Research Article

Improving Food Safety: Understanding Consumer Behaviour in Chilled or Frozen Food Purchases with "Design Thinking"

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ABSTRACT

An innovation is introduced to improve the situation of storing and transporting chilled or frozen perishable items by applying design thinking approach based on the IDEO method of Stanford d.school. This study was initiated to find out the problems faced by consumers when buying their chilled or frozen foods, and come up with a holistic solution through "design thinking techniques" to tackle their existing problems especially pertaining to the maintenance of temperature integrity along the journey from outlet to their home. Seven respondents from various backgrounds (professional, business owner, retiree, expatriates and person with special needs (disability) were interviewed at various places including at hypermarkets, coffee café, primary school, office, online conversation and at their home within Klang Valley and Johor Bahru. The instrument used was a semi-structured interview and all inputs were analysed thematically. The design thinking approach was used, focusing on resolving the problem posed by increase in storage temperature whilst transporting chilled and frozen foods due to direct exposure to sunlight that would increase the temperature in the car trunk, thus without proper temperature control through the usage of a specialized container, the foods would deteriorate faster and lead to speedy growth of microorganisms that could lead to foodborne illnesses. Based on the findings, it was concluded the development of a "specialized storage box" was deemed the best solution in addressing consumers' pains and gains with regards to transporting their chilled or frozen foods. Therefore, the implementation of the temperature-controlling storage device holds promising results in reducing spoilage, improving efficiency, and ensuring the quality of the chilled or frozen items during transportation. This study proposes an option to consumers in preserving their foods whether chilled or frozen during transportation between market and home, thus ensuring food safety.

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1. Introduction

Food safety has become one of the main topics in health that nowadays has attracted increased attention by the public. According to the World Health Organization (WHO), an estimated 600 million fall ill after eating contaminated foods and around 420,000 people die each year due to this (WHO, 2023). Furthermore, nearly one in ten individuals become unwell each year as a result of consuming contaminated

food, making foodborne infections a serious public health risk (World Health Organization, 2015; Lee and Yoon, 2021). Although people frequently link eating outside the home with foodborne disease, many foodborne infections are brought on by food made at home (Redmond and Griffith, 2003).

Nowadays, people tend to shop for their groceries at hypermarkets that are rising in numbers especially in newly industrialized countries such as Malaysia. The more well-known hypermarkets in Malaysia are Giant, Lotus's, AEON, and AEON BiG. Most of these hypermarkets offer varieties and complete product line up especially in the food and beverage sector whereby it is believed they sell good, safe and quality products due to their reputation. A study conducted by Talbot *et al.* (2020) appeared to show that, although cabinets may operate at the necessary overall temperature(s), some frozen products within those cabinets may spend a significant amount of time, up to 45% at above sub-optimal temperatures (> -12^{o}C). The study focused on temperature monitoring of frozen retail display cabinets of one major UK supermarket chain. Food quality and shelf-life are expected to suffer as a result, even if the food's safety will remain unaffected. This situation might happen in our local hypermarket and when the source of foods is already in an unsuitable condition at the point of purchase due to improper frozen storage conditions. If further intervention and controls are not addressed along the food supply chain until the point of consumption, the safety of consumers might be at risk.

Temperature violations normally could happen during transportation of foods or groceries between source (mini market, supermarket, hypermarket, etc.) to home. Within 40 – 60 minutes and 90 – 130 minutes, the temperature of goods kept in the refrigerator rose by 20 – 30°C (Kim *et al.,* 2013). After 90 minutes, temperatures for frozen meat in particular reaches the danger zone. Among possible factors that might contribute to the increase of temperature of chilled or frozen foods during storage among others is consumers take long time to arrive home due to other things / errands to be completed during the journey. This has been highlighted in several studies (Al-Asmari and Ismail, 2023; Nabwiire *et al.,* 2023; Kim *et al.,* 2011; Karabudak *et al.,* 2008; Badrie *et al.,* 2006) involving consumers from Saudi Arabia, U.S. Virgin Islands, Korea, Turkey and Trinidad respectively. They found that a portion of their consumers took around approximately 1 – 4 hours to transport their food from the market to their home. This is high risk especially in hot countries like Malaysia and Saudi Arabia, and during summer in temperate countries.

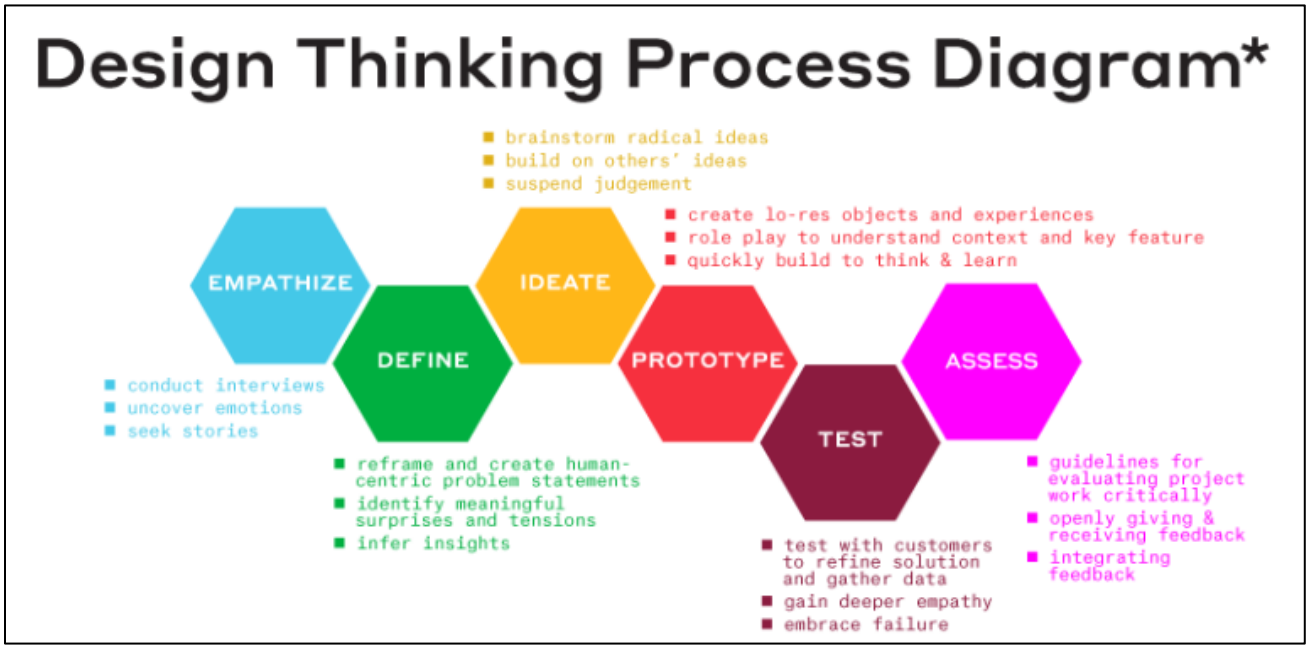
Foods stored in the boot of the car tend to have a rapid temperature increase especially when the car was parked in an open space exposed to direct sunlight, especially in tropical countries or during summer in temperate countries. A little over 50% of Americans said they carried groceries (food) home in their car boot (Geuens *et al.,* 2003; Godwin and Coppings, 2005). Similar circumstances exist in Korea, where 50.3% of buyers reported using their car's boot to transport food products they had purchased from department stores and at steep discounts (Kim *et al.,* 2011). Other factors that might be considered are related to the weather and consumer awareness. Kim *et.al.* (2012) showed that the temperature of a car's interior and its food are impacted by cloud cover and solar radiation as well. Malaysia is exposed to this due to its geographical location very close to the Equator. It is noteworthy that surveys conducted by Nabwiire *et al.* (2023); Karabudak *et al.* (2008); Jevsnik *et al.* (2008) respectively revealed that around 27.5%, 4.8% and 15.5% of their consumer respondents used some form of insulated bags to transport their perishable foods. If these consumers put their foods in home chillers/freezers immediately upon reaching home and these pieces of equipment were functioning properly, possibly the negative impacts of poor storage during transportation could be reduced.

However, this is usually not the case based on studies by Jovanovic *et al.* (2022), where their findings of 120 households in Belgrade showed that temperature exceeding 5˚C was reached by a majority of refrigerators (82.5%) used by these respondents. A substantial increase in average temperature ($p < 0.05$) was seen in households with children. Refrigerators aged more than 10 years were also running at higher temperatures ($p<0.05$). Furthermore, total viable counts (TVC), total coliform counts (TCC), and total yeast and mold counts were used to evaluate the hygienic condition of a subset of 42 residential refrigerators. The unsatisfactory sanitation state of internal refrigerator surfaces was indicated by TVC screening findings as high as 8.4 $\log_{10}$ CFU/cm^2. These findings showed that foods might continue to deteriorate even in these supposedly well control conditions, which could lead to food-borne diseases. This situation concurs with findings that "domestic kitchen" was the most often reported setting (87.5%) linked to foodborne outbreaks

in 2019, according to data from the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC) (EFSA and ECDC, 2021).

As made popular by IDEO and the Stanford d.school, design thinking (DT) is a transdisciplinary, user-centered approach to innovation (Dunne and Martin, 2006). The most often used methodologies, according to Micheli *et al.* (2019), are those from IDEO (Inspiration, Ideation, Implementation), Stanford d.school (Empathise, Define, Ideate, Prototype and Test), and IBM (Understand, Explore, Prototype, Evaluate). Despite having a wide range of applications, the DT technique has not been frequently used in the development of new foods (Olsen, 2015). Therefore, in order to popularize the usage of DT especially in the area of food science/food technology/food safety which is definitely a rare tool in this field, this study utilized DT based on the Stanford d.school approach which consists of major structured stages which are empathize, define, ideate, prototype, and test stages as indicated in Figure 1.

Figure 1. Design thinking process diagram (Source: Stanford d.school)

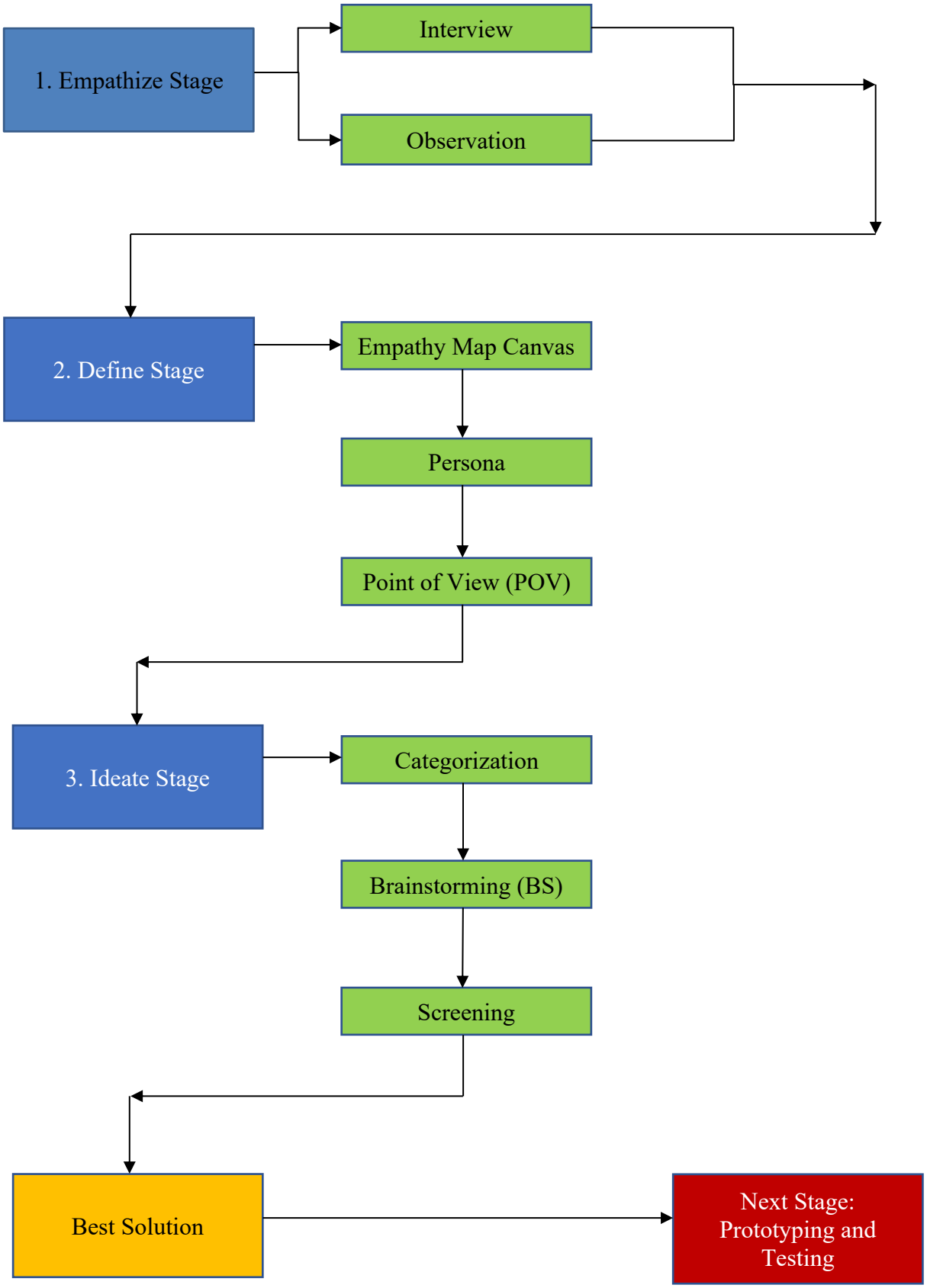


Therefore, this project was initiated to find out what were the problems faced by consumers when buying their chilled and frozen foods, and through design thinking techniques to come up with a holistic approach solution to tackle their existing problems especially pertaining to the maintenance of temperature integrity along the journey from market to their homes.

2. Materials and Methods

This study applied the "Design Thinking" approach using the model established and popularized by IDEO and the Stanford d.school which consists of structured "empathize", "define", "ideate", "prototype" and "testing" stages. However, for this study, only stages of "empathize", "define" and "ideate" were done to have in-depth exploration with consumers to identify their goals and pains, thus finding an effective best solution that could be used to ensure and improve food safety. The overall research framework is illustrated in Figure 2.

Figure 2. Research framework of the "Design Thinking" approach used in this study



2.1 Empathize Stage

In this stage, interviews were conducted with selected consumers within the period of 30th April 2023 until 24th May 2023 through a semi-structured qualitative approach which consisted of approximately 26 questions, and guided through their journey from home to the market and vice versa, similar to the method used by Kim *et al.* (2013). Selection of respondents was based on their demography and unique characteristics, which were professionals with degree qualification, business owner, retiree, expatriate, and person with special needs (disability). Interviews were done at hypermarkets, coffee café, primary school, respondent's office and home, and online platform. Furthermore, information on the actual practices of consumers in general was also gathered through observation done on-site at selected hypermarket (GIANT, Kajang) by taking pictures and videos.

2.2 Define Stage

All the information obtained and gathered through various methods such as interviews and observations, were analyzed and transformed into "empathy map" canvases. From there, individual Personas were developed which led towards their own "point-of-views" (POVs). Personas were established according to similarities of the respondents.

2.3 Ideate Stage

In this stage, through the goals and pains obtained from the Personas and POVs, the main problems faced by the consumers were given priority as not all problems could be addressed at once. From this list of priorities, possible solutions were considered in brainstorming sessions, which included postgraduate students, lecturers of AHIBS UTM, and the researchers. They were further screened to come up with the best solution that is related to food safety improvement.

3. Results and Discussion

3.1 Empathize Stage

For this purpose, we have conducted seven interviews with consumers with various background in Klang Valley and Johor Bahru. These interviews were conducted either in-person or via online platform. The interview questions have been pre-determined and all interviews used standardized questions to ensure no deviation in the questions posed to the consumers. The selected consumers are listed in Table 1.

Table 1. Consumers selected for the interview

No.	Name	Occupation	Characteristic
1	Mr. Asri	Food Technologist	Married with no children
2	Mr. Irza	Business Man	Married with children
3	Ms. Kriza	Masseuse	Person with special needs with visual impairment
4	Ms. Nor Aini	Architect	Retiree
5	Mr. Marek	General Manager	Expatriate
6	Ms. Mazwa	Training Coordinator	Single
7	Mr. Wan Adlan	Safety & Health Officer	Married with children

For each interview, an empathy map was developed for use in the "define stage". The important findings that were gathered through this empathy stage are listed in Table 2.

Table 2. Important findings based on selected consumers

No.	Consumer	Findings
1	Mr. Asri	• Sometimes car is parked in the open at hypermarket that is exposed to the sun. Depends on the availability of covered parking. • Stores groceries in car boot. • Uses car that is black in colour. • Conditions of raw foods in wet markets not very good.
2	Mr. Irza	• Sometimes car is parked in the open at hypermarket that is exposed to the sun. Depends on the availability of covered parking. • Not aware of "dangerous" temperature zone for microbial growth (5°C-60°C). • Buys groceries from afternoon to late afternoon. • Takes about one hour to reach home. • After grocery shopping, will usually stop by other places before reaching home. • Does not use special/insulated bags to preserve/maintain food temperature. • Thaw frozen foods by submerging in stagnant water for a particular period.
3	Ms. Kriza	• Does not use special/insulated bags to preserve/maintain food temperature. • Use e-hailing transportation for grocery shopping. • Uses a non-dedicated knife at home to process foods.
4	Ms. Nor Aini	• Buys groceries from afternoon to late afternoon. • After grocery shopping, will usually stop by other places before reaching home. • Does not use special/insulated bags to preserve/maintain food temperature. • Distance of market within 10 km. • 30 minutes to reach home from market. • Takes about 15 minutes to store food groceries into fridge/freezer after arriving home.
5	Mr. Marek	• Does not use special/insulated bags to preserve/maintain food temperature. • Always prepare foods at home. • Does not use microwave for thawing frozen foods.
6	Ms. Mazwa	• Does not use special/insulated bags to preserve/maintain food temperature.
7	Mr. Wan Adlan	• Stores groceries in car boot. • Buys groceries in bulk once a month.

Apart from collecting empathy data through interviews, pictures, videos, etc, a simple survey of consumers consisting of 40 respondents around the Klang Valley was conducted on their habits and practices in purchasing and transporting chilled / frozen foods from market to their home. The questions asked in this survey is listed in **Appendix I**. Following that survey, we found out the following important information through their feedbacks:-

i) 57.5% normally parked their car outside the hypermarket/market without coverings which is directly exposed to the sun;
ii) 70% do not use a special insulated container / bag to store their chilled / frozen foods after grocery shopping and during transportation in the car; and
iii) 77.5% store their foods in the car boot after grocery shopping.

These findings provided further insights for the subsequent stages of design thinking to come up with a solution to tackle the problem posed by an increase in storage temperature whilst transporting chilled/frozen foods due to direct exposure to sunlight that would increase the temperature in the car boot. Without proper temperature control through the usage of a specialized container, the foods would deteriorate faster and there would be faster growth of microorganisms that could lead to foodborne diseases.

3.2 Define Stage

The empathy map canvases from the interviews of the seven consumers are showed in **Appendix II**. The next step following the empathy mapping is the development of Personas. For this step, all empathy maps were assessed, followed by identification of similarities, particularly those based on demography, pains and gains. Eventually, four (4) empathy maps were re-developed and their respective Personas were established using fictional characters as listed below:-

i. Hasnah, the disabled buyer (special example, Ms. Kriza Mei)
ii. Senthil, the wonderer buyer (Ms. Nor Aini and Mr. Irza)
iii. Sanusi, the conscious buyer (Mr. Wan Adlan and Mr. Asri)
iv. Siew Mei, the simple buyer (Ms. Marek and Ms. Mazwa)

The identification of individual Personas can be seen in **Appendix III**. Subsequently, four "point-of-view" statements (POVs) were also established and can be referred in **Appendix lV**.

3.3 Ideate Stage

Based on each Persona, 23 "how might we" (HMW) questions were developed as listed below: -

1). Hasnah, the disabled buyer

i. How might we help her go to outlets that are far away from home?
ii. How might we help her choose foods by herself?
iii. How might we help her prevent thawed frozen foods from dripping onto the carpet of the car and the floor of the house?
iv. How might we help her go grocery shopping by herself?
v. How might we help her preserve the temperature of chilled/frozen foods?
vi. How might we help her from being reported by e-hailing drivers?
vii. How might we help her arrange and segregate foods and groceries accordingly and neatly?

2). Senthil, the wonderer buyer

i. How might we help him go to other places to complete unsettled errands before arriving home?
ii. How might we help him prevent thawed frozen foods from dripping onto the carpet of the car and the floor of the house?
iii. How might we help him prevent frozen foods from thawing upon arriving home?
iv. How could we help him to preserve the temperature of chilled/frozen foods?
v. How might we help him arrange and segregate foods and groceries accordingly and neatly?

3). Sanusi, the conscious buyer

i. How might we make frozen food lasts longer?
ii. How might we carry perishable items while stopping at several places afterwards?
iii. How might we separate different types of goods purchased in one shopping bag?
iv. How might we separate frozen food and household items?
v. How might we make storage bag that is enough to fit all items?

4). Siew Mei, the simple buyer

i. How might we make goods transportation easy?
ii. How might we make shopping bag fun?
iii. How might we transport frozen & chilled food safely?
iv. How might we make the shopping bag lightweight?

v. How might we make everybody aware of food safety during frozen food transportation?
vi. How might we make everybody aware of the cooler bag's functions?

The 23 HMW questions were further grouped into seven categories according to similarities and common themes. Consequently, possible solutions for each category were derived through "brainstorming" technique as listed in Table 3.

Table 3. Possible solutions of HMW question category

Category	HMW Questions	Possible Solutions
1	1. How might we transport frozen & chilled food safely? 2. How might we carry perishable items while stopping at several places afterwards? 3. How might we help her preserve the temperature of chilled/frozen foods? 4. How might we help him prevent frozen foods from thawing upon arriving home? 5. How might we help him go to other places to complete unsettled errands before arriving home? 6. How could we help him to preserve the temperature of chilled/frozen foods? 7. How might we make frozen food lasts longer? 8. How might we help her go to outlets that are far away from home?	1. Use a polystyrene box 2. Use an insulated bag (the same used by p-hailing drivers) 3. Couple with cooling gel 4. The box / bag has access to car's air conditioner source of cool air 5. Use a mobile thermometer to track the temperature.
2	1. How might we separate different types of goods purchased in one shopping bag? 2. How might we help him arrange and segregate foods and groceries accordingly and neatly? 3. How might we help her arrange and segregate foods and groceries accordingly and neatly? 4. How might we separate frozen food and household items?	1. Differentiate between chilled/frozen foods and other types of groceries 2. Focus on chilled/frozen foods for development of unique compartment within storage box/bag 3. Compartment built using slices/layers of polystyrene materials. 4. Compartment built using card box paper (covered by aluminium foil).
3	1. How might we help her prevent thawed frozen foods from dripping onto the carpet of the car and the floor of the house? 2. How might we help her from being reported by e-hailing drivers?	1. Whole internal part of storage box/bag covered with aluminium foil to prevent dripping (if any) from coming out. 2. Floor of storage box/bag covered with layer of sponge that could absorb any dripping. It could also be taken out, washed, dried and reused. 3. Floor of storage box/bag covered with disposable high quality tissue paper to absorb dripping (if any).
4	1. How might we help her choose foods by herself? 2. How might we help her go grocery shopping by herself?	This is a special Persona by a visually impaired buyer. This aspect would not be the focus currently.

Category	HMW Questions	Possible Solutions
5	1. How might we make shopping bag fun? 2. How might we make goods transportation easy? 3. How might we make the shopping bag lightweight?	1. The outer box/bag decorated well to make it attractive. 2. The box/bag could be stored inside a mobile trolly. 3. Use of lightweight materials such as polystyrene/card box paper. 4. Storage box/bags have handles to hook them to conventional shopping trollies.
6	1. How might we make everybody aware of food safety during frozen food transportation? 2. How might we make everybody aware of the cooler bag's functions?	1. Contains self-explanatory notes on box/bag regarding food safety. 2. Contains self-explanatory notes on box/bag regarding safe and dangerous food temperatures.
7	1. How might we make storage bag that is enough to fit all items?	We will focus on chilled/frozen foods initially for the storage box/bag which is the heart of the problem.

From the list of possible solutions developed through the identified similarities/common themes, it was concluded that a "specialized cooler box" to aid storage of chilled/frozen foods be developed as the best solution. Characteristics of the "specialized cooler box" that were identified by screening according to priorities are listed as in Table 4.

Table 4. Finalized characteristics of the "Specialized Cooler Box"

No.	Characteristics
1	Use a polystyrene box
2	Use an insulated bag (the same used by p-hailing drivers)
3	Couple with cooling gel
4	The box / bag has access to car's air conditioner source of cool air
5	Use a mobile thermometer to track the temperature.
6	Differentiate between chilled/frozen foods and other types of groceries
7	Focus on chilled/frozen foods for development of unique compartment within storage box/bag
8	Compartment built using slices/layers of polystyrene materials.
9	Compartment built using card box paper (covered by aluminium foil)
10	Whole internal part of storage box/bag covered with aluminium foil to prevent dripping (if any) from coming out.
11	Floor of storage box/bag covered with layer of sponge that could absorb any dripping. It could also be taken out, washed, dried and reused.
12	Floor of storage box/bag covered with disposable high quality tissue paper to absorb dripping (if any).
13	The outer box/bag decorated well to make it attractive
14	The box/bag could be stored inside a mobile trolly
15	Use of lightweight materials such as polystyrene/card box paper.
16	Storage box/bags have handles to hook them to conventional shopping trollies.
17	Contains self-explanatory notes on box/bag regarding food safety.
18	Contains self-explanatory notes on box/bag regarding safe and dangerous food temperatures.

The data gathered in this study provided a comprehensive overview and understanding of consumer behaviours related to purchase, storage, and transportation of chilled and frozen foods. However, a deeper discussion is needed to analyze the implications of these findings on food safety practices. One key point

of discussion is the prevalence of consumers parking their cars outside without coverings, exposing their groceries to sunlight. This practice could lead to an increase in storage temperature, accelerating food spoilage and microbial growth. By not using specialized insulated containers or bags to maintain proper temperatures during transportation, consumers are inadvertently putting themselves at risk of foodborne illnesses.

Furthermore, the lack of awareness among consumers regarding the "dangerous" temperature zone for microbial growth (5°– 60°C) is a significant concern. Without this knowledge, consumers may unknowingly compromise the safety of their chilled and frozen foods, leading to potential health risks. The findings also highlighted the need for education and awareness campaigns to promote proper food safety practices among consumers. By addressing these gaps in knowledge and behaviour, interventions can be developed to improve the handling and transportation of perishable items, ultimately enhancing food safety standards.

The limitation of this research is its small sample size. In order to improve the generalizability and relevance, the study could benefit from a larger and more diverse sample size to ensure a broader representation of consumer behaviours and perspectives. Moreover, utilizing more advanced qualitative analysis techniques such as thematic analysis or content analysis could provide deeper insights into the data collected from the interviews. Furthermore, conducting member checks or peer debriefing to validate the findings and interpretations could enhance the credibility and trustworthiness of the study. Subsequently, collaborating with experts in food safety and consumer behaviour could bring additional insights and expertise to the study, strengthening its methodology and conclusions. These improvements might enhance its impact and contribute more effectively to the field of food safety through the design thinking approach.

In conclusion, the results underscored the importance of addressing consumer behaviours and knowledge gaps to ensure safe storage and transportation of chilled and frozen foods. Moving forward, interventions and solutions that lead to the development of a “specialized cooler box” could be tailored to meet the specific needs and challenges identified in this study, ultimately contributing to safer food handling environment for consumers. Besides functionality, the invention should also be affordable and addresses the user experience throughout the development process up to commercialization. The next phase of development within this scope of study will be the final stages of the “Design Thinking” approach which involve the “prototyping” and “testing” stages.

Conclusion

Throughout the process of implementing design thinking to address the issue of temperature control in transportation of perishable items, we have gained valuable insights and experienced the power of empathy and creative problem-solving. In the empathize stage, we immersed ourselves in the shoes of those who experience differently the process of selecting, buying, transporting, and storing perishable food and raw materials. We listened to their stories, understood their frustrations with water dripping, heavy carrier/plastic bags and restriction to visit other places after grocery shopping and we truly empathized with their needs. This deep understanding helped in our ideation stage, where we brainstormed countless ideas to tackle the challenge at hand. Through a collaborative and inclusive approach, we fostered a supportive environment where everyone's ideas were valued and encouraged.

The conclusion drawn from the data gathered through qualitative interviews is that understanding consumer behaviours is crucial in improving food safety practices, particularly in the storage and transportation of chilled and frozen foods. The analysis of themes, coding, and empathy mapping allowed for a deeper exploration of consumer perspectives and challenges. By identifying common pain points and needs among different buyer personas, the study highlights the importance of addressing specific issues such as exposure to sunlight and inadequate temperature control to mitigate the risk of foodborne illnesses. Moving forward, the research will focus on prototyping and testing solutions derived from the insights gained during the empathize, define, and ideate stages of the "Design Thinking" process.

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We would like to express our heartfelt gratitude and appreciation to all those who have contributed to the completion of this project. Their support, guidance, and encouragement were instrumental in making this endeavour a success. We also would like to extend our appreciation to the participants and stakeholders who generously shared their experiences, insights, and expertise. Their input and feedback were invaluable in understanding the challenges and opportunities related to the transportation of perishable items, and they were crucial in shaping our solutions. In conclusion, this project would not have been possible without the collective effort and support of everyone involved. We are sincerely grateful for the contributions made by each individual, and we look forward to the positive impact our work will have in the field of food safety and beyond.

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Appendix I

Question Survey for Consumers

Survey on consumer habits and practices in purchasing and transporting chilled or frozen foods from market to home

You are required to answer all questions in this survey. Your personal information will be kept undisclosed. The data / response received from each respondent will be analyzed and the outcome of the analysis will be used for future research developments in the area of food safety.

Your cooperation and assistance in completing this survey is very much appreciated. Thank you.

1. What is your age?

a. 20 – 29 years old
b. 30 – 30 years old
c. 40 – 49 years old
d. 50 – 59 years old
e. More than 60 years old

2. What is your occupation?

a. Government sector
b. Private sector
c. Own business
d. Other; please specify:_____

3. What is your education level?

a. Secondary school
b. Diploma
c. Degree
d. Masters
e. PhD
f. Professional/technical qualification

4. What is your marital status?

a. Married
b. Single

5. If married, number of children?

a. 0
b. 1
c. 2
d. 3
e. 4
f. 5
g. More than 5

6. What is your home address (full address not necessary)?

_____

7. Where is the main location of buying chilled/frozen foods (meat, poultry, fish, fruits, vegetables, ice cream etc.)?

a. Mini market (e.g., *kedai acheh*, etc.)
b. Supermarket (e.g., Speedmart, KK, etc.)
c. Hypermarket (e.g., Giant, Lotus's, AEON, etc.)
d. Wet market (e.g., *pasar borong*, etc.)

8. What is the frequency of purchase of chilled/frozen foods?

a. Everyday
b. Several times a week
c. Once a week
d. Once in 2 weeks
e. Other; please specify:_____

9. What is the time of purchase of chilled/frozen foods?

a. Morning
b. Afternoon (after 12:00 pm)
c. Late afternoon (after 3:00 pm)
d. Evening (after 6:00 pm)

10. Do you take chilled/frozen foods at the later/last stage before paying at the counter?

a. Yes
b. No

11. What is the distance between market (usual place of purchase of chilled/frozen foods) and home?

a. Less than 5 km
b. 5 – 10 km
c. 11 – 20 km
d. 21 – 30 km
e. More than 30 km

12. What type of vehicle used for purchase of chilled/frozen foods?

a. Motorcycle
b. Sedan cars (e.g., Proton Persona, Proton Saga, Proton Wira, etc.)
c. SUV cars (e.g., Proton X50, Proton X70, Perodua Ativa, etc.)
d. MPV cars (e.g., Proton Exora, Perodua Alza, Honda BRV, etc.)
e. Truck (e.g., Hilux, Triton, Ford Ranger, etc.)

13. What is the paint colour of vehicle used in transporting chilled/frozen foods?

a. Light coloured (e.g., white, silver, light blue, light red, etc.)
b. Dark coloured (e.g., black, dark blue, dark purple, dark red, etc.)

14. What is the usual location of parking of vehicle used in transporting chilled/frozen foods?

a. Not covered (under the sun)
b. Covered (inside premise/with parking cover)

15. Do you use specific containers/bag to store the chilled/frozen foods purchased (cooler box, cooler bag, insulator bag, etc.)?

a. Yes
b. No

16. Where is the location of chilled/frozen foods stored in vehicle?

a. Car boot/trunk
b. Back passenger seat/area
c. Front passenger seat/area
d. Cargo bed (for trucks like Hilux, Trition, Ford Ranger, etc.)

17. After purchasing of chilled/frozen foods from market, do you tend to stop at various places before reaching home?

a. Yes
b. No

18. What is the time taken for chilled/frozen foods to reach home?

a. Less than 10 minutes
b. 11 – 20 minutes
c. 21 – 30 minutes
d. 31 – 40 minutes
e. 41 – 50 minutes
f. 51 – 60 minutes
g. More than 60 minutes

19. What is the time taken for chilled/frozen foods to be stored in refrigerator upon arriving home?

a. As soon as possible
b. Within 5 minutes
c. 6 – 10 minutes
d. 11 – 15 minutes
e. 16 – 30 minutes
f. More than 30 minutes

20. Additional question: How do you thaw frozen foods at home?

a. Submerge food in stagnant water inside a container (sink, basin, etc.)
b. Thaw in running water
c. Thaw in chiller overnight
d. Microwave thawing
e. Other; please specify:_____

21. Additional question: Do you use separate chopping boards to differentiate between raw and cooked/ready to eat (RTE) foods?

a. Yes
b. No

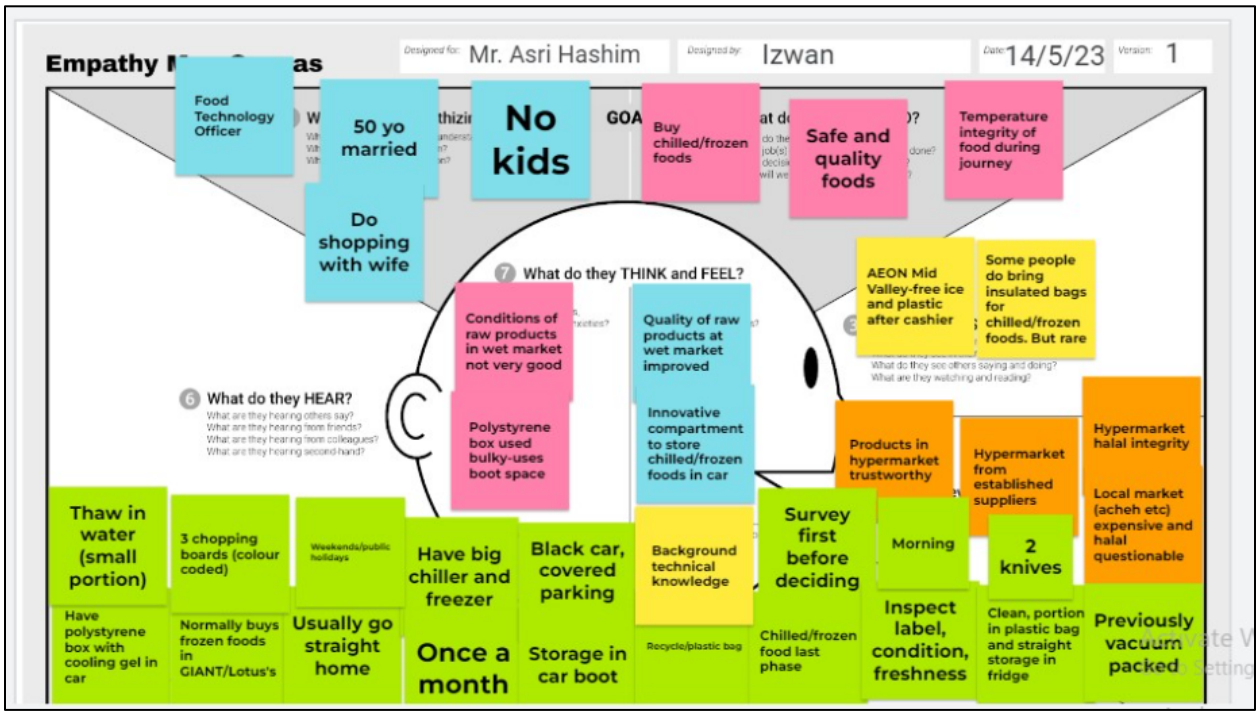
22. Do you have any other additional information to be shared with the researchers to assist in this study?

_____

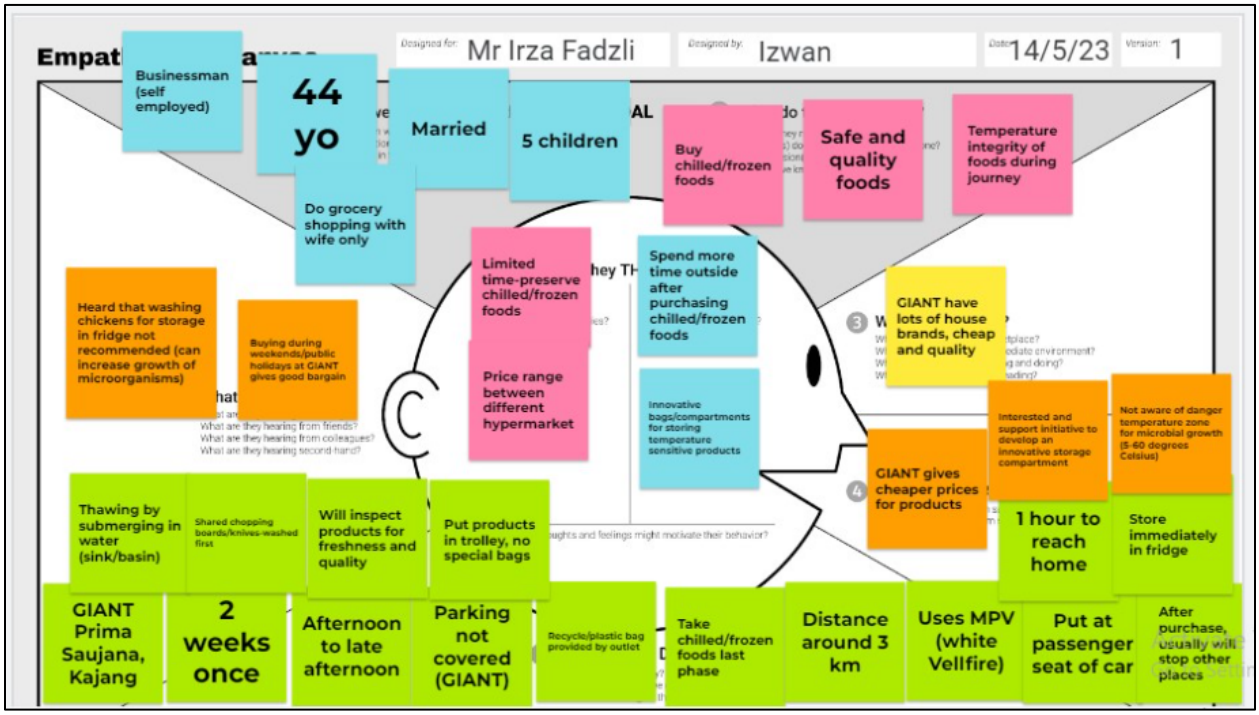
_____

Empathy Map Canvas of Consumers

1. Mr. Asri

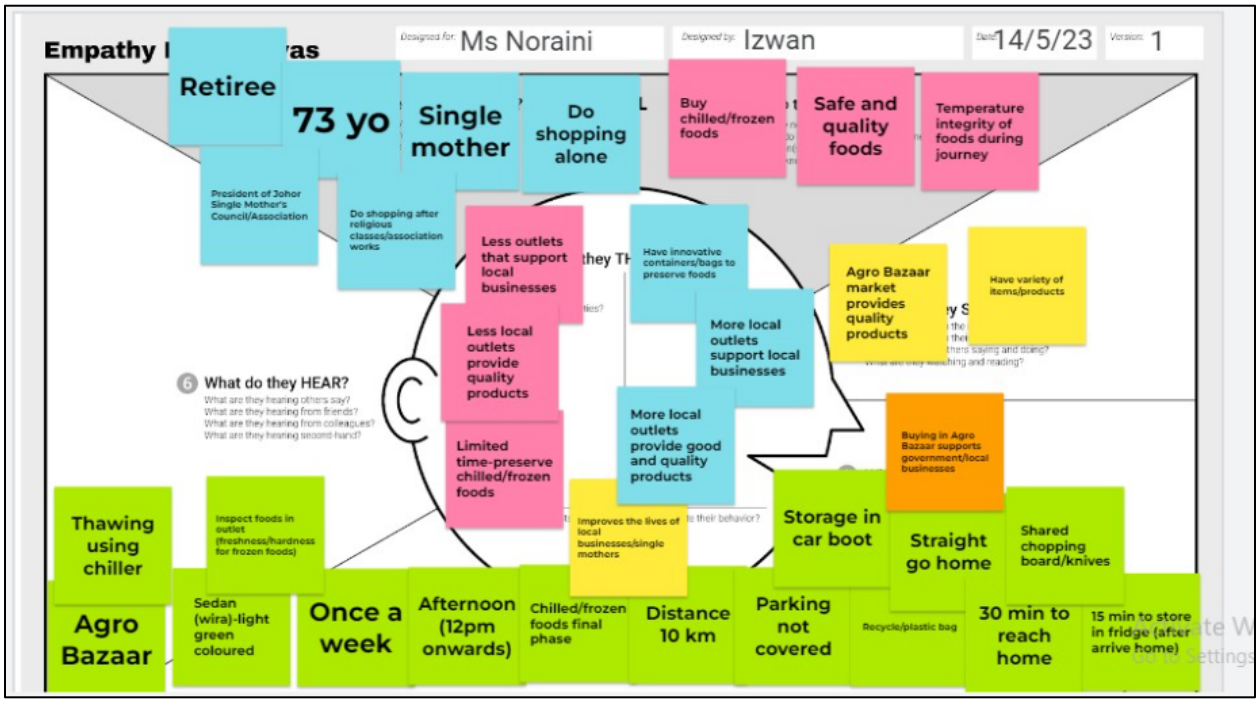


2. Mr. Irza

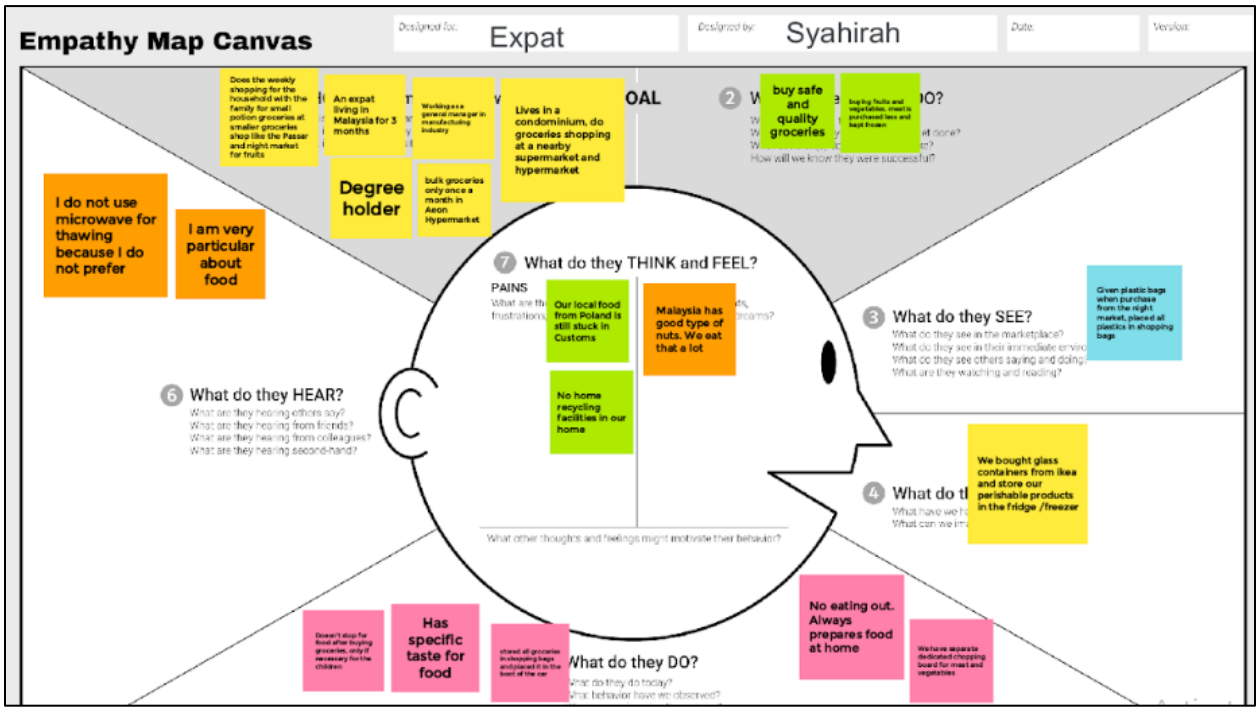


3. Ms. Kriza

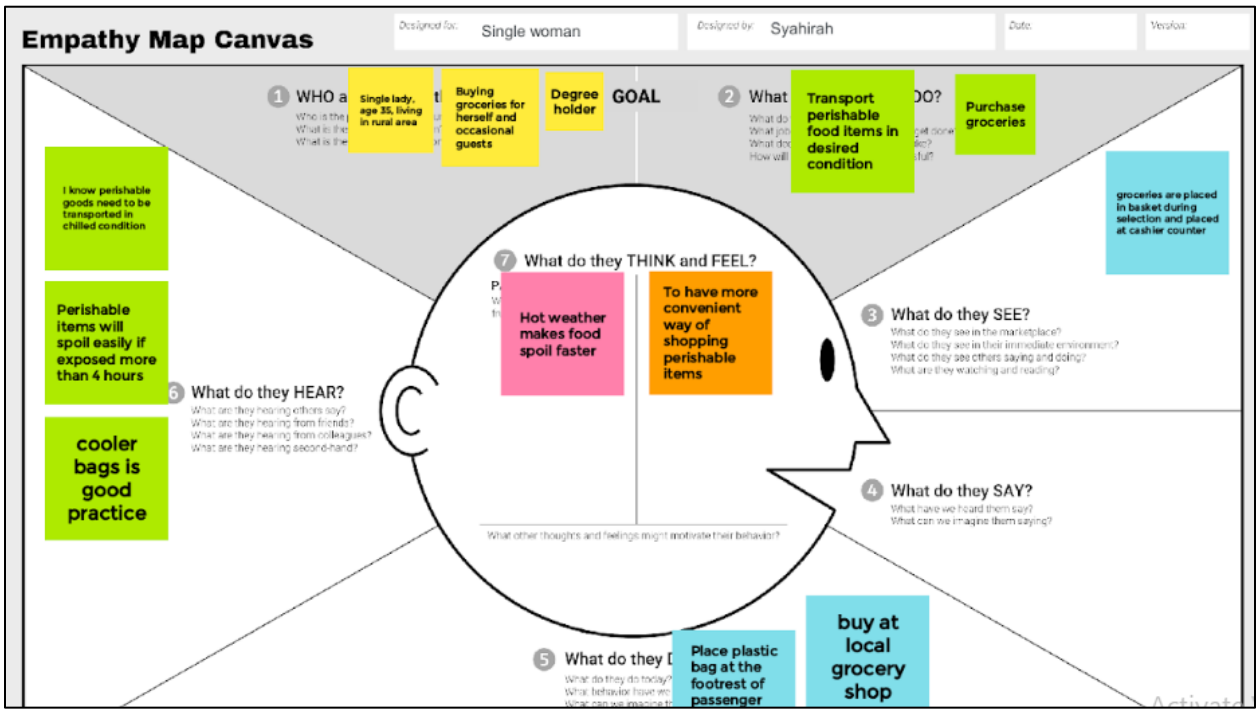
4. Ms. Nor Aini



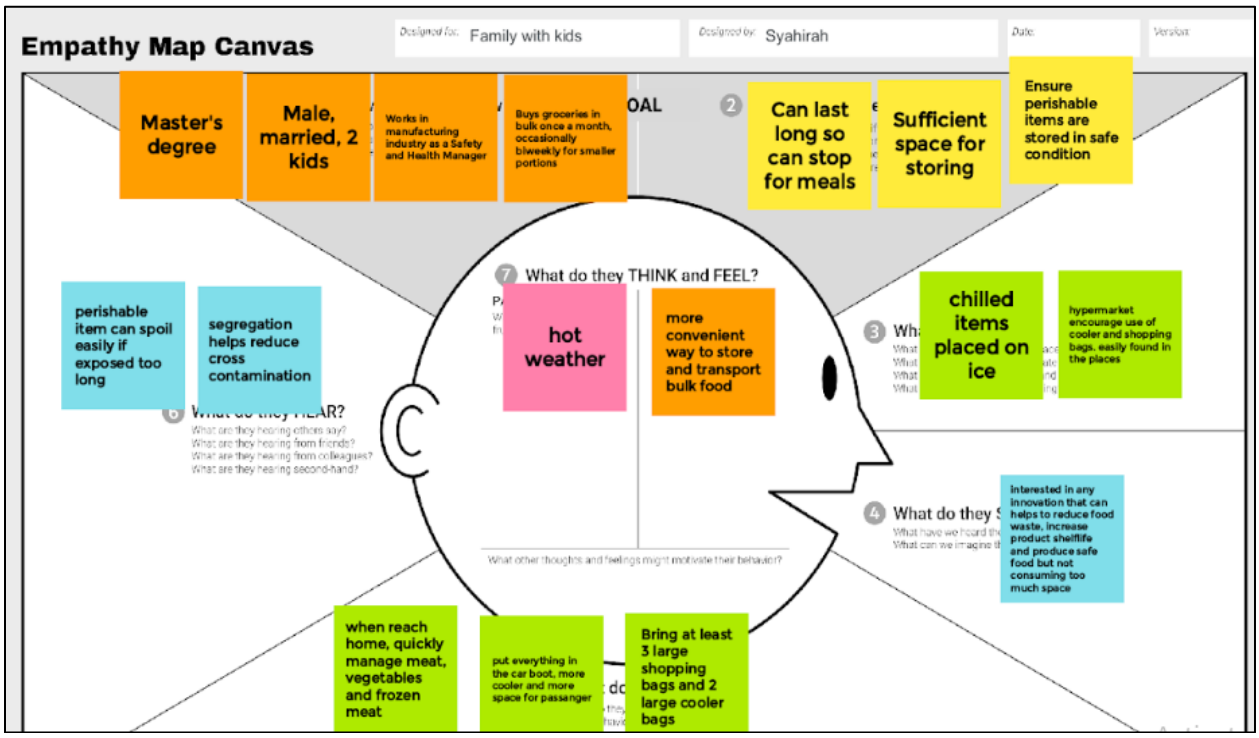
5. Mr. Marek



6. Ms. Mazwa



7. Mr. Wan Adlan



Appendix III

Personas of Consumers

1. Hasnah, the disabled buyer

AGE 34 years old

STATUS Single

EDUCATION Masseur Cert.

WORK Masseur

BACKGROUND

Hasnah, a disabled (blind) woman who lives on her own and cooks her own food. She needs to buy her own groceries (chilled/frozen raw materials) to cook her own food.

HASNAH, THE DISABLED BUYER

GOALS
- Go out grocery shopping on own self.
- Ability to choose foods on own self.
- Use bag/container that could arrange and segregate foods and grocery accordingly and neatly.
- Use bag/container that could preserve temperature of chilled/frozen foods.
- Go out to outlets that are far away from home.

PAINS
- Frustrated have to depend on friend to go grocery shopping.
- Frustrated have to depend on friend to choose foods to be bought.
- Disappointed when water from melted frozen foods will drip on carpet of car and floor of house; make a mess and could be reported by E-Hailing driver.
- Frustrated have to shop at nearby outlet only.

CURRENT PRACTICE IN TRANSPORTING CHILLED/FROZEN FOODS
- Foods are put in trolly during grocery shopping at outlet.
- Use plastics provided by the outlet or own recycle bags.
- Groceries are usually stored in the car boot.
- Uses E-Hailing services (Grab car etc) for transportation of groceries.

KNOWLEDGE IN FOOD SAFETY

1 — 4 — 10

2. Senthil, the wonderer buyer

AGE 44 years old

STATUS Married, 5 kids

EDUCATION Degree

WORK Businessman

BACKGROUND

He buys groceries (including chilled/frozen raw materials) every two (2) weeks in large amounts (to cater to a large family) and usually will stop by other places before reaching home.

SENTHIL, THE WONDERER BUYER

GOALS
- After grocery shopping at outlet will go to other places to complete unsettled errands before arriving home.
- Use bag/container that could arrange and segregate foods and grocery accordingly and neatly.
- Use bag/container that could preserve temperature of chilled/frozen foods.

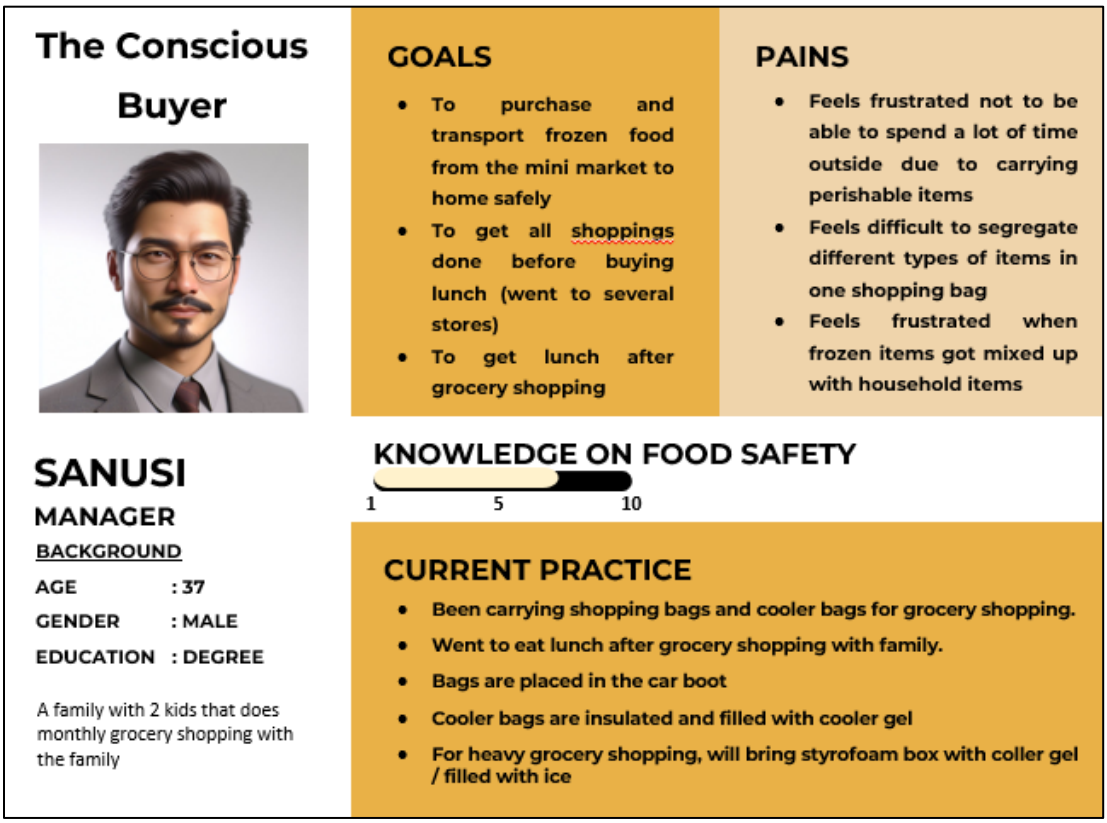
PAINS
- Feels frustrated when frozen foods bought melt upon arriving home.
- Feels uncomfortable when water from melted frozen foods will drip on carpet of car boot and floor of house; make a mess and develop foul odor in car.
- Frustrated could not stop by other places after grocery shopping due to limited time.

CURRENT PRACTICE IN TRANSPORTING CHILLED/FROZEN FOODS
- Foods are put in trolly during grocery shopping at outlet.
- Use plastics provided by the outlet or own recycle bags.
- Groceries are usually stored in the car boot.
- Car is usually parked in uncovered parking lots (under the sun).

KNOWLEDGE IN FOOD SAFETY

1 — 4 — 10

3. Sanusi, the conscious buyer



4. Siew Mei, the simple buyer

Appendix IV

POVs of Consumers

1. Hasnah, the disabled buyer

POINT OF VIEW (POV) STATEMENT
HASNAH THE DISABLED BUYER

USER	NEEDS	INSIGHTS
Hasnah, a disabled (blind) women who lives on her own and cooks her own food.	She needs to buy her own groceries (chilled/frozen raw materials) to cook her own food.	As she is blind, she requires someone (a friend) to help her to select the foods she requires and to determine whether the foods are in good condition (fresh, safe, and of good quality).
		She needs to preserve the temperature of the foods (especially chilled/frozen foods) during transportation to her home.
		She has to do this as she does not dine outside and cooks her own food.

2. Senthil, the wonderer buyer

POINT OF VIEW (POV) STATEMENT
SENTHIL THE WONDERER BUYER

USER	NEEDS	INSIGHTS
Senthil, is a businessman and a married man with five (5) kids.	He buys groceries (including chilled/frozen raw materials) every two (2) weeks in large amounts (to cater to a large family) and usually will stop by other places before reaching home.	After grocery shopping, he usually will do other errands on the way home. This normally will take around an hour or more.
		Thus, he needs to preserve the temperature of the foods (especially chilled/frozen foods) during transportation to his home.
		He has to do this as he has limited time due to the nature of his job as a businessman.

3. Sanusi, the conscious buyer

SANUSI THE CONSCIOUS BUYER
POV STATEMENT

User	Needs	Insights
Sanusi	He wants to ensure food items are kept at right condition and reduce risk of food poisoning	• He brings cooler bag and cooler gel to maintain the temperature inside cooler bag • Storage containers are placed in the car bonet • He went home straight away after grocery shopping • He brings styrofoam boxes and filled with ice at the hypermarket • He kept perishable items instantly after returning from grocery shopping

4. Siew Mei, the simple buyer

SIEW MEI THE SIMPLE BUYER
POV STATEMENT

User	Needs	Insights
Siew Mei	• Lightweight / grocery bag with wheels	• Grocery bags are heavy and needs to be lifted up / carried all the way
	• More support / public campaign to encourage safe transport of food	• No practice of cooler storage among people in the community