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DIGITAL STRATEGIES FOR RESHAPING THE COMPETITIVENESS OF HOPSCA

HOI WAFONG

SINGAPORE MANAGEMENT UNIVERSITY

2021

DIGITAL STRATEGIES FOR RESHAPING THE COMPETITIVENESS OF HOPSCA

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Submitted to Lee Kong Chian School of Business
in partial fulfilment of the requirements for
the Degree of Doctor of Business Administration

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SINGAPORE MANAGEMENT UNIVERSITY
2021
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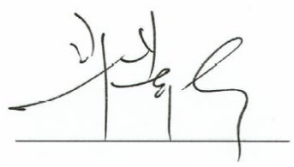
which have been used in this dissertation.

This PhD dissertation has also not been submitted for any degree
in any university previously.



HOI Wafong
28 April 2021

ABSTRACT

DIGITAL STRATEGIES FOR RESHAPING THE COMPETITIVENESS OF HOPSCA

HOI Wafong

The digital transformation strategy has a profound impact on the commercial real estate industry in China. However, so far, research on digital innovation strategies in the business field predominantly surrounds the retailing and systematic research identifying the effect of digital strategies on HOPSCA and commercial operational service provider has yet to be conducted. On the issue of digital transformation strategies of HOPSCA, there is currently a lack of relevant empirical evidence in the fields of management and economics to quantitatively analyze its effects, and there is not readily available and reliable experience for reference in the business practices.

Based on real-world business scenarios deployed by digital tools jointly developed by IT Corporation Y, Property Corporation B, and Tencent Holdings Ltd., this dissertation regards specific HOPSCA (shopping malls) as the analysis unit and takes advantages of unique first-hand business data and statistical causal identification methods, striving to make up for this research gap. This dissertation highlights three dimensions of the HOPSCA digital strategies, namely Digitalization, Networkization, and Intelligentized. Based on

the technical attributes of different digital tools, it proposes a taxonomy of technologies under the above-mentioned three dimensions and the conceptual framework of “Accuracy-Prediction-Quality-Linkage”(准-预-质-连).

Based on business practice, literature summary and theory, this dissertation puts forward a set of hypotheses that can be tested quantitatively and empirically. By combining the first-hand business data with the Difference-in-Differences method, we examine the effect of digital tools on the competitiveness of HOPSCA. The result suggests that the deployment of PMS/AMP can effectively reduce the cost of labor and management, improve operation efficiency, and increase NOI. When the scale of assets under management gets larger, the marginal benefits become more significant. The Precise Customer-flow Statistics System can greatly improve the accuracy and reliability of customer-flow statistics data, distinguish customer segments, and provide direct and powerful customer preference data for targeted marketing and leasing strategies. When it is connected to the Membership management system, it can make marketing more efficient and increase the input-output ratio for marketing and operation. The interrelation and combination of various digital tools can produce synergistic and interactive effects.

On the mechanism, digital tools have multiple channels that sharpen the competitiveness of HOPSCA. First, digital tools can increase the customer-flow, the total number of members, and the number of stores that customers visit. By

improving these direct factors, digital tools will then have an impact on the performance of HOPSCA. Secondly, digital tools can have an impact on consumer behavior preferences, thereby improving the fitness between consumer preferences and HOPSCA's tenant and brand mix, thereby enhancing the competitiveness of HOPSCA. Finally, digital tools can also affect the competitiveness of HOPSCA by changing the strategies and practices of HOPSCA operations (for example, digital tools can improve the efficiency of operation management, optimize business format portfolio or traffic flow settings through digital transformation).

Based on the above conclusions, we have put forward a few of feasible industry recommendations, the significance of which lies in guiding the application of digital technologies in HOPSCA, laying the foundation for studying how digital technologies can create effective added value for business, and providing a theoretical basis for Chinese commercial real estate operators' new digital strategies. These recommendations also focus on bringing about industry technology innovation and introduce feasible technology roadmaps to other HOPSCA in China and the world.

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ACKNOWLEDGEMENTS

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I dedicate this honors thesis to my family. I credit my success thus far to your unconditional love and constant support. I am forever in gratitude for that.

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Last but not least, I would like to express my gratitude to all the friends and classmates who have offered me help. There were the happiest four years I have had. While challenging, it was undoubtedly exciting. Thank you to everyone I have met along the way.

CHAPTER 1. INTRODUCTION

1.1 Research background, purpose, and significance

1.1.1 Research background

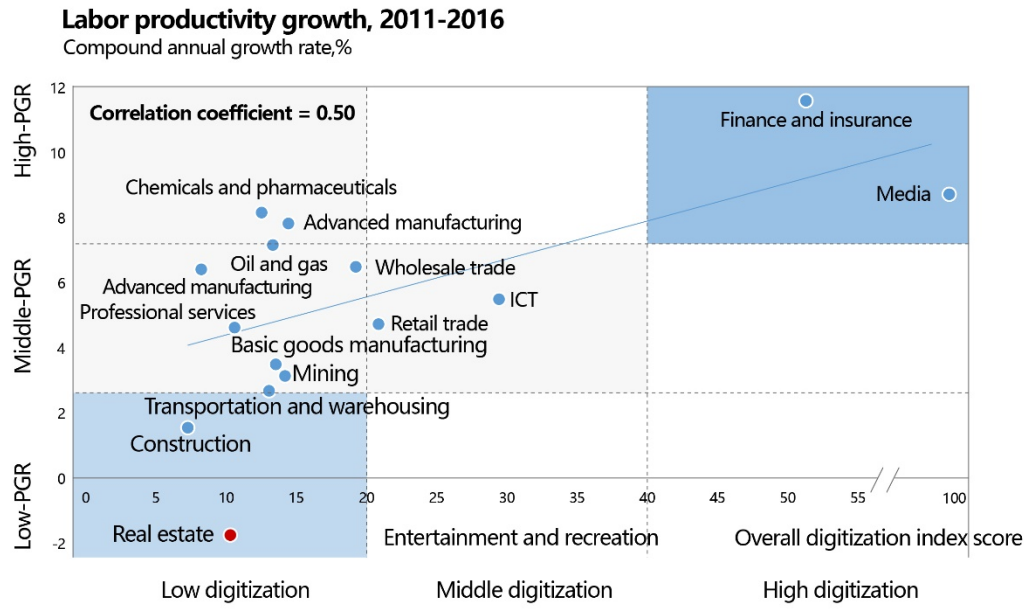
The digital economy has become an important part of the global economy. The scale of the global digital economy is about 1.3 billion U.S. dollars, accounting for 15.5% of global GDP. The rapid development of the industrial internet platform has promoted technological upgrades such as the Internet and digitalization from the consumer side to the supply side.

With the advent of the stock era of China's commercial real estate, the entire industry is confronted with unprecedented changes. The rapid rise of e-commerce has had an overwhelming impact on the offline retail share of shopping malls. In addition, the COVID-19 pandemic in 2020 has changed consumers' consumption habits and the consumption structure to a certain extent and has also had a profound impact on the commercial real estate. Faced with the changes in consumer behavior, the erosion of offline consumption caused by the rise of e-commerce, and the challenges of the regulatory environment changes, how to reshape the competitiveness of HOPSCA through digital strategies has become an important issue for commercial real estate operators and retailers. In this context, it is not difficult to find that domestic real estate operators have begun to use digital technology to transform shopping

malls, improve data management and analysis capabilities, and actively brave the digital wave (Ross, Beath and Sebastian, 2017).

According to forecasts, China's real estate sales will exceed RMB 18 trillion in 2021. For commercial real estate, according to the urgent demand for service quality and diversification on the demand side, the digital transformation on the supply side is still lagging behind.

China’s real estate industry, especially the commercial one, is still in a “digital depression”. According to a research report by McKinsey, on the two-dimensional coordinate axis measured by the degree of digitalization and productivity growth, China’s real estate industry is still in the double-low range of “low digitalization” and “low productivity growth” (see Figure 1). Judging from the experience of digital transformation in other industries, labor productivity growth will usually increase significantly with the increase of digitalization, which also means that the digital transformation of the real estate industry has huge potential and late-comer advantages. As an important infrastructure, digital technology will increasingly become a driving force for the strategic transformation and innovative development of China’s real estate industry.



Source: McKinsey Global Institute.

Figure 1: The degree of digitalization and labor productivity growth rate in various industries in China from 2011 to 2016

Although the overall digitization of the real estate industry is not high, this issue has been widely concerned by the industry and digitalization has been put into practice. However, People still lack a clear understanding of which dimensions and elements digital technology will have a profound impact on commercial real estate, and what profound impact will the digital transformation of commercial real estate have on the retail ecosystem and traditional business models of commercial real estate. Therefore, a systematic theoretical study and a summary of practical experience are pending.

So far, research on digital strategy innovation in the business field predominantly surrounds the retail industry and systematic research identifying the impact of digital strategies on HOPSCA and business operators has yet to be conducted. When it comes to the issue of digital strategy transformation of

HOPSCA, there is currently a lack of relevant empirical evidence in the fields of management and economics to quantitatively analyze its effects, and there is not readily available and reliable experience for reference in the industry practices. This dissertation aims to differ from past research that focus on the business environment of the retail industry. Rather, this dissertation will look at a bilateral customer-business market. This dissertation will include, but will not be limited to, research on how various combinations of digital technological products, such as social media tools, mobile intelligence application, computer vision, intelligent video analysis, electronic payment, cloud computing, Big Data tools and other digital technologies, generally impact the capacity of business management, asset management and return on asset.

The integration of digital technology and business scenarios is a prerequisite for enhancing the competitiveness of HOPSCA. The delay in integrating the commercial real estate industry with digital technology is mainly due to the two-sided market characteristics of commercial entities connecting consumers and businesses, the difficulty of underlying data governance and business standardization, the difficulty of information collection, and the high maintenance costs of digital transformation.

In such a two-sided market, the impact of high-technology products manifests relatively more complex correlational characteristics. Singular technology could result in users' active and positive response, but could also lead to

negative feedback, whereas combinations of various technologies and strategies could counteract among themselves and therefore create great challenges for accurately choosing a digital strategy in HOPSCA.

In recent years, the rapid iteration of the underlying digital technology has greatly reduced the cost of digitalization. For example, low-cost, low-power sensor technology promotes the advancement of the Internet of Things technology and makes up for the gaps in the previous data collection; the upgrade and evolution of the big data computing framework solves the low-cost storage and large-scale processing of massive data; cloud services and computing Development has solved the problem of large-scale storage and computing capacity, and has become a highly scalable and low-cost storage infrastructure for various industries. On this basis, the coverage and reshaping of commercial entities by digitalization began to accelerate.

This dissertation hopes to demonstrate that an appropriate combination of various digital tools can substantially sharpen the competitiveness of HOPSCA (including consumer experience, business revenue, and net operating returns, etc.). It also tries to find the most effective combining strategies through a series of field experiments and quantitative analysis to produce guiding significance for business practice.

1.1.2 Research purpose

The experiments in this dissertation are based on actual business cooperative

projects and firms cooperative R&D behaviors, which have immediate realistic values for the development of China's commercial real estate industry. Concomitantly, the effectiveness of data and execution is greater than that in most other research because of the non-artificial conditions presented in the research. This dissertation will study the peak pioneering technology available currently, including, but not limited to, Tencent's computer vision technology (access authorized by Tencent YouTu Lab), WeChat mini apps related technology, digital payment, LBS Maps, TDC Database, and new generation data collection boxes. Through effective, collaborative research and development, these technologies will be applied to target places and research paths.

Previously, neither academia nor the industry has conducted a comparable systematic verification as described above. Many companies have invested in large-scale R&D and innovation in the field of online and offline integration or digital technology innovation. However, as far as we know, no company has specified a solution based on the key differences between retail and commerce, nor has one company summarized the experience of applying digital tools in two-sided markets such as HOPSCA. Therefore, the conclusions from previous research studies lack pertinently defined goals and sufficient understanding of digital technology application. As a result, there has not been a case where digitalization is prominently successful in sharpening the competitiveness of

HOPSCA.

Firstly, this dissertation hopes to provide theoretical evidence as guidance for IT Corporation Y[1]'s digital tools deployment in the 44 HOPSCA of Property Corporation B[2]. Secondly, this dissertation looks to provide more industry cases, empirical evidence, and theoretical support for future HOPSCA operators when endeavoring into digitalization innovation. Finally, we also hope that this research can arouse the attention of digital technology suppliers, help them improve the underlying technology logic in a more targeted way, fully understand the specific needs and business philosophy of HOPSCA, and improve their ability to transform the underlying technology into application products, thus further triggering related digital technology innovation.

1.1.3 Research significance

Predominantly, previous empirical research on digital technology application is based on the classic retailing theory of 3P (People, Product, and Place)[3], and focuses on ways to increase the operation efficiency and customer acquisition capacity. Such research does not completely comport with the operation model of HOPSCA. As both property owner and operator, HOPSCA differs from retail industry in the following apparent dictions:

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[1] IT Corporation Y is a China-based IT company principally engaged in providing enterprise-grade digital solutions and SaaS products to property developers and other industry participants along the real estate value chain.

[2] Property Corporation B is China's leading commercial property investor and operator.

[3] For the retailing theory of 3P (People, Product, and Place), see section 1.3 in this chapter.

Retail faces selling products to consumers directly, while HOPSCA does not face consumers directly. HOPSCA has two categories of clients: merchants and consumers. HOPSCA should focus on the first clients, merchants. The first and foremost task for HOPSCA operation is to provide adequate support and service to merchants without compromising consumer experience.

The goal of retail is to promote sales efficiency, while the goal of HOPSCA is to increase property value. For HOPSCA, this goal is more flexible and allows more freedom in operation, but at the same time much more difficult in terms of strategy planning and execution.

Retail industry has relatively more advantages in the areas of “People” and “Product.” Its innovation focuses on the upstream and downstream of the transaction chain, improving the efficiency of the supply chain, and, because it directly controls sales representatives, increasing the rate of flow and liquidity ratio. On the contrary, commercial complex operators are different in that they do not control sales, nor do they have control over people or product. Despite that, HOPSCA operators, as property owners, have absolute control over “Place,” and thus have a substantial advantage in renovating the premises and improving the consumer experience. For them, increasing the importation of resources into the premises and enhancing user adhesion (time of stay and rate of return) is a more effective option (see Figure 2).

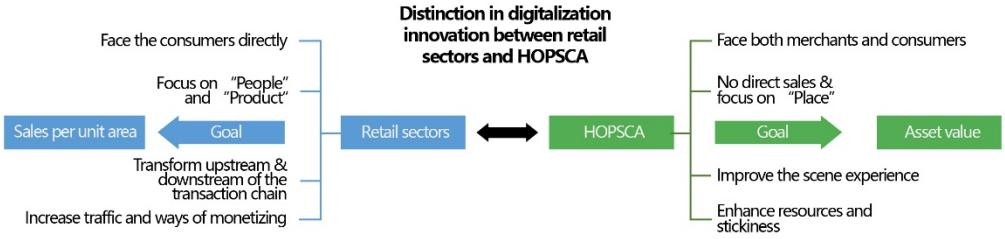

Figure 2: The difference of digital innovation between retail and commercial sectors

Applying the digital technology in HOPSCA should focus on the property owner and operator's perspectives. This focus should study how to provide effective support and service for both merchants and consumers, and what innovative technology combination ought to be implemented to maximize operations and increase asset value. Currently, no research has analyzed digital innovation in HOPSCA from this perspective. Theoretically, this dissertation attempts to fill the knowledge gap (see Figure 3).

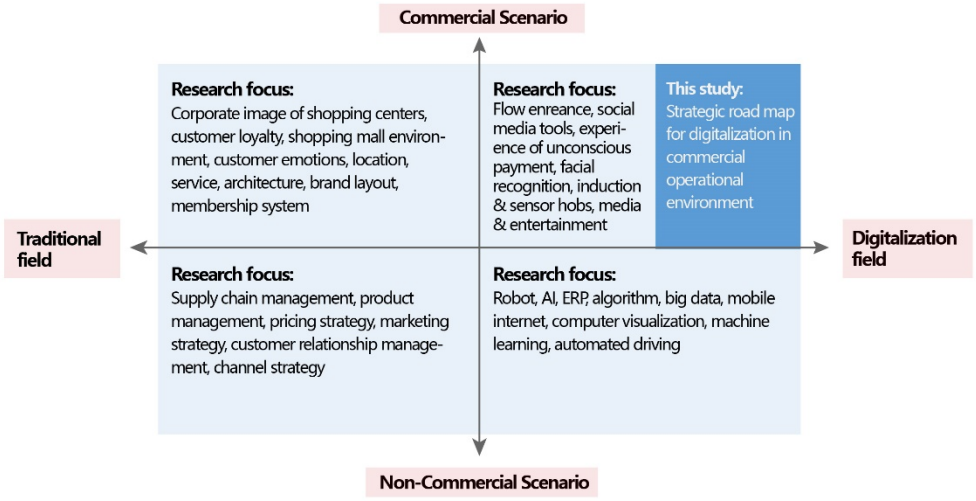

Figure 3: The field of investigation

1.2 Core arguments and research framework

The research focuses on three issues: ① Do digital tools improve the

competitiveness of HOPSCA? How effective are these digital tools? ②How do digital tools influence the competitiveness of HOPSCA? What is the influence mechanism? ③What is the effect of combinations of, and interaction between, digital tools?

The expected opinion of this dissertation is that digitalization can comprehensively strengthen HOPSCA's competitiveness, and it is necessary to adopt some of them to improve competitiveness in a certain aspect. A reasonable portfolio can deliver an even better result.

The research purposes of this dissertation: ①Verifying the effect of digital tools based on actual business cooperative projects and firms cooperative R&D behaviors; ②Providing industry cases, empirical evidence, and theoretical support for future HOPSCA operators; ③Triggering related digital innovation. The research process not only examines the effect of different digital tools on HOPSCA, but also introduces the factor of consumer decision-making preferences into the theoretical framework, thereby explaining the influence mechanism of digital tools. We will build a model of the influence mechanism in which consumers' perceived value affects consumer preferences and analyze the degree and significance of the impact of different digital tools on consumers' consumption preferences. We will also analyze whether digital tools sharpen the competitiveness of HOPSCA by improving the fit between consumer needs and the business operation portfolio or not.

The significance of introducing the factor of consumer decision-making preferences is that we can explore the mechanism of digital tools for HOPSCA competitiveness, that is, we can not only solve the “What” problem, but also solve the “Why” and “How” problems. Using digital tools, HOPSCA can more efficiently explore consumer preferences, implement business operation portfolio adjustments and precision marketing, increase customer acquisitions and sales volume, to improve operation capability. This is in line with the development philosophy of smart business. Digital tools can rely on users to accurately connect with customers’ needs, thereby guiding business planning and adjusting shopping malls layout. Digital tools can integrate online and offline resources of HOPSCA, and ultimately achieve precision operation and improve management efficiency.

Eventually, this dissertation hopes that through research and analysis, we can obtain a comprehensive digital combination plan for HOPSCA, provide effective support and services for operators, merchants, and consumers, and use the current reasonable combination of technology innovation to make offline scene operations more effective and assets value increase. This combination plan has the potential to be promoted to other HOPSCA. So, it is not only conducive to the digital innovation development strategies of the entire commercial real estate industry, but also provides reference and inspiration for future related research.

The research framework of this dissertation is shown in the Figure 4 below:

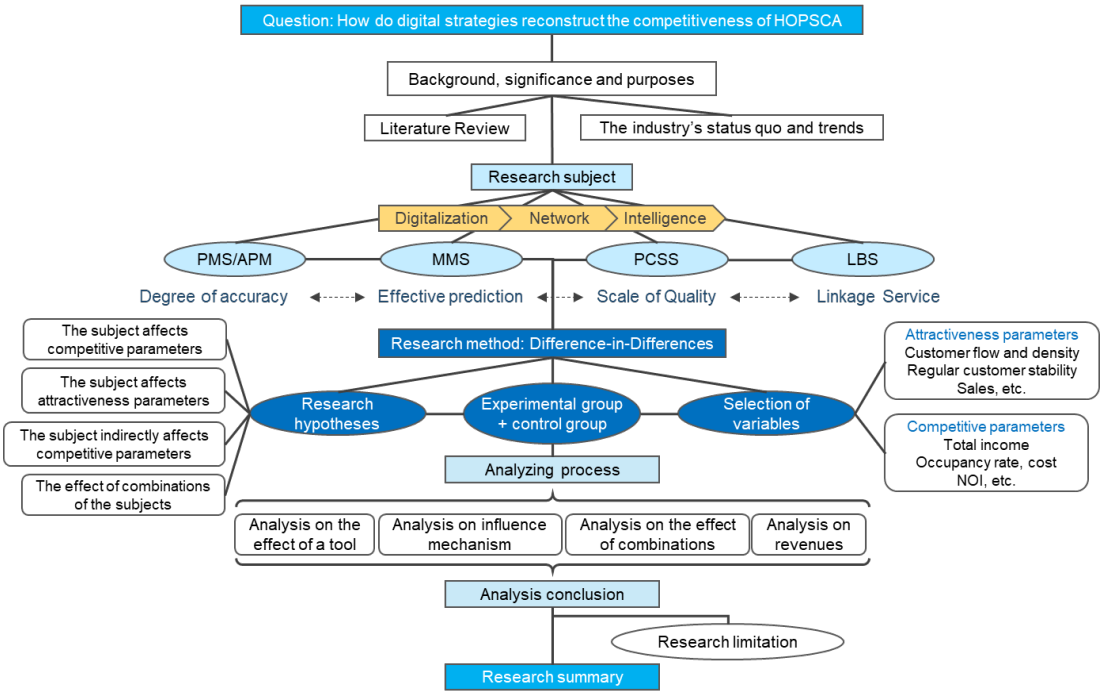

Figure 4: The research framework of this study

1.3 Concept definition: HOPSCA, as a two-sided market

The theme of this dissertation is the impact of digital tools on the competitiveness of HOPSCA. The concept of the HOPSCA is like commercial complex, which refers to multi-functional block buildings that include Hotel, Office, Park, Shopping mall, Connectivity and Apartment, etc. The definition of HOPSCA in this dissertation is an urban complex with commercial format as the main body, supplemented by some other format functions. Commercial formats include various shopping malls, open and enclosed shopping streets within large-scale and multi-functional development projects, underground shopping centers and various types of their combinations. Other types of format include hotel, office, apartment, art venues, etc. For example, a shopping mall plus hotel complex is a HOPSCA defined in this dissertation.

HOPSCA is a traditional market platform that has the characteristics of two-sided markets, whose feature is “cross-network externality.” As a platform, the competitiveness of HOPSCA will be enhanced with the increase in the number and quality of consumers and merchants (Täuscher & Laudien, 2018). Taking shopping malls as an example, the demand for retailers to enter the shopping center not only depends on the number and quality of the merchants that have already entered, but also depends more on the consumer size and purchasing power of consumers in the shopping center. And by the same logic, consumers’ demand for visiting shopping malls not only depends on the customer scale and purchasing power of other consumers, but also depends on the number and quality of retailers in the shopping mall (indicated by the positioning and rationality of the retail format portfolio). As a two-sided market that connects merchants and consumers, HOPSCA mainly profits from rents and property management fees.

Advances in digital technology will promote the transformation of HOPSCA and the reconstruction of business models. Thanks to digital economy, the transformation of the commercial real estate industry has evolved from the initial online scenario (that is, online channel purchase) to the digitalization of the entire industry chain and business model reconstruction. With the continuous progress of digital technology and the deepening empowerment of the core elements of HOPSCA “People-Product-Place “, business efficiency is

expected to continue to be improved.

“People”: Digital technology provides new marketing models and tools for HOPSCA. The deepening of user digitalization is expected to help operators and retailers more easily get accurate portraits of consumers, achieve personalized marketing and targeted delivery. The deepening of user digitalization also increases customer adhesion, customer unit price and purchase frequency.

“Product”: Provide users with more diverse and cost-effective product combination based on continuously improving the supply chain efficiency. Strengthen the refined product management and product turnover efficiency, further reduce retail sales levels, release efficiency space, and effectively improve the industrial chain efficiency.

“Place”: The application of more digital technologies will help reduce the cost of attracting customers and customer acquisition in offline scenarios, improve operation efficiency and consumers’ shopping experience, and achieve full-channel and full-scene coverage.

In such a two-sided market like HOPSCA, digital tools can open various links in the “People-Product-Place “ model and penetrate various fields including business activities, scenarios, supply chains, operation management, and customer management. Digital tools can rebuild the business philosophy of commercial real estate and retail industry, thus improving customer experience

and enhance the competitiveness of HOPSCA. Digital tools also can further help HOPSCA operators accumulate digital assets and realize data-driven innovation.

1.4 Selection of research subject

The research subject of this dissertation involves a series of digital tools which are deployed and implemented in real business scenarios of HOPSCA. We will explain in detail the technical features of these digital tools and the reason why these digital tools are selected as the research subject.

The three dimensions, digitization, network, and intelligence are the outstanding features of digital transformation in most industries. Our research centers on the three dimensions of HOPSCA digitization: digitalization, network, and intelligence. Digitalization refers to the technical approach of storing, transmitting, processing, and applying information carriers (texts, pictures, images, signals, etc.) in the form of digital codes. It emphasizes the display and processing of information. Network refers to taking advantage of information and communication technologies to connect electronic terminal equipment distributed in different locations to realize the sharing among software, hardware, and data resources. It emphasizes on providing a physical carrier for information dissemination. Intelligence refers to proactively perceiving and satisfying users' various needs by means of artificial intelligence and other technologies. It emphasizes the quality attributes of digital tools.

The research on commercial digital tools will also center on “Digitalization, Network, and Intelligence”. The application of digital strategies in HOPSCA is not an evolutionary process. In the initial stage, digital technology is usually used to directly replace certain sectors in the HOPSCA business process to improve efficiency. Then, digitization is the process of reengineering and optimizing business processes through simplification or reconstruction, transforming all businesses into quantifiable data, and promoting business process innovation. After that, network is the process of transforming most HOPSCA businesses into Internet-based operations. In the final stage, intelligence is the process of proactively influencing business models by means of Big Data analysis and modeling.

Table 1: The three dimensions of digitalization and the digital tools examined in this study

Dimension	Research subjects	Parameters	Measurement dimension
Digitalization	PMS	Competitiveness parameters	Degree of Accuracy + Linkage service
	AMP		
Networkization	MMS	Attractiveness parameters & Competitiveness parameters	Scale of quality + Precise linkage
Intelligentization	PCSS	Attractiveness parameters Indirectly affecting competitiveness parameters	Degree of Accuracy + Effective prediction
	LBS		Degree of Accuracy + Effective prediction+ Scale of quality

The digital tools studied in this dissertation come from IT Corporation Y. IT Corporation Y is a digital operations and solutions provider for China’s real estate developers. The specific research will rely on the real business scenarios,

namely the exclusive cooperation project established by IT Corporation Y, Property Corporation B and Tencent, introduce several cutting-edge digital technology and resources, and design a series of digital products and services suitable for commercial scenarios by means of integrated application technology. Therefore, this is a bold and exploratory research supported by sufficient practical resources, which may have the potential of influencing digital application development in the future HOPSCA field.

The digital tools in Table 1 are selected from a series of digital tools (implemented and/or planned), including:

(1) PMS

PMS refers to the property management system, which is used to integrate financial management and business operation functions. PMS is essential for providing HOPSCA operation services. This system integrates five subsystems, including project management subsystem, tenant sourcing and lease management subsystem, operation and marketing subsystem, engineering planning and management subsystem, and cost management and tender subsystem. The main functions of each subsystem are described as follows:

The project management subsystem can supervise each stage of the commercial operations before HOPSCA opens, including market positioning, formulating business activities, tenant, and brand combination plans, tracking the progress of tenants' investment attraction, and preparing for the opening ceremony.

The tenant investment attraction and leasing management subsystem can provide systematic management for HOPSCA like property leasing services, including formulating business and brand combination plans, setting appropriate rental rates, and monitoring the contract signing process.

The operation and marketing subsystem allows HOPSCA to analyze and supervise various aspects of the retailer property in real time, including customer-flow and sales volume. In addition, the system automates the charging process and greatly improves the management efficiency of HOPSCA.

The project planning and management subsystem provides systematic management of the daily maintenance and revamping of retailer property in HOPSCA.

The cost management and tender subsystem includes a supplier pool in which HOPSCA can launch online bidding procedures and ensure that qualified suppliers are selected at a reasonable cost.

As a digital platform for HOPSCA, PMS supervises and manages various aspects of retailer property operation and management, helping improve HOPSCA operation efficiency and reduce operation cost. In addition, as an interface to other platforms, PMS can build a comprehensive online digital ecosystem.

(2) AMP

AMP refers to the asset management platform, which is a system provided for

HOPSCA owners to monitor the performance of their property portfolios. By connecting of PMS to AMP system, HOPSCA operators can share all business data collected from commercial operation services to the property owners on a real-time basis. Property owners' asset management team would then be able to automatically monitor, analyze and track relevant data and produce relevant reports from the owner's perspective to maximize their management efficiency. The key function of AMP is to be able to establish a complete cash flow in which the project's life cycle is fully considered. It can estimate HOPSCA based on the operation indicators (NOI, NPV, IRR, Cap rate) to reflect fluctuations in project operation parameters, changes in financing structure, and implicit value driving factors and risk points, and predict the sales price and the optimal time to exit or refinance.

(3) Membership management system

The Membership management system consists of traditional CRM and WeChat mini apps, and is dedicated to intricately connecting consumers, merchants and HOPSCA.

From the consumer's point of view, firstly, the Membership management system allows them to obtain commercial information, such as searching for favorite stores, sales discount information and other shopping promotion activities more conveniently. Secondly, the Membership management system allows them to use other services, such as viewing the floor plan of HOPSCA

or paying parking fees. Thirdly, the Membership management system allows them to manage membership reward points and redemption.

From the perspective of merchants, firstly, the Membership management system allows them to promote goods or services and convert online customer-flow into real offline sales. Secondly, the Membership management system allows them to better manage the store and record all sales and operation data. Thirdly, the Membership management system allows them to provide after-sales service more easily and attract customers to visit the store again. For HOPSCA operators, all the operation data from the Membership management system will be collected and stored in the PMS so that it can analyze and monitor the performance of tenants and provide real-time feedback. By consulting the tenants' operation data, HOPSCA operators can also develop better strategies to manage the relationship with tenants.

(4) Precise Customer-flow Statistics System

The customer-flow system is one of the most basic information systems for traditional physical stores like shopping malls and supercenters. The Precise Customer-flow Statistics System examined in this dissertation can correct the real customer-flow statistics, realize the conversion from the number of visits to the number of people, and further provide precise identification of customer behavior. Therefore, it can be used to analyze the hot and cold areas of HOPSCA's customer-flow, the efficiency of frequently visited places, merchant

flow and the regular customers' revisiting efficiency. This system is connected with the Membership management system.

The business values of the Precise Customer-flow Statistics System include (for detail see Figure 5):

Monitor and forecast customer-flow. Help shopping malls and merchants arrange resources more reasonably, evaluate customer acquisition ability of the business more objectively, and optimize decisions.

Conduct customer group analysis (gender/age/activity), help merchants improve marketing strategies, provide more targeted services, improve customer experience, and increase customer adhesion and loyalty.

Collect customer-flow data and aggregate sales data and help HOPSCA operators evaluate the performance of personnel/activities/business more objectively and accurately.

Identify customers (identification/behavior analysis), help HOPSCA and merchants reach out to the member groups more directly, strengthen interaction, and increase customer adhesion and loyalty.

Analyze customer-flow routes and hotspots, help HOPSCA capture the distribution of hot and cold business activities more accurately, and optimize the layout more reasonably. Help merchants further realize coordinated development, optimize in-store displays, product categories, and personnel arrangements more rationally, and continue to enhance their ability to attract

customers.

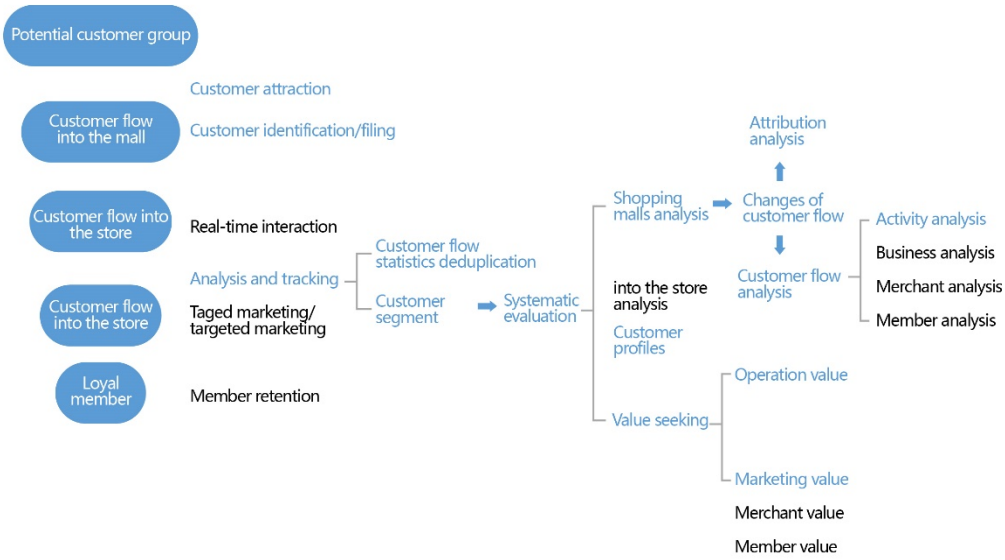

Figure 5: The business value of Precise Customer-flow Statistics System

(5) Location-based service (LBS)[4]

Location-based service system provides all data information of users' using Tencent location, that is, the number of locations made by users of all Tencent location service products (WeChat, QQ, Tencent Maps, JD and Meituan, etc.) anywhere in the world. Location-based service can monitor the changes of customer-flow in HOPSCA, segment the customer group, and help the shopping mall fully grasp the customer-flow conditions to fully tap the customer-flow resources and realize accurate crowd mining of the shopping mall operation and promotion.

Location-based service covers a full range of consumers' offline travelling places and supports customer identification in 15 categories and over 200 sub-

[4] A Location-based service (LBS) is a general term denoting software services which utilize geographic data and information to provide services or information to users.

scenarios. In the early stage of consumer decision-making, it can identify targeted customers after matching customer characteristics with offline scenarios. And in the effect closing stage, it can promptly capture consumers who visit offline. Location-based service supports multi-dimensional cross-analysis of space, time, and people, and provides statistical analysis targeting the population, source of customer-flow, customer-flow distribution, customer visiting preferences, customer group portrait tags, etc. in various places such as land, shopping circles, projects, and stores. The analysis results can guide store location selection, investment marketing strategies and effect evaluation.

The above-mentioned digital tools will be based on the research hypothesis of technology application and be regarded as the main research content to support the theoretical research. IT Corporation Y implements these digital tools on projects of HOPSCA owned by Property Corporation B, collects data and feedback, and verifies and analyzes the results in a preset research path, thus drawing experimental conclusions. In this process, we may also identify some digital technology and products that are expected to be effective but cannot work.

1.5 A taxonomy of digital technologies

Different digital tools have different technical attributes. This dissertation attempts to propose a precise and a taxonomy of technologies based on the four technical attribute parameters. Its significance is to summarize the common and

individual information of the technical attributes of different digital tools and explain the relevance and complementarity among different digital tools in a technical aspect. The four technical attribute parameters include:

“Degree of accuracy”: Accurate support for business operation and accurate match with consumer experience.

“Effective prediction”: Accurate quantification of efficiency, NOI, and user demand information.

“Scale of quality “: Scale supported by quantitative parameters, including member activation rate, merchants’ effective sales, etc.

“Linkage service”: two-side connections between merchants and consumers.

Each of the above four parameters has both consumers perspective and merchants’ perspective. Feedback from both perspectives must be taken into consideration, especially when it comes to related situation of mutual gain or counteraction.

Based on the aim of enhancing the competitiveness of HOPSCA and centered on the two-sided markets of “Merchant-HOPSCA-Consumer”, we select from the digital tools pool and decide what technology products or digitals tools will be the research subject.

The effects we hope to achieve include:

(1) Significantly reduce the operation cost of HOPSCA; since the operation cost accounts for a high proportion of the total coast, its impact on NOI is extremely

obvious.

(2) Collect as much relevant and high-quality data from merchants and consumers as possible.

(3) Dynamically link the operation and consumer behavior of "People, Product, Places", so that HOPSCA enjoys the highest efficiency of decision-making.

(4) Collect as much related external data as possible, especially those surrounding consumers, to improve business operation and merchants' leasing capacity.

(5) With the objectives having been achieving, consider the optimal cost-benefit ratio (which can be converted into the comprehensive input per square meter every three years).

The five aspects mentioned above is the significance of "Accuracy-Prediction-Quality-Linkage" proposed in this dissertation. Therefore, this dissertation does not provide a thorough analysis of technologies or solutions that only improve retail operation or single experience of customers but focuses on the landing strategy- "how to make HOPSCA better connect and serve merchants and customers, make wise decisions to achieve higher leasing capacity and operation efficiency". This is the reason why we have chosen a series of technical products and digital tools, including those which we had chosen but finally gave up, as the research object of this dissertation.

1.6 Competitiveness parameters of HOPSCA

As it is mentioned above, different HOPSCAs will choose different digitalized technical tools and deploy these tools in different scales, leading to discrepant effectiveness. If these tools cannot be precisely measured regarding their functionalities and the investment upon them, their effectiveness (external effectiveness) in other marketplaces is hard to calculate, making it unfathomable to improve market profits. In addition, from the perspective of industry practice, operators generally focus on how to configure digital tools to maximize the HOPSCA's competitiveness; only by answering this question, can operators know how to make business decision. Therefore, this dissertation will accurately define the parameters of measuring HOPSCA's competitiveness.

There are many elements for HOPSCA's success. While leveraging both theory study and industry practice to analyze HOPSCA, we summarize the applicable index system of competitiveness as shown the following Table 2.

According to the research background and data availability of this dissertation, we define the parameters of HOPSCA's competitiveness (see Figure 6). From the perspective of "people, product, place", we have split HOPSCA's operation profit (rental income) into such core factors as direct parameters and indirect parameters and measure the competitiveness with the variation of specific index.

Table 2: The index system of HOPSCA's competitiveness evaluation

No	Index	Detailed indicators
1	Mix of Investment Attraction and	1. proportion of internationally renowned brands and manufacturers entering the market

	Commodity	2. combination capability of different industries
		3. industries allocation and planning of anchor shops
2	Premises of Site Selection	1. environmental attractiveness of the selected site
		2. population, density, income, and consumption capability of the commercial district
		3. commercial district, retail entertainment, catering, and peer competence
3	Management Team and Strategy	1. advisory team (e.g., architects, designers, etc.)
		2. management background/motivation/team
		3. professional competence of developers
		4. pre-planning and executive control capabilities
		5. independent or combined operation strategies
		6. daily management
		7. management capability
		8. human resources investment
4	Marketing Planning	1. marketing Plan
		2. thematic features (differences from other HOPSCAs)
		3. market analysis and investigation
		4. competitiveness in the commercial district
5	Cost of Land Development	1. cost of land acquisition
		2. investment cost control
		3. quality of construction and business management
6	Customer Service Capability	1. service quality
		2. parking policy (other ancillary facilities)
		3. rich consumption experience
7	Commercial Space and Moving Line Planning	1. main body/features of architecture
		2. moving line planning of shopping centers
		3. appropriate mass
		4. performance in, and appeal of, spatial vision
		5. integration capability of architectural design
		6. hardware facilities and features of construction planning
		7. internal and external design and smooth moving line design

Direct parameters: Key parameters that can be directly collected, observed, analyzed, and have a direct impact upon the business status in HOPSCA's operation. Most of these are consumer behavior indicators, which help to

identify real-time changes in consumer patterns. These parameters are comprised of customer-flow and customer-flow density, frequent customer stability and sales efficiency. Customer-flow, penetration rate and frequent visitor stability reflect HOPSCA's operation capability in managing customers: the capability to establish standards to hierarchize members, to provide frequent customers with differentiated and customized product services on the appropriate premises, to integrate resources to offer members of all levels specialized services. Sales efficiency refers to the turnover per square meter of shopping circle, directly reflecting merchant's comprehensive profitability and HOPSCA's overall income efficiency.

Indirect parameters: Mainly refers to the financial indicators that can reflect HOPSCA's operation results, composed of total revenue, total cost, and net operating income (NOI). Most of these are key operating indicators which reflect the performance of HOPSCA. NOI is a driving factor in determining the value of commercial real estate. Calculating NOI involves subtracting operating expenses from HOPSCA 's Operating income. Operating income includes rents, property management fees, promotion fees and parking fees, while operating costs are associated with labor, maintenance, utilities, and operation activities. Non-operating income is excluded from operating income. Non-operating expenses, such as financial expenses, depreciation and amortization, investment commission (entrusted management fees), and so forth, are calculated outside

the operating expenses. NOI most accurately reflects HOPSCA's business performance and thus is the most important evaluation indicator of commercial real estate. The industry often uses NOI/ capitalization rate to estimate a project's potential ROI.

Figure 6 show the relationship between direct parameters and indirect parameters and calculation formulas of these indicators.

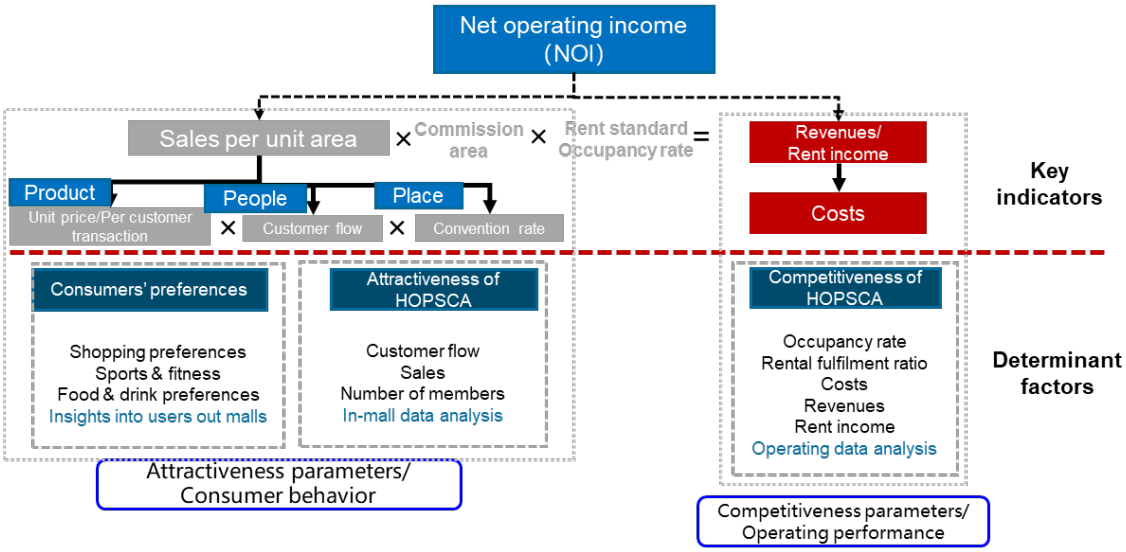

Figure 6: The index system of competitiveness parameters for HOPSCA to be adopted in this study

CHAPTER 2. DIGITAL TRANSFORMATION TREND OF THE COMMERCIAL REAL ESTATE IN CHINA

2.1 Status quo and trend of the commercial real estate in China

In recent years, China's commercial real estate has developed rapidly, featuring rapid growth of HOPSCAs, increasingly saturated market, fierce competition, and accelerated cycle of consumer behavior change.

The Figure 7 show that the GFA[5] of commercial operation service provider increased from 276.5 million square meters in 2013 to 546.2 million square meters in 2018, with a CAGR of 14.6%. It is expected that the building area will continue to increase in the future, reaching 983.2 million square meters in 2023, with the CAGR from 2018 to 2023 of 12.5% (Sullivan & Frost, 2019).

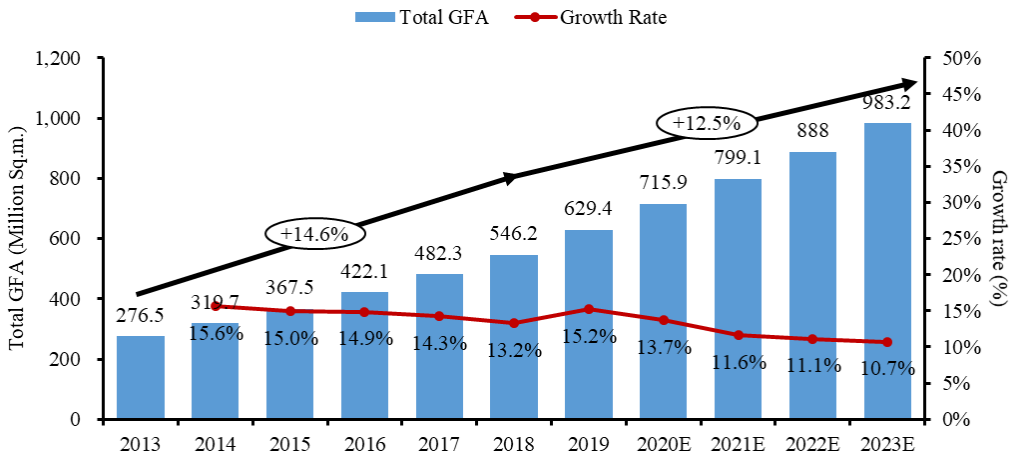

Figure 7: Total GFA under management by commercial operational service providers in China, 2013–2023E

[5] GFA under management refers to the aggregate of gross floor area of shopping malls operated by commercial operational service providers.

With the acceleration of urbanization and the increasing investment in commercial properties, the commercial operational service market kept fast growth in recent years. The Figure 8 show that from 2013 to 2018, the total revenue of commercial operation service providers in China increased from RMB 52.7 billion to RMB 130.1 billion, with a CAGR of 19.8%. In the future, with the further implement of favorable policies issued by Chines government in promoting consumption, such as “13th Five-Year Development Plan”, the development of commercial operational service market is expected to maintain stable growth. In 2023, the total revenue of commercial operational service market is projected to reach RMB 278.1 billion, with an expected CAGR of 16.4% from 2018 to 2023.

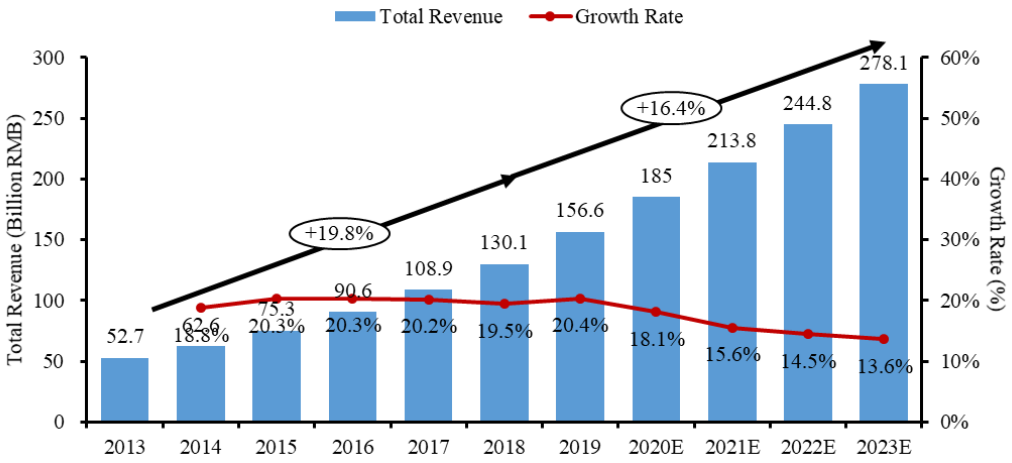

Figure 8: Total revenue of commercial operational service providers in China, 2013-2023E

China’s commercial property investment has increased rapidly in recent years, while the total building area of commercial properties under construction and completed has maintained steady growth, bringing huge consumption potential

and broad development prospects to the commercial operation service market. Investment in commercial properties continues to grow, so the total number of shopping malls continues to increase. The Figure 9 show that from 2013 to 2018; the total number of shopping malls increased from about 2,280 to about 4,550, with a CAGR of 14.8%. In the future, the total number of shopping malls in China is expected to rise to about 8,150, with a CAGR of 12.4% from 2018 to 2023.

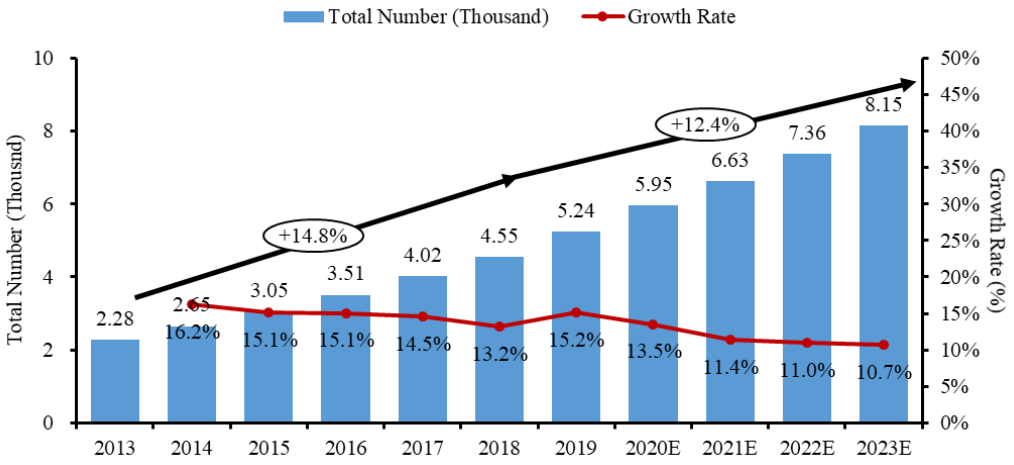

Figure 9: Total number of shopping malls in China, 2013-2023E

Considering the trends above, the commercial real estate market in China has faced and will face many opportunities and challenges soon:

(1) Increasing market concentration

Commercial properties have emerged in large numbers in China since 2012, bringing fierce competition in the commercial operational service market. Among commercial operational service providers, property developer-affiliated operators will gradually dominate the market with increasing market

concentration. The continuous expansion of branded commercial properties will support the development of property developer-affiliated commercial operational service providers, who fully understand the strategies, operation models and relevant expertise. Furthermore, the relatively small-scale property developers have the preference to operate their commercial properties under renowned brands to have more visitor flows, higher occupancy rates and higher rentals, and are inclined to use affiliated commercial operational service providers of these renowned brands accordingly. Therefore, the commercial operational service market will have an increasing market concentration of property developer-affiliated operators in the future.

(2) Popularity of asset-light model and strategy

Asset-light model and strategy, which can lighten the financial burdens of holding and acquiring assets by commercial operational service providers and improve operational efficiency, will popularize in the future along with the development of the commercial operational service market in China. With the asset-light model and strategy, commercial operational service providers will optimize the allocation of resources and provide reasonable service portfolios by outsourcing part of their services such as cleaning, gardening, and maintenance. Accordingly, the trend of popularity of asset-light model will bring higher profit margins to commercial operational service providers and is conductive to promote the outward expansion in the market.

(3) Diversification of service categories

Due to the vigorous development of the commercial operational service market in China, there has been increasingly fierce competition among commercial operational service providers. To maintain market competitiveness and establish advantages, commercial operational service providers will provide more diversified services, improve service qualities, and invest in human resources to ensure operational efficiency and gain more market shares. While constantly improving traditional operation and management services, the commercial operational service providers are committed to combine with online platforms and mobile applications and enrich the value-added services such as paid memberships, membership points, gift cards and portable battery rental for better promotion and a good shopping experience for consumers.

(4) Rising labor and operation cost

The commercial operational service market is a labor-intensive market and involves many workers such as securities, cleaners, and maintainers. The minimum monthly wage is increasing continuously in recent years, resulting in growing labor costs to commercial operational service providers. Training and management of these workers to ensure high-quality and standardized services is a great challenge as well. Moreover, the utility fees such as electricity and water have likewise increased in the last few years. Therefore, the rising labor and operation costs may reduce the profit margin for commercial operational

service providers and impose greater pressure for those providers in the market.

2.2 The challenges of digital transformation of HOPSCA

HOPSCA applies digital tools and resources to improve operational efficiency and business efficiency, and boost consumer contribution, so it can obtain higher operating return on assets. However, HOPSCAs, especially large shopping centers, are still facing numerous constraints when pursuing digital transformation. These challenges mainly include:

(1) Customer-flow is massive and industry retail brands in the industry are complicated, making it hard to apply digitalized strategies.

(2) Digital tools are kaleidoscopically numerous, and operators and merchants are not clear about what intuitive effects they will have upon improving operational efficiency.

(3) The link between HOPSCA and consumers is weak; in addition, consumers vary from one to another; HOPSCA lacks effective technical means to have consumers involved; moreover, the member system of shopping malls and of brands are severely separated and against each other, resulting in poor consumer experience.

(4) Space operations are pyramidally relying on technical means and data collection, but HOPSCA lacks the ability to make correct choices for digitalized strategies.

(5) Consumers frequently switch between offline stores and digital channels,

thereby blurring the boundary between online and offline and accelerate integration. Offline entities need to consider how to integrate and collaborate with online ones.

2.2.1 The operators of HOPSCA does not understand their first clients—merchants

Differing from retail business operators, the operators of HOPSCA do not face consumers directly; rather, they generate revenue from rent and commission paid by merchants, which means the ability to provide service and support to merchants greatly affects consumers' actual experience. Therefore, merchants are in fact HOPSCA's first clients. It has long been the case that HOPSCA's operators lack the motivation to invest and provide adequate support for merchants, thus they are short of reasonable understanding of merchants. This is reflected by the reality that there is no operation data collection, no capability to support various effective services, and no mutually beneficial relationship with merchants when developing technology tools.

Such deficiency of collaboration is reflected in all aspects in business operation. Most commercial operators in China regard rent collection from, supervision of, management of, and risk avoidance calculations for merchants as the top KPIs, which usually leads to an antagonizing relationship between the project developer and the merchants. When carrying out innovation of digitalization under such circumstances, expenses and resources allocated by business

operators become repurposed merely to business planning and marketing. Furthermore, the project developing team tends to put its own needs—meeting the annual KPI, as the top priority. With such executive intentions in mind, the merchants' needs are downgraded to secondary matters.

As a result, the first issue in the digitalization revolution is to rebuild the commercial operators' understanding and revive their support of their most important clients—the merchants. The solutions include in-depth analysis of the operation status quo and data of merchants, peripheral dynamic information exchange with merchants, and study on how to provide support for merchants from a service perspective.

2.2.2 Lacking capability to effectively serves customers

So far, most HOPSCAs' Membership management system, marketing strategies, main theories, tools, and strategies regarding customers originate from the department store industry. However, as it is discussed above, because HOPSCAs do not have a direct consumption relationship with consumers, there is unavoidable confliction when these tools and strategies are applied. More specifically, simple offline promotions and activities cannot compete with online channels, nor are they able to increase brand loyalty. On the contrary, in aspects that the consumers really care about, for instance, convenience of access to public facilities and resources, ease of freeing the mobile phones or other complex tools, linking Membership management system to individual

merchants, and so forth, HOPSCAs lack sufficient capacity.

There are many reasons to such phenomenon, and among them an obvious one is that HOPSCAs' operators of commercial operation in China are predominately composed of professional managers from the traditional department stores and retail industry. As a matter of fact, early-stage professional managers from department stores and supermarkets dominated the starting phase of business in China. This research will analyze the characteristics and differences between retail business and HOPSCA, because ignoring such differences leads to the current situation in which most business operators treat consumers the same as those in the retail industry. This creates inconsistency since there is no transactional relationship between them.

To rebuild capacity to effectively serve consumers, the operators of HOPSCA need to realize that resources on the premises are the key elements in operating HOPSCAs, and only technological applications based on these resources can bring optimal efficiency and effectiveness.

2.2.3 Lacking effective linkage between merchants and consumers

Unless awarded with coupons, consumers have no reason to use HOPSCA's App or membership card, which is considered as a non-effective transaction. In the meantime, merchants usually do not expect HOPSCA to cooperate with them. Such a commonly seen phenomenon indicates that HOPSCA are in a low-efficiency-low-effectiveness status regarding their clients from both aspects,

and it further explains why HOPSCA operators could hardly gain feedback from either consumers or merchants, let alone achieve effective interaction.

To have better relationships with its clients, HOPSCA needs to obtain great breakthroughs in identifying focused consumers, building a better accounting system, and improving financial services. At the same time, HOPSCA needs to avoid conflicts with its merchants to avoid triggering data privacy crisis. For its operators, not all data is useful, and the business data system the retail industry needs is different from the one HOPSCA needs. Traditional high-tech tools merely provide simple data spanning phone numbers, occupation, customer-flow, vehicle flow, and the like to HOPSCA, whereas HOPSCA today needs more intricate data, such as merchants' sales capacity, contract status, competitive products tracking, core clients, sales success rate, time and area of shopping, percentage of returning customers, and so forth. Such data is based on the uniqueness of individual consumers but meanwhile does not require the depth of complete customer profile or business-to-customer precise marketing and tracking—such in-depth survey often leads to consumers' dissatisfaction in market experience.

2.2.4 HOPSCA finds it hard to respond to the new consumer demands

In 1980s, supply began to fall short of demand in China's market. Merchants who owned the products will occupy the whole market, regardless of the quality of the products. Around 2000, there was a large supply of products in the market,

and therefore, those who controlled the distribution and sales channels secured a decisive advantage over other merchants. During this period, we can observe such a situation of chain stores, and regional or national supermarkets.

Table 3: New consumer demands under 'New Retail' Revolution

	New Consumer Demands
Product	1. New consumption upgrade 2. Innovation in new product categories 3. More customized SKU consumption
Customer	1. Shopping time: 24×7, any time, any place 2. Shopping channels: Online vs. Physical store 3. Shopping experience: Online, in store, community group buying 4. Payment method: mobile payment
Channel	Online + Offline (Physical store, Omni-channel)

However, nowadays, China is experiencing a new round of retail revolution. There are numerous supply and sales channels, including online, offline, and national channels. Customers, especially new generation of customers, have developed assorted product preferences. In terms of products, they began to level their current consumption up, such as purchasing more high-end products than basic products, and looking for innovative merchandise, for instance, dishwashers that they did not like before. There is why more specialized and differentiated SKU comes into play (see Table 3).

In addition, consumers have higher and higher requirements in the form of shopping. Thanks to the rapid development of Internet, consumers can shop anytime and anywhere. These rising demands of consumers drive merchants to

re-examine their products, channels, and services.

Furthermore, today's mainstream consumer groups are generations of post-80s, post-90s, and post-00s, who are born and grow up in the digital media environment. They share evident inclination for technology, spending over 3 hours on mobile phones every day. Among all types of mobile phones, iPhone is most used among working consumers, while Chinese brands, such as Vivo and Oppo, with outstanding cost performance, music, and camera functions, are favored by student groups. High school students are the most active QQ-users. They have the highest demand for gaming and music functions, spending 36 hours on music Apps every week.

Under the digital economy, these consumers have stepped out of the "product economy" and come to embrace the "experience economy". In a survey, nearly half of consumers think that "For shopping, preference is more important than practicality", and consumers value their experience highly. Comfortable and convenient scenes are easier to trigger shopping than preferential prices. 52% to enable them to have pre-experience. At the same time, more than 50% of customers are calling for AI shopping, hoping that through the advanced technology and the help of the shopping assistant, they will enjoy more convenient and comfortable shopping experience. In addition, the experience of participation could more effectively trigger the desire of shopping.

Social networking has become an important medium to trigger shopping.

Nearly half of consumers said that shopping became a by-product of their social interaction. Especially for the fast-paced, high-income young consumers, who are proven to be the most active groups in social networking activities. The WeChat social circles basically revolve around the sharing of food, sports, tourism, entertainment, reading and fitness. These social circles play a vital role in the awareness, triggering, action, and experience of shopping. Nearly 90% of young consumers confirm that the sharing, triggering, and action of shopping are all discovered within their social media circle.

2.3 Status quo of applying digital technologies in retailing and HOPSCA

2.3.1 The development and application of digital technology in the retailing

The digitalized technology in the retail industry has been advancing. At present, the application of digitalized technology conforms with the following two major trends: (1) Great progress in experience, efficiency, channels, data mining, since it interacts with consumers and transactions. However, most shopping centers focus on the back-stage data consumer solution, which will not immediately generate additional customer-flow or revenue; (2) Evolution in technology and online retailing after iteration, which becomes a force to upgrade HOPSCA. Current technology used in shopping centers lags the market, making shopping centers an outdated place. For example, while mainstream technology has steered towards artificial intelligence, shopping

centers are still throwing money at ERP systems, spare no time or budget to attend to new technology.

The is Figure 10 a tentative model that lists the most advanced technologies a shopping center could possibly adopt:

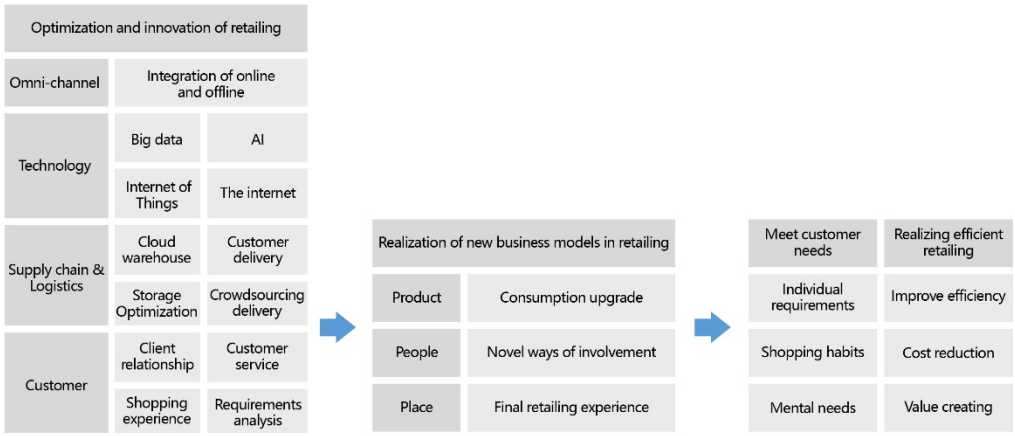

Figure 10: New technologies potentially applicable to shopping malls

With the high-speed development of cloud computing, Big Data, Internet of Things, mobile Internet and other technologies in recent years, the physical retail industry has ushered in the second stage of digitalization upgrade. The upgrade is attributable to multiple aspects: First, retailing has begun to shift online to offline again, underlining the edges of offline stores. What they need to do is to improve their operation capabilities to integrate online and offline retailing; Second, the new generation of managers accentuate more to the development of digitalization and insight into consumers.

For example, although HaiDiLao Hotpot is a traditional hotpot brand, it aims to stand at the forefront of China's catering industry. Via new technology, HaiDiLao not only understands customers' needs and provide targeted services

accordingly, but also improves dining efficiency, thereby shortening waiting time to boost customer satisfaction. HaiDiLao draws on new technologies to enrich customer's overall experience. For instance, it has installed vending machines in the waiting area, and customers can pay with their membership account or add the expense to the dinning bill. In addition, customers can help themselves purchase HaiDiLao's products at the unmanned counter by scanning a product code, the cost which will be sent to customer's bill and customer can take the product away when they leave; Moreover, HaiDiLao provides customers with QR codes for the waiting list and they can enjoy free manicure services when they are waiting, so that customers do not need to wait in the restaurant and can remotely check the waiting list. Through HaiDiLao App, customers can make reservation online, order takeout, and get on the waiting list remotely. Automatic telephone hotline is also available for pre-ordering, answering commonly asked questions, such as restaurant address and business hours, which taking care of customers who will not use the Internet. Because all orders of its restaurants are completed on tablet computers, HaiDiLao can gather customer data and analyze consumption behaviors in time to provide a variety of customized value-added services, such as automatic recommendation, and even automatic ordering of dishes, referring to the order history (see Figure 11). In the future, there is reason to believe that more merchants will strive for innovation in the field of retailing digitalization.

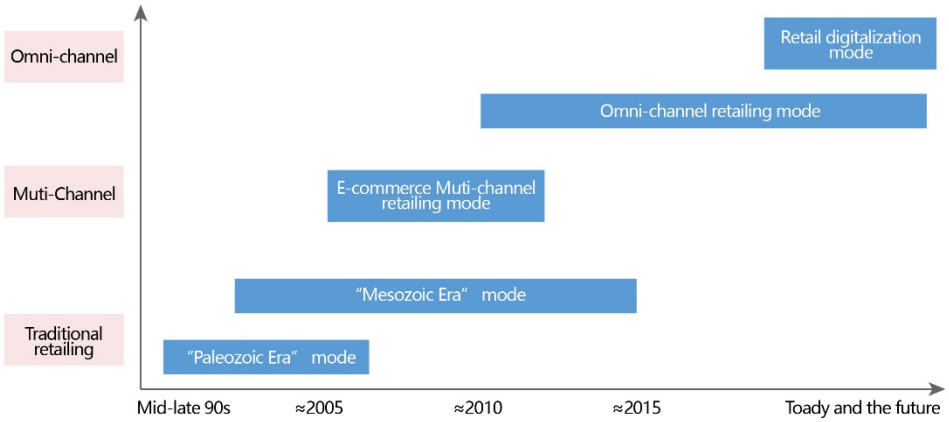

Figure 11: Evolution of IT architecture of Chinese retail enterprises

2.3.2 Competition and integration of Online and Offline that HOPSCAs have experienced

As of 2019, there are over 6,000 shopping centers all around China, roughly another 500 new ones being opened. The increasing number of shopping centers and new products makes the competition progressively intense with each passing day.

On the other hand, shopping centers are lack of differentiated competitive advantage, which is a commonly seen industrial phenomenon. When consumers walk into different shopping centers, 90% brands and shops they encounter are similar. Shopping centers need to offer unique products to attract consumers. In today's Chinese market, offline shopping centers are losing their appeal to users as compared with online competitors. Shopping centers lack convenience, accessibility, and availability of overseas goods that online users can easily purchase (Hortaçsu & Syverson, 2015).

At the same time, online technology is also promoting changes in offline

operation. Today's internet information technology enables us to create rich and personalized experiences, and track users' interactions for the purpose of real-time analysis. Supplemented by the data collected from the various smart devices and sensors installed in HOPSCAs, business operators have a chance to make our design more adaptable to provide a more transparent and enjoyable experience. In computer science, "self-adaptive system" refers to an interactive system that can autonomously modify its behavior in response to the user information and usage scenarios, without disturbing users. The principle underlined is to employ sensors on smart devices to gather data to understand the users' usage scenarios, which encourages designers to add "self-adaptive design" into their mental model.

A great example is Google Now[6]—it can predict questions the user might have by analyzing the usage scenarios and user's mobile phone data. Through a series of smart cards appearing on the user's device, Google Now can show the user the weather and traffic conditions in the current location beforehand, or, when the next train arrives while the user is standing on the platform; it can update the real-time scores of the match of the user's favorite sports team. Google Now will record and analyze the user's habits and settings on mobile phone, for instance, collecting the user's browsing record when surfing the Internet, to

[6] Google Now is an intelligent personal assistant feature available for the Google Android and Apple iOS platforms.

update sports team the user might have interest in. The user's current location and earlier locations help form the user's trajectory, predict where the user is going next, and tell the user in advance the next possible location's traffic situations. Such a series of applications bring an enhanced experience without disturbing customers.

2.4 Application scenarios of digital technologies

2.4.1 Digitalization of operations

IT Corporation Y and Property Corporation B have worked closely to digitize the business operations in two aspects. On the one hand, Property Corporation B employs PMS and AMP systems covering all businesses (i.e., PMS and AMP); On the other hand, it stretches to the field of merchants based on these systems, incorporating a part of their business into a unified digital system. In essence, this is a two-way interaction mechanism. On the one hand, Property Corporation B obtains the data from merchants; on the other hand, Property Corporation B simplifies the interaction with merchants by overlapping section of their business and help them improve capability of providing data-driven service.

As the operator, Property developer B can make full use of such digitalized products to occupy an advantage. HOPSCA's operators have higher-end commercial resources and obvious advantages in introducing brands. At the same time, the management and control platform of commercial operation has

been optimized internally to provide operators with a more accurate operation data base, thereby making it easier for commercial operators to accumulate experience of commercial operation management.

There is another consideration for designing such digitalized products. HOPSCAs and merchants are integrated regarding digitalization, which makes it more effective to solve problems encountered by small and medium-sized merchants as they are approaching operation and management in digitalization transformation. In addition, it frees HOPSCA from the chaos brought by the multi-service system. Moreover, through such technical systems as “facial recognition payment”, “automatic collect membership points”, “dynamic ticketless parking” and “facial recognition”, and via integrating of various contact products and datasets of Internet of Things, HOPSCA establishes its own data asset system to solve the difficulties about customer-flow, sales, membership, and marketing analysis.

The development of digital scenarios and digital marketing tools is not only meet the HOPSCA’s demand, but also the necessary means for merchants against the new commercial background. However, establishing such technical systems is too costly for small and medium-sized merchants. Therefore, it requires the combined efforts of HOPSCA and merchants to build an integrated platform of digitalization to satisfy the needs of both parties at a much lower cost of merchants’ digitalization transformation.

Based on data received from Tencent's Location Big Data-based LBS, IT Corporation Y and Property Corporation B can provide an insight analysis on specific shopping circle in a flexible and efficient way and conduct business decision analysis for specific areas of concern to business operators. The integration of LBS and PMS\AMP will be applied in the following aspects: Assessment for land acquisition, decision-making on location and position, leasing promotion guidance, analysis of competitors and competing products, and guidance on marketing (see Figure 12).

Figure 12: An architecture combining internal information systems and external dataset

2.4.2 Applications based on WeChat

Many of the digital tools studied in this paper are based on the in-depth cooperation projects established among IT Corporation Y, Property Corporation B and Tencent Holdings Ltd., among which the most important element is to make use of WeChat and WeChat related applications and resources (mini apps and entrances) owned by Tencent Holdings Ltd.

On WeChat, this application provides various application ends for consumers and merchants, respectively. Compared with the mobile system of APP, mini apps do not need to integrate too many functions in one application, which also makes it easy to use. These two constitute the two most significant function combinations in the cooperation project with Tencent.

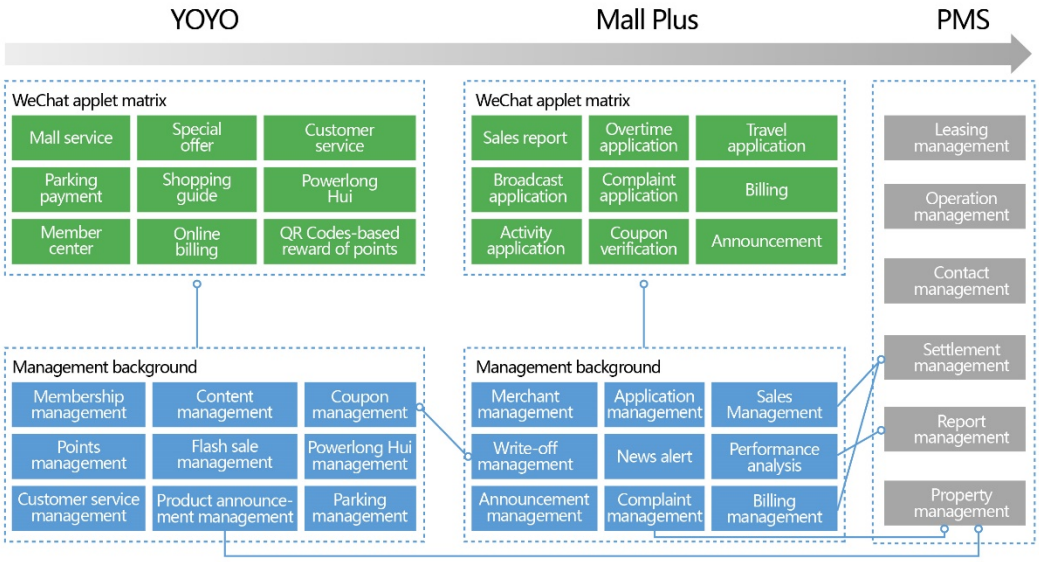

Figure 13: WeChat-based digital tools ecosystem

2.4.3 Unconscious technology products

Concentrating on their technical accumulation in the fields of WeChat, payment and facial recognition, IT Corporation Y and Property Corporation B have designed and provided a series of technical products with “unconscious” as the core concept through their cooperation with Tencent.

The so-called “unconscious” means throughout the process of providing services to users, accessing to information, triggering interaction and identification, and analysis, every effort should be made to reduce users’

interference and the number of times they operate mobile devices. At its best, users do not even need to participate in data delivery or use their phones at all to complete the service. This series of application products currently include unconscious parking, face-scanning payment, face recognition customer-flow, unconscious member points, etc.

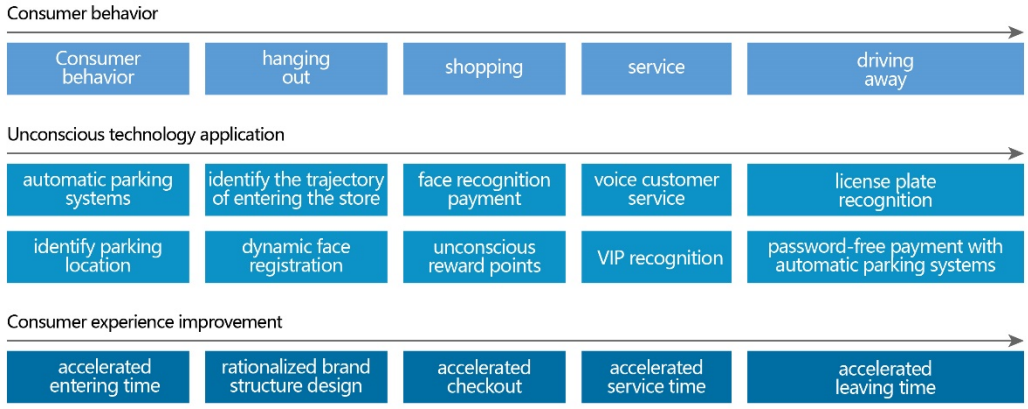

Figure 14: The usage scenarios of unconscious technologies

Technologies like face recognition-based Customer-flow Statistics technologies, intelligent unconscious parking system are easier to deploy and enabled compared with the traditional ones. For example, a business group can establish a complete set of intelligent parking management background while managing the parking lot of its many HOPSCA; and the parking lots are in accordance with the smart license plate recognition+ unconscious pay technology system structure (see Figure 14).

Specific to face recognition-based Precise Customer-flow Statistics System, the usage of the four technologies including face image acquisition and detection, face image preprocessing, face image feature extraction and face recognition

and matching for the goal of extracting the customer-flow properties not only enriches the diversity of traditional customer-flow data, but also enhances the value of customer-flow statistical data analysis. Its main function is embodied in customer-flow analysis, customer analysis of age and gender, repeat analysis, automatic identification of VIP customers, intelligent alarm reminder, etc. After cross-analysis with commercial PMS operation management platform, through real-time and accurate statistics of inbound and outbound customer-flow, the obtained customer-flow data provide decision-making basis for market analysis and business planning of enterprises. The unconscious collecting membership rewards points is another case of digital application of HOPSCA based on face recognition technology. At present, the mainstream points strategy of HOPSCA in the market is to install the cashier data collection box equipment between the cash register and the printer. When the QR code is successfully printed on the purchase receipt, the user needs to open WeChat to scan the QR code for points, which degrades user experience because it fails to make unconscious customer service.

When the face recognition technology is added and applied, the recognition program in the face recognition PAD can be started at the same time as the shopping receipt is detected, and the facial features of the set area can be captured and uploaded to the cloud for comparison；When the cloud interacts with the Yoyo membership platform system and successfully identifies the

member, the member ID is transmitted back to the face recognition PAD. The machine binds the purchase receipt information with the member ID and communicates with Yoyo to complete the action of collecting membership points. The whole process is completed silently by the combination of face technology and digital platform, without the active participation of users.

2.4.4 Digital content

Good digital content creates an immersive experience, a kind of psychological state where people achieve the optimal experience when participating in an activity. Users who are engaged in an immersive experience enjoy the experience better. Once an immersive experience is achieved, there is a strong desire to maintain a relationship with the content system and a stronger loyalty to that system. Therefore, user's immersive experience can strengthen the connection between the brand and the individual and therefore contribute to the formation of brand loyalty.

Customer value plays a decisive role in consumers' repurchase intention. In addition to directly influencing customer loyalty, purchase situational factors also affect customer loyalty indirectly by acting on the composition of customer value (see Figure 15).

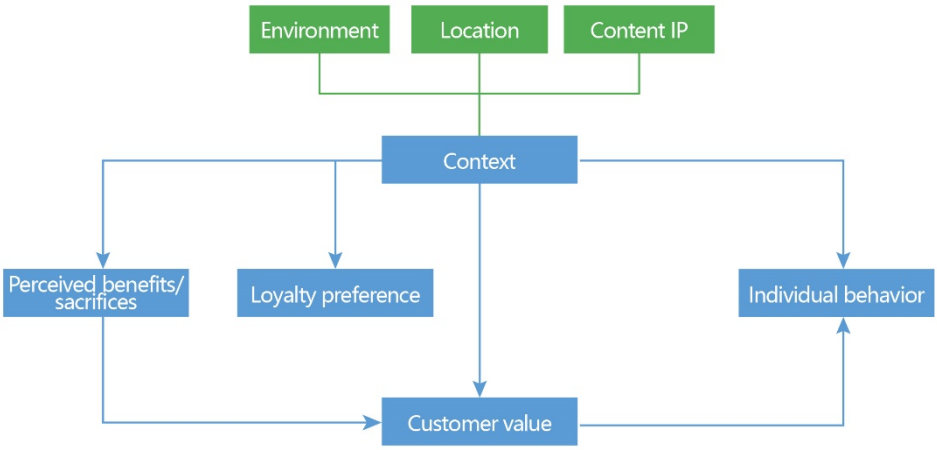

Figure 15: The impact of digital tools on customer value and loyalty

IT Corporation Y and Property Corporation B has introduced digital content in members, services, online and offline as new marketing and promotion means including pan-entertainment tools such as games and media, as well as well-known IP and related peripheral products. All of these are an organic part of the application of release technology.

For example, the large-screen immersive VR of “King of Glory” is an experience scene in which Tencent cooperates with IT Corporation Y and Property Corporation B to discuss how digital IP can be combined with HOPSCA and launched. It works by matching the face features captured by the camera with the avatars of 90 heroes in the game “King of Glory”. Then the hero avatar with the highest matching degree will be combined with the consumer’s face image and gets displayed on the screen. At the same time, there will be a QR code link of matching degree, and consumers can scan the QR code to save the matching result and share it to WeChat Moments. On the one

hand, this experience enhances the interesting experience of consumers, and on the other hand, relying on the IP traffic advantage of “King of Glory”, activities in the business can be quickly shared and spread.

CHAPTER 3. LITERATURE REVIEW

3.1 Theories related to digital strategy for two-sided markets

3.1.1 Features of digital strategies for two-sided markets

According to relevant research, the digital strategies for two-sided markets has the following characteristics (Rysman, 2009):

Rapid changes and transformation: Driven by the wave of investment and innovation, the digital ecosystem is highly dynamic, which is embodied in the following aspects: on the demand side, substitute products for consumers are changing rapidly, and the future market may vary significantly from the existing market. On the supply side, computers and digitization have become necessary tools for operators to reduce costs and expand market share.

Winner-take-all: Competition between business models or platforms is more important than competition within a business model or platform, as platform competition often leads to winner-take-all outcomes (Muzellec, Ronteau and Lambkin, 2015).

Network effects: Digital markets are characterized by strong network effects and economies of scale, which reinforces the trend of market dominance through competition (Kirpalani & Philippon, 2020).

Multilateral markets: Two or more user groups benefit from digital platforms.

High level of investment: Digital markets are characterized by high levels of

investment and innovation, which contributes to rapid technological progress in the field.

Importance of quality and innovation: Competition revolves around evolving technologies that compete with innovative products (Gazé & Vaubourg, 2011).

The growth and importance of Big Data: The collection and analysis of large-scale data is an important feature of the digital marketplace, and data has the potential to become a strategic asset.

The role of mobile services: The benefits of the digital ecosystem to stakeholders and the economy are partly due to the substantial investment by mobile operators in networks and their quality.

3.1.2 Theoretical analysis of digital strategies for two-sided markets

Frishammar et al. (2018) published a research paper “Digital Strategies for Two-sided Markets: A Case Study of Shopping Malls” on February 9, 2018. The researchers propose that large shopping malls should fully embrace the Big Data strategy. At the same time, they point out in their paper that the research on the Big Data strategy of large shopping malls still needs to be practiced and tested in concrete operation.

In the study, they argue that shopping malls try to attract consumers and retailers by creating maximum value of real estate assets. However, digitization is changing this traditional business logics. Digital technologies are changing the ways companies define their sources and propositions of values. Some retailers

use data collected from shoppers' smart phones to provide real-time customized experiences for shoppers, such as route recommendations for store shopping. Digital technology allows retailers to improve their management operations and reduce costs. In this fast-changing context, digitization questions the traditional value proposition of malls, retailers, and customers. Physical resources such as mall facilities provide an indispensably unique value in the buying experience that cannot be completely replaced. Continued digitization also presents several opportunities for malls. The digital domain can provide shopping malls with a range of tools to better manage the interactions between retailers and shoppers by enhancing intercommunity interaction and analyzing Big Data. In addition, shopping malls can enhance the value of shoppers by leveraging the networked nature of digital technology. But most shopping malls have failed to devise a successful strategy in a digital environment.

Based largely on descriptive data generated through case studies, with the aim of theorizing rather than testing theories, this paper's researcher concludes that digitization is reshaping the entire retail ecosystem and that digitization is not only a major challenge but also a limitless opportunity for shopping malls. Although developing and implementing a digital strategy may require great efforts on the part of shopping malls. The lack of a clear digital strategy can lead to inadequate resource allocation and financial losses, while a right and specific strategy can help not only shopping malls, but also their partners to

navigate in an increasingly complex retail environment (Margetis, Ntoa and Stephanidis, 2019).

3.2 Development experience of HOPSCA (shopping malls) in developed countries

The construction and development of shopping malls abroad has a long history, and great progress has been made. Much can be seen specifically in the United States, Europe, Japan, Southeast Asia, and many other countries, which has been illustrated in many domestic studies. For example, Burnaz & Topcu (2011) focuses on how to plan, design and construct shopping malls. Eppli & Shilling (1995) discusses the characteristics of shopping malls in developed countries that influence functions and operation management. Jackson (1996) analyze the development process and conditions of shopping malls in the United States. Bloch, Ridgway and Dawson (1994) discusses the development model of shopping malls in the United States, the United Kingdom, Japan, and Southeast Asia. Nie & Jia (2006)introduces the main investment and financing modes of American shopping malls.

Based on this, some literature puts forward corresponding countermeasures and suggestions for the development of shopping malls in China. For example, Kwak et al. (2013) believe that shopping malls should be located in relatively developed regions of China, and their main customers should be the middle class of China. And community-based shopping malls may become the major

direction of future development.

In terms of theoretical research, although shopping malls have evolved rapidly in developed countries in the past half century, there has been few relevant theoretical research. Zheng & Liu (2003) have introduced relevant economic theories from two aspects of shopping mall planning and operation by briefly summarizing the research results of foreign scholars and analyzing their specific application. Eppli & Benjamin (1994) gives a systematic review of the development of shopping malls, pointing out that heterogeneous shopping malls are conducive to consumers' multipurpose shopping. Homogeneous shopping mall can reduce the search cost of consumers and eliminate the uncertainty about the difficulty of buying a satisfactory product. However, no matter it is a heterogeneous or a homogeneous shopping mall, the amount of revenue depends on the size of its customer-flow which is related to the lease portfolio of the primary tenants and the secondary tenants. With the further development of American shopping malls, the externality of retail demands and evaluation of shopping malls become two relatively new fields in the study of American shopping malls.

3.3 Factors influencing the competitiveness of HOPSCA

3.3.1 Location factors

Foreign scholars' research on locations of shopping malls mainly includes two parts: conditions of shopping circles and the visibility and accessibility of the

location.

Locations are inseparable with shopping circles. Central Place Theory (CPT) of Christaller (1966) emphasized two basic concepts: the threshold of minimum purchasing power and the travel range or distance for consumers to shop, forming the concept of shopping circles. It is not difficult to find the importance of shopping circles for shopping malls. The characteristics of population, number of families, family income and purchasing power level in the areas served by shopping malls affect their scale and composition to a large extent. Some studies point out that the condition of shopping circles is one of the important factors affecting market rents of shopping malls (Eaton & Lipsey, 1982).

For example, Sirmans & Guidry (1993) point out that the rent will be higher if the shopping mall is located in areas with following factors: ① densely populated; ②with great potential of growth; ③with high income. Ownbey, Davis and Sundel (1994) take shopping malls in the neighborhood as the research object, using the radius of one mile to represent its main shopping circles. The study finds that the total number and income of households around the shopping circle has a positive impact on rents, but rivals within the circle will diminish the rental income available to the shopping mall.

Numerous studies have pointed out that shopping mall developers should be aware of the important impact of location on retailers' operation performance

(Forgey & Goebel, 1996; Hardin III & Wolverton, 2000; Mejia & Benjamin, 2002). This is because its location determines whether a shopping mall can attract retail tenants to a certain area, as well as whether the tenants can eventually succeed in operating in the area, which all affect the area occupation of a shopping mall and the possible total rental income (Kimball, 1991). Many studies have identified locations as an important determinant of retail rents, with an important consideration of the accessibility and visibility of its transportation. As Sirmans & Guidry (1993) pointed out, a major determinant of a successful shopping mall is its location being highly visible and easily accessible to shoppers. To be specific, the positioning of most successful shopping malls is close to arterial roads, not only to make it easier for consumers to find, but also for them to easily get in and out. Considering the convenience of private cars, a large parking lot is an essential facility which directly affects the effectiveness of shopping malls. Nearby public transport systems such as bus stops, and subway stations should also be considered to attract the maximum number of people. However, Ownbey et al. (1994) propose specific measurement terms for the location accessibility and visibility of shopping malls, such as the number of parking spaces per unit area and the daily traffic flow of adjacent arterial roads. Visibility is the percentage visibility of tenant signs from the main road and the supermarket parking lot, respectively.

3.3.2 Architectural factors

The architectural features of the building center include the size of the shopping mall, the age of the building and the design of the building.

The size of a shopping mall is one of the important factors affecting its competitiveness and may be positively correlated with it (Gatzlaff, Sirmans and Diskin, 1994). Larger shopping malls may have higher consumer appeal due to their diversity and thus attract a broader consumer base. In addition, tenants achieving spatial aggregation in larger shopping malls should be able to achieve comparison shopping more effectively, thus attracting more consumers.

The building age of shopping malls is also one of the factors that affect their competitiveness (Sirmans & Guidry, 1993). The style of shopping malls changes over time, and newer and more modern facilities in malls are expected to capture higher rents from tenants. Older shopping malls are often vulnerable to be ignored by consumers due to their inadequate functions or outdated buildings. When consumer demands change, their tenant space is often unable to adjust correspondingly effectively.

Building design is another important factor in determining rent levels. Common building structures of shopping malls include L-shaped, U-shaped, and linear or strip shopping malls (Anselmsson, 2006; Dennis et al., 2002).

3.3.3 Shop factors

The competitiveness of a shopping mall also depends on the specific condition

of the shops, including the types of shops, retail types, shop area, shop locations and chain types (Gerbich, 1998).

(1) Types of shops

After distinguishing the types of shops in malls, we can effectively identify the determinants of rents of different types and make comparisons between them. The types of shops in malls can be divided into anchor shops and non-anchor shops (Eppli & Shilling, 1993). Anchor shops can make attractive, while non-anchor ones benefit from being close to them. Brueckner (1993) and Eppli & Shilling (1995) further point out that anchor shops can bring customer-flow to other shops in the mall thanks to its external economy.

(2) Types of retail

Different types of retail also differ in the impact on rental of shopping malls (Rosiers, Theriault and Menetrier, 2005; Yuo et al., 2004). Typically, shopping malls have a variety of tenants including department stores, hypermarkets, clothing, shoe, jewelry stores, and some stalls. Different types of retail shops may pay different levels of rents due to the difference in rent affordability of different demand for retail space.

(3) Shop locations

Charles & Kerry (2005) points out that the space of a shopping mall is heterogeneous and can be measured through ①the distance to the Moore shopping mall; ②the distance to the nearest vacant shop; ③the distance to the

nearest similar shop; and ④the distance to the nearest entrance and exit. Most buildings of Chinese shopping malls are multi-storeyed buildings, and the customer-flow on different floors varies significantly. Therefore, it is usually uneasy to guide shoppers to upper floors, so tenants are reluctant to rent upper ones.

(4) Chain types

ULI (1987) provides a detailed overview of store chain types and finds that there are three distinct categories of chain types. One is national chains, such as supermarkets or drugstores which serve as anchor stores in many neighborhood or community shopping malls. They both provide stability for malls and attract a lot of customers. Another type of tenant is local chain stores, such as women's clothing stores, and they tend to have more stable sales. The third category of tenants are independent stores, which generally have fewer stable sales (Benjamin, Boyle and Sirmans, 1990, 1992). Since then, many studies have taken chain types of stores as one of the important variables affecting tenants' rents.

3.3.4 Lease factors

A lease is a contract between property owners and tenants. A lease often contains an option for the owner to cancel it. In Benjamin et al. (1992)' s study on price discrimination of shopping mall leases, the independent variables also include terms of owners' cancellation of leases, rent adjustment, lease renewal

terms and so on. In their empirical study on the rents of Hong Kong shopping malls, Tay, Lau and Leung (1999) adopt five variables, namely lease renewal, property fees, lease terms, rent-free periods, and rent terms based on turnover, to obtain the impact of different lease terms on rent levels (see the Table 4).

Table 4: Main control variables obtained from the literature review

Category		Explanatory variable	Suggestions or possible problems
Location	1	The purchasing power of shopping circles	hard to be quantified
	2	The Number of population/households in shopping circles	hard to be quantified
	3	The visibility of the mall sign from the main road	
	4	The visibility of a mall sign from a parking deck	
	5	The daily traffic flow of adjacent arterial roads	
	6	The number of bus routes	
	7	The number of parking spaces	5 ~ 9 all reflect the surrounding traffic conditions with strong correlation
	8	The distance from subway station	
	9	The number of adjacent main streets	
Building	1	The size of shopping mall	
	2	The Rentable total area	strong correlated with the size of the shopping mall
	3	The age of the building	
	4	The design of the building	domestic classification standard
Shop	1	The Shop area	
	2	The types of shops	segmentation of anchor, sub-anchor, and non-anchor shops
	3	The types of retails	need to be subdivided
	4	The types of chains	hard to be quantified
	5	The visibility of the shop	can be specified
	6	The accessibility to the shop	can be specified
	7	The number of similar shops	
Lease	1	The contract year	

2	The lease Time	
3	The lease type	
4	The rent-free period	
5	The renewal of the lease	
6	The sub-let clause	
7	The cancellation clause	

3.4 Studies on consumers' pleasure in shopping malls

As an important retail channel, shopping malls has always been regarded as a place where consumers meet their needs for products (Podsakoff, 2003). With the development of society and driven by a series of psychological needs or hedonistic values, consumers require a kind of obtaining that goes beyond values of products and service (Davis & Hodges, 2012).

In addition, competition is fiercely intensifying as the number of shopping malls keeps increasing (Tsai, 2010). The strong growth of online shopping also leads to the above situation (Ahn, Ryu and Han, 2004). Therefore, the analysis of consumers' psychology is helpful for shopping malls to better serve consumers and survive in long-term competition. The above literature illustrates that shopping mall operators need to provide additional emotional and entertainment value to consumers. It is suggested that the operators actively seek changes to make the malls different from the traditional ones, such as bringing fresh shopping experience through optimized interior decoration (Alavi et al., 2016; Bloch et al., 1994; Das & Varshneya, 2017).

3.4.1 Leisure satisfaction with shopping malls

In the past, consumers went straight to malls with a shopping list. But now, consumers are also looking for leisure and fun (Arnold & Reynolds, 2009). According to Shafiee & Es-Haghi (2017), consumers' shopping happiness is more about pleasure and fun than merely completing tasks.

Shopping malls have evolved from a destination for buying products to a place where consumers spend their leisure time. More and more consumers begin to go to malls to merely relax themselves without any intention of shopping. According to Arnold & Reynolds (2009), consumers pursue not only utilitarian benefits, but the emotional benefits of enjoyment and entertainment while shopping. Shopping malls are considered as places where people enjoy their time and satisfy their recreational and social needs rather than simply meet their functional needs (Dennis et al., 2010; Nsairi, 2012).

The above literature indicates a rise in entertainment and social expectations of consumers. But no previous research has probed into what types of innovations will satisfy consumers' growing entertainment and social needs (Herrmann et al., 2013).

3.4.2 Indoor environment of shopping malls has a great impact on improving customers' shopping experience

Calvo-Porral & Lévy-Mangin (2017) research shows that a pleasant and attractive environment inside a shopping mall is the main determinant of

attracting customers. Shopping malls should make customers feel satisfied to win returning customers (Anselmsson, 2016).

3.4.3 Stress relievers in an oppressive shopping environment

Stressful situations while shopping in crowded retail environments are important because stress can lower customers' satisfaction, willingness to pay and repatronage intentions, and increases shoppers' impulsive buying behavior and store abandonment(Albrecht, Hattula and Lehmann, 2017; Lucia-Palacios, Pérez-López and Polo-Redondo, 2018; Maier & Wilken, 2014). Current research indicate that stress can be reduced by managing physical cues of the store servicescape such as music, light, and temperature (Baker & Wakefield, 2012; Mehta, 2013). Similarly, in a service environment, interactions between people, such as companionship from sales partners and shopping partners can help customers relieve the stress of shopping in crowded malls (Hanks, Line and Kim, 2017; Lucia-Palacios et al., 2018; Tombs & McColl-Kennedy, 2003). Congruency works as a mediator between a retail setting, sensory cues, products, service, and store image. Consumers prefer, compare, and categorize sensory cues in relation to the specific product in the mall, the service offered by the mall and the store image. From the perspective of content marketing, IKEA's marketing content available on the social media is excellent (Helmefalk, 2016).

3.4.4 How does shopping companionship enhance the shopping experience

As shopping begins to be regarded as a social experience, shopping companionship may enhance the experience. Studies have shown that when consumers shop in groups, they browse more areas and purchase more, both in volume and on-sale products than when they shop alone (Chebat, Haj-Salem and Oliveira, 2014; Sommer, Wynes and Brinkley, 1992; Woodside & Sims, 1976). The current report is limited to traditional effects, because the improved response to shopping with family members is only evident when consumers have a low level of identification with the shopping environment (Borges, Chebat and Babin, 2010). Interestingly, Luo (2005) finds that the shopping experience with companionship encourages impulse buying.

3.4.5 Customer loyalty to shopping malls

Based on the research of Wright & Sparks (1999), customer loyalty is especially important to maintain the market share of shopping malls. Earlier research has shown that loyal customers are more valuable to shopping malls, as they shop frequently and buy more, which directly brings higher rental income (Adkins Lehew, Burgess and Wesley, 2002; Ahmad, 2012; Pan & Zinkhan, 2006; Rabbanee et al., 2012). For shopping malls, providing some differentiated services and membership offerings might help improve customer loyalty and maintain the brand of shopping malls (Loureiro & Roschk, 2014).

3.4.6 Technology and shopping malls

There is less literature on the impact of technology on retail and shopping malls. Freeman et al. (2011) discusses the innovation and productivity of Wal-Mart. One quarter of the productivity growth in the United States is attributed to the retail industry, while one sixth of the growth in the retail industry is attributed to Wal-Mart. As a technology and business leader of retail enterprises, Wal-Mart has world-class information technology. It boasts its own database which provides information to managers and partners in the supply chain, and coordinates production and consumption. The application of bar code technology and RFID technology, electronic recruitment of high-tech workers, etc., has greatly improved the operation efficiency of Wal-Mart.

In terms of specific technology application, Porter & Millar (1985) believe that information technology improves labor efficiency and competitiveness of retail enterprises. Holmes (2001) points out that the wide application of information technology in retail enterprises is beneficial to reducing inventory, invigorating logistics and expanding enterprise scale. Bitko (2006) discusses the application of RFID technology in the retail industry and how it improves the technical efficiency of retail enterprises. Doms, Jarmin and Klimek (2004) finds that large retail enterprises pay more attention to the investment of information technology, and the productivity improvement brought by information technology to large enterprises is much higher than that to small enterprises.

Park & King (2007) emphasizes the role of the efficiency of information technology in food retailing, the research is based on the panel data from 563 supermarkets randomly selected from 32,000 supermarkets across the United States each year provided by the food industry center at the university of Minnesota, and the method of DEA and distance functions. They concluded that data sharing technology, decision support technology and the products classification, pricing and purchasing technology is particularly important to improve efficiency. Basker (2012) discuss the effect of bar code scanners on the improvement of technology and productivity in the retail sector, their research traces back the emergence, development, and popularization of bar code scanners, and uses a simple input-output model to analyze the impact application of bar code scanners on the efficiency of retail enterprises.

Some retail shopping malls have experimented with methods to try to help improve their retail efficiency (Frishammar et al., 2018; Köksal & Penez, 2015). Most malls, however, were just installing some technologies in their background systems, rather than interacting with customers. Some malls, for example, installed sensors to track customers' purchases to improve inventory. There are some papers that discuss new methods to evaluate digital technology products and services, such as ICT and sensors (Iansiti & Lakhani, 2014; McIntyre & Srinivasan, 2017; Zott, Amit and Massa, 2011). In practice, shopping malls relied on technology to improve their understanding of their

customers.

3.5 Literature review summary

On February 9th, 2018, Frishammar et al. (2018)published a research paper titled “Digital Strategies for Two-sided Markets: A Case Study of Shopping Malls” which is most relevant to this paper. The study proposes that shopping malls should fully embrace Big Data strategies. At the same time, they pointed out that research on the Big Data strategies of large shopping malls still needed to be practiced and tested in operation.

The study argues that while shopping malls try to attract consumers and retailers by creating the greatest value of mall assets, digitization is changing this traditional business logic. The adoption of digital technologies is changing the ways companies define their sources and value propositions. Some retailers use data collected from shoppers’ smart phones to provide real-time customized experiences for shoppers, such as route recommendations for purchases in-stores. Digital technologies allow retailers to improve their management operations and reduce costs. In this fast-changing context, digitization questions the traditional value proposition of the malls, retailers, and customers. Physical resources such as mall facilities provide a unique value in the buying experience that cannot be completely replaced. Continued digitization also presents a few opportunities for malls. The digital domain can provide shopping malls with a range of tools to better manage the interactions between retailers and shoppers

by enhancing intercommunity interaction and Big Data analytics. In addition, shopping malls can enhance the value of shoppers by leveraging the networked nature of digital technology. But most shopping malls have failed to devise a successful strategy in a digital environment.

Based largely on descriptive data generated through case studies, with the aim of theorizing rather than testing theories, this paper's researcher concludes that digitization is reshaping the entire retail ecosystem and that digitization is not only both a major challenge but also a limitless opportunity for shopping malls. Although developing and implementing a digital strategy may require great efforts on the part of shopping malls. The lack of a clear digital strategy can lead to inadequate resource allocation and financial losses, while a right strategy can help not only shopping malls, but also their partners to navigate in an increasingly complex retail environment.

In terms of research results, this paper's central argument is that digitization is reshaping the whole digital retail ecosystem, but still more or less unique for shopping malls (see Table 5). It signifies not only a major challenge but also a limitless opportunity and needs to be correctly navigated under specific strategies. The paper also proves that digitization is a significant direction which is less explored since much research has stopped to further probe into the field. This study proceeds with the topic and will covers a larger range (this study targets on HOPSCAs, which have wider range than shopping malls) in

accordance with actual situations.

Table 5: Summary of core studies in the field

Authors	Topic	Conclusion
Shafiee & Es-Haghi (2017)	Mall image, shopping well-being and mall loyalty	Shopping well-being is affected by mall image and hedonic value but not by utilitarian value. Shopping well-being is more about pleasure and fun than doing task-oriented activities.
Calvo-Porral & Lévy-Mangín (2018)	Pull factors of the shopping malls	Tenant variety and the internal environment of the mall. Understood as an adequate tenant mix and a pleasant, attractive environment, are the main determinants of attracting customers. However, the convenience of the shopping mall and the communication activities do not show a significant influence as full factors.
Das & Varshneya (2017)	Consumer emotions: Determinants and outcomes in a shopping mall	Perceived human crowding has a positive impact on arousal. Co-visitor has a positive impact on both arousal and pleasure. Promotional events have a positive impact on both arousal and pleasure.
Kushwaha, Ubeja and Chatterjee (2017)	Factors influencing selection of shopping malls	Key factors attracting customers to shopping malls: Service experience, internal environment, convenience, utilitarian, acoustic, proximity and demonstration.
Frishammar et al. (2018)	Digital strategies for two-sided markets: A case study of shopping malls	Shopping malls serve as two-sided markets, with primary function to be connecting retailers and shoppers. Omnichannel strategy typology for shopping malls: digital awaiter, digital data gatherer, and digital embracer. Shopping mall digital strategies shall involve digital technologies, physical resources, and ecosystem agents (retailers and shoppers) as a whole.
Niemelä, Heikkilä and Lammi (2017)	A social service robot in a shopping mall: Expectations of the management, retailers, and consumers	A social service robot can have a positive role in a shopping mall by attracting new consumers with product novelty and improving shopping experience. The utility function of the robot is important, engaging social interaction makes the added value when novelty effect wears off. Stakeholders and retailers expect robots to increase customers' amount and satisfaction, not to serve as cheap labor or to improve shopping efficiency.

This study focuses on the competitiveness of HOPSCA, including but not limited to investment, environment, technology, and user research, and covers findings of national and international mainstream research. Although this paper studies digital strategies, it is also reliant on the stage of development of the entire business environment.

The past few years saw various studies on the development of HOPSCA. Based on previous literature, this study develops and explicates a research framework: The business environment of a HOPSCA is a two-sided market, providing services to both consumers and merchants.

Any strategy of a HOPSCA (including a digital strategy) is intricately connected to investment and societal trends (especially the general environment of users and technologies).

The evaluation of HOPSCA's digitalized outcomes needs to be considered in terms of its impact on operational efficiency, and on consumers and merchants. The digitization of HOPSCA manifests its benefits through direct and indirect factors (as described above).

The rate-of-return of digital technologies in a HOPSCA c can be estimated by analyzing the benefits and costs involved.

Digital strategies can improve the competitiveness of HOPSCA, results varying along with different digital tool portfolios. We can select the optimal digital strategy in various business scenarios.

CHAPTER 4. RESEARCH METHODOLOGY

4.1 Conceptual model

The conceptual model in this paper focuses on the effects of digital tools when they are deployed in HOPSCA. In this conceptual model, there are two types of effects of digital tools: the direct impact of digital tools on the competitiveness of a HOPSCA (indirect parameters), which is referred to as the "direct effect" in this paper; and the impact of digital tools on the competitiveness of a HOPSCA (indirect parameters) by affecting direct parameters, which is referred to as "indirect effect". To facilitate the illustration, we will label the digital tools as X, the direct parameters of HOPSCA competitiveness as Y and the indirect parameters of HOPSCA competitiveness as Z.

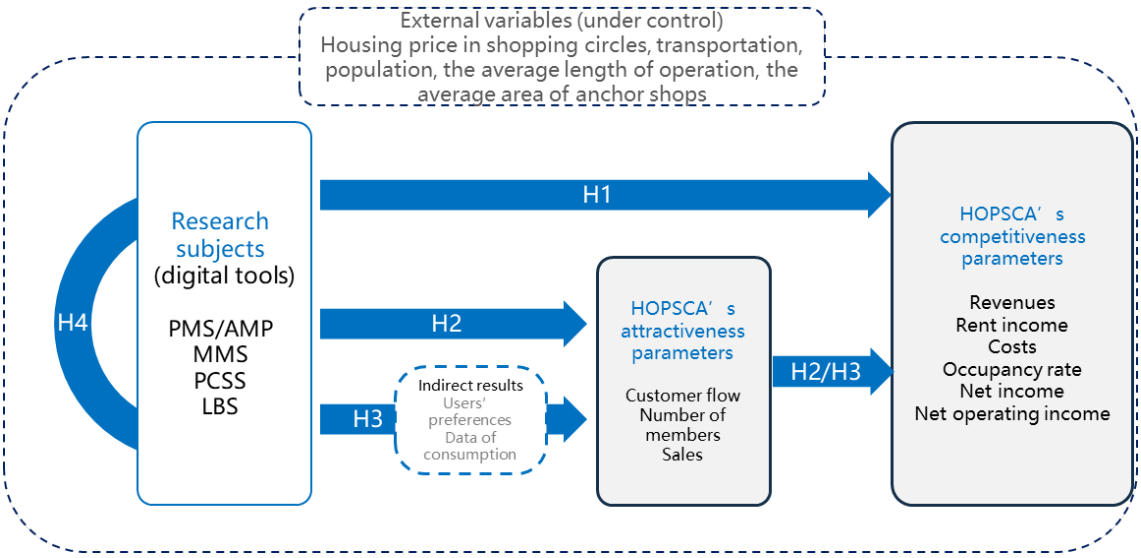

Figure 16: Conceptual model of relationships among digital tools, consumer behavior and operating performance

Figure 16 shows the conceptual model of this paper. Influence process H1 (the influence of X on Z) represents the direct effect, i.e. a digital tool can influence the competitiveness of a HOPSCA by changing the strategies and practice of its operations management (e.g., improving operation management efficiency through digital transformation, optimizing tenant mix or the design of traffic flow patterns). Along this path, there are no intervening factors between X and Z. The impact processes H2 (impact of X on Y) and H3 (impact of Y on Z) represent indirect effects, i.e. digital tools first improve the traffic, membership, depth of visit or consumer behavior and preferences, and by enhancing these direct parameters, they then have an impact on the performance of the HOPSCA. Along this path, Y plays the role of a mediating variable. The middle part of the conceptual model is the set of attributes that characterize the HOPSCA, and these external variables act as moderators in the model. This means that in the way in which the digital tools will affect the competitiveness of different HOPSCA is heterogeneous, depending on their resources, capacity for absorption, competitiveness, and locational characteristics.

In the later sections, we will argue in detail the various types of relationships and structures demonstrated by the conceptual model and lead to the four research hypotheses of this paper. In the later empirical analysis, Model 1 corresponds to the impact process H1 in the framework diagram, i.e., the direct effect of the digital system (PMS/AMP) on the competitiveness (rental income,

occupancy rate, return on assets) of the HOPSCA. Models 2 and 3 correspond to the impact process H2 in the Figure 16, and Model 4 corresponds to the impact process H3, where the digital tools (Precise Customer-flow Statistics System and Membership Management system) have an indirect effect on the competitiveness of HOPSCA (total sales revenue) through the improvement of key intermediate variables (customer-flow, number of members, customer retention) and changes in the preferences of people nearby the mall. The dashed line indicates that external variables also have an impact on how digital tools improve the competitiveness of HOPSCA, a process that is often difficult to quantify precisely due to the large number of variables and the complexity of the impact mechanisms. However, we have taken these factors into account in our models by having some external variables as covariates in each regression model. We have covered a large amount of information about the mall that LBS can provide in Model 5 to examine the combined effects of the digital tool portfolio and these external variables on the competitiveness of the mall.

4.2 Research hypotheses

4.2.1 The relationship between digital tools and direct parameters of the competitiveness of HOPSCA

Many practices in real estate industry have proven that transforming business processes through digitalized property management systems can reduce waste and loss from information transmission, coordinate and maximize utilization of

resources such as people, equipment, materials, and energy, improve overall productivity and reduce manufacturing costs. Particularly in the manufacturing industry, the use of Big Data analysis of production can provide guidance for decision-making, enabling efficient collaboration, lean management, and continuous improvement in all aspects of production for digitalized collaboration and intelligent production. Similarly, in the commercial real estate industry, the use of Internet-based information property management systems can also help commercial real estate enterprises to improve efficiency and integrate resources.

The traditional commercial real estate industry has a narrow application of information technology, for example, ERP software for the real estate industry is only applied to financial or sales departments, while the core business of commercial real estate is still operating according to traditional management methods. For the increasingly bigger and more complex organizational structure of commercial real estate enterprises, it becomes extremely difficult for sub-companies at different levels and multiple departments to collaborate in the daily project operation. It is difficult for the Group to keep track of its asset status in real time, making contract management and cost control even more difficult. Due to inconsistencies in the caliber of businesses between finance and operations, no one can tell how big the gap is between a project and its budget, and where the gap is, resulting in longer and longer approval cycles.

The PMS/AMP system combines the best practices of top-tier enterprises and highlights “Degree of accuracy” and “Effective prediction”, two of the four elements of “Accuracy-Prediction-Quality-Linkage”, i.e., the internal optimization of the commercial operation control platform gives operators a more accurate operational data base, thus making it easier for commercial operators to accumulate operation management experience.

The development of Big Data technology provides an opportunity for offline retail to integrate online and offline practices. By analyzing the consumption habits of customers offline using “Big Data” as a medium, commercial operational service provider can offer personalized integrated pushes and bring consumers better shopping experience. Precise Customer-flow Statistics System helps improve more than sales in operation. The application scenarios include positioning, marketing, sales, and operations, which are highly versatile. Amongst other things, the operator of HOPSCA can use it to plan, organize, implement, and control the entire business process. Digital guidance on operations enables insight into consumers, media value research, market competition analysis and brand management, and through the integration of online and offline resources, customer information can be managed more comprehensively. Offline customer-flow data contributes to precise targeting of customer groups. With the user-centered approach, we can design and decompose operation processes to achieve potential customer screening and

marketing and make comprehensive assessment of the overall operation within the HOPSCA, and upgrade shop layout and other operation strategy to achieve refined and intelligent operation.

Precise Customer-flow Statistics System includes four core technologies to extract the attributes of customer-flow, namely, facial image collection and detection, facial image preprocessing, facial feature extraction, and facial recognition and match. It helps not only to enrich the traditional customer-flow Statistics, but also to enhance the value of customer-flow data analysis. Its main functions are the analysis of customer-flow/gender/age/regular customer/automatic identification of VIPs/intelligent alarm reminders, etc. After cross-analysis with the PMS/AMP of commercial operational service provider, through real-time and accurate statistics on the incoming and outgoing customer-flow, the result of customer-flow provides a guidance for decision-making on market analysis and business planning.

In summary, we propose hypothesis I:

H1: After controlling for external environmental factors, the continued deployment of digital tools can enhance the direct parameters of a HOPSCA's competitiveness, including customer-flow, numbers of members and consumer behavior and preferences in nearby areas.

H1a = "PMS/AMP can improve the efficiency of merchant-inviting and managing, thus boosting HOPSCA's occupancy rate";

H1b = "PMS/AMP can reduce the needs for IT workers through digital management, thus lower labor costs";

H1c = "PMS/AMP can bring higher rent income and lower costs, thus increased net income";

4.2.2 Influence of the direct parameters of the competitiveness of HOPSCA on the indirect parameters

The impact of direct parameters on indirect parameters of competitiveness of HOPSCA has been proven by the industry's practices. Here, we take the Precise Customer-flow Statistics System and the Membership management system as examples to demonstrate from a business perspective how increased accuracy of customer-flow data results in increased depth and breadth of customer-flow in HOPSCA, which in turn leads to increased indirect parameters of HOPSCA's competitiveness, thus completing the chain of argument in the conceptual model.

Precise Customer-flow Statistics System can improve the accuracy of the customer-flow data, thus increasing the number of visitor volume and the depth of visit to the HOPSCA.

Besides providing on-demand data about customer-flow and cross analysis by comparing historical traffic data with current ones, Precise Customer-flow Statistics System can also be applied with other systems in place to provide a comprehensive and multi-faceted analysis of HOPSCA, producing more

detailed performance reports and providing managers with valuable information to analyze the current situation, adjust business tactics and determine future direction.

The main sources of revenue for the operator of HOPSCA are rents, parking fees and service charges such as advertising. To increase operating income, it is necessary to increase the occupancy rate and rents of shops and advertising spaces as much as possible. Leasing represents the market value of a shopping center. A high vacancy rate is often a problem for shopping center management, as vacant space is not only unproductive, but it also affects the productivity of other tenants. The limited number of shops has a direct impact on customer-flow and consequently on turnover, a situation that is very detrimental to both shops and shopping center operators. On the other hand, an unreasonable distribution of shops can also have a significant impact on the distribution of traffic and how it is driven. Therefore, shopping centers should not only improve the occupancy rate of shops, but also make reasonable arrangements for the tenant mix on different floors so that the flow of customers through shops is maximized and the shopping center tends to be evenly populated.

By deploying Precise Customer-flow Statistics System at the entrances and exits of the shopping center, on each floor, each pathway and even in front of each shop, the distribution of customer-flow at different times can be obtained, so that the best performing tenants among the same type and the poorly

performing shopping circles can be observed immediately. Therefore, adjustments to the tenant mix will no longer be blind, but can be made entirely through scientific analysis of customer-flow data. More importantly, the traffic data gives the shopping center's Merchandising Department reliable information in determining the rents of specific floors and areas and in making future rent adjustments. By observing traffic data at entrances and exits, it can help to determine the pricing of advertising spaces and properly identify important advertising placement.

Precise Customer-flow Statistics System can provide shopping centers with practical and effective data on the level of shop rents, optimize shopping center layout and tenant locations, and make efficient use of advertising spaces.

Shopping centers usually organize different types of themed events during holidays to increase visibility and attract people while branding and promoting themselves.

The major types of events are opening events (once only); regular and seasonal events; temporary or special events; and single shop promotions, etc. Through these events, customers are attracted to shopping centers to enjoy a full range of services and experiences, and their diverse needs are met, thus being prompted to purchase, turning potential demands into purchase behavior.

Themed events in shopping centers can significantly increase customer traffic and generate significant revenue. This is where the role of Precise Customer-

flow Statistics System becomes relevant. During the event, Precise Customer-flow Statistics System provides accurate customer-flow data (based on the number of people instead of visitors), which not only enables effective evaluation of the event, but also helps to analyze the return on investment in marketing activities and promotions in combination with other data reports. In addition, the flow data from the same period in history can be compared and analyzed to provide a basis for future event planning.

A macro view of customer traffic statistics can provide general guidance for the successful operation of specific facilities in the shopping center, assess and adjust the operation of the shopping center in general, and provide day-to-day guidance to its internal management.

In the day-to-day operation of a shopping center, an over-population in some areas will not only reduce the quality of service of public facilities and staff, but also undermine the experience and enjoyment of customers, while if the number of customers is too low, the willingness to buy will be affected, which is not conducive to the effective operation of the shopping center. Therefore, it is important to make detailed plan according to the timing in a day so that the number of customers entering the shopping circle each day is in line with the anticipated number and the flow of traffic can be evenly distributed, thus maintaining a high level of operational efficiency and customer satisfaction (Rychalski & Hudson, 2017). The relationship between the day-to-day

operation of a shopping center and the statistics of customer-flow is inextricably linked.

Firstly, the daily statistics of customer-flow enable the operations department to have a clear picture of the entire shopping center operation. Secondly, human resources can be more properly allocated according to changes in customer-flow, including staff of property management, maintenance, security, cleaning. Thirdly, based on the analysis of current customer-flow and changing trends, measures can be taken to prevent emergencies in areas with high customer-flow. A successful shopping center is never a retail enterprise, but a management enterprise, and service enterprise. In the actual operation of a shopping center, the value-added process is not a mere “chain”, but a “cycle”. A variety of systems collect a large amount of data, after screening, aggregation, and mining, to provide strong data support for operational management decision analysis to make the cycle of “analysis → decision → enhancement → re-analysis → re-decision → re-improvement” possible. Only by following this cycle to guide and support the optimization of management processes, we can improve management efficiency. In this way, the management and service level of the shopping center will be continuously improved. Each step is a process of adding value in the simplest way, step by step, cycle by cycle, starting with the first step of operation up to the end, where the shopping center achieves profitability. To date, most HOPSCAs develop their membership and marketing systems

based on theories, tools and strategies originated from the department store industry, which has resulted in a lack of effective connectivity (data and interaction) between merchants and consumers. The absence of a direct consumer relationship creates an unavoidable conflict in the application of these tools and strategies that promotions and campaigns are not enough to compete with online channels or increase consumer loyalty.

In the areas that the consumers really care about, HOPSCA also falls short of expectations, such as easy access to and friendliness of public facilities and resources, reduced digital service complexity, collaboration in Membership management system with individual merchants. Unless awarded with promotions or coupons, consumers have no reason to use the HOPSCA App or membership card, which we consider as a non-effective transaction. In the meantime, merchants usually do not expect too much from the HOPSCA. Such a phenomenon indicates that HOPSCA is in a low-efficiency operation regarding their clients from both sides, and it further explains why HOPSCA operators can hardly gain feedback from either consumers or merchants, let alone achieve effective interaction.

To re-establish the connection and interaction between consumers and merchants, a HOPSCA needs to have breakthroughs in identifying key consumers, building a better accounting system, and improving financial services. At the same time, a HOPSCA needs to avoid conflicts in data use with

its merchants and to prevent a privacy crisis. For HOPSCA operators, not all data is useful, and the data system that the retail industry needs is different from the data that a HOPSCA needs. Traditional high-tech tools merely provide data including phone numbers, identity, customers, and vehicle traffic to HOPSCA, whereas HOPSCA today needs more intricate data, such as merchants' sales capacity, contract status, competitor tracking, core clients, capture rate, shoppers' stay time and preferred areas, visit frequency. Such data is based on the uniqueness of individual consumers but at the same time does not constitute a detailed and expansive customer profile for business-to-customer precise marketing and tracking—such depth often compromises consumer experience. Take the membership points system as an example, low-efficiency and challenges in operation are common. The membership point system of each merchant in the shopping circle is separate and they hardly collaborate with each other, which not only undermines its usability, but also prevents merchants' collaboration in member acquisition, restraining the overall flow in the shopping circle. The online Membership management system for Property Corporation B, namely "Powerlong YoYo", allows for automatic membership points collection after WeChat payments. Automatic points collection through WeChat Pay will help achieve digitalization on the user side on the premises and digital upgrade on the trading side of the shops and will also establish a stronger connection between members and the shopping mall, enhancing

HOPSCA's customer stickiness. In addition, the digital solution of the Membership management system of the HOPSCA enables a direct connection between all players, including HOPSCA operators, shops and all the merchants, and this vertical and horizontal connection brings higher efficiency and more possibilities in the marketing of the mall. Outside the mall, membership-based systems that enable precision marketing can attract people to the shopping mall; inside the mall, through functions such as points for gifts or payment for coupons, cross-marketing can be achieved to expand the consumer scenarios, increasing customer engagement.

To sum up, we propose hypothesis II:

H2: After controlling for external environmental factors, the continued deployment of digital tools can enhance the indirect factors that contribute to a HOPSCA's competitiveness, including sales revenue, rental income, occupancy rate, operating and management costs, and return on assets.

H2a = "Membership Management System can boost the customer flow, the number of members and sales";

H2b = "Precise Customer-flow Statistics System can bring higher customer flow, customer retention, customer-flow density and the number of members";

4.2.3 The direct link between digital tools and the competitiveness of HOPSCA

The digital strategy transformation of HOPSCA is based on an in-depth analysis

of data. In addition to the mining and research of the HOPSCA's data, a wide range of industry data and an advanced algorithmic model are also required for insights into the needs of their customers. Based on Tencent Holdings Ltd.'s Location-Based Service, HOPSCA is provided with customer preferences and location information of customers who are outside the malls. After integration of Tencent LBS with other digital tools, the application can be used for the analysis of property, decisions on positioning, guidance for attracting investment, analysis of competitor products, and guidance on sales and marketing, thus being able to have a direct impact on the sales revenue, rental income, occupancy rate, operating and management costs and return on assets of a HOPSCA by changing its current strategy and practice plan.

Combined with information on consumer's preferred areas on the premises, it is possible to understand more intuitively and concretely how digital tools work through the mechanisms described above. LBS can be directly applied to explore potential business opportunities in the shopping circle to improve the accuracy of commercial planning and business decisions. For example, HOPSCA can design smart recommendation mechanisms based on location data from the perspectives of time, population, and location. From the time perspective, it shows the density of traffic in the shopping circle by analyzing the flow change over time. From the location perspective, the spatial distribution of traffic is analyzed to predict future traffic in the area. From the

population perspective, by analyzing users' starting points, routes, and clustering points, together with the results of user preference analysis, we can develop a comprehensive understanding of user behavior. It helps improve the overall revenue of the business, optimizing the tenant mix, and contributing to more effective marketing. Besides, LBS can also assess the impact of other digital tools on consumer behavior and provide data standards.

In summary, we propose the following hypothesis:

H3: After controlling for external factors, the continued deployment of digital tools can directly raise the indirect parameters of HOPSCA' competitiveness, including sales revenue, rental income, occupancy rate, operating and management costs, and return on assets (the impact is made through changes to HOPSCA' strategy and practice plan to improve operational efficiency).

H3a = "LBS can deliver a more accurate analysis of customer behaviors and preferences by using big data, and fulfill the goal of targeted marketing and intelligent business decisions by coordinating with other systems, thus indirectly affecting the customer flow, the number of members or rent";

4.2.4 Combined and synergistic effect of digital tools

The digital transformation for a HOPSCA cannot be achieved by a single product or solution, but by a more integrated and intricate digital tool portfolios. The combination of these tools and their flexible use according to different business needs can bring about different results. Some digital tools have

complementary functions and produce synergy when combined. The combined use of PMS and Precise Customer-flow Statistics System enables analysis of precise customer-flow, tenant contribution and rental contribution; the combined use of Precise Customer-flow Statistics System and LBS contributes to the behavioral analysis of regular customers and potential customers; the use of Membership management system + LBS + Precise Customer-flow Statistics System can set filters for data about member behaviors, traffic and preference, which can provide guidance for sales and marketing for the same type of customers.

In summary, we propose hypothesis four:

H4: The deployment of a digital tool portfolios by HOPSCA operators can generate a synergy effect to further enhance their (direct and indirect parameters of) competitiveness.

4.2.5 The relationship between the analytical roadmap and the conceptual model

The relationship between the analytical framework of "Accuracy-Prediction-Quality-Linkage" and the conceptual model presented in the introduction to this paper is illustrated as follows.

Degree of accuracy

- On merchants

Merchants need support in terms of flow guidance, sales and marketing, content,

and membership points, and require that effective data to be offered, especially when it comes to the data about customer-flow, key consumers, time, and adhesion, and LBS data in operation.

- On consumers

Consumers have service needs on the premises, especially membership service, points exchange, public facilities, access to resources, customer experience, and interaction effect.

(2) Effective prediction

- On merchants

Capability to make predictions about merchant operation (sales per unit area and NOI-adjusted), costs, and customer-flow.

- On consumers

Capability to make predictions about consumers' visit frequency, stay time, and preferred areas and merchants, as well as popularity among tenants and service capacity of public facilities.

(3) Scale of quality

- On merchants

Merchants' effective sales revenue, especially that with low consumer-flow acquisition costs, combined with marketing and technological application, to increase related sales capacity.

- On consumers

Categorization of consumer roles, identification of key consumers, collection of information on consumer visiting frequency, stay time, preferred areas, activation and usage percentage of membership, payment, and unconscious technology.

(4) Linkage service

- On merchants

The degree of linkage with merchants, including accounting, collaborative marketing, membership points exchange, data exchange, and financial service tool application.

- On consumers

The degree of linkage with consumers, including authorized matching of facial recognition and personal information, unconscious and non-passcode usage percentage, the activation rate of membership points cash-in, the activation rate of Membership management system, and level of effectiveness of online sales and marketing.

4.3 Empirical methods

4.3.1 Endogeneity problem

The main challenge of our empirical study is to address the issue of endogeneity. In the analytical framework that examines the impact of digital tools on the competitiveness of HOPSCA, there are three main sources of endogeneity problems.

The problem of endogeneity due to omitted variables: many factors that influence the competitiveness of HOPSCA cannot be observed in reality and thus cannot be included as control variables in the regression equation. These omitted control variables may be closely related to the explanatory variable, i.e., the effect of the digital tools, which results in biased estimates confounded with other omitted factors.

Endogeneity due to reverse causality: the implementation of digital tools affects the competitiveness of the HOPSCA, while in turn, the competitiveness of the HOPSCA itself also affects the level of investment in digital tools, since the better performance of the HOPSCA means that it will put more resources into its digital transformation.

Endogeneity due to sample selection bias: if the implementation of a HOPSCA's digital strategy is not random but is also influenced by factors that affect the dependent variable, this could lead to a situation where HOPSCAs in the sample with high digital inputs are also those more competitive ones, thus making the impact of digital tools on the competitiveness of HOPSCA overestimated potentially. Ideally, it would be more plausible to examine the difference of competitiveness between two types of HOPSCA after, assuming that there are no significant differences in competitiveness between the two types in the period T0, and that latter's competitiveness is increased in the period T1 due to the deployment of digital tools.

A method to address the above endogeneity issues and thus to establish a causal relationship between the implementation of digital tools and the competitiveness of HOPSCA is the randomized or Natural Experiments method. The object of our study is business decision-making. However, large-scale randomized experiments at the company level are almost impossible to achieve. Therefore, we need to address the endogeneity issue with other methods. Methodologically, this study takes advantage of the fact that IT Corporation Y and Tencent's advanced digital solutions for HOPSCA of Property Corporation B is characterized by a step-by-step process with different types of businesses and draws on natural experiments and difference-in-differences method to estimate the causal effect of digital tools on the competitiveness of HOPSCA.

4.3.2 Principles and assumptions of the DID design

This study uses Difference-in-differences, an econometric evaluation approach to establish a causal linkage between the application of digital tools and the increased competitiveness of HOPSCA.

The rationale of the DID design: The DID approach is an econometric method for estimating causal effects. The basic idea is to consider a policy as a natural experiment and, to assess the net impact of policy implementation, the entire sample data is divided into two groups: one group that is affected by a policy and called the treatment group, and the other group that is not affected by the same policy and called control group. Once a specific economic indicator is

selected, the first difference is made according to before and after the policy is implemented to obtain two sets of changes. After ruling out the first difference, we can eliminate the heterogeneity of individuals that do not change over time. Then a second difference is made to the two sets of changes to eliminate the incremental changes over time, and finally, the net effects of the policy implementation is obtained.

Hence, in our example, digital tools create, on the one hand, differences in competitiveness before and after the introduction of the digital tools on the same HOPSCA and, on the other hand, differences between HOPSCA that introduced digital tools and those that did not at the same point in time. Estimates are formed based on this double difference, which effectively controls for the effects of other covariates and ex ante differences between the two types of HOPSCA, and thus identify the causal effects brought about by digital tools.

DID estimation also require:

(1) Parallel Trends Assumption: i.e., the changing trend of competitiveness of the treatment group (HOPSCA that have introduced digital tools) and the control group (HOPSCA that have not introduced digital tools) is the same in the absence of the implementation of a digital strategy. In other words, the changing trend of the competitiveness of the treatment and control groups is the same before the introduction of digital tools. This hypothesis is quite intuitive that unobservable factors do not affect the probability of a particular HOPSCA

being included in the treatment group, i.e., whether each HOPSCA in the sample enters the treatment or control group is completely random; certain characteristics of the HOPSCA in the treatment and control groups do not show different changes over time.

(2) Stable Unit Treatment Value Assumption (SUTVA): No interference: digital tools applied to the treatment group do not affect the outcome of control group, or the introduction of digital tools in HOPSCA does not have spillover effects.

The purpose of including a control group was to disentangle the effects of the experimental treatment from other confounding factors. In short, the confounding variable works in both the treatment and control groups, which means its net effect can be eliminated by overserving differences between pre- and post-intervention differences (see Table 6 and Figure 17 for details).

Table 6: Principles of the DID method

	Pre-digital	**Post-digital**	**Difference**
Treatment group	$\alpha_0 + \alpha_1$	$\alpha_0 + \alpha_1 + \alpha_2 + \alpha_3$	$\alpha_2 + \alpha_3$
Control group	α_0	$\alpha_0 + \alpha_2$	α_2
Difference	α_1	$\alpha_1 + \alpha_3$	α_3

4.3.3 Model specification

Since our digital tools were used at different times in different HOPSCA of Property Corporation B, and since HOPSCA other than those of Property Corporation B (with similar characteristics to those of Property Corporation B) in the same city did not use a similar digital tool, which satisfies the conditions for the DID method. Therefore, we develop the following model (Model 1):

$$Y_{it} = \beta_0 + \beta_1 \times (Treated_i * AfterTreated_t) + \alpha \times Treated_i + \gamma \times AfterTreated_t + \beta_2 \times X_{it} + \mu_t + \epsilon_{it}$$

The dependent variable Y_{it} represents a dimension of the competitiveness of a HOPSCA and may be different for different digital tools. $Treated_i$ is a dummy variable representing whether a HOPSCA has applied a digital tool during the research period? $Treated_i$ takes on the value of 1 if a digital tool has been implemented, otherwise it takes on the value of 0. $AfterTreated_t$ is a dummy variable for the treatment period. $AfterTreated_t$ is assigned the value of 0 before the digital tools were applied, otherwise it takes on the value of 1. X_{it} represents a series of control variables, including the purchasing power, traffic flow, and size of the shopping circle. The coefficient β_1 of $Treated_i * AfterTreated_t$ is what we really care about, representing the real impact of the digital tools on the HOPSCA. μ_t is a time-fixed effect, controlling for all unobservable time-invariant factors which are correlated with the outcome.

DID analysis aim to estimate the overall impact of digital tools on the competitiveness of HOPSCA, linking digital tools (X) to the performance of shopping malls (Y). Such results, however, lack an analysis of the intermediate mechanism. Therefore, it is worth further exploring how digital tools affect the competitiveness of HOPSCA. In terms of operation, the digital strategy of a HOPSCA is a disruptive innovation that improves the competitiveness of a HOPSCA by implementing a digital tool portfolio, the mechanisms of which

are mainly achieved by introducing measures such as key customers identification, customer retention and activation, online and offline traffic connection. For example, the Membership management system can form a unified membership points system with omni-channel membership benefits, thus helping HOPSCA to form a consumer ecosystem, enhance consumer shopping experience and increase customer stickiness (Li et al., 2018). In addition, digital tools also make it possible to align use scenarios, consumer preferences and tenant mix using precision marketing.

Therefore, in the second part of the empirical analysis we include changes in consumer behavior to the theoretical framework, addressing how digital tools affect consumer behavior (whether there is a change in industry preferences for different types of customers). As our LBS system has extensive variables about shopping circles and consumer characteristics, by using insight data from the shopping circles of the HOPSCA, we can analyze whether the introduction of digital tools has had an impact on the behavioral preferences of consumers within shopping circles. If it does, then it is possible to confirm the mechanism by which digital strategies influence consumer preferences and therefore the competitiveness of offline HOPSCA in terms of channel innovation, customer education, product improvement and strategic business units. To this end, the following model is developed (Model 2):

$$Y_{it} = \beta_0 + \beta_1 \times (Treated_i \times AfterTreated_t) + \beta_2 \times X_{it} + \alpha_i + \mu_t + \epsilon_{it}$$

The dependent variable $\overline{Y_{it}}$ indicates the proportion of consumers who visit a HOPSCA in the shopping circle covered by the HOPSCA (within a 3 km radius), and $\overline{X_{it}}$ represents the attributes of a range of consumer groups in the shopping circle, including gender, education, marital status, age, etc. The coefficient $\overline{\beta_1}$ of $Treated_i * AfterTreated_t$ is the effect of digital tools on consumer preferences in the shopping circle. μ_t is the time fixed effect, controlling for all unobservable time-invariant factors which are correlated with the outcome.

In the current model, the independent variable takes on value of 0 or 1, which indicates whether a HOPSCA has implemented a certain type of digital tool or not but does not reflect differences in the extent of implementation of digital tools. To this end, we construct continuous variables that represent the extent of digital implementation from two perspectives: product penetration and subjective evaluation by operations staff. One is to set a baseline in terms of product penetration, e.g., if the baseline is 20%, then we can look at the effect of digital tool investment from 0 to 10% and from 10% to 20%. This would in turn answer the question of how digital tools to be deployed if a client wants a 10% increase in mall performance, which is truly relevant for business decisions in the real estate industry. The other measure is to score the extent of implementation of digital tools for different HOPSCAs. Different HOPSCA operators have different perceptions of digital tools and therefore have different degrees of application of digital tools and of supporting resources. We scored

the extent of implementation of digital tools in different HOPSCAs on a 5-point scale, with 1 being very unsatisfactory and 5 being very satisfactory. By converting the dummy variable into a continuous variable, we can examine whether the stronger the implementation of digital tools, the greater the effect on the competitiveness of the HOPSCA.

Finally, the allocation of HOPSCA's digital tools is not free. High investment costs and long lead times as well as insufficient capacity and resources to develop and deploy digital tools, will undermine HOPSCA's commitment to implementing digital strategies. Therefore, we need to prove whether a digital strategy can truly enhance the commercial value of a HOPSCA, so that the operators have an incentive to allocate resources to digital tools. The value of a HOPSCA as an asset depends on how much the investor will gain from the asset in the future and assessing the value of a HOPSCA investment using the income approach will involve indicators such as NOI and the Cap rate.

NOI is usually used to measure the net revenue generated by a property's income, i.e., a property's recurring rental income or other income subtracting the associated operating expenses, and includes property taxes, insurance premiums, utility costs, property management fees and maintenance funds, but excludes the management costs, interest costs, capital expenditure and depreciation costs of REITs. The Cap rate (capitalization rate) usually reflects the relationship between the NOI and the market valuation, and the Cap rate is

crucial in determining the market price of a commercial property, the higher the Cap rate, the better the return on the investment. Therefore, finally, we will also assess how effective the digital tools are in improving the NOI and Cap Rate of HOPSCA.

To improve the reliability of the estimates, we had to ensure that the unobservable attributes of the HOPSCA in the research sample were as highly comparable as possible (e.g., two HOPSCA in the same area, in the same locality and of similar size for comparison). Therefore, we analyzed the four dependent variables corresponding to the four systems in the same model. For this, we set up the following model for regression analysis (Model 3).

$$Y_{it} = \beta_0 + \beta_1 \times (Treated_{1i} \times AfterTreated_{1t}) + \beta_2 \times (Treated_{2i} \times AfterTreated_{2t}) + \beta_3 \times (Treated_{3i} \times AfterTreated_{3t}) + \beta_4 \times (Treated_{4i} \times AfterTreated_{4t}) + \beta_5 \times X_{it} + \alpha_i + \mu_t + \epsilon_{it}$$

To examine the effect of the combined effect of different digital tools, we selected HOPSCA that had applied more than two types of digital tools at the same time and examined the effect of the interaction items, thus identifying the effect of the combination of two digital tools and which specific aspects of competitiveness had improved compared to those that had applied only one digital tool. Our focal model is (Model 4):

$$Y_{it} = \beta_0 + \beta_1 \times (Basic_i \times AfterTreated_t) + \beta_2 \times (Advanced_i \times AfterTreated_t) + X_{it}\beta_3 + \alpha_i + \mu_t + \epsilon_{it}$$

The dependent variable $\overline{Y_{it}}$ is the measurement of outcome variables;

$Basic_i \times AfterTreated_t$ indicates if singular digital tool were in use at HOPSCA i in time t. $Advanced_i \times AfterTreated_t$ indicates if multiple or duplicate digital tools were in use at HOPSCA i in time t. Other specification and variables same to above model.

4.3.4 The limitation of the DID estimation in this thesis

The HOPSCA operator do not randomly use digital tools. Digital strategies is a strategic choice made by each HOPSCA operator. If we ignore the potential endogeneity this creates, then our estimate of the relationship between digital tools and the competitiveness of the HOPSCA may reflect the possibility that HOPSCA that choose to use digital tools have characteristics that inherently lead to increased competitiveness, rather than capturing a more direct relationship. We mitigate this potential bias in the DID model specification (see Figure 17).

In this study, there may be systemic differences between the commercial entities that have deployed digital tools and the control group before deployment. If this initial difference is ignored and only a horizontal comparison between the treatment group and the control group after the treatment is implemented, the estimated treatment effect is likely to be biased due to the influence of the initial difference. In order to solve this problem, this paper adds a fixed year effect to the DID model to control the possible differences in different years. In addition, we also tested whether the competitiveness of the two commercial entities in

the treatment group and the control group has parallel trends. Before deploying digital tools, the competitiveness performance indicators of the treatment group and the control group compare their competitiveness performance indicators over time. Consistency, there is no significant difference, and the parallel trend assumption is satisfied, which to some extent can explain the applicability of the DID model to the scenarios in this article.

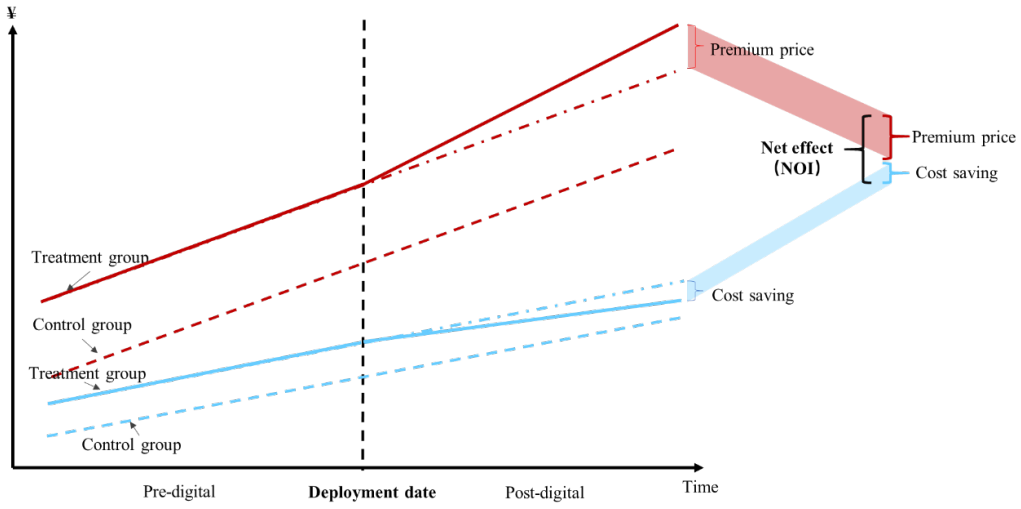

Figure 17: Principles view of the DID method

4.4 Variable specification

4.4.1 Independent variables

The independent variable DID in this thesis is a dummy variable, namely the value of 1 if the digital tools has been implemented, and value of 0 if the opposite.

The dummy variable indicates the impact of the presence or absence of a particular digital tool on the HOPSCA, but the applicability and effectiveness of the tool itself is difficult to assess. If the impact of digital tools is only

evaluated in terms of output benefits while the merits of the digital tools are drawn on such, it will create circular reasoning, which is one of the logic fallacies. For this reason, the following improvements will be made in the study.

(1) Inclusion of non-significant results from the regression analysis to establish valid procedures and show the advantages and disadvantages of digital tools.

(2) Supplement industry-related data of PMS, Membership management system and customer-flow analysis systems, producing analysis and explanations against these competitors horizontally.

Current data analysis links digital tools (X) to the performance of shopping malls (Y), such that the results lack an intermediate mechanism (e.g., whether there is a change in industry preferences in terms of different types of customers) and merchant behavior (e.g., marketing or advertising placement). We therefore add changes in customer behavior to our theoretical framework. The LBS system has abundant variables about shopping circles and consumer characteristics, the data of which can partially address the issues about consumer behavior changes.

The current measurement model, with independent variables of 0 and 1, can only reflect the presence or absence of digital tools, not the effectiveness of the digital tools themselves or the level of the investment, so it is not feasible to estimate the effect of digital tools in other HOPSCA (external validity), thus making it impossible to provide an actual roadmap to improve the performance

of a HOPSCA.

To measure the digital tool itself more precisely, a baseline can be set in terms of product penetration, e.g., if the baseline is 20%, then we can look at the effect of digital tool investment from 0 to 10% and from 10% to 20%. This would in turn answer the question of how digital tools to be deployed if a client wants a 10% increase in mall performance, which is truly relevant for business decisions in the real estate industry.

4.4.2 Dependent variables

Different digital tools have an impact on different aspects for improving the competitiveness of HOPSCA and therefore correspond to different dependent variables.

Dependent variables related to PMS/AMP: Occupancy rate, total revenue, rent income, total management costs, labor costs, Other costs, rental fulfillment ratio, etc.

Dependent variables related to Precise Customer-flow Statistics System: Customer-flow, customer-flow retention, conversion rate, average stay time, customer-flow density, traffic depth, inbound marketing Capability, etc.

Dependent variables related to Membership management system: Member traffic, the number of in-store Members, members' stay time, sales from member transactions, total number of members, etc.

Dependent variables related to the Location-Based Service system: statistical

analysis of the number of people in the shopping circle, customer sources, the distribution of customer traffic, the preference of customer visits, customer profile labels. We mainly focus on the visit preference of potential customers, including the proportions of people's visits for different types of business format such as Shopping, Sports & Fitness, Food & Drink, etc.

Detailed definitions of all the regression variables are shown in Table 7.

Table 7: A descriptive summary of the regression variables

Independent variables	Dependent variables	Definitions
PMS/AMP	Occupancy rate	A rate calculated as actual leased area divided by available lease area of a commercial property as of the end of each relevant period, reflecting the operating condition of the HOPSCA
	Total revenue	The total revenue of a HOPSCA during its operating period, including rental revenue, property management revenue, diversified business and advertising revenue, income generated from car parking, forfeited deposit income and other income and gains.
	Rent income	The income generated from property leasing services.
	Total management costs	The sum of all direct and indirect costs incurred during the operating period of a HOPSCA, including property tax, value-added tax, security and cleaning service fees, maintenance and energy fees, personnel, and administrative expenses, planning and promotion costs, etc.
	Labor costs	The sum of direct and indirect costs incurred on the labor during the operating period of a HOPSCA.
	Other costs	Any other costs other than those mentioned above during the operating period of the HOPSCA.
	Rental fulfillment ratio	Percentage of received rents versus accrued rents derived from available lease area of a commercial property in the same period.

Precise Customer-flow Statistics System	Customer-flow	The number of customers entering the mall/store.
	Customer-flow retention	The number of customers in the mall/in-store over a period.
	Conversion rate	The number of transactions divided by the number of customers in the mall/in-store, reflecting the sales success rate of the mall/store.
	Average stay time	The average length of time a customer spends in the mall/store.
	Customer-flow density	The density of customer in a certain area at a given time.
	Traffic depth	The average number of sections visited by customers, reflecting the mobility of customers in the mall/store.
	Inbound marketing Capability	Customer-flow divided by mall/store area, reflecting the mall's /store's ability to attract customers.
Membership Management System	Member traffic	The number of members entering the mall in a certain period.
	The number of in-store Members	The number of members entering the store in a certain period.
	Members' stay time	The average length of time for members spends in the mall.
	Sales from member transactions	The amount of money spent by members in the mall.
	Total number of members	The number of registered members of a HOPSCA.
Location-Based Service System	Shopping	The visiting preferences of the people in the area covered by a HOPSCA for various business format; the ratio of visiting preferences is the ratio of people who prefer a particular type of business to all the people in the area.
	Sports & Fitness	
	Food & Drink	
	Cars	
	Education & training institution	
	Tourist attractions	
	Hotels	
	Health care	
	Recreational facilities	
	Amenities	

4.5 Data sources

The data sources involved in each of our studies are listed below.

Table 8: Breakdown of 44 commercial property projects of Property Corporation B

Project Name	Opening Date	Location	Leasable GFA in operation
Fuyang Plaza	December 2015	Hangzhou	77,186
Hechuan Plaza	December 2014	Chongqing	147,403
Fuzhou Plaza	April 2007	Fuzhou	186,178
Penglai Plaza	November 2016	Penglai	148,213
Laishan Plaza	December 2016	Yantai	100,027
Chengyang Plaza	October 2009	Qingdao	443,262
Zhengzhou Plaza	Dec 2009	Zhengzhou	235,606
Wuxi Plaza	October 2010	Wuxi	192,865
Bengbu Plaza	December 2009	Bengbu	346,880
Luoyang Plaza	December 2011	Luoyang	138,350
Qingpu Plaza	September 2018	Shanghai	171,673
Taian Plaza	September 2012	Tai'an	102,677
Yancheng Plaza	September 2011	Yancheng	199,409
Licang Plaza	December 2011	Qingdao	174,167
Suqian Plaza	September 2011	Suqian	150,660
Jimo Plaza	December 2011	Qingdao	175,513
Anxi Plaza	December 2010	Quanzhou	85,374
Haiyang Plaza	June 2017	Haiyang	37,470
Xinxiang Plaza	September 2012	Xinxiang	171,433
Jinjiang Plaza	December 2013	Jinjiang	236,892
Jiangyou Plaza	November 2018	Jiangyou	91,342
Tianjin Plaza	December 2014	Tianjin	162,836
Cao Lu Plaza	December 2013	Shanghai	81,720
Taicang Plaza	March 2007	Taicang	25,476
Baoshan Plaza	December 2015	Shanghai	35,854
Zhenjiang Plaza	September 2015	Zhenjiang	138,880
Binjiang BL City	December 2016	Hangzhou	286,699
Qibao BL City	October 2016	Shanghai	150,567
Changzhou Plaza	June 2016	Changzhou	170,134
Jiaozhou Plaza	February 2015	Jiaozhou	164,772
Dongying Plaza	September 2016	Dongying	169,917
Huaxin Plaza	December 2015	Shanghai	51,113
Huaian Plaza	July 2017	Huai'an	59,384
Fengxian Plaza	November 2015	Shanghai	117,715
Lingang Plaza	December 2015	Shanghai	70,720
Yangzhou Plaza	January 2017	Yangzhou	88,659
Xiaoshan Plaza	December 2015	Hangzhou	143,836

Jiading Plaza	October 2016	Shanghai	144,072
Xiamen BL One City	September 2018	Xiamen	170,585
Fuling Plaza	December 2017	Chongqing	113,854
Xiasha Plaza	November 2014	Hangzhou	98,660
Wujing Plaza	July 2017	Shanghai	45,017
Yiwu Plaza	November 2017	Yiwu	90,992
Fuyang Plaza	December 2017	Fuyang	140,441

PMS/AMP system: we collected dataset on occupancy rate, total revenue, net operating income, rent, total management costs, labor costs, other project costs, and standard rental fulfillment ratio for 44 commercial real estate projects of Property Corporation B from 2016-2019, and estimated the impact of the PMS system on these variable fields. All the financial data are collected from the financial statements of Property Corporation B and the duration of collecting data is 2016-2019.

Membership management system: we collected 44 commercial real estate projects of Property Corporation B, of which the control group consisted of five projects, based on five HOPSCA projects in Xiamen (Dec 19), Binjiang (Dec 18), Qibao (Jun 19), Baoshan (Apr 20) and Suqian (Nov 19), and collected monthly data on customer traffic and sales from Jan 2019 to July 2020. We also estimated the impact of the membership management system on these variable fields. The time in brackets indicates when the membership management system was put into operation. Unlike the previous data on an annual basis, here we use monthly data.

Precise Customer-flow Statistics System: we collected four data fields on

customer-flow, retention, customer density and membership for 44 commercial real estate projects of Property Corporation B from 2016-2019 and estimated the impact of the Precise Customer-flow Statistics System on these variables.

LBS: We collected customer attributes of the shopping circle covered by six commercial real estate projects, namely Powerlong One City in Xiamen, Powerlong City in Binjiang, Hangzhou, Powerlong City in Qibao, Shanghai, and those in Jinjiang, Fujian, Xiaoshan Hangzhou, and Fengxian Shanghai respectively, with the shopping circle coverage set at 3 km. Those are monthly figures in October 2019 and September 2020. Customer attributes included basic attributes (gender, age, education, marital status), wealth attributes (consumption level, frequency of shop visits, housing prices in residential communities) and visiting preferences (10 categories including Shopping, Sports & Fitness, Food & Drink, etc.).

All data were sorted in excel and analyzed using R software. The attributes, size and data used for different digital tools for specific commercial real estate projects can be found in Table 8, Table 9 and Figure 18.

Table 9: Range of data sampling for various digital tools

Digital tools	Variables	Range of sampling	Projects involved	Time period	Frequency
PMS/ AMP	Occupancy rate, total revenue, net operating income, rent income, total management costs, labor costs, other costs, rental fulfillment ratio, etc.	Experimental group: 44 HOPSCAs Control group: 3 projects excluded	Nationwide	2016-2019	annually
MMS	Customer flow, total number of members, sales, etc.	44 HOPSCAs Experimental group: 5 Control group: 39	Experimental group: Shanghai A, Zhejiang A, Jiangsu A, Fuzhou A Control group: other projects	2019.01-2020.07	monthly
PCSS	Customer flow, customer retention, customer-flow density, total number of members, etc.	44 HOPSCAs Experimental group: 3 Control group: 41	Experimental group: Xiamen A, Shanghai A, Hangzhou A Control group: other projects	2016.01-2020.06	monthly
LBS	Within 3 kilometers from shopping circles: Customer basic attributes (gender, age, background, marriage) Customer wealth attributes (the level of consumption, visit frequency, housing price) Customer visit preferences (10 items including shopping, recreation, sports & fitness)	Experimental group: 3 Control group: 3	Experimental group: Xiamen A, Shanghai A, Hangzhou A Control group: Fuzhou A, Shanghai B, Hangzhou B	2019.10-2020.09	monthly

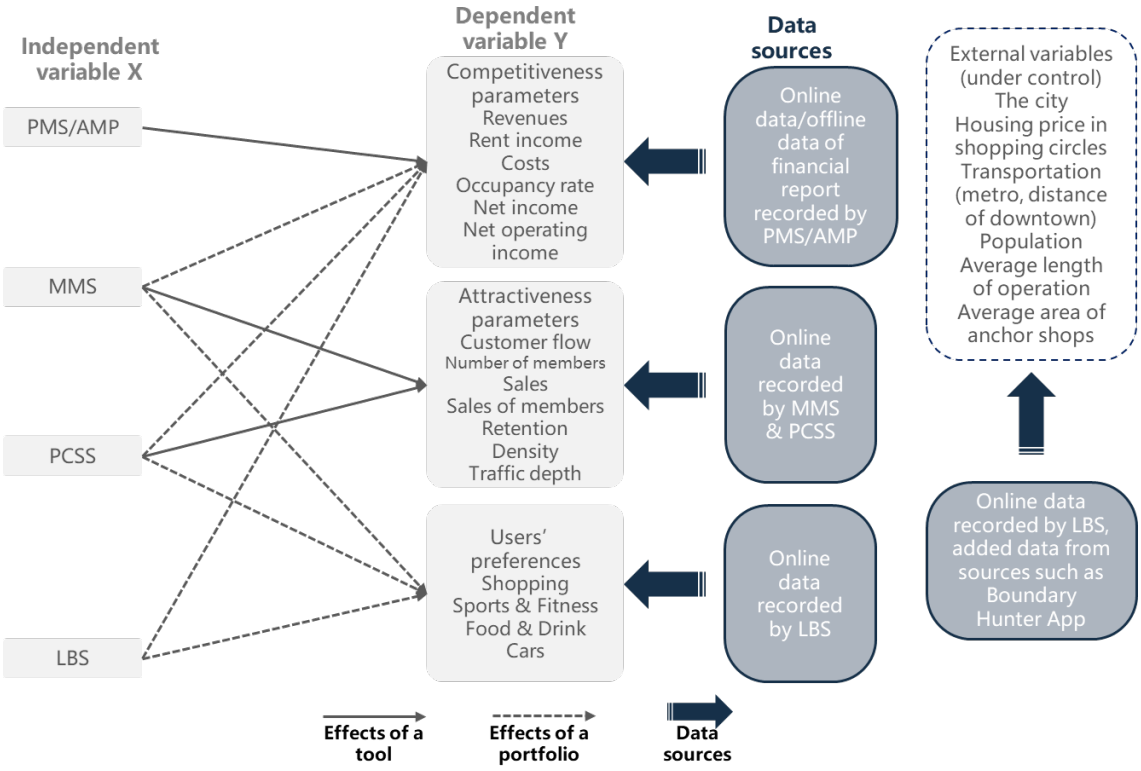

Figure 18: Data sources for various digital tools

4.6 Analysis process

The purpose of this paper is to examine the impact of digital tools on the competitiveness of HOPSCA. Our research is divided into three broad

dimensions.

Firstly, based on the digital strategy practices of HOPSCA built by Property Corporation B and Tencent Holdings Ltd. in collaboration, we quantitatively assess the impact of these new digital tools and technologies on the operational efficiency of HOPSCA.

Secondly, we evaluate the impact of digital tools on the behavioral decisions and consumption habits of consumers in shopping circles by combining in-venue data with off-venue customer insights from LBS, thereby identifying the specific channels and mechanisms through which digital tools affect the competitiveness of HOPSCA.

Thirdly, we not only study whether there is an effect or how much of that effect was due to digital tools but will further investigate the differences in effects of applying digital tools in different HOPSCA, that is, further study the determinants of the effects of digital tools. This has important reference significance for commercial real estate operators' digital strategy-related business decisions.

We will make more detailed arguments on the analysis process of these three levels.

4.6.1 Research on the impact of digital tools and new technologies on the competitiveness of HOCSCA

According to a report from the McKinsey Global Institute, China's real estate

industry is still in the “double low” area of “low digitalization” and “low production growth rate.” It can be said that China’s commercial real estate is clearly a digital depression. As the level of digitization increases, the growth of labor productivity will also increase significantly, which means that the digitization of commercial real estate has broad potential and room for growth. Although the overall digitalization of commercial real estate is not high, this topic has been discussed and practiced in the industry. Regardless of improving the consumer experience, integrating online and offline retail, or improving the efficiency of resource allocation, the significance of the digitalization of the commercial real estate industry is beyond doubt.

The core of the digital strategy of the commercial entity is to establish a user-centric product and service system, and to leverage the ecological business upgrading of the commercial entity’s platform of two-sided markets under the premise of operating digital user assets. Especially in the commercial real estate operation and management link, digital tools can provide business support, integrate business resources, build a marketing platform with businesses, provide consumers with diversified consumer services, stimulate, and boost potential consumer demand, and realize to maintain and increase the value of the business and property.

Based on the above analysis, when commercial real estate implements its digital strategy, it needs to consider the optimal implementation path to allow

digitalization to sink into all aspects of commercial real estate operations. If there is a lack of a clear digital transformation strategy, simply by investing many resources and technology in a short period of time to apply all kinds of fashionable digital technologies, often the results and investment ratio will not meet expectations.

Therefore, it is particularly important to evaluate the effect of the digital strategy of a HOPSCA. This evaluation ultimately hopes to establish a correlation with the competitiveness indicators of HOPSCA. We expect that various digital tools will have a significant effect on different dimensions of business competitiveness, but some differences are difficult to quantify due to the stages and investment of the project. For example, PMS/AMP and Precise Customer-flow Statistics System have more intuitive results, but the investment is relatively large. LBS has minimal investment and relatively high room to play, but it has higher requirements for the operation team. A reasonable digital tool portfolio (mainly integrated PMS/AMP, Membership management system, Big Data resources and intelligent Internet of Things) can directly affect the profitability of HOPSCA. We will use a group of econometric models to quantitatively estimate the effect of different digital tools and new technologies on various dimensions of competitiveness of HOPSCA.

4.6.2 Analysis of the mechanism of digital tools on the competitiveness of HOPSCA

The digital strategy of a commercial entity involves the three elements of "people, products, and places". The traditional value of a commercial real estate is to use the " places" to aggregate merchant brands and visitor flow to form a "transaction" platform, and collecting rent or commission is the main profit model. Therefore, traditional retail real estate operation indicators and organizational models are developed around the two value points of " places" and "transactions" (namely, development and positioning, property maintenance, lease promotion/occupancy rate management, marketing). The advantages of digitalization largely lie in the analysis of Big Data and the linkage between the analysis results and the transaction link. This particularly involves the factors that change people. One is the accurate portrait of consumers, and the other is the construction and implementation of personalized marketing activities to guide or change consumer preferences.

Off-site data is a basic portrait of consumers within the coverage of commercial entity providers, to accurately control consumer preferences and continuously match the three elements of " people, products, and places" to the best. With the help of Big Data, HOPSCA can also gather consumer needs and actively make business adjustments and differentiated products and services to meet consumer needs. From this perspective, digital tools can guide or even change

consumers' preferences and behaviors, which may be an important channel for digital tools to enhance the competitiveness of HOPSCA. Therefore, in this part, we will start with shopping circle-level data and incorporate consumer visit preferences into the analysis framework to provide a basis for a more comprehensive understanding of the relationship between digital tools and commercial competitiveness.

4.6.3 Analysis of effect of digital tools on the value of HOPSCA

Commercial real estate is essentially a core asset, and its complexity is reflected in the integration of commerce, real estate, and finance. Its development and operation have gone through capital operation, real estate development and commercial operation. The profit that the entire commercial real estate operation can bring, the bottom income depends on the retail sales of the merchants generated during the commercial operation stage, and the commercial real estate owners obtain rental income. Therefore, the valuation basis of commercial real estate is based on commercial operations. Digital tools can enhance the competitiveness and operational capabilities of HOPSCA. Therefore, in theory, digital strategies will indirectly increase the market value of a commercial real estate.

To evaluate the impact of digital strategy on business valuation, we need to proceed in two stages.

First, it is necessary to quantitatively evaluate the impact of different digital

tools on the financial performance of commercial projects, such as costs and benefits. This impact can be obtained from the previous analysis.

Secondly, we need to grasp the cost of land acquisition, sales return, the value of holding assets, the expected growth rate of holding assets, annual costs, and benefits of holding assets during the operation phase of a typical commercial project, and then calculate the NOI of the HOPSCA, and then substituting the cost and benefit changes brought about by the implementation of digital tools, can finally calculate the impact of digital strategies on the asset valuation of the HOPSCA.

4.7 Empirical results

We have established regression models for prediction of effects of digital tools such as the operation management system, member management system, Precise Customer-flow Statistics System, and Tencent Holdings Ltd.'s Location-Based Service system on the specific aspect of the competitiveness of HOPSCA and obtained the following empirical results.

4.7.1 Empirical results on PMS/AMP

For the operation management system, we estimated the impact of the PMS/AMP system on these variables on data fields such as occupancy rate, total revenue, rent, management cost, labor cost, and rent achievement rate. The covariates in the model include HOPSCA's gross floor area (GFA), the number of years of business operations, the city (dummy variables), and year (virtual

variable).

Table 10: The influence of PMS/AMP on the competitiveness of HOPSCA

Variables	(1) Occupancy rate	(2) Total revenue	(3) Rent income	(4) Management costs
DID	0.03	124.263***	74.050**	21.705***
	(0.055)	(22.857)	(16.248)	(9.143)
GFA	-0.000***	0.019***	0.015***	0.008***
	(0.000)	(0.004)	(0.003)	(0.001)
Year 2017	0.03	1284.030**	992.247**	513.612**
	(0.033)	(521.963)	(407.032)	(208.785)
Year 2018	-0.002	1215.159**	1050.834**	486.064**
	(0.035)	(562.183)	(436.546)	(224.873)
Year 2019	-0.094	24.37	186.746	9.748
	(0.065)	(1029.296)	(785.611)	(411.718)
Location Shanghai	0.109	3731.449**	3286.256***	1492.579**
	(0.093)	(1467.491)	(1100.919)	(586.996)
Location Xiamen	0.183	5053.753**	3841.983**	2021.501**
	(0.127)	(1997.236)	(1498.290)	(798.894)
Location Hangzhou	0.094	4047.973***	3867.248***	1619.189***
	(0.089)	(1404.739)	(1053.795)	(561.896)
N	158	156	152	156
R^2	0.626	0.64	0.622	0.64
adj R^2	0.526	0.542	0.516	0.542
AIC	145.616	2872.177	2711.775	2586.294

It can be seen from the regression results of the model shown in Table 10 that after the PMS/AMP system was launched, the annual rental rate of each commercial entity increased by 3.4% on average; the total annual income of each commercial entity increased by 1.24 million yuan, of which rent income increased by 740,000 yuan on average; the rate of meeting rent standards rose by 16.9%.

Table 10 (continued)

Variables	(5) Labor costs	(6) Other costs	(7) Rental fulfillment ratio
DID	-67.994***	289.712***	0.169
	(24.400)	(104.743)	(1.785)
GFA	0.005***	0.002***	0
	(0.001)	(0.000)	(0.000)
Year 2017	359.528**	154.084**	-2.245*
	(146.150)	(62.636)	(1.173)
Year 2018	340.244**	145.819**	-2.362*
	(157.411)	(67.462)	(1.260)
Year 2019	6.824	2.924	-3.046
	(288.203)	(123.515)	(2.180)
Location Shanghai	1044.806**	447.774**	1.032
	(410.897)	(176.099)	(3.132)
Location Xiamen	1415.051**	606.450**	6.916*
	(559.226)	(239.668)	(4.110)
Location Hangzhou	1133.433***	485.757***	0.628
	(393.327)	(168.569)	(2.983)
N	156	156	145
R^2	0.64	0.64	0.288
adj R^2	0.542	0.542	0.077
AIC	2475.012	2210.655	873.277

Notes: Standard errors (clustered by projects) in parentheses; ***p<0.001, **p<0.01, *p <0.05, .p <0.1.

At the same time, the research results show that although the application of PMS/AMP increases the occupancy rate and income of the project, it also brings about an increase in costs. The average annual management cost of each HOPSCA increased by 214,000 yuan, while labor costs decreased by 679,000 yuan. This conclusion is inconsistent with our assumption that PMS/AMP can effectively reduce operation and management costs. The main reason is that our cost data here is not real one but is derived from the net operating income using a formula. The formula we used is:

NOI: Management fee=0.05-0.08.

Management cost: management fee=0.85-0.9.

Labor cost: management cost=0.7-0.75.

The project management cost derived from this is necessarily proportional to the net income, which interferes with our analysis results.

In addition, from the actual point of view, the commercial projects collected by PMS/AMP will be launched in 2018 and after. The initial deployment of the digital system will increase the operating personnel and management costs, which will also affect the model results. After deployment, these costs will drop significantly as the personnel become more proficient, and the system will be upgraded and improved. And according to our previous business calculations, the labor costs of projects that are not related to the system can be reduced by 20% to 30% with the deployment of PMS/AMP.

Considering that the average annual income and cost difference of each HOPSCA in the model has increased by 7.73 million yuan after the system is online, that is, profit has increased. This result demonstrates our hypothesis: Operational management systems can improve operational efficiency.

The coefficients of the covariate “city” in the six models shown in Table 9 are estimated to be Xiamen>Hangzhou>Shanghai. Taking the impact on the total revenue of shopping malls as an example, positioning Xiamen can bring an average annual income of 50.54 million yuan, positioning the location in

Hangzhou is 40.48 million yuan, while the location income of Shanghai is 37.31 million yuan. Among the 44 projects covered by our data, the distributions in these three cities are Xiamen: Xiamen BL One Mall; Hangzhou: BL City in Binjiang and three B Plazas; Shanghai: BL City in Qibao and seven BL Plazas. After reorganizing and positioning its products, Property Corporation B launched three new product lines: BL One Mall, BL City, and BL Plaza, corresponding to ultra-high-end products, high-end products, and mid-end mainstream products, and update and build O2O platform. Our model illustrates the guiding significance of this strategy. Accurate positioning and management upgrades can effectively increase business revenue and bring value enhancement.

4.7.2 Empirical results on Membership management system

For the membership management system, we separately estimated its impact on the HOPSCA's customer-flow and total sales revenue. Different from the previous annual data, here we use the monthly data from January 2019 to July 2020.

Table 11: The influence of the membership management system on the competitiveness of specific aspects of HOPSCA

	(1)	(2)
Variables	**Member Traffic**	**Sales from member transactions**
DID	70179.885	1012864.034***
	(68580.914)	(289604.864)
GFA	2.193***	179.514***
	(0.304)	(12.055)

Age	-111289.092***	-4458242.090***
	(18123.024)	(697225.613)
Location Shanghai	700752.406***	1565368.923
	(171196.462)	(6484306.473)
Location Xiamen	835660.259***	32010825.890***
	(215550.600)	(8158778.252)
Location Hangzhou	523516.705***	1687549.872
	(160544.264)	(6107218.797)
N	855	722
R^2	0.634	0.719
adj R^2	0.620	0.708
AIC	24505.637	25937.529

Notes: Standard errors (clustered by projects) in parentheses; ***p<0.001, **p<0.01, *p <0.05, .p <0.1.

As you can see from the regression results in Table 11, the Membership management system has significantly improved the two key indicators of commercial values of the HOPSCA's customer-flow and mall sales revenue. According to the data we collected, before the membership management system was launched, the average monthly visitor flow of each HOPSCA was 1.156 million, and the regression results showed that after the launch, the average monthly visitor flow of each HOPSCA increased by 70,200. The deployment of the membership management system has increased the business volume by 1-2% on average every month. At the same time, the average total sales revenue increased by 1.01 million yuan per month, which was 2-3% of the average monthly total sales revenue (49.02 million yuan) before the system went live.

At the same time, we found that shopping malls' opening years are inversely correlated with visitor flow and total sales revenue. The model results show that the average monthly visitor flow in the *t+1* year is about 100,000 fewer than

the previous year (*t*), and the total monthly sales revenue decreases by about 446,000 yuan. This is because as time goes by, people's sense of freshness in the existing businesses weakens, and at the same time new businesses will disperse part of the visitor flow, resulting in a decrease in visitor flow and sales revenue. Therefore, if HOPSCA want to have stable or even growing visitor flow and sales revenue for a long time, they need the help of digital management systems.

Compared with the traditional Membership management system based on APP and its own traffic, the WeChat-based Membership management system can obtain member traffic at a lower cost and is convenient to use. A significant increase in customer-flow can be seen in above result, which suggest that the new Membership management system has played a significant role in encouraging users to pay more attention to shopping mall information and participate in shopping mall activities. Customer stickiness has been improved, and marketing costs can be indirectly reduced.

4.7.3 Empirical results on Precise Customer-flow Statistics System

Table 12: The impact of Precise Customer-flow Statistics System on the competitiveness of specific aspects of HOPSCA

	(1)	(2)	(3)	(4)
Variables	**Customer-flow**	**Average stay time**	**Customer-flow density**	**Total number of members**
DID	699455.485***	576621.290***	26.700***	188160.294***
	(121312.200)	(101126.017)	(10.146)	(26244.560)
GFA	19.526***	1.627***	-0.000***	0.387***

	(5.434)	(0.453)	(0.000)	(0.054)
Age	635433.152	52952.763	16.597***	14590.578***
	(407257.958)	(33938.163)	(3.405)	(2473.141)
Year 2017	2633193.419***	219432.785***	19.572***	22291.893***
	(805095.667)	(67091.306)	(6.731)	(5201.049)
Year 2018	3767115.884***	313926.324***	31.888***	48331.833***
	(793207.398)	(66100.616)	(6.632)	(5166.865)
Year 2019	5798818.234***	483234.853***	49.369***	56407.277***
	(793207.398)	(66100.616)	(6.632)	(5166.865)
Location Shanghai	1861939.935	155161.661	82.277***	38041.830***
	(3361066.134)	(280088.844)	(26.447)	(8949.661)
Location Xiamen	2600728.746	216727.395	113.493***	37815.129**
	(4657806.859)	(388150.572)	(28.100)	(17863.899)
Location Hangzhou	1227783.480	102315.290	115.342***	14486.373
	(3163399.165)	(263616.597)	(38.941)	(9553.914)
N	165	165	165	137
R^2	0.800	0.800	0.742	0.815
adj R^2	0.746	0.746	0.672	0.768
AIC	5469.104	4649.085	1610.745	3140.874

Notes: Standard errors (clustered by projects) in parentheses; ***p<0.001, **p<0.01, *p <0.05, .p <0.1.

For the Precise Customer-flow Statistics System, we estimated the impact of it on these variables on data fields such as annual visitor flow, detention, visitor flow density, and number of members. With the “two-pronged approach” of the Membership management system and the Precise Customer-flow Statistics System, we can more accurately and conveniently obtain the core data that the mall pays attention to, and guide business strategies and information systems deployment through data analysis.

The regression results in Table 12 show that, on average, the digital system brings an increase in visitor flow of 699,000 visitors per year per commercial entity; an increase in visitor flow retention of 577,000; visitor flow density increased by 26.7 people per square meter; and the number of members

increased 188,000 people. Moreover, the coefficient estimates of the independent variable D in all models are significant, which fully shows that after the deployment of the sophisticated visitor flow system, the precision marketing and planning activities of the mall have effectively increased the attractiveness of the mall to the customer group.

At the same time, it can be seen from the regression results that the positive influence of the year variable on each dependent variable is increasing year by year. Taking visitor flow retention as an example, the response coefficient after excluding the influence of other factors in 2017 was 219,400; the year effect in 2018 was 313,900, an increase of about 43% over the previous year; in 2019, it was 483,200, compared with an increase of about 53.9% from the previous year. It is inferred from this that the accumulation of data volume and the increase of data quality by the Precise Customer-flow Statistics System will exponentially help the improvement of the efficiency of shopping malls.

4.7.4 Empirical results on LBS

Table 13: Analysis of people's preferences based on LBS

	(1)	(2)	(3)	(4)	(5)
Variables	**Shopping**	**Sports & Fitness**	**Food & Drink**	**Cars**	**Education & training**
Constant	-190.650**	-112.770**	-222.296**	-129.889*	41.716
	(59.703)	(41.989)	(86.234)	(51.758)	(27.759)
DID	8.692	12.199	65.338*	-9.442	-26.941**
	(20.309)	(14.283)	(29.333)	(17.606)	(9.442)
Bachelor	-3.081***	-1.153**	-10.180***	-2.207***	2.162***
	(0.499)	(0.351)	(0.720)	(0.432)	(0.232)
Male	-1.456**	-1.106**	-5.467***	1.114*	-0.113
	(0.566)	(0.398)	(0.818)	(0.491)	(0.263)

Married	-0.455	0.351	3.030*	-0.919	-1.854**
	(1.009)	(0.710)	(1.457)	(0.875)	(0.469)
Age 3	12.287***	4.806***	22.331***	6.125***	-0.069
	(1.590)	(1.118)	(2.297)	(1.378)	(0.739)
Age 5	16.228***	8.019***	20.333***	7.850**	3.133*
	(2.769)	(1.947)	(3.999)	(2.400)	(1.287)
N	12	12	12	12	12
R^2	0.987	0.969	0.985	0.959	0.992
adj R^2	0.971	0.933	0.966	0.91	0.982
AIC	58.861	50.413	67.685	55.433	40.481

Using the data of visiting preferences in Tencent's Location-Based Service (LBS), we made a set of regression on the impact of the Membership management system and the Precise Customer-flow Statistics System. The sample data we have collected is monthly figures in October 2019 and September 2020 from six places built by Property Corporation B, namely a shopping mall in Binjiang, Hangzhou, a city plaza in Xiaoshan, Hangzhou, a shopping mall in Qibao, Shanghai, a city plaza in Fengxian, Shanghai, a shopping mall in Xiamen and a city plaza in Jinjiang, Fujian. The selected response variables are population coverage with 10 visiting preferences. Covariate Age 3 represents 25-to-30-year-olds and Age 5 represents 36-to-40-year-olds. Results of the regression are as follows (all the numbers estimated are showed in the form of percentage).

Table 13 (continued)

	(6)	(7)	(8)	(9)	(10)
Variables	**Tourist Attractions**	**Hotels**	**Healthcare**	**Recreational Facilities**	**Amenities**
Constant	-331.867***	-387.753***	-6.51	-232.657***	227.743***

	(58.743)	(58.178)	(23.403)	(45.449)	(49.325)
DID	-54.739**	-32.39	-14.354	-0.504	-13.247
	(19.982)	(19.790)	(7.961)	(15.460)	(16.778)
Bachelor	3.734***	1.202*	1.402***	-0.493	0.637
	(0.491)	(0.486)	(0.195)	(0.380)	(0.412)
Male	3.274***	3.635***	0.829**	1.532**	1.292**
	(0.557)	(0.552)	(0.222)	(0.431)	(0.468)
Married	-3.972**	-2.396*	-1.019**	-0.401	-1.168
	(0.993)	(0.983)	(0.395)	(0.768)	(0.834)
Age 3	7.001***	6.811***	0.093	4.838**	5.019**
	(1.564)	(1.549)	(0.623)	(1.210)	(1.314)
Age 5	11.366***	12.493***	0.205	7.558**	8.196**
	(2.724)	(2.698)	(1.085)	(2.108)	(2.287)
N	12	12	12	12	12
R^2	0.994	0.984	0.984	0.959	0.976
adj R^2	0.987	0.965	0.964	0.911	0.948
AIC	58.472	58.24	36.385	52.314	54.278

Notes: Standard errors (clustered by projects) in parentheses; ***p<0.001, **p<0.01, *p <0.05, .p <0.1.

According to the results of regression in Table 13, Digital tools has a positive estimation on preferences of shopping, fitness and catering, and a negative estimation on others. It suggests that guided by Precise Customer-flow Statistics System and LBS, the Membership management system will boost customer-flow of three types of business format among samples, namely shopping, Sports & Fitness Food & Drink, while the ratio of population coverage with other preferences will decrease accordingly when it generally remains the same. The consumption income mainly comes from the three types of business, which means penetration data in the LBS system can accurately and effectively improve the overall revenue of HOPSCA and upgrade portfolios of types of business. This validates our hypothesis that Location-Based Service

(LBS) will empower the operators to better make regional analysis and decisions.

Regression prediction, analysis and demonstration using models targets the impact of individual digital systems on the competitiveness of HOPSCA, but in real situations, these systems are complementary to each other. Precise Customer-flow Statistics System and LBS provided us multi-dimensional core business data of high quality and precision, only based on which analysis of customer behavior and preferences can be significant for guiding operating strategies. Equipped with digital systems, multi-dimensional and precise data can be collected in a more convenient way, consuming fewer human resources and less time with improved management efficiency.

4.7.5 Empirical results on digital tool portfolios

To evaluate effects of different digital portfolios, we collected monthly figures and peripheral attributes of 15 HOPSCAs applying at least two digital tools, including areas of the malls, length of business operation, the average price of resold houses nearby, distance to stations, with or without a metro in 3km, population (ten thousand) in 3km and areas of anchor stores.

Table 14: Effects of digital portfolios

Variables	(1) Rent income	(2) Customer traffic	(3) Total sales revenue	(4) Other income
Single	48.390	6.088	732.600	6.509
	(45.511)	(12.602)	(512.209)	(15.593)
Portfolio	4.536	6.138	778.583**	5.760
	(27.156)	(7.629)	(308.500)	(9.349)

GFA	0.010***	0.004***	0.149***	0.004***
	(0.002)	(0.000)	(0.018)	(0.001)
Age	28.154***	10.284***	371.924***	8.377***
	(9.058)	(2.490)	(105.738)	(3.212)
New house price	-0.008***	-0.002**	-0.136***	-0.006***
	(0.003)	(0.001)	(0.037)	(0.001)
Second-hand house Price	0.015***	0.002***	0.191***	0.007***
	(0.003)	(0.001)	(0.035)	(0.001)
Station	3.010	5.933***	183.608***	2.337***
	(2.424)	(0.779)	(27.868)	(0.849)
Metro	1.503	19.593	237.703	5.197
	(39.389)	(12.549)	(494.362)	(15.086)
Population	4.294***	0.647***	22.701***	1.446***
	(0.536)	(0.208)	(6.225)	(0.190)
Anchor	-0.008**	-0.005***	-0.115***	-0.002**
	(0.004)	(0.001)	(0.038)	(0.001)
N	202	200	274	279
R^2	0.608	0.429	0.636	0.579
adj R^2	0.587	0.399	0.622	0.564
AIC	2643.665	2082.452	4997.402	3143.089

Notes: Standard errors (clustered by projects) in parentheses; ***p<0.001, **p<0.01, *p <0.05, .p <0.1.

In Model 4, the independent variable *Single* shows if there is at least one digital system, and *Portfolio*, another independent variable, represents if there are two or more digital tools.

We found during data collection that many malls lacked data before deploying digital systems. In other words, they lacked standardized data management, which made some of the malls unsuitable to serve as a sample. In fact, this will hinder operators from getting a full knowledge of the mall's operation and making business decisions and evaluations. It can be concluded from the perspective of cognition that digital systems can integrate resources between departments in a property corporation for synergetic management and better

efficiency.

Regression results showed in Table 14 suggest that compared to a single-tool system, a portfolio plays a bigger role in rental income, customer-flow, total sales, and other income including property management and diversified operation. The increase of rental income with a portfolio was 45,300 yuan more than that with a system of only a single digital tool. That was about 10% of the increase with a single-tool system (483,900 yuan). What is more, the increase of the customer-flow was added by 61,400 yuan, and that of the total sales by 7.79 million yuan in each mall per month on average, which is equivalent to doubling the effect of a single-tool system. The increase of property management, diversified operation and other income was added by 57,600 yuan per month on average.

Moreover, Table 14 suggests covariates including distance to stations, with or without a metro in 3 km, the population in the neighborhood also have a say in terms of competitiveness of HOPSCA. Malls with a metro nearby enjoyed a customer-flow of 195,900 more than those without on average per month. Their total sales were increased by around 2.337 million yuan and other income by around 52,000 yuan per month. The model shows that directions of effects that the average price of new houses and resold houses have on the competitiveness of HOPSCA are in the opposite. The price of new houses cannot truly reflect the comprehensive value of areas due to policy restrictions and developers'

hoping to win money back quickly. Rather, the price of resold houses can better reflect the value of areas and how locations affect competitiveness because resold ones are predictable in their quality and property rights. The parameter estimation in the model for areas of anchor stores in malls is negative, which means the larger areas occupied by anchor stores in similar projects of HOPSCA, the smaller room available for making business decisions and adjustment taking use of data. As a result, the impact of digital systems on business operation will drop accordingly.

These attributes of commercial projects are critical factors in decisions from lands-use permits to construction and operation. LBS can provide key information mentioned above at a critical moment of decision-making, helping managers to embrace opportunities and sharpen edges.

4.7.6 Costs incurred for deployment of digital tools

The following methods were used to calculate the cost efficiency of a digital tool/product in real situations.

Take three years as a cycle (tools requiring annual fees cost consistently throughout years while others require first-year investment and maintenance fees of 10% to 15% in subsequent years.

Take HOPSCA of 50,000 square meters as a standard unit (HOPSCA generally covers 30,000 to 80,000 square meters and this is a compromised figure).

Assign the full cost to x yuan/square meter/3 years.

To analyze in this way:

PMS/AMP: Property Corporation B spent around 20 million yuan on 40 projects in 3 years. 30 million yuan is an efficiency boundary because other products will also be considered. It is believed that all investment in digitalization should be controlled at 5% or so of rental income. 5% to 10% is a game zone. Once surpassing 10%, digital tools will be regarded as a burden and have a negative effect if they do not create value by themselves. Any income needs to be deducted by excess expenditure. For comparison, Wanda Group spent 150 million on 200 projects while Future Land Development Holdings Limited spent 70 million on 100 projects. It is acceptable from their perspective of operation.

Precise Customer-flow Statistics System: the set costs are around 35 yuan/square meter/3 years. It is the goal to be 20 yuan in the future. For comparison, the costs of Wanda Group were around 120 yuan/square meter/3 years, and the average costs in the market were about 45 yuan/square meter/3 years.

Membership management system: 40 projects of Property Corporation B cost 8 million yuan in the first year, and 1 million yuan every year after that. It cost Wanda 120 million yuan and Future Land Development Holdings Limited Holdings 30 million yuan in 3 years. Both Wanda Group and Future Land Development Holdings Limited have completed the first-year development and

pay annual subscription fees for continued access to the system ‘s services (the former spent 200,000/project/year and the latter 100,000/project/year.

LBS: annual expenses of 40 projects of Property Corporation B were around 1 million yuan. No comparison projects are available.

CHAPTER 5. CONCLUSION AND POLICY IMPLICATIONS

5.1 Conclusion

Tools at the stage of digitalization (such as PMS/AMP and most of Membership Management System in the paper) have a noticeable and quantifiable effect on enhancing HOPSCA's attractiveness and competitiveness parameters.

Tools at the stage of networkization (such as Membership Management System and Precise Customer-flow Statistics System in the paper) have a noticeable, quantifiable and synergetic effect on HOPSCA's attractiveness parameters, but attractiveness parameters' effect on competitiveness remains unknown.

Quantitative contributions of tools with the goal of intelligentization (such as Precise Customer-flow Statistics System and LBS in the paper) can be measured in a portfolio but cannot as a single tool.

Our analysis results have considered that the initial deployment of the PMS system will correspondingly increase the operating personnel and management costs. However, it is worth noting that the cost of system upgrades every 2-3 years is also an expense that cannot be ignored. Therefore, it is important to make a longer-term plan for the system, to achieve precise positioning of requirements and ease of deployment as much as possible.

5.1.1 Effect of PMS/AMP

PMS/AMP: The system significantly lowers labor and management costs, thus larger profit margin and higher efficiency of HOPSCA. It plays a critical role in improving data accuracy and business interconnectivity. As the system is more widely deployed and used, related costs will drop, and marginal returns will increase.

The system will contribute to higher indicators of financial evaluation such as occupancy rate, revenue, NOI and returns on assets, and thus improved operation efficiency of HOPSCA. After the usage of PMS, the occupancy rate of each HOPSCA increased by 3.4% per year on average, Total revenue increased by 1.24 million yuan annually in each HOPSCA on average (not growth-adjusted)，with an increase of 3% to 4%. Rental income increased by 740，000 yuan annually in each HOPSCA on average, with an increase of 3% to 5%, and the proportion of standardized rents by 16.9%. At the same time, research results show although PMS brings higher occupancy rate and revenue, it costs more. Annual administrative expenses increased by 214,000 yuan and labor cost decreased by 679,000 yuan in each HOPSCA on average. Net operating income (NOI) in 2018 after the deployment of PMS hit 71,350,800 yuan, with an increase of 17,703,200 yuan, which was around one third of the data before. 2019 witnessed further growth in NOI.

All the analysis has considered the added operating personnel and management

costs brought by initial deployment of PMS. But it should be noted that system upgrading in every 2 to 3 years also costs more than a little. Thus, it is especially important to have long-term plans and simpler deployment for systems, and to achieve targeted positioning according to demands.

5.1.2 Effect of Membership management system

Membership management system: compared to traditional app-based ones with their own traffic, WeChat-based Membership management system are more convenient and able to obtain user traffic with lower costs, resulting in surges in registration and activation. According to data of payments, points, and parking, the new Membership management system plays a distinct role in encouraging users to get information and engage into activities of malls. User adhesion is enhanced with lower marketing costs.

Thanks to the membership management system, customer-flow in HOPSCA grew by 1% per month on average. And average total sales revenue increased 1.01 million yuan per month, accounting for 2-3% of the figure before applying the system, which was 249.02 million yuan.

The point of this paper is a Membership management system based on WeChat ecosystem boasts significant values of digital quality (the authentic and active degree of members) and linkage capability and provides lower development costs and better operation effects.

5.1.3 Effect of Precise Customer-flow Statistics System

Precise Customer-flow Statistics System: the accurate customer-flow system plays a critical role in ensuring accuracy and quality of data and making business prediction. Besides values offered by traditional customer-flow systems, Precise Customer-flow Statistics System also provides more analyzable core data that malls highlight, such as data of regular customers, visit frequency, time length, paths and monitoring on operation in key areas. Precise Customer-flow Statistics System can guide operation and upgrade strategies as well as business allocation. Hence, wrong shopper-guiding and planning can be avoided, and business effects can be evaluated more accurately with less costs on marketing and research. Once equipped with Membership management system based on WeChat, Precise Customer-flow Statistics System can guide malls in better servicing key customers.

HOPSCA deployed with Precise Customer-flow Statistics System enjoyed a surge in customer-flow of additional 699,000 visits and in customer retention of additional 577,000 visits on average per year. At the same time, density of customer-flow increased by 26.7 people per square meter and there were 188,000 more members in each HOPSCA every year. What is more, accumulated volume and better quality of data brought by Precise Customer-flow Statistics System exponentially helped improve operation efficiency of malls.

5.1.4 Effect of LBS

LBS: data of location, the geographically based penetration data, presents its value on quality and accuracy of data as well as business prediction. It is capable to replace traditional studies and customer research and to provide extremely precise guide and analysis for business evaluation and marketing. It contributes to increased overall revenue of business, upgraded portfolio and better targeted marketing strategies. It can also evaluate the impact of other digital tools on consumer behavior while providing data standards.

The study found that LBS brought higher customer-flow to three types of business among samples, namely shopping, fitness and catering, while the ratio of customer-flow with other preferences decreased accordingly when it generally remained the same. The consumption income mainly came from those three types of business, which means penetration data in LBS system can accurately and effectively improve the total revenue of HOPSCA and optimize portfolios of business format.

Table 15: Summary of empirical results

Digital tools	Independent variables	Linkage effects	Conclusions
PMS/AMP	Occupancy rate	The occupancy rate increased by **3.4%** annually in each HOPSCA on average.	**Accuracy + Linkage Service** The system significantly lowers down labor and management costs, thus larger margins, and higher efficiency of commercial projects. It plays a critical role in ensuring data accuracy and business interconnectivity.
	Total revenue	(For experimental group) Total revenue increased by **1.24 million yuan** annually in each HOPSCA on average (not growth-adjusted), with an increase **of 3% to 4%.**	
	Rent income	(For experimental group) Rental income increased by **740，000 yuan** annually in each HOPSCA on average, with an increase **of 3% to 5%** (see notes).	
	Total management costs	Total management costs increased by **214,000** yuan annually in each HOPSCA on average.	
	Labor costs	Labor costs decreased by **679,000** yuan annually in each HOPSCA on average.	
	Rental fulfillment ratio	The proportion of standardized rent increased **by 16.9%** annually in each HOPSCA on average.	
Membership management system	Customer-flow	Customer flow added by **70,200** visits each HOPSCA per month on average, with an annual increase of **1% to 2%.**	**Scale of quality + targeted linkage** WeChat-based Membership management system are more convenient and able to obtain user flow with lower costs by taking advantage of the quality and scale of accumulated membership data. User adhesion is enhanced with lower marketing costs.
	Sales	Sales volume added by **1.01 million** yuan each HOPSCA per month on average, with an annual increase **of 2% to 3%.**	
Precise Customer-flow Statistics System	Customer flow	Customer flow increased by **699,000** in each HOPSCA annually on average, with an increase **of 1%** or so.	**Accuracy + effective prediction** The accurate customer-flow system plays a critical role in ensuring accuracy and quality of data and making business prediction.
	Customer retention	Customer retention increased by **577,000** in each HOPSCA annually on average.	
	Customer-flow density	Density of customer flow increased by **26.7 people per square meter** in each HOPSCA annually on average.	
	Number of members	There were **188,000** more members on average in each HOPSCA every year, with an increase **of 1.5%** or so.	
LBS	Shopping	Ratio of visits increased by 0.8 percentage point.	**Accuracy + scale of quality + effective prediction** Data of location presents its value on quality and accuracy of data as well as business prediction.
	Food & Drink	Ratio of visits increased by 6.5 percentage points.	
	Sports & Fitness	Ratio of visits increased by **1.2** percentage points.	

5.1.5 A summary on conceptual models

Figure 19 displays a summary on conceptual models. To be more specific:

- PMS/AMP systems have a direct effect on competitiveness parameters.
- Membership management system has a significant effect on attractiveness parameters. On top of that, Precise Customer-flow Statistics System can have a synergetic effect, but its direct influence on competitiveness parameters is hard to tell.
- Doubtless but hard to be quantified is the influence of attractiveness parameters on competitiveness.
- LBS has through indirect results an effect on other products, which can be observed in a portfolio but cannot be measured.
- Tool portfolios have noticeable synergetic effects. Precise Customer-flow Statistics System and LBS show their potential in value in the portfolio,

which is expected to be further improved.

How digital tools have an impact on the competitiveness of HOPSCA: Through data analysis of LBS in business circles, it is confirmed that consumers' behavior preferences can be influenced by digital tools, so they will better match the types of operation of HOPSCA. In other words, digital strategies have an impact on consumer preferences through channel innovation, client education, product upgrading and strategic business units, hence reshaping the competitiveness of HOPSCA.

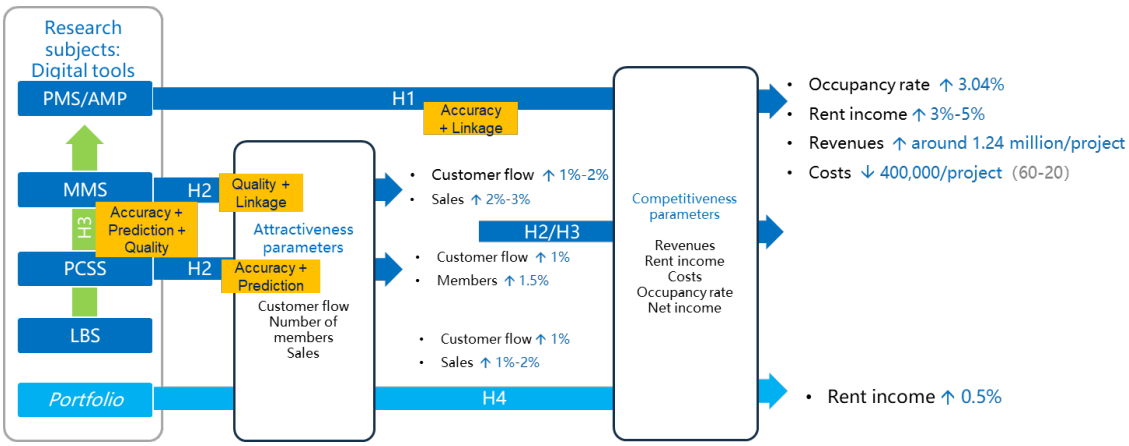

Figure 19: A summary on conceptual models

Deploying three types of digital tools contributes to a more obvious increase in rental and other income, customer-flow and sales volume compared to deploying only one type. During regression analysis, we controlled attributes of shopping malls including their scales, ages, with or without a metro nearby, distance to the downtown, proportion of areas of anchor stores, and population in 3 km.

It can be concluded that there exists an interactive effect among the three digital

tools. One of them can have an impact on the effects of another by influencing a third one. As a result, two types of tools that are interactive with each other may change as a third digital tools is involved, influencing competitiveness of HOPSCA even more profoundly.

Regression results suggest that effects of three types of digital tools have all passed significance test while the interaction effect between them is positive at 1%. That means the interaction does exist and the empirical model is reasonable. The interaction effect of Precise Customer-flow Statistics System is also tested positive, manifesting the system will operate better with the support of other digital tools.

5.1.6 Possible limitations in this study

The following potential paradoxes are unavoidable in research due to the wide range of digital tools with uneven quality produced by different suppliers:

① HOPSCA progresses, by its nature. There is a possibility that its development has nothing to do with digital tools.

② There may well have been other more excellent digital products/tools besides those mentioned in this study.

③ Whether some strengths/weaknesses of the digital tools have not been investigated in this study.

To answer the above paradoxes, exploratory research and robust tests were conducted, and they are concluded that:

(1) This study investigated the development trend of Property-Corporation-B-owned HOPSCA of the same type with/without digital products at the same time. Such a design excludes biases caused by management, enterprises, and business types to the largest extent. HOPSCA in a same management system shares general commonalities, thus suitable for research on impact of digital products.

(2) IT Corporation Y had had over 7 years of experience in deploying digital products in HOPSCA before producing the products mentioned in the paper. Up to 2020, IT Corporation Y had investigated all kinds of digital tools including those for procurement, usage, R&D, and implementation, and kept an eye on their effects. It turned out that most tools did not survive the tests, including O2O platforms, Wi-Fi and Bluetooth positioning, indoor robots, sales data collection, online shopping malls and delivery, data of indoor maps, smart displays, app-based membership platforms and unmanned parking systems. No products or other candidates in the market succeeded except unmanned parking systems, which are valuable and ready for application but irrelevant to the paper's goals. We finally chose to cooperate with Tencent and design products with the support of its technological expertise, for its technology be a good representative in the industry.

(3) It cost us a whole year to R&D and implement each tool/product, and to adjust, redeploy and research it. There is a possibility that the study does not

have a clear enough insight into the effectiveness and side effects of these tools with the consideration of evolution of technology and the scale of study, but the risk can be offset to a large extent thanks to market attributes of the team. Some or all the products mentioned in the paper are deployed in the following target companies. They are SCPG, China Merchants Property, China Overseas Estate, Huafa Group, Suning, China Overseas Property, Aux, CIFI, Country Garden Culture Tourism Group, Greenland Business Group and Bright Real Estate. These commercial property corporations are leading in Chinese market and their successful moves prove the study is at least relatively correct.

(4) Some coefficients of key independent variables are of low significance, but their signs are correct when testing the effect of digital tool portfolios. It is mainly because that studying the effects requires multiple digital tools to be deployed in HOPSCA with as long intervals between deployment as possible. But HOPSCA meeting the requirements accounts for a small proportion in our samples, thus limited accuracy of estimation. We are looking forward to seeing subsequent studies verify the interaction between different digital tools and test whether their substitution and complementary effects are stronger or weaker, as digital tools are more extensively used and samples increase.

(5) According to practical experience in business, it can be foreseen that the effects of digital tools will also be influenced by how they are used in different HOPSCA. Investment in digital tools has a non-linear, inverted U-shaped

impact on competitiveness of HOPSCA. It will deliver both additional returns and costs to HOPSCA. But marginal returns are highly likely to diminish while marginal costs to increase. Once rising to a certain point, more investment will not continue to improve its competitiveness. Therefore, there is an optimal range of investment in digitalization and digital portfolios. However, data obtained does not support the study to evaluate differences of the degree of digitalization and investment between HOPSCAs, and the question is left to further exploration.

5.2 Policy implications

HOPSCA's digital strategies should attaches great importance to the principle of the hierarchical construction (digitalization – networkization – intelligentization), and have portfolios as possible when costs are controllable. Contributions should be evaluated with the scientific system (Accuracy-Prediction-Quality-Linkage). Intelligent tools play their part mainly by strengthening fundamental tools. A strategy following this path can enhance HOPSCA's attractiveness and overall competitiveness.

Several highly feasible policy implications for digital strategies of HOPSCA are derived from the conclusions:

(1) Strengthened operating systems, which are digitalized and networked, can bring reduced management costs, improved operating efficiency and greater NOI as well as per capita productivity. The larger the scale of assets under

management, the more significant marginal benefits.

(2) The Precise Customer-flow Statistics System can greatly improve the accuracy and reliability of customer-flow statistics data, distinguish customer segments, and provide direct and powerful customer preference data for targeted marketing and leasing strategies. When it is connected to the Membership management system, it can make marketing more efficient and increase the input-output ratio for marketing and operation.

(3) Member traffic and customer activation rate can be increased with lower costs, by combining use of payments, points, and parking data. It is suggested the Membership management system plays a significant role in encouraging customers to pay close attention to promotion information to engage into promotion activities of HOPSCA. As a result, customer stickiness is enhanced and there is less of a likelihood of customer churn, thus marketing costs are reduced indirectly.

(4) LBS, the geographically based penetration data, is capable to replace traditional market investigation and research, providing extremely precise guiding and analysis for business evaluation and marketing plan. LBS also can enhance the market revenue capacity, optimize business format portfolio, and provide better targeted marketing strategies. It can also evaluate the effect of other digital tools on consumer behavior while providing data standards.

By effective deploying PMS, the Membership management system, the

accurate customer-flow system and LBS, a comparatively perfect commercial Big Data system is formed. Fully equipped with resources and capability that a web-based intelligent system requires, the system can obtain most of the necessary business data of internal control, users, externalities, scenarios and so on. However, with each additional tool in the portfolio, business operations efficiency or revenue are continuously improving, while the effect of other digital tools is also strengthened.

(5) The effectiveness of this digital tool portfolio stands out among various portfolios we have tried to implement, forming a relatively reliable digital architecture & application strategy. Different deployment sequence for the different stages may produce various outcomes, which also are investigated and analyzed.

Based on the above conclusions, we have put forward a few of feasible industry recommendations, the significance of which lies in guiding the application of digital technologies in HOPSCA, laying the foundation for studying how digital technologies can create effective added value for business, and providing a theoretical basis for Chinese commercial real estate operators' new digital strategies. These recommendations also focus on bringing about industry technology innovation and introduce feasible technology roadmaps to other HOPSCA in China and the world.

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