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Design and Development of Restaurant for Senior Adults with Natural Lifestyle in Thailand

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ABSTRACT

In recent times, senior adults have faced mobility and daily activity challenges, including dining out with their families. Many restaurant facilities are ill-equipped to accommodate their physical limitations, often prioritizing aesthetics and cost-cutting. However, a new generation of self-reliant senior adults has emerged in the 2020s, prompting a fresh approach to restaurant and facility design. The objective is to enhance senior adults' comfort while bridging generational gaps by providing amenities that enhance the dining experience. This approach aims to create a platform supporting senior adults' well-being and an active social life outside their homes. Guidelines for facility and service design have been formulated using Product Design and Development (PDD), playing a pivotal role in shaping restaurant layouts. This encompasses menu design, table setup, lighting, and safety measures. The proposed approach incorporates ergonomic design principles to ensure cutlery is user-friendly for senior adults while catering to all customers' needs for an inclusive dining experience. The originality lies in crafting a comprehensive guideline for restaurant owners, combining insights from questionnaires and industry standards. This innovative approach ensures alignment with customer preferences and industry best practices, encompassing various aspects such as seating, spacing, lighting, acoustics, and accessibility. It provides practical tools for optimizing restaurant platforms and layouts, enhancing the dining experience. An ideal restaurant experience combines modern and traditional elements, including sleek design, diverse menus, advanced technology integration, and sustainability practices. The goal is to create an appealing atmosphere for all generations, ensuring a memorable and enjoyable dining experience.

Keywords: Customer's perception; Finite element analysis; Product design and development; Senior adult; Standard design of restaurant; Usefulness

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1. Introduction

In general, senior adults (those aged 65 and older) may experience various diseases and symptoms as a result of the natural aging process and the cumulative effects of lifelong exposures. Some common conditions observed in this age group include cardiovascular diseases (such as high blood pressure, heart disease, and stroke), arthritis (causing joint pain and stiffness), osteoporosis (weakening the bones and increasing fracture risk), respiratory diseases (such as COPD and pneumonia leading to breathing difficulties), dementia and Alzheimer's disease (resulting in cognitive decline and memory loss), diabetes (especially type 2, often influenced by lifestyle factors), increased risk of certain cancers, vision and hearing impairments (such as macular degeneration and hearing loss), depression and anxiety (due to life changes and health challenges), incontinence (affecting bladder or bowel control), and a higher susceptibility to falls and fractures due to decreased balance, muscle strength, and bone density. It is important to acknowledge that not all seniors will experience these conditions, and individual experiences can vary [1-10].

As individuals age, it is important for senior adults to be mindful of certain food considerations and constraints. Research and self- administered questionnaires have revealed that factors such as changes in metabolism, health conditions, and medication interactions can influence the types of foods that should be avoided or consumed in moderation. Some common considerations include reducing sodium intake for individuals with high blood pressure, limiting sugar and carbohydrates for those with diabetes, avoiding allergenic foods for individuals with allergies, and being cautious of potential interactions between certain medications and specific foods. In addition, senior adults may benefit from focusing on nutrient-dense foods to meet their nutritional needs while managing portion sizes to maintain a healthy weight. To navigate these considerations effectively, it is highly recommended that seniors consult with healthcare professionals or registered dietitians who can provide personalized guidance based on their specific health conditions and dietary needs.

Furthermore, there may be limitations in the application of the five senses: touch, hearing, seeing, tasting, and smelling. These sensory changes can occur due to natural aging processes or health conditions. For instance, the sense of touch may become less sensitive, making it more challenging to perceive certain textures or temperature changes. Hearing loss is common among senior adults, affecting their ability to hear sounds clearly. Vision changes such as reduced acuity or sensitivity to contrast may impact visual perception. Changes in taste buds can lead to a decreased ability to taste certain flavors or experience diminished taste sensations. Lastly, the sense of smell can also decline, making it more difficult to detect and differentiate odors. These sensory limitations can impact the overall sensory experience and may require adaptations or adjustments in daily life activities and dietary choices.

One of the activities that senior adults often enjoy for stress relief is dining out with close friends and family at nostalgic, old-school-style restaurants they used to visit in the past. This experience brings them a sense of comfort, nostalgia, and connection to their memories. Eating at these familiar establishments allows them to reminisce about earlier times, share stories, and enjoy the company of loved ones. The ambiance, decor, and traditional menu items evoke a sense of familiarity and evoke positive emotions. It provides an opportunity for seniors to relax, unwind, and create new memories while cherishing the past.

One of the key considerations for providing senior adults with a pleasant experience is creating "a welcoming ambiance". Ambiance refers to the

atmosphere or mood of a place, often created by a combination of various elements such as lighting, decor, music, and overall surroundings. It encompasses the overall sensory experience and can influence the emotional response and perception of a particular environment. In the context of a restaurant, ambiance refers to the overall feel, vibe, and character of the establishment, including factors such as the design, lighting, music, and overall aesthetic that contribute to the atmosphere and overall dining experience.

A contemporary restaurant platform is being developed through our research, strategically blending modern and classic styles. The goal is to provide features that contribute to the comfort and enjoyment of the restaurant environment, with a specific emphasis on enhancing the experience for senior adults and bridging generational gaps. This approach is intended to support the well-being of senior adults, enabling them to enjoy a more active and social life outside their homes. This development involves the implementation of ergonomic design principles to ensure comfortable cutlery use for senior adults and the provision of facilities that meet the needs of all patrons. Guidelines for facility and service design have been formulated using a product development approach, encompassing concept development, system-level design, detailed design, and production ramp-up. These steps serve as a framework for the creation of effective and accommodating restaurant environments.

2. Research Background

2.1 The status of senior adults in society

According to the Department of Mental Health [11], Thailand is projected to become an aged society by 2021, with mature adults accounting for 20% of the population. As of December 31, 2022, the total population of Thailand was approximately 66,090,475 people, with females accounting for around 33,819,860 and males around 32,270,615 people, according to data from the Department of Provincial Administration, Ministry of Interior. This data suggests that mature adulthood in Thailand makes up about 18.94% of the population, which is equivalent to 12,519,926 people, comprising 5,512,223 males and 7,007,703 females. With the increasing number of elderly individuals, it becomes crucial to prioritize the health of mature adults in order to live longer alongside their descendants.

2.2 Common health problems among seniors

From the research background and self-administered questionnaires, the common health problems among seniors are expressed as *gastrointestinal tract disease*, *hypertension*, and *osteoarthritis*. *Gastrointestinal tract diseases* refer to conditions that affect the digestive system, such as gastritis, peptic ulcers, and irritable bowel syndrome. These conditions can cause symptoms like abdominal pain, indigestion, and changes in bowel movements. *Hypertension*, also known as high blood pressure, is a chronic medical condition characterized by elevated blood pressure levels. It can lead to various complications, including an increased risk of heart disease, stroke, and kidney problems. *Osteoarthritis* is a degenerative joint disease that primarily affects the cartilage in the joints, causing pain, stiffness, and reduced mobility. It is the most common form of arthritis and commonly affects weight-bearing joints such as the knees, hips, and spine [12-14].

Depression is a mental health condition that can affect individuals of any age, including senior adults. It is characterized by persistent feelings of sadness, hopelessness, and a loss of interest or pleasure in activities. In senior adults, depression may be triggered by various factors, such as the loss of loved ones, chronic health conditions, social isolation,

or changes in life circumstances. Depression in senior adults can manifest differently than in younger individuals. Senior adults may be more likely to experience physical symptoms, such as fatigue, sleep disturbances, appetite changes, and unexplained physical pain. They may also be less likely to openly express their emotions or seek help for their mental health concerns. The mental well-being of senior adults is an important aspect to consider, including the potential challenges they may face, such as depression and other mental health issues. Depression, in particular, can impact senior adults, leading to feelings of sadness, hopelessness, and a loss of interest in activities. It is crucial to address and support their mental health needs through proper diagnosis, treatment, and access to resources. By providing a supportive and understanding environment, promoting social connections, and encouraging open discussions about mental health, we can help improve the emotional well-being of senior adults and address issues like depression effectively.

Fig. 1 provides an illustration of the various factors and circumstances that contribute to mental issues and concerns in senior adults, leading to feelings of depression. It highlights the complex nature of these challenges and emphasizes the importance of addressing them to support the emotional well-being of older individuals. Senior adults often have the inclination to go out with friends and participate in various activities, as they seek companionship and the enjoyment of shared experiences. They may also deeply value conversations and connections with their close friends, finding solace and fulfillment in these meaningful interactions. Additionally, senior adults may have a strong sense of nostalgia and a longing for the past, particularly when reminiscing about moments spent eating with their family. These moments are often regarded as precious quality time, evoking a deep sense of longing and sentimentality.

Fig. 1. Emotional and mental well-being of senior adults-depression (mental health concerns).

2.3 Strategies for managing health issues in seniors

Creating a supportive and understanding environment for senior adults, promoting social connections, and encouraging open conversations about mental health can contribute to their overall well-being and help address and manage depression effectively. Managing these conditions through proper medical care, lifestyle modifications, and appropriate dietary choices is crucial for maintaining the health and well-being of mature adults. Many centenarians recommend a healthy diet that includes fish, fruits, vegetables, whole grains, beans, and lentils. However, some mature adults may face challenges in consuming certain healthy foods due to health conditions such as peanut allergy, celiac disease, and latex-fruit syndrome. Therefore, selecting appropriate foods in each meal is essential for mature adults to prevent complications. As an agricultural country, Thailand offers a wide variety of fresh ingredients that can be utilized to create signature dishes based on individual preferences.

In this research, the design team has analyzed data from various sources to

identify the key components of existing restaurants in metropolitan areas of Thailand. The team focused on factors such as air ventilation, seating capacity, table arrangements, lighting conditions, utensil design, spacing between tables, integration with natural surroundings, and parking availability.

To ensure a welcoming ambiance for senior adults, the integration of various key factors is imperative. By studying the pros and cons of each factor, the team has developed guidelines and visual platforms to help business owners enhance their facilities and improve overall customer experience [15-19].

2.3.1 Air ventilation

Incorporating a well-designed ventilation system that ensures a continuous flow of fresh air is essential. This not only contributes to a comfortable dining environment but also promotes a healthy and pleasant atmosphere.

2.3.2 Seating capacity and table arrangements

Optimal seating capacity and thoughtfully arranged tables are crucial. Providing spacious seating with comfortable chairs and strategically organizing tables to allow easy navigation for seniors enhances both accessibility and sociability.

2.3.3 Lighting conditions

Thoughtful lighting design is essential. Incorporate natural light where possible and ensure a balance between ambient and task lighting. This creates a warm and inviting atmosphere, aiding visibility without causing discomfort.

2.3.4 Utensil design

Consideration for the design of utensils is paramount. Utensils should be ergonomic, easy to handle, and suitable for senior adults with varying physical abilities. This contributes to a positive dining experience.

2.3.5 Spacing between tables

Adequate spacing between tables is crucial for easy movement. This not only ensures a comfortable dining experience for seniors but also allows for smooth assistance from caregivers or staff.

2.3.6 Integration with natural surroundings

Connecting the restaurant with natural surroundings, such as outdoor seating or large windows with scenic views, can create a serene atmosphere. Nature has a calming effect and contributes to the overall well-being of seniors.

2.3.7 Parking availability

Convenient and accessible parking facilities are essential for senior customers. Proximity to the entrance and clearly marked parking spaces contribute to a stress-free arrival.

By carefully integrating these elements, a restaurant can create an environment that is not only welcoming to senior adults but also considers their comfort, safety, and overall well-being. An illustrative example of the restaurant's comfortable and relaxed ambiance is presented in Fig. 2.

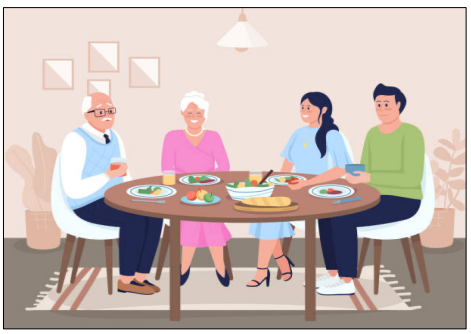


Fig. 2. Example of an ideal restaurant experience with a contemporary and comfy-feeling platform.

Furthermore, this study capitalizes on the advantage and opportunity of utilizing fresh, organic ingredients sourced from local farmers and their own farm to prepare

nutritious meals. With the motto "*Good Food, Good Mood, All Good*," the restaurant employs a dedicated nutritionist who ensures that each dish is well-balanced and provides adequate calories. The menu is carefully crafted based on market surveys conducted among the target customer segment, including mature adults and their descendants, to cater to their specific preferences and needs. The collaboration between the nutritionist and chef, coupled with competitive research, contributes to the restaurant's appeal and distinctiveness. By offering a wide range of healthy, organic Thai and Western cuisine and beverages at affordable prices, complemented by a greenhouse-style interior decor, the restaurant successfully retains its customer base. For the business owners, the concepts of optimization, efficiency, and technological integration can inspire innovative approaches to improve restaurant operations and sustainability [20, 21].

2.3.8 The key points

An ideal restaurant experience with a contemporary platform could involve a fusion of modern and traditional elements. For example, the restaurant could feature a sleek and stylish interior design with comfortable seating and a warm ambiance. The menu could offer a blend of classic and innovative dishes, catering to a wide range of tastes and dietary preferences. Advanced technology could be integrated into the dining experience, such as digital menus or interactive tabletops for ordering and entertainment. Additionally, the restaurant could prioritize sustainability by using locally sourced ingredients and implementing eco-friendly practices. The goal is to create an atmosphere that appeals to both younger and older generations, providing a memorable and enjoyable dining experience for all.

3. Research Concepts

3.1 Target customer

The conceptual framework of food insecurity, as described by the elderly in this study, aligns with factors identified by previous research [22, 23]. Despite their reluctance to go out with family or children, many elderly individuals actually have a strong desire to engage in social activities. However, their concerns primarily revolve around limitations in the environment and physical constraints. As previously mentioned, our target customers can be categorized into two groups: direct customers and indirect customers. Direct customers refer to potential customers aged 50 and above, who may have encountered or currently face certain challenges. Their feedback directly informs us about their perspectives and specific needs. On the other hand, indirect customers include individuals from infancy to adulthood up to age 49, who typically dine with adults. The questions posed to this group mainly focus on their feelings and viewpoints. To successfully design and develop the restaurant, careful attention must be given to ensure it caters to the needs of all customers.

In today's world, there is a growing focus on health and well-being. Many individuals prioritize healthy eating, opting for organic and plant-based food options in their meals. As a result, restaurants have adapted to this trend by incorporating healthy dishes into their menus to cater to the demand. Thailand boasts numerous restaurants that specialize in healthy food, including establishments like "*Nature Lifestyle Restaurant*." The guidelines for the proposed platform are shown as the restaurant that offers a variety of key dishes, such as Thai cuisine, salads, soups, and steaks, which appeal to a wide range of customers from childhood to mature adulthood, aligning with our target audience.

3.2 The proposed ideas for "Nature Lifestyle Restaurant"

Currently, there are numerous options for healthy dishes and various organic restaurants available. However, many of these establishments are not elderly-friendly, with issues such as distant car parking areas, difficult-to-read food menus, excessive sunlight, and a lack of a relaxing atmosphere. The proposed *"Nature Lifestyle Restaurant"* aims to address these concerns by providing additional services, including lightweight eating utensils and wheelchair-accessible facilities. The ultimate goal is to create a comfortable and enjoyable dining experience for customers of all ages.

Table 1 outlines the common facilities and services offered at our restaurants. The data for this table was gathered through surveys conducted with direct customers who are aged 50 and above. The survey results revealed that the majority of these customers share similar preferences. Their top three favorite types of food include fruit and vegetable salads, steak, and soups, respectively. Furthermore, the customers emphasized the importance of convenient parking near the restaurant, easily readable menus, and accessible restrooms for the elderly.

Table 2 presents information on popular food choices based on data from commercial websites catering to customer needs.

Table 3 highlights the preferred facilities based on customer requirements. After categorizing the types of food and facilities for the elderly through questionnaires and research, the collected data was carefully analyzed to serve as guidelines for the development of a new product.

Table 1. Common facilities and services of restaurants.

Facilities and services	Features	Pros	Cons
Restaurant near the parking lot	This is the first location for all customers who walk into restaurant. The convenience and comfort will make a better first impression.	Comfortable for everyone. Lowering danger while parking.	Noise and may disturb customers inside.
Easy-to-read menu	The key consideration for customers to order any food. It would provide photos, details, which are able to be read easily.	Easy to see any dishes and details. Easier to make decisions.	Heavy size of menu. Tablets cost (alternative)
Relaxing atmosphere	When people have a family meal, they would prefer to enjoy their time together. Imagine if this location is relaxed, cozy, and shady. All customers would feel good to spend their time here absolutely.	Good place to have a good time with family.	Construction cost will be higher, especially due to the area cost.
Lightweight eating utensils	This is another factor to some customers, which majority of people do not know. The more you can serve, the greater the customer satisfaction.	Elderly people or people with musculoskeletal disease will be able to eat easily.	More expensive than normal equipment.
Facilities for wheelchair users	Although the construction is difficult and costs more than usual, in the long run it will be worth it and have a positive effect on the restaurant.	More convenient, more comfortable, and safer to wheelchair users.	Any details must be thoroughly thought out and planned from the beginning.

Table 2. Popular type of food from commercial websites.

No.	Name	Key component	Ingredient	Price (THB)
1	Salad Factory, Healthy Salad with Japanese Shoyu Dressing.	Organic. Low fat and calorie. Improve the excretory system. Enrich vitamins and minerals that are essential to the body.	Lettuce Tomato Red cherry Carrot Shoyu dressing	149
2	Sizzler BBQ Pork Boston.	Premium pork collar steak. Provide high energy to the body. High protein which helps the body grow and build the muscle.	Pork collar steak BBQ sauce Tomato Loaded potato with cream	449
3	Audrey's Cream of Mushroom Soup with Truffle Oil Infused.	European taste. Mushroom soup helps reduce blood fat levels. Helps to detoxify the accumulated toxins in the body. Making brighter and better skin.	Champignon mushroom Herbs Dairy Cream Truffle oil	299

Table 3. Popular type of facilities.

No.	Name	Key component	Feature	Pros
1	Menu	Easy to read. Lightweight. No sharp side.	Matte paper. Provide both information and picture of foods. Text is easy-to-read.	Menu is easy-to-read even if the eyesight is not good. There is no sharp edge that could hurt the hands.
2	Restaurant parking	Parking nearby the restaurant. Provide enough space. Smooth road surface. Provide special parking for the elderly and the disabled.	The parking space is 3.2 meters wide. There is parking for more than 60 cars. The paved road is not rough.	Elderly and disabled people can get in and out of the car more easily due to the wider space.
3	Toilet for elderly and disabled people	The sliding door is wide enough. The space in the toilet is wide enough. Provide facilities for elderly and disabled people. There are ring buttons provided (for emergency use)	The sliding door is 100 cm wide. The space inside the toilet must be more than 1.5×2 meters. Use flat, non-slip floors. Provide grab bar. The sink is 80 centimeters from the floor.	Elderly and disabled be able to help themselves. Wheelchair users can conveniently use. If emergency, user can press the button for help.

Table 4 provides a reference for the menu, highlighting the preferred food choices for the elderly.

Table 5 presents the specifications for grab bars, ensuring their appropriate design and placement.

Table 6 outlines the recommended parking patterns, taking into account the specific needs of elderly customers.

These tables serve as valuable references for the design and development team, enabling them to create a product that effectively caters to the needs of the elderly population.

Table 4. The reference of salad, steak, and soup.

Type of dish	Level of healthiness	Ingredient	Flavour	Price (THB)
Smoked Salmon with Avocado salad	High	Salmon Avocado Mixed vegetable Aromatic Japanese dressing	The aroma of smoked salmon Oiliness from avocado Sweet and sour flavour from aromatic Japanese dressing.	295
Fresh Tuna Salad	High	Tuna Crab stick Mixed vegetable Aromatic Japanese dressing	Fresh tuna is firm and slightly salty Sweet and sour flavour from aromatic Japanese dressing	475
Grilled Salmon Fillet with Lemon Cream Sauce	Medium	Salmon Italian herb Lemon cream sauce Lettuce	The salmon is tender and sweet Lemon cream sauce has a sour taste that goes well with the grilled salmon	395
Pan Fried Snow Fish with Lemon Cream Sauce	Medium	Snow fish Baked bread Lemon cream sauce	Fried snow fish gives a mellow taste and oiliness. Lemon cream sauce has a sour taste that goes well with the grilled snow fish.	795

Table 5. The reference of the grab bar.

Type of grab bar	Flexibility of use	Level support	Features
Straight grab bar	Low	High	Made from 304 stainless steel, which strong and durable to use. Polished surface texture. Support pressure pull up to 200 kilograms. Be able to install both horizontally and vertically. Be able to install height proportional to the users.
T-Grab bar	Low	High	Made from 304 stainless steel, which strong and durable to use. The satin surface provides a non-irritating touch and makes the grip firm to the hand. Support pressure pull up to 200 kilograms.
WS-Grab bar	High	High	Made from 304 stainless steel, which is strong and durable to use. Polished surface texture. Support pressure pull up to 200 kilograms. Can be folded up when not in use.
Double WS-Grab bar	High	High	Made from 304 stainless steel, which is strong and durable to use. Polished surface texture. Support pressure pull up to 200 kilograms. The user can use both hands to help support themselves.

Table 6. The reference of parking.

Type of parking	Level of driver skill	Pros	Cons
Angle parking	Low	Can drive your car and park easily without changing any gear. Easy to get on and off the car. Limited space since there is no need a lot of driving space.	If there is a car that not parking in the slot, it may cause others car to park incorrectly as well.
Parallel parking	High	Suitable for very limited spaces.	Required high driving skill. Must be in neutral gear after parking. Due to parking close to the side, difficult to get on and off the car. Long wheelbase cars are quite difficult to park.
Perpendicular parking	Medium	Can choose to park by driving either forward or backward into a slot. Easy to enter and exit from the slot. Easy to get on and off the car.	Required more space. If the space management is not good, the driving area will be narrower and space between slots will be narrower.

3.3 Product design and development

Product Design and Development (PDD) encompasses the process of creating and refining new products or services prior to their launch. PDD includes various stages such as concept development, system-level design, detailed design, testing and refinement, and production ramp-up (Fig. 3). Prior to implementing any ideas, it is crucial for the owner to actively listen to customer feedback in order to understand their requirements and make improvements accordingly.

The design of restaurant facilities, including parking areas, has been tailored to meet the preferences and needs of senior adults. This approach involves translating their requirements into 3D models of spoon styles, table-chair sets, restaurant layouts, and parking spaces that accommodate wheelchairs or other walking assistive devices. The goal is to enhance the satisfaction of senior adults when dining out with their families. A happy and comfortable dining experience for seniors contributes to the overall joy of family outings. Consequently, younger adults can feel at ease and delighted to bring their parents or grandparents for shared activities without any constraints on the comfort of dining in a restaurant.

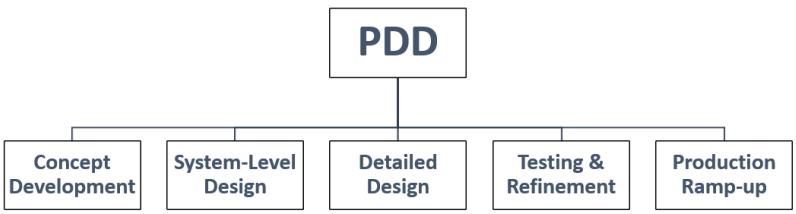


Fig. 3. Five phases of PDD for creating a new product.

The concept of "*Nature Lifestyle Restaurant*" is applied, following these steps:

3.3.1 Concept development

In this stage, the need to take care of mature adults and serve them organic and healthy food is considered. The concept comprises four main points: easy-to-enjoy food, seasonal menus with accessible prices, a sanitary restaurant, and suitable portion sizes. The concepts can be explained in terms of Form, Fit, and Function. The primary objective of this stage is to transform customer requirements into a preliminary product design or conceptual model. Questionnaires will be distributed to the target customers. The researchers conducted a study on the perceptions and behaviors of individuals residing in the capital city, specifically the Bangkok metropolitan region.

Survey questions were designed to observe people's thoughts regarding dining

at restaurants. Initially, the researchers had limited information on the subject, and they assumed that half of the participants purchased bottled water to maximize variability. From this following Eq. (3.1) [24]:

$$\left(\frac{(Z)^2 \times p \times q}{e^2} \right) = n, \quad (3.1)$$

where e is the desired level of precision (the margin of error, or confidence interval). p is the estimated proportion of the population which has the attribute to the question. q is $1 - p$.

In this study, the researchers aimed for a confidence level of 95% with a desired precision of at least 5%, equivalent to a margin of error of plus or minus 5%. Using the standard normal distribution table, the Z-value for a 95% confidence level is 1.96. Therefore, the formula for calculating the required sample size is:

$$\left(\frac{(1.96)^2 \times 0.5 \times 0.5}{0.05^2} \right) = 385.$$

Based on the calculated requirements, it was determined that a random sample of 385 respondents from the target population would suffice to achieve the necessary confidence levels. In practice, around 400 sets of questionnaires were distributed, both digitally and manually, to the target customers. However, during the initial phase of concept development, limitations in accessing the digital platform and participant fatigue in providing written responses resulted in only 137 participants contributing. To supplement the dataset, our design teams conducted direct interviews with an additional 75 individuals possessing technical expertise in strategic systems and backgrounds in business. These interviews generated valuable insights, meticulously documented and integrated to refine the restaurant's conceptual model. The gathered data played a crucial role in identifying essential components necessary to meet the unique needs of senior adults in the restaurant environment. Our study employed a digital questionnaire platform to collect responses from participants.

3.3.2 System-level design

In this stage, the detailed components of "*Nature Lifestyle Restaurant*" are addressed. The farm and restaurant are divided into four main components: containers, dining cutlery, ingredients, and homemade menus. Specifically, the fork, knife, and spoon are redesigned and created using SolidWorks. All components are developed to support and cater to the needs of the target customers.

3.3.3 Detailed design

This stage focuses on selecting high-quality organic vegetables, fruits, and meats as primary ingredients. Special attention is given to the dietary restrictions and limitations of customers, particularly the elderly with specific health concerns. Supporting items and alternatives are created to address these concerns.

3.3.4 Refinement and testing

During this stage, feedback is gathered from potential customers, who are mature adults. The ingredients are prepared by a nutritionist, and surveys are conducted to collect feedback on the menus, supporting items, and overall dining experience. This helps in understanding customer preferences, determining actual customer needs, and ensuring customer satisfaction.

3.3.5 Production ramp-up

The production process involves planting, harvesting, and preparing organic ingredients for each menu. Before launching a new menu, customers are surveyed to ensure dishes that align with their preferences are offered. For example, popular options include smoothie beverages, pumpkin soup, and steamed and grilled fish with Caesar salad. Special eating equipment tailored to the target customers is provided. Different channels are offered for customers

to provide feedback, such as soft openings with partial menus, online platforms for food delivery, and engagement through social media channels like Facebook, Instagram, and TikTok. To ensure customer retention, continuous improvement of dishes and services based on customer feedback is prioritized. Online and offline connection channels are created to communicate with customers and keep them updated with restaurant news. The sustainability of "*Nature Lifestyle Restaurant*" relies on customer satisfaction and retention. Emphasis is placed on maintaining food quality and addressing any mistakes or issues promptly. Additionally, understanding essential factors such as costs, feedback, pricing, time, customers, and competitors helps in assessing the feasibility and competitiveness of the restaurant in the market. Through careful analysis of competitors, maintaining originality, and conducting competitive analyses, a strong presence in the market is established, and success is achieved despite the competition within the restaurant industry.

3.4 Form-Fit-Function (3Fs) concept

From the market survey by launching the questionnaire to direct and indirect customers, we obtain the requirements from customers and then, analyze them as a key reference for a new product.

3.4.1 Form

The form concept includes the consideration of the shape, size, and dimensions of the product or service. In the case of the healthy food container, white round plates have been chosen based on research indicating that this type of plate provides the highest customer satisfaction [25]. The plates are made of white clean ceramic material to maintain a hygienic appearance. For the utensils, namely the spoon, fork, and knife, they have been designed specifically for mature adults, as depicted in Fig. 4.

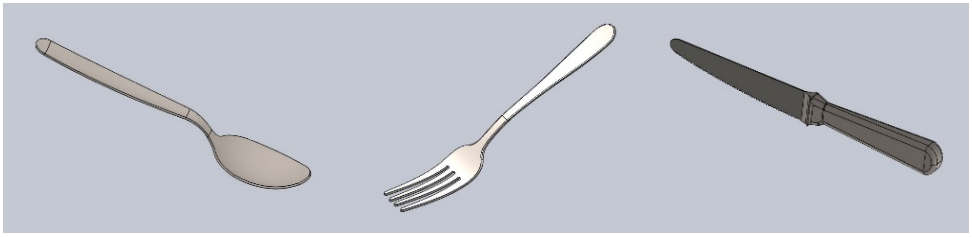


Fig. 4. Fork, Spoon, and Knife (illustrated from left to right) for mature adults.

All of these utensils are crafted from stainless steel. They possess special features that make them lightweight and easy to use, taking into consideration the limitations some individuals may have with gripping and holding objects. A special spoon designed for individuals with ALS (Amyotrophic Lateral Sclerosis) is specifically tailored to assist those with limited hand and arm mobility. The spoon typically features a larger handle that is easy to grip and control, making it more manageable for individuals with muscle weakness or coordination difficulties. The design often includes features such as a built-up handle for a secure grip, an angled or weighted head for easier scooping and lifting of food, and sometimes even a strap or attachment to secure the spoon to the hand. These adaptations help individuals with ALS maintain their independence and enjoy meals with greater ease and comfort [26-27]. Not only the questionnaire but the 3F concept, Form, Fit, Function, and usability showed in Fig. 5, also apply in order to meet all the customers' demands.

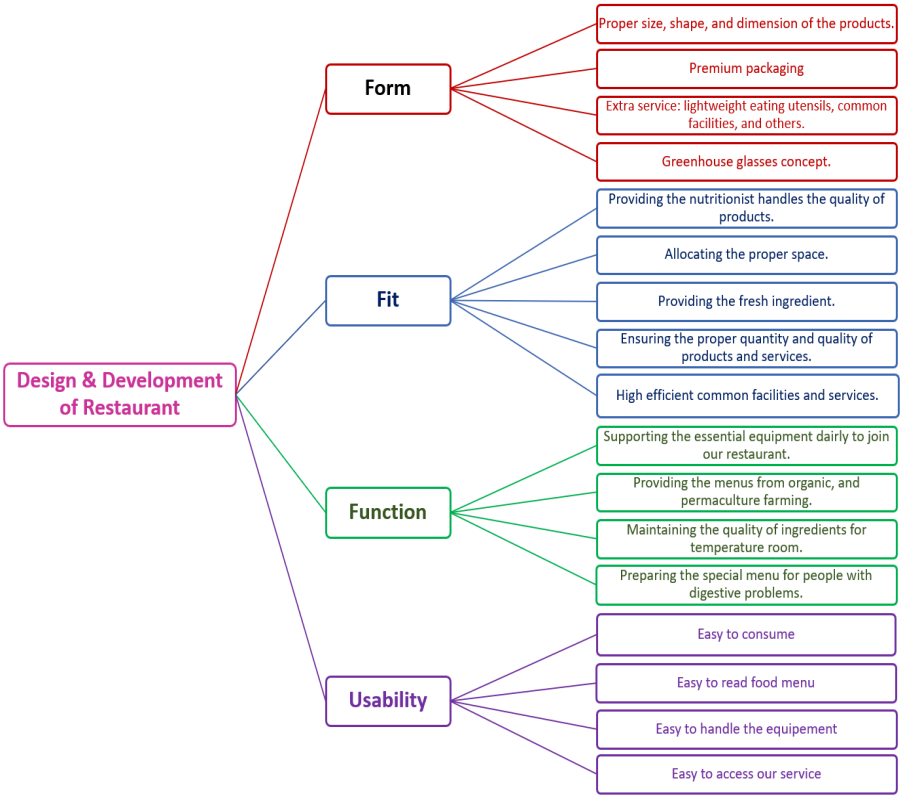


Fig. 5. 3Fs concept and Usability.

Moreover, Fig. 6 presents a specialized spoon design referred to as the *"Silver Spoon"*, catering to individuals with ALS (Amyotrophic Lateral Sclerosis) or similar mobility limitations. This spoon is crafted from a lightweight plastic-type material known as Pp 2500h, weighing 16 grams. Its design aims to address the unique requirements of individuals with ALS, ensuring a more comfortable and convenient dining experience for them.

Fig. 6. Special spoon for individuals with ALS (Amyotrophic Lateral Sclerosis) issue [28].

3.4.2 Fit

The Fit concept encompasses various aspects such as location, quality, processes, usage, and target group. At "*Nature Lifestyle Restaurant*," a nutritionist is employed to create and monitor the nutrient levels in the dishes, ensuring they meet the appropriate standards. To align with the restaurant's concept, all ingredients are sourced from organic farmers and affiliated partners, guaranteeing that customers receive fresh and high-quality meals.

3.4.3 Function

In terms of function, "*Nature Lifestyle Restaurant*" specializes in serving healthy and organic food to its customers. We offer a diverse menu that includes soups, salads, steaks, and smoothies, all made from fresh and organic ingredients. The development of each menu item takes into account the results obtained from questionnaires distributed to both direct and indirect customers. These results serve as the primary consideration in crafting the menu. To provide customers with vital information about the dishes, caution signs are included on the menu to indicate specific ingredients, such as gluten-free options or the presence of shrimp,

allowing customers to avoid allergens. Additionally, the restaurant's facilities are designed with the principles of universal design, ensuring that customers understand how to utilize them correctly.

3.5 Usefulness of Services and Products

The usefulness of "*Nature Lifestyle Restaurant*" was assessed through a questionnaire administered to two main groups: the Junior and Adulthood platforms. This survey enabled the measurement and evaluation of fundamental needs, allowing for the identification and analysis of effective design and development strategies. The findings reveal the potential of the restaurant to support and assist individuals with physical disabilities and dietary restrictions. The equation used for identifying usefulness of the developed platform of "*Nature Lifestyle Restaurant*," is expressed as [29]:

$$Usefulness(U) = Important\ level(L) \times Popularity\ of\ use(R) \times Usage\ frequency(F) \times Usage\ duration(D). \quad (3.2)$$

3.5.1 Important level

In terms of the importance level, it encompasses the components that are deemed essential and impactful for customers. Through the questionnaires, important attributes were identified, reflecting the basic needs of the restaurant. These findings directly influenced the selection and consideration of our farm and restaurant. Table 7 illustrates the five levels of importance for customer use, providing a comprehensive overview of their significance.

3.5.2 Popularity of use

"*Nature Lifestyle Restaurant*" prioritizes the use of healthy and organic ingredients, ensuring that a wide range of people can enjoy their meals. This trend of consuming healthy and organic foods is not only popular among adults but also among pre-adults. Additionally, there is a long-standing cultural practice of consuming healthy and organic food, with many people believing that such choices contribute to a longer and healthier life. As a result, healthy restaurants have gained popularity among health-conscious individuals.

Table 7. Level of importance of "nature lifestyle restaurant" farm and restaurant.

Code	Points on a scale of 5	Level of importance	Type of importance	Product examples
A	5(>4.0-5.0)	Extreme	Essential support equipment	Spoon, Fork, and Knife for mature adults, Special spoon for ALS, and Menu for the physically challenged
B	4(>3.0-4.0)	Very High	Recreational area, Facilities daily activities	Spoon, Fork, and Knife for mature adults, Special spoon for ALS, and Menu for the physically challenged
C	3(>2.0-3.0)	High	Digital platform, Payment system, Temperature controllable, Electrical appliance	Temperature-Controlled Room (for ingredients from the farm), Refrigerator, Internet Access, and QR Code (for Payment and Online Orders)
D	2(>1.0-2.0)	Medium	Household appliances, Electrical appliances, Recreation activities	Air Conditioning System, Cashier, Live Music, Washing Machine, and Warm Lighting
E	1(0.0-1.0)	Low	Entertainment systems and activities	Computer, Video Game Console, Playground, and Smart Television

3.5.3 Usage duration

The usage duration of "*Nature Lifestyle Restaurant*" includes two main components that cater to both direct and indirect customers.

Firstly, it involves the preparation of organic ingredients, ensuring that fresh and high-quality ingredients are available for consumption on a daily basis.

Secondly, the restaurant focuses on providing supportive equipment, particularly for individuals with physical disabilities. Lightweight eating utensils and other facilities are designed and made available to assist and accommodate these customers. All necessary facilities and equipment are prepared and set up prior to the restaurant's opening.

3.5.4 Assessing product usefulness

There are several factors to consider regarding the usefulness of the product: the level of importance, the popularity of use, and the duration of usage. Prior to the launch of our farm and restaurant, it is essential to compute the unit of usefulness. Maslow's hierarchy of needs, depicted in Fig. 7, provides a framework for classifying these needs into five categories. *"Nature Lifestyle Restaurant"* focuses on addressing the basic and psychological needs of both direct and indirect customers by providing essential food, supportive equipment, and facilities. To fulfill safety needs, we have designed lightweight utensils such as spoons, forks, and knives specifically for mature adults. Our dishes are prepared using the highest quality ingredients and in appropriate quantities to ensure customer satisfaction.

Lastly, for customers seeking love and a sense of belonging, our farm and restaurant offer an environment conducive to enjoying organic food and spending quality time with family. *"Nature Lifestyle Restaurant"* caters to three key types of needs: basic or psychological needs, safety needs, and love and belongingness needs.

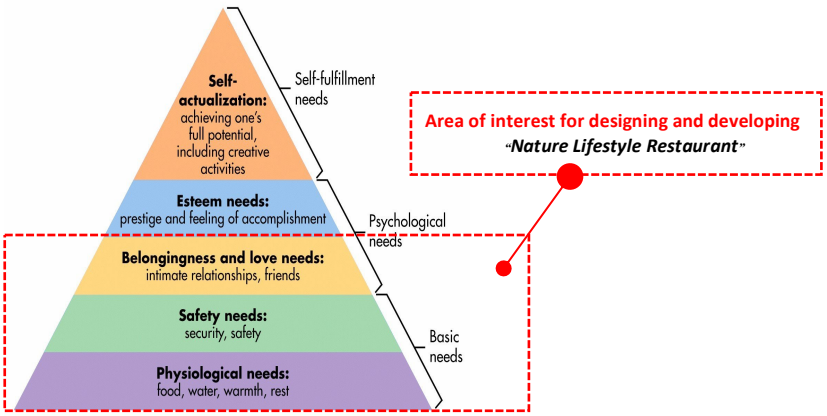


Fig. 7. Maslow's Hierarchy of Needs [30].

3.6 Key considerations for the design stage

The proposed *"Nature Lifestyle Restaurant"* primarily cater to mature adults as our direct customers. The key concept we focus on is the *"Limitation of the body"*, which addresses the overall challenges faced by mature adults. We have observed that many individuals in this demographic often lack the necessary equipment to meet their daily needs when utilizing similar services. To address this, we provide a range of supportive equipment such as spoons, knives, and forks designed specifically for individuals with ALS and mature adults**.** In order to assess the need for such equipment, we collected data through a Google Form survey targeted at mature adults who frequent "*Nature Lifestyle Restaurant*". The survey aimed to determine the percentage of individuals requiring various levels of support equipment, classified as *Extremely, Very, Moderately, Slightly,* and *Not at all.* The results indicated that approximately 8.93% of respondents required extreme equipment, while 26.79% required very specific equipment. Additionally, around 44.64% expressed a moderate need for equipment, as they encountered similar challenges within their families. A smaller percentage of 10.71% indicated a slight need, while 8.93% reported not requiring any equipment at all. The data collection involved a total of 56 direct customers. Based on the data collected, we have identified the key concept of *"Limitation of the body"* as being relevant to individuals who have physical challenges or special needs. This concept serves as the foundation for providing support to our customers. It is important to note that the support equipment

we offer is not limited to direct customers but can also benefit indirect customers across different generations.

However, we have identified a weakness in the support equipment, particularly in terms of stress tolerance and durability due to their lightweight nature. Additionally, the production cost of these specialized designs is relatively high, considering they are intended for individuals with specific needs. As a suggestion, we aim to reduce the prime cost and manufacturing overhead expenses associated with producing the support equipment. We also recognize the potential for future advancements in technology that can aid in the redesign and development of equipment catering to the unique requirements of special groups and mature adults.

3.7 Calculating "Usefulness (U)"

In the context of our study, the support equipment, including spoons, forks, and knives for mature adults and individuals with ALS, aligns with the usefulness concept. To evaluate the usefulness of these equipment, we consider four factors: Importance level, Popularity of use, Usage frequency, and Usage duration**.** These factors help us assess the overall value and effectiveness of the product. Based on the background of our study, the support equipment fulfills the safety needs of mature adults and individuals with ALS. These individuals require specialized utensils to ensure a comfortable and accessible dining experience.

The data collected through the questionnaires, conducted using *Google Forms* and targeting our direct customers, provides valuable insights. The questionnaire responses indicate the percentage of people who expressed their preferences and requirements for the support equipment. Among the respondents, approximately 80.36% (combining those who reported extremely, very, and moderately feeling requirements) emphasized the importance of this equipment, ranking them between 4.0 and 5.0 on a scale of 1 to 5.

Upon analyzing the collected data from the direct customers, we found that out of the 56 people surveyed, 8.93% expressed an extreme requirement for the support equipment, while 26.79% reported a very high requirement. Furthermore, 44.64% indicated a moderate level of requirement. We can group these three categories together as essential equipment, as the remaining respondents did not perceive the equipment as necessary. Consequently, out of the 56 surveyed individuals, 45 expressed the need for the essential support equipment.

These findings demonstrate the significance and demand for the support equipment among our direct customers, reinforcing the notion that they play a crucial role in ensuring a positive dining experience for mature adults and individuals with ALS.

3.7.1 Usefulness Calculation for "Design of Spoon for mature adults"

Based on Fig. 4 and considering the important level, the spoon designed specifically for mature adults is a crucial component of the support equipment. The proposed *"Nature Lifestyle Restaurant"* operates for approximately 8 hours a day and caters to both direct and indirect customers. According to the feedback received, certain groups of customers require the spoon designed for mature adults to facilitate their food consumption.

3.7.2 The key points

The respondents expressed satisfaction with the spoon, primarily due to its lightweight design. However, the number of people requiring this specific utensil during the restaurant's opening hours is relatively low. As a result, the time spent using the spoon amounts to approximately 4 hours per day.

3.7.3 Design of spoon for mature adults

The computation of the usefulness of the spoon designed for mature adults can be done using the given factors:

1. Importance of use (*L*): The importance level of the spoon for mature adults is rated as 4.5 on a scale of 4.0 to 5.0.

2. Rate of popularity for use (*R*): Based on the surveyed platform, 80.36% of the respondents expressed satisfaction and indicated a requirement for the spoon.
3. Rate of use (*F* × *D*): The approximate rate of use is calculated as 4 hours out of a total of 24 hours of restaurant operation.

Using these factors, the usefulness (*U*) of the spoon can be computed using the formula Eq. (3.1).

$$Usefulness(U) = Important\ level(L) \times Popularity\ of\ use(R) \times Usage\ frequency(F) \times Usage\ duration(D).$$

Substituting the values:
Usefulness (*U*) = (4.5/5) × (45/56) × (4/24),
= 0.121.

Therefore, the computed usefulness of the spoon for mature adults is approximately 0.121. This value will serve as the index for comparison with the other designs and platforms, including the fork, knife, and a specialized spoon.

3.7.4 Usefulness Calculation for "Design of Fork for mature adults"

Based on the information provided, the fork for mature adults can be considered to have the same importance and usage characteristics as the spoon for mature adults, as they both fall within the same category. Therefore, the factors and formula used to compute the usefulness of the spoon can be applied to the fork as well.

3.7.5 Design of fork for mature adults

The factors to consider are:
1. Importance of use (*L*): The importance level of the fork for mature adults is also rated as 4.5 on a scale of 4.0 to 5.0.
2. Rate of popularity for use (*R*): Based on the surveyed platform, 80.36% of the respondents expressed satisfaction and indicated a requirement for the fork.
3. Rate of use (*F* × *D*): The approximate rate of use is calculated as 4 hours out of a total of 24 hours of restaurant operation.
Using the formula:

$$Usefulness(U) = Important\ level(L) \times Popularity\ of\ use(R) \times Usage\ frequency(F) \times Usage\ duration(D).$$

Substituting the values:
Usefulness (*U*) = (4.5/5) × (45/56) × (4/24),
= 0.121.

Therefore, the computed usefulness of the fork for mature adults is approximately 0.121, which is equivalent to the computed usefulness of the spoon. Furthermore, this value will once again be used as the index for comparing with the other designs and platforms, including the knife and a specialized spoon.

3.7.6 Usefulness Calculation for "Design of Knife for mature adults"

Based on the provided information, the factors to consider for the knife for mature adults are as follows:
1. Importance of use (*L*): The importance level for the knife for mature adults is rated as 4.2 on a scale of 4.0 to 5.0.
2. Rate of popularity for use (*R*): Based on the surveyed platform, 71.43% of the respondents expressed satisfaction and indicated a requirement for the knife.
3. Rate of use (*F* × *D*): The approximate rate of use is calculated as 2 hours out of a total of 24 hours of restaurant operation.
Using the formula:

$$Usefulness(U) = Important\ level(L) \times Popularity\ of\ use(R) \times Usage\ frequency(F) \times Usage\ duration(D).$$

Substituting the values**:**
Usefulness (*U*) = (4.2/5) × (40/56) × (2/24),
= 0.05.

Therefore, the computed usefulness of the knife for mature adults is approximately 0.05. Once again, this value will be utilized as the index for comparison among the other designs and platforms, including the spoon, fork, and a specialized spoon.

3.7.7 Usefulness Calculation for "Design of Special spoon for ALS problem"

Based on the given information, the factors to consider for the special spoon for ALS problems are as follows:

1. Importance of use (*L*): The importance level for the special spoon for ALS problems is rated as 4.0 on a scale of 4.0 to 5.0.
2. Rate of popularity for use (*R*): Based on the surveyed platform, 8.93% of the respondents expressed satisfaction and indicated a requirement for the special spoon for ALS people.
3. Rate of use (*F* × *D*): The approximate rate of use is calculated as 0.5 hours out of a total of 24 hours of restaurant operation.
Using the formula:

$$Usefulness(U) = Important\ level(L) \times Popularity\ of\ use(R) \times Usage\ frequency(F) \times Usage\ duration(D).$$

Substituting the values:
Usefulness (*U*) = (4/5) × (5/56) × (0.5/24)
= **0.015**.

After calculation, the results indicate that the computed usefulness of the specialized spoon for ALS problems is approximately 0.015, while the computed usefulness of the knife for mature adults is approximately 0.05. These values will be used as the index for comparison with the other designs and platforms, including the spoon, fork, and knife.

3.8 Discussion-assessment of usefulness of design

Based on the analysis, findings, and suggestions provided, it can be summarized as follows:

3.8.1 Analysis

The farm and restaurant operate for 8 hours a day and offer four main essential support equipment*: Spoon, Fork, and Knife* for "mature adults", and a *Special Spoon* for "ALS people". These equipment items are categorized based on their level of importance, with the spoon and fork being general basic needs and safety needs, while the knife and special spoon cater to specific requirements.

3.8.2 Selecting value

The importance level for the support equipment is determined based on the scale from 4.0 to 5.0. The spoon and fork have an importance level of 4.5, indicating their extreme importance. The knife for direct customers has a level of 4.2, as it applies to specific courses. The special spoon for ALS people has a level of 4.0. The selection of values also takes into account factors such as spending time and popularity of use.

3.8.3 Suggestions

The essential support equipment plays a crucial role, and there are minimal differences in terms of importance, popularity of use, and frequency of use. They all fall within the range of 4.0 to 5.0 on the importance scale, indicating their significance. Therefore, the focus should be on providing convenient and lightweight support to customers.

3.8.4 Findings

Designs of spoon, fork, knife, and special spoon include the essential support equipment. While they serve the same purpose, there are variations in their importance levels, spending time, and frequency of use. However, they share a common objective of providing convenience and support to customers.

The key takeaway is the importance of the essential support equipment and the need for lightweight and convenient designs. By considering the importance, popularity, and frequency of use, the farm and restaurant can effectively cater to the needs of mature adults and ALS people.

3.9 Finite Element Analysis (FEA)

To minimize the risk of pain in the hand and arm that is often due to muscle, tendon, or ligament damage from holding and carrying a load all the time or every day. These have led to the next sub-section that is about the study of loads that are from the spoon itself and the food carried. For studying the effect of loads, the estimated weight of the food carried on the spoon is used to be as the reference for the design of load contribution activity – "testing and refinement" by the application of Finite Element Analysis (FEA) method [31-32].

The key components, which are required as the inputs for the simulation, are *the type of material used for making the spoon, the direction of load applied on the bag,* and *the type of motion applied*. Moreover, the setting of commands applied in the simulation are the same; except for the fixed geometry, force, and mesh size, which will be changed according to the area of interest.

Finite Element Analysis (FEA) is utilized in this research to determine the forces exerted on the spoon in two favorite styles. The simulation process can be done by setting the following steps: Part > Connections > Fixture > External Load > Mesh > Run.

First, the spoon design is modeled as a part in the FEA software. This includes defining the geometry, dimensions, and material properties of the spoon for accurate analysis.

Next, the connections of the spoon, such as the attachment points of the handle and the bowl, are established. These connections ensure that the spoon components behave as a unified structure during the analysis.

Fixture conditions are then applied to simulate the spoon's real-world usage. This may include fixing certain points or restraining specific movements to represent the spoon's interaction with the user's hand or mouth.

External loads are applied to replicate the forces experienced by the spoon during its intended use. This can include the impact of stirring, scooping, or biting forces, depending on the chosen styles.

The spoon model is then meshed, dividing it into small elements to facilitate accurate calculations and predictions of force distribution. The mesh density and quality play a crucial role in obtaining reliable results.

Finally, the simulation is run, and the FEA software calculates the forces exerted on the spoon in the two favorite styles. This analysis provides insights into the stress and deformation experienced by the spoon under different loading conditions.

By employing FEA, this research aims to evaluate the structural integrity and performance of the spoon designs, ensuring that they can withstand the expected forces without failure or discomfort. The results obtained from the FEA simulations can guide the design process, allowing for optimization and improvements to enhance the functionality and usability of the spoons. It should be noted that the application of FEA is a valuable tool in engineering and design, providing valuable insights into the behavior and performance of complex structures like spoons.

3.9.1 Application of FEA in this study

For Finite Element Analysis (FEA), the area of interest is around the neck of the spoon, where the simulation with commands was performed in the SolidWorks program - to identify the von Mises stress of the interested area. The static/stress is selected to calculate displacements, reaction forces, stresses, strains, and factors of safety distribution of the model. Using this simulation can support the design team to avoid failure, bend, or crack due to high stresses. The external load of 50 N is applied to the *handle of the spoon*.

Firstly, setting the proper material of the spoon in "*Part Property Manager*" is performed when all materials used for this design are provided in the library of the SolidWorks software.

Secondly, "*Connections Property Manager*" is done by setting "*Component Interactions and Local Interactions*". The *Component interaction* is used to specify the interaction conditions that control the action of the selected components during simulation, while "*Local interaction*" is used to define interactions between sets of geometric entities of solids, shells, and beams. In addition, *Local interactions* settings override component-level interactions. In this case, the researchers specify the component interaction only.

Thirdly, the *Fixture Property Manager* is used to define displacements on vertices, edges, or faces of the model. The *Fixed Geometry* command is used to assign value and location depending upon the area of interest.

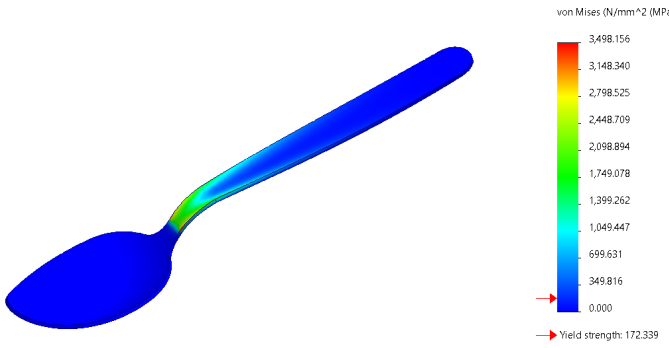
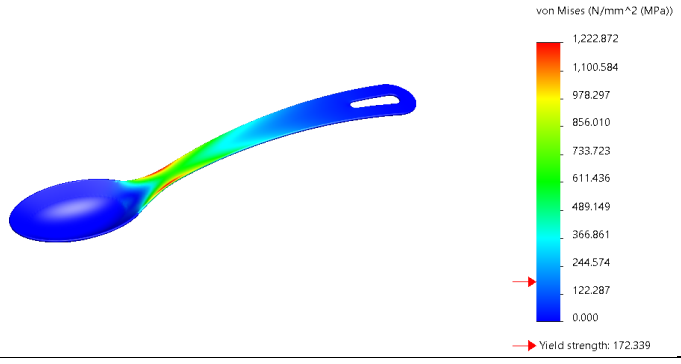
Fourthly, the *Distributed Mass, Gravity,* and *Force* commands in the *External Loads Property Manager* are used in the simulation.

Fifthly, in the *Mesh application*, the *blended curvature-based mesh* is used with a mesh size of 1.5 mm for both designs. The *Distributed mess* of 0.03 kg acts as the estimated weight of the food (rice with side-dished) in a spoon assigned at the bowls of the spoon [33]. At the center of the model, the *gravity force* is applied. Moreover, the *force* is assigned to the handle part of the spoon.

Finally, the program starts to simulate the conditions assigned where the time spent for simulation depends upon the mesh size, no. of interesting areas, and size of the virtual model. In this study, the range of time indicated around 7 seconds for each simulating process. During the analysis of the finite element (FE) part, it was assumed that the food placed on the bowl part of the spoon was fixed to each other, which established the contact conditions among them. A total of 11,293 elements and 58,540 elements were used in the analysis of design A and design B consequently.

Table 8 presents the FEA Simulation results for 'Design – A' and 'Design – B' of the spoon. The material type and properties assigned in the simulation are based on the expertise of the design team and experts currently engaged in a similar business.

Table 8. FEA Simulation on "Design – A" and "Design – B" of the spoon.

Design	Mass (g)	Max von Mises (MPA)	Result
A	2.460	3,498.156	
B	2.636	1,222.872	

Results: The simulation result showed that the maximum von Mises occurred in design A is 3,498.156 MPa while design B is 1,222.872 MPa.

In conclusion: from the two designs where the same material is applied: (stainless steel), the maximum von Mises occurs is exceed the yield strength or Young's modulus of the stainless steel, which means that the area of interest (Neck) for both designs, will have the possibility to bend or break with the load of 5 kg or 50 N. With almost the same weight of both designs, the maximum von Mises that occurs for "Design – B" is three times less than "Design – A".

3.9.2 Key considerations

To articulate the central idea of "*the equivalent load applied on the fork or spoon by senior adults*," researchers have sought to illuminate and summarize the concept in the following manner. The force exerted on a fork or spoon during typical use is subject to considerable variation, influenced by factors such as individual strength, grip, and the specific task at hand. Nevertheless, a force of approximately 50 Newtons (N) falls within the range of the typical force applied by an average person when using utensils. This 50-N force proves sufficient as a distributed force for utensils, especially when considering related studies.Research indicates that forces applied on utensils during the consumption of sticky foods, which demand higher force than in standard eating scenarios, can range from 10 to over 20 Newtons. Therefore, the designated 50-N force value for simulation purposes not only meets but surpasses the requirements, safeguarding users from the risk of utensil breakage or distortion during eating.

However, this is a rough estimate and individual variations can occur. Additionally, factors like the design and ergonomics of the utensil can influence the force applied. Moreover, the design and ergonomics of the utensil itself can significantly influence the force exerted.

3.9.3 In standard eating scenarios

Cutlery (Fork or Knife): According to biomechanical studies, the force applied to a fork or knife during typical eating activities can range from 5 to 10 Newtons (N) [34]. This estimate takes into account the variability in individual strength and the diverse nature of foods encountered during meals.

Spoon: When considering the force applied to a spoon during eating, the range is typically found to be between 3 to 8 Newtons, reflecting the variations in individual capabilities and the ergonomic design of the utensil [35].

3.9.4 In special eating scenarios

The maximum force or weight applied to a utensil during eating or chopping sticky food can vary depending on factors such as the type of food, the individual's strength, and the design of the utensil. It is challenging to provide a precise value, as it can be influenced by many variables.

Cutting with a Knife: According to biomechanical studies, individuals may exert higher forces when cutting through tougher or stickier foods. The force applied during such tasks can vary widely, typically ranging from 10 to 20 Newtons or more, contingent on the specific demands of the task and the individual's strength [36].

Force on Fork or Spoon: When picking up sticky food with a fork or spoon, individuals may apply forces in the range of 5 to 15 Newtons. This force is influenced by factors such as the stickiness of the food and the user's strength, as indicated by studies in biomechanics [37].

Chopping with a Knife: Chopping motions, especially through sticky or dense foods, may involve forces exceeding 20 Newtons. The actual force applied can depend on various factors, including the type of food and the user's strength [38].

4. Conceptual Design for Supporting "Nature Lifestyle Restaurant"

4.1 Platform of restaurant

The design concept of the restaurant follows the *Nordic and Minimal style*, which aims to harmonize with the surrounding nature and create a clean and simple aesthetic. The use of appropriate materials and decorations ensures that the restaurant blends well with the environment. The minimal concept focuses on simplicity, smooth lines, rounded edges, and eliminating unnecessary elements. The space within the restaurant is divided into six areas: the entrance/waiting area, dining area, cashier, toilet, kitchen, and labor area. Considerations have been made to ensure the comfort of the elderly and people with disabilities. Clear and visible signage, handrails on stairs, ramps for wheelchairs, wide doors and corridors, bathrooms with handrails, and nearby parking facilities (as shown in Figs. 8-9) are incorporated into the design.

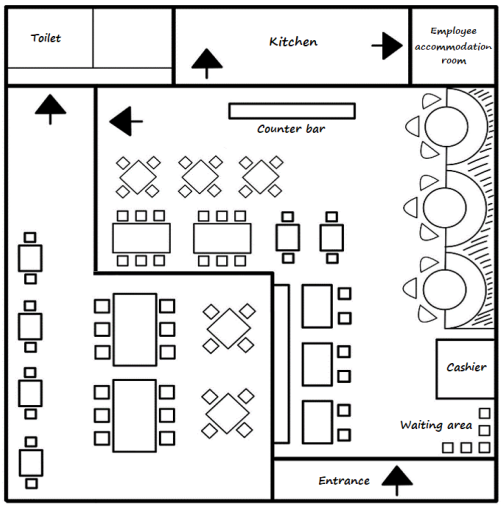


Fig. 8. The interior design of the restaurant.

The size of the dining tables is determined based on the number of customers they can accommodate. Tables are available for 2, 4, and 6 people. Each person requires a certain width of the table (around 0.5-0.7 meters) and the depth of a chair (approximately 0.4 meters). Sufficient space must be provided for customers to move in and out of their chairs without blocking the aisle, with a recommended distance of about 1.25 meters.

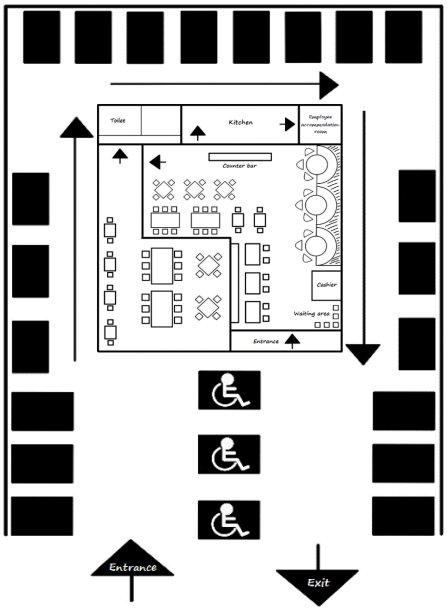


Fig. 9. The overview design of the proposed platform of restaurant.

For example, a dining table for 1-2 persons should have dimensions of approximately 80×65 cm. A square table for 4 persons should have an area of around 85×85 cm, while a rectangular table should be about 80×125 cm (as shown in Fig. 10). A dining table for 6 people should have an area of approximately 80×175 cm, and a round table should have a diameter of about 1.25 meters (as depicted in Figs. 11-12). The height of the tables should be suitable for wheelchair users, typically around 80 cm.

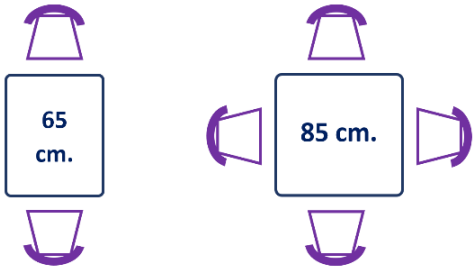


Fig. 10. The dimension of the table for 2 and 4 people.

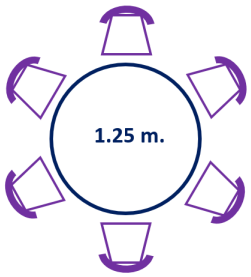


Fig. 11. The style of circular table – 6 people.

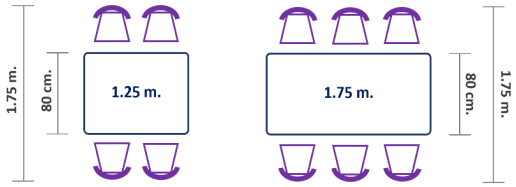


Fig. 12. The styles of rectangular table for 4 and 6 people.

4.2 Interior components

For supporting the design team to create the platform of "interior components", five main topics have been taken into consideration: *Lighting in Restaurant Design*, *Daytime Lighting and Ambiance*, *Evening Lighting and Decorative Elements*, *Balancing Ambient and Functional Lighting*, and *Ventilation in Restaurant Spaces* [39-45]. The layout of the air ventilation system, as depicted in Fig. 13, ensures a balanced and controlled airflow, facilitating proper air change and movement.

In terms of lighting, the restaurant takes advantage of natural light, allowing sunlight to penetrate the space. The lighting is not excessively bright, as the natural light creates a comfortable atmosphere for customers. The design of the restaurant prioritizes functionality, accessibility, and aesthetics, ensuring a pleasant dining experience for all customers, including the elderly and individuals with disabilities.

During the daytime, the restaurant benefits from natural sunlight as the main source of light. Additionally, lanterns or ambient lighting fixtures are strategically placed to add visual interest and enhance the overall atmosphere. The combination of natural and artificial lighting creates a pleasant and inviting ambiance for customers.

In the evening, the restaurant's interior is enriched with decorative elements, including hanging pictures and ornaments that harmonize with the establishment's style and theme. Lighting fixtures strategically illuminate these elements, capturing attention and infusing the space with a lively and engaging atmosphere. Soft lamp lighting is employed to foster a sense of relaxation and comfort among the diners. While creating a cozy ambiance is important, it is equally crucial to ensure that the lighting is sufficient for customers to clearly see the details of the food. Adequate lighting levels are maintained to enable customers to appreciate the presentation and visual appeal of the dishes, aligning with the restaurant's menu and culinary offerings. This careful balance between ambient lighting and functional lighting ensures an enjoyable dining experience where customers can appreciate both the aesthetics and the culinary delights of the restaurant.

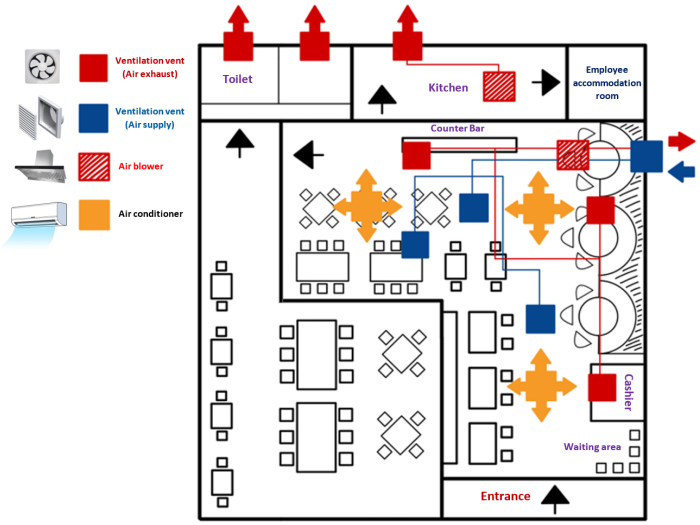


Fig. 13. The layout of the air ventilation system.

Air circulation and ventilation in a restaurant play a crucial role in maintaining air quality and ensuring the comfort of customers. The presence of air pollutants such as Carbon dioxide, Formaldehyde, particulate matter, pollen, bacteria, and viruses can pose health risks to individuals. Therefore, it is important to implement effective ventilation measures to remove or reduce these pollutants from the indoor environment. While air conditioning systems are commonly used for cooling, they alone are not sufficient for proper ventilation as their primary function is to circulate and cool indoor air. To achieve good ventilation, additional methods are employed in conjunction with air conditioning. These include ceiling ventilation, ventilation fans, and outdoor ventilation. Ceiling ventilation helps in extracting stale air from the restaurant's interior. Ventilation fans aid in facilitating air movement and circulation within the space. Outdoor ventilation, involves introducing fresh outdoor air into the restaurant. This can be achieved through the use of air dampers or other ventilation systems. By incorporating these ventilation methods, air can be effectively exchanged and circulated inside the restaurant.

The ventilation volume required can be calculated based on factors such as the room area, height, and standard value. In the case of a restaurant or kitchen, the standard value typically ranges around 15 air changes per hour. By meeting these ventilation requirements, customers in the restaurant can experience a comfortable and clear environment, free from any discomfort caused by inadequate air circulation or pollutants. This allows them to fully enjoy the food and atmosphere of the restaurant.

Prioritizing proper ventilation and air circulation is crucial for restaurant owners and managers in order to create a healthy and inviting dining environment for their customers. Regular maintenance and monitoring of the ventilation system are essential to ensure optimal performance and maintain high air quality.

4.3 Virtual model of the developed Restaurant

The design process for the kitchen room can be divided into three phases: determining the space requirements, planning the architectural layout, and planning for efficient operations. These phases help ensure an organized and functional kitchen space. The concept of dividing the design process into these phases was mentioned in the Kitchen Planning Standard [46]. By following these phases, restaurant owners and managers can create a well-designed and efficient kitchen that

meets their specific needs and optimizes workflow.

Phase I: The kitchen room is situated at the top of the layout, adjacent to the labor room, providing ample space for organizing the standard kitchen equipment (Fig.14). This includes a four-burner gas stove, electric roaster, dishwasher, freezer, storage cabinets, kitchen tabletop, and countertops.

Phase II: In this phase, the standard dimensions of the equipment are determined. Fig. 15 illustrates the size and shape of the kitchen countertop. The most ergonomic average dimension for a kitchen countertop is 36 inches, which ensures comfort for staff members during food preparation. The countertop height is tailored to accommodate staff members of average height, ranging from 5 feet 2 inches to 5 feet 8 inches. The selection of shelves depends on the restaurant's size, with storage cabinet shelves being used in this case study due to their capacity for managing ingredients.

Fig. 14. The created Kitchen area I.

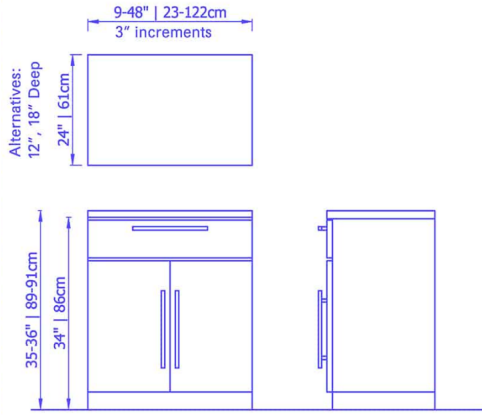


Fig. 15. The standard dimension of the kitchen countertop.

Fig. 16 outlines the acceptable dimensions for a long-design shelf, measuring 31.785 inches in width, 18.5 inches in depth, and 83.5 inches in height.

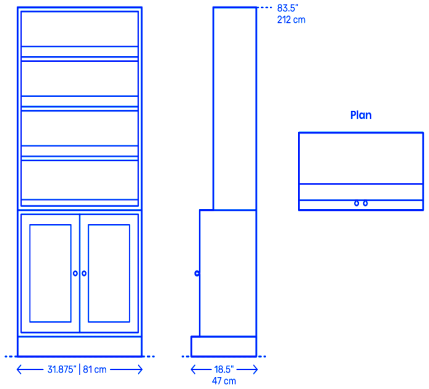


Fig. 16. The minimum dimension of the storage cabinet shelf.

Phase III: This is the crucial stage in kitchen design as it focuses on efficient location placement to minimize staff idle time. The positioning of the kitchen countertop is near and opposite the burner gas stove and shelf, serving as a functional space for placing dishes, equipment, and ingredients. Regarding the storage cabinet shelf shown in Fig. 17, it consists of four levels with specific purposes:

Level 1: The top level is designated for lightweight equipment.

Level 2: The second level accommo-dates frequently used components such as glass jars of grain, liquid aminos, Himalayan salt, and cans.

Level 3: The third level is dedicated to heavy and frequently used materials based on menus, such as bottles of grain, seeds, monk fruit sweetener, glass jars, and flour.

Level 4: The transparent zone on the fourth level provides detailed restocking of necessary ingredients, including sesame oil, Bertolli, and flour.

Fig. 17. Kitchen area II.

In the kitchen zone, ingredients for dishes are prepared in appropriate quantities. Components and ingredients are checked daily before opening and after closing to prevent understocking or overstocking. The restaurant's concept revolves around a greenhouse farm and garden, which offers the benefits of maintaining fresh greens and purifying the air. However, it also poses challenges related to greenhouse gas emissions and associated costs, such as handling suitable temperatures and carbon taxes. To address this, the installation of solar energy systems, known as "clean energy", can be considered as a solution."

A study by Julius in 2014 suggests that conventional production systems release more emissions compared to organic systems based on production. Figs. 18-20 illustrate a simulation of a farm and garden using "The Sims 4" animation platform. Analyzing the marketing strategy can attract customers and yield high potential profits. The inclusion of a souvenir shop is a common choice that helps reduce overstocking during certain periods and enables the sale of seasonal and off-season greens. While these concepts offer interesting ideas for restaurant owners, they may be limited by dimensions, space availability, and seed variety.

However, this platform cannot provide accurate dimensions and may support only a basic range of vegetables, fruits, and other ingredients. Some functions may not accurately represent real-life situations.

Fig. 18. Farm and Garden I.

Fig. 19. Farm and Garden II.

Fig. 20. Farm and Garden III.

Designing parking spaces for a restaurant is crucial and requires consideration of various types of layouts. The Borough of Charnwood Local Plan (2004) [47] provides guidance on parking space requirements. For a restaurant classified as "*Class A3 Food and Drink*", it is essential to ensure the availability of suitable parking facilities. A normal car parking space should have a minimum dimension of 2.4 meters in width, 5 meters in length, and 2 meters in headroom, as depicted in Fig. 21.

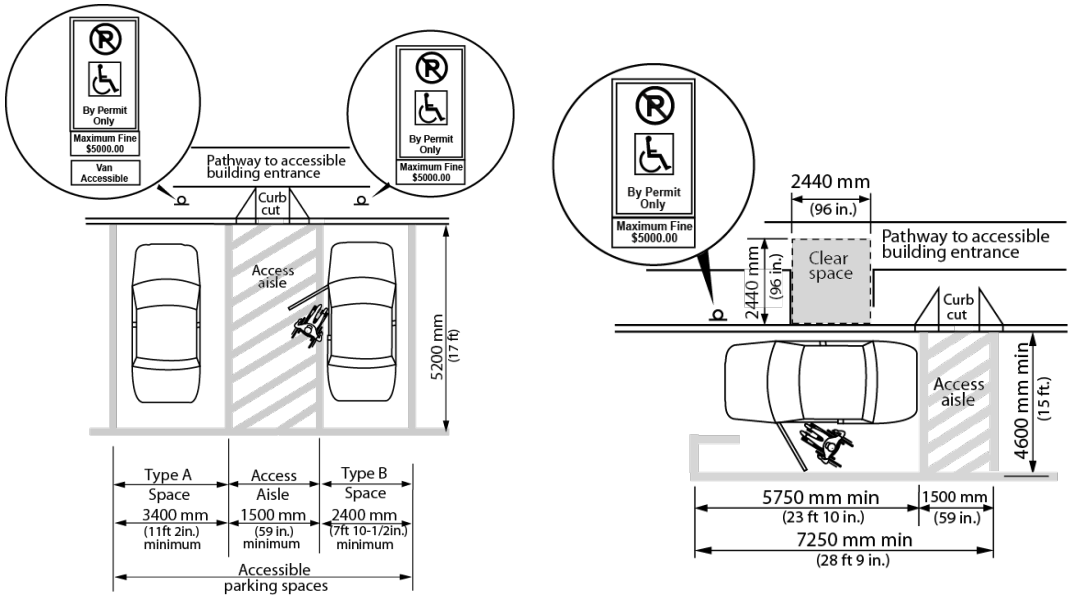


Fig. 21. Standard car parking space [48].

In addition to regular parking spaces, this study also includes parking spaces for disabled individuals. These spaces should be designed with a width of either 3.2 meters or 3.6 meters to accommodate the specific needs of disabled drivers. It is important to clearly mark these parking spaces with the "Disabled symbol", as shown in Fig. 22, indicating that only individuals with limited mobility can park in those areas. Fig. 23 illustrates an imaginary-drafted platform for the car parking layout, providing a visual representation of the parking area.

This study provides parking for disabled people since it uses more space than normal space. This parking should be clearly 3.2 meters wide or 3.6 meters. Additionally, developers are required to provide a minimum of one accessible parking space for disabled individuals per 200 m^2 of floor space. The restaurant should be marked with a "Disabled symbol" to represent that only a limited person can park in the area.

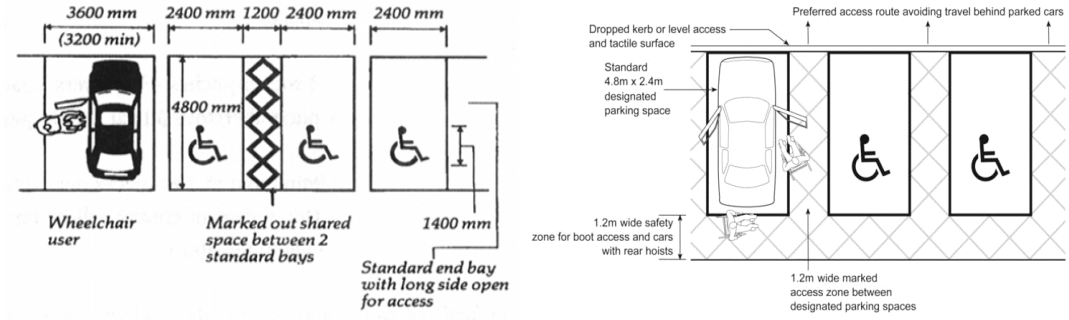


Fig. 22. Disabled people space car parking platform [47, 49].

Fig. 23. Car parking platform.

In summary, the phrase "*For a restaurant classified as 'Class A3 Food and Drink'*" refers to a specific classification system used to categorize different types of businesses. In this case, "*Class A3*" pertains to establishments primarily focused on serving food and beverages to customers. It could include restaurants, cafés, and similar establishments. The statement "*it is essential to ensure the availability of suitable parking facilities*" means that it is important for restaurants in this category to have adequate parking spaces to accommodate their customers' vehicles. This is because patrons visiting restaurants often arrive by car and need a place to park while dining. Providing appropriate parking facilities ensures convenience for customers and can contribute to a positive dining experience.

5. Discussion

5.1 Overall considerations

This research focuses on designing and evaluating the feasibility of the "*Nature Lifestyle Restaurant*" for mature adults aged 50-80. We employ Finite Element Analysis (FEA) to investigate forces applied to spoons of two styles. A usefulness calculation determines the most suitable utensil design, considering factors such as ease of use, grip comfort, and functionality. This information guides the selection and optimization of utensils to meet the specific needs of our target demographic. Demographic refers to a group sharing common characteristics like age, gender, income, or location. It helps analyze and understand a particular population subset. Finite Element Analysis (FEA) evaluates the structural integrity and performance of utensils, ensuring durability and safety. The combination of usefulness calculation and Finite Element Analysis (FEA) considers ergonomic and technical aspects. This research enhances the dining experience for mature adults, focusing on menu design, customer satisfaction, and utensil evaluation. The findings and recommendations promote a restaurant environment that caters to the unique requirements of mature adults, prioritizing their well-being.

5.2 Contribution

An ideal restaurant experience with a contemporary platform could involve a fusion of modern and traditional elements. For example, the restaurant could feature a sleek and stylish interior design with comfortable seating and a warm ambiance. The menu could offer a blend of classic and innovative dishes, catering to a wide range of tastes and dietary preferences. Advanced technology could be integrated into the dining experience, such as digital menus or interactive tabletops for ordering and entertainment. Additionally, the restaurant could prioritize sustainability by using locally sourced ingredients and implementing eco-friendly practices. The goal is to create an atmosphere that appeals to both younger and older generations, providing a memorable and enjoyable dining experience for all.

5.3 Originality

The originality of the research is underscored by its focus on the design and layout of a restaurant, utilizing questionnaires and industry standards to develop a comprehensive guideline for restaurant owners. This innovative approach aims to create an optimal platform and layout that aligns with the desires of the target market. The integration of insights obtained through questionnaires forms the cornerstone for the development of this guideline, ensuring that it caters to customer preferences and expectations. This guideline encompasses industry standards and best practices, encompassing aspects like seating

arrangements, table spacing, lighting, acoustics, and overall ambiance. It goes beyond aesthetics, considering factors such as accessibility, functionality, and flow of movement within the restaurant. Recommendations regarding the strategic placement of key elements, including entrances and service areas, are provided to optimize customer convenience. The unique combination of questionnaires and industry standards in crafting the guideline ensures that the restaurant's platform and layout align with customer expectations and industry best practices. This research significantly contributes to the understanding of effective restaurant design, providing practical tools to enhance establishments' platforms and layouts. By implementing this guideline, restaurant owners can elevate the overall dining experience, attracting more customers and achieving greater business success. The findings and recommendations from this research serve as a valuable resource for entrepreneurs and industry professionals, aiding them in optimizing their restaurant's platform and layout to meet evolving customer demands.

5.4 Advantages of the proposed approach

The superiority or advantages of the proposed methodology can be expressed in the following key points: the PDD approach employed in developing the guidelines for facility and service design not only fosters an inclusive dining experience but also prioritizes safety, customer satisfaction, resource efficiency, and adherence to industry standards; all of which are significant benefits of this method. Furthermore, to assist restaurant owners and design teams in achieving this objective, the formulated guidelines for facility and service design have been created using a Product Design and Development (PDD) approach, which offers several significant key benefits.

5.4.1 Enhanced safety

PDD places a strong emphasis on creating a safe dining environment for senior adults, effectively reducing the risk of accidents. By carefully considering factors such as lighting, layout, and the placement of key elements, it significantly improves overall safety within the restaurant.

5.4.2 Optimized customer experience

The incorporation of ergonomic design principles ensures that cutlery is easy to use for senior adults while still meeting the needs of all customers. This not only enhances the comfort of senior diners but also contributes to an improved dining experience for everyone, promoting customer satisfaction.

5.4.3 Efficient Resource Allocation

PDD allows for a more efficient allocation of resources, ensuring that restaurant owners invest in areas that truly matter. This method prioritizes elements that have the most significant impact on customer experience, making the best use of available resources.

5.4.4 Consistency and compliance

By adhering to industry standards and best practices, the proposed approach promotes consistency in restaurant design and layout. This not only ensures compliance with regulations but also helps establish a positive brand image for the restaurant.

6. Limitations and Recommendations

6.1 Production ramp-up

In order to provide additional details, explanations, or information to enhance the clarity and comprehensiveness of the proposed approach, a more in-depth and thorough discussion has been developed, referred to as "*the guidelines containing key considerations*". This research serves as the initial version with the intention of contributing to future phases. The comprehensive guidelines, along with a systematic platform and direction, can assist designers and researchers in establishing a structured 3D model or restaurant design, akin to architectural planning. This encompasses crucial elements such as

adapted menus, ideal lighting conditions for dining, physical specifications for tables and chairs, and creating favorable external and internal conditions for the restaurant to ensure easy access, safety, and customer satisfaction for senior adults. For this current version of the proposed research, *"Production Ramp-up"* has been introduced as a 2D-information platform, serving as an instructional manual for business owners or designers to grasp the fundamental design concept. It provides key requirements for selecting appropriate materials to support the design stage.

6.2 External decoration

Fig. 24 displays the overall layout of the restaurant, covering an area of 40×30 square meters, equivalent to approximately 0.75 rai. The front side of the restaurant is divided into the entrance and relaxation zone, designed with a green and minimal concept. This appealing design attracts both direct and indirect customers, including the elderly, young adults, and disabled individuals, ensuring a diverse customer base in the future. The entrance area is of utmost importance in providing convenience to customers. Handrails are essential support equipment, especially for the elderly and disabled individuals, as depicted in Fig. 25. Special handrails are utilized, marked by a black and yellow line, offering enhanced visibility during nighttime for visually impaired and differently abled individuals. Wall lights and lamp posts with a cool white tone of 4,100 Kelvin are installed to provide comfortable visibility and a refreshing ambiance. This means that when installing the wall lights and lamp posts in the restaurant, a specific color temperature of light is chosen, which is measured in Kelvin. In this case, the chosen color temperature is 4,100 Kelvin, which is considered cool white. This indicates that the light emitted from these fixtures has a slightly bluish hue, creating a crisp and refreshing ambiance in the restaurant. Additionally, recommended menus are provided to assist customers in making their food choices. The area serves as a landmark point, characterized by a minimal design and a green fantasy forest concept. Fig. 26 illustrates the environmental area, resembling a mini-flower garden. Special activities, such as creating dried and fresh flower bouquets, mini crochet, and a photo zone, are offered to enhance customer satisfaction.

Fig. 24. Bird's-eye view of the restaurant from the top.

Fig. 25. The entrance area.

Fig. 26. The relaxation zone and co-working space.

6.3 Internal decoration

Transitioning to the interior decor, Fig. 27 and 28 highlight two areas, featuring a gas stove burner and a roaster (View A and B). A four-burner gas stove is employed for cooking, allowing the staff to prepare four different meals simultaneously, thereby saving time. The left and right sides of the stove feature counters for ingredient

preparation. An electric roaster, which is smokeless, is used for grilling meat, ensuring safety and minimizing pollution compared to traditional roasters that utilize coal. In the center of the area, a special counter is dedicated to sub-ingredient preparation, reducing idle time and enhancing efficiency during peak hours. This efficient service contributes to customer satisfaction.

Fig. 27. A gas stove burner and a roaster (View A).

Fig. 28. A gas stove burner and a roaster (View B).

The first zone (Zone I) of the restaurant, illustrated in Fig. 29, features a light pale tone that affects customers' psychology. The ambiance aims to engage all five senses, providing detailed table settings, including cutlery sets, menus, tomato sauce, and opaque glassware. The walls of this zone tell stories about the farm and restaurant, capturing the interest of customers during their dining experience.

Zones II (Fig. 30) and III (Fig. 31) are divided into three categories: dark brown wood tables, long white tables, and long grey tables. Two styles of chairs are provided for ergonomic and safety purposes: dark brown and warm light chairs, as well as light brown and warm light ladder-back chairs.

Fig. 29. Dining Area (Service Area) - Zone I.

Fig. 30. Dining Area (Service Area) - Zone II.

Fig. 31. Dining Area (Service Area) - Zone III.

The Scandinavian furniture style, presented in Fig. 32, is specifically designed to cater to the elderly and older generations. This design emphasizes simplicity, functionality, and minimalism, with furniture components made from natural wood and neutral tones. Transparent jars of white flowers, samples of ceramic tea sets, and a flower carpet contribute to the storytelling aspect of the restaurant.

The employee accommodation room follows a mid-century modern design, employing furniture in white and earth tones. Providing fully functional facilities is crucial for staff convenience. This area is divided into two zones: the dressing zone, depicted in Fig. 33, serves to prevent accidents and facilitate uniform checks, while Fig. 34 represents the meeting room utilized by the

staff. Soft tones are employed in this area to reduce stress and fatigue during working hours.

Fig. 32. Waiting area.

Fig. 33. Employee accommodation room – Zone I.

Fig. 34. Employee accommodation room – Zone II.

Key considerations include designing all furniture and materials within the restaurant with rounded edges to prevent accidents and create a safe environment. This environment not only enhances customer safety but also instills a sense of pride and confidence in consuming the ingredients.

6.4 Restaurant platform summary

This section focuses on the design and layout of a restaurant, utilizing questionnaires and industry standards to develop a comprehensive guideline for restaurant owners. The aim is to create an optimal platform and layout that meets the needs and expectations of customers. Through the administration of questionnaires, valuable insights were obtained regarding customer preferences and expectations for a restaurant's platform and layout. These insights served as the foundation for developing a guideline that aligns with the desires of the target market.

The guideline incorporates industry standards and best practices to ensure a high-quality dining experience. It covers various aspects, including seating arrangements, table spacing, lighting, acoustics, and overall ambiance. By following the guideline, restaurant owners can create a pleasant and comfortable environment that enhances customer satisfaction. Additionally, the guideline takes into account factors such as accessibility, functionality, and flow of movement within the restaurant. It provides recommendations on the placement of key elements such as the entrance, service areas, and restroom facilities to optimize customer convenience.

The integration of questionnaires and industry standards in developing the guideline ensures that the platform and layout of the restaurant are aligned with customer expectations and industry best practices. This research contributes to the understanding of effective restaurant design and provides restaurant owners with a practical tool to improve their establishment's platform and layout.

By implementing the guideline, restaurant owners can enhance the overall dining experience, attract more customers, and ultimately achieve business success. The findings and recommendations from this research serve as a valuable resource for entrepreneurs and industry professionals seeking to optimize their restaurant's platform and layout to meet customer demands.

7. Conclusion

The conclusion is drawn based on the results obtained from various aspects, including the assessment of the 'Usefulness of Services and Products,' the analysis of

simulated force distribution through 'Finite Element Analysis,' and the translation of Form/Fit/Function via data-driven product design and development. The 2D guidelines produced in this study serve as a valuable outcome and contribution, facilitating real-world applications for business owners and designers. These guidelines enable a streamlined approach, reducing the time spent on trial-and-error design while aiding in the selection of appropriate conditions, materials, and components to address restaurant design requirements. The results presented here are derived from a combination of theoretical methods and a comprehensive set of digital simulations, with input parameters carefully determined by the researchers specializing in design and development. However, it is worth noting that literature reviews concerning standard values and parameters related to parking lot and table-chair sets remain crucial. These references are indispensable during the design phase, as they inform the creation of 3D models for spoons, tables, chairs, and parking spaces.

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