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Assessment of menu management in an offshore food and nutrition unit from the perspective of the Lean Thinking

Avaliação da gestão de cardápios em uma unidade de alimentação e nutrição offshore sob a perspectiva da filosofia Lean

Abstract

Introduction: In food and nutrition units, menu planning is a central step for meal production in increasingly complex productive, economic, and social contexts. In this regard, Lean can be an effective approach for menu management, promoting operational efficiency and quality by eliminating waste in the processes. **Objective:** To analyze the menu planning process of an offshore food and nutrition unit and propose improvements based on the application of Lean Thinking principles. **Methods:** A descriptive, qualitative, and quantitative case study was conducted on a training ship anchored in the state of Rio de Janeiro. The structural and physical-functional conditions of the food and nutrition unit were analyzed using a checklist based on sanitary legislation; menu planning and work perceptions were assessed through a semi-structured interview with the cook; the production flow was mapped; and crew food preferences were evaluated using a qualitative-quantitative questionnaire. **Results:** Thirty-three percent of non-conformities were identified based on the hygienic-sanitary checklist; long food processing times; flow crossovers and waste; and lack of menu planning, which negatively impacted operational flow and the cook's work. **Conclusion:** The survey of the crew revealed a positive perception of healthy eating, with a preference for foods from their regions of origin. Therefore, it is recommended to implement menu management that optimizes the entire process from planning to meal delivery, focusing on quality. The adoption of Lean Thinking is suggested as an effective method for this improvement.

Keywords: Menu Planning. Food Services. Lean Six Sigma. Total Quality Management. Workflow. Food Quality.

Resumo

Introdução: Em unidades de alimentação e nutrição, o planejamento de cardápios é etapa central para a produção de refeições em contextos produtivos, econômicos e sociais cada vez mais complexos. Neste sentido, o *Lean* pode ser uma abordagem eficaz para a gestão de cardápios, promovendo eficiência operacional e qualidade, por meio da eliminação de

desperdícios nos processos. **Objetivo:** Analisar o processo de planejamento de cardápios de uma UAN *offshore*, para propor aprimoramentos a partir da aplicação dos princípios da filosofia *Lean*. **Métodos:** Realizou-se estudo de caso descritivo, qualitativo e quantitativo em navio-escola fundeado no Estado do Rio de Janeiro. Analisaram-se as condições estruturais e físico-funcionais da UAN utilizando lista de verificação baseada na legislação sanitária; o planejamento do cardápio e as percepções do trabalho, através de entrevista semiestruturada com o cozinheiro; o fluxo produtivo, por meio do mapeamento do processo; e as preferências alimentares dos tripulantes, através de questionário quali-quantitativo. **Resultados:** Foram identificados 33% de inconformidades quanto à lista de verificação higiênico-sanitária; longo tempo de processamento dos alimentos; cruzamentos de fluxos e desperdícios; ausência de planejamento de cardápios, com impacto negativo sobre o fluxo operacional e no trabalho do cozinheiro. **Conclusão:** Na pesquisa com a tripulação, identificou-se uma percepção positiva sobre a alimentação saudável, com preferência por alimentos de suas regiões de origem. Recomenda-se, portanto, a implementação da gestão de cardápios que otimize desde o planejamento à entrega das refeições, com foco na qualidade. A adoção da filosofia *Lean* é sugerida como um método eficaz para essa melhoria.

Palavras-chave: Planejamento de cardápio. Serviços de alimentação. *Lean* Seis sigma. Gestão da Qualidade Total. Fluxo de Trabalho. Qualidade dos Alimentos.

INTRODUCTION

The menu is the list of culinary preparations that make up the meals, serving as a vehicle for information, sales, and assistance for the diners.^{1,2} As a communication tool, it can influence choices and guide the consumption of certain foods.³ As the foundation of the work process in a food and nutrition unit, it will serve to define the production flow,⁴ equipment, preparation techniques, inputs, and staff qualifications,³ serving as a decision-making tool in the structuring and operation.

Menu planning follows a flow: recognizing the target audience, choosing the foods and characteristics of the preparations, and managing the food and nutrition unit.² The menu is structured through the articulation between the value to be delivered to the customer and the operational aspects that include budgeting, supplier selection, and the organization of the production process. The value for the customer is defined by the dimensions of nutritional, sensory, symbolic, hygienic-sanitary, and socio-environmental quality,⁵ which make up the service quality requirements.

The concept of quality has expanded in recent decades, leading to Total Quality Management.⁶ In this phase, quality takes on a strategic role, from planning to service, focusing on customer experience and societal expectations.⁷

This expansion stems from globalization and technological advancement, which have led to increased competitiveness, quality standards, and consumption. Thus, the exploitation of natural resources has intensified, resulting in societal demands for sustainable processes and social responsibility.⁷⁻⁹ Consequently, 21st-century manufacturing has come to be characterized by individualized products¹⁰ that, in order to be competitive, consider the needs of individuals or groups.

Meal production, whether public or private, follows the same logic regarding the quality standard expected by diners in relation to the sensory, nutritional, hygienic-sanitary, and legal dimensions,⁵ as well as the expectations for catering to specific groups, such as vegetarians, individuals with food selectivity, Indigenous peoples, quilombolas, migrants, and those with health conditions that must be considered in menu planning.^{8,9}

With regard to technological advancement and costs, there is an increased demand for processes capable of producing more meals in less time and with fewer workers.¹⁰

In the food and nutrition unit, these issues have led to complex meal production systems. These were structured through large-scale production,¹¹ derived from the Fordist model of work organization,^{11,12} consisting of inflexible processes and large production batches, which hinder the enhancement of quality, product individualization, undermine workers, and generate waste.¹²

It is urgent to manage the menu to deliver quality, with meals that ensure food and nutritional security, while also addressing commensality, culture, and contributing to fair food systems, sociobiodiversity, and promoting decent working conditions, as well as financial and environmental sustainability with support for agroecology.¹³⁻¹⁵

Thus, for planned menus to be effectively executed,^{11,12} the term "menu planning" proves to be insufficient, leading to the proposal of the term "menu management." It is a broad-scope concept referring to the continuous process of planning, pricing, designing, operationalizing, and developing the menu,³ a topic on which scientific literature is still limited. This proposal aims to address the urgency of improving quality throughout the entire production process in food and nutrition unit.

To this end, it is necessary to research a management system that operationalizes quality and materializes menu management in the face of the complexity of challenges posed by socioeconomic and technological contexts.

In this sense, Lean philosophy¹⁶ stands out as a system that overcomes Fordism and proposes the delivery of value, that is, all the quality requirements, through the reduction of seven types of waste, with a focus on respect and autonomy for workers.¹⁷ Also known as "Lean Thinking," it originated in Japan and is derived from the Toyota Production System (TPS) developed in the automotive industry.^{17,18}

Its pursuit of efficiency, flexibility, and continuous improvement¹⁹ supports studies in food and nutrition unit for cost and waste reduction,²⁰ optimization of large-scale production,²¹ reduction of queue times,²² process optimization in small and medium-sized food businesses,²³ creation of menu applications,²⁴ and food safety,²⁵ and can be adapted for menu management in food and nutrition unit.

The Lean approach is based on five principles:¹⁵ i) Value: identifying customer needs and delivering high-quality products and services; ii) Value stream: defining the value chain, i.e., the best combination of stages, from raw material supply to final delivery; iii) Continuous flow: eliminating interruptions and waste, establishing a continuous workflow; iv) Pull production: producing only what is necessary, based on customer demand, with reduced inventory; v) Perfection: continuous improvement of the process, using data and involving all team members in identifying problems and implementing efficient practices.¹⁹

In menu management, Lean can coordinate the demands contained in value and break them down into operations, using production data for continuous improvement.¹⁹ Here, there are greater chances of aligning with sustainability actions,¹³⁻¹⁵ trends, and customer expectations, through the instrumentalization of total quality management.⁶

The challenge of managing production through menu planning was highlighted in a food and nutrition unit that is part of the maritime hospitality service of a ship. This service is characterized by the provision of supplies and personnel for meal and accommodation services, offering the crew appropriate food, hygiene, and comfort for their long-term stay onboard.²⁶

Based on the above, this study aimed to analyze the menu planning process of an offshore food and nutrition unit, to support the discussion about the need for improvements in this system, based on the principles of Lean philosophy.

METHODS

This is a descriptive, qualitative, and quantitative case study,²⁷ conducted in an offshore-type food and nutrition unit, on a training ship anchored in the state of Rio de Janeiro, from August 2023 to April 2024.

The sample consisted of 18 people, distributed into two teams: 9 workers per crew. The research was structured according to the following stages:

First stage: a bibliographic search on the topic, conducted through two databases (PubMed and Scielo), using six indexing terms - DeCS/MeSH (Menu Planning; Food Services; Lean Six Sigma; Total Quality Management; Workflow; Food Quality), with filters related to languages (Portuguese, English, and Spanish), peer-reviewed original articles, and a 10-year period (2014 to 2024).

In the bibliographic research, using the descriptors, 337 articles were found in PubMed and 621 articles in SciELO. The inclusion criterion was articles addressing the implementation and management of menus

and the foundations for their development. Articles focusing on the Qualitative Evaluation of Menu Preparations, nutritional assessment, and diet therapy were excluded. Of these, only nine were included.

Second stage: evaluation of functional and structural conditions of galley through the application of a checklist consisting of the following questions: sanitary conditions regarding physical, environmental, and regulatory aspects, work conditions, technical and operational aspects, and worker health, totaling 286 questions distributed across 16 sections. The application was conducted during work activities. The checklist used was adapted from Da Cunha et al.²⁸ and Medeiros et al.²⁹.

Third stage: mapping the production flow to identify the stages, times, and operational activities. The instrument was structured in the form of a spreadsheet, recording the time of activities, materials and techniques used, a color code to identify the worker responsible for each task, and the type of meal being produced.^{17,30}

Fourth stage: interview with the responsible cook, conducted using a semi-structured script,³¹ with open-ended questions about the professional's perception of the service and during the work period, in an individualized manner and in a private room. At the time of the research, the service had one cook responsible for managing the food and nutrition unit.

Fifth stage: application of the self-administered questionnaire. The qualitative-quantitative questionnaire³² contained 22 questions divided into four sections regarding the socioeconomic conditions and food preferences of the crew, conducted with 18 crew members, nine from each team. The questionnaire was distributed to the crew after a meeting about the research, addressing possible questions and the use of the instrument. The crew members had one week to return it.

The qualitative data were analyzed using content analysis, according to Bardin.³³ In this process, a thorough reading of the responses obtained from the interview was conducted, aiming to identify opinionated, descriptive sentences, comments, and words that revealed the understanding of the service provided, focusing on menu management. The analysis was thematic, as it aimed to identify the core meanings that constitute communication, where their presence is significant for the defined objective.³⁴ The data from the structured questionnaire were tabulated and analyzed using Excel@2021, with descriptive statistics in the form of relative frequency.³² The open-ended questions were grouped and analyzed, respecting the rule of similar meanings.³³

The project was approved by the Research Ethics Committee of the Faculdade de Medicina da Universidade Federal Fluminense (CEP-FM/UFF) (Faculty of Medicine of the Federal Fluminense University, under the CAEE (Certificate of Ethical Appreciation Presentation) No. 29713920.7.0000.5243.

RESULTS AND DISCUSSION

The food and nutrition unit of the training ship produces, daily, a minimum of 45 meals and a maximum of 130, including breakfast, lunch, snack, dinner, and supper. The minimum quantity is based on the fixed crew, consisting of nine crew members, including one manager and eight workers with a 28-day onboard work schedule and the same period of shore leave. The maximum quantity is based on the total number of beds in the ship's cabins, which has the capacity to accommodate 26 people, including nine crew members and 17 researchers/students.

The food and nutrition unit has four workers (two per workgroup), one cook responsible for the production process, and one cook assistant who performs tasks such as pre-preparation, storage

organization, and cleaning. The workers work a 12-hour shift per day. There is no nutritionist managing the daily activities.

The menu planning process of this offshore food and nutrition unit was analyzed through the five principles of Lean philosophy, with a view to identifying process gaps and proposing the expansion of the menu planning concept, based on the guidelines and tools that make up this management methodology.

Value - The first principle of Lean Thinking

All activities must focus on delivering value to both external and internal customers, and on the needs of stakeholders.¹⁷ In the offshore food and nutrition unit, the subject of this study, the analysis of the data collected to determine value and menu planning was carried out through interviews with the cook and the crew members.

Interview with the cook

The responsible cook is male, has completed high school, received specific training as a cook for offshore operations, and has been performing this role on the training ship since 2021, with prior experience in commercial restaurants. He pointed out that he does not identify the service as institutional, but rather as domestic, since the meals are prepared for a small number of people. Despite his training, he does not follow the proper steps for an efficient production flow and appears to be nonchalant when describing the lack of use of personal protective equipment (PPE) and the failure to implement Good Manufacturing Practices (GMP) for food, showing a lack of knowledge regarding these issues.

The Federal Nutrition Council³⁵ characterizes maritime hospitality as a collective food service, and the Collegiate Board Resolution (RDC) No. 216/2004³⁶ establishes GMP for food services (FS). Therefore, even a food and nutrition unit considered small, in terms of the number of meals produced and served, must comply with the regulations established to ensure the sanitary quality of the meals. Regarding the cook's knowledge of food safety, it positively impacts hygienic-sanitary practices related to personal hygiene, environmental hygiene, and health control measures.³⁷ Therefore, it is understood that acquiring this knowledge is essential for mitigating sanitary risks and improving the service. It is known that hygienic-sanitary control is crucial for reducing outbreaks of waterborne and foodborne diseases (DTHA).³⁸ However, theoretical training appears to be insufficient for food handlers to adopt good practices. Therefore, it is necessary to adopt more effective strategies, such as practical training, production planning, improvement of infrastructure and working conditions, worker motivation, and the establishment of goals.²⁸

The menu is prepared weekly by the cook, who defines the types of preparations and quantities based on the existing storage for the period, as well as the preferences and consumption of the crew. The purchase of supplies, or "provisions," is made monthly, based on a list of fixed items. It is common for the ship's authorities to interfere in both the quantity and type of preparation, according to their personal opinions.

According to the cook, the menu is prepared based on the preferences of the crew, whom he claims to know, and requests made by the workers related to cultural food practices in the offshore system. As an example, the interviewee mentioned that Sunday barbecue: "is a tradition among sailors." This is a traditional preparation of this work system, made on Sundays as a permanent practice.

Considering the relevance of the symbolic dimension⁵ of quality, it is important to include preparations in the planning that respect the cultural habits of the diners, based on the analysis of the data collected on what is valued by the group being served.

At the same time, it is essential to use objective data and scientific evidence, excluding personal opinions, to calculate the type and frequency of these preparations in the menu, aligning cultural demand with the dimension of nutritional quality, i.e., balancing food preferences and the adequate consumption of macro and micronutrients.

This planning and its execution by the foodhandlers must be standardized and managed at all stages,³ to meet the quality requirements and promote satisfaction and health. Hence, the importance of menu management for coordinating all resources, eliminating waste and bottlenecks,³⁰ facilitating the use of data for decision-making, and continuous improvement of planning. In this sense, the principles of Lean Thinking emerge as a possibility, providing methods and tools that support the correct execution of planning.

When asked about the menu and the offering of healthy foods, the cook stated: "Many workers have developed chronic diseases and gained weight since they arrived." An increase in body mass index (BMI) and serum cholesterol levels was identified up to three decades after the end of onboard work in research.³⁹ These factors reinforce the importance of preparing nutritionally adequate and healthy meals, as outlined by the National Food and Nutrition Policy (PNAN).⁸

Regarding storage, the cook emphasized that no fixed date is set for purchasing supplies, which are bought monthly in large volumes. At the end of the month, meals tend to be simpler, without salads and side dishes, highlighting the need for a management system that orders the flow and stocks between stages, ensuring the provision of adequate meals throughout the entire period.¹⁸ Thus, it is possible to assess how planning the management of supplies throughout the entire flow is necessary to prevent compromising nutritional quality.

These challenges occur when the ship is serving only the crew and are amplified when the accommodation capacity is reached. The inefficiency of planning and the culture of large batch production result in incorrect demand forecasts and waste. This practice leads to poorly stored food, with a risk of spoilage, increased costs, and higher stress in the work environment due to insecurity in the process.

According to the interviewee, purchases were made at nearby supermarkets with high costs and were later shifted to retail and wholesale stores near the base where the ship is anchored. However, there are difficulties in acquiring supplies during trips to other states.

Lean Thinking advocates that supplies be received as frequently as possible and that storages be kept as low as possible, with receipt almost concurrent with production.¹⁷ Given the impossibility, daily production must be paced.⁴⁰ Therefore, the value stream must be continuous, with the elimination of waste and analysis of production data.

Supplier selection, correct quantification of supplies and inventory, and the frequency of receipt are essential for the Lean system and must be defined based on an understanding of the need, or value.¹⁷ This understanding is based on the questions: for whom, how, how much, when, and where the product should be delivered.¹⁷ Quantities should be presented in clear, simple, and visual standards for galley workers.²¹

Once this information is gathered, the production stages, their times and resources, and their best combination for a value stream, where people and machines stay close, generating stability at each stage, will be defined.¹⁹

Interview with the crew

The quantitative data indicated that most are between 30 and 60 years old (66.6%), are male (94.4%), and have a family income ranging from R\$2,863.00 to R\$5,724.00 (33.3%). Regarding dietary restrictions, 11.1% have lactose intolerance, and 88.9% have no restrictions. About healthy eating, 88.3% stated that they follow it, but 61.4% find it challenging to maintain, justifying that intense work routine, the high cost of quality products, and the difficulty of changing habits, both at home and on board, are the main obstacles (Table 1).

Table 1. Socioeconomic and dietary data of the crew members in the studied Food and Nutrition Unit. Rio de Janeiro, RJ, 2024.

Questions	Specificity	% Percentage
Age	30-50 years	33.3
	51-60 years	33.3
	>60 years	27.8
	Did not respond	5.6
Gender	Male	94.4
	Female	5.6
Household income	Up to R\$1.908.00	5.6
	R\$1.909.00 to R\$2.862.00	5.6
	R\$2.863.00 to R\$5.724.00	33.3
	R\$5.725.00 to R\$9.540.00	27.8
	R\$9.541.00 to R\$14.310.00	5.6
	Above R\$14.311.00	11.1
	Did not respond	11.1
Dietary restrictions	Yes	11.1*
	No	83.3
	Did not respond	5.6
Type of diet	No restrictions	88.9
	Did not respond	11.1
Do you follow a healthy diet?	Yes	83.3
	No	11.1
	Did not respond	5.6
Is it difficult to maintain a healthy diet nowadays?	Yes	61.1
	No	27.8
	Did not respond	11.1

Source: Prepared by the authors. 2024.

The crew members had a good perception of healthy eating, identifying foods that are beneficial for health, providing examples. All were aware of the benefits of this type of diet and pointed out that it "ensures a better quality of life, preventing diseases and strengthening the immune system." They also identified the harms that an unhealthy diet can bring to health: "it leads to cardiovascular diseases, cancer, diabetes, obesity, gastritis, constipation, high blood pressure, anemia, and foodborne infections" (multiple responses).

Among the preparations whose inclusion was requested, regional options with high lipid content - such as oxtail, feijoada, pork crackling, feijão tropeiro, ribs, liver, and gizzard - represented 18.8% of the total

protein dishes requested. The other choices included lean beef (28.1%), fish (25%), chicken (18.8%), eggs (6.3%), and shellfish (3,1%).

Regarding the foods prepared on the ship, the interviewees stated that they like beef, chicken, and fish (33.8%), rice with beans (20.6%), fruits, vegetables, and greens (20.6%), pasta (7.4%), meats with high lipid content (7.4%), farinaceous foods (4.4%), eggs (2.9%), offal (1.5%), and shellfish (1.5%).

Although they are aware of the difficulty in maintaining a healthy diet, the crew members request the inclusion of preparations with high lipid content in the menu. It is important to note that a large portion of these individuals are from the Northeast, which characterizes a cultural issue. It is known that an adequate and healthy diet should be rooted in food culture and align with biological and social aspects, as well as gender, race, and ethnicity dimensions.⁹

However, health is also considered in the choice of foods that will make up the menu. The menu should be a tool for promoting a harmonious diet in both quantity and quality; varied, balanced, moderate, enjoyable, and healthy,⁹ and should mitigate the potential risk of generating non-communicable chronic diseases (NCDs).⁴¹

Offshore work is associated with worse physical and mental health outcomes, related to overweight and obesity, stress, fatigue, difficulty disconnecting from work, sleep problems, smoking, and alcohol consumption,⁴²⁻⁴⁴ factors that are also linked to the development of non-communicable chronic diseases (NCDs).⁴¹

The results highlight the importance of having a nutritionist to manage the activities of the food and nutrition unit, carrying out their duties in collective food service according to CFN Resolution No. 600/2018.³⁵ These actions, combined with a management system suitable for the new social, economic, and technological demands that influence meal production for the collective, can optimize work processes in food and nutrition unit, eliminating unnecessary practices that harm the quality of meals and the health of food handlers, reducing costs, and mitigating sanitary risks.³⁵

Value Stream and Continuous Flow - the second and third principles of Lean philosophy

From the definition of value, the value stream will be established: the best combination of production stages to deliver value.¹⁹ This flow must be continuous, with the elimination of the seven types of waste (motion, transportation, waiting, inventory, overprocessing, overproduction, and rework)¹⁷ that hinder value delivery and cause poor working conditions.¹⁶ These should be eliminated at each stage, starting from the menu planning. Thus, the structure, layout, and production flow in the food and nutrition unit under study were evaluated.

Evaluation of the physical-functional conditions

The physical structure of the kitchen has 5.51m² and includes a 13.5m² storage area with cabinets and cold storage units (4 vertical freezers and 2 refrigerators), as well as a 19.5m² dining area.

The checklist showed a 33% non-conformity rate (Box 1).

Box 1. Average percentage of nonconformities related to the checklist sections in the studied Food and Nutrition Unit.

Section	% Nonconformity
Documentation and recordkeeping of the facility	22
Buildings and structures of the storage area	11
Sanitary facilities	17
Storage area	5
Measuring instruments	85
Cleaning of facilities, equipment, furniture, and utensils	60
Hygiene habits and health status	20
Clothing	10
Reception of raw materials, ingredients, and packaging	36
Storage	34
Food preparation	40
Storage and transportation of the final product	33
Display for consumption of the prepared food	65
Documentation and recordkeeping of food preparations	35
Responsibility	77

Source: Prepared by the authors, 2024.

The type and order of the meal production stages were determined by the cook as the service developed. The combination of these stages created a cross-flow in which the quality dimensions are not achieved and is characterized by waste in movement, transportation, waiting, inventory, and overproduction, which culminates in the threat of cross-contamination, increased sanitary risk factors, and inefficiency in preparation techniques.

The physical area of the food and nutrition unit is small and has an unfavorable layout. In this case, the value stream should have been planned to minimize structural problems and facilitate work while ensuring quality.

Strategies to ensure food safety and the safety of food and nutrition unit workers can only be outlined after a thorough evaluation of the operational flow, with the proper circulation of raw materials and people that should follow a rational flow to avoid activity crossovers.⁴⁵ To design the flow, it is necessary to identify all the activities performed

throughout the production chain, the sequence, and the individuals responsible for their execution, through the development of a process model.⁴⁶

In the case analyzed, the disordered flow and its crossovers were highlighted by the process mapping and confirmed by the application of the checklist. Overlaps of operations, contact between surfaces, and contact between raw food and ready-to-eat food were observed, characterizing cross-contamination, which is considered an important risk factor²⁸ for waterborne and foodborne diseases (DTHA)⁴⁷ and directly impacts the execution of the planned menu.

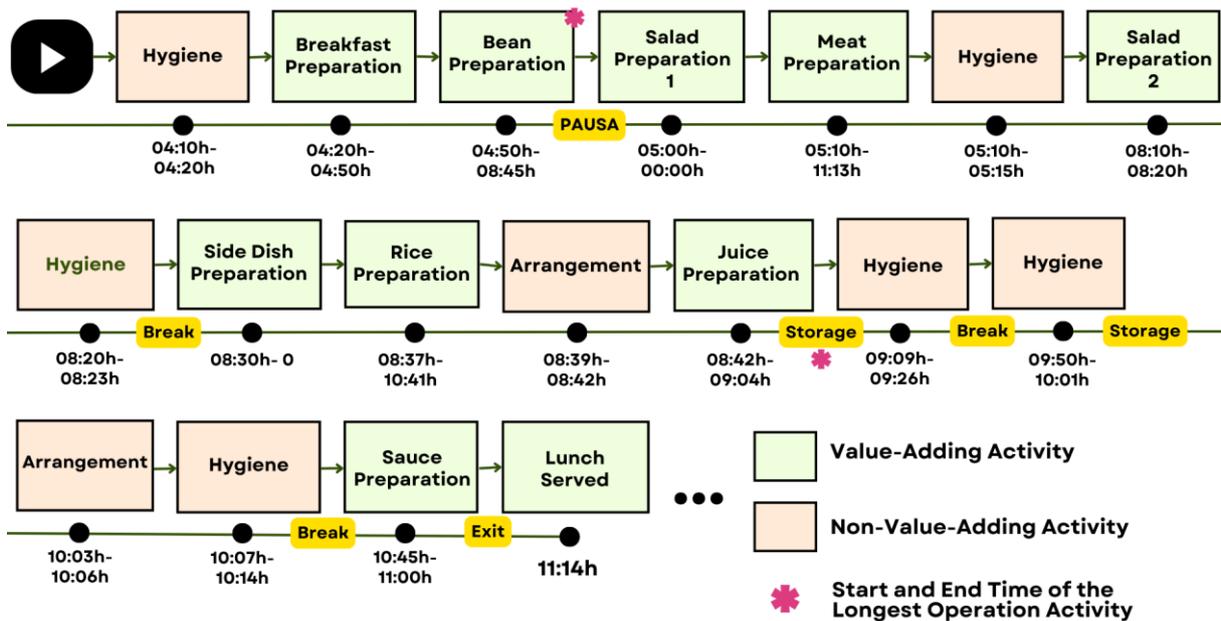
In food and nutrition unit, the flow must be organized, linear, without crossovers and setbacks, starting with the receipt of goods and ending with the distribution of food ready for consumption.⁴⁵ Inadequate flows can lead to food contamination, disorder, and losses in the rationalization of work processes, with an increase in accidents, reduced quality in the hygienic-sanitary, sensory, and nutritional dimensions, lower productivity, and higher costs.⁴⁸

It is noteworthy that the environment and working conditions of the offshore-type food and nutrition unit have specific characteristics such as physical, chemical, ergonomic, metabolic, and mental risks and hazards;³⁹ limited space for performing activities; cultural and ethnic diversity; and work shifts that require a cyclical reversal.⁴⁹ These factors can lead to stress associated with the workload.⁴⁹ Furthermore, working in kitchens is already a stress-inducing factor, which, when combined with the complexity of the menus, considerably contributes to burnout situations.⁵⁰

Production flow mapping

In the production flow mapping (Figure 1), it was observed that the cook takes seven hours from the start of food preparation to its distribution, with several gaps between the stages and long intervals after the meal. After preparation, the food is placed on the thermal counter for distribution and remains exposed for an average of four hours, with no time and temperature control at this stage of the process, which increases the sanitary risk for waterborne and foodborne diseases (DTHA).³⁶

Figure 1. Observed flow of the studied production process.



Source: Prepared by the authors. 2024.

For the Lean system, which aims to make production systems more efficient,¹⁹ the total process time or lead time¹⁷ is the main indicator of efficiency and quality, and therefore, the pursuit of reducing this time should be constant. Lead time¹⁷ consists of the time for. Value-adding activities (such as seasoning and cooking, for example) plus the time for activities considered waste, such as movement and waiting, which should be reduced or eliminated.

The elimination of waste should be achieved through the stability of labor, machine, material, and method (4M's) at each stage of the production process.¹⁸ In this way, practices will be executed correctly when resources and knowledge are available and coordinated so that the path to safe behavior and correct preparation techniques is the easiest and shortest.⁵¹

Stability at the stages can contribute to valuing the food handler's knowledge, eliminating waste, and implementing standardization, essential conditions for adding value.¹⁹

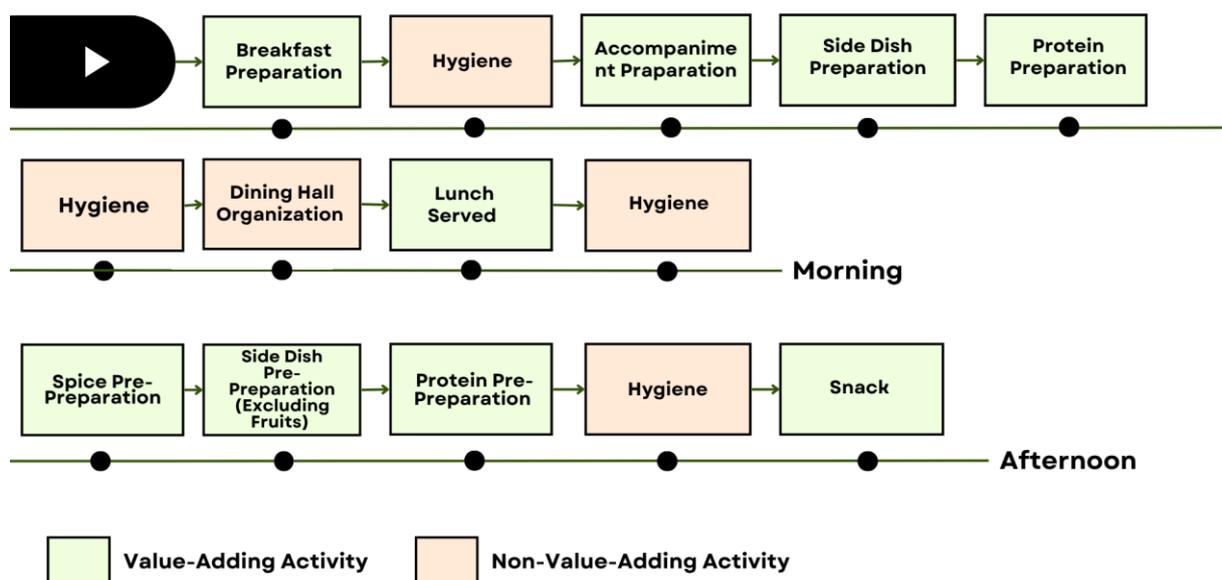
The loss of food quality begins immediately after production is completed and continues until delivery.⁵² Thus, it is understood that reducing the interval between production and distribution, i.e., the lead time, can improve the quality of the meals distributed. According to the World Health Organization (WHO, 2001), maintaining food at proper temperatures is one of the five keys to safer food.⁵³

Post-cooking food should remain exposed for no more than six hours at a temperature above 60°C and under refrigeration below 5°C.³⁶ Sanitary legislation provides for time and temperature control throughout the production chain in order to mitigate the risk of waterborne and foodborne diseases (DTHA).³⁶

The management of the time-temperature binomial throughout the production chain increases food safety and reduces losses due to deterioration,⁵⁴ in addition to being crucial for sensory and nutritional quality⁵⁵ and for the proper yield of preparations.²

The high lead time of the process is due to the frequent repetition of tasks and movements, and consecutive interruptions during meal production on the ship, creating a disordered flow. These interruptions constitute the seven wastes defined in Lean philosophy.^{19,20} Establishing continuous flow could increase productivity and quality (Figure 2).^{19,55}

Figure 2. Proposed flow for the studied production process.



It was observed that the amount of food prepared exceeds the actual demand, considering both the number of diners and per capita consumption. This excess characterizes the waste described by Lean as overproduction - a waste that indicates others, raising production costs and negatively impacting the total service cost.¹⁹

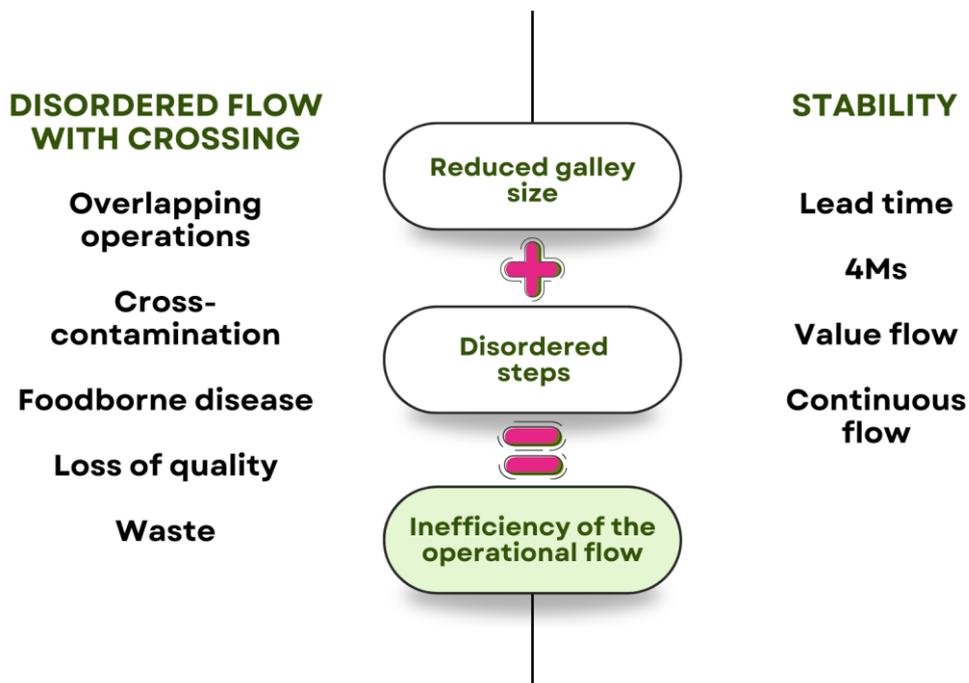
The total cost of a food and nutrition unit is the sum of goods and services consumed and applied to obtain products and new services. In this case, raw materials represent the highest financial item, thus requiring strict control.^{2,56}

The inclusion of a nutritionist in food services results in significant cost saving.⁵⁷ Therefore, it can be said that a professional qualified to manage a food and nutrition unit has the knowledge to organize the service and reduce costs through systematic monitoring.

It was observed that food remains in cooking for longer than necessary, characterizing over processing. It emphasized adopting standard times and temperatures for cooking and minimally invasive preparation methods capable of preserving the nutritional quality of the food.^{20,58} Additionally, handlers improperly use personal protective equipment (PPE), such as hairnets, shoes, and uniforms. Failures in their use can lead to cross-contamination and there is a direct and significant correlation between the use of PPE and food contamination.^{59,60}

Finally, the handlers do not use machines that automate the process and reduce waste, such as the dishwasher and industrial coffee machine available in the production area. As a result, the lead time increases, with waste in movement, transportation, and waiting, and time loss for value-adding activities, such as food pre-preparation. The use of technology in food processing can improve quality, safety, and production efficiency, provided it is applied in stabilized stages^{17,19,61} (Figure 3).

Figure 3. Current analysis of the process and the Lean system.



Source: Prepared by the authors. 2024.

Fourth principle of Lean Thinking- Pull System

The Pull System means producing only what is necessary, at the right time and in the right quantity.¹⁹ Lean uses the pull method, but in food service with a distribution counter, the push method is established, which involves preparing the food before the customer "requests" it and generating a storage of ready-to-serve preparations.³⁰ However, in food and nutrition unit, it is necessary to combine both methods: pulling from pre-prepared storages. For this, waste elimination, stability, and standardization in menu management would be necessary, reducing operation times.¹⁹ Based on the results, it is concluded that there are many wastes in the process, preventing it from being a continuous flow, generating large amounts of leftovers, and negatively impacting the correct execution of the planned menu, that is, the delivery of value. Therefore, a pull system would still not be possible.

Fifth principle of Lean Thinking - Perfection

Perfection means the pursuit of continuous improvement or "Kaizen," the key to which is understanding that excess capacity or inventory hides underlying problems in processes, and that Lean provides a mechanism to expose these problems.

Kaizen occurs through the systematic resolution of problems and the constant elimination of waste at each stage, involving the entire team in identification, analysis, and resolution.^{18,19} In the studied food and nutrition unit, continuous improvement has not yet occurred, and for this, it is necessary for the first three principles to be applied to management.

CONCLUSION

The evaluation of the menu planning and execution process of the offshore food and nutrition unit identified inefficiencies both in planning, which fails to objectively determine value and results in high inventory levels, and in production with cross-flow, waste, structural problems, and a low level of knowledge of the cook regarding process and menu management.

The results suggest the importance of expanding planning to menu management, operationalizing quality management from supplier selection to the delivery of the product and service to the customer. Therefore, Lean Thinking can be considered an efficient method

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Contributors

Medeiros MGGA participated in the conception and design, data analysis and interpretation, review, and approval of the final version; Mota ABS participated in data analysis and interpretation, review, and approval of the final version; Bainha FSA participated in the design, data analysis and interpretation, review, and approval of the final version; Lourenço MS and Penha MP participated in the review and approval of the final version.

Conflict of Interest: The authors declare no conflict of interest.

Received: August 30, 2024

Accepted: June 1, 2025