it works.

Mao, B., 2019. Research and Development of Supermarket Management System based on J2EE architecture Master's thesis, Xidian University.

Taipalus, T., 2023. *Journal of Systems and Software*, 111872.

Tong, D., 2017. Design and Implementation of Chain Convenience Store Information Management System Master's thesis, University of Chinese Academy of Sciences.

Venkatachalam, B., Bharathi, B., 2020. *In Advances in Computational and Bio-Engineering: Proceeding of the International Conference on Computational and Bio Engineering,* 2, 395-403.

Yuan, Q., Li, M., 2021, September. *In 2021 International Conference on Computer Information Science and Artificial Intelligence* (pp. 1088-1091), IEEE.

Zhuang, S., 2022. *Information Systems Engineering* (01), 105-108.