

Senior Entrepreneurship and Technology

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Abstract

Fortunately, population is living longer. Although this fact is positive, it also represents a challenge for societies, namely in terms of employment and social participation. This implies more individuals out of the labor market at a later stage of life both because they get unemployed, and it is harder for them to find a new job (compared to younger individuals), or because they retire.

Senior entrepreneurship is defined as a process in which the older individuals (aged over 50) create a new business in their late professional career or after retirement. This option of social participation by older individuals might be positive for both the individual (e.g., by allowing to apply the human and social capital accumulated in life, being active in society through work); and the society in general (e.g., by contributing to decrease the economic and social burden of an increasing group of inactive people in the labor market).

Senior entrepreneurs may face several challenges, being technology use and adoption an important topic which is still understudied among this social group. This master thesis examines the link between senior entrepreneurship and technology. Specifically, it analyses the importance given by senior entrepreneurs to technology; the existing needs and challenges facing during the development of their business, as well as the potential concerns which are critical for entrepreneurship. This study is undertaken by comparing senior with younger entrepreneurs. Moreover, the thesis adopts the Business Model Canvas framework to map technologies according to the main building blocks of a business and allow for a more detailed discussion about which technologies can hinder or foster senior entrepreneurs' activity.

This thesis allows for a better understanding of the types of technologies that are considered important by a specific group of individuals – Chinese entrepreneurs working a specific activity/industry – catering – and operating within a specific geographic boundary – Portugal and China. The research addresses the key challenges entrepreneurs are facing with the technologies currently adopted and unveils potential needs for other

technologies. The present analysis draws implications both for policy makers, organizations that support businesses, and entrepreneurs in general.

Keywords: population aging, senior entrepreneurship, technology, Business Model Canvas, building blocks, catering industry, Chinese entrepreneurs.

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1. Introduction

1.1. Background and Problem Description

The aging of the population in the contemporary world is the most important trend in the change of the age structure of the world population (He, Goodkind & Kowal, 2016). It is characterized by the relative decrease of the young population in the total population and the corresponding increase of the elderly population. For a long time, people often thought that the phenomenon of population aging was unique to developed countries, however this phenomenon has become a widespread worldwide problem since the 1970s (United Nations, 2016). Therefore, whether in developed or developing countries, population aging has become a major concern at the global level.

At the beginning of this century, the World Health Organization put forward the concept of "active aging", which means that people should actively participate in political, economic, cultural and social activities when they are old, so as to increase social vitality and promote social development while maintaining their quality of life (OECD, 2012). As one of the ideal approaches to achieve "active aging", senior entrepreneurship has been attracting academic attention since the early 1980s (OECD, 2012).

In the process of modernization, young people are often associated with characteristics such as "innovation, progress and efficiency", while the elderly are negatively labeled as "retreating and backward", ignoring their accumulated life experience and value (Liu, 2017). The current information and Internet environment also promotes the cognitive changes in the social economy, culture, life and consumption of the elderly. Due to the rapid development of the Internet and artificial intelligence technology, science and technology products have been integrated into people's daily life, and the space-time distance between people is getting closer and closer (Yan, Xie, Shi & You, 2019). However, information, means and tools are adapted relatively slowly by the elderly who, therefore, face this "digital divide" in a particularly obvious way (Yan, Xie, Shi & You, 2019).

In the 21st century, technology plays a central role in almost every aspect of peoples' life. Hence, entrepreneurs constantly need to find new and practical ways of using technology as a tool for business development¹. Whether they are building a fledgling company or at a critical juncture of rapid growth, today's entrepreneurs must understand that technology is the foundation of all business operations¹. In the ancient times when the level of productivity was low, people's understanding of technology was limited to the subjective abilities such as skills, techniques and operation methods acquired on the basis of production experience (Hou, 2018). Technology is the knowledge, experience, skills and means accumulated by human beings in the process of long-term utilization and transformation of nature in order to meet their own needs and desires, follow the laws of nature, and is the sum of the methods, skills and means by which human beings use nature to transform nature (GYF, 2021).

1.2. Context

Most of the European countries are struggling to find ways to tackle the demographic consequences of the aging workforce (Stypinska, Franke & Myrczik, 2019). Kautonen, Gelderen & Tornikoski (2013) pointed that these demographic changes also affect the entrepreneurial activities in Europe where it is possible to notice a current rise of older entrepreneurs. The senior entrepreneur has years of experience, whether corporate experience or experience managing a family and he/she is eager to embrace new opportunities (Isele & Rogoff, 2014).

According to Cabral², the challenge of socio-demographic ageing in Portugal is greater than in most countries in Europe and indeed in the world, not only life expectancy is improving more than OECD (Organization for Economic Cooperation and Development) average but, above all, the present Portuguese fertility rate is among the lowest in the

1 BDWK. (2021). The role of technology in entrepreneurship cannot be ignored.

2 Cabral, M. V. (2017). The Ageing Challenge in Portugal and Europe.

whole world (2014 = 1.21, 2015 = 1.31). The author mentions that the population is currently decreasing in Portugal and may decline by 25% in the next 30 - 40 years, the population of Lisbon city is much older than the country average: 28% of people living in Lisbon had 65 years or more in 2015. The Portuguese socio-demographic reality demonstrates the European trend of increasing the population's aging index, especially in recent years (Maia & Costa, 2021). The authors also mentioned that "the population aging index in Portugal, set in 2017 at 153.2%, reveals the growing trend of recent years". The resident Chinese community in Portugal received the highest increase in fellow countrymen in 2013, according to data contained in the latest Immigration, Frontiers and Asylum report by the immigration and borders service (Wei, 2020).

As the world's most populous country in 2021, China is in a better position to show the problem of aging population (Jiang, Xiang & Gao, 2018). China's population is aging faster than almost any other country in modern history (Rapoza, 2017). In 2017, in China, the proportion of Chinese citizens above 60 years old was of 17.3 percent, approximately above 241 million individuals and it is expected that China's 65-year-old population will reach 487 million, or nearly 35 percent in 2050 (Chi, 2018). Thus, the aging population circumstances of Portugal and China are increasingly serious than most of other countries with regard of the demographic trends discussed above. In other words, senior entrepreneurship in Portugal and China is a valuable and meaningful phenomenon to be studied due to the population aging dynamics occurring within these two countries.

In order to reduce the influence of the variable "nationality" on the results of the study, the research objects are specified as Chinese senior entrepreneurs. Chinese business immigrants in Portugal emphasize their high degree of self-employment and concentration in the textile and catering industries (Li, 2018).

On the other hand, it is evident that the impact of technology on our day to day lives has grown exponentially over the past decade (Martin & Omrani, 2019). According to Martin and Omrani (2019), whether it be laptops or cell phones, technology helps us connect with the world around us and acts as a portal to vast amounts of knowledge which can be

accessed with ease. However, the author mentioned that many new entrepreneurs do not utilize technology to its full extent to propel themselves to new heights, especially senior entrepreneurs (Martin & Omrani, 2019). While innovation remains a focus of policymakers, very little is known about how older entrepreneurs adopt new technology or introduce new products. Similarly, demographic studies of entrepreneurship are mostly interested in nonage-related demographic influence on entrepreneurial behavior (Colovic, Lamotte & Bayon, 2019).

Therefore, it is critical to understand which technologies facilitate the start-up and development of a business and which limitations senior entrepreneurs face regarding the use of those technologies in business start-up or development.

1.3. Purpose and Objectives

In order to operationalize the study, this dissertation assesses the types of technologies that Chinese (senior and younger) entrepreneurs – who operate in China and/or Portugal – have used and plan to use in the catering industry.

The analysis concentrates on the catering industry essentially because it is composed by many small businesses, with relatively low entry barriers and with the potential to offer relevant insights on the use of technology among senior and younger Chinese entrepreneurs in both Portugal and China. The catering industry comprehends food production and operation, providing consumers with all kinds of drinks, food, consumption places and facilities through immediate processing and production, commercial sales and service labor (Liu, 2005). The catering industry has an important impact in improving the quality of people's life, as well as to explore employment channels and revitalize the economy; moreover, it plays an increasingly important role in improving people's lives (Liu, 2005).

With the goal of framing entrepreneurs' perception of technology adoption in business start-up and development, the present research uses the Business Model Canvas (BMC)

typology (Osterwalder & Pigneur, 2010). There are several building-blocks entailed in a BMC which relate to the diverse key aspects of a business (Sawitri & Suswati, 2019). The Business Model Canvas is widely used by researchers and practitioners, and it can help entrepreneurs generate ideas, reduce guesswork, make sure they're targeting the right audience, and solve the right problems (Yan & Mi, 2019). Therefore, the Business Model Canvas conceptual framework is an appropriate and effective method for characterizing and defining the role played by technology within each of the business building-blocks and, consequently, to achieve the goals of the present dissertation. The next section outlines the relevant research questions and methodological steps drawn from the literature in order to approach the phenomenon at study.

A) Research Questions

- What technologies are important and essential in catering industry, in general?
- What roles do these technologies play at every stage of the business model canvas?
- What technologies are perceived as important within the catering industry for the entrepreneurs in general?
- To what extent age associates with the importance of technology, as perceived by entrepreneurs?
- To what extent age associates with the limitations of technology, as perceived by entrepreneurs?

B) Methodological Steps

- Review which technologies are important and essential in entrepreneurship according to previous literature.
- Link technologies with the nine building blocks of Business Model Canvas.
- Analyze how these technologies can play a role in defining/ addressing/ developing/ organizing/ involving/ improving those nine building blocks.

-
- Analyze senior entrepreneurs' perceived necessity, importance and satisfaction level with these technologies.
 - Integrate and analyze the results, summarize the key findings and discuss differences in age, taking into account the theoretical underpinnings from the literature review.

1.4. Structure of the dissertation

The dissertation is divided into the following chapters:

- **Introduction:** This chapter presents the background and problem description under study, the objectives of the dissertation, the research questions defined to fulfill the objectives and an outline of the dissertation, which is the current section.
- **Literature review:** Definitions, concepts, challenges and technology adoption models related to the research questions and hypotheses at hand are discussed with focus on the relationship between technology and senior entrepreneurship.
- **Research design and methods:** This chapter determines the direction of the study and explains how the data will be collected and assessed. The process underlying the definition of the technologies used in the catering industry is discussed and the connection between these technologies and each of the nine building blocks of Business Model Canvas is explained.
- **Preliminary (first-round) result and discussion:** The preliminary technology lists originating from theoretical and practical sources are presented and discussed. After making a scientific and robust integration, the new list of technologies in the catering industry is obtained. The relationships between these technologies and the BMC building blocks are discussed.
- **Data optimization:** The information obtained from the survey is integrated and transformed into numerical data to perform a statistical analysis (using the STATA

software package).

- **Final (second-round) analysis and discussion:** This chapter is devoted to the analysis of all the data gathered in the previous stag and the discussion of the results obtained.
- **Conclusions and limitations:** The final conclusions as well as the limitations of the study are presented and discussed.

2. Literature Review

2.1. Senior Entrepreneurship

2.1.1. Definition and Importance

Senior entrepreneurship refers to a process in which the older group of people (aged over fifty years old) creates a new business in their later career – the senior entrepreneurs. The United Nations has agreed that over 65 years may be usually denoted as old age and this is the first attempt at an international definition of old age. However, the World Health Organization (WHO) defines older people as those over the age of 60 (WHO, 2002). In fact, the appearance of these concepts has several reasons. In recent years, the world's older population is growing dramatically (National Institute on Aging, 2016). Population aging is widespread across the world. Population aging is a shift in the distribution of a country's population towards older ages. This is usually reflected in an increase in the population's mean and median ages, a decline in the proportion of the population composed of children, and a rise in the proportion of the population composed of the older (Jakovljevic, Netz, Buttigieg, Adany, Laaser & Varjacic, 2018). Asia and Europe are the two regions where a significant number of countries face population ageing. Within twenty years, many countries in these regions will face a situation where the largest population cohort will be those over 65 and average age approach 50 years old. As a career choice in the later life of social subjects, senior entrepreneurship can give full play to the residual heat of the older group and create value, increase employment and promote economic development. It has become an important way to reduce the negative impact of population aging (Kautonen, Down & Minniti, 2014). In Australia, for example, a third of small business owners are over 50, and this group is growing faster than younger groups. Under the current international trend of population aging, it is an important measure to reduce the negative impact of population aging to stimulate and enhance the willingness of the elderly to engage in entrepreneurial activities (Wu, 2022).

With the increasing trend of aging in the world, people pay more and more attention to

senior entrepreneurship (Maritz, Jones, Foley, Klerk, Eager & Nguyen, 2021). The authors also mentioned Entrepreneurship of the elderly can not only provide employment, but also increase the second entrepreneurship under the background of economic transformation, reduce the negative impact of aging population, and promote social and economic development. The research of domestic and foreign scholars focuses mainly on the behavioral problems, advantages and disadvantages of senior entrepreneurship and its contribution to social economy (Harms, 2014). The economic impact of the businesses started and run by senior entrepreneurs is very significant, including their own self-reliance and their communities'—indeed the world's—economic vitality (Isele & Rogoff, 2014). Senior entrepreneurs are creating jobs for themselves and for people of all ages. Senior entrepreneurship also can reduce social isolation and prevent loneliness, provide social support, build social cohesion, and promote lifelong learning skills (Crossen-White, Hemingway & Ladkin, 2020).

2.1.2. Senior versus Young Entrepreneurship

Growing numbers of seniors have the resources, skills, and interest in venturing out on their own, often after years of wage and salary employment (Hudson & Goodwin, 2014). According with the United States Senate (2014) the world is beginning to understand how senior entrepreneurs with their wealth of work and life experience, deep networks, and eagerness to remain productive are a huge untapped resource. Additionally, the United States Senate (2014) mentions that 70% of senior-owned enterprises last more than three years compared to only 28% among younger start-ups. In recent research, Stypinska, Franke & Myrczik (2019) found that some specific advantages of senior entrepreneurship have been revealed, such as: work and industry experience, more developed social networks, higher technical and managerial skills, as well as a stronger financial position compared to younger persons. Moreover, contrary to the traditional perception that entrepreneurship is a young person's endeavor, seniors are the most entrepreneurial age group in what concerns to entrepreneurial intentions (Amoros & Bosma, 2013), as it is

shown in figure 1.



Figure 1 – The percentage of entrepreneurial intention from different age groups. Adapted from GEM Special Topic Report (2016-2017)

On the other hand, it is obvious that senior entrepreneurship has some weaknesses. Often with limited experience and resources needed for striking out on one's own, the likelihood of failure is real. As well, savings accumulated over a lifetime of work can be eaten up in a failed or struggling venture (Hudson & Goodwin, 2014). Among the obstacles faced by older entrepreneurs, few financial and social resources, problems of receiving preferable credits, ageism and age discrimination, lack of information and communication technology (ICT) skills or health problems may create barriers to entry into successful self-employment (Zissimopoulos & Karoly, 2007).

2.1.3. Concerns of Senior Entrepreneurship

According to the literature and some research reports, there are several concerns that need to be noticed. Starting an entrepreneurial activity is a risky endeavor under any circumstances and at any age. However, entrepreneurs whose age is over 65 are most likely to be willing to take a risk, which is represented in figure 2. Self-employment rates increase dramatically with age, the older an entrepreneur is, the more likely he or she is to own a larger and more established business (Isele & Rogoff, 2014). Among key findings about the self-employed is the fact non-entrepreneurial and non-knowledge-based endeavors are less desirable (Hudson & Goodwin, 2014). The same author claims that

many involved individuals pointed less to income being the main reason for embarking into this arena than their desire to be recognized, to keep busy, and to give back to society.

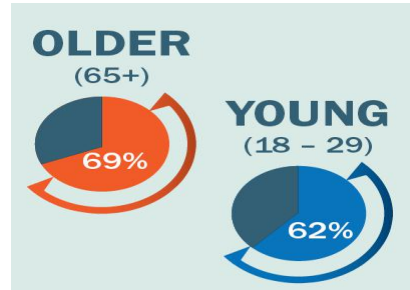


Figure 2 – Relationship between entrepreneurs and risk. Adapted from GEM Special Topic Report (2016-2017)

Stypinska et al. (2019) found that most of the businesses created within the projects needed to close their operation after 1 or 2 years due to the high cost of running a one-person company. Moreover, in the same study, the businesses were being closed due to family obligations (caring of older parents) or own health issues. Finally, the study shows that employment rates of older population increased and the better economic situation in the labor market and more options for employment, the less interest and willingness of older adults for starting or continuing self-employment, as a steady job position is considered a more attractive alternative to entrepreneurship.

2.1.4. Challenges and Solutions of Senior Entrepreneurship

Some articles such as Dabao (2021) show that many successful senior entrepreneurs exist. However, their percentage of all the senior entrepreneurs is non-ideal which means most of the older hardly succeed. There are specific ways to improve senior entrepreneurship, as mentioned by United States Senate (2014); some of those measures are the following:

- Rise the retirement age for the older and work longer hours.
- Reduce social discrimination against the older, improve social recognition and

expectations.

- Senior entrepreneurs are an untapped resource whose success can be furthered through microloans, crowd-funding capital, reduced loan rates, and tax incentives, among other interventions.
- In general, senior entrepreneurs have lower technical skills than their younger counterparts, a reduced tolerance for financial risk, and a shorter time horizon for their business ventures. One common solution to the problems raised by these needs is for senior entrepreneurs to work in teams.
- Since it is common knowledge that long-term unemployed seniors are the least likely to ever get a job again, the government is wasting millions of dollars on what constitutes a senior welfare program, when they could be investing those benefits in senior entrepreneurship education and seed capital for senior business start-ups from which the government would receive a significant economic return on that investment (United States Senate, 2014).

Educational institutions that reach active and involved seniors through their continuing education programs should consider adding “entrepreneurship for seniors” programs to their curriculum. Participation in the courses, training, and counseling significantly increased their skills and knowledge (Isele & Rogoff, 2014).

2.2. Aging and Technology

2.2.1. Technology Production

Technological products are material objects that have been designed by people and developed through technological practice to serve particular functions³. Technical products not only include new discoveries, new inventions, new theories, new processes,

³ BDBK. (2019). The price composition and pricing characteristics of technical products.

new procedures and other knowledge products, but also include new materials, new devices, new equipment and other physical products. It includes patent right, trademark right, copyright, license, proprietary technology, design scheme, technical specification, technical information and software. However, the technical products we talk about here mainly refer to the technology which are (going to be) essential and important in catering industry.

With the development of technology, many different technology products have been invented one after another. However, not all age groups are suitable for the same technology, and each group's attitudes and adaptability toward that technology are also diverse (Hauk, Hüffmeier & Krumm, 2018).

2.2.2. Technology Adoption

Technology is the sum of techniques, skills, methods, and processes used in the production of goods or services or in the accomplishment of objectives, such as scientific investigation (Liddell & Scott, 1980). As the figure 3 shows, technological advancements have become widespread, and their implementation into products of everyday use is accelerating.



Figure 3 – Rogers' curve (Tsai, 2015).

Technology has the potential to improve the lives of older adults by increasing their safety, security, and independence in daily life. However, too often older adults' capabilities and

limitations are not considered in the design of current and future technologies (Rogers, Stronge & Fisk, 2005). Surveys of technology use show that older adults tend to lag behind the general population in adopting new technologies (Wu, 2022). A stereotypical view might be that older adults are unable to learn to use these new technologies or are simply uninterested in “newfangled” technologies. However, such a view is overly simplistic and likely to be misleading. It is important to understand the factors that influence the adoption of new technologies; this understanding will provide insights to improve design, to develop better instructional support, or to direct the development of new technologies that perhaps better match the needs of the older adult population (Rogers, Stronge & Fisk, 2005).

In fact, there are already several case studies which can show and prove the importance of technology adoption and its effectiveness for the older. According to “the Statistics on the Total Population of Senior Citizens (aged 65 and above) in the World” (2020), there are 723 million senior citizens in total, of which 169 million are in China, accounting for 23.35%, ranking first in the world. Further investigation revealed, about 274 million elderly people (aged 60 and above) in China use mobile phones, among which about 134 million (48.9%) elderly people use smart phones to surf the Internet (China Ministry of Industry and Information Technology, 2020). Kinsella and Velkoff (2001) found that the proportionate rate of increase in Internet use is highest for the over-50 age group and pointed that Australian seniors are the largest and fastest-growing segment of online banking service users, totaling more than 775,000. Additionally, the authors pointed out that the number of senior Internet users in the United Kingdom recently surpassed 2 million (13% of that nation’s online population). Sweden and Denmark, however, boast the highest percentage of senior Internet users in Europe; 17% and 16% of their respective national Internet user populations are older adults. In addition, the idea that robotics technology might be used to support the everyday activities of older adults is not new. Following Engelhardt and Edwards (1986), these efforts recently have begun to come to fruition with the design of robots to support older adults in their homes such as the *Nursebot* project which has the goal of developing robotic assistants for older adults. The

robots are designed to support memory, social interactions, connections with caregivers, navigation assistance, and manipulation with objects such as the microwave. For example, China's output of service robots totaled 9.214,400 units in 2021, up 48.9 percent year on year (National Bureau of Statistics, 2021). In 2020, due to the impact of COVID-19, China's service robot market witnessed explosive growth, with the market size reaching 38.38 billion yuan, up 37.4% year on year. With the aging of the population and rising labor costs, the market demand for service robots is huge, and the market size is expected to reach 54.23 billion yuan by 2022 (China Business Industry Research Institute, 2022).

A) Difference of Technology Adopted by Younger and Older Individuals

“Not all functional abilities decline in all people, and the rate of decline varies widely across individuals” (Schaie, 1983). Because most changes are gradual, older adults often develop compensatory strategies to deal with age-related changes in perception, cognition, movement control, and anthropometry (Dixon, Lars & Backman, 2013). “Many capabilities either remain intact or improve with age, such as semantic memory and previously acquired procedural skills. With proper training, adults of all ages can learn new behaviors” (Rogers, Stronge & Fisk, 2005).

“Different from young people, old people are quite different from young people in terms of thinking logic and way of action. Only by considering more details can they truly enjoy the convenience brought by technology”⁴. Rogers et al. (2005) said that older adults may adopt new technologies only when they are convinced that the benefits of the new system clearly outweigh the associated costs. Such costs may be investments of money (e.g., purchasing new products), time (e.g., learning and practicing a new method), or effort (cognitive resources required for learning). However, Xie (2003) mentioned “it is true that older adults, as a group, tend to lag behind younger adults in technology adoption. Older adults may also have more strongly negative attitudes toward technology, but general claims about attitudes toward computer technology must be tempered by an

4 People's Daily of China: Discussion on entrepreneurship in the elderly from the perspective of active aging, 2020

understanding of the period during which the study was conducted, the computer technologies being assessed, the methodologies used, and the sample of the population being assessed.” Technology companies have made a lot of money by focusing on providing young people with quality service experiences. At the same time, many elderly people in China are stuck in the digital divide due to their separation from scientific and technological products⁵. Some evidence suggests that older adults are less likely to rely on automation. Relative to younger adults, older adults appear to be more sensitive to changes in reliability, which affects their trust and reliance (Sanchez, 2004). While changes in cognitive make-up may explain why older people may be less innovative, there are significant differences in the way younger and older people adopt new technology. Moreover, the emerging literature on technology adoption by older people suggests that seniors are slower than other categories of workers to adopt innovative tools such as information and communication technology (Friedberg, 2003). Older people are relatively conservative, and compared with young people, they have less subjective willingness to accept new things⁶. “Maintaining the same is often the safe choice for most of them”, pointed out by the institution, “however, with the development of science and technology and the advance of society, to let the elderly enjoy the convenience brought by science and technology, we need to integrate technology into daily life, so that they do not feel obvious changes³”.

2.3. Chapter Conclusion

Technology is pervasive in today’s world. In some cases, we choose to use technologies to support our activities but, in other situations, we have no choice because there are no alternatives, especially for senior entrepreneurs. Another fact of the world today is that the population is growing older—there are millions of adults over the age of 65 worldwide, and the proportion of older adults continues to increase. By exploring the existing literature, it

5 China Economic Net: How to Cope with aging technology, 2021

6 People's Daily of China: Discussion on entrepreneurship in the elderly from the perspective of active aging, 2020

is possible to clarify and discuss the characteristic of senior entrepreneurship. Comparing with the young entrepreneurs, senior entrepreneurs have many advantages such as life experience, resources and skills. On the other hand, several weaknesses of senior entrepreneurs are discovered as well such as lack of information, physical condition and willing to take a risk. After analyzing the status of senior entrepreneurship, some challenges (such as how to solve the reduced tolerance of senior entrepreneurs for financial risk) were found and the corresponding solutions are put forwarded as well. Then, the importance of technology to senior entrepreneurship is lead in and several cases of technology adoption are illustrated. However, through literature and journal searches, there is not much useful information on the relationship between senior entrepreneurship and technology, or between senior entrepreneurship and catering industry. Thus, how does this older segment of the population manage to adopt and adapt to new technologies is significant. Therefore, we will focus our discussion on newer technologies with which senior entrepreneurs are likely to be interacted in catering industry.

3. Research Design and Methods

3.1. Research Design

3.1.1. Key Steps

It is significant to assess the technologies which are adopted and useful in catering industry. The following research steps aim to explain the assumptions adopted in order to define a list of key technologies:

- Search technologies that may help and be adopted in catering industry, originating from research papers, articles and websites. Sort it into an initial technologies' list.
- Make an initial interview to a sample of entrepreneurs for obtaining the potential complementary technologies and validating/expanding the initial list. Ask a simple question: What technologies do you think are important for your business?
- Through content analysis, clear up and aggregate respondents' opinions and sort into a new technology list (according with the practitioners' perspective).
- Compare the two lists of technologies, coming from different (theoretical and practical) sources and develop an effective combination of both into a final new list.
- Design a reasonable and complete questionnaire using the new/final list as reference.
- Carry out a survey/set of interviews to 100 entrepreneurs of catering industry.
- Collect and organize the data that is obtained from the survey.
- Use data analysis software (STATA) to analyze the attitude of entrepreneurs in catering industry towards new technologies and the relationship between the technology and the nine building blocks of the Business Model Canvas.
- Compare the difference of technologies that are adopted or going to be adopted according with entrepreneurs' age and other characteristics.

-
- Unveil the technologies which can improve senior entrepreneurs' businesses.

Before the technology searching, it is necessary to introduce the BMC method, which is useful to structure the key aspects of any company/business and serve as a tool to analyze the relationship between a specific technology and the different dimensions of a company.

3.1.2. Technology Searching

According to Chad⁷, there are 10 technologies that are essential for small businesses. Most of them have correlation with catering industry, such as Shopping Cart Software. To accept payments via a website, Chad mentioned that the site must have shopping cart software. The software is designed to offer credit card processing, as well as check, PayPal or other methods of processing payments. The software also provides shoppers tools for calculating the costs of shipping and taxes. In addition to letting customers purchase items online, the software provides businesses options for keeping track of inventory and generating reports automatically (Chad, 2012). However, there is one technology that may be not related with dining industry which is Webinar Services. Chad pointed out that for many businesses dealing with clients across the country and around the globe, it is important that those in each location stay connected. One way to do so is through Webinar Services, which allow businesses to conduct presentations over the Internet, he said. The services provide businesses with the necessary tools to present online sales presentations, web seminars and product demonstrations to their clients, regardless of where they are located (Chad, 2012). But according to Lan (2017), the entrepreneurs normally start a small business with one place at first especially for catering industry. This phenomenon provides the evidence that the entrepreneurs of catering industry hardly adopt the Webinar Services technology. By this way, the rest of 9

⁷ Chad, B. (2012). 10 Tools You Need to Start a Small Business.

technologies are found to be suitable for use in the catering industry.

Gregory⁸, classified 33 kinds of technologies into 5 categories for small businesses. These five categories are Productivity, Financial, Marketing, Collaboration and Learning, Customer Service, Mobile Working and Telecommuting⁵. Through a similar process that the one explained before⁹, 9 technologies that have less or no possibility to be adopted by catering industry's entrepreneurs are cut off. (8 technologies such as Time Tracking are also cut off which are repetitive with the ones that are put forward by Chad Brooks.) In the end, there are 16 different kinds of technologies that are added to the technology list.

Finally, in order to improve the comprehensiveness and reliability of the list, it is necessary to validate it through the opinion of practitioners/entrepreneurs.

3.1.3. Initial Interview and Analysis

Two research strategies were used to perform the interviews. The first one consisted in visiting a local restaurant, avoiding dining rush hours, and talking with the owner(s) face-to-face. The second one is implied finding the available contact of entrepreneurs who have businesses in catering industry and communicate with them online. The information about all the subjects who accepted the interview is shown in the Table 1.

Table 1 – Information of Restaurants Who Accepted The Interview

Name	Type	Location
Sushi Come	Sushi Buffet	Av. Antonio Augusto de Aguiar 24A, Lisboa.
Da Wanmian	Chinese noodle	Calçada da Mouraria, Lisboa.
Chongqing Hotpot	Hotpot Buffet	R. Antonio Pereira Carrilho 18a, Lisboa.
Osaka	Japanese Buffet	Av. Praia da Vitoria 35B, Lisboa.
Han	Table Barbecue	R. Gomes Freire 11B, Lisboa.
Mr. Lu	Tradition Chinese	R. Antonio Pedro 95, Lisboa.
Grande Palacio	Tradition Hong-Kong	R. Pascoal de Melo 8, Lisboa.
Old House	Tradition Chinese	Alameda dos Oceanos 10611C, Lisboa.

8 Gregory, A. (2019). 33 Ways to Use Technology In Your Small Business.

9 Searching for connections between technologies and the catering industry and discussing the necessity and importance of specific technologies with restaurants' owners.

166 Barbecue	Chinese Barbecue	Haan Street, Xiangfang District, Harbin
Wuer Laotan	Sauerkraut Fish	Jingjiang East Road, Daoli District, Harbin
Literary Family	Hotpot & Seafood	Hongjun Street, Daoli District, Harbin
Xijiade	Chinese Dumpling	Guogeli Street, Nangang District, Harbin
Dicos	Fast Food	Xida Road, Xiangfang District, Harbin

According to the opinions of these entrepreneurs, some similar options are integrated as one technology. For example, most of the entrepreneurs put forward that the environment is very important due to the fact that it influences the dining willing of their customers. The entrepreneur of *Literary Family* mentioned that the theme design of the restaurant is significant as well. “Our library theme design draws the attention and increases the interests of customers”, he said. (The library theme restaurant is shown in figure 4.) In fact, the theme design is also a design of the restaurant environment and they can be considered as one technology which is the interior design. By this way, there are 12 technologies in the end that are summarized from the opinions of these entrepreneurs.



Figure 4 – Library theme restaurant. Adapted from the *Literary Family Official website*

What is the relationship between these technologies and the nine building blocks of BMC? The analysis of this connection is essential and critical for the current dissertation. For instance, the Location Selection technology is simultaneously related with Customer Segments, Cost Structure, Value Propositions and Key Resources. If the restaurant is near a school, its main customers will be the students. If the restaurant is near an administration building, its main customers will be the office staff. And different kinds of customers have different requirements on dining styles which is the Value Propositions of

the restaurant. On the other hand, a bustling and downtown location will have more costs than a remote and rural one. In addition, different locations have various resources. For example, if the restaurant is near the sea or aquatic product market, the seafood resources will be more abundant. As a consequence, the Location Selection technology is found that it influences four building blocks of the BMC after analysis.



Figure 5 – Ordering device. Adapted from Baidu.com

Another special example of the analysis is about the Ordering System technology. Most of restaurants in Lisbon don't have order device, the waiters usually deliver the paper of menu to the customers and write down or mark the name list of dishes they ordered. On the contrary, most of restaurants in Harbin (city of China) have order device (shown in figure 5) which can show the photos of every dish. The customers can order the dish by themselves the information from the device and the order will be automatically delivered to the waiter. The waiters need only to confirm the order which can save the ordering time and increase the efficiency. It means the restaurant no longer requires the number of waiters as before which can save employment cost. But this device and technology will cost more money comparing with traditional ordering way. So, it is difficult and complicated to determine if this technology can reduce the cost. The only thing that is certain is this technology is related with Cost Structure building block. Following this analyzing pathway, the connection between these technologies and the nine building blocks are characterized.

3.2. Methods

3.2.1. The Business Model Canvas (BMC)

A) Introduction

Business Model Canvas is a strategic management and lean start-up template for developing new or documenting existing business models (Barquet et al., 2011). It is a visual chart with elements describing a firm's or product's value proposition, infrastructure, customers, and finances. It assists firms in aligning their activities by illustrating potential trade-offs. Formal descriptions of the business become the building blocks for its activities. Many different business conceptualizations exist; Osterwalder's 2010 book and 2004 thesis propose a single reference model based on the similarities of a wide range of business model can be found in figure 6.

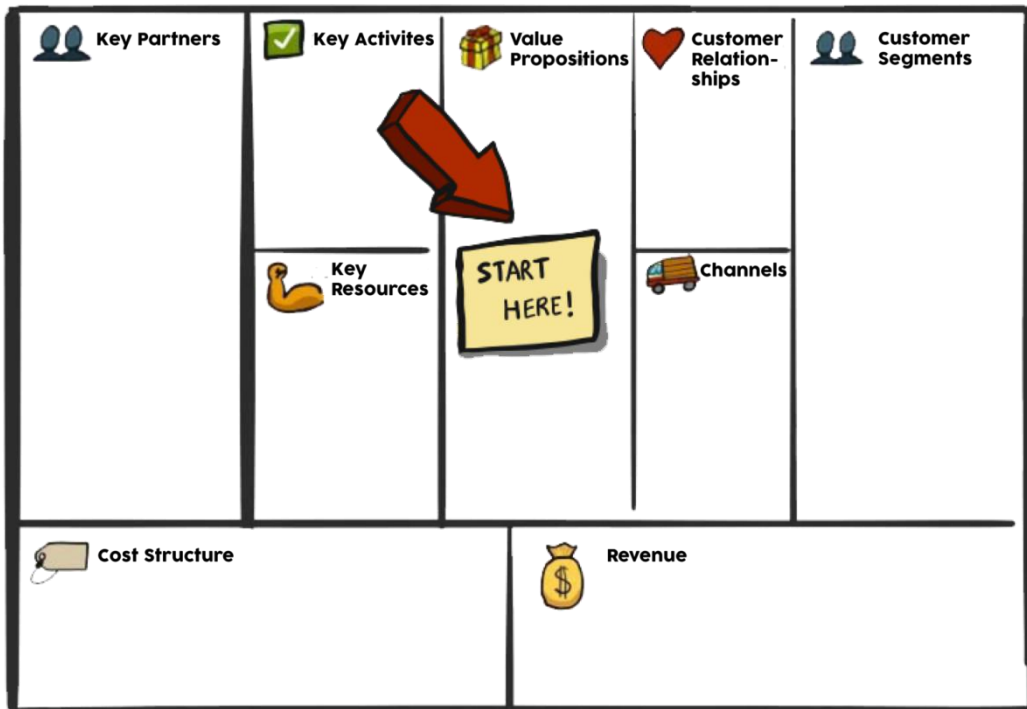


Figure 6 – The business model canvas. Adapted from Osterwalder and Pigneur, the nine business model building blocks(2010)

With his business model design template, an enterprise can easily describe its business model. Osterwalder's canvas has nine building-blocks; the name and central concept of

each is as follows:

- Key Activities

The most important activities in executing a company's value proposition. For example, the pen manufacturer would be creating an efficient supply chain to drive down costs.

- Key Resources

The resources that are necessary to create value for the customer. They are considered assets to a company that are needed to sustain and support the business. These resources could be human, financial, physical and intellectual.

- Partner Network

In order to optimize operations and reduce risks of a business model, organizations usually cultivate buyer-supplier relationships so they can focus on their core activity. Complementary business alliances also can be considered through joint ventures or strategic alliances between competitors or non-competitors.

- Value Propositions

The collection of products and services a business offers to meet the needs of its customers.

- Customer Segments

To build an effective business model, a company must identify which customers it tries to serve. Various sets of customers can be segmented based on their different needs and attributes to ensure appropriate implementation of corporate strategy to meet the characteristics of selected groups of clients.

- Channels

A company can deliver its value proposition to its targeted customers through different channels. Effective channels will distribute a company's value proposition in ways that are fast, efficient and cost-effective. An organization can reach its clients through its own

channels (store front), partner channels (major distributors), or a combination of both.

- Customer Relationships

To ensure the survival and success of any businesses, companies must identify the type of relationship they want to create with their customer segments.

- Cost Structure

This describes the most important monetary consequences while operating under different business models.

- Revenue Streams

The way a company makes income from each customer segment.

B) Applications

There are already many articles and case studies in which Business Model Canvas are adopted, reasonable and feasible suggestions are proposed by analyzing the BMC.

For example, Sawitri and Suswati (2019) created a canvas business model that was suitable in accordance with the behavior of Micro, Small and Medium Enterprise (MSME) actors in Trenggalek (a regency in East Java, Indonesia) by referring and integrating several successful MSME entrepreneurs in Trenggalek through studying the description of the business model for MSMEs, especially for producers of Trenggalek food. The authors found that the small and medium businesses implemented the Canvas Business Model and Product Diversification and had used SWOT Analysis (a strategic planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning) as an analytical tool and indirectly. Another finding was that business actors find it difficult to reach the international market (export) because of document problems, legality, permits and access.

By analyzing the nine building blocks of Business Model Canvas of Alipay¹⁰, Bu (2016) found a very good performance of Alipay in key resources, business channel and revenue streams while the lack of performance in value propositions, key partnerships customer relationships. After that, the author analyzed the competitiveness of Alipay's business model through SWOT evaluation of each block and put forward five advice including keeping innovation advantage to implement the value proposition, reduce the dependency of partnerships to lessen the correlation risk, compete actively to reduce the loss of customers and so on.

Yan and Mi (2019) optimized the cost structure and revenue streams of the Business Model Canvas into a profit model and took Comprehensive Energy Services¹¹ (CES) as the industry form to analyze the elements of CES from market entity, value proposition, key resource, customer segment, customer relationship, key activities and profit model. Finally, they provided a quick and effective positioning tool for related enterprises to understand and distribute integrated energy services.

After understanding how to apply the BMC method, it is necessary to discover the technologies that are used or going to be used by entrepreneurs in the catering industry. In order to develop the research within the present dissertation, it is central to obtain, organize and analyze the opinions of entrepreneurs of catering companies. Therefore, we apply the Delphi Method which is suitable to compile, validate/triangulate the inputs of practitioners/specialists (in the present case: entrepreneurs in the restaurants/catering business).

¹⁰ Alipay (China) Network Technology Co., LTD., founded in 2004, is a third-party payment platform in China, committed to providing enterprises and individuals with "simple, safe, fast and convenient" payment solutions.

¹¹ Comprehensive energy services, understandable to provide integrated services to use wisdom energy, is a renewable energy as a priority, on the basis of electric energy, integrated energy such as heat, cold, gas, comprehensive utilization of the Internet technology, such as depth of fusion energy system and information communication system, to achieve a variety of energy conversion and optimize configuration to realize saving energy and reducing consumption, low carbon green.

3.2.2. Delphi Method

The Delphi method is a structured communication technique or method, originally developed as a systematic, interactive forecasting method which relies on a panel of experts (Dalkey & Helmer, 1963). Delphi is based on the principle that forecasts (or decisions) from a structured group of individuals are more accurate than those from unstructured groups (Rowe, 2001). The experts answer questionnaires in two or more rounds. After each round, a facilitator or change agent provides a summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments (McLaughlin, 1990). Thus, experts are encouraged to revise their earlier answers considering the replies of other members of their panel. According to Brown (1968), it is believed that, during this process, the range of the answers will decrease and the group will converge towards the "correct" answer. Finally, the process is stopped after a predefined stop criterion, and the mean or median scores of the final rounds determine the results (Rowe, 1999).

Following the idea of Delphi method, it is necessary to organize and analyze the technologies from theoretical source and practical interview. Then, it is important to make a reasonable and scientific combination of these technologies and prepare for the second-round survey.

3.2.3. Correlation Analysis Method and STATA

In order to study the influence of variables on the technology adoptions, It is necessary to make correlation analysis of factors and entrepreneurs' decisions. Since most questions of the survey are choices and some of them can be compared – such as importance and satisfaction – it is reasonable to consider them as categorical variables. In this dissertation, the methods that are going to be used for analyzing the correlation of categorical variables are Chi-square Test and Ordinal Logistic Regression Analysis.

A) Chi-square Test

Chi-square test is a very versatile hypothesis test method, which is applied in statistical inference of classified data, including: chi-square test for comparison of two rates or two constituent ratios; Chi-square test for comparison of multiple ratios or multiple constituent ratios and correlation analysis of classified data (Wang, Zhou & Gao, 2000). Chi-square test is the deviation degree between the actual observed value and the theoretical inferred value of the statistical sample. The deviation degree between the actual observed value and the theoretical inferred value determines the chi-square value (Lu & Liu, 2008). If the Chi-square value is larger, the deviation degree will be larger. On the contrary, the smaller the deviation is; If the two values are exactly equal, the chi-square value is 0, indicating that the theoretical values are in perfect agreement (Lu & Liu, 2008).

The specific steps of this method are as follows (Lu & Liu, 2008):

(1) Propose the original hypothesis:

H_0 : The distribution function of population X is $F(x)$.

If the population distribution is discrete, then it is assumed that

H_0 : the distribution law of population X is $P\{X=x_i\} = p_i, i = 1, 2, \dots$

(2) Divide the value range of the population X into K non-intersecting cells $A_1, A_2, A_3, \dots, A_k = (a_0, A_1], A_2 = (A_1, A_2], \dots, A_k = (A_{k-1}, A_k)$,

(3) The number of A_i sample values falling between the i -th cell is denoted as f_i , which becomes group frequency (true value), and the sum of all group frequency $f_1 + f_2 + \dots + f_k$ is equal to sample size n .

(4) When H_0 is true, the probability p_i that the value of population X falls into A_i between the i th cell can be calculated according to the assumed theoretical distribution of the population. Thus, np_i is the theoretical frequency (theoretical value) of the sample value falling into A_i between the i th cell.

(5) When H_0 is true, the frequency f_i/n of A_i that the sample value falls into the i -th cell in n

trials should be close to the probability p_i ; when H_0 is not true, f_i/n differs greatly from p_i . Based on this idea, Pearson introduced the following test statistics,

$$x^2 = \sum_{i=1}^k \frac{(f_i - np_i)^2}{np_i}$$

which obey the Chi-square distribution of $k-1$ degree of freedom under the assumption of 0.

B) Ordinal Logistic Regression Analysis

Logistic Regression, also known as Logistic Regression Analysis, is a generalized linear regression analysis model, which is often used in data mining, automatic diagnosis of diseases, economic forecasting and other fields (Yu & Zhan, 2004). The essence of Logistic Regression is to divide the probability of occurrence by the probability of non-occurrence and take the logarithm (Yu & Zhan, 2004).

Logistic Regression Analysis (Logit Regression) can be generally divided into three categories, namely Binary Logistic Regression Analysis, Multi-classification Logistic Regression Analysis and Ordinal Logistic Regression Analysis. The types of logistic regression analysis are as follows (SPASSAU, 2020).

Table 2 - Types of Logistic Regression Analysis

Independent variable x	Dependent variable y	Research methods
Quantitative data / Categorical data	Categorical data (Two groups)	Binary logistic regression analysis
Quantitative data / Categorical data	Categorical data (Multiple groups and ordered)	Multiple classification logistic regression analysis
Quantitative data / Categorical data	Categorical data (Multiple groups and ordered)	Ordinal logistic regression analysis

The basic idea of ordinal regression is:

$$\text{logit}(p_j) = \ln\left(\frac{p_j}{1-p_j}\right) = \alpha_j + \beta_1x_1 + \beta_2x_2 + \dots + \beta_nx_n$$

$p_j = P(y \leq j | x)$, this is the cumulative probability of taking the first j values of y .

Cumulative probability function is:

$$p_j = p(y \leq j | x) = \begin{cases} \frac{\exp(\alpha_j + \beta_x)}{1 + \exp(\alpha_j + \beta_x)}, & 1 \leq j \leq k - 1 \\ 1, & j = k \end{cases}$$

Grades of J fall into two categories: $\{1, \dots, j\}$ and $\{j+1, \dots, k\}$.

The logit defined on the basis of these two categories represents: the logarithm of the cumulative probability of the following $k-j$ grades and the advantage of the cumulative probability of the first j grades, so the model becomes the cumulative odds model (Yu & Zhan, 2004).

C) STATA Software

STATA is a complete and integrated statistical software that provides its users with data analysis, data management and professional graphing. It has many features, including linear hybrid models and balanced repetition models (Acock, 2008). STATA has strong statistical function. In addition to traditional statistical analysis methods, STATA also collects new methods developed in recent 20 years, such as Cox proportional risk regression, exponential and Weibull regression, Logistic regression of multiple results and ordered results, Poisson regression, negative binomial regression and generalized negative binomial regression, random effect model, etc. In this dissertation, the STATA software is going to be used for processing the Chi-square Test, Ordinal Logistic Regression Analysis and some other statistical instructions (Acock, 2008).

3.3. Chapter Conclusion

In this chapter, the research direction is explained at first. And the potential technologies related with dining industry are discovered through theoretical and practical approaches. From the theoretical approach, a technology list is summarized from papers, articles and websites. On the other hand, following a practical/exploratory approach, a simple interview is implemented to 13 entrepreneurs to obtain the complementary technologies. Then, the Business Model Canvas method is introduced for assessing the key building business blocks that apply to the catering industry; moreover, these building blocks will be central to understand how senior entrepreneurs use technology within the various key dimensions of their business. In addition, the Delphi method is introduced which support the improving process for gaining the comprehensive suggestion of the entrepreneurs by a second interview. At last, by identifying the type of data from the questions, the Correlation Analysis method and a software named STATA which has strong functions to process the Chi-square Test and Ordinal Logistic Regression Analysis are illustrated.

4. Preliminary Result and Discussion

4.1. Preliminary Technology List

4.1.1. Theoretical Result

According to Tao (2021), the professional conditions and technical requirements for the opening of the catering industry include: operation service site, production service facilities, operation management and business technology. The author also mentioned that there are five trends that food service startups need to look out for which respectively are Touch-screen food vending machines, Tablet restaurant management, Automatic biodiesel converter, LED alarm system and Network video surveillance. However, these technologies and machines are not significant and essential in catering industry. After the review and analysis of the articles, papers and journals, it is determined to use the 25 technologies which is more comprehensive and reasonable from the web articles by Chad (2012) and Alyssa Gregory⁵. The definitions and the assistance description of these technologies, defined by the other authors' literature and the discussion with the restaurants' owners in Table 1, are illustrated in Table 3.

Table 3 – Technology List of Definition and Assistance Description from Theoretical Part

Serial Number	Technology Name	Technology Definition	Technology Assistance Description
1	Online Business Plan Services	Online business plan software provides the tools and templates to create professional presentations that can be placed in front of potential investors to demonstrate where you want your business to go and how you plan to achieve your goals.	Earn an amount of money in the period time of plan.
2	Web Hosting	Web hosting, also known as virtual server, is a single host or host group on the implementation of multi-domain services, can run multiple websites or services technology.	Store data and communicate with others.
3	Shopping Cart Software	Shopping cart software is e-commerce software on a Web server that allows users who visit An Internet site to select the final purchase.	Customer online ordering, manager online procurement.
4	Anti-virus Software	Antivirus software is a program or group of programs designed to prevent, search for, detect, and remove software viruses and other malicious software, such as worms, Trojans, adware, etc.	Cashier machine, ordering machine and so on.
5	Credit Card Processing	Credit card processing is a non-cash transaction payment method. No cash payment is required at the time of consumption and the payment will be made before the Billing Date.	Process payment.
6	POS System	A point-of-sale (POS) system is where your customers pay for products or services at your store. In short, every time a customer makes a purchase at your store, they complete a point-of-sale transaction.	POS machine.
7	Time Tracking and Management Software	Time tracking software is a great tool to help you know where and with whom your time is being spent. When used correctly, these analyses are important for accountability, process improvement, and productivity.	To know the time distribution of customer from arriving to leaving.
8	Online Data Storage	Online data storage refers to the act of storing electronic data through Internet access to third-party services.	Daily sales, ingredients surplus and so on.
9	Online Project Management Software	It provides a process for a project that product developers, coordinators, stakeholders, and other stakeholders can follow to ensure that the product is delivered on time and meets expectations.	How to save time from ordering to pass-through, staff dispatching.
10	Email Management Process	E-mail management includes the management of E-mail address book and folder, as well as the filtering of mail received by users, so as to ensure the security of mail and computer system.	Connect with stakeholders, staffs and customers.
11	Online Invoicing Service	Use online invoicing services to reduce the cost of receiving customer payments.	Save time and money.
12	Accounting Software	Use comprehensive accounting software to simplify your business finances.	Income and outgoing flows' statistics

			and checking.
13	Open-Source Applications	Explore Open-Source applications to replace some of the more expensive "name-brand" alternatives	Opening up sources, sharing functions, lower costs. (QR code)
14	Social Media Software	Use social media sites like Facebook, Twitter, Google +, Pinterest, and YouTube to promote your business, products, and services.	Promote foods and preferential policy.
15	Start a Blog	A person who uses specific software to publish, publish, and post personal articles on the web, or a website that posts new articles from time to time, usually managed by an individual.	Promote foods and preferential policy.
16	Email Addresses Collection	Collect email addresses through selected forms and begin to harness the power of email marketing.	Promote foods and preferential policy.
17	Video Marketing	Video marketing refers to the network platform mainly based on video websites and uses carefully planned video content to achieve the purpose of product marketing and brand communication	Promote foods and preferential policy.
18	Website and/or Online Advertising	Promote your business through websites or online advertising.	Publicity.
19	Online Business Training	Expand your knowledge and empower your team with online business training.	Online pre-work training, online business training.
20	Cloud Files and Data Sharing	It mainly includes data resources and software resources. Meanwhile, cloud sharing technology is based on cloud computing technology.	Store and share data with others.
21	Intranet for Local File Sharing	An Intranet is a computer network that is used to share information, collaboration tools, operating systems, and other computing services within an organization and is usually inaccessible to outsiders.	Information transfer among subbranch and staff.
22	Online Help Desk or Ticket System	Set up an online help desk or ticketing system to handle customer problems.	Online service, admission by tickets only.
23	Online Appointments Scheduling	Online reservation is the in-depth application of the Internet, users through the Internet, can stay at home, easily and leisurely to achieve their reservation of hotel tables, KTV rooms, catering and food, a form of online consumption.	Reservations.
24	Online Surveys and Questionnaires	Network questionnaire survey is a survey method that survey companies invite participants to answer questionnaires through the network to obtain market information, which is one of the online surveys.	Obtain feedback of customers.
25	Screen-casting Tools	Screen-casting is a screen recording tool that can record the operation of mobile phone into MP4 format video.	Ordering.

From the Table 3, it is clear to see how these technologies can help the entrepreneurs in the catering industry. For example, the Time Tracking and Management Software can help the entrepreneurs know the time distribution of customers since they arrive and until they to leave the shop. Moreover, entrepreneurs can calculate in which operational step (such as waiting for the tables or foods) the customer have wasted more time and may feel tired or exhausted. Thus, this technology brings benefits by allowing a more reasonable time distribution (Key Activities), increasing staff's efficiency (Key Resources), identifying the customers' category (if they enjoy the dining service and environment, or they are so busy that they just want to eat and leave (Customer Relationships)), and reducing the total waiting time of customers to improve the entire service efficiency (Revenue Streams). This way, the BMC method was to classify the connection between technologies and key building blocks of a company. Table 4 was developed based on the technologies listed and the building blocks from BMC in order to identify and the existing connections and frame technologies within specific BMC building blocks.

Table 4 - Initial Framework of Technology from Theoretical Part with Building Blocks

Order	Technology	Key Activities	Key Resources	Partner Network	Value Propositions	Customer Segments	Channels	Customer Relationships	Cost Structure	Revenue Streams
1	Online Business Plan Services	✓		✓	✓				✓	
2	Web Hosting	✓	✓	✓	✓	✓				
3	Shopping Cart Software	✓		✓	✓		✓		✓	✓
4	Anti-virus Software	✓								
5	Credit Card Processing	✓								
6	POS System	✓								
7	Time Tracking and Management Software	✓	✓					✓		✓
8	Online Data Storage	✓	✓	✓	✓	✓	✓			✓
9	Online Project Management Software	✓	✓							✓
10	Email Management Process						✓			
11	Online Invoicing Service	✓						✓	✓	
12	Accounting Software		✓	✓					✓	✓
13	Open-Source Applications									
14	Social Media Software						✓	✓		
15	Start a Blog						✓	✓		

16	Email Addresses Collection		✓				✓	✓		
17	Video Marketing			✓			✓	✓	✓	
18	Website and/or Online Advertising			✓			✓	✓	✓	
19	Online Business Training		✓	✓	✓				✓	
20	Cloud Files and Data Sharing	✓	✓	✓			✓			
21	Intranet for Local File Sharing			✓					✓	
22	Online Help Desk or Ticket System	✓			✓		✓	✓	✓	
23	Online Appointments Scheduling	✓		✓			✓		✓	✓
24	Online Surveys and Questionnaires									
25	Screen-casting Tools									

From the Table 4, it is obvious that there are only two technologies (Email Management Process and Anti-virus Software) that have relationships with only one building block. All the other technologies relate with two or more than two building blocks. Some building blocks can also influence each other throughout the analysis. For instance, most of software technologies such as Social Media Software have contributions to Customer Relationships due to the fact that these software provide the service to the customers and establish a reliant and long-term cooperation. On the other hand, most operations or services that can improve the Customer Relationships are also considered as an additional payment. This means that these software are likely to influence the Cost Structure of the nine building blocks.

4.1.2. Practical Result

The relationships between those 12 technologies and 9 building blocks, defined by the discussion with the entrepreneurs, are presented in Table 5. (“✓” represents that the technology is related with only one building block; “?” represents the uncertain relationship between a technology and a building block; the cell will be empty if there is no relationship; some of the relationships have explanations in the cells that can help understanding.)

Table 5 – Initial Framework of Technology from Practical Part with Building Blocks

Technology	Key Activities	Key Resources	Partner Network	Value Propositions	Customer Segments	Channels	Customer Relationships	Cost Structure	Revenue Streams
Health Management	Food safety ✓			✓			Trust ✓		
Location Selection		✓		✓	Special customer ✓			✓	
Budgeting Technique								✓	
Staff Management	Cooking Skill ✓		✓				Service ✓	✓	
Interior Design				✓				✓	
Marketing and Advertisement						✓		✓	
Transportation Management		Food material ✓	Supplier ✓					✓	✓
Inventory Management	Semi-product ✓	✓						✓	✓
Layout Design	✓			✓				✓	
Online Ordering Software			✓	Delivery service ✓	Special customer ✓	✓			✓
Chef Selection (culture)	✓	✓			Cooking style ✓				✓
Ordering System	✓		✓					Reduces cost?	

4.2. Integrated Result

4.2.1. New Technology List

From the theoretical technology list, there are 25 technologies that are recommended for the entrepreneurs of catering industry to adopt. Since one of the main goals of this dissertation is to discover the digital technologies that can help entrepreneurs in the food/restaurant industry, Chef Selection and Health Management which are barely related with digital from the first technology list are cut off. In addition, some conflicting and repetitive technologies from different technology lists are aggregated as one technology. For instance, the Staff Management from Table 3 and the Time Tracking and Management Software from Table 2 are redundant. The Staff Management which is obtained from the interview is extensive and hollow, so the Time Tracking and Management Software from technology searching is preserved. This circumstance also occurs between the Marketing and Advertisement and the Social Media Software in which the Social Media Software is retained. After the aggregation of these two lists, there are 6 technologies from Table 3 that are considered into Table 2. These technologies are Location Selection, Interior Design, Transportation Management, Inventory Management, Layout Design and Ordering System, which means that the new integrated list has 31 technologies in the end. The final technology list is shown in Table 6.

Table 6 – The New Technology List in Catering Industry

Order	Technology	Order	Technology
1	Accounting Software	2	Anti-virus Software
3	Cloud Files and Data Sharing	4	Credit Card Processing
5	Email Management Process	6	Email Addresses Collection
7	Interior Design	8	Intranet for Local File Sharing
9	Inventory Management	10	Layout Design
11	Location Selection	12	Online Appointments Scheduling
13	Online Business Plan Services	14	Online Business Training
15	Online Data Storage	16	Online Help Desk or Ticket System
17	Online Invoicing Service	18	Online Project Management Software
19	Online Surveys and Questionnaires	20	Open-Source Applications
21	Ordering System	22	POS System
23	Screen-casting Tools	24	Shopping Cart Software
25	Social Media Software	26	Start a Blog
27	Time Tracking and Management Software	28	Transportation Management
29	Video Marketing	30	Web Hosting
31	Website and/or Online Advertising		

4.2.2. New Framework Using BMC

According to the analysis of the relationships between these technologies and the nine building blocks, the final structure information is emerged in Table 7. (“✓” represents that the technology is related with the building block; “?” represents the uncertain relationship between a technology and a building block; the cell will be empty if there is no relationship.)

After the integration of technologies and the BMC method, it is necessary and important to obtain the opinions of the entrepreneurs in catering industry which calls for the need of performing a a second-round survey (following the Delphi method). The survey will contain all the information required to contribute to refine the technologies’ list and the overall framework.

Table 7 – Integrated Framework of Technologies and Building Blocks

Order	Technology	Channels	Cost Structure	Customer Relationships	Customer Segments	Key Activities	Key Resources	Partner Network	Revenue Streams	Value Propositions
1	Accounting Software		✓					✓		
2	Anti-virus Software					✓				
3	Cloud Files and Data Sharing			✓						✓
4	Credit Card Processing								✓	✓
5	Email Management Process					✓				
6	Email Addresses Collection	✓		✓						
7	Interior Design		✓	✓						?
8	Intranet for Local File Sharing						✓	✓		
9	Inventory Management		✓			✓	✓			
10	Layout Design		✓	✓		✓				
11	Location Selection		✓		✓		✓			✓
12	Online Appointments Scheduling			✓		✓				✓
13	Online Business Plan Services		✓				✓	✓		
14	Online Business Training		✓			✓		✓		
15	Online Data Storage			✓	✓					
16	Online Help Desk or		✓	✓						✓

	Ticket System									
17	Online Invoicing Service		✓	✓						
18	Online Project Management Software						✓	✓		
19	Online Surveys and Questionnaires			✓						✓
20	Open-Source Applications		✓					✓		
21	Ordering System		?	✓		✓		✓		✓
22	POS System								✓	✓
23	Screen-casting Tools		✓	✓						✓
24	Shopping Cart Software								✓	✓
25	Social Media Software	✓	✓	✓						
26	Start a Blog	✓		✓						✓
27	Time Tracking and Management Software		✓				✓			
28	Transportation Management		✓				✓	✓		
29	Video Marketing	✓	✓	✓						
30	Web Hosting	✓	✓							
31	Website and/or Online Advertising	✓	✓							

4.3. Chapter Conclusion

In this chapter, the preliminary technology lists were obtained through complementary theoretical and practical approaches and their connection with the BMC building blocks are shown in Table 4 and 5. Then, it is important to aggregate these two lists in an effective way. Some technologies which are summarized from the initial interview are transversal as it was mentioned before. The aggregation of those two technology lists provided a specific and comprehensive basis for pursuing with the second-round survey.

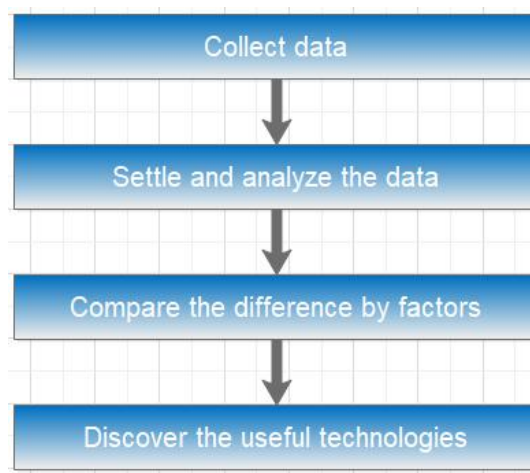


Figure 7 – The main steps for the dissertation’s methodology

After the designing of the survey, the following steps are to:

- Carry out the survey to 100 entrepreneurs of catering industry.
- Collect and organize the data that is obtained from the survey.
- Use data analysis software (STATA) to understand the attitude of entrepreneurs in catering industry towards new technologies and the relationship between the technology and the nine BMC building blocks.
- Compare the difference of technologies that are adopted or going to be adopted taking into account factors such as age.
- Identify the technologies with the potential to improve senior entrepreneurs’ businesses.

The key steps defined for the interviewing process are the following:

- Go to a restaurant in Harbin (city of China); avoid the busy time (lunch and dinner).
- Arrange the interview with the owner or the manager of the restaurant immediately if possible or schedule another date.
- Ask the entrepreneur's basic information (such as age) and email (for contacting later if possible).
- Ask the entrepreneur's satisfaction about every aspect of the business (such as working hours).
- Ask the entrepreneur about the use of specific technologies within the working context. (If he or she doesn't know some of the technologies discussed, introduce the definition and basic purposes of the technology.)
- Ask the entrepreneur if he or she think the technology is helpful in catering industry, if he or she would like to spend time and money on using it, if the technology is important to his or her business.
- Ask the entrepreneur if he or she think there is any other technology (beyond the ones addressed by the interviewer) is important/used in the catering industry.
- Ask the entrepreneur which technologies mentioned before can provide help in Ordering, Cooking, Cashiering and Delivering, which are part of the first building block (Key Activities) of the BMC. If the entrepreneur doesn't know, according to the connection from Table 7, suggest some technologies. Follow the same procedure for the remaining eight other building blocks of the BMC, one by one.

5. Data Optimization

5.1. Technology List Optimization

As the investigation goes on, a substantial portion of entrepreneurs put forward the suggestions that some of these 31 technologies are ambiguous and redundant. After the re-analysis and combination with the entrepreneurs' suggestions about the type of technologies, several changes have been made in accordance with the following steps:

- Credit Card Processing is combined with POS System;
- Email Management Process is combined with Email Addresses Collection;
- Start a Blog is combined with Social Media Software;
- Video Marketing is combined with Website and/or Online Advertising;
- Online Surveys and Questionnaires is combined with Online Help Desk or Ticket Systems;
- Ordering System is combined with Online Appointments Scheduling;
- Inventory Management and Transportation Management technologies are merged with Inventory and Transportation Management technologies;
- Web Hosting technology, Cloud File Data Sharing and Screen-casting Tools are deleted.

The final technology list after the reorganization is shown in Table 8.

Table 8 - Final Technology List and Assistance Description

Serial Number	Technology Name	Technology Assistance Description
1	Online Business Plan Services	Earn an amount of money in the period time of plan.
2	Shopping Cart Software	Customer online ordering, manager online procurement.
3	Anti-virus Software	Cashier machine, ordering machine and so on.
4	POS System	POS machine.
5	Time Tracking and Management Software	To know the time distribution of customer from arriving to leaving.
6	Online Data Storage	Daily sales, ingredients surplus and so on.
7	Online Project Management Software	How to save time from ordering to pass-through, staff dispatching.
8	Online Invoicing Service	Save time and money.
9	Accounting Software	Income and outgoing flows' statistics and checking.
10	Open-Source Applications	Opening up sources, sharing functions, lower costs. (QR code)
11	Social Media Software	Facebook, google and so on.
12	Email Addresses Collection	Convenient to promote preferential policy.
13	Website and/or Online Advertising	Publicity.
14	Online Business Training	Online pre-work training, online business training.
15	Intranet for Local File Sharing	Information transfer among subbranch and staff.
16	Online Help Desk or Ticket System	Online service, admission by tickets only.
17	Logistics Distribution Service	Food delivery.
18	Location Selection	Prosperity, customer flow, housing price.
19	Interior Design	Decorative materials, decorations.
20	Layout Design	Kitchen, toilet, cashier desk, dining area, waiting area.
21	Transportation and Inventory Management	Ingredients' surplus and replenishment, procurement and dispatching routes.

5.2. Data Integration

Due to the fact that age and gender are discontinuous factors, and most questions of the survey relate to choices, it is reasonable to make correlation analysis of categorical variables. Therefore, the survey results are transformed into integer numbers through the following steps:

Table 9 - The Acronym of Satisfaction, Technology and Building block

Category	Name	Acronym	Name	Acronym
Satisfaction aspect	Working Hours	wh	Environment	env
	Income	inc	Customer Volume	cv
	Working Ability	wa	Customer Consumption Level	cl
	Effort Level	el	Customer Evaluation	ce
	Working Performance	wp	Employee	emp
Technology	Online Business Plan Services	obp	Email Addresses Collection	eac
	Shopping Cart Software	scs	Website and/or Online Advertising	woa
	Anti-virus Software	avs	Online Business Training	obt
	POS System	pos	Intranet for Local File Sharing	ils
	Time Tracking and Management Software	ttm	Online Help Desk or Ticket System	ohd
	Online Data Storage	ods	Logistics Distribution Service	lds
	Online Project Management Software	opm	Location Selection	ls
	Online Invoicing Service	ois	Interior Design	id
	Accounting Software	as	Layout Design	ld
	Open-Source Applications	osa	Transportation and Inventory Management	tim
Building Block of BMC	Customer Segments	cs	Key Resources	kr
	Value Propositions	vp	Key Activities	ka
	Channels	ch	Partner Network	pn
	Customer Relationships	cr	Cost Structure	cst
	Revenue Streams	rs		

- Use the acronym of technology name to represent the technology, as it is shown in Table 9.
- Use the acronym of building block's name to represent the building block (In order to

make a distinction between Cost Structure and Customer Segments, change the acronym of Cost Structure from “cs” to “cst”.);

- Use “_” to connect each technology and its questions (For example: obp_know represents the answer of entrepreneurs that if they know the Online Business Plan Services technology.);
- Use “_bmc_” to connect each technology and building block (For example: obp_bmc_cs represents the answer of entrepreneurs that if they think that the Online Business Plan Services technology can help with the Customer Segments block of BMC.);
- Use “satisfy_” and the acronym of satisfaction aspects’ name to represent the satisfaction of specific aspect, as it is shown in Table 9.
- Set the factors “sex”, “age”, and all the factors contains “_” as categorical variables;
- Set the value of “sex” is equal to 0, if the category of “gender” is “Female”;
- Set the value of “sex” is equal to 1, if the category of “gender” is “Male”;
- Set the value of answer “Y” is equal to 2, set the value of answer “M” is equal to 1, set the value of answer “N” is equal to 0 (It is convenient to assign integer value to categorical variables.);
- Set the value of answer “U” is equal to 1 (Because “U” represents uncertain option which means the entrepreneurs have no idea to choose “Y” or “N”. Therefore, the true value of “U” should be close to the mean value between “2” and “0”. As we know that “M” represents medium option which value is “1”, so it is reasonable to assign the same value to “U”.);
- Set the value of “Full satisfied” is equal to “3”, set the value of “General satisfied” is equal to “2”, set the value of “Dissatisfied” is equal to “1”, set the value of “Very dissatisfied” is equal to “0”.

After the data arrangement, all the survey answers have been transformed into integer

figures. The Table 10 shows all the variables (306 in total), their description and value representations. ("satisf_*" represents all the possible aspects of the satisfaction; "*_xxx" represents all the possible technologies; "bmc_*" represents all the possible building blocks of the BMC.)

In order to obtain robust statistical results, it is necessary to use a data analysis software. Therefore, the integrated data is going to be imported into the statistics software (STATA) and the data analysis is going to be processed.

Table 10 - The Variables of The Data Base

Descriptions	Variables	Characteristics	Min	Max	Number of Variables	Representations
Gender	sex	Categorical / Integer	0	1	1	0 represents female and 1 represents male.
Age	age	Categorical / Integer	26	68	1	Value represents true age.
<u>Satisfaction</u> to aspects	satisf_*	Categorical / Integer	0	3	10	The higher the value is, the higher the entrepreneur's satisfaction with the technology.
If the entrepreneurs <u>know</u> the technology	*_know	Categorical / Integer	0	2	21	The higher the value is, the higher the entrepreneur's knowledge about the technology.
If the entrepreneurs think the technology can <u>help</u> with their business	*_help				21	The higher the value is, the higher the entrepreneur's perception about the technology helpfulness.
If the entrepreneurs would like to spend <u>time</u> on learning the technology	*_time				21	The higher the value is, the higher the entrepreneur's perception about time savings associated with the technology.
If the entrepreneurs would like to spend <u>money</u> on using the technology	*_money				21	The higher the value is, the higher the entrepreneur's perception about financial return associated with the technology.
If the entrepreneurs think the technology is <u>important</u> to their business	*_import				21	The higher the value is, the higher the entrepreneur's perception about the technology importance.
If the entrepreneurs would like to use the technology in the specific building block of <u>the BMC</u> .	*_bmc_*	Categorical / Integer	0	1	189	1 accounts for the entrepreneurs' willingness to use the technology, 0 otherwise.

6. Data Analysis and Discussion

6.1. Satisfaction Analysis and Discussion

When the entrepreneurs filled in the questionnaire, some of them gave different answers and reasons in several aspects. For example, some entrepreneurs feel dissatisfied with their Working Hours because their business is understaffed. A few entrepreneurs are dissatisfied with income and shared the fact that their restaurants have been losing money for a period of time, which possibly relates to the COVID-19 pandemic. However, if they close the business, the losses would be much higher. Four entrepreneurs felt very dissatisfied with the Environment and admitted that their restaurants are located at an unattractive location which led to the lack of customers. Last but not the least, quite a few entrepreneurs are dissatisfied or very dissatisfied with the Customer Consumption Level and mentioned the fact that they spent a lot of money on housing and decoration, however the consumption level didn't match the environment they provided.

It is necessary to have a holistic understanding of entrepreneurs' situation before a further and deeper exploration. Therefore, the satisfaction analysis is going to be processed in the first place. After importing the integrated data, the satisfaction data was summarized, as shown in Table 11, below.

Table 11 - Summarized Satisfaction Result

Variable	Technology	Obs	Mean	Std. Dev.	Min	Max
satisf_wh	Working Hours	100	2.73	0.548	2	4
satisf_inc	Income	100	2.4	0.492	2	3
satisf_wa	Working Ability	100	2.66	0.476	2	3
satisf_el	Effort Level	100	2.62	0.616	2	4
satisf_wp	Working Performance	100	2.85	0.672	1	4
satisf_env	Environment	100	2.35	0.575	1	4
satisf_cv	Customer Volume	100	2.12	0.686	1	3
satisf_cl	Customer Consumption Level	100	2.43	0.59	1	3
satisf_ce	Customer Evaluation	100	3.12	0.64	2	4
satisf_emp	Employee	100	2.62	0.546	2	4

From Table 11, it is obvious that these 10 variables have similar Means and Standard Deviations. And there is only 1 variable that has a Mean value over 3 which is “satisf_ce”. “satisf_ce” represents the entrepreneurs’ satisfaction to the customer evaluation. It means the entrepreneurs’ customers are generally satisfied with their services. It is also not difficult to find that the variable “satisf_cv” has the lowest Mean value which is 2.12. “satisf_cv” represents the entrepreneurs’ satisfaction to the customer volume. Combining the current situation and the reasons provided by the entrepreneurs, it is noticeable that the COVID-19 has been (negatively) influencing the affluence of customers. In other words, those customers would not like to take the risk to have a meal in the restaurant which means the take-out or food delivery solutions are safer and more popular. Those 21 technologies which can provide help at this level are important and essential.

Due to the fact that “age” is a discrete variable, it is convenient and necessary to transform it into a categorical variable to analysis its correlation with other dependent variables. Table 12 shows the summarized data of age.

Table 12 - Summarized Age Result

Variable	Obs	Mean	Std. Dev.	Min	Max
age	100	43.29	9.459	26	68

It can be seen from the Table 12 that the Mean value is 43.29 and the median value is 43. In order to have a general result comparison between the young and the old, those 100 observations are going to be divided in two groups. If it is cut by the senior entrepreneurs’ definition (age over 50), the old group will only have 24 observations whereas the young group will have 76 observations which can cause sample nonequilibrium. It is convenient to have the cutting point which was taken every 5 years. Hence, it is logical to make a cut near age 43 and make sure the two groups have a similar number of observations to reduce the sample difference and increase reliability. If the cut is made at age 40, the two groups will have 26 quantity variance. If the cut is made at age 45, the two groups will have only 16 quantity variance which would be a better solution.

Table 13 shows the summarized satisfaction data among young group of entrepreneurs with up to 45 years. The other group's summarized satisfaction data can also be found in Table 13 through the similar way.

Table 13 - Summarized Satisfaction Result Grouped by Age

Age<=45						
Variable	Technology	Obs	Mean	Std. Dev.	Min	Max
satisf_wh	Working Hours	58	1.69	0.537	1	3
satisf_inc	Income	58	1.345	0.479	1	2
satisf_wa	Working Ability	58	1.534	0.503	1	2
satisf_el	Effort Level	58	1.707	0.649	1	3
satisf_wp	Working Performance	58	1.69	0.706	0	3
satisf_env	Environment	58	1.293	0.496	0	2
satisf_cv	Customer Volume	58	1.034	0.674	0	2
satisf_cl	Customer Consumption Level	58	1.431	0.596	0	2
satisf_ce	Customer Evaluation	58	2.069	0.697	1	3
satisf_emp	Employee	58	1.759	0.54	1	3
Age>45						
Variable		Obs	Mean	Std. Dev.	Min	Max
satisf_wh	Working Hours	42	1.786	0.565	1	3
satisf_inc	Income	42	1.476	0.505	1	2
satisf_wa	Working Ability	42	1.833	0.377	1	2
satisf_el	Effort Level	42	1.5	0.552	1	3
satisf_wp	Working Performance	42	2.071	0.558	1	3
satisf_env	Environment	42	1.429	0.668	0	3
satisf_cv	Customer Volume	42	1.238	0.692	0	2
satisf_cl	Customer Consumption Level	42	1.429	0.59	0	2
satisf_ce	Customer Evaluation	42	2.19	0.552	1	3
satisf_emp	Employee	42	1.429	0.501	1	2

It is not difficult to find that some variables' Mean values in the young group (Age<=45) are bigger than the old group (Age>45), in the meanwhile the other variables' Mean values are smaller. However, the difference is not significant which means it is necessary to analyze it deeper and try to find a coherent explanation.

We obtain the Pearson Chi-square result of age to the Working Hours of satisfaction. The Pearson Chi-square result for the other 9 aspects of satisfaction has also been collected,

as shown in the Table 14.

Table 14 - Pearson Chi-square Result of Age to Satisfaction (All ages)

Variables	WH	INC	WA	EL	WP	ENV	CV	CL	CE	EMP
Pr	0.93	0.475	0.138	0.015	0.1	0.813	0.868	0.914	0.565	0.502

One can observe, in Table 14, that there is 1 variable's P-value lower than 0.05, which is EL. In other words, the variable "age" associates with the entrepreneurs' satisfaction in Effort Level within a 95% confidence interval. On the other hand, it is also obvious from Table 12 that the Young group (Age<=45) has a larger Mean value of EL than the old group (Age>45). Combining this result and the satisfaction reasons given by the entrepreneurs, it is likely that the senior entrepreneurs have enough experience and stable business conditions, which means they don't have to make as much efforts as the young entrepreneurs. That's why the young entrepreneurs show higher satisfaction in Effort Level.

6.2. Technology Analysis and Discussion

As revealed by the survey, there are 21 different kinds of technologies. For each of them there are 5 related questions that entrepreneurs had to answer, namely:

- Do you know this technology? (_know)
- Do you think this technology can help with your business? (_help)
- Would you like to spend time to learn this technology? (_time)
- Would you like to pay for this technology? (_money)
- What is the importance level of this technology to your business? (_import)

In order to obtain the general attitude of entrepreneurs towards these technologies, it is necessary to summarize the technology data by each question. Table 15 summarizes technology data related with the first question.

Table 15 - Summarized Technology Data by The First Question (Know?)

Variable	Technology	Obs	Mean	Std. Dev.	Min	Max
obp_know	Online Business Plan Services	100	0.26	0.525	0	2
scs_know	Shopping Cart Software	100	1.84	0.526	0	2
avs_know	Anti-virus Software	100	2	0	2	2
pos_know	POS System	100	1.91	0.288	1	2
ttm_know	Time Tracking and Management Software	100	0.3	0.628	0	2
ods_know	Online Data Storage	100	1.41	0.494	1	2
opm_know	Online Project Management Software	100	0.71	0.957	0	2
ois_know	Online Invoicing Service	100	1.84	0.545	0	2
as_know	Accounting Software	100	2	0	2	2
osa_know	Open-Source Applications	100	0.75	0.903	0	2
sms_know	Social Media Software	100	2	0	2	2
eac_know	Email Addresses Collection	100	0.15	0.359	0	1
woa_know	Website and/or Online Advertising	100	2	0	2	2
obt_know	Online Business Training	100	0.88	0.998	0	2
ilf_know	Intranet for Local File Sharing	100	1.8	0.603	0	2
ohd_know	Online Help Desk or Ticket System	100	1.76	0.653	0	2
lds_know	Logistics Distribution Service	100	1.93	0.256	1	2
ls_know	Location Selection	100	0.9	1	0	2
id_know	Interior Design	100	2	0	2	2
ld_know	Layout Design	100	2	0	2	2
tim_know	Transportation and Inventory Management	100	0.85	0.957	0	2

It can be seen from the Table 15 that there are 6 kinds of technologies that have 0 Standard Deviation. All the Mean values have the value of 2, which means that these six technologies only have a positive (“yes”) answer from entrepreneurs to the first question (Know?). In other words, these 6 technologies are widely known and essential to all the entrepreneurs regardless their age, specifically these technologies are: Anti-virus Software technology, Accounting Software technology, Social Media Software technology, Website and/or Online Advertising technology, Interior Design technology and Layout Design technology. Therefore, it is unnecessary to analyze their correlation and perform regression analysis by age.

In addition, there are 5 technologies with the value of 1, or close to 1, standard deviation, namely: Online Project Management Software technology, Open-Source Applications,

Online Business Training technology, Location Selection technology and Transportation and Inventory Management technology. In order to study the reason of these high standard deviation value, a regression analysis has to be performed.

The Ordinal Logistic Regression result of the first question (Know?) of Online Business Training technology by Age which is shown in the Table 16.

Table 16 - Ordinal Logistic Regression Result of "obt_know" by Age

obt_know	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
age	.81	.033	-5.16	0	.748	.878	***
cut1	-8.719	1.744	.b	.b	-12.136	-5.301	
Mean dependent var	0.880		SD dependent var		0.998		
Pseudo r-squared	0.360		Number of obs		100		
Chi-square	49.429		Prob > chi2		0.000		
Akaike crit. (AIC)	91.757		Bayesian crit. (BIC)		96.967		

*** $p < .01$, ** $p < .05$, * $p < .1$

As shown in the Table 16, the Odds Ratio of variable Age is 0.81. It means that the senior entrepreneurs are 0.81 times more likely to know about the Online Business Training technology comparing with the young entrepreneurs. Therefore, the effect of Age to the Online Business Training technology is very weak and negative.

Following the same process, the correlation data of the other four questions about technologies can also be collected and analyzed using the Pearson Chi-square and regression procedures. The summarized results are shown in the Table 17.

Table 17 - Summarized Correlation Technology Result of Questions by Age

Question Type	Condition	Acronym of Technology
Know?	Correlation with Age	ods, osa, obt
	Strong and Positive	None
	Strong and Negative	ods, osa, obt
Help?	Correlation with Age	ttm, opm, eac
	Strong and Positive	None
	Strong and Negative	ttm, opm, eac
Time?	Correlation with Age	scs, ttm, opm, ois, woa, ld, tim
	Strong and Positive	scs
	Strong and Negative	ttm, opm, ois, woa, ld, tim
Money?	Correlation with Age	ods, ls
	Strong and Positive	None
	Strong and Negative	ods, ls
Import?	Correlation with Age	pos, ods, ois, as, sms, ld
	Strong and Positive	None
	Strong and Negative	pos, ods, ois, as, sms, ld

From the Table 17, it is clear to see all the available technologies under the different conditions to each question. It is not difficult to obtain the general correlations of those technologies and age in the different questions. For instance, there are 3 technologies that show strong negative correlation with age in the first question (Know?), which means that as the age increases, the entrepreneurs know less about the Online Data Storage technology, Open-Source Applications technology and Online Business Training technology.

If the acronyms of some technologies are not displayed in the Table 17, it doesn't mean these technologies is good or bad, useful or useless; it rather represents two situations:

- i) One is that most of the entrepreneurs provide the same answer to that question and there is none or a little correlation between that dependent variable and age, which can be extracted effortlessly from the summarized technology data such as the Table 15. For example, "avs" doesn't appear in any place of the first question (Know?) of Table 17 and its Mean value is 2 in Table 15 which represents that all the entrepreneurs know the Anti-virus Software technology

no matter how old they are;

- ii) The other situation is that the entrepreneurs provide different and irregular answers to the same questions and it may be too complicated to determine the correlation between the technology and age. For example, the Standard Deviation values of “opm” and “ls” are 0.957 and 1 in Table13. However, these two acronyms don’t appear in the results of Correlation with Age in Table15.

In addition, there is an interesting phenomenon present in all the five questions, which is the fact that all the analyzed technologies have strong negative correlation on age except the “scs”. It suggests that, as the age increases, the entrepreneurs have less knowledge, less aspiration to spend money and time, more negative assessment of importance about most of the technologies. This conclusion echoes the context of literature review in the previous chapter. On the other side, “scs” appears to have a strong positive condition in the third question (Time?). In other words, senior entrepreneurs would like to spend more time (than the young entrepreneurs) learning about the Shopping Cart Software. The fact that results show that senior entrepreneurs may adopt new technologies only when they are convinced that the benefits of the new system clearly outweigh the associated costs (Wendy, 2005) is aligned with the discussion developed in the literature review.

Taking into account the conversations developed with the entrepreneurs while they were filling the surveys, it is reasonable to explain the result that the Shopping Cart Software is famous and widely used not only in catering industry and the young entrepreneurs have been adopting or they have already known how to adopt this technology. An entrepreneur (Zhang) said: “I often buy some daily necessities on the Internet, and I think there should be no young people who can't use the Internet to shop.” That’s why they spend less time than the senior entrepreneurs.

In order to compare the influence degree of the independent variable age on those technologies to which it has correlations, it is necessary to collect their Odds Ratios from the Ordinal Logistic Regression results and rank them, as shown in Table 18.

Table 18 - The Technology Correlation Ranking on Age

Rank	Questions									
	Know?		Help?		Time?		Money?		Import?	
	Acro.	O.R.	Acro.	O.R.	Acro.	O.R.	Acro.	O.R.	Acro.	O.R.
1st	osa	0.771	eac	0.732	ois	0.720	ls	0.811	as	0.814
2nd	obt	0.810	ttm	0.807	woa	0.758	ods	0.826	pos	0.831
3rd	ods	0.885	opm	0.826	opm	0.811			ois	0.846
4th					ttm	0.825			sms	0.865
5th					tim	0.873			ods	0.878
6th					ld	0.913			id	0.879
7th					scs	1.003				

6.3. BMC Analysis and Discussion

Before analyzing the BMC related data, it is important to connect the BMC with the exact content of the catering industry of the entrepreneurs from the survey:

Table 19 - The BMC connected with Catering Industry

Key Partners Shareholders Suppliers Third-party Platform	Key Activities Ordering Cooking Cashiering Delivering Key Resources Capital Ingredient Staff	Value Propositions Dishes Quality Environment Etiquette	Customer Relationships Returned Customers Occasional Customers Channels Physical Restaurants Online Delivering (Third-party Platform) Advertising	Customer Segments Students Office Workers Event Organization (Birthday, Wedding)
Cost Structure		Revenue Streams		
1. Fixed Cost: Housing Decoration Liquidity Advertising	2. Variable Cost: Ingredient Human Resources Daily Consumption	1. Third-party Platform: Cooperation Profit Sharing		2. Cashiering: Cash Virtual Currency

With the help of BMC, a clear understanding of the entrepreneur's catering structure was developed. As a result, it is easy to estimate in which building blocks the technology is

necessary and useful, and what help it can provide. In order to have a better understanding of the entrepreneurs' thoughts, we obtain the summarized data of technology in Customer Segments of BMC, as shown in Table 20.

Table 20 - Summarized Result of Technology in Customer Segments of BMC

Variable	Technology	Obs	Mean	Std. Dev.	Min	Max
obp_bmc_cs	Online Business Plan Services	100	0	0	0	0
scs_bmc_cs	Shopping Cart Software	100	0	0	0	0
avs_bmc_cs	Anti-virus Software	100	0	0	0	0
pos_bmc_cs	POS System	100	0	0	0	0
ttm_bmc_cs	Time Tracking and Management Software	100	0	0	0	0
ods_bmc_cs	Online Data Storage	100	.2	.402	0	1
opm_bmc_cs	Online Project Management Software	100	0	0	0	0
ois_bmc_cs	Online Invoicing Service	100	.01	.1	0	1
as_bmc_cs	Accounting Software	100	0	0	0	0
osa_bmc_cs	Open-Source Applications	100	0	0	0	0
sms_bmc_cs	Social Media Software	100	0	0	0	0
eac_bmc_cs	Email Addresses Collection	100	0	0	0	0
woa_bmc_cs	Website and/or Online Advertising	100	0	0	0	0
obt_bmc_cs	Online Business Training	100	0	0	0	0
ilf_bmc_cs	Intranet for Local File Sharing	100	.01	.1	0	1
ohd_bmc_cs	Online Help Desk or Ticket System	100	0	0	0	0
lds_bmc_cs	Logistics Distribution Service	100	0	0	0	0
ls_bmc_cs	Location Selection	100	.63	.485	0	1
id_bmc_cs	Interior Design	100	.26	.441	0	1
ld_bmc_cs	Layout Design	100	.14	.349	0	1
tim_bmc_cs	Transportation and Inventory Management	100	0	0	0	0

From the Table, all the Maximum and Mean values of each variables can be seen. The Max value "0" means that all the entrepreneurs consider this technology is useless to the Customer Segments of BMC. Comparing with it, the Max value "1" represents that some of the entrepreneurs think this technology can help with the Customer Segments of BMC and the larger the Mean value is, the more entrepreneurs it has. Then, it isn't difficult to rank those technologies by importance (Mean value) whose Max value is "1".

Through this sorting method, the ranking of all the other technologies connected to the other 8 building blocks can be processed, as shown in the Table 21. The technologies

whose number of positive observations is lower than 3 are considered to be no quantitative results and, therefore, they will not appear in the ranking list. The technologies with more than 50% positive observations are significant and highly essential (marked in red in the Table 21).

Table 21 - The Technology Importance Ranking by The 9 Building Blocks

Rank	The Acronym of the Building Blocks								
	CS	VP	CH	CR	RS	KR	KA	PN	CST
1st	ls	obp	ohd	sms	as	ods	lds	obp	as
2nd	id	ls	scs	woa	scs	as	obt	ilf	scs
3rd	ods	obt	sms	ohd	lds	obt	opm	as	ois
4th	ld	ods	woa	ttn	ttn	tim	ttn	obt	obp
5th		scs	eac	eac	ods	ilf	scs	scs	id
6th		ohd		ois	opm	ls	tim	lds	tim
7th		ld			tim	opm	ohd	woa	ld
8th						ttn	avs	ods	lds
9th								ohd	ls
10th									woa
11th									obt

As presented in Table 21, there are 2 kinds of technology (Location Selection and Accounting Software) marked by red color. It means that over 50% of the entrepreneurs think the Location Selection technology is very important in Customer Segments of BMC. Combining with the social life experience, it is recognizable and logical. Having a restaurant near a school or university possibly can attract more customers, namely students. Having a restaurant near a company or administration building is likely to attract more customers such as office workers. The number of customers is different for restaurants locating downtown or in the suburbs.

On the other hand, more than 50% of the entrepreneurs consider the Accounting Software technology is significant and highly essential in Revenue Stream and Cost Structure of BMC which is reasonable and explainable as well. The Accounting Software have been popular and well-used in the past twenty years. It can solve most of the finance issues related with cash flows and its position is unassailable.

For comparing the influence degree of the independent variables Age to the BMC, it is necessary to use the Ordinal Logistic Regression to obtain the influence degree of these technologies that are correlated with age. The technology correlation ranking of BMC on age is shown in Table 22.

Table 22 - The Technology Correlation Ranking of BMC on Age

Technology Rank		The Acronym of the Building Blocks								
		CS	VP	CH	CR	RS	KR	KA	PN	CST
1st	Acronym	ois	ohd	ls	eac	ttm	ttm	ttm	ilf	ls
	Odds Ratio	0.898	0.797	1.044	0.926	0.884	0.603	0.967	0.915	0.962
2nd	Acronym							avs		
	Odds Ratio							1.187		

As shown in Table 22, most of the Odds Ratios of Ordinal Logistic Regression are lower than 1 which means that the independent variable age has a negative effect on those technologies. In other words, as the age grows, the entrepreneurs think that those technologies are less important to the different building blocks of BMC in the catering industry. For instance, the Odds Ratio of “ilf” in “PN” is 0.915 which means that senior entrepreneurs are 0.915 times more likely than the young entrepreneurs to think the Local File Sharing technology is important to the Partner Network of the BMC building blocks. To further understand their difference, we obtain the Mean values of the Intranet for Local File Sharing technology in Partner Network of BMC grouped by Age (group of younger entrepreneurs up to 45 years old vs. senior entrepreneurs older than 45 years). Their Mean values respectively are 0.345 and 0.071. This technology can assist the entrepreneurs to share data and transfer information not only between the shareholders but also between the companies’ branches. This may happen because young entrepreneurs are ambitious to start a big catering business but don’t have enough funds and they have to make joint investments, which means they have more possibility to have not only one or more shareholders but also several branches than the senior entrepreneurs. That’s why these entrepreneurs evaluate the Intranet for Local Sharing technology as more significant and essential in Partner Network of BMC than the senior

ones.

In addition, the odds ratio 0.603 of “ttm” in “KR” is the lowest, which means that, as the age increasing, senior entrepreneurs are 0.603 times more likely than the young entrepreneurs to think the Time Tracking and Management technology is significant to the Key Resources of the BMC building blocks. There are 2 possibilities to explain it. One is that the senior entrepreneurs know well about this technology and they do think this technology is useless in their businesses. The other one is that the senior entrepreneurs know little about this technology, so they think it is useless. Combining with the conversations to them, the second scenario is more likely to be true. So, this technology can be recommended for senior entrepreneurs to use in the Key Resources building block of the catering industry.

On the other side, there are two odds ratios that are larger than 1 which respectively are “ls” in “CH” and “avs” in “KA”. It means that the independent variable age has a positive effect on these two technologies. In other words, as the age grows, the entrepreneurs believe that the Location Selection technology and Anti-virus Software technology are more significant and essential to the Channels and Key Activities of the BMC building blocks respectively in the catering industry. For example, the odds ratio 1.044 of “ls” in “CH” means that, as the age increasing, senior entrepreneurs are 1.044 times more likely than the young entrepreneurs to think the Location Selection technology is significant to the Channels of the BMC building blocks. Combining this result with the conversations held with several entrepreneurs while they were finishing the surveys, it is logical to explain this result that some senior entrepreneurs started a business at a prosperous or sparsely populated location in the catering industry many years ago. The different locations have different customer volumes which directly influence their business. As a key customer acquisition channels, the physical restaurant is more important for the senior entrepreneurs after years of operation while the young entrepreneurs pay more attention on the online restaurant (delivering).

6.4. Chapter Conclusion

In this chapter, the integrated data is analyzed in three parts: Satisfaction, Technology Questions and Building Blocks of BMC and the discussion of several typical results obtained through the STATA software has been illustrated. Therefore, if a senior entrepreneur is going to startup a business in catering industry, the general suggestion is:

- The essential and significant technologies are: Shopping Cart Software, Social Media Software, Website and/or Online Advertising, Location Selection, Transportation and Inventory Management, POS System, Interior Design, Layout Design, Anti-virus Software. (Concluded from the summarized technology data from the second question “help”; justified by the Mean value which is over 1.9 out of 2.)
- The technologies which seem to be neglected but show high potential for adoption by senior entrepreneurs are: Online Invoicing Service, Website Online Advertising, Open-Source Application. (Concluded from the Table 18; justified by the Odds Ratio which is less than 0.8 or more than 1.2; the Email Addresses Collection is cut off because it is generally considered not important.)
- The top 3 technologies which show significant impact on Customer Segments (students, office workers, birthday, etc) are: Location Selection, Interior Design, Online Data Storage. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Value Propositions (dishes, quality, environment, etc) are: Online Business Plan Services, Location Selection, Online Business Training. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Channels (physical restaurants, online delivering, advertising, etc) are: Online Help Desk or Ticket System, Shopping Cart Software, Social Media Software. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Customer Relationship (returned customers, occasional customers) are: Social Media Software, Website

and/or Online Advertising, Online Help Desk or Ticket System. (Obtained from the Table 21.)

- The top 3 technologies which show significant impact on Revenue Streams (third-party platform) are: Accounting software, Shopping Cart Software, Logistics Distribution Service. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Key Resources (capital, ingredient, staff, etc) are: Online Data Storage, Accounting Software, Online Business Training. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Key Activities (ordering, cooking, cashiering, etc) are: Logistics Distribution Service, Online Business Training, Online Project Management. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Partner Network (shareholders, suppliers, third-party platform, etc) are: Online Business Plan Services, Intranet for Local File Sharing, Accounting Software. (Obtained from the Table 21.)
- The top 3 technologies which show significant impact on Cost Structure (housing, decoration, daily consumption, etc) are: Accounting Software, Shopping Cart Software, Online Invoicing Service. (Obtained from the Table 21.)
- The technologies which seem to be neglected and but show high potential to be recommended to the senior entrepreneurs are: Online Help Desk or Ticket System in Value propositions, Time Tracking and Management Software in Key Resources. (Concluded from the Table 22; justified by the Odds Ratio which is less than 0.8 or more than 1.2.)

7. Conclusions and Limitations

The present dissertation addresses the following research question: “What technologies are important and helpful for senior entrepreneurship?” Through a literature review, the dissertation focuses on the challenges and solutions faced by senior entrepreneurs, such as population aging. This research was built upon a broad review of scientific papers and articles that provided the background for the empirical approach.

Exploratory conversations to several entrepreneurs in the catering industry in Lisbon were developed. Therefore, the methodology used to answer the research question was formulated after a thorough identification of relevant technologies following a complementary theoretical and empirical approach. The BMC method was used to analyze the specific business of senior entrepreneurs and the Delphi method were used to integrate the technology list.

After the integration of technology, it was necessary to design the survey with the technology list. Understanding entrepreneurs' satisfaction with different aspects helps to better understand their situation and facilitate technology analysis. In order to obtain the opinions of the entrepreneurs about different building blocks of the BMC and reduce the interview time, it is necessary to combine the technology and the building blocks of the BMC. Therefore, the completed survey with three parts of questions was finished and the interview was able to be carried out.

While the interview was in progress, several entrepreneurs put forward the suggestions and the technology list needed to be optimized. With all the data provided by them, it was convenient to analyze it in the software STATA which means it was necessary to build a model and assign values to variables.

By analyzing the integrated data in STATA, the summarized, Pearson Chi-square and Ordinal Logistic Regression results of each part were obtained. The reasons for some particular results were also discussed and elaborated. For example, as the age increases, the entrepreneurs have less knowledge, less aspiration to spend money and time, more

negative assessment of importance about most of the technologies. However, the senior entrepreneurs would like to spend more time than the young entrepreneurs learning about the Shopping Cart Software. The analysis of the results shed light on which technologies were known and considered helpful by the entrepreneurs, which technologies the entrepreneurs would like to spend time and money on and which they wouldn't, which technologies were significant and essential in every building block of the BMC and their importance sequence, and whether the independent variable Age affected the results for senior and younger entrepreneurs.

Combining the analysis results with the ideas of literature review which are mentioned before, it seems to make sense. To some extent, the general conclusions (in chapter 6.4) also have referential significance to the entrepreneurs who are active or prepare to start-up a business in the catering industry. By using the Business Model Canvas, the businesses under analysis could be approached in detail and technology use could be assessed according with its importance for different areas of the business. Based on entrepreneurs' feedback, the technologies which are important and essential for each area are presented and ranked according to their significance.

This study, however, presents limitations. First, there are a plenty of answers "U" (Uncertain) provided by the entrepreneurs — for example some interviewees state that "It is difficult to determine because I don't know how much time and money it requires." This kind of situation may lead to cases where the survey was not completed and the evaluation and study to each technology are insufficient. Secondly, the survey was accomplished within a special historical period (COVID-19) which means the data obtained from the entrepreneurs may not apply in different periods under different (and not so restrictive) circumstances. (The evaluation to the technologies might have bias: those technologies (such as Shopping Cart Software) which are more related to the online ordering and delivering might be overvalued; those technologies (such as Location Selection) which are more related to the physical restaurant might be underestimated.) In addition, while the interviews were made to entrepreneurs from the catering industry in Lisbon of Portugal and Harbin of China, the survey have been implemented among

entrepreneurs of the catering industry in Harbin of China. Different geographic positions may imply different catering culture and opinion, which can bias the attempt to extrapolate some aspects and results of the study. Last but not the least, this dissertation focuses on the catering industry and should not be extrapolated to other industries.

As a concluding remark, the senior entrepreneurship is becoming popular and stimulated to against the aging of population and other social issues. However, people (not only the senior entrepreneurs) have to accept and learn new technologies to adapt to the ever-improving social life. As science and technology develop, software and applications which are essential and convenient for small and medium business will expand. Only the continuous learning of the senior entrepreneurs can catch the footsteps of the young entrepreneurs and give full play to their advantages.

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Appendix: Survey

Please answer the question according to the instruction. Your information will be kept confidential and used only for academic purposes.

Basic information

Name / Gender / Age / Contact Information

Technology Section																
Questions	Do you know this technology?			Do you think this technology can help with your business?			Will you spend time to learn this technology?			Will you pay for this technology?			Please evaluate the importance of this technology with 1, 2, 3. (1 not important and 3 very important)			
	Yes	No	Not sure	Yes	No	Not sure	Yes	No	Not sure	Yes	No	Not sure	1	2	3	
1. Online Business Plan Service																
2. Shopping Cart Software																
3. Anti-virus Software																
4. POS System																
5. Time Tracking and Management Software																
6. Online Data Storage																
7. Online Project Management Software																
8. Online Invoicing Service																
9. Accounting Software																
10. Open-Source Applications																
11. Social Media Software																
12. Email Addresses Collection																

13. Website and/or Online Advertising																
14. Online Business Training																
15. Intranet for Local File Sharing																
16. Online Help Desk or Ticket System																
17. Logistics Distribution Service																
18. Location Selection																
19. Interior Design																
20. Layout Design																
21. Transportation and Inventory Management																

Is there any other technology that is important which doesn't show up here?

Satisfaction Section <i>(Please choose your satisfaction to the following aspects regarding your real feelings)</i>					
Aspects	Fully satisfied	General satisfied	Dissatisfied	Very dissatisfied	Why?
Working hours					
Income					
Working ability					
Effort level					
Working performance					
Environment					
Customer volume					
Customer consumption level					
Customer evaluation					
Employee					

The Business Model Canvas Section <i>(Please try to choose the technologies' orders that you (will) adopt (in the future) related with the nine building blocks)</i>		
Building blocks	Technologies' orders	Supplement
Key Activities (Ordering, Cooking, Pass-through)	2, 3, 5, 7, 14, 16, 18, 22	
Key Resources (Capital, Staff)	1, 6, 7, 9, 14, 15, 16, 19	
Partner Network (Shareholder, Third part)	1, 7, 9, 10, 13, 15, 16, 21	
Value Propositions (Dishes quality, Environment, Etiquette)	1, 14, 17, 20, 22	
Customer Segments (Students, Office workers)	8, 15, 18, 19, 20	
Customer Relationships (Returned customer)	11, 12, 15, 17, 20	
Channels (Stores, Online shops)	2, 11, 12, 13, 17, 18	
Cost Structure (Fixed cost, Variable cost)	1, 2, 6, 8, 9, 19, 21	
Revenue Streams (Benefit)	1, 2, 3, 4, 6, 8, 9, 18	

The questionnaire is finished. Thank you for your patience and cooperation.