Using Design Thinking Methodology to Transition from Paper to Digital System

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Abstract

Gembirafood relies on a paper-based monitoring system, leading to potential inefficiencies, errors, and challenges for users. This research employs a design thinking approach to identify pain points, understand user needs, and propose user-centric solutions to improve the monitoring system's effectiveness and user experience. This research employed the initial three stages of the design thinking process: empathize, define, and ideate. Empathize involved understanding user needs through interviews and observations. The define stage focused on problem identification and prioritization based on gathered insights. Finally, the ideate stage generated potential solutions to address the identified challenges. Key challenges identified include complex and cumbersome forms, language barriers, lack of standardization, and limited data accessibility. Users desire a simplified, user-friendly system with improved data accuracy, faster processing, and enhanced traceability. The research proposes implementing digital forms, language localization, automated data entry, and centralized data repositories. User training materials and clear communication are also emphasized. The proposed solutions could improve data accuracy, efficiency, user satisfaction, and food safety compliance at Gembirafood. Future recommendations include pilot testing, considering technology feasibility, and adapting to evolving regulations. This design thinking project offers a framework for transforming Gembirafood's monitoring system into a user-friendly, efficient, and impactful tool for ensuring food safety and operational excellence.

Keywords

Paper-based Monitoring, Food Safety Monitoring, Design Thinking, Solution, User Satisfaction.

Introduction

Johor, a key economic driver for Malaysia, contributed a substantial 9.4% to the nation's GDP in 2019. This strategic state has positioned itself as a regional economic powerhouse, with its state capital Johor Bahru emerging as a focal point for development. The Halal industry has been identified as a strategic growth sector for Johor. Aligned with the broader national agenda, the state seeks to capitalize on the global demand for Halal products and services. This focus is part of a larger regional economic integration strategy, with Johor aiming to be a catalyst for the SIJORI Growth Triangle (Johor State Economic Planning Division, 2020). By leveraging its strategic location and infrastructure, Johor aspires to become a regional hub for Halal trade, investment, and innovation. However, ensuring food safety and quality throughout the production process remains a constant challenge. Traditional paper-based monitoring practices, while familiar, often suffer from limitations in data accuracy, accessibility, and analysis, potentially hindering timely identification and resolution of food safety issues. This project delves into exploring and implementing digital solutions to elevate food safety monitoring practices within Gembirafood, a food manufacturing facility located in Johor Bahru.

User-Centered Design Approach

The successful implementation of the paperless food safety monitoring system at Gembirafood is a testament to the power of user-centered design (UCD) in paperless food safety monitoring (Kurniawan, 2004). By placing the needs and perspectives of users at the core of the development process, the system has been tailored to effectively support their roles and responsibilities (Justin Lai, 2010). User experience encompasses a wide range of human interactions, including those with customers, employees, citizens, students, teachers, and others (Pande & Bharathi, 2020). The application of ethnographic research methods, as described by Creswell and Poth (2018), enabled a deep understanding of users' work contexts and challenges. This knowledge informed the design of system features that aligned with users' mental models and workflows. By prioritizing user experience, the system has been designed to minimize errors and maximize productivity. Furthermore, the collaborative approach involving Gembirafood employees throughout the development process fostered a sense of ownership and engagement, increasing the likelihood of successful adoption and utilization of the system.

Design Thinking Methodology

Tim Brown, head of IDEO, is often credited with popularizing the term *design thinking*, which he defines as innovating by focusing on empathy, iteration, experimentation, and a willingness to embrace uncertainty. The design process is more akin to a dynamic system of interconnected spaces than a rigid sequence of steps. These spaces, as shown in Figure 1 below, represent distinct but interrelated activities that collectively contribute to the innovative journey. While design thinking may initially appear chaotic, its non-linear, iterative nature ultimately becomes evident as the project progresses. Despite deviating from traditional linear, milestone-based business processes, design thinking proves to be a highly effective approach to innovation (Brown, 2008). To effectively address complex, ambiguous challenges and grasp human needs, ambidextrous Thinking Modes are essential, providing a counterbalance to the dominant analytical perspective in management (Auernhammer & Roth, 2021).

A recent literature review highlighted ten common attributes associated with design thinking: Abductive reasoning, visualization, a blend of analysis and intuition, creativity and innovation, a gestalt view, interdisciplinary collaboration, iteration and experimentation, problem-solving, tolerance for ambiguity and failure, and a user-centered and involved approach (Micheli et al., 2018). Design thinking, at its core, is a five-step problem-solving methodology centered on user-centric innovation. It begins with empathizing with the user by observing and listening to their needs. This understanding is then defined into a clear problem statement that aligns with user requirements. Ideation follows, generating a range of potential solutions. Prototyping allows for rapid, low-cost creation of these solutions to test their efficacy.

Finally, the most promising solution is implemented organization-wide (Ford & Yoho, 2024). The stages of design thinking, in correct order, are the empathy stage, define stage, ideate stage, prototype stage, and testing stage (Olsen, 2015). In the empathy stage, designers aim to understand the experiences and perspectives of the people they are designing for. They put themselves in the shoes of the users and try to see things from their point of view. Designers need to gain empathy by considering the feelings, thoughts, and challenges faced by the users. They put themselves in the users' shoes to understand their needs, desires, and frustrations (Gasparini, 2015). Empathy involves developing an emotional understanding of the users' experiences. Prior to engaging a design consultant, the prevailing role of design as a service-based industry and the perceived *needs* of the client significantly shape the conceptualization of any design project (Whiting, 2017).
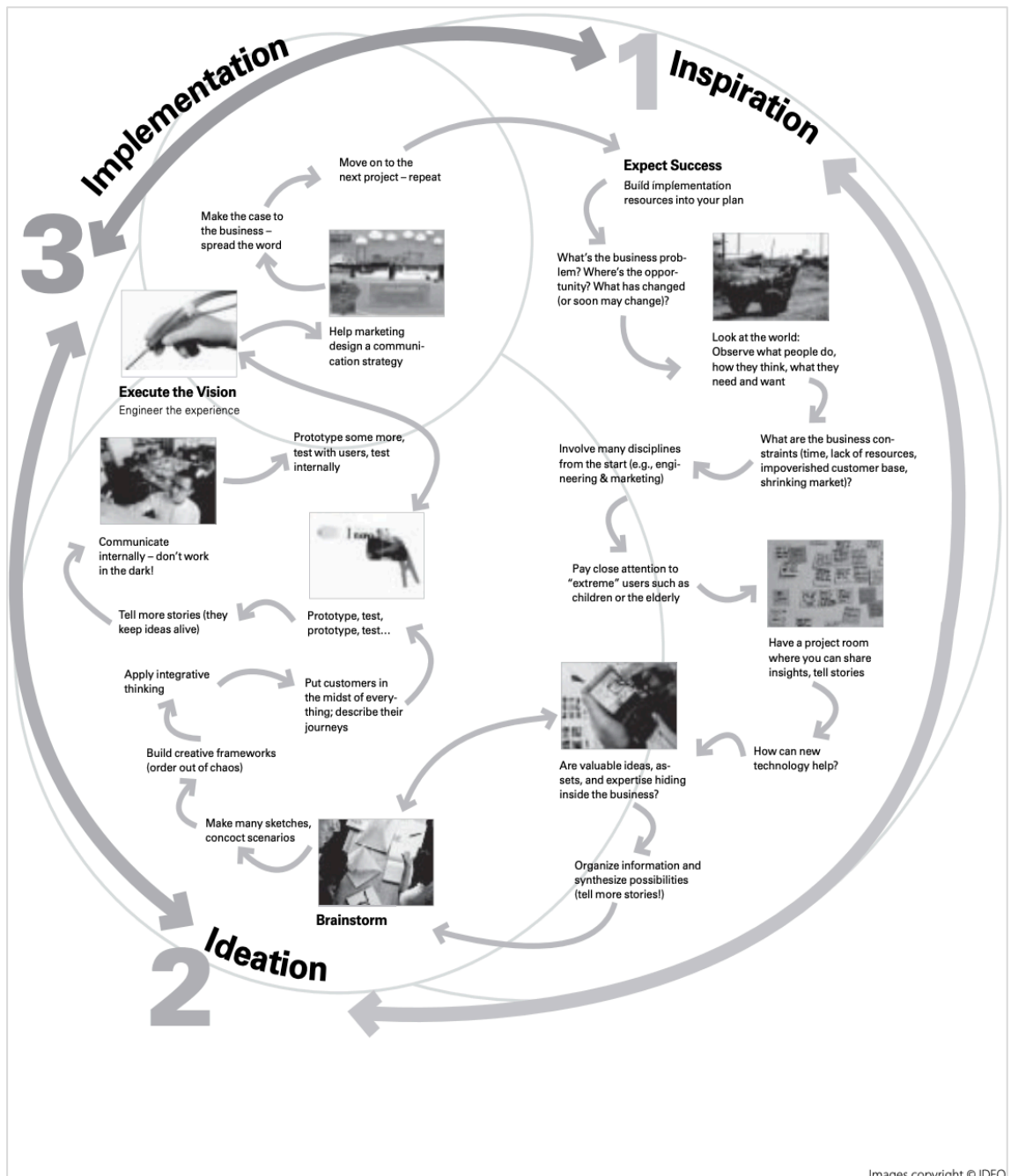

Figure 1: *Inspiration, Ideation, Implementation.*

Designers try to connect with the emotions that the users may go through and recognize how these emotions influence their actions and decisions. Listening plays a crucial role in the empathy stage. Designers actively listen to the users, paying attention to their thoughts, opinions, and feedback. They strive to hear and understand the users' needs, concerns, and desires. To gain empathy, designers immerse themselves in the users' environment. They observe and engage with the users' social circles, such as friends, family, and community, to understand how these relationships influence their experiences and behaviors. Designers aim to understand the users' thought processes, beliefs, and motivations. They try to grasp the underlying reasons behind the users' actions and decisions, and what drives them to behave the way they do. Designers take on the role of advocates for the users' needs and desires. They ensure that the design solutions they create address the users' challenges and improve their overall experiences (Cross, 1992). During the empathy stage, designers connect the information they gather from various sources to form a comprehensive picture of the users' needs and experiences. They identify patterns, similarities, and differences to gain deeper insights. Designers go beyond the surface-level understanding of the users and delve into their cultural, social, and personal backgrounds. They recognize that these aspects play a significant role in shaping the users' perspectives and expectations. To develop empathy, designers need to step out of their own familiar world and embrace different perspectives. They actively challenge both their own and others' perspectives, including the entrenched assumptions, biases, and preconceived notions of experts and stakeholders involved in the problem's development.

Technology Integration and Infrastructure

Traditionally, food manufacturing has relied on paper-based systems for monitoring and control. However, these methods often suffer from limitations such as inaccuracy, lack of real-time data, and inefficiencies. Recognizing these shortcomings, the industry is increasingly turning towards digital solutions powered by sensors, IoT devices, and data collection tools. This transition, while promising, also presents its own set of challenges and requires careful consideration of technology integration and infrastructure modifications (Demartini et al., 2018). At the heart of this digital transformation lies the integration of various technologies and hardware. Sensors, for example, can be strategically deployed to monitor critical parameters like temperature, humidity, pressure, gas composition, and even product movement. Wireless sensor networks, as demonstrated by Konur et al. (2021), offer efficient data transmission without complex wiring, particularly crucial for monitoring cold storage units. IoT devices act as intelligent data collectors, processing information locally and communicating with other devices or cloud platforms. Baire et al. (2019) showcase their application in smart controllers optimizing energy consumption within production lines. Finally, data collection tools like cloud-based platforms act as the central nervous system, integrating with sensors and devices to acquire, store, and analyze data. These platforms offer features like data visualization, reporting, and alerts, as exemplified by cloud-based data management systems for food safety compliance explored by Tian (2017) Effectively integrating these technologies within existing manufacturing infrastructure is crucial for a successful transition. Challenges may arise due to factors like legacy systems requiring upgrades or adaptations, ensuring reliable and secure network infrastructure, and maintaining data standardization across diverse sensors and devices. Cybersecurity concerns are paramount, demanding robust measures to protect sensitive data and production processes. However, successful integration offers significant benefits. Enhanced data integrity and traceability, facilitated by digital systems, allow for precise product tracking and improved food safety management. Real-time monitoring and analysis, as demonstrated by the research of Glasgow et al. (2004), enable immediate identification of potential issues and proactive interventions, ultimately leading to better decision-making and optimized production processes. Transitioning from paper to digital systems undoubtedly necessitates careful consideration of challenges. Initial investment costs in hardware, software, and potential infrastructure upgrades require careful planning. User training and change management strategies, as addressed by Baire et al. (2019), are crucial to ensure personnel adapt effectively to new workflows. Additionally, data security and privacy concerns must be addressed through robust security measures and compliance with relevant regulations.

Despite these challenges, the rewards of embracing a digital monitoring system are compelling. Improved food safety and quality, driven by enhanced monitoring and data analysis, are paramount concerns in the industry. Increased efficiency and productivity, achieved through automated processes and data-driven decision-making, lead to significant cost savings and competitive advantages. Enhanced regulatory compliance, facilitated by the accessibility and reporting capabilities of digital systems, simplifies auditing processes and ensures adherence to industry standards. Finally, sustainability and resource optimization become achievable goals through data-driven insights that minimize waste and resource consumption.

Communication Challenges Due to Diverse Languages

The studies by Emuze and James (2013) and Wood et al. (2018) highlight the critical role of language and culture in organizational performance. In the context of the construction industry, Emuze and James emphasize the negative consequences of ineffective communication arising from language and cultural barriers, including increased rework, diminished product quality, and decreased employee morale. While the construction industry presents a specific case, the findings have broader implications for organizations operating in diverse environments. Wood et al.'s (2018) research underscores the challenges of balancing linguistic diversity with organizational policies. The careful selection and integration of language within educational settings demonstrates the potential for fostering inclusivity while maintaining operational efficiency. These studies collectively emphasize the need for organizations to develop strategies that acknowledge and address language and cultural differences. By fostering effective communication and promoting inclusivity, organizations can mitigate risks, enhance collaboration, and improve overall performance.

Data Collection and Analysis

The integration of technology into food safety management systems has become increasingly crucial. Ellahi et al. (2023) highlight the potential of block chain technology in addressing longstanding challenges related to data integrity and traceability within the food sector. By providing a transparent and immutable record of transactions, block chain can enhance trust and confidence in the food supply chain. However, as Demsky et al. (2006) point out, effective implementation of such technologies requires addressing underlying infrastructural and operational challenges. This includes improving data handling practices, enhancing enforcement mechanisms, and investing in necessary technological capabilities (Brian et al., 2006). To fully realize the benefits of block chain technology, a comprehensive approach is required. This involves not only the adoption of the technology but also the development of supporting infrastructure, training of personnel, and the creation of appropriate regulatory frameworks. By addressing these factors, the food industry can harness the potential of block chain to improve food safety, transparency, and consumer confidence.

Regulatory Compliance and Quality Assurance

The pivotal role of technology in achieving regulatory compliance within the food industry is underscored by both theoretical frameworks and empirical research. While standards like ISO 22000:2018 provide the regulatory backbone, practical implementation is often hindered by the challenges outlined by Mensah and Julien (2011). The study by Mensah and Julien highlighted financial constraints, infrastructural limitations, and human factors as primary barriers to FSMS adoption (Mensah & Julien, 2011). Technology offers a potential solution to these challenges. By automating routine tasks, improving data accuracy, and enhancing communication, technology can mitigate the financial burden associated with FSMS implementation. Additionally, it can address infrastructural limitations by providing scalable and flexible solutions. For instance, cloud-based platforms can eliminate the need for on-premise IT infrastructure, reducing upfront costs. Regarding human factors, technology-enabled training and knowledge management systems can bridge the skills gap and foster a culture of continuous improvement. Clause 8.7 of ISO 22000:2018 mandates stringent controls over software used for monitoring and measuring processes within a food safety management system.

Organizations must validate this software, either internally or through external parties, to ensure its accuracy and reliability. Comprehensive documentation of the validation process is essential. Moreover, the standard emphasizes the importance of keeping software up-to-date and revalidating as needed to maintain system integrity and effectiveness. By adhering to these guidelines, organizations can enhance data accuracy, mitigate risks, and support informed decision-making in their food safety management efforts (International Organization for Standardization, 2018). In essence, technology serves as a bridge between the regulatory imperatives outlined in standards like ISO 22000:2018 and the practical challenges faced by food businesses. By strategically leveraging technological advancements, organizations can not only meet regulatory requirements but also enhance their overall food safety performance.

User Training and Change Management

The successful implementation of technology, such as a paperless food safety monitoring system, is contingent upon user acceptance and adoption. Research by Igbaria and Iivari (1995) underscores the pivotal role of training and education in fostering a sense of self-efficacy among users, thereby enhancing their comfort level with the technology. This aligns with the findings of Gallego et al. (2015), which emphasize the positive and direct impact of trainer support on technology usage behavior. These studies collectively highlight the importance of effective training programs in promoting user acceptance of technology solutions. By equipping users with the necessary skills and knowledge, training can mitigate resistance to change and build confidence in the system's capabilities. Furthermore, the presence of supportive trainers can provide ongoing assistance and guidance, reinforcing positive user experiences and encouraging continued use of the technology. Consistent with Roth et al. (2010), socio-political support, leadership practices, work design characteristics, and environmental factors can all impact the effectiveness of design thinking.

In the context of food safety management systems, well-structured training programs can empower employees to effectively utilize the system, leading to improved data accuracy, enhanced compliance, and ultimately, a stronger food safety culture within the organization

Methodology

Problem Identification

The current paper-based recordkeeping and manual data entry practices in food safety monitoring in Gembirafood are riddled with errors, loss, and misinterpretation, resulting in unreliable data for risk assessment and decision-making. This lack of data accuracy and traceability hampers the effective identification and tracking of foodborne illness outbreaks, hindering corrective actions and supply chain management. Additionally, the absence of real-time monitoring and risk assessment tools limits the ability to promptly detect and respond to potential risks, increasing the likelihood of outbreaks. Furthermore, the lack of a collaborative platform for sharing data and information among stakeholders impedes effective communication and coordination, hindering the implementation of preventive measures and outbreak response strategies.

Results

Empathy

The research methodology is a systematic approach used to conduct and analyze a study, providing a framework for data collection, analysis, and interpretation to answer specific research questions or objectives. In this project, design thinking methodology is implemented in the proposed intervention of this study. The flow of this project is shown in Figure 2 below:
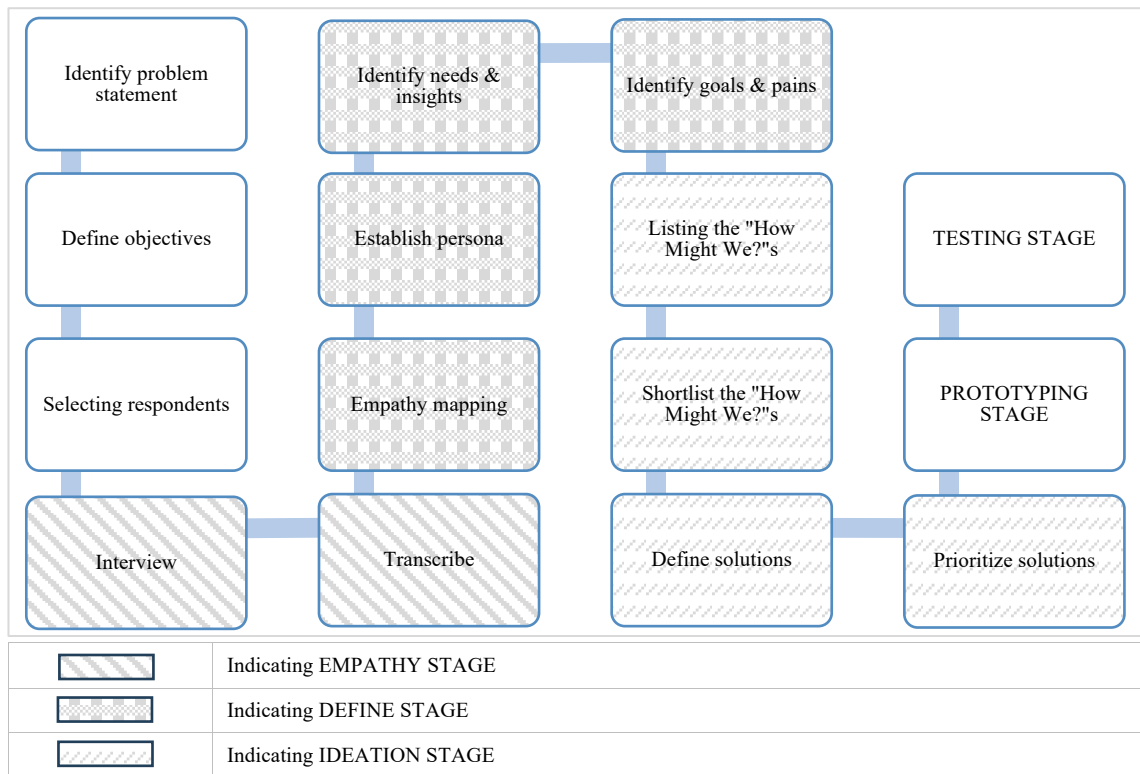
	Indicating EMPATHY STAGE
	Indicating DEFINE STAGE
	Indicating IDEATION STAGE

Figure 2: *Flow of Study.*

The Empathy Map (EM) is a valuable method used for designing business models based on customer perspectives, surpassing mere demographic characteristics and delving deeper into comprehending the customer's environment, behavior, aspirations, and concerns. The primary objective of the EM is to cultivate a sense of empathy for a specific person. The EM is rooted in a user-centered approach, where the focus lies in truly understanding the individual by viewing the world through their eyes. This understanding empowers stakeholders to recognize how even minor design changes can significantly impact users. Design thinking utilizes a collaborative engagement mechanism to foster internal collaboration among employees and external partnerships with users and other key stakeholders (Mayer & Schwemmle, 2024). By employing the EM, businesses gain invaluable insights into their customers, fostering more empathetic and effective design choices (Ferreira et al., 2015). In this study, 7 respondents have been selected for interview. The respondents are selected to represent the groups of personnel working in Gembira Food Sdn Bhd. The respondents are selected to represent the Director, the Quality Assurance / Control Department, Production workers, and External Auditor.

1. *Interview*
The interview questions that is used in this study has been validated by the course instructor, Dr Haliyana Khalid. The sample questionnaire can be seen in Appendix I.

2. *Observation*
A recent assessment of Gembirafood revealed strong foundational food safety practices including robust hygiene, effective temperature control, and employee awareness of safe food handling. However, improvements are necessary in record-keeping procedures and employee training on data recording to enhance data accuracy and efficiency. Addressing these areas will further solidify the company's commitment to producing safe and wholesome food products and contribute to the ongoing elevation of food safety standards within the pastry manufacturing industry.

3. *Document Analysis*

Document analysis proved invaluable due to its accessibility, stability, and efficiency. Unlike interviews, documents offer consistent data points, allowing for repeated analysis. This method effectively complemented other research approaches, providing a comprehensive understanding of the research topic. Gembirafood demonstrated a strong commitment to record-keeping, fulfilling ISO 22000 requirements. The company maintains detailed operational procedures and has undergone successful audits, validating the effectiveness of its record management system.

Define

1. *Empathy Mapping*

Semi-structured interviews were conducted with seven key informants (n=7) at Gembirafood, including employees and an external auditor. Observations and discussions were integrated into the interview process to gather comprehensive data. Data saturation was reached, indicating that no new information was emerging from subsequent interviews.

Table 1: *Insights from the Empathy Map.*

Respondent	Insights
Director	Mr. Y is the director of Gembirafood, responsible for strategic direction and operational efficiency.
	Possesses final approval authority over proposals and initiatives.
	Culinary background provides valuable insights into food industry operations.
	Bilingual proficiency enhances communication and collaboration.
	Faces language barriers, cumbersome paper-based systems, and the pressure to achieve ISO 22000 certification.
	Envisions a paperless system that improves efficiency, reduces costs, and enhances communication while maintaining stringent food safety standards.
	Worries about system complexity, the potential impact on safety standards, and the ability of his team to adapt.
	A simple, effective, and secure paperless system that aligns with the company's culture and values.
Quality Assurance personnel	Importance of addressing data completeness and communication bottlenecks.
	Potential for a hybrid system combining digital and paper-based elements to ensure a smooth transition.
	Importance of reliable internet connectivity in all production areas.
	Need for solutions that are accessible and user-friendly for staff with varying technology comfort levels.
Local production workers	A balance between paper-based and digital systems might be necessary to accommodate different user preferences and technical capabilities.
	Data accuracy and clarity are critical for effective monitoring and decision-making.
	Both individuals highlight the need for a system that is robust, user-friendly, and accessible in low-internet connectivity environments.
Foreign production workers	Production worker is responsible for maintaining accuracy and hygiene.
	Language barriers, complex forms, and inconsistencies in data recording.
	Potential for errors and inefficiencies due to language and form design.
	Dedicated to food safety and proactive reporting of issues.
	Clear and simple recording methods, with options for multilingual support.
External auditor	Quality Assurance personnel
	Assesses Gembirafood's compliance with food safety standards.
	Reviews food safety management system, observes production processes, and interacts with employees.
	Gembirafood demonstrates a commitment to food safety but can improve record monitoring and employee training.
	Local production workers
	Works closely with management to implement changes.
	Continuous pursuit of excellence and consumer safety.

2. *Creating Personas*

In this specific case, by analyzing data from 7 respondents, we were able to develop 5 distinct personas. These personas now serve as invaluable tools, guiding our design decisions and ensuring that the solution we develop resonates deeply with our target audience. By leveraging the power of personas, we can move beyond guesswork and design with confidence, knowing that we are creating something that truly meets the needs and expectations of our users. Based on the personas we developed, we gained valuable insights into our users' backgrounds, goals, frustrations, tech comfort levels, potential gains, and challenges related to record management and food safety. While their specific goals varied depending on their roles and responsibilities, some key themes emerged:

- Language Barrier: Difficulty understanding and using forms due to language limitations presents a significant challenge for some users. Addressing this through multilingual options or visual aids will be crucial.
- User-Focused Forms: The current personalized forms, while intended to cater to individual needs, create frustration due to difficulty in interpreting and filling them out. Exploring standardized formats with clear instructions could improve user experience.
- Individual Frustrations: Despite diverse roles, all users share frustration with the current system's complexity and lack of user-friendliness. Simplifying data entry and ensuring forms are clear and accessible will be key to improving user acceptance and compliance.

3. *Reframed Problem Statement*

In design thinking, identifying the problems is crucial for tackling complex problems. It captures the identified issue from the *Empathize* stage and becomes the bedrock for the *Define* stage. To ease the process of brainstorming, the points of view from each persona have been summarized into Goals and Pains which is shown in the Table 2.

Table 2: *Summary of Points of View, and Goals & Pains.*

Persona	Points of View		Goals	Pains
	Needs	**Insights**		
Gary the Chef Boss	- To quickly identify and address critical issues to minimize disruptions and maintain operational efficiency. - To have a system that provides real-time updates on operational performance and alerts for urgent matters. - To ensure strict adherence to food safety regulations, hygiene standards, and company policies. - To provide clear guidelines and training to ensure all staff understand their roles and responsibilities. - To have access to accurate and timely data to make informed decisions regarding operations, staffing, and resource allocation.	- Conducts regular inspections of the production area to monitor staff performance, identify potential issues, and ensure compliance with safety protocols. - Relies on paper-based systems for tracking production data, which can be time-consuming and prone to errors. - Prioritizes safety and ensures that all staff members adhere to proper personal protective equipment (PPE) guidelines. - Faces difficulties in communicating with staff members who may have language barriers or limited understanding of food safety procedures.	- Develop clear, concise, and easily understandable SOPs for all production processes, ensuring consistency and compliance across the team. - Implement a modern, digital system for food safety monitoring that is user-friendly, efficient, and capable of real-time data collection and analysis. - Provide comprehensive training programs to ensure all employees understand the SOPs, utilize the digital system effectively, and are equipped with the necessary skills for their roles. - Leverage the digital system to collect and analyze data, enabling data-driven decision-making and continuous improvement in food safety practices.	- Struggles to effectively communicate complex procedures and safety guidelines to employees with varying levels of understanding and language proficiency. - Frustrated by the time-consuming and error-prone process of manual data entry and recordkeeping, which can lead to inconsistencies and delays in decision-making. - Concerned about the potential for cross-contamination and other safety risks associated with manual data recording, especially in high-pressure production environments. - Frustrated by the lack of standardization in procedures and forms, which can lead to confusion, errors, and inconsistencies across the team.

| Maria the Quality Controller | - To have access to real-time data and analytics tools to identify trends, pinpoint root causes of quality issues, and implement corrective actions.

- To streamline the process of investigating and resolving quality issues, including effective communication with production staff and timely implementation of corrective measures.

- To automate data collection and reporting processes, reducing the burden of manual data entry and minimizing errors.

- To transition from paper-based records to a digital system that is more efficient, secure, and accessible.

- To have a platform for effective collaboration and communication with production staff, ensuring timely feedback and support. | - Spends significant time manually transcribing data from paper forms to reports, which is time-consuming and prone to errors.

- Relies primarily on verbal communication to address quality concerns with bakers and management, which can be inefficient and lead to misunderstandings.

- Must review previous day's forms to identify deviations and inconsistencies, which can be inefficient and delay the detection of quality issues.

Limited access to real-time data on production processes and quality metrics, making it difficult to identify and address issues promptly. | - Implement a digital platform for real-time communication and collaboration with bakers, enabling efficient information sharing and issue resolution.

- Establish a robust system for tracking ingredients and products throughout the production process, ensuring traceability and accountability.

- Implement automated systems for monitoring critical food safety parameters, such as temperature, pH, and moisture levels, to ensure compliance and detect potential issues early.

- Leverage data analytics to identify trends, analyze quality data, and make informed decisions to optimize production processes and improve product quality.

Foster a culture of continuous improvement by regularly reviewing quality data, identifying areas for enhancement, and implementing corrective actions. | - Struggles to accurately transcribe handwritten data from forms, leading to errors and inconsistencies in the data.

- Overwhelmed by the time-consuming and error-prone process of manual inspections and checks, which can lead to missed issues and increased risk of non-compliance.

- Frustrated by the need for frequent retraining of staff on form filling procedures, which can be time-consuming and impact productivity.

- Limited access to real-time data on quality parameters, making it difficult to identify and address issues promptly. |
| Ahmad the Local Operator | - To have clear and standardized cleaning procedures that ensure the thorough cleaning and sanitization of all machinery and equipment.

- To have a digital system for reporting cleaning activities, eliminating the need for manual recordkeeping and improving efficiency.

- To have a reliable and efficient communication platform for reporting issues, requesting assistance, and receiving updates from management.

- To have access to training and resources that ensure compliance with safety regulations and best practices for cleaning and sanitation.

- To be provided with ergonomic tools and equipment that reduce the physical strain of cleaning tasks and improve safety. | - Spends significant time manually tracking batch numbers and recording observations on paper forms, which can be error-prone and time-consuming.

- Relies on a manual process of recording data after production is completed, which can delay the identification and resolution of issues.

- Relies primarily on verbal communication with supervisors to report issues and ask questions, which can be inefficient and lead to misunderstandings.

- Limited access to real-time data on production processes and equipment performance, making it difficult to identify and address issues promptly. | - To effectively adopt and utilize digital tools for recording data and communicating with supervisors, improving efficiency and accuracy.

- To have access to training and development opportunities to learn new skills and stay updated on industry best practices.

- To have access to real-time monitoring tools that provide feedback on performance, identify errors, and support continuous improvement.

- To utilize digital tools and skills to enhance his career prospects and contribute to the overall success of the organization.

- To leverage digital tools to streamline tasks and improve efficiency, leading to a better work-life balance. | - Overwhelmed by the complexity and volume of paper-based instructions and records, leading to confusion and errors.

- Frustrated by the lack of standardization in procedures and forms, which can make it difficult to follow and comply with requirements.

- Spends significant time manually entering data into forms, which is time-consuming and prone to errors.

- Struggles with disorganized and inefficient workflow processes, which can lead to delays, bottlenecks, and reduced productivity.

- Limited access to real-time feedback on performance, making it difficult to identify and address issues promptly. |

Shahab the Foreign Operators	- To have clear and standardized cleaning procedures that are easy to understand and follow, even for those with limited language proficiency. - To have access to digital tools for reporting deviations, taking photos, and sharing information with the team, eliminating the need for manual recordkeeping. - To have access to language support resources or training to improve communication and understanding of workplace procedures. - To receive comprehensive safety training, including information on proper cleaning techniques, PPE usage, and hazard identification. - To be recognized for his contributions and efforts in maintaining a clean and safe work environment, with opportunities for rewards or incentives.	- Relies on a manual process of collecting and storing records, which can be time-consuming and prone to errors. - Faces difficulties in communicating with colleagues and understanding written instructions due to language barriers. - Limited access to relevant information and resources, which can hinder his ability to perform his tasks effectively. - Relies on others to assist with tasks or provide information, which can be inefficient and lead to misunderstandings. - May encounter cultural differences or misunderstandings that can impact communication and collaboration with colleagues.	- To consistently perform his duties to the highest standards, ensuring accuracy, efficiency, and compliance with all relevant regulations. - To develop strong digital skills, enabling him to effectively utilize digital tools for communication, reporting, and data management. - To improve his language skills, enhancing his ability to communicate effectively with colleagues and understand workplace instructions. - To utilize his skills and knowledge to advance his career within the organization, taking on new responsibilities and contributing to the team's success. - To build strong relationships with colleagues and integrate into the workplace culture, fostering a positive and inclusive work environment.	- Struggles to communicate effectively with colleagues who only speak Bangladeshi, limiting his ability to understand instructions and seek assistance. - Frequently makes mistakes when recording data, leading to inaccuracies and inconsistencies in the records. - Faces difficulties in deciphering handwritten notes, even when written in his native language, which can lead to misunderstandings and errors. - May encounter cultural differences or misunderstandings that can impact communication and collaboration with colleagues. - Limited access to clear and concise instructions, leading to confusion and uncertainty in performing his tasks.
Siti the Auditor	- To have access to a centralized digital platform for storing and reviewing all relevant food safety records, including temperature logs, cleaning schedules, and HACCP plans. - To utilize automated tools to monitor compliance with food safety regulations and identify potential non-conformances, reducing the burden of manual reviews. - To have access to real-time data on critical food safety parameters, enabling timely analysis and identification of potential risks. - To have a system for tracking and monitoring corrective actions implemented by the factory, ensuring timely completion and effectiveness. - To have the ability to conduct remote audits using technology, reducing travel time and costs while maintaining the effectiveness of the audit process.	- To assess the effectiveness of training programs and ensure that workers understand and can effectively use the new system. - To identify gaps or inconsistencies in data recording, ensuring that all relevant information is captured and accurately documented. - Relies on manual methods to compile and analyze data from paper records, which can be time-consuming and prone to errors. - Limited access to real-time data on food safety parameters, making it difficult to identify and address potential risks promptly. - Recognizes that subjective assessments of compliance can introduce bias and inconsistencies in the audit process.	- To transition from paper-based records to a digital system that is efficient, secure, and accessible. - To ensure that all food safety procedures are clear, concise, and easily understood by all employees. - To maintain high standards of data quality and integrity, ensuring that all records are accurate, complete, and well-organized. - To ensure that all employees have received adequate training on food safety procedures, regulations, and the use of the new digital system. - To foster a culture of continuous improvement by regularly reviewing food safety practices, identifying areas for enhancement, and implementing corrective actions. - To conduct risk-based audits that prioritize areas of higher risk and ensure that resources are allocated effectively.	- Struggles to elicit clear and concise explanations of processes from workers, leading to difficulties in understanding and assessing compliance. - Frustrated by the time-consuming, error-prone, and disorganized nature of paper-based record-keeping, which can hinder the audit process. - Concerned about the quality and accuracy of recorded data, including illegible handwriting and missing information. - Challenges in analyzing and interpreting data from paper records, making it difficult to identify trends, patterns, and potential risks. - Recognizes that subjective assessments of compliance can introduce bias and inconsistencies into the audit process.

4. *Ideate*

Following the crucial Define Stage, where we identified key user problems, we now embark on the exciting journey of Ideation. This is where we leave behind assumptions, challenge the status quo, and unleash our collective creativity to explore a multitude of potential solutions. Ideation thrives on collaboration. By working together, we can approach problems from diverse perspectives, sparking innovative ideas that might not emerge individually. The insights gleaned from the Empathy and Define phases, ensure our solutions remain firmly rooted in user needs. To fuel this exploration, we leverage *How Might We* questions.

These prompts act as springboards, unlocking a plethora of ideas and solutions to address the challenges we've identified. This initial brainstorming generates a rich tapestry of diverse possibilities, laying the groundwork for further refinement and selection. The *How Might We?*s questions are shown in Table 3.

Table 3: *Summary of "How Might We?" and the solutions.*

Persona	How might we?	Solution
Gary the Chef Boss	How might we make the forms used to be less complicated to be understood by the workers?	Simplify form layout and language, maximize use of memorable icons
	How might we improvise manual data entry?	Implement automated data entry processes
	How might we develop simple procedure and records that can be understood by everybody?	Use clear and concise language
	How might we have a paperless solution for data recording?	Transition to digital forms
Maria the Quality Controller	How might we use internet-based paperless solution when there is no internet connection?	Offline functionality
	How might we resolve the difficulty to understand the handwriting of the worker?	Encourage typed documentation
	How might we resolve the issue of having to retrain the staff on the same procedure every time?	Develop training manuals
	How might we resolve frustration with unclear documentation, leading to inconsistencies in quality checks?	Standardize documentation format
	How might we resolve pressure to meet production deadlines, potentially compromising quality standards?	Implement realistic production schedules
	How might we add more criteria to the form?	Utilize dropdown and checkboxes
	How might we improve traceability of ingredients and production processes?	Implement barcode scanning
Ahmad the Local Operator	How might we resolve the issue of forgetting to fill up the forms?	Set automated reminders
	How might we resolve the issue of inaccuracy and confusion in paper-based instructions and records?	Digitize and centralize documentation
Shahab the Foreign Operators	How might we resolve the issue of some operators only understand Bangladeshi?	Provide multilingual training / materials
	How might we avoid making mistakes when recording data?	Implement data validation rules
	How might we resolve the issue of the handwriting of the notes is often messy and hard to decipher, even in our own language? (Bangladeshi)	Switch to digital notes or typing
Siti the Auditor	How might we resolve the issue of worker not knowing how to explain their process?	Provide easily accessible instruction reference
	How might we resolve the inefficiencies and limitations of paper-based record-keeping?	Transition to digital records
	How do we resolve the issue of difficulty to read the record?	Ensure clear formatting, optical character recognition (OCR)

Based from the solutions provided above, we categorize the solutions based on their similar approaches and how the solution may be materializing in a later stage. We have managed to summarize them into 7 categories as below:

1. Formatting
2. Digitalization
3. Automation
4. User manual
5. Implementation of realistic production schedule
6. Offline functionality
7. Data validation rules

Table 4: *Summary of categories of solution.*

Categories				
Formatting	**Digitalization**	**Automation**	**User manual**	**Uncategorized**
Provide multilingual training / materials	Switch to digital notes or typing	Implement automated data entry processes	Provide easily accessible instruction reference	Implement a realistic production schedule
Standardize documentation format	Transition to digital records	Optical character recognition (OCR)	Develop training manuals	Offline functionality
Simplify form layout and language, maximize the use of memorable icons	Encourage typed documentation	Implement barcode scanning for traceability		Implement data validation rules
Use clear and concise language	Digitize and centralize documentation	Set automated reminders		
Ensure clear formatting	Transition to digital forms			
Utilize dropdown and checkboxes				

Discussion and Conclusion

1. *Formatting*

Gembirafood has a unique opportunity to optimize data management through various approaches. The first one is enhancing Clarity and Accessibility. Gembirafood can provide Multilingual Training and Documentation to cater to diverse users by offering training and documentation in Bahasa Malaysia, English, and other relevant languages. They can also consider employing engaging formats like video demonstrations or interactive tutorials. Standardize documentation with clear guidelines and templates for easy adoption. By reducing clutter and jargon in forms, opting for concise terms and visuals like icons for better understanding. Utilize clear and consistent formatting, including font sizes, spacing, and headings, to improve readability. They can minimize open-ended text fields by incorporating dropdowns and checkboxes for streamlined data entry.

2. *Digitalization*

To embrace Digital Transformation, they can digitize existing paper records and create a central, searchable repository. They can also encourage electronic submissions for all documentation to enhance accessibility. Gembirafood can also design user-friendly digital forms mirroring paper versions and integrate them with the central repository. They can also implement systems for direct data capture through online forms and mobile apps. They can utilize tools for automated data entry from scans or barcodes to minimize manual work. By leveraging Optical Character Recognition (OCR) technology, they can convert scanned documents into editable text.

3. *Automation*

In order to leverage Automation for Efficiency, they can use Barcode Scanning for Traceability: to integrate barcode systems for tracking products, ingredients, and equipment, boosting accuracy and efficiency. They can set Automated Reminders to set up notifications for upcoming tasks, data submissions, or expiring documents to ensure timely action. They can also impose Data Validation Rules which implement checks and alerts to prevent invalid data entry, maintaining data quality and accuracy.

4. *User Manual*

To empower Users with Knowledge, they can provide easily Accessible User Manuals by developing comprehensive user manuals in multiple languages and formats (online, printable) for easy reference. They can also establish Training Programs to create training materials specific to new features, updates, or procedures, delivered through various channels like online modules, workshops, or video tutorials.

5. *Implementation of the Realistic Production Schedule*
By producing Realistic Production Schedules, they can plan and adjust schedules based on actual capacity and resources to avoid stress and errors.

6. *Offline Functionality*
Offline Functionality will ensure systems function with or without internet connectivity to enable uninterrupted data collection.

7. *Data Validation Rules*
Data validation rules are a set of guidelines or constraints applied to data to ensure its accuracy, consistency, and reliability.

By implementing these solutions and adopting a user-centric approach with effective communication, training, and continuous improvement, Gembirafood can achieve a truly transformed data management system, fostering efficiency, accuracy, and enhanced food safety practices. Instead of simply creating a joyful user experience, user research empowers researchers to confidently design questions and interactions that directly address user goals. This is achieved by understanding the user's unique perspective and the complexities of their world. This research acts as a launchpad for design thinking, which delves deeper into user needs and challenges to craft user-centric solutions.

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